

10 CFR 50.75

LR-N11-0289 September 15, 2011

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

> Salem Generating Station, Units 1 and 2 Renewed Facility Operating License Nos. DPR-70 and DPR-75 NRC Docket Nos. 50-272 and 50-311

> Peach Bottom Atomic Power Station, Units 2 and 3 Renewed Facility Operating License Nos. DPR-44 and DPR-56 NRC Docket Nos. 50-277 and 50-278

Hope Creek Generating Station Renewed Facility Operating License No. NPF-57 NRC Docket No. 50-354

Subject: Site-Specific Cost Estimates for Hope Creek, Salem Unit Nos. 1 and 2, and Peach Bottom Units 2 and 3

References:

- (1) LR-N11-0086, NRC Decommissioning Funding Status Report, dated March 31, 2011
- (2) NRC Letter to Mr. Thomas Joyce, Request for Additional Information Regarding 2011 Decommissioning Funding Status Report, dated July 1, 2011
- LR-N11-0240, Response to Request for Additional Information, 2011 NRC Decommissioning Funding Status Report, dated August 1, 2011

In Reference 1 PSEG Nuclear LLC (PSEG) provided the NRC a status of its decommissioning funding pursuant to 10 CFR 50.75(f)(1).

The NRC Staff responded with a Request for Additional Information (RAI); see Reference 2. In Reference 3 PSEG provided a response to the RAI. In that August 1, 2011 letter, PSEG stated in response to RAI #3 that they intend to provide an update to the site-specific cost estimate for Hope Creek, as well as site-specific cost estimates for Salem Unit Nos. 1 and 2 and Peach Bottom Units 2 and 3.

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Attachment 1 to this submittal provides the updated site-specific cost estimate for Hope Creek. Attachment 2 to this submittal provides the site-specific cost estimate for Salem Unit Nos. 1 and 2, and Attachment 3 to this submittal provides the site-specific cost estimate for Peach Bottom Units 2 and 3.

There are no commitments contained in this letter.

If you have any questions or require additional information, please do not hesitate to contact Ms. Emily Maguire at (856)339-1023.

Sincerely,

Paul R. Duke, Jr. Licensing Manager



Mr. W. Dean, Administrator, Region I, NRC Mr. R. Ennis, Project Manager, NRC NRC Senior Resident Inspector, Salem NRC Senior Resident Inspector, Hope Creek Mr. P. Mulligan, Manager IV, NJBNE Mr. L. Marabella, Corporate Commitment Tracking Coordinator

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PSEG Nuclear LLC

Forty-Year Safstor Decommissioning Cost Analysis

for the

Hope Creek Generating Station

September 15, 2011

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#### I. Summary

This report presents estimates of the cost to decommission the Hope Creek Generating Station Unit 1 ("Hope Creek") following the end of the current licensed operating period ending on April 11, 2046.

This report relies in part on a December 2002 report by TLG Services entitled *Decommissioning Cost Analysis for the Hope Creek Generating Station Unit1* ("TLG Report"), with updates to account for the time value of money and a change in decommissioning method from DECON to a forty-year SAFSTOR. The TLG Report is included in its entirety in Appendix B to this report.

This report is based on two fundamental assumptions: (1) spent nuclear fuel ("SNF") management costs will be borne by the United States Government; and (2) Hope Creek will be placed in a forty-year period of safe storage following end of license in 2046.

While spent fuels management costs are discussed in this report and its appendices, those costs are contractually the responsibility of the Government of the United States<sup>1</sup>, and are therefore not considered a liability that must be funded by the Hope Creek Decommissioning Trust Fund. The Salem/Hope Creek site has an Independent Spent Fuel Storage Installation ("ISFSI"), that is appropriately sized to receive all SNF generated from the Hope Creek unit through its licensed life.

PSEG Nuclear considered the following three decommissioning options for Hope Creek:

- DECON: The equipment, structures, and portions of the facility and site that contain radioactive contaminants are removed or decontaminated to a level that permits termination of the license after cessation of operations. Until 2008, this was the strategy that was to be used to decommission Hope Creek.
- SAFSTOR: The facility is placed in a safe stable condition and maintained in that state until it is subsequently decontaminated and dismantled to levels that permit license termination. During SAFSTOR, a facility is left intact, but the fuel has been removed from the reactor vessel and radioactive liquids have been drained from systems and components and then processed. Radioactive decay occurs during the SAFSTOR period, thus reducing the levels of radioactivity in and on the material and potentially the quantity of material that must be disposed of during decontamination and dismantlement. This is the method PSEG will use to decommission Hope Creek.
- ENTOMB: involves encasing radioactive structures, systems, and components in a structurally long-lived substance, such as concrete. The entombed structure is appropriately maintained, and continued surveillance is carried out until the radioactivity decays to a level that

<sup>&</sup>lt;sup>1</sup> See US Department of Energy Contract No. DE-CR01-83NE44411, Hope Creek Generating Station Nos. 1 Unit Contract for Disposal of Spent Fuel and/or High-Level Radioactive Waste (Jun. 13, 1983), as amended.

permits termination of the license. Because most power reactors will have radionuclides in concentrations exceeding the limits for unrestricted use even after 100 years, this option will generally not be feasible and was not deemed to be viable for Hope Creek.

This report assumes a forty-year period of safe storage for the Hope Creek unit after end of its current licensed operating period<sup>2</sup>. PSEG Nuclear LLC, the Operator of Hope Creek, has chosen a forty year SAFSTOR period (approximately 7.6 half-lives of the radioactive isotope Cobalt 60) as a prudent measure to reduce overall radiation exposure to workers during the decommissioning period. An added benefit of the SAFSTOR method is that worker efficiency will be greater due to fewer radiological restrictions during performance of the work. However, economic benefits from gains in efficiency will be partially off-set by maintenance and security costs during the SAFSTOR period, and these costs have been explicitly addressed in this report.

#### **II. Methodology**

The TLG Report provided in Appendix B to this report provided the primary source of information related to costs associated with decommissioning Hope Creek. PSEG personnel used the information in that report to develop the estimate applicable to SAFSTOR described in this report.

Because costs were reported in the TLG Report in 2002 dollars, the first step in the process was to escalate the 2002 costs to 2010 dollars. This re-evaluation produced an increase adjustment of 27% for 2010 Labor & Equipment Costs over the 2002 TLG Report. The New Jersey labor rates from 2003 through 2010 as well as Construction Equipment Costs over the same time frame were used to develop the overall adjustment. The SAFSTOR Decommissioning value was arrived at by taking the 2010 immediate decommissioning cost and adjusting it to reflect significant reduction in residual radioactivity thereby reducing/eliminating the radiation hazards during the dismantling and demolition. This expected improvement will lead to a reduction in overall decommissioning cost, and that improvement is reflected in this study. Details of the adjustment factors used are provided in Table 2.

Aside from the conversion from 2002 to 2010 dollars, two other significant changes were made to update the 2002 TLG Report to address the current forty-year SAFSTOR strategy for Hope Creek. The first change involved shifting the initial costs for preparing the plant for decommissioning from the start of the seven-year decommissioning and dismantlement period assumed in the DECON scenario to prior to the start of the SAFSTOR period. These up-front costs are incurred in three years immediately following termination of operations. The second major change was adding a forty-year period of safe storage prior to final decommissioning. A timeline of these activities is shown in Appendix A to this report. Detailed information showing cash flows, major events, and assumptions is contained in a one-page summary in Table 5 of this report.

 $<sup>^2</sup>$  The forty-year SAFSTOR period will begin after a three-year period during which systems are drained, fuel is removed, and the plants are readied for safe storage.

III. Tables

Work Category <sup>3</sup>	Cost 2002\$ (thousands)	Cost 2010\$ (thousands)	Percent of Total Costs
Decontamination	30,745	39,046	2.4%
Removal	192,120	243,992	14.3%
Packaging	16,049	20,382	2.1%
Transportation	6,008	7,630	2.1%
Waste Disposal	132,615	168,421	14.6%
Off-Site Waste Processing	53,630	68,110	3.0%
Program Management (incl.			
Eng. and Security)	260,625	330,994	42.0%
Spent Fuel Pool Isolation	9,060	11,506	1.6%
ISFSI Related (including capital)	40,239	51,103	12.1%
Insurance and Regulatory Fees	7,148	9,078	2.1%
Energy	11,769	14,947	1.4%
Characterization and Licensing Surveys	13,937	17,700	1.2%
Misc. Equipment and Site Services	9,157	11,629	1.1%
Total	783,102	994,539	100.0%
License termination (10 CFR § 50.75 decommissioning activities) <sup>4</sup>		794,000	
Site Restoration (non- 50.75 activities)		128,500	

### Table 1: Summary of Decommissioning Cost Elements- Hope Creek

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<sup>&</sup>lt;sup>3</sup> Includes contingencies.

<sup>&</sup>lt;sup>4</sup> This total includes spent fuel management.

### Table 2: Summary of Cost Efficiency Adjustments- Hope Creek

				SAFSTOR <u>Adjustment</u>	Factors Cost Reduction	
				Cost Efficiency Factor	Adjustment Contam. To Decontam.	
	Factors	TLG 2002\$ (thousands)	TLG 2010\$ (thousan	ds)		SAFSTOR 2010\$ (thousands)
Decommissioning						
Non Contaminated	71%	\$ 399,653	\$ 507,559		0%	\$ 456,803
Contaminated	29%	\$ 163,239	\$ 207,313		25%	\$ 155,485
Spent Fuel Mgmt	100%	\$ 50,144	\$ 63,683		0%	\$ 63,683
Other Fixed	100%	\$ 40,823	\$ 51,845	100%	0%	\$ 51,845
Sub-Total		\$ 653,859	\$ 830,400	•		\$ 727,816
Contingency		\$ 129,241	\$ 164,136			\$ 143,380
Total Hope Creek 1 <sup>5</sup>		\$ 783,100	\$ 994,537	,		\$ 871,196

<sup>5</sup> Individual line items are rounded so totals may vary slightly due to round-off error.

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Location:	Hope Creek Generating Station
Project:	Decommissioning of Nuclear Plants After Safe Storage

Decommissioning Cost For Hope Creek Nuclear Power Plant After Forty Years of Safe Storage

#### Analysis:

#### **Bases of Cost - TLG Cost 2002**

Plant Prep & Temp Service Rigging Construction Control & Tooling Security Staff (except Spent Fuel Mgt.) Utility Staff (except Spent Fuel Mgt.) Final Site Survey

Based on the cost of items to be decontaminated (from TLG estimate), determined that Contaminated Factors represent approx. 29% of the total cost to decommission a Nuclear Plant. Therefore, Non - contaminated factors represent approx. 71% of the total cost.

#### **Cost Efficiency Factors:**

The 2002 TLG Estimate was based on single unit demolition basis for Hope Creek, and in our review we acknowledge an economy scale should be applied since Salem and Hope Creek will be done in tandem. We will reference EPRI study ESC-4685 SIA 83-420 a Nuclear Power Construction study prepared by United & Construction Inc. that supports multi unit construction has efficiency reduction (summarized below).

Station	Reactor Type	Multi Unit Efficiency Direct Craft Labor	
Hope Creek	BWR	1-2 11%-22%	1-3 28%-36% Data Source EPRI p. 3-79 & 3-80

#### **Cost Assumptions:**

#### Hope Creek -

In consideration of the EPRI study, efficiency reduced the variable costs. Fixed cost elements (see base cost allocation above) remain constant on a per unit basis. The TLG cost was reduced by 10% since this will be a mass demolition (non contaminated) vs. controlled demolition (contaminated)

The Spent Fuel will follow the same fact pattern and cash flow pattern as in the 2002 TLG Study for Hope Creek.

Since decommissioning after 40 yrs would be equivalent to normal demolition work in a Fossil Plant an additional allowance of 15% savings has been made to contaminated portion of the work only. (Working in a contaminated area can account for a loss of productivity of an additional 25% or 2 Man Hrs/Day). The breakdown of unproductive time is listed below, is based on field observations made at the nuclear sites.

Security:	0.5 MH	6.25%
Suit Up requirements (two times/day)	1 MH	12.5%
Clean up at the end of day	0.5 MH	6.3%
Total	2 MH	25.0%

The other factors affecting productivity in a contaminated area physical restrictions congestion, height adjustment in work space (crawl space or 40ft. In the air), outage schedule (comprised time line) and ALARA (level of allowance radiation) & proximity of other on going projects. The cost assumptions correspond to present circumstances and to the present status & availability of technology.

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# Table 3: Hope Creek Unit 1 SAFSTOR vs. Non-SAFSTOR Summary of Costs 2010\$ (millions)

	Non SAFSTOR			
Description	TLG 2002	TLG (esc.) 2010	PSEG 2010	
Site Specific Cost				
Lic. Termination	625.2	794.0	670.7	
Spent Fuel Mgmt.	56.7	72.0	72.0	
Site Restoration	101.2	128.5	128.5	
Total (100% Share)	783.1	994.5	871.2	
PSEG Share (w/Spent Fuel) <sup>6</sup>	783.1	994.5	871.2	
Spent Fuel Costs	(56.7)	(72.0)	(72.0)	
PS share (w/o Spent Fuel)	726.4	922.5	871.2	
Site Restoration ( PSEG Share)	(101.2)	(128.5)	(128.5)	
PS share (w/o Site Restoration & Spent Fuel)	625.2	794.0	742.7	

 $^{6}$  The spent fuel management cost include an allocation from the contingency shown on table 2.

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total	O&M Security During SAFSTOR
2046 2047 2048 2049 2050 2051 2052 2053 2054 2055 2056 2057 2058 2059 2060 2061 2062 2063 2064 2065 2066 2067 2068 2069 2070 2071 2072 2078 2070 2071 2072 2073 2074 2075 2076 2077 2078 2077 2078 2079 2080 2081 2082 2083 2084 2085 2086 2087 2088 2089 2080	6.9 35.2 10.2 38.8 38.8 38.3 57.5 141.6	0.2 4.0 1.8	0.2 1.1 1.0 .9 0.9 1.3 2.2	0.0 0.9 1.0 0.0 24.4 39.2 41.4	0.5 3.9 5.1	7.8 45.1 19.1 43.6 87.1 130.7 217.8	2.6 2.6
2093	111.5	15.7	3.5	29.6	13.9	174.2	

#### TABLE 4: SCHEDULE OF ANNUAL EXPENDITURES Hope Creek Unit 1 - SAFSTOR (millions, 2010 dollars)

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2094	109.8	14.4	1.3	0.0	5.2	130.7	
2095	58.4	24.4	0.9	0.0	3.4	87.1	
Total	608.2	112.4	13.3	136.5	72.8	943.2	104.0

#### **Table 5 Hope Creek 1 Cash Flows**

Year	Annual Expenditures thousands 2010	DTF Fund Balance 2% Real Rate of Return dollars less expenditures	SAFSTOR Year	Notes
		399,298	Balan	<u>ce as of 12/31/2010</u>
2011		407,284		
2012		415,430		
2012		423,738		Fund balances escalates at 2%
2013		432,213		
2014		440,857		per annum during remaining period of operation
2015				period of operation
2010		449,674		
2017		458,668 467,841		
2018		407,198		
2019		486,742		
2020		496,477		
2022		506,406		
2022		516,535		
2024		526,865		
2025		537,402		
2025		548,151		
2020		559,113		
2028		570,295		
2029		581,702		
2030		593,336		
2031		605,202		
2032		617,307		
2033		629,653		
2034		642,246		
2035		655,091		
2036		668,192		
2037		681,556		
2038		695,187		
2039		709,091		
2040		723,273		
2041		737,738		
2042		752,493		
2043		767,543		
2044		782,894		
2045		798,552		
2046	7,800	806,723		Expenses to put plant in
2047	45,100	777,757		SAFSTOR Condition, includes
2048	19,100	774,213		security and O&M
2049		787,097	1	Annual Security and O&M
2050		800,238	2	cost during SAFSTOR is
2051		813,644	3	\$2.6MM PSEG
2052		827,316	4	
2053		841,263	5	
2054		855,488	6	
2055		869,998	7	
2056 2057		884,798	8 9	
2057		899,894 915,292	9 10	
2058 2059		915,292 930,997		
2059			11 12	
2060		947,017 963,358	12	
2061		980,025	13	
2062		997,025	14	
2003		1,014,366	16	
2065		1,032,053	17	
2066		1,050,094	18	
2000		•,••••,••		

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2067		1,068,496	19
2068		1,087,266	20
2069		1,106,411	21
2070		1,125,940	22
2071		1,145,858	23
2072		1,166,176	24
2073		1,186,899	25
2074		1,208,037	26
2075		1,229,598	27
2076		1,251,590	28
2077		1,274,022	29
2078		1,296,902	30
2079		1,320,240	31
2080		1,344,045	32
2081		1,368,326	33
2082		1,393,092	34
2083		1,418,354	35
2084		1,444,121	36
2085		1,470,404	37
2086		1,497,212	38
2087		1,524,556	39
2088		1,552,447	40
2089	43,600	1,539,896	
2090	87,100	1,483,594	
2091	130,700	1,382,566	
2092	217,800	1,192,417	
2093	174,200	1,042,065	
2094	130,700	932,207	
2095	87,100	863,751	

Costs during 7-year decommissioning period includes security and O&M

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**Table 6: Decommissioning Waste Summary**Please see Table 5.1, Decommissioning Waste Summary, in the TLG Report, attached asAppendix B to this report.

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**Table 7: Detailed Cost Analysis**Please see Appendix C in the TLG Report, attached as Appendix B to this report.

# **IV. Appendices** A. Time Line

B. December 2002 TLG Decommissioning Cost Analysis

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Appendix A: Time Line

Hope Creek 1

Activity

2046 2047 2048 2049 - 2088 2089 2090 2091 2092 2093 2094 2095

Shutdown<br/>through<br/>Transition
x
x

Safe storage period
x

Decommissioning<br/>and Site Restoration
x

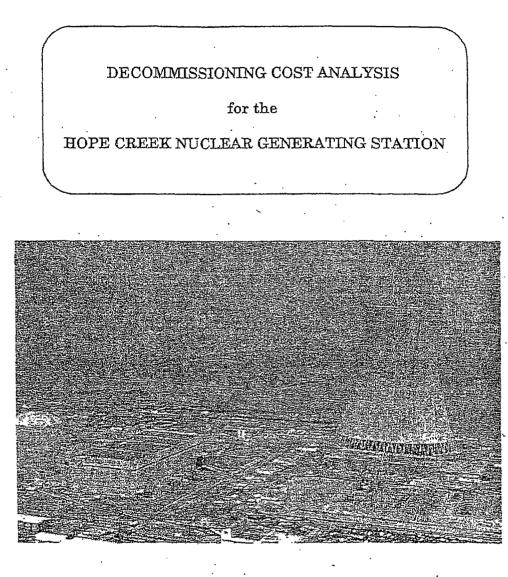
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Appendix B: December 2002 TLG Decommissioning Cost Analysis

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prepared for

#### PSEG NUCLEAR, LLC

prepared by

TLG Services, Inc. Bridgewater, Connecticut

December 2002

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TLG Services. Inc.

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Hope Creek Nuclear Generating Station Decommissioning Cost Analysis

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#### **REVISION LOG**

No.	CRA No.	Date	Item Revised	Reason for Revision
0		12-05-02		Original Issue
U.				

TLG Services. Inc.

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#### EXECUTIVE SUMMARY.

This report presents the costs to promptly decommission (decontaminate and dismantle) the Hope Creek Nuclear Generating Station (Hope Creek) following a scheduled cessation of plant operation. The analysis relies upon the site-specific, technical information developed for a previous evaluation prepared in 1995-96, updated to reflect current plant conditions and operating assumptions. The estimate is designed to provide PSEG Power, LLC with sufficient information to assess its financial obligations as they pertain to the eventual decommissioning of the nuclear station.

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 cooling period of approximately five years for the spent fuel that resides in the plant's storage pool when operations cease. Any residual fuel remaining in the pool after the five-year period will be relocated to an on-site, interim storage facility to await the transfer to a DOE facility. The estimate also includes the dismantling of non-essential structures and limited restoration of the site.

#### Alternatives and Regulations

The Nuclear Regulatory Commission (NRC) provided general decommissioning guidance in the rule adopted on June 27, 1988.<sup>[1]</sup> In this rule the NRC set forth technical and financial criteria for decommissioning licensed nuclear facilities. The regulations addressed planning needs, timing, funding methods, and environmental review requirements for decommissioning. The rule also defined three decommissioning alternatives as being acceptable to the NRC – DECON, SAFSTOR, and ENTOMB.

<u>DECON</u> 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."<sup>[2]</sup>

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. Ibid. Page FR24022, Column 3.

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<u>SAFSTOR</u> 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,"<sup>[3]</sup> Decommissioning is to be completed within 60 years, although longer time periods will be considered when necessary to protect public health and safety.

<u>ENTOMB</u> 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."<sup>[4]</sup> 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. As such, the NRC is currently re-evaluating this option and the technical requirements and regulatory actions that would be necessary for entombment to become a viable option.

In 1996, the NRC published revisions to the general requirements for decommissioning nuclear power plants to clarify ambiguities and codify procedures and terminology as a means of enhancing efficiency and uniformity in the decommissioning process. 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 describes the methods and procedures that are acceptable to the NRC staff for implementing the requirements of the 1996 revised rule that relate to the initial activities and the major phases of the decommissioning process. The costs and schedules presented in this analysis follow the general guidance and process 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<sup>[5]</sup> developed by the Atomic Industrial Forum (now Nuclear Energy Institute). This reference

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

TLG Services, Inc.

Ibid.

<sup>&</sup>lt;u>Ibid.</u> Page FR24023, Column 2.

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describes a unit factor method for determining decommissioning activity costs. The unit factors used in this analysis incorporate site-specific costs, and the latest available information on worker productivity in decommissioning.

The estimate also 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 technical challenges of decommissioning commercial nuclear units.

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

#### Contingency

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Consistent with industry 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.<sup>27[6]</sup> The cost elements in the estimate is based on ideal conditions; therefore, the types of unforeseeable events that are almost certain to occur in decommissioning, based on industry experience, are addressed through a percentage contingency applied on a line-item basis. This contingency factor is a nearly universal element in all large-scale construction and demolition projects. It should be noted that contingency, as used in this estimate, 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.

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

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#### 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 Disposal Act" in 1980, and its Amendments of 1985,<sup>[7]</sup> the states became ultimately responsible for the disposition of radioactive waste generated within their own borders.

New Jersey is a member of the three-state Atlantic Interstate Low-Level Radioactive Waste Management Compact, formed after South Carolina formally joined the Northeast Regional Compact. The Barnwell Low-Level Radioactive Waste Management Facility, located in South Carolina, is expected to be available to PSEG Nuclear to support the decommissioning of Hope Creek. It is also assumed that PSEG Nuclear could access other disposal sites should it prove cost effective. As such, rate schedules for both the Barnwell and the Envirocare facility in Utah were used to generate disposal costs.

#### High-Level Radioactive Waste Management

Congress passed the "Nuclear Waste Policy Act"<sup>[8]</sup> in 1982, assigning the responsibility for disposal of spent nuclear fuel created by the commercial nuclear generating plants to the DOE. This legislation also created a Nuclear Waste Fund to cover the cost of the program, which is funded by the sale of electricity from nuclear reactors since 1993, and an estimated equivalent value for assemblies irradiated prior to 1983. The Nuclear Waste Policy Act, along with the individual disposal contracts with 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. Operation of DOE's yet-to-be constructed geologic repository is currently scheduled for the year 2010, assuming that the licensing could be completed expeditiously and a national transportation system established. The agency has no plans for receiving spent fuel from commercial nuclear plant sites prior to this date and startup operations may be phased in, creating additional delays.

The NRC requires licensees to 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. For estimating purposes, PSEG Nuclear has assumed that the high-level waste repository, or some interim storage facility, will be fully

"Low-Level Radioactive Waste Policy Amendments Act of 1985," Public Law 99-240, 1/15/86. "Nuclear Waste Policy Act of 1982 and Amendments," U.S. Department of Energy's Office of Civilian Radioactive Management, 1982.

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operational by 2015. Interim storage of the fuel, until the DOE has completed the transfer, will be in an independent facility located on the Artificial Island site. This will allow PSEG Nuclear to proceed with decommissioning and terminate its operating licenses in the shortest time possible.

The spent fuel storage facility, which is independently licensed and operated, will be sized to accommodate the inventory of spent fuel residing in the plant's storage pools at the cessation of operations, in addition to any operational inventory already in residence. When emptied, the station could be dismantled without maintaining the wet storage pools. Based upon this scenario, and an anticipated rate of transfer, spent fuel is projected to remain on site for approximately 20 years following the cessation of plant operations.

#### Site Restoration

The efficient removal of the contaminated materials at the site may result in damage to many of the site structures. Blasting, coring, drilling, and the other decontamination activities will substantially damage power block structures, potentially weakening the footings and structural supports. Prompt demolition once 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 to the demolition work force. Consequently, this study assumes that site structures will be removed to a nominal depth of three feet below the local grade level wherever possible. The site will then be graded and stabilized.

#### Summary

The DECON decommissioning alternative involves the prompt removal of the contaminated and activated plant components, including structural materials, from the site following permanent shutdown. The facility operator may then have unrestricted use of the site with no further requirement for a license. This study assumes that the remainder of the non-essential plant systems and structures, not previously removed in support of license termination, are dismantled and the site restored.

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

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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.

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#### COST SUMMARY

(Thousands of 2002 Dollars)

Activity	•	Cost		
		·		
Decontamination	•	30,745		
Removal .		192,120		
Packaging		16,049		•
Transportation		6,008	••	
Waste Disposal	• *	132,615		
Off-site Waste Processing		. 53,630	· · ·	•
Program Management (including Engineering	g and Security)	260,625		
Spent Fuel Pool Isolation		9,060	• ,	
ISFSI Related (including capital)		40,239		•
Insurance and Regulatory Fees		7,148		
Energy	• •	11,769		
Characterization and Licensing Surveys		13,937		-
	• •	•		· ·
Misc. Equipment and Site Services		9,157		· ·
Misc. Equipment and Site Services		9,157		
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Misc. Equipment and Site Services		9,157		
Misc. Equipment and Site Services		9,157		· · ·
Misc. Equipment and Site Services Total <sup>1</sup>		9,157  783,102		
Misc. Equipment and Site Services Total <sup>1</sup> License Termination <sup>2</sup>		9,157 783,102 681,889		
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Misc. Equipment and Site Services Total <sup>1</sup> License Termination <sup>2</sup>		9,157 783,102 681,889		

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Hope Creek Nuclear Generating Station Decommissioning Cost Analysis

#### 1. INTRODUCTION

This decommissioning analysis is designed to provide PSEG Power with sufficient information to prepare the financial planning documents for decommissioning, as required by the Nuclear Regulatory Commission (NRC or Commission). It is not a detailed assessment, but a financial analysis prepared in advance of the engineering and planning that will be required to carry out the decommissioning of the Hope Creek Nuclear Generating Station (Hope Creek).

#### 1.1 OBJECTIVES OF STUDY

The objectives of this study are to prepare comprehensive estimates of the costs to decommission Hope Creek for the scenario outlined in Section 2, to define a sequence of events, and project the volume of waste produced from the decontamination and dismantling activities.

For the purposes of this study, the shutdown date was taken as April 11, 2026. This time frame, which reflects 40 years of operating life, was used as an input for scheduling the decommissioning activities.

#### 1.2 SITE DESCRIPTION

Hope Creek is located on the southern part of Artificial Island on the east bank of the Delaware River in Lower Alloways Creek Township, Salem County, New Jersey. The site is 15 miles south of the Delaware Memorial Bridge, 18 miles south of Wilmington, Delaware, 30 miles southwest of Philadelphia, Pennsylvania, and 7½ miles southwest of Salem, New Jersey.

The Nuclear Steam Supply System (NSSS) consists of a boiling water reactor and a two-loop recirculation system. The generating unit has a rated core thermal power of 3,293 MWt (thermal) with a corresponding gross electrical output of approximately 1,118 MWe and a net electrical output of 1,067 megawatts (electric).

The two-loop reactor recirculation system contains two, vertical centrifugal pumps and is located within the "primary containment structure." This structure consists of the drywell, the suppression system, and interconnecting vent system. The drywell is a steel pressure vessel in the shape of a light bulb. The pressure suppression chamber is a torus-shaped steel pressure vessel located below and encirching the drywell.

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This chamber is connected to the drywell by eight equally spaced vent pipes. These vent pipes are connected to a common header within the suppression chamber. Eighty downcomers, connected to the header, terminate below the water level of the suppression pool. As a system, the drywell, suppression chamber, and interconnecting piping, acts to reduce the pressure increase in the event of a local process system piping failure.

Heat produced in the reactor is converted to electrical energy by the power conversion system. A turbine-generator system converts the thermal energy of steam produced in the reactor vessel into mechanical shaft power and then into electrical energy. The unit's turbine generator consists of a tandem compound, six-flow, non-reheat unit. It is comprised of one double-flow, high-pressure turbine and three double-flow, low-pressure turbines driving a direct-coupled generator at 1,800 rpm. The turbine is operated in a closed feedwater cycle, which condenses the steam; the condensate/feedwater is returned to the reactor recirculation system. Heat rejected in the main condenser is removed by the circulating water system.

The circulating water system is designed to circulate the flow of water required to removed the heat load from the main condenser and other auxiliary equipment and to discharge it to the atmosphere through a natural draft cooling tower. Some heat may be rejected to the Delaware estuary from the cold water side of the cooling tower in the form of blowdown.

#### **1.3 REGULATORY GUIDANCE**

The NRC provided initial decommissioning guidance in its rule "General Requirements for Decommissioning Nuclear Facilities," issued in June 1988.[1]\* This rule set forth technical and financial criteria for decommissioning licensed nuclear facilities. The regulation addressed funding methods, decommissioning planning needs, timing, 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 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 amendments.

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

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The rule defined three decommissioning alternatives as being acceptable to the NRC: DECON, SAFSTOR, and ENTOMB. It 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 could 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 definition of unrestricted release and 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 reevaluated this alternative. The resulting feasibility study, based upon an assessment by Pacific Northwest National Laboratory, concluded that the method did have conditional merit for some if not most reactors. However, the staff also found that additional rulemaking would be needed before this option could be treated as a generic alternative. The NRC is considering rulemaking to alter the 60-year time for completing decommissioning and to clarify the use of engineered barriers for reactor entombments. Pending completion of such rulemaking, entombment requests will be handled on a case-by-case basis.

In 1996, the NRC published revisions to the general requirements for decommissioning nuclear power plants.<sup>[3]</sup> When the decommissioning regulations were adopted in 1988, it was assumed that the majority of licensees would decommission at the end of the operating license life. Since that time, several licensees permanently and prematurely ceased operations without having submitted a decommissioning plan. In addition, these licensees requested exemptions from certain operating requirements as being unnecessary once the reactor is defueled. 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.

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Under the revised regulations, licensees would submit written certification to the NRC within 30 days after the decision to cease operations. Certification would also be required once the fuel was permanently removed from the reactor vessel. Submittal of these notices would 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 would be 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 would be required to submit an application to the NRC to terminate the license, along with a license termination plan (LTP).

#### 1.3.1 Nuclear Waste Policy Act

Congress passed the Nuclear Waste Policy Act<sup>[4]</sup> in 1982, assigning the responsibility for disposal of spent nuclear fuel from the commercial nuclear generating plants to the Department of Energy (DOE). Two permanent disposal facilities were envisioned, as well as an interim facility. To recover the cost of permanent spent fuel disposal, this legislation created a Nuclear Waste Fund through which money was to be collected from the consumers of the electricity generated by commercial nuclear power plants. The Nuclear Waste Policy Act, along with the individual disposal contracts with utilities, specified that the DOE was to begin accepting spent fuel by January 31, 1998.

After pursuing a national site selection process, the Act 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 in the opening date for the repository, from 1998 to 2003. Two years later, in 1989, an additional 7-year delay was announced, primarily due to problems in obtaining the required permits 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 a recent decision, the U.S. Court of Appeals for the Federal Circuit reaffirmed the utility position that DOE had breached its contractual obligation. However, even with the August 2000 ruling,<sup>[5]</sup> DOE's position has remained unchanged. The agency continues to maintain that its delayed performance is

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unavoidable because it does not have an operational repository and does not have authority to provide storage in the interim. Consequently, DOE has no plans to receive spent fuel from commercial U.S. reactors before the year 2010.

The NRC requires licensees to establish a program to manage and provide funding for the management of all irradiated fuel at the reactor until title of the fuel is transferred to the Secretary of Energy in 10 CFR 50.54 (bb).<sup>[6]</sup> This funding requirement is fulfilled through inclusion of certain high-level waste cost elements within the estimates, as described below.

For estimating purposes, PSEG Nuclear has assumed that the high-level waste repository, or some interim storage facility, will be fully operational by 2015. Interim storage of the fuel, until the DOE has completed the transfer, will be in an independent facility located on the Artificial Island site. This will allow PSEG Nuclear to proceed with decommissioning and terminate its operating license in the shortest time possible.

Based upon the projected capacity of the spent fuel storage pool, supplemental storage will be required before the current operating license expires so as to maintain full core off-load capability. Therefore, this analysis assumes that an on-site independent spent fuel storage installation (ISFSI) will be constructed to support plant operation and will be available to support decommissioning

The spent fuel storage facility, which is independently licensed and operated, will be sized to accommodate the inventory of spent fuel residing in the plant's storage pool at the cessation of operations, in addition to any operational inventory already in residence. When emptied, the station could be dismantled without maintaining the wet storage pool. Based upon this scenario, and an anticipated rate of transfer, spent fuel is projected to remain on site for approximately 20 years following the cessation of plant operations.

Expenditures are included in the analysis for the isolation and continued operation of the spent fuel pool throughout the first five years of decommissioning. Expenses are also included for loading the spent fuel assemblies remaining in the storage pool after the cessation of plant operation into multi-purpose canisters, for canister costs and overpacks, and for the operation of the ISFSI through the year 2046, when all the fuel is expected to be transferred to the DOE.

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1.3.2 Low-Level Radioactive Waste Policy Amendments Act

Congress passed the "Low-Level Radioactive Waste Disposal Act" in 1980, 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. With little progress, the "Amendments Act" of 1985<sup>[7]</sup> extended the target, with specific milestones and stiff sanctions for non-compliance.

New Jersey is a member of the three-state Atlantic Interstate Low-Level Radioactive Waste Management Compact, formed after South Carolina formally joined the Northeast Regional Compact. The Barnwell Low-Level Radioactive Waste Management Facility, located in South Carolina, is expected to be available to PSEG Nuclear to support the decommissioning of Hope Creek. It is also assumed that PSEG Nuclear could access other disposal sites should it prove cost-effective. As such, rate schedules for both the Barnwell as well as the Envirocare facility in Utah were used to generate disposal costs.

1.3.3 Radiological Criteria for License Termination

In 1997, the NRC published Subpart E, "Radiological Criteria for License Termination,"<sup>[8]</sup> amending Part 20 of Title 10 of the Code of Federal Regulations (10 CFR §20). This subpart provided radiological criteria for releasing a facility for unrestricted use. The regulation provides that the site could 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 residual radioactivity has been reduced to levels that are As Low As Reasonably Achievable (ALARA). The decommissioning estimate for Hope Creek assumes that the site will be remediated to a residual level consistent with the NRCprescribed 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

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or Superfund). An additional limit of 4 millirem per year, as defined in 40 CFR Part 141.16, is applied to drinking water.

On October 9, 2002, the NRC signed an agreement with the EPA on the radiological decommissioning and decontamination of NRClicensed sites. The Memorandum of Understanding (MOU) 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 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 EPA. However, if there are other hazardous materials on the site, EPA may be involved in the cleanup. As such, the possibility of dual regulation remains for certain licensees.

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### 2. DECOMMISSIONING ALTERNATIVE

The following section describes the basic activities associated with the DECON 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 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 estimates developed for Hope Creek are also divided into phases or periods; however, demarcation of the phases is based upon major milestones within the project or significant changes in the projected expenditures.

#### 2.1 PERIOD 1 – PREPARATIONS

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

#### 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

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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. <u>Major</u> 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 Greater-than-Class C waste (GTCC), as defined by 10 CFR §61. Major components are further defined as comprising the reactor vessel and internals, large bore reactor 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 bounded by previously evaluated environmental assessments or impact statements. In this instance, the licensee would have to submit a license amendment for the specific activity and update the environmental report.

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

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#### 2.1.2 <u>Site Preparations</u>

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

• Characterization of the site and surrounding environs. This includes radiation surveys of work areas, major components (including the reactor vessel and its internals), sampling of internal piping contamination levels, and primary shield cores.

Isolation of the spent fuel storage pool and fuel handling systems, such that decommissioning operations could commence on the balance of the plant. Decommissioning operations are scheduled around the fuel handling area to the greatest extent possible such that the overall project schedule is optimized. The fuel will be transferred to the DOE as it decays to the point that it meets the heat load criteria of the containers and, as such, it is assumed that the fuel pool will remain operational for a minimum of five years following the cessation of plant operations.

Specification of transport and disposal requirements for activated materials and/or hazardous materials, including shielding and waste stabilization.

• Development of procedures for occupational exposure control, control and release of liquid and gaseous effluent, processing of radwaste (including dry-active waste, resins, filter media, metallic and nonmetallic components generated in decommissioning), site security and emergency programs, and industrial safety.

#### 2.2 PERIOD 2 – DECOMMISSIONING OPERATIONS

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. Building

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modifications may be required to the Reactor Building to facilitate access of large/heavy equipment. Modifications may also be required to the refueling area of the Reactor 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.
- Disconnection of the control blades from the drives on the vessel lower head.
   Blades are transferred to the spent fuel pool for packaging.
- Transfer of the steam separator and dryer assemblies to the dryer-separator pool 'for segmentation. 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, segmentation and packaging of the core shroud and in-core guide tubes. Some of the material is expected to exceed Class C disposal requirements. As such, those segments will be packaged in a modified fuel canister for geologic disposal. Interim storage can be in the pool, as space permits, or in the ISFSI.
- Removal and segmentation of the remaining internals including the jet pump assemblies, fuel support castings and core plate assembly.
- Draining and decontamination of the reactor well and permanently sealing of the spent fuel transfer gate. Install shielded platform for segmentation of reactor vessel. Cutting operations are performed in-air using remotely operated equipment within a contamination control envelope, with the water level maintained just below the cut to minimize the working area dose rates.

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Sections are transferred to the dryer-separator pool for packaging and interim storage.

- Disconnection of the control rod drives and instrumentation tubes from reactor vessel lower head. The lower reactor head and vessel supporting structure will then be segmented.
- Removal of the reactor recirculation pumps. Exterior surfaces are decontaminated and openings covered. Components can serve as their own burial containers provided that all penetrations are properly sealed.

Demolition of the sacrificial shield activated concrete by \_controlled demolition.

At least two years prior to the anticipated date of license termination, a LTP is required. Submitted as a supplement to the Final Safety Analysis Report (FSAR), or equivalent, the plan must include: a site characterization, description of the remaining dismantling activities, plans for site remediation, procedures for the final radiation survey, designation of the end use of the site, an updated cost estimate to complete the decommissioning, and any associated environmental concerns. The NRC will notice the receipt of the plan, make the plan available for public comment, and schedule a local hearing. LTP approval will be subject to any conditions and limitations as deemed appropriate by the Commission. The licensee may then commence with the final remediation of site facilities and services, including:

- Removal of remaining plant systems and associated components as they become nonessential to the decommissioning program or worker health and safety (e.g., waste collection and treatment systems, electrical power and ventilation systems).
- Removal of the steel liners from the drywell, disposing of the activated and contaminated sections as radioactive waste. Removal of any activated/ contaminated concrete.
- Removal of the steel liners from the steam separator and dryer pool, reactor well, and spent fuel storage pool.
- Surveys of the decontaminated areas of the containment structure.
- Removal of the contaminated equipment and material from the Turbine and Radwaste Buildings and any other contaminated facility. Use radiation and

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contamination control techniques until radiation surveys indicate that the structures could 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 will facilitate surface decontamination and subsequent verification surveys required prior to obtaining release for demolition.

• Removal of the remaining components, equipment, and plant services in support of the area release survey(s).

Routing of material removed in the decontamination and dismantling to a central processing area. Material certified to be free of contamination would be 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 NUREG/CR-1575, "Multi-Agency Radiation Survey and Site Investigation Manual" (MARSSIM).<sup>[9]</sup> 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.

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#### 2.3 PERIOD 3 – SITE RESTORATION

Following completion of decommissioning operations, site restoration activities may begin. Efficient removal of the contaminated materials and verification that residual radionuclide concentrations are below the NRC limits may result in substantial damage to many of the structures. Although performed in a controlled and safe manner, blasting, coring, drilling, scarification (surface removal), and the other decontamination activities will substantially degrade power block structures, including the Reactor, Auxiliary, and Fuel Handling Buildings. Verifying that subsurface radionuclide concentrations meet NRC site release requirements may 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 costeffective option. It is unreasonable to anticipate that these structures would be repaired and preserved after the radiological contamination is removed. The cost to dismantle site structures with a work force already mobilized on site is more efficient than if the process is deferred. Site facilities quickly degrade without maintenance, adding additional expense and creating potential hazards to the public and future workers. Abandonment creates a breeding ground for vermin infestation and other biological hazards.

This cost study presumes that non-essential structures and site facilities will be 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, and 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 demolition activities is processed to remove rebar and miscellaneous embedments. The processed material is then used on-site to backfill voids. Excess materials are trucked off-site for disposal as construction debris.

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### 2.4 POST PERIOD 3 – ISFSI OPERATIONS

The ISFSI will continue to operate under a separate and independent license (10 CFR §72) following the relocation of the spent fuel from the plant's storage pools. Transfer of spent fuel to a DOE or interim facility will be exclusively from the ISFSI once the fuel pools have been emptied and the structures released for decommissioning. Assuming initiation of the federal Waste Management System in 2015, transfer of spent fuel from Hope Creek is anticipated to continue through the year 2046. Any delay in the transfer process, for example, due to a delay in the scheduled opening of the geologic repository, a slower acceptance rate, or a combination of a delayed start date and lower transfer rate, will result in a longer on-site residence time for the fuel discharge from the reactor, and therefore additional caretaking expenses.

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 currently proposed design for the ISFSI is based upon the use of concrete overpacks 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 and the license for the facility terminated, the modules can be dismantled using conventional techniques for the demolition of reinforced concrete. The concrete storage pad is then removed, and the area graded and landscaped to conform to the surrounding environment.

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### 3. COST ESTIMATE

The cost estimate prepared for decommissioning Hope Creek consider the unique features of the site, including the nuclear steam supply system, power generation systems, support services, site buildings, and ancillary facilities. The bases of the estimate, including the sources of information relied upon, the estimating methodology employed, site-specific considerations and other pertinent assumptions are described in this section.

#### 3.1 BASIS OF ESTIMATE

The current estimate was developed using the basic design information originally generated for the decommissioning analysis prepared in 1995-96.<sup>[10]</sup> The information was reviewed for the current estimate and updated, as deemed necessary. The site-specific considerations and assumptions used in the previous estimate 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 this cost estimate follows the basic approach originally presented in the AIF/NESP-036 study report, "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates,"<sup>[11]</sup> and the US DOE "Decommissioning Handbook."<sup>[12]</sup> 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 <u>activity-dependent</u> 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.<sup>[13]</sup>

This estimate 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 has provided additional insight into the process, the

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regulatory aspects, and 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%
			•	10/0 10 20%
•	<b>Respiratory Protection Factor</b>		•	10% to $50%$
•	Radiation/ALARA Factor	•	•	10% to 37%
- <b>B</b>	Protective Clothing Factor	•		10% to 30%
-8	Work Break Factor	•	· :	8.33%
۰	Productivity	•		adjustable

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 relied 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

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engineering, equipment rental, and support services such as quality control and security. This systematic approach for assembling decommissioning estimates ensures a high degree of confidence in the reliability of the resulting costs.

#### 3.3 FINANCIAL COMPONENTS OF THE COST MODEL

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

Inherent in any cost estimate that does not rely on historical data is the inability to specify the precise source of costs imposed by factors such as tool breakage, accidents, illnesses, weather delays, and labor stoppages. In TLG's 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"<sup>[14]</sup> 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 estimate 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 estimate, 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

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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, could 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 will be the disposition of the reactor vessel and internal components, which have become highly radioactive after a lifetime of exposure to radiation produced in the core. The disposition of these highly radioactive components forms the basis for the critical path (schedule) for decommissioning operations. Cost and schedule are inter-dependent 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 risk and uncertainties associated with this task are that the expected optimization 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. 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 can range from 0% to 75%, depending on the degree of difficulty judged to be appropriate

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		• •	
•	TLG's actual decommissioning experience. s used in this study are as follows:	The contingency	
1. TANKA A	anon in aith alland and an an an an	· · ·	
•	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%	
۰.	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 overall contingency, when applied to the appropriate components of the estimates on a line item basis, results in an average value of 19.8%.

#### 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:

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• 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.

 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 much 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, it is recommended that the areas of

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uncertainty or risk be 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

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

The total inventory of assemblies that will need to be handled during decommissioning is based upon several assumptions. The pickup of commercial fuel is assumed to begin in the year 2015 and will proceed on an oldest fuel first basis. The rate at which the fuel is removed from the commercial sites is based upon an annual capacity at the geologic repository of 3,000 metric tons. A delay in the startup of the repository, or a decrease in the rate of acceptance rate, will correspondingly prolong the transfer process and extend the duration that the fuel remains at the site.

For estimating purposes, spent fuel will be removed from the Hope Creek site during, and following decommissioning, with the transfer complete by the end of year 2046. Built to support continuing plant operations, an ISFSI will be available to support decommissioning, i.e., the fuel residing in the pool following the cessation of plant operations could be relocated to the ISFSI so that decommissioning can proceed on the Reactor Building. The assemblies will be relocated to the ISFSI during the first five years following final shutdown. Costs are included for the purchase

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of the 25 canisters and overpacks required to empty the pool (an additional five will be used to package the GTCC).

Operation and maintenance costs for the ISFSI are included within the estimates and address the cost for staffing the facility, security, insurance, and licensing fees. Costs are also provided for the final disposition of the facility once the transfer is complete.

#### ISFSI Design Considerations

A multi-purpose (storage and transport) dry shielded storage canister with a vertical, reinforced concrete storage silo is used as a basis for the . cost analyses. Approximately 50% of the silos 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 overpackes for controlled disposal. The cost of the disposition of this material, as well as the demolition of the ISFSI facility, is included in the estimate.

3.4.2 Reactor Vessel and Internal Components

The NSSS (reactor vessel and reactor recirculation system components) will be decontaminated using chemical agents prior to the start of cutting operations. A decontamination factor (average reduction) of 10 is presumed.

The reactor pressure vessel and internal components are segmented for disposal in shielded, reusable transportation casks. Segmentation will be performed in the dryer-separator pool, where a turntable and remote cutter are installed. The vessel will be segmented in place, using a mastmounted cutter supported off the lower head and directed from a shielded work platform installed overhead in the reactor well. Transportation cask specifications and transportation regulations will dictate segmentation and packaging methodology.

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, DOE has indicated it will accept title to this waste for disposal at the future high-level waste repository.<sup>[15]</sup> 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

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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 DOE would accept this waste prior to completing the transfer of spent fuel. Therefore, until such time as the DOE is ready to accept GTCC waste, it is reasonable to assume that this material would remain in storage at Hope Creek.

Intact disposal of the reactor vessel and internal components could 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, the location of the Trojan Nuclear Plant 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 Hope Creek ceases operation. Future viability of this option will depend upon the ultimate location of the disposal site, as well as the disposal site licensee's ability to accept highly radioactive packages and effectively isolate them from the environment. Consequently, as a bounding condition, the study assumes the reactor vessel will have to be segmented.

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#### 3.4.3 <u>Primary System Components</u>

Reactor recirculation 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 shipped by shielded van. The reactor recirculation pumps and motors are lifted out intact, packaged, and transported for processing or 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 condenser will also be disassembled and moved to a laydown area. Material will then be prepared for transportation to an off-site recycling facility where it will be surveyed and designated for decontamination, volume reduction, or 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 of the Code of Federal Regulations.<sup>[16]</sup> The contaminated material will be packaged in Industrial Packages (IP I, II, or III) 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.

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.

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The segmentation scheme for the vessel and internal segments are designed to meet these limits.

The transport of large intact components, e.g., large heat exchangers and other oversized components, will be by a combination of truck, barge, 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. Memphis, Tennessee will be used as the destination for off-site processing. Transportation costs are estimated using published tariffs from Tri-State Motor Transit.<sup>[17]</sup>

#### 3.4.6 Low-Level Radioactive Waste Disposal

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

Material requiring controlled disposal will be packaged and transported to one of two currently available burial facilities. Very low-level radioactive material, e.g., structural steel and contaminated concrete, will be sent to Envirocare. More highly contaminated and activated material will be 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 PSEG Nuclear's own future

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plans for the site, e.g., the electrical switchyard will remain in support of the electrical transmission and distribution system.

The large underground tunnels between the cooling water intake, Turbine Building, and cooling tower will be isolated, sealed, and abandoned in place. Site utility and service piping are abandoned in place. Electrical manholes are backfilled with suitable earthen material and abandoned. Asphalt surfaces in the immediate vicinity of site buildings are broken up and the material used for backfill on site, if needed. The site access road will remain.

The estimate does 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.

Structures will be removed to a nominal depth of three feet below grade. Concrete rubble generated from demolition activities will be processed and made available as clean fill. The site will be graded following the removal of non-essential structures to conform to the adjacent landscape, and vegetation will be established to inhibit erosion. This degree of site restoration will constitute compliance with the CAFRA document dated July 9, 1976.

#### 3.5 ASSUMPTIONS

The following are the major assumptions made in the development of the estimate for decommissioning the site. Decommissioning activities will be performed in accordance with the current regulations that are assumed to be in place at the time of decommissioning, including the Industrial Site Recovery Act (ISRA), which is mandatory under current New Jersey State Regulations.

#### 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.

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#### 3.5.2 Labor Costs

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. Costs for site administration, operations, construction, and maintenance personnel are based upon average salary information provided by PSEG Nuclear.

PSEG Nuclear, as the licensee, will oversee the decommissioning operations and provide site security, radiological controls, and overall site administration. PSEG Nuclear will provide contract management of the decommissioning labor force and subcontractors. Engineering services for preparing the activity specifications, work procedures, activation, and structural analyses, are provided by PSEG Nuclear personnel.

The costs associated for the transition of the operating organization to decommissioning, e.g., separation packages, retraining, severance, and incentives are not included in this estimate and are considered to be ongoing operating expenses.

#### 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., cesium-137, strontium-90, 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.<sup>[18]</sup> Actual estimates are derived from the curie/gram values in NUREG/CR-3474 and adjusted for the different mass of Hope Creek components, projected operating life, and different periods of decay. Additional short-lived isotopes were derived from NUREG/CR-0130<sup>[19]</sup> and NUREG/CR-0672<sup>[20]</sup> and benchmarked to the long-lived values from NUREG/CR-3474.

The disposal cost for the control blades removed from the vessel with the final core load is included within the estimate. Disposition of any blades stored in the pools from operations is considered an operating expense and therefore not accounted for in the estimates.

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

#### 3.5.4 <u>General</u>

#### Transition Activities

Existing warehouses will be cleared of non-essential material and remain for use by PSEG Nuclear and its subcontractors. The warehouses may be dismantled as they become surplus to the decommissioning program. 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.

• Excess acid, caustic, and all chemicals listed (at shutdown) in the New Jersey "Right to Know Report" will be removed and the storage container returned to the vendor. It is assumed that these chemicals will have some value; therefore, the cost for their removal will be compensated through their subsequent sale.

#### Scrap and Salvage

The existing plant equipment is considered obsolete and suitable for scrap as deadweight quantities only. PSEG Nuclear will make economically reasonable efforts to salvage equipment following final plant shutdown. However, dismantling techniques assumed by TLG for equipment in this estimate 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 estimate

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does not attempt to quantify the value that PSEG Nuclear may realize based upon those efforts.

It is assumed, for purposes of this estimate, that any value received from the sale of scrap generated in the dismantling process would be more than offset by the on-site processing costs. The dismantling techniques assumed in the decommissioning estimate 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 from a facility currently being decommissioned has required the removal and disposition of the PCB-contaminated insulation, an added expense. With a volatile market, the potential profit margin in scrap recovery is highly speculative, regardless of the ability to free release this material. This assumption is an implicit recognition of scrap value in the disposal of clean metallic waste at no additional cost to the project.

Furniture, tools, mobile equipment such as forklifts, trucks, bulldozers, and other such items of personal property owned by PSEG Nuclear will be removed at no cost or credit to the decommissioning project. Disposition may include relocation to other generating 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.". The NRC's financial protection requirements are based on various reactor (and spent fuel) configurations.

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#### Property Taxes ...

Property tax payments will cease upon shutdown of each unit.

#### 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

The costs projected for the decommissioning of Hope Creek are provided in Table 3.1. Decommissioning costs are reported in the year of projected expenditure; however, the values are provided in thousands of 2002 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.

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Year	•••••	Period 1 Preparations	(1 nous Period 2 Decommissioning Operations	sands, 2002 Dolla Period 3 Site Restoration	rs) Period 4 Dry Fuel Storage *	Period 5 ISFSI Decommissioning	Totals
2026 2027 2028 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2048 2044 2045 2046		38,285 55,590	80,410 185,734 99,099 81₁587 89,928 98,728 19,599	24,792 49,179 \$8,804	105 500 499 499 499 500 499 499 499 499 499 500 499 14,090	2,429	88,285 86,000 135,794 99,099 81,587 89,528 98,728 44,391 49,179 38,910 500 499 499 499 499 499 500 499 499 500 499 16,519
		93,874 * Operating a	554,885 nd decommissioning co	112,775 sts for the ISFSI are	19,188 shared with the	2,429 Salem Station	788,102

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Hope Creek Nuclear Generating Station Decommissioning Cost Analysis

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#### 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 required cooling period for the spent fuel.

A schedule or sequence of activities is presented in Figure 4.1. The schedule reflects the prompt decommissioning alternative and the start date consistent with a scheduled shutdown in 2026. The sequence assumes that fuel will be removed from the spent fuel pool within the first five years. The key activities listed in the schedule do not reflect a one-to-one correspondence with those activities in the Appendix C cost table, but reflect dividing some activities for clarity and combining others for convenience. The schedule was prepared using the "Microsoft Project 2000" computer software.<sup>[21]</sup>

#### 4.1 SCHEDULE ESTIMATE ASSUMPTIONS

The schedule was generated using a precedence network and associated software. Activity durations are based upon the actual man-hour estimates calculated for each area. The schedule was assembled by sequencing the work areas, considering work crew availability and material access/egress. The following assumptions were made in the development of the decommissioning schedule:

- The Reactor Building will continue to serve as the spent fuel storage/ transfer facility until such time that all spent fuel has been removed from site. The Reactor Building is expected to operate for approximately five years after the cessation of operations.
- All work (except vessel and internals removal activities) will be 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

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and laydown space; and 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 Appendix C are based upon the durations developed in the schedule for the decommissioning of Hope Creek. 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.

The project timeline is shown in this section as Figure 4.2. Milestone dates are based on a 40-year plant operating life from the issuance of the operating license, a five-year wet storage period for the last core discharge, and continued operation of the ISFSI until DOE can complete the transfer.

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## FIGURE 4.1

## DECOMMISSIONING ACTIVITY SCHEDULE

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age operations	torage pool operations
Summary task	
Performed During Period	

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## FIGURE 4.1

## (continued)

Task Name		26	27	'28	'29	'30	'31	'32	'33	'34	'85
Remove systems not supporting wet fuel storage					Ē		Ĵ				· <del></del>
Decon buildings not supporting wet fuel storage						<u></u>	<u>+</u> ]				
License termination plan approved		· ·				:	4	ŀ			
Fuel storage pool available for decommissioning						-	4	ŧ			•
Period 2c - Decontamination following wet fuel storage	• • •	].					E				
Dry fuel storage operations	· · · · · · · · · · · · · · · · · · ·				·		Ę				
Remove remaining systems	· · · · · · · · · · · · · · · · · · ·	1					[				
Decon wet fuel storage area		•					P				
Period 2e - Plant license termination			· .					E	2		
Dry fuel storage operations	•••••••••••••••••••••••••••••••••••••••							Ē	ſ		
Final Site Survey		1						E	•		
NRC review & approval					:						
Part 50 license terminated		1						-	۲		
Period 3b - Site restoration		·		-	-	-			Z	777	
Dry fuel storage operations				-						m	
Building demolitions, backfill and landscaping	•.	1		-				-		777	Ī

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Summary task Critical Path Task Performed During Period

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## FIGURE 4.2

# DECOMMISSIONING TIMELINE (not to scale)

## Shutdown 04/11/2026

1:a	1b	2a	2b	2c	2e	3b	3c through	
12.1m 4/26	'5.9m 4/27	18.7m 10/27	1 29.3m - 05/29	, 11.6m 10/31	' 9.1m 09/32	27.5m 07/33	131.9m 10/35	10/46
Prepara	tions		Decommissioning	Operations	••••	Site Restoratio	ISFSI Opera	tions
		· · ·			• •		• •	
	Wet Fue	l Storage			•	、 ・	· · ·	• • • • • • • •
B	Dry Fue	l Storage		· · ·			······································	· ·
	. <u>.</u>	t tegizzen anterlas				•••	21 <sup>-1</sup> 1	
	· .			•			•	
•					•	•	· · · ·	
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		· ,			•	•	•	

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#### 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,<sup>[22]</sup> 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, 10 CFR §71 defines radioactive material and 10 CFR §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). For this study, commercially available steel containers are presumed to be used for the disposal of piping, small components, and concrete. Larger components can serve as their own containers, with proper closure of all openings, access ways, and penetrations.

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

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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 and 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 <sup>137</sup>Cs will still control the disposition requirements.

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The waste material generated in the decontamination and dismantling of Hope Creek will primarily be generated during <u>Period</u> 2. Material considered potentially contaminated when removed from the radiologically controlled area will be sent to processing facilities for conditioning and disposal at a unit cost of \$2.00 per pound. Heavily contaminated components and activated materials will be routed for controlled disposal. The disposal volumes reported in the table reflects the savings resulting from reprocessing and recycling.

For purposes of constructing the estimate, 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 the majority of plant components and activated concrete deemed unsuitable for processing or recovery. An average disposal rate of \$415 per cubic foot 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 will be disposed of at the Envirocare facility. This includes lower activity material such as miscellaneous steel, metal siding, scaffolding and structural steel. A rate of \$298 per cubic foot was used for containerized waste, \$70 per cubic foot for disposal of DAW, and approximately \$20 per cubic foot for bulk material, e.g., concrete.

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## TABLE 5.1

## DECOMMISSIONING WASTE SUMMARY

	Waste Class <sup>1</sup>	Volume (cubic feet)	Weight (pounds)
ow-Level Radioactiv	re Waste	, <u>, , , , , , , , , , , , , , , , , , </u>	· · · · · · · · · · · · · · · · · · ·
Barnwell, South Card	olina (contaminat	ed/activated metal	lic waste and concre
	A B C	107,679 20,945 918	9,328,192 3,230,562 64,020
Envirocare, Utah (mi	iscellaneous steel	, contaminated/act	ivated concrete)
Containerized/DAW	A	48,467	4,386,491
Bulk	A	49,513	2,656,402
Bulk Geologic Repository (	A Greater-than Cla		2,656,402
	A Greater-than Cla >C		2,656,402
Geologic Repository (	A Greater-than Cla >C	ass C)	
Geologic Repository (	>C	ass C) 851	166,199

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

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#### 6. RESULTS

Costs were developed to decommission Hope Creek following a scheduled cessation of plant operations. The analysis relied upon the site-specific, technical information developed for a previous analysis prepared in 1995-96, then updated to reflect current plant conditions and operating assumptions. While not an engineering study, the estimate does provide PSEG Nuclear 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 approximately five years following the cessation of operations for continued cooling of the assemblies. An ISFSI will be used to safeguard the spent fuel, once sufficiently cooled, until such time that the DOE can complete the transfer of the assemblies to its repository. The scenario also includes the costs for the dismantling of non-essential structures and limited restoration of the site.

The cost projected to promptly decommission Hope Creek is estimated to be \$783.1 million. The majority of this cost (approximately 87.1%) is associated with the physical decontamination and dismantling of the nuclear unit and caretaking of the spent fuel, so that the license could be terminated. The remaining 12.9% is for the demolition of the remaining 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 and the duration of the program. It is assumed, for purposes of this analysis, that PSEG Nuclear will oversee the decommissioning program, managing 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 has been 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 approximately five years following the cessation of plant operation. The pool will be

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isolated and an independent spent fuel island created. This will allow decommissioning operations to proceed in and around the Reactor <u>Building</u>. Over the five-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 DOE is able to receive them. Dry storage of the fuel under a separate license provides additional flexibility in the event 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 incurred by PSEG Nuclear.

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, will be at the Envirocare facility. The more highly radioactive material will be 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 will be packaged for controlled disposal at one of the currently operating facilities. The costs identified for processing are all-inclusive, incorporating the ultimate disposition of the material.

Removal costs reflect the labor-intensive nature of the decommissioning process and 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 could be more cost-effective than deferral, due to the ultimate deterioration of facilities (and therefore the working conditions).

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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 estimate, material will be primarily moved overland by truck.

Decontamination will be used to reduce the plant's radiation fields and minimize worker exposure. Slightly contaminated material or material located within a contaminated area will be sent to an off-site processing center, i.e., this estimate does not assume that contaminated plant components and equipment could be economically decontaminated for uncontrolled release in-situ. Centralized processing centers have proven to be a more efficient 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 need to be confirmed and will add to the expense of surveying the facilities alone.

The remaining costs include allocations for heavy equipment and temporary services, and 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.

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#### TABLE 6.1

### SUMMARY OF DECOMMISSIONING COST ELEMENTS

Work Category	Cost 2002\$ (thousands)	Percent of Total Costs
Decontamination	30,745	
Removal	192,120	
Packaging	16,049	
Transportation	6,008	3.1 . 0.8
Waste Disposal	132,615	.0 16,9
Off-site Waste Processing	53,629	.8 6.8
Program Management (including Engineering and	Security) 260,624	.7 33.3
Spent Fuel Pool Isolation	9,060	).3 1.2
ISFSI Related (including capital)	40,238	3.9 . 5.1
Insurance and Regulatory Fees	7,147	7.7 0.9
Energy	11,768	3.5 1.5
Characterization and Licensing Surveys	13,936	5.8 1.8
Misc. Equipment and Site Services	9,156	5.8 1.2

Total

783,101.6 100.0

Note: Columns may not add due to rounding

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TT.G Services. Inc.

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#### APPENDIX A

#### UNIT COST FACTOR DEVELOPMENT

TLG Services, Inc.

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#### 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 Activity ID Description	Activity Critical Duration Duration
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
g Unbolt from mounts h Remove contamination controls	15 15
i Remove, wrap in plastic, send to the waste p	rocessing area <u>60</u> <u>60</u>
Totals (Activity/Critical)	355 255
Duration adjustment(s): + Respiratory protection adjustment (50% of critica + Radiation/ALARA adjustment (37.08% of critical	l duration) 128
n an	
Adjusted work duration	478
+ Protective clothing adjustment (30% of adjusted of	luration) <u>143</u>
Productive work duration	621
+ Work break adjustment (8.33 % of productive du	ration) <u>52</u>
Total work duration min	673 min

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

TT.C. Services. Inc.

## Document P07-1425-002, Rev. 0 Appendix A, Page 3 of 4

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APPENDIX A (continued)

#### LABOR REQUIRED

Crew	Number	Duration (hr)	Rate (\$/br)	Cost
Laborers	.3,00	11.217	40,61	1,366.57
Craftsmen	2.00	11.217	56.29	1,262.81 -
Foreman	1.00	11.217	60.17	. 674.93
General Foreman	0.25	11.217	67.66	189.74
Fire Watch	0.05	11.217	40.61	22.78
Health Physics Technician	1.00	11.217	45.90	<u>514.86</u>
Total labor cost		••	•	\$4,031.69

#### EQUIPMENT & CONSUMABLES COSTS

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Equipment Costs

Equipment Costs		none
Consumables/Materials Costs		
-Gas torch consumables 1@\$4.57/hr x 1 hr {1}		\$4.57
-Blotting paper 50 @ \$0.47 sq ft {2}	• •	\$23.50
-Plastic sheets/bags 50 @ \$0.12/sq ft {3}	•	\$6.00
Subtotal cost of equipment and materials		\$34.07
Overhead & sales tax on equipment and materials (	@16.00 %	\$5.45
Total costs, equipment & material		\$39.52
moment door	· · · ·	

#### TOTAL COST:

Removal of contaminated heat exchanger <3000 pounds: \$4,071.21

	•	• • •		
Total labor cost:	• • • • •		\$4,031.69	• .
Total equipment/material costs:	-	•	\$39.52	•'
Total craft labor man-hours required pe	er unit:		81.884	

TTG Sermices Inc.

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#### 5. NOTES AND REFERENCES

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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. R.S. Means (2002) Division 01590, Section 400-6360 pg 24

2. McMaster-Carr Ed. 106 pg 1778

3. R.S. Means (2002) Division 01540, Section 800-0200 pg 17

Material and consumable costs were adjusted using the regional indices for Wilmington, Delaware.

TLG Services, Inc.

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APPENDIX B

### UNIT COST FACTOR LISTING (DECON: Power Block Structures Only)

TLG Services, Inc.

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#### APPENDIX B

#### UNIT COST FACTOR LISTING (Power Block Structures Only)

Unit Cost Factor	Cost/Unit(\$)
Removal of clean instrument and sampling tubing, \$/linear foot	0.46
Removal of clean pipe 0.25 to 2 inches diameter, \$/linear foot	4.80
Removal of clean pipe >2 to 4 inches diameter, \$/linear foot	6.93
Removal of clean pipe >4 to 8 inches diameter, \$/linear foot	13.70
Removal of clean pipe >8 to 14 inches diameter, \$/linear foot	.26.29
	• • • •
Removal of clean pipe>14 to 20 inches diameter, \$/linear foot	34.03
Removal of clean pipe >20 to 36 inches diameter, \$/linear foot	50.10
Removal of clean pipe >36 inches diameter, \$/linear foot	59.60
Removal of clean valves >2 to 4 inches	91.18
Removal of clean valves>4 to 8 inches	136.96
Removal of clean valves >8 to 14 inches	262.88
Removal of clean valves >14 to 20 inches	340.30
Removal of clean valves>20 to 36 inches	501.04
Removal of clean valves >36 inches	595.95
Removal of clean pipe fittings>2 to 4 in	101.25
Removal of clean pipe fittings >4 to 8 in	160.64
Removal of clean pipe fittings >8 to 14 in	262.88
Removal of clean pipe fittings >14 to 20	340.30
Removal of clean pipe fittings > 20 to 36	540.30 501.04
	28.12
Removal of clean pipe hangers for small bore piping	20.12
	109.45
Removal of clean pipe hangers for large bore piping	103.45
Removal of clean pumps, <300 pound	227.86
Removal of clean pumps, 300-1000 pound	640.33
Removal of clean pumps, 1000-10,000 pound	2,542.96
Removal of clean pumps, >10,000 pound	4,906.95

TLG Services, Inc.

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#### APPENDIX B (continued)

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Unit Cost Factor	Cost/Unit(\$
Removal of clean pump motors, 300-1000 pound	271.14
Removal of clean pump motors, 1000-10,000 pound	1,061.82
Removal of clean pump motors, >10,000 pound	2,389.10
Removal of clean turbine-driven pumps > 10,000 pounds	6,577.50
Removal of clean heat exchanger <3000 pound	1,363.81
Removal of clean heat exchanger >3000 pound	3,417.62
Removal of clean feedwater heater/deaerator	9,646.37
Removal of clean moisture separator/reheater	19,849.31
Removal of clean tanks, <300 gallons	293.47
Removal of clean tanks, 300-3000 gallons	931.33
Removal of clean tanks, >3000 gallons, \$/square foot surface area	7.81
Removal of clean electrical equipment, <300 pound	126.22
Removal of clean electrical equipment, 300-1000 pound	441.45
Removal of clean electrical equipment, 1000-10,000 pound	882.90
Removal of clean electrical equipment, >10,000 pound	2,112.91
Removal of clean electrical transformers < 30 tons	1,467.39
Removal of clean electrical transformers > 30 tons	4,225.80
Removal of clean standby diesel-generator, <100 kW	1,498.81
Removal of clean standby diesel-generator, 100 kW to 1 MW	3,345.43
Removal of clean standby diesel-generator, >1 MW	6,925.72
· · · · · · · · · · · · · · · · · · ·	
Removal of clean electrical cable tray, \$/linear foot	11.66
Removal of clean electrical conduit, \$/linear foot	
Removal of clean mechanical equipment, <300 pound	126.22
Removal of clean mechanical equipment, 300-1000 pound	
Removal of clean mechanical equipment, 1000-10,000 pound	882.90
Removal of clean mechanical equipment, >10,000 pound	- 2,112.91
Removal of clean HVAC equipment, <300 pound	126.22

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#### APPENDIX B (continued)

		· ·
	Unit Cost Factor	Cost/Unit(\$)
	Removal of clean HVAC equipment, 300-1000 pound	441.45
	Removal of clean HVAC equipment, 1000-10,000 pound	882.90
	Removal of clean HVAC equipment, >10,000 pound	2,112.91
	Removal of clean HVAC ductwork, \$/pound	0.48
• .	Removal of contaminated instrument and sampling tubing, \$/linear foot	1.42
:	Removal of contaminated pipe 0.25 to 2 inches diameter, \$/linear foot	18.49
	Removal of contaminated pipe >2 to 4 inches diameter, \$7/linear foot	32.88
	Removal of contaminated pipe >4 to 8 inches diameter, \$/linear foot	52.70
_	Removal of contaminated pipe >8 to 14 inches diameter, \$/linear foot	103.92
	Removal of contaminated pipe >14 to 20 inches diameter, \$/linear foot	125.17
	Removal of contaminated pipe >20 to 36 inches diameter, \$/linear foot	174.16
•	Removal of contaminated pipe >36 inches diameter, \$/linear foot	206.34
••	Removal of contaminated valves >2 to 4 inches 409.23	•
	Removal of contaminated valves >4 to 8 inches 491.64	· .
	Removal of contaminated valves >8 to 14 inches	1,004.93
	Removal of contaminated valves >14 to 20 inches	1,279.12
	Removal of contaminated valves >20 to 36 inches	1,707.42
	Removal of contaminated valves >36 inches	2,029.16
		· '
•	Removal of contaminated pipe fittings >2 to 4 inches	222.48
•	Removal of contaminated pipe fittings > 4 to 8 inches	562.42
	Removal of contaminated pipe fittings > 8 to 14 inches	1,004.93
	Removal of contaminated pipe fittings > 14 to 20 inches	1,279.12
	Removal of contaminated pipe fittings >20 to 36 inches	1,707.42
·	Removal of contaminated pipe hangers for small bore piping	96.90
	Removal of contaminated pipe hangers for large bore piping 317.71	
	Removal of contaminated pumps, <300 pound	872.56
	Removal of contaminated pumps, 300-1000 pound	2,038.66
	Removal of contaminated pumps, 1000-10,000 pound	6,721.04

TLG Services, Inc.

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### APPENDIX B

(continued)

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#### Cost/Unit(\$)

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۰.	Removal of contaminated pumps, >10,000 pound	16,369.44	
	Removal of contaminated pump motors, 300-1000 pound	856.70	
	Removal of contaminated pump motors, 1000-10,000 pound	2,726.06	•
	Removal of contaminated pump motors, >10,000 pound	6,120.23	· .
	Removal of contaminated turbine-driven pumps < 10,000 pounds	18,918.88	
			•
	Removal of contaminated heat exchanger <3000 pound	4,071.21	
	Removal of contaminated heat exchanger >3000 pound	11,752.21	•
	Removal of contaminated feedwater heater / deaerator	28,760.26	•
	Removal of contaminated moisture separator / reheater	63,002.71	
•	Removal of contaminated tanks, <300 gallons	1,448.59	
	Removal of contaminated tanks, >300 gallons, \$/square foot	28.80	• •
	Removal of contaminated electrical equipment, <300 pound	684.21	• .
•	Removal of contaminated electrical equipment, 300-1000 pound	1,664.73	
	Removal of contaminated electrical equipment, 1000-10,000 pound	3,204.54	• •
•	Removal of contaminated electrical equipment, >10,000 pound	6,299.81	
•		0,200.01	
•	Removal of electrical transformers < 30 tons	5,079.02	
••••••	Removal of electrical transformers > 30 tons	12,470.88	
÷	Removal of standby diesel-generator, < 100 kW	4,387.47	•
	Removal of standby diesel-generator, 100 kW to 1 MW	9,471.87	· ·
	Removal of standby diesel-generator, >1 MW	20,474.76	
	Temoval of Stationy dieser-generator, > 1 with	20,414.10	
·	Removal of contaminated electrical cable tray, \$/linear foot	32.93	
	Removal of contaminated electrical conduit, \$/linear foot	14.92	
	Removal of contaminated mechanical equipment, <300 pound	761.89	
	Removal of contaminated mechanical equipment, 300-1000 pound	1,841.14	•
·	Removal of contaminated mechanical equipment, 1000-10,000 pound	3,538.42	• •

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Hope Creek Nuclear Generating Station Decommissioning Cost Analysis

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#### APPENDIX B (continued)

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Unit Cost Factor			Cost/Unit(\$)
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Removal of contaminated mechanical equ	upment. >10,000 poun	f	6,299.81
Removal of contaminated HVAC equipme		·· ·	761.89
Removal of contaminated HVAC equipme			1,841.14
Removal of contaminated HVAC equipme	· · ·	L	3,538.42
Removal of contaminated HVAC equipment			6,299.81
Removal of contaminated HVAC ductwor	ck, \$/pound	· ·	3.03
Removal of clean standard reinforced con	crete, \$/cubic yard	-	72.67
Removal of grade slab concrete, \$/cubic y	ard	۰.	204.33
Removal of clean heavily rein concrete w	#9 rebar, \$/cubic yard		211.46
Removal of clean heavily rein concrete w	#18 rebar, \$/cubic yard	L	267.46
	•		· - :,
Removal of below-grade suspended floors	s, \$/cubic yard		316.55
Removal of clean monolithic concrete str	uctures, \$/cubic yard	• •	1,897.58
Removal of clean foundation concrete, \$/c	cubic yard		626.97
Removal of clean hollow masonry block v	•	••••	75.24
Removal of clean solid masonry block wa	11, \$/cubic yard	3	75.24
Placement of concrete for below-grade vo	ids, \$/cubic yard	•	99.90
Removal of subterranean tunnels/voids,	\$/ linear foot		141.76
Backfill of below grade voids, \$/cubic yar	d .		17.31
Excavation of clean material, \$cubic yard	1		3.05
Removal of clean building metal siding,	S/square foot	•	1.34
Removal of standard asphalt roofing, \$/s	ouare foot	'	2.15
Removal of Galbestos panels, $s/square$ fo			2.19
Scarifying contaminated concrete surface		are foot	12.54
Scabbling contaminated concrete floors,			7.42
Scabbling contaminated concrete walls, S			8.15
Scabbling contaminated ceilings, \$/squar	re foot	• •	73.38
Removal of clean overhead cranes/monor		each ·	623.14
Removal of contaminated overhead crane			ea. 1,734.71

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#### APPENDIX B (continued)

#### 

Unit Cost Factor	Cost/Unit(\$)
Removal of clean overhead cranes/monorails >10-50 ton capacity, each Removal of contaminated overhead cranes/monorails >10-50 ton capacit	1,495.51 y, 4,162.61
each	· .
Removal of polar cranes > 50 ton capacity, each Removal of gantry cranes > 50 ton capacity, each	6,286.50 26,411.28
Removal of clean structural steel, \$/pound	0.35
Removal of clean steel flöör gräting, \$/square foot	3.19
Removal of contaminated steel floor grating, \$/square foot	9.69
Removal of clean free-standing steel liner, \$/square foot	33.75
Removal of clean concrete-anchored steel liner, \$/square foot	5.85
Removal of contaminated concrete-anchored steel liner, \$/square foot	39.31
Placement of scaffolding in clean areas, \$/square foot	13.73
Placement of scaffolding in contaminated areas, \$/square foot	22.10
Removal of chain link fencing, \$/linear foot	2.10
Removal of asphalt pavement, \$/square foot	1.05
Core drilling 2 to 4 inch diameter, linear foot	354.68

TLG Services, Inc.

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#### Hope Creek Nuclear Generating Station Decommissioning Cost Analysis

TLG Services, Inc.

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#### APPENDIX C

#### DETAILED COST ANALYSES

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#### . . :. TABLE C

HOPE CREEK NUCLEAR GENERATING STATION DETAILED COST ANALYSIS (Thousands of 2002 Dollars) •

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Activity Index	Activity Description.	Deci		i Packaging Costa	Transport Costs	Oll-Site Processing Costs	LLRW Disposal Costs	Olher Costs	Total Contingency	Total Costs	NRC Lic. Term. Casts	Spent Fuel Management 1 Costs	Sile Restoration Costs	Processed Voluma Cu, Feet	Class A Cu. Feet	Burizi Y Class B Cu. Feet	Clase C	GTCC Cu. Feet	Buriai Weight Lbs.	Craft Manhours	Utility and Contractor Manhours
eriod in I	Period Dependent Costs (continued) ISESI Transfer and Depital Costs	· ·		· · ·			• •	•		•			•		•						
1.10	Spent Fuel Pool Q&M				-	• •	•	· 266 853	· 55 · 148	411 2.098	:	1.086			:			· •	••	:	-
II	ISRA Compliance Staff				. •	. •		81ġ	. 192	989	039	-			:	:	:		• • •	• :	:
L4.12 L4.13	Dry Fuel Storoge Oddl Costs Security Staff Cost		•. •	•	· · · .	· · · ·	• •		8	27		37	•	•	•	-	•	••		•	·
	Utility Staff Cost		· · · · ·					\$9,290	· 172 4,894-	1,332 38,664	1,828 88,684				:	· :		. ::			59,244 442,497
4	Sublatal Period La Period Dependent Co	cala .	812	. 14	<b></b>	•	. 52	\$5,298	5,410	41,684	89,953	1.581	•	•	748				14,991	184	501,741
.0 ·	TOTAL PERIOD 14 COST	• • •	812	н			52	\$5,222	¢,917	55,091	51,128	1,581	\$12	. •	748 '		••.	•	14,091	184	580,341
ERIOD 1	1b - Decominissioning Proparations				•		•	·	· .				·. ·	•		•	•	••			•
mind 1b D	Direct Decommissioning Activities		• • • •		• .	·	·. ;	• •		•		• :	•			•					•
	ork Procedures		•	•.		• •	۰.				•				•					•	•
	Plant systems NSSS Decontamination Flush	•	•	•			••	345	52	897	857	•	. 40	••••		•		•	• .		4,733
	Reacing Internals	. 3						- 78 - 292	11	84 \$38	84 836	. •	. •	· •	• `	. •	•	-	•	•	1,000
LLI B	Remaining buildings							·. 98	15		· \$39		As	:	:	:	:	:	•	•	4,000
115 0	ORD housings & MIs	•		•	• .	· • ·		78	' 11	118	84							:		:	1,000
116 1	Incore Instrumentation Removal primery containment	•	-		<b>*</b>	••	•	· 78	' 11	84 12	86			•	•	•	-	. • ·	•	•	1,000
LLS	Reactor vessal			• •	· · ·	• •		11	· 40 ·	12	. 12 . 805 -		•	•	•.	•	•	•		•	145
1.1.9 H	Facility closecut.							- 85	18	101	. 50		50					:	:	<u> </u>	3,630 1,200
1110 5	Sacrificial abiold Reinforced concrete	•					. •	. 86	3 28	101	101	• •		•		۰.		-	· •		1,200
1.12 7	Darbina & condanaera			· · ·			1.13	· 78 804	` 11 { 46	84 850	42		42	· · ·		: .	••	•		•	1,000
LLIS A	Moisture separators & reheaters	•	· .				: :	146	22	168	168			:	:		-	:	:	:	4,167 2,000
1116 1	Redweste building Reactor building	•	-			• •	• • •	109 199	. 80	229 229	206	•••	23	-	. ••	-	•		•	•	2,730
.1.1 1	Total		· · ·		:			9,828	- 849 80	2,676	2,413		. 265		:		. •		:	:	9,730 81,886
	Depui NSSS Subbal Period 16 Activity Cools	53 55		:				• •	267	801	801 ·	••••	• •	•	•	•	•	•	•	1,067	-
	dditional Costs.	. 53	•					• 2,826 A	· 616	3,477	8,21 <b>4</b>	: .	263		•	•	•	•	. •	1,067	31,885
21 S	Spent Furl Pool Isolation		•••		• • •		· :	<sup>+</sup> 7,879 ,	· 1,182	9,050	9,060	•	. • .						•	• ·	
22 S 2 S	Site Characterization . Subtotal Period 1b Additional Costs	. > .					•••	685 8,574	104	800 8,860	800 9,660		-	• •							
	allalaral Costs	•			•		• .		· · ·		• • •		•		、 .		• •				
31 D 32 D	Denn squipment Incers liquid waste	7i 2		224	922		2,187	· . • .	. 107 .	817 \$,915	817 8,215 ·		• •	•			•	•	457,254	97	•
13 S.	mall tool allowance		· · ·				2,187		. 604	3,310	8,210			:	:	2,642	:	:	457,254	97	:
24 P.	The cutting aguinment		911		• .				187 '	2,048	1,048	•			. ·	-			-	•	
	Subtotal Period Ib Collateral Costs	75	6 912	224 .	222	· . •	. 2,187		. 847	5,081	8,081	. • •			-	à'e (3	•	•	487,254	97	• •
4.1 D	rriod-Dependent Costs Jecon supplies	2	2.		•	· • •			<b>5</b> .	27	<b>2</b> 7			••••			•	•	• •	•	-
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44 H	fealth physics supplies		282			, .				250	290			:	:	:		:	:	:	
4.5 B	leavy equipment rental	•	. 175	. • •		•	,	• .	. 25	158	198	. ·. · .	· · · ·		•.	. •	· •	:	• •	•	• •
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		`.	•.			нор	e Crie (G	etailt	TABLE C LEAR GEN ID COST A ands of 2002 J	NALTS	3	: ION	•	•••		•	•		•		<b></b>	
,   	Adivity Description + ++	Decor Cosi		Packoging Cosis	Transport Costs	O(I-Sile Processing . Costs	LLRW Disposel Costs	Diher Cosis	Tolaj Contingency	Total Caste	NRC Lic. Term. Coats	Spont Fuol Management Costs	Site Rectoration Costa	Processed Volume Cu, Feat	Class A Cu. Poet	Burial Class B Cu. Feat		GTCC Gu. Feet	Burtal Weight Lbs.	Craft Manhours	Utility and Contractor Manhours	
<ul> <li>Disposed Plant case</li> <li>NRO Fea</li> <li>Briergen</li> <li>ISFSI Tyr</li> <li>Spent Flui</li> <li>ISILA Casi</li> <li>Day Fuel</li> <li>Security St</li> <li>Utility St</li> </ul>	positient Corts (continued) of DAW generated ergy budget as reprinting Fore antire and Capital Costs ai Peol Oak Silonges Oak Oogra Silaf Cost Infl Cost		404				27	1,628 161 17 1,007 470 408 12 567 14,448 19,048	.: 943 18 91 181 181 50 85 91 85 91 91 91 91 91 91 91 91 91 91 91 91 91	44 1,867 189 19 1,168 841 469 18 682 16,612 22,436	14 1,867 199 453 652 18,614 20,706	18 1,158 541 13 1,780			885 - - - - -				7,735	95 	39,219 518,234 247,465	
TOTAL	PERIOD IL COST	1,294	•	281	224	•	2,164	29,040	. 5,877	40,854		1,780	203		, 856	2,642		• • •	444,979	1,258	241,455 , 270,389	
1 TOTAL	s	i. 1,294	° <b>9,</b> 129	245	228	•••	2,118	75 168	12,894 .	<b>93,874</b>	80,989	8,910	, 578	-	. 1,134	2,642	•	•	459,970	3,449	869,680	
Direct Dec	a Companent Removal commissioning Accivition	•	•				. •	•			•	· · · · ·		· · ·	· · · ·	•				•.	•	
បយោករដ្ ស	siy System Removni tipa System Piping, & Valvès Bon Rumps & Motors & Nik Ramoval cesel laternais cesel	123 \$3 . \$20 \$14 .99 690	48 165 2,288 4,671	28 15 229 5,555 1,708 7,709	16 12 ,47 1,260 478 1,610	80 - 80	597 784 589 11,808 9,069 29,769	925 925 449	. 100 210 264 2,503 3,564 18,896	1,227 1,089 1,814 90,610 94,908 59,515	1,927 1,089 1,814 50,610 24,906 59,645			104 104	1,554 1,031 5,536 876 10,925 18,933	2,353 2,379 4,782	918	,	142,614 150,250 141,063 <i>455,555</i> 1,429,550 2,819,141	4,936 1,626 7,193 39,348 28,348 79,852	1,465 1,465 2,932	• . •
l Major Sqi Major Turb Majo Com	bing/Generator		. 482 2,119	607. 834	197 148	5,462 - 5,508	8,552 1,931	•	1,917 1,928	19,907 12,987	12,207 12,257		· · · ·	. 27,260 27,989	11,811 6,148 .	•		:	1,014,885 851,850	9,408 41,623	:	
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	ch Nuclear Cenerating Station issioning Cost Analysis	· · · ·				DET	TABLE C NUCLEAR GEN CALLED COST AI Lougands of 2002 I	ALYSIS	TION					Document P07-1495-0 Appendiz C, Pi	02, Rev. 0 128 8 0f 13 171
	tivity dex Activity Description	Decor	Removal Cost	Packaging Trai		LLRW Disposal C	Diher Tota) Costs Contingency	NRC Total Lic, Term. Costa Costa	Spent Fuol Management Costa	Site Restoration Costs	Processed Volume Cu. Fact	Glass A Class B	Volumes . Class 0 ' GTCC Cu, Foel Cu, Feel	Burial Welght Craft Lbs. Manhours	Utility and Contractor Manhours
Disp 32.1. 32.1. 32.1. 22.1. 22.1. 22.1. 22.1. 22.1. 22.1. 22.1. 22.1. 22.1. 22.1. 22.1. 22.1. 22.1. 22.1. 22.1. 22.1.	essal of Plant Systams (continued) 1.22 NSIV Scaling (IIP) 1.23 NSIV Scaling (IIP) 1.24 Mini Generator (Kd4) 1.25 Mini Turkine (AD) 1.25 Mini Turkine (AD) 1.26 Mini Turkine (AD) 1.27 Missalianeous (AD, QM, XX) 1.28 Neuton Monitoriag (SD) 1.28 Neuton Monitoriag (SD) 1.29 Eastor Protection (SD) 1.20 Safity & Turkine (AD) 1.21 Sampling (RO) 1.22 Strukine Scaling (CD) 1.23 Turkine Generator Lube Oil (UB) 1.35 Turkine Scaling Steam (CA) 4. Totals	ng (EG)	5 5 820 765 96 96 30 313 289 47 51 157 502 132,405 2,065		0 36 0 16 30 1883 30 1,262 1 62 1 1 70 4,668 1 86 1 86 1 86 7 2,275 8 4,492 7 2,275 8 4,492 7 2,275 8 4,492 7 2,275 8 4,922 8 4,925 8	892 3,748		11 11 81 81 9258 3.825 4,441644 193 182 0 255 236 255 236 105 105 70 777 777 1,613 1,613 1,613 1,613 2,025 2,326		0 15 70 893	16 90 4,487 5,799 510 88 <u>92,935</u> 129 191 2,465 1,877 74,115 , 1,109	2,034 4,079 285 162 		- 105 182,467 16,639 3956,824 18,721 - 1,724 - 1,724 22,253 1,161 - 267,503 16,323 6,235 - 67,503 - 67,503 - 61,515 - 7,211 80,255 10,136 3,313,655 273,607 15,750 46,433	
2s.1 Perio	Subtotal Period 2a Activity Costs		25,844	9,581	2,498 28,125	44,818	449 . 88,018 .	142,216 141,628		895	180,577	. 74,836 . 4,782	916 .	7,213,104 450,618	2.932
20.7.) 20.2	<ol> <li>Ouris Surcharge (Encluding RFV) Sublocal Period 2s Additional Cor</li> </ol>	da d				1,817 1,817		1,684 1,684 1,686 1,684					• • •	: :	
Pedo 22.3.1 23.3.2 25.3.2 25.3	2 Small tool allowance	56 56	401, 401,	21.	50 80	212 212	98 • 60 • 158	487 407 461 415 929 883		48 46			-	45,459 77 • 48,459 77	•
	d 24 Period Dependent Costs 1 Deem supplies 2 Jarurana 3 Perparty bares 4 Health physics supplies 5 Disposal of DAW generated 9 Finat enary budget 9 NBC Fess 9 Eurogramy Plandus Fess 10 JSFSI Transfer and Ospital Costs 11 Spant Puel Food Oath 12 JSRA Compliance Staff 3 Day Fuel Storts Oath 3 Sounty Staff Cost	67 cat Costs 67 813	9,258 2,992 - - - 5,190 30,934	175 175 176 9,777 9	48 48 609 26,125	669 669 43 669 50	17 1,010 101 564 400 564 440 500 52 8 975 41 1,475, 321 1,475, 327 1,475, 3271,475, 327, 327, 327, 327, 327,	84         84           1,111         2,822           2,822         3,372           7,011         1,071           2,763         3,46           57         3,16           1,485         1,483           1,485         1,483           47,915         47,915           56,380         58,710           2,108,485         2,08,068	57 sie 1.637 41 9,130 2,110		130,677	8,409 9,409 8,409 84,844 5,126	51Ş	186,558 2,310 	114,111 1926,423 740,034 743,765
<u>TLG Servic</u>	es. Inc.			•		· · · · ·					. :		Cor	yright PSEG Nuclear15	99/2000
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<u> </u>	• •		·	<u> </u>	··	Olf-Site	LLRW	(110000			NRC	Spent Fuel	Sita	Processed			Vojumes		Burlal		Utility and	
	Activity Description	Decon Gost	Removal Cost	Packaging Costs	Transport Costa		Disposal Costs	Olher • Costs	Total Contingency	Totai- Costs	Lio. Term. Costa	Management Coèle	Restoration Costs	Volume Cu. Feet	Class A Cd. Fret	Claux B Cl. Feet	Claza C . Cui Feat	Gitco Cil. Fee	Weighi L Lbo.	Craft Manhours	Contractor Manhours	
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nt Sýstar	di B	۰		•						·.	•	· .	•						825,269	29,895	_	
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1 Sthem	tliation (CT) (FD) re Coolant Injaction (BJ)	120	50 147 181	2 9. 99	. 9	: - 10 111	917 898		108 850	204 649 1;700	649 1,700			152 . 557	494 2,038	• •		:	44,930 182,761	. <u>7,995</u> 4,412	:	
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tor Auxi Ior Doro	iliaries Cooling (ED)	49	829 81	· 10	15	1,164 81	276		- 809 124	2,019 589	2,019 553	•	· .	6,771 165	629	:	:	:	56,446 117,888	2,520	-	
tor Wate	ar Clearlúp (BG) giar Transfer (BN)	240	369. 02	• 28		· 71 82	878 59	ί.	\$70 . 71	1,654 349	1,654 349		. :	854 408	1,914 195	••••	:	:	12,136 989,875	2,146	-	
dual Rós	at Removal (BC) uid Control (BH)	1,130	1,178	190	·, · 42	695 41	4,781	:	,2,168 16'	10,030	10,030 98)		:	9,973 204	10,808	:	:	:	1,993,667	799	•	
		2,108	8,088	424	110	8,016	8,743	÷*	6,278	26,780	98,750		• :	18,079	92,283	·	•	•••	17,199	58,041	-	
- F -	n support of decommissioning.	•	<sup>2,682</sup> .	· 25	. 6	277	60		708	8,658	3,65Č		•.	1,985	192	,	• •					
ctae Bull	a Buildings	6,041	8,096	615	975	· · 8,170	5,967		8,966	26,829	25,529		•	15,801 59	24,754 594	:	- '	. :	9,239,997 59,076	172,651 9,900	-	
den & Ro	adwaata Storngo Facility idwaata Building	119	59 	', 9 14	' 7 • 81	. B 97	·. 19 103	:	. 81 . 553	, 295 1,819	295 1,919 5,968	•		185 4,589	2,662 . 10,175	• •	· · ·	:	265,202	14,895 63,894	:	
dina Duite	ding	1,989 8,648	1,811 4,719	165 880	125 442	918 4,193	289 8,774		1,558 7,968	5,268 83,511	\$3,811		· ·	20,668	88,196		.•	•	-9,555,195	259,746	-	
otal Peri	fod 26 Activity Costs	10,754	<b>J2,8</b> 87	1,278	501	7,426 :	16,677	•	15,944	62,927	82,927	۰.		\$7,128	60,620		,	:	5,566,051	428,667	••	
Lardi Cos					۰	1.		. ·	. 1,817	0,674	9,674					7,964	•	-	1,815,776	295	-	
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yy agulp	ics aupplies ment rental	:	2,690 . 4,800		•			:	. 720	5,820 1,036	5,620 1,095	. :	1	· · ·	a'osa	:		:	182,142	2,282		
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Fee	-	-	-	•	÷		:	709 • 61	11	· 779 • 80	770	90			:	-	•	•		:	:	
H Transi	Ibnning Face for and Capilel Costs	.:	:					28,006 2,817	8,451 840	28,455 2,684	:	26,455 2,664	. :	:	• :	:	:	:	-	-	:	•
st Fuel P weels Pr	ool OaM occasing Equipment/Services		:	:	•			410	. , 68	808	. 506 9,281			: '		• :		:			•	
A Compli	Jante Staff janga Oádi Costs	. :	:	• :	• :		. : .	1,984 - 58	: \$88 	9,281 . 55	•	86	•		-	. :	÷	÷	:	:	143.994	
wity Stat	h Cost		• •	•	•	• :	•	2,794 69,674	419 9,881	3,213 73,455	8,919 73,466	•		: •	_	•	. •	•	182,143	2,992	963,360 1,107.264	
lly Slaff	Cost dod 25 Period-Dependent Costs	1,932	7,590	- 189	47	•	696	95,854	16,770	126,728	98,463	29,275	• . •	•	9,089	•	• . •	•	7,053,979	451,088	1,107.384	
-	UOD 25 COST	12,670	20,163	2,120	1,278	7,426 .	28,644 -	. 98,884°	92,589	198,770	159,498	28,275	• •••	97,128	69,709	7,854	•	•	1,003,918	401,000		

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i														·				
Rope Creek Nuclear Generating Station Decommissioning Cast Analysis			· · · · · · ·	• • • •			•		• •	· · · · · · · · · · · · · · · · · · ·		•	, , , ,		•	Document . App	207-1425-00 endix C, Paj	8, Rev. 0 16 7 of 12
•	•		•		HOPE CI		TABLE C LEAR GEN			ION						· ·	17	3 .
		·	<u>.</u>	· · ·		(Thous	ED COST A				·							
Activity Index Activity Description	. Decon Cost		Packaging Costs	Transport Pr	Olf-Sita LLR occassing Dispo Costs Cos	sal 'Other	Total Contingency	Total Costa	NRC Lic. Term, Costs	Spent Fuel Management Costs	Sila Restoration Costa	Processed Volume Cu. Feet		Burial Volumes Class B Class Cu. Feet Cu. Fe		Burial Weight Lb≤.	Craft Manhour <del>s</del>	Utility and Contractor Manhours
PERIOD 20-Decontantuation Following Period 20 Direct Decommissioning Activities 20.2.1 Remote Spent fuel racks	Wat Puel Storage	7 .78	157	85	1,921	129	768	8,616	8,618			6,606	1,451		· · · ·	180,901	1,632	•
Disposal of Plant Systems 2c.1.2.1 Administration Building HVAC (G 2z.1.2.2 Asplit StopPap Hee/Aux Boiler H 2z.1.2.3 Auxiliary Oil Storarge (PA) 2z.1.2.4 Auxiliary Storan Generators (FA) 2z.1.2.5 Newsking Air (GO, KH)	VAC (GF)	49 52 190 44 500	· . · · ·	4	242		7 8 28 7 112	37 216 51 650	860		86 97 818 51	1,212			-		1,082 649 8,861 920 6,830	• •
2c.1.2.5 · Building & Equip Radwaste Drains 2c.1.2.7 (Standard) Waster (CD) 2c.1.2.8 (Calified Waster (CB) 2c.1.2.9 (Control Area Chilled Water (CJ) 2c.1.2.10 (Control Room Supply & Exhaust (G 2c.1.2.11) Dech Fullity (HD)		7 2,960 20 851 195 34 101	- 145 12	20 . 22	1,428	94	8,127 3 - 431 - 29 5 - 53	13,150 22 2,744 9225 40 959	13,160 2,744 269		22 925 40	761 7,140 93	9,637 213			840,655 - - - 19,149	104,933 421 16,733 4,271 732 1,999	
2c.1.2.12 Demissenillerai Waier Makeup/Tran 2c.1.2.15 Diezel Arez Supply & Exhaust (OM 2c.1.2.14 Diezel Fuel Oil Storagt & Transfer 2c.1.2.15 Domestic Water (SD) 2.2.1.2.16 Domestic Water & GCA (SD)	)	- 708 49 . 170 . 76 . 184	1	18 8	844		805 7 28 11 57	1,878 - 57 - 194 - 67 - 824	1,876 		57 196 87	4,220 504					I3,825 1,052 3,518 1,636 3,022	
20.12.17 Electrical 20.12.18 Electrical - RCA 20.12.19 Electrical - RCA (Clean) 20.12.29 Filtration/Rodry & Vanilation (GU)		8,810 1,015 2,216 85	11 18 2	14 82 . 1	827 j 2,101 66	16	672 411 875 41	• 4,952 2,897 5,241 281	9,097 8,941 281		4,882	4,135 10,606 332	271 82			24,309 7,531	77,827 20,585 43,910 2,689	

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. 2-12,16 Domestic Water - RCA (RD)	•	.184	1.	ġ.,	ini		57	824	. 824			504		• • •	-	·	. 3.022		
2c.1.2.17 Electrical		8,810					572	. 4.952			4,882						77,827	-	
2c.L.2.18 Electrical - RCA		1.018	11 .	. 11	827 · · 118	•	411	2,897	2,007			4,185	271	• •		- 24,309	20,555		
2c, L2.19 Electrical - RCA (Clean)		2,216	· 18	82	2,101 .		. 875	5,241	5,241			10,608	-	-			43,910		
2a1,2.20 Filtration/Rocky & Ventilation (GU)	••	85		i.'	65 . 86	•	41	281	. 281		•	332	· 82			. 7,531	1,689		
2c. 1.2.21 Fire Protection (EC)		321	·				48	869	•	-	369		· ·				.6,540		
2c.1.2.22 Fire Protoction - RGA (RC)		930	. 6	11 .	699 -		389	1,986	1,955 .		•	,8,497	· •				18,689		
2-19.23 Fresh Water (AM)	-	57					. 9	66			68		-	•	•	• • •	1,187		
2c.1.2.24 Fuel Pool Cooling (EC)		660	· 40	11	210 938	•	447	2,975	2,878			1.402	2,156		-	- 191,922	13,411	-	
2c.1.2.25 Instrument Compressed Air (RB)	•	529	. 1	õ	819	•	191	1,037	1,037	-	· .	1,693	· -	-	•	• •	10,082	•	
2r.1.2.25 Intake Structure HVAC (GQ)	-	11		· •		•	2	13	•	•	18		-	-	•		231	•	•
2c.1.2.27 Liquid/Chemical Radwaste (HB)	1,672	2,098	, 180	88 .	771 8,914		S.168	i1,077	11,077	•		5,656	10,011	•	• •	<ul> <li>\$00,834</li> </ul>	67,621	•	1
2c.1.9.28 Hormal Drains (LF.LG)	•	76		• *		•	11	86		•	. 68			•	• .		1,676	•	1
2e 1.2.29 Oily Wasta (LE)		107 .		• • •	· . ·		. 15	198			123		.•	• .			9,273	• •	i
2c.3.2.30 Plant Heating (QA)	. • • •	. 659			461		. \$85	1,886	1,866		• .	2,305			-		15,789		Ł.
. 2c.1.2.31 Primary Containment Instrument Gas (RL)	•	82 /	í . 1 .	1	106		. 87	228	. 228	•		532		•	. •	• •	1,525		Ł
2c.1.2.32 Process Radiation Monitoring (SP)		115	` • <b>1</b> "	1.	69 <b>. 2</b> 2	• • •	48 '	242	248		. • .	296	. 60	• • •	•	- 4,466	2,818	•	
2c.1.2.33 Rad Laundry (HH,ZZ)	•	' 12,	, 2 .	. 1 .	22 58		• 86	192	192	٠.	-	109	101	-	• •	- 11,868	1,431	•	1
2c.1.2.34 Radwaste Tank Vent Filters (OH)	• •	<b>416</b>	. τ.	a	244 327		174	972	972 -	•	-	3,820	290	- '	-	- 25,989	6,098	•	2
. 2c.1.2.35 Reactor Building HVAO (GE)	•	638	. 6 .	1.	416 78	· • .	242	1,981	1,881	- í	•	2,080	188	· ·	•	- 14,861	11,663	•	5
Se.1.9.36 Security (BO)	•	5	•	•	• •	-	1	8	•	•	6		• •	,	•		100	•	i i
2c.1.2.37 Bervine Area Supply & Brhaust Air (GL)	· •	40		•.			8	· 46	• •	-	45	•	• • •	• '	•	• •	862	•	1
2c.1.2.38 Service Compressed Air (KA)	. •	538	, <b>8</b> .	' 6 .	374 •	-	191	• 1,110	1,110	. •	•	1,865.	•	-	•	• • •	10,157	•	1
Sc.1.2.39 Service Water (EA)	•	87	•				8	65		•	65 .	•	· •	•	•	• •	1,182	-	1
2e12.10 Service Water - RCA (EA)	•	214	θ.	10 .	678	•	157	1,065	1,065	•	-	9,889	•	-		• •	4,289	•	1
2c.1.2.41 Service Water Hypochlerination (EP,EQ)	•	65 -	• ·.	•		•	; <u>to</u>	. 76	. •	. •	75		•	•.	-	• •	1,340	•	(
2c.1.2.43 Solid Radwaste (EC)	-	841 '	86	18	267 · 1,980	•	- 767	8,948	8,948			1,535	4,693	•	•	403,187	16,886	•	:
2c.1.2 (3 Standby/Emergency Dissel Generator (KJ)	· • •	137	•••	•	• •	• •	- 21 .	. 158	-	-	158	-	•	•	•	· . ·	2.854	•	ł
2c.1.2.44 Storm Drains (LA,LB)	•	1,227	. •	• •.	•. •		184	. 1,411	-	•	1,611	•	• .	-	•	• •	25,161	• •	{
2c.1.2.45 Suppression Pool/Torus Cleanup (EE)		84 ,	2	1	80 48	•	55	178	178	۰.	•	· 161	· 109	• •	• •	• 9,785	1,307	•	:
2c 1.2.15 Turbine Building HVAC (GE)		B19	` g	10	556 138	· .	853	1,900	1,900	•	•	2,882	804	-		\$ 27,228	16,932	•	;
2a.1.2 Totals	. · 4,309	23,613	657	250 . 1	1,074. 13,649		,12,097	69,747	66,959	• • •	7,789	\$5,370	- 28,126	. • .	• •	- 2,883,484	549,198	•	1
	•			·		• .		· .	• • • • •	• • •						•			1
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-TLA Senders		•	· . · .		P		*.		•	•. •					clear1959/2000	
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	•				· · ·	ti gas, s	ي. وينان هورو	на — — — — — — — — — — — — — — — — — — —	; ; ;			•			• • •	
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	het Analysik				•	·. ·					4								. 6444	, . 1999 - 19	1	74	<b>\$5</b> 2
			•		•		нор		etailt	TÁBLE C LEAR GEN D COST AI	NÀLYSI		אכ	•					•	•			. •
	Λείίγιη Description	. Dec Co		emováľ Cost	Packaging . Costa	Transport Costs	Off-Sile Processing Costs	LLRW Disposal Coala	Officer Casts	Tolal ConUngenty	Total Dogils	NRC Lio. Term. Costo	Spent Fuel Management	. Site Rectomilon Costs	Processed Voluma Du, Feat	Class A Cu, Fest	CIASE B	Clumes Class C Cu. Feet	GTCC Cu, Feel	Builel Weight Lbs.	Crah Manhours	Utility and Contractor Manhours	•
ninatio	af Sile Buildings ar (post fuel)	. :	725	1,024	128			• 1.993		. 1,que	4.484	. 4,484				7,854		· ·		740,573	32,895		
- 1	ding in support of decommissionin		725 •	1,024 516	125 	87	93 . 58	i,898 12	••.	1,006 141	4,454 731	4.481 781 .	•	· .	467	7,654 98	-	•	•	740,573 8,440	32,835 11,608		
ธิบังน์เ	al Period 20 Activity Costa			26,428	'à25	878	12,644	18,509	•	14,008	22,846	64,789	۰.	7,789	62,720	87,465	-	•	•	8,257,698	695,268	•	
Decon Svibibi	ral Costo 2 Hauid wasta tool allowánea missioning Raulponant Diopositio al Pariod 20 Collatoral Costa	•	228 • • •	649 648	401 48 449	498 19 511	530 540	8,950 4,077	•	1,219 81 117 1,417	0,306 625 835 7,756	0,305 625 836 7,198			2,700 2,700	, 973 978	8,276 5,225		•	810,824 89,507 843,881	418 739 1,152	:	•
Period. Decon	Dependent Costs aupplies ince ty inces	÷.,,	(40 ·		·. •	• •	•	·	Inc	. 86	. 175	178	-	-	•	:	:	•	:	:	:	:	
Heavy Dicphi Flant	i physics supplies equipment zental ml of DAW gonarnied encizy budget			2,488 1,908	168	4		696	103 635	10 532 286 171 95	118 8,108 4 9,191 966 780	118 3,108 2,191 \$65 520 8b2			•	8,505 -				170,446	2,088		
TODA	ency Planning Free anto Proceeding Equipment/Service Compliance Sin H		•		•				806 92 849 707 29 1,109	166	892 80 401 905 26 1,278	801 908 6 1,275	'se 26					•		-	•	57.145 329,725	•
UHIN	uni Sioraga Odan ity Staff Cost Staff Cost Staff Cost Inl Period 2a Period-Dependent Co	sta i	.40	4,891 ·	158	ų		598	21,647 36,041	9,£47 • 4,846	96,895 \$5,214	24,895 86,153	61	• •		8,505	•	:		170,445	2,088 698,604	386,871 586,871	•
TOTA	L PBRIOD & COST	6,2	229	80,863	1,401	928	19,084	18,181	25,041	20,270	115,528	107/679	·- : *1	7,789	65,420	46,847	6,225	•	•	4,971,975		000,011	
i	nense Termination	. •			•	•	· . ·	÷		· .			•••	· · ·				•		•			
ORISE	Decommissionics Activities I confirmatory survey nata licence al Period 20 Activity Costa	· .		•		••		• • •	122 122	87 \$7	158 A 158	158 '158	· · •	••••		•	•	•		 -	•	•	•
Additio Final Sublot	nal Costa Site Survey al Period Ze Additional Costa	•		:	:			· •	11,280 11,285	1,693 . 1,693 .	12,978 12,978	12,978 12,978				•	:		•	. :	227,917 297,917	•	•
Period- Insure	Dopendent Costs ince Ry Laxes	• •	•	· .		•	· :		. 80		65.	65				:		÷ :	-	•	• :	:	
Bealt	ty taxes a physics supplies al of DAW generated	•		)1,125 -	10			· 39		281 11	1,406 64	1, 108 61	•			. 663	:	:	:	11.274	138		•
Plant NRC 4	energy budget Teas			:		:	Ξ.		248 505 •	87° . 11	· 285 836 28	386	38					÷	• -	:	:	:	
ISRA	ency Planning Fees Compilence Staff and Storage O&M Costs	•		•	•				014 17	' 62 · 5	. 708 20	705		:	:	' :	•	:	-	•		24,445	
	lty Staff Cost			•	•	•		٠	474	71	-845	¢15			•	. •		•				•	
īne.	· · ·	• ,			•	• •	•••				•	• •		•	•	•			Co,	pyright PSB	Nuclear JS.	9/2000	
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TABLE O HOPE GREEK NUCLEAR GENERATING STATION DETAILED COST ANALYSIE (Thousands of 2008 Dollars)

			•	•			•		(Thous	2002 lo shu	Dollars)	•	•	•	•			• `	•			
Activity Index			Decon Cost	Removal Cast	Packaging Costs	Transport Costa	Olf-Sile Processing Costs	LLRW Disposal Cosis	Other ·	total Contingency	Total Gasts	NRC Lic. Term. Costa	Spent Puel Magagemen Costa	Slie Restoration Costs	Processed Volume Cu. Feet	Class A.	Clase B	Clans C Clans C Cu, Feet	GTCC Cu, Peet	Burlal Weight Lbr.	Craft · Manhours	Utility and Contractor Manhours
.4.11	e Period-Dependent Costs (continued) Utility Staff Cost	•	· t· ;		•••			<u>.</u>	, 11,540	j,751	18,271	18.271		• •.				•	•			167,117
4	Subtotal Period 2¢ Period-Dependent	t Costs	•	1,125	10	. 3		89	19,804	2,268		16,701	4	۹·. •	•	563	•	•	•	11,974	138	191,623
נ	TOTAL FERIOD & COST			1,125	10	8.		. 99	94,711	8,997	29,686	29,838	· . 4		. •	563	•	. •	•	12,374	227,455	191,623
RIOI	2 TOTALS	-	19,712	82,685	18,839	4,806	46,635	85,626	189,997	99,135	\$54,835	515,113	81,49	· 8,228	233,125	200,953	18,304	918	•	18,798,860	1,710,248	2,429,615
105	3b-Site Restoration		•		·		•		<sup>.</sup> .			•			•	۰,		• •		•		
od 31	Direct Decommissioning Activities	•			•••••••••••••••••••••••••••••••••••••••	<u>`````</u>						•	· ·				•	. '	•			
1)LIC	n of Remaining Site Buildings . Reactor Building			•	••					· • •	• •	•	• •	· ·	•	-		••••				
1.2	Administration Hide (12 Turbine Hid	ю.		13,159 1,887 .		•			• :	- 1,974 288	15,183 9,170	\$,270		12,863 2,170	•		•	•	•		164,666 15,538	• •
L.S	Administration Building (TB2)		1	1,671	•	:		•		251	1,921			1,921	:	:		:	· · ·	:	26,644	
	· Aux Boiler & Domestia Wir Pre-Treat Barre Facility	Bidg .		459 5,125						69 469	527 . 8,694	•	· · ·	627		•	•	•	• `	•	5,922	•
1.5	Carpenter Shop	••		3,125				• •	:	407	. 8,084 - 39	:		8,594			:	:	•	•	40,381 849	-
	Centralized Warebouse		- <b>1</b> •	1,841	• • •	· •	• •	•		. 291	1,772			1,772		:		:	:	:	18,426	:
	Change House Circulating Water Pump Structure		••	139				. ' •		. 81	160			. 160	•	-	• ·	• •	•		1,793	•
	Cooling Tower	•	. :	1,919 -195					••	- 268	9,207 870	۰.		2,207	-	· · ·	•	-	· ·	•	29,328	
11	Diesel & Control Building			4,662		· • • • •		:		74 699	. 6.352	: :	:	570 6,352	• •		• •	-			7,673 67,685	-
75	Fire Water Pump House	-	••	86					-	. 5	43	•	-	. 42		·· :			:	:	615	-
113	Fire Water Tunk Fdn and Valve Pit		•	- 91	*	• • •	14 I	•	• •. •	14	204			· 104	•		• ,•	• •		-	1,160	• •
	Guard House Guard House Emurgency Generalor B		•	167		· · ·	• • •		•	24	. 180	۰.	•	, 180	• •	••	•••	•	•	-	- 2,658	•
3.16	Low Loval Endwaste Storege Facility	sormers.		. 679			•			1 182	1,011	61 ·	•	. 8	· · ·			•	•	• •	110 12,018	• •
117	Miscellaneous Sita Structures			826		·				. 49	374	51	•	374		2		•			6,516	
1.18	Miscellaneous Yard Tanks & Pads			1.408						211	1.619			1,619							17.417	
1,19	Nuclear Service Building	•	· · · ·	386	•				• • •	- BB	. 444	• •		444			•	· · ·		•	6,197	
1.30	Service & Radwaste Building	1		6,021	. •	••••				-l· 903	8,924	692		6,282		· • '	•		•	-	56,764	
	Service Water Intoke Structure Turbine Building	· .		1.864	: •					205	1,569	· • •	•	1,668		• •	•	•	• •	.*	16,480	•
	Turbine Pedrstal		· ·	14,495				:	•	2,165 241	15,601 1,848	1,860	· •	14,941 1,849	- 1	-	:	:	•	-	238,992 19,164	
	Unit 2 Reactor Building Foundation			6.143	• •					. 921	7.055	• •		7,085				:			T4.280	
95	Unit 2 Turbins Pedestal	• .		1,444	• • ••	•	· · ·			217	1,650	-	•	1,660	•					••	17.091	
	Totals	· · .	••••	63,894			•	•	· .	9,509	72,903	4,075.	•	68,230	• . • •	•• •	•	•	••		889,469	
w	out Activities			•	• •		· •					:	•••	•	• •							Í
2	BackFill Sile	• •		1,851	• •			• .	1 1	/ ong	. 1,554 '	• _ •		1.864			: '	· .	-		6,021	
	Grade & hadscape site		•	595		·				203	681			681						-	1.946	
	Final report to NRO					• •	• • •	• •	214-	17	181	. 181	• •				-	· .	•	•		1,550
	Subtotal Pariod 3b Activity Coscs			65,898	• •	: • ;	• • • • •	•	114	, 1 9,818	75,270	4,604		70,466	•	•	•		-	•	897,416	1,660
	Additional Costs Concrete Crushing				, s <sup>.</sup>		. * .	۰,	1,818	· · 227	3,712		· · · ·	. 1,743	•			• • •			9,071	. 1
	Asbestos Disposal				• •	· · ·	3. <b>.</b> .	•	1,405	. 1 - 211	1,616	1,615								• •	-	:
	Subtatal Period Sb Additional Costs						şe.		2,920	436	8,858	1,615	•	1,742		· • .	". •	•	-	. •	· 9,071	·
136	Collateral Costs	. '	֥ .			2 Y 2 Y				.'	•			••	•							
ι	Small tool allowance		· • '	822.	•.'	· • •	. :	2	• •	123	843	•	:	· 945		•	÷ .		-		-	
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# TÁBLE C HOPE CREEK NUCLEAR GENERATING STATION DETAILED COST ANALYSIS (Thousands of 2008 Dollars)

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# TABLE O HOFE CREEK NUCLEAR GENERATING STATION DETAILED COST ANALYSIS (Thousands of \$009 Dollars)

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**PSEG Nuclear LLC** 

Forty-Year Safstor Decommissioning Cost Analysis : •

for the

Salem Generating Stations

September 15, 2011

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#### I. Summary

This report presents estimates of the cost to decommission the Salem Nuclear Generating Station Units 1 and 2 (together, "Salem") following the end of their current licensed operating period ending on August 13, 2036 and April 18, 2040, respectively.

This report relies in part on a December 2002 report by TLG Services entitled *Decommissioning Cost Analysis for the Salem Generating Station, Unit 1 and 2* ("TLG Report"), with updates to account for the time value of money and a change in decommissioning method from DECON to a forty-year SAFSTOR. The TLG Report is included in its entirety in Appendix B to this report.

This report is based on two fundamental assumptions: (1) spent nuclear fuel ("SNF") management costs will be borne by the United States Government; and (2) Salem Units 1 and 2 will be placed in a forty-year period of safe storage following end of license in 2036 and 2040, respectively.

While spent fuels management costs are discussed in this report and its appendices, those costs are contractually the responsibility of the Government of the United States<sup>1</sup>, and are therefore not considered a liability that must be funded by the Salem Decommissioning Trust Fund. The Salem/Hope Creek site has an Independent Spent Fuel Storage Installation ("ISFSI"), that is appropriately sized to receive all SNF generated from the Salem units through their licensed life.

PSEG Nuclear considered the following three decommissioning options for Salem:

- DECON: The equipment, structures, and portions of the facility and site that contain radioactive contaminants are removed or decontaminated to a level that permits termination of the license after cessation of operations. Until 2008, this was the strategy that was to be used to decommission Salem.
- SAFSTOR: The facility is placed in a safe stable condition and maintained in that state until it is subsequently decontaminated and dismantled to levels that permit license termination. During SAFSTOR, a facility is left intact, but the fuel has been removed from the reactor vessel and radioactive liquids have been drained from systems and components and then processed. Radioactive decay occurs during the SAFSTOR period, thus reducing the levels of radioactivity in and on the material and potentially the quantity of material that must be disposed of during decontamination and dismantlement. This is the method PSEG will use to decommission Salem.
- ENTOMB: involves encasing radioactive structures, systems, and components in a structurally long-lived substance, such as concrete. The

<sup>&</sup>lt;sup>1</sup> See US Department of Energy Contract No. DE-CR01-83NE44480, Salem Generating Station Nos. 1 and 2 Units Contract for Disposal of Spent Fuel and/or High-Level Radioactive Waste (Jun. 13, 1983), as amended.

entombed structure is appropriately maintained, and continued surveillance is carried out until the radioactivity decays to a level that permits termination of the license. Because most power reactors will have radionuclides in concentrations exceeding the limits for unrestricted use even after 100 years, this option will generally not be feasible and was not deemed to be viable for Salem.

This report assumes a forty-year period of safe storage for each Salem unit after end of its current licensed operating period<sup>2</sup>. PSEG Nuclear LLC, the Operator of Salem, has chosen a forty year SAFSTOR period (approximately 7.6 half-lives of the radioactive isotope Cobalt 60) as a prudent measure to reduce overall radiation exposure to workers during the decommissioning period. An added benefit of the SAFSTOR method is that worker efficiency will be greater due to fewer radiological restrictions during performance of the work. However, economic benefits from gains in efficiency will be partially off-set by maintenance and security costs during the SAFSTOR period, and these costs have been explicitly addressed in this report.

#### **II. Methodology**

The TLG Report provided in Appendix B to this report provided the primary source of information related to costs associated with decommissioning Salem. PSEG personnel used the information in that report to develop the estimate applicable to SAFSTOR described in this report.

Because costs were reported in the TLG Report in 2002 dollars, the first step in the process was to escalate the 2002 costs to 2010 dollars. This re-evaluation produced an increase adjustment of 27% for 2010 Labor & Equipment Costs over the 2002 TLG Report. The New Jersey labor rates from 2003 through 2010 as well as Construction Equipment Costs over the same time frame were used to develop the overall adjustment. The SAFSTOR Decommissioning value was arrived at by taking the 2010 immediate decommissioning cost and adjusting it to reflect significant reduction in residual radioactivity thereby reducing/eliminating the radiation hazards during the dismantling and demolition. This expected improvement will lead to a reduction in overall decommissioning cost, and that improvement is reflected in this study. Details of the adjustment factors used are provided in Table 2.

Aside from the conversion from 2002 to 2010 dollars, two other significant changes were made to update the 2002 TLG Report to address the current forty-year SAFSTOR strategy for Salem. The first change involved shifting the initial costs for preparing the plant for decommissioning from the start of the seven-year decommissioning and dismantlement period assumed in the DECON scenario to prior to the start of the SAFSTOR period. These up-front costs are incurred in three years immediately following termination of operations. The second major change was adding a forty-year period of safe storage prior to final decommissioning. A timeline of these activities is

 $<sup>^2</sup>$  The forty-year SAFSTOR period will begin after a three-year period during which systems are drained, fuel is removed, and the plants are readied for safe storage.

shown in Appendix A to this report. Detailed information showing cash flows, major events, and assumptions is contained in a one-page summary in Table 5 of this report.

III. Tables

Work Category <sup>3</sup>	Cost 2002\$ (thousands)	Cost 2010\$ (thousands)	Percent of Total Costs		
Decontamination	13,463	17,098	2.4%		
Removal	79,587	101,075	14.3%		
Packaging	11,727	14,893	2.1%		
Transportation	11,632	14,773	2.1%		
Waste Disposal	80,911	102,757	14.6%		
Off-Site Waste Processing	16,802	21,338	3.0%		
Program Management (incl.					
Eng. and Security)	233,535	296,589	42.0%		
Spent Fuel Pool Isolation	9,060	11,506	1.6%		
ISFSI Related (including capital)	67,207	85,353	12.1%		
Insurance and Regulatory Fees	11,464	14,559	2.1%		
Energy	8,046	10,218	1.4%		
Characterization and Licensing Surveys	6,440	8,179	1.2%		
Misc. Equipment and Site Services	6,025	7,652	1.1%		
Total	555,899	705,992	100.0%		
License termination (10 CFR § 50.75 decommissioning activities) <sup>4</sup>	523,818	665,249			
Site Restoration (non- 50.75 activities)	32,081	40,743			

#### Table 1A: Summary of Decommissioning Cost Elements- Salem 1

<sup>&</sup>lt;sup>3</sup> Includes contingencies.

<sup>&</sup>lt;sup>4</sup> This total includes spent fuel management.

Work Category <sup>5</sup>	Cost 2002\$ (thousands)	Cost 2010\$ (thousands)	Percent of Total Costs
Decontamination	13,577	17,243	2.3%
Removal	100,874	128,110	16.8%
Packaging	11,746	14,917	2.0%
Transportation	11,734	14,902	2.0%
Waste Disposal	80,039	101,649	13.7%
Off-Site Waste Processing	17,175	21,812	2.9%
Program Management (incl.			
Eng. and Security)	272,325	345,853	45.5%
Spent Fuel Pool Isolation	6,040	7,671	1.0%
ISFSI Related (including capital)	53,776	68,295	19.0%
Insurance and Regulatory Fees	9,209	11,695	1.5%
Energy	7,344	9,327	1.2%
Characterization and Licensing Surveys	6,440	8,179	1.1%
Misc. Equipment and Site Services	6,423	8,157	1.1%
Total	598,702	694,494	100.0%
License termination (10 CFR § 50.75 decommissioning activities) <sup>6</sup>	544,985	5 692,13	1
Site Restoration (non- 50.75 activities)	53,717	68,22	1

### Table 1B: Summary of Decommissioning Cost Elements- Salem 2

<sup>&</sup>lt;sup>5</sup> Includes contingencies.

<sup>&</sup>lt;sup>6</sup> This total includes spent fuel management.

# Table 2A: Summary of Cost Efficiency Adjustments- Salem 1

					SAFSTOR		
					Adjustment	Factors	
						Cost	
						Reduction	
					Cost	Adjustment	
					Efficiency	Contam. To	
					Factor	Decontam.	
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		Factors					
			TLG	TLG			SAFSTOR
			2002\$	2010\$			2010\$
			(thousands)	(thousand	ds)		(thousands)
Decomn	nissioning						
	Non Contaminated	71%	\$ 249,358	\$ 316,685	90%	0%	\$ 285,017
	Contaminated	29%	\$ 101,851	\$ 129,351	0%	25%	\$ 97,013
	Spent Fuel Mgmt	100%	\$ 64,655	\$ 82,112	100%	0%	\$ 82,112
	Other Fixed	100%	\$ 53,656	\$ 68,143	100%	0%	\$ 68,143
	Sub-Total		\$ 469,520	\$ 544,643			\$ 532,285
Continge	ency		\$ 86,379	\$ 100,200	I		\$ 97,408
Total Sa	llem 1 <sup>7</sup>		\$ 555,899	\$ 644,843			\$ 629,693

<sup>&</sup>lt;sup>7</sup> Individual line items are rounded so totals may vary slightly due to round-off error.

# Table 2B: Summary of Cost Efficiency Adjustments- Salem 2

					SAFSTOR		
					Adjustment	Factors	
						Cost	
						Reduction	
					Cost	Adjustment	
					Efficiency	Contam. To	
					Factor	Decontam.	
		Factors					
			TLG 2002\$ (thousands)	TLG 2010\$ (thousand	is)		SAFSTOR 2010\$ (thousands)
Decom	nissioning						· · ·
	Non Contaminated	71%	\$ 256,847	\$ 326,197	90%	0%	\$ 293,577
	Contaminated	29%	\$ 104,909	\$ 133,234	0%	25%	\$ 99,923
	Spent Fuel Mgint	100%	\$ 105,973	\$ 134,586	100%	0%	\$ 134,586
	Other Fixed	100%	\$ 38,635	\$ 49,066	100%	0%	\$ 49,066
	Sub-Total		\$ 506,364	\$ 643.082			\$ 577,152
Conting	ency		\$ 92,388	\$ 117,333			\$ 105,619
Total Sa	alem 2 <sup>8</sup>		\$ 598,702	\$ 748,922			\$ 682,771

<sup>&</sup>lt;sup>8</sup> Individual line items are rounded so totals may vary slightly due to round-off error.

# Location: Salem Generating Station Project: Decommissioning of Nuclear Plants After Safe Storage

Decommissioning Cost For Salem Nuclear Power Plant After Forty Years of Safe Storage

#### Analysis:

#### **Bases of Cost - TLG Cost 2002**

Plant Prep & Temp Service Rigging Construction Control & Tooling Security Staff (except Spent Fuel Mgt.) Utility Staff (except Spent Fuel Mgt.) Final Site Survey

Based on the cost of items to be decontaminated (from TLG estimate), determined that Contaminated Factors represent approx. 29% of the total cost to decommission a Nuclear Plant. Therefore, Non - contaminated factors represent approx. 71% of the total cost.

#### **Cost Efficiency Factors:**

The 2002 TLG Estimate was based on single unit demolition basis for Salem, and in our review we acknowledge an economy scale should be applied since Salem and Hope Creek will be done in tandem. We will reference EPRI study ESC-4685 SIA 83-420 a Nuclear Power Construction study prepared by United & Construction Inc. that supports multi unit construction has efficiency reduction (summarized below).

Station	Reactor Type	Multi Unit Efficiency Direct Craft Labor		
Salem	PWR	1-2 11%-22%	1-3 28%-36% Data Source EPRI p. 3-79 & 3-80	

#### **Cost Assumptions:**

Salem -

In consideration of the EPRI study, efficiency reduced the variable costs. Fixed cost elements (see base cost allocation above) remain constant on a per unit basis. The TLG cost was reduced by 10% since this will be a mass demolition (non contaminated) vs. controlled demolition (contaminated)

The Spent Fuel will follow the same fact pattern and cash flow pattern as in the 2002 TLG Study for Salem.

Since decommissioning after 40 yrs would be equivalent to normal demolition work in a Fossil Plant an additional allowance of 15% savings has been made to contaminated portion of the work only. (Working in a contaminated area can account for a loss of productivity of an additional 25% or 2 Man Hrs/Day). The breakdown of unproductive time is listed below, is based on field observations made at the nuclear sites.

Security:	0.5 MH	6.25%
Suit Up requirements (two times/day)	1 MH	12.5%
Clean up at the end of day	0.5 MH	6.3%
Total	2 MH	25.0%
Total		∠J.0%

The other factors affecting productivity in a contaminated area physical restrictions congestion, height adjustment in work space (crawl space or 40ft. In the air), outage schedule (comprised time line) and ALARA (level of allowance radiation) & proximity of other on going projects. The cost assumptions correspond to present circumstances and to the present status & availability of technology.

## Table 3A: Salem Unit 1 SAFSTOR vs. Non-SAFSTOR Summary of Costs 2010\$ (millions)

	Non SAFSTOR			
Description	TLG 2002	TLG (esc.) 2010	PSEG 2010	
Site Specific Cost				
Lic. Termination	449.8	571.3	495.0	
Spent Fuel Mgmt.	74.0	94.0	94.0	
Site Restoration	32.1	40.7	40.7	
Total (100% Share)	555.9	706.0	629.7	
PSEG Share (w/Spent Fuel) <sup>9</sup>	319.1	405.3	361.5	
Spent Fuel Costs	(42.5)	(54.0)	(54.0)	
PS share (w/o Spent Fuel)	276.7	351.3	307.5	
Site Restoration (PSEG Share)	(18.4)	(23.4)	(23.4)	
PS share (w/o Site Restoration & Spent Fuel)	258.2	327.9	286.1	

 $<sup>^{9}</sup>$  The spent fuel management cost include an allocation from the contingency shown on table 2.

# Table 3B: Salem Unit 2 SAFSTOR vs. Non-SAFSTOR Summary of Costs 2010\$ (millions)

	Non SAFSTOR		
Description	TLG 2002	TLG (esc.) 2010	PSEG 2010
Site Specific Cost			
Lic. Termination	420.2	533.6	456.0
Spent Fuel Mgmt.	124.8	158.5	158.5
Site Restoration	53.7	68.2	68.2
Total (100% Share)	<b>598.</b> 7	748.9	682.7
PSEG Share (w/Spent Fuel) <sup>10</sup>	343.7	429.9	391.9
Spent Fuel Costs	(71.6)	(90.9)	(90.0)
PS share (w/o Spent Fuel)	272.1	339.0	301.9
Site Restoration (PSEG Share)	(30.8)	(39.1)	(39.1)
PS share (w/o Site Restoration & Spent Fuel)	241.2	299.9	262.8

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 $<sup>^{10}</sup>$  The spent fuel management cost include an allocation from the contingency shown on table 2.

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total	O&M Security During SAFSTOR
2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055 2056 2057 2058 2055 2056 2057 2058 2059 2060 2061 2062 2063 2064 2065 2066 2067 2068 2066 2067 2068 2069 2070 2071 2072 2073 2074 2075 2076 2077 2078 2077 2078 2079 2080 2079 2080 2081 2082 2083	5.1 26.4 7.7 13.6 13.5 20.3 50.0 39.4	0.2 3.0 1.4 0.8 4.6 6.0 6.9 5.5	$0.2 \\ 0.8 \\ 0.7$ $0.3 \\ 0.3 \\ 0.5 \\ 0.6 \\ 1.2$	0.0 0.7 0.8 0.0 8.6 13.9 14.6 10.5	0.3 2.9 3.8 0.6 3.8 5.4 4.8 4.9	5.8 33.8 14.4 15.3 30.8 46.1 76.9 61.5	2.6 2.6

#### TABLE 4A: SCHEDULE OF ANNUAL EXPENDITURES Salem Unit 1 - SAFSTOR (millions, 2010 dollars)

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2084 2085	39.0 20.6		0.5 0.3	0.0 0.0	1.5 1.3	46.1 30.8	
Total	235.6	42.1	5.4	49.1	29.3	361.5	104.0

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Year	Labor	Equipment & Materials	Energy	Burial	Other	Total	O&M Security During SAFSTOR
2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055 2056 2057 2058 2059 2060 2061 2062 2063 2064 2065 2066 2067 2068 2066 2067 2068 2069 2070 2071 2072 2073 2074 2075 2076 2077 2078 2077 2078 2079 2070 2077 2078 2079 2070 2077 2078 2079 2070 2077 2078 2079 2080 2077 2078 2079 2080 2081 2082 2083 2084 2085 2086	8.5 43.9 12.8 13.3 13.2 20.0 48.9 38.5	0.2 5.0 2.3 0.8 4.5 5.9 6.8 5.4	0.3 1.4 1.2 0.3 0.3 0.5 0.7 1.2	0.0 1.1 1.3 0.0 8.4 13.6 14.3 10.2	0.7 4.9 6.4 0.7 3.8 5.3 4.6 5.0	9.7 56.3 24.0 15.1 30.2 45.3 75.3 60.3	2.6 2.6

#### TABLE 4B: SCHEDULE OF ANNUAL EXPENDITURES Salem Unit 2 - SAFSTOR (millions, 2010 dollars)

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2088	38.2	5.0	0.4	0.0	1.7	45.3	
2089	20.2	8.4	0.3	0.0	1.5	30.4	
Total	257.5	44.3	6.6	48.9	34.6	391.9	104.0

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#### Table 5A Salem 1 Cash Flows

Year	Annual Expenditures thousands 2010	DTF Fund Balance 2% Real Rate of Return dollars less expenditures	SAFSTOR Year	Notes
		255,599		Balance as of 12/31/2010
2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028		260,711 265,925 271,244 276,669 282,202 287,846 293,603 299,475 305,464 311,574 311,574 317,805 324,161 330,645 337,257 344,002 350,883 357,900 365,058		Balance as of 12/31/2010 Fund balances escalates at 2% per annum during remaining period of operation
2029 2030 2031 2032 2033 2034 2035		372,359 379,807 387,403 395,151 403,054 411,115 419,337		
2036 2037 2038 2039 2040 2041	5,800 33,800 14,400	421,924 396,592 390,124 395,326 400,632 406,045	1 2 3	Expenses to put plant in SAFSTOR Condition, includes security and O&M Annual Security and O&M cost during SAFSTOR is \$2.6MM (PSEG Share)
2042 2043 2044 2045 2046		411,566 417,197 422,941 428,800 434,776	4 5 6 7 8	
2047 2048 2049 2050 2051 2052		440,871 447,089 453,431 459,899 466,497 473,227	9 10 11 12 13 14	
2053 2054 2055 2056 2057		480,092 487,094 494,236 501,520 508,951	15 16 17 18 19	
2058 2059 2060 2061 2062 2063		516,530 524,260 532,146 540,188 548,392 556,760	20 21 22 23 24 25	
2064 2065 2066		565,760 574,001 582,881	26 27 28	

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2067		591,939	29
2068		601,177	30
2069		610.601	31
2070		620,213	32
2071		630,017	33
2072		640,017	34
2073		650,218	35
2074		660,626	36
2075		671,235	37
2076		682,060	38
2077		693,101	39
2078		704,363	40
2079	15,300	703,150	
2080	30,800	686,413	
2081	46,100	654,041	
2082	76,900	590,222	
2083	61,500	540,527	
2084	46,100	505,237	
2085	30,800	484,542	

Costs during 7-year decommissioning period includes security and O&M

.

#### Table 5B Salem 2 Cash Flows

Year	Annual Expenditures thousands 2010	DTF Fund Balance 2% Real Rate of Return dollars less expenditures	SAFSTOR Year	Notes
		234,780		Balance as of 12/31/2010
2011		239,476		
2012		244,265		
2012		249,150		Fund balances escalates at 2%
2015		254,133		per annum during remaining
2014		259,216		period of operation
2015		264,400		period of operation
2017		269,688		
2018		275,082 280,584		
2019		•		
2020		286,196		
2021		291,919		
2022		297,758		
2023		303,713		
2024		309,787		
2025		315,983		
2026		322,303		
2027		328,749		
2028		335,324		
2029		342,030		
2030		348,871		
2031		355,848		
2032		362,965		
2033		370,224		
2034		377,628		
2035		385,181		
2036		392,885		
2037		400,743		
2038		408,758		
2039		416,934		
2040	9,700	415,574		Expenses to put plant in
2041	56,300	367,584		SAFSTOR Condition, includes
2042	24,000	350,936		security and O&M
2043		355,354	1	Annual Security and O&M
2044		359,861	2	cost during SAFSTOR is
2045		364,459	3	\$2.6MM (PSEG Share)
2046		369,148	4	
2047		373,931	5	
2048		378,809	6	
2049		383,786	7	
2050		388,861	8 9	
2051		394,039		
2052		399,319	10	
2053		404,706	11	
2054		410,200	12	
2055		415,804	13	
2056		421,520	14	
2057		427,350	15	
2058		433,297	16	
2059		439,363	17	
2060		445,551	18	
2061		451,862	19	
2062		458,299	20	
2063		464.865	21	
2064		471,562 ,	22	
2065		478,393	23	
2066		485,361	24	
2067		492,469	25	

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2068		499,718	26
2069		507,112	27
2070		514,655	28
2071		522,348	29
2072		530,195	30
2073		538,198	31
2074		546,362	32
2075		554,690	33
2076		563,183	34
2077		571,847	35
2078		580,684	36
2079		589,698	37
2080		598,892	38
2081		608,270	39
2082		617,835	40
2083	15,100	615,092	
2084	30,200	597,193	
2085	45,300	563,837	
2086	75,300	499,510	
2087	60,300	449,510	
2088	45,300	413,201	
2089	30,400	391,065	

Costs during 7-year decommissioning period includes security and O&M

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**Table 6: Decommissioning Waste Summary**Please see Table 5.1, Decommissioning Waste Summary, in the TLG Report, attached asAppendix B to this report.

**Table 7: Detailed Cost Analysis**Please see Appendix C in the TLG Report, attached as Appendix B to this report.

# **IV. Appendices** A. Time Line

I.

B. December 2002 TLG Decommissioning Cost Analysis

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Appendix A: Time Line

Salem 1

Activity	2036 2	2037	2038	2039	9 - 2078	2079	2080	2081	2082	2083	2084	2085
Shutdown through Transition	x	x	x									
Safe storage p	eriod				x							
Decommission and Site Resto						x	x	x	x	x	x	x
Salem 2												
Activity	2040 2	2041	2042	2043	- 2082	2083	2084	2085	2086	2087	2088	2089
Shutdown through Transition	x	x	x									
Safe Storage period					x							
Decommission and Site Resto	-					x	x	x	x	x	x	x

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Appendix B: December 2002 TLG Decommissioning Cost Analysis

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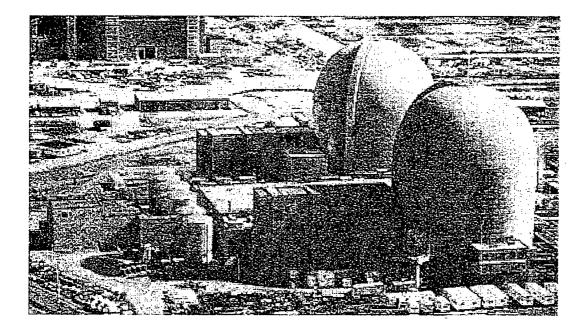
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# DECOMMISSIONING COST ANALYSIS

for the

# SALEM GENERATING STATION, UNITS 1 AND 2



prepared for

# PSEG NUCLEAR, LLC

prepared by

TLG Services, Inc. Bridgewater, Connecticut

December 2002

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#### APPROVALS

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2. 5.

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TLG Services, Inc.

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# **REVISION LOG**

No.	CRA No.	Date	Item Revised	Reason for Revision
0		12-05-02		Original Issue

TLG Services, Inc.

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#### EXECUTIVE SUMMARY

This report presents the costs to promptly decommission (decontaminate and dismantle) the Salem Generating Station (Salem Station) following a scheduled cessation of plant operations. The analysis relies upon the site-specific, technical information developed for a previous evaluation prepared in 1995-96, updated to reflect current plant conditions and operating assumptions. The estimates are designed to provide PSEG Power, LLC with sufficient information to assess its financial obligations as they pertain to the eventual decommissioning of the nuclear station.

The estimates are based on numerous fundamental assumptions, including regulatory requirements, project contingencies, low-level radioactive waste disposal practices, high-level radioactive waste management options, and site restoration requirements. The estimates incorporate a cooling period of approximately five years for the spent fuel that resides in the plant's storage pools when operations cease. Any residual fuel remaining in the pools after the five-year period will be relocated to an on-site, interim storage facility to await the transfer to a DOE facility. The estimates also include the dismantling of non-essential structures and limited restoration of the site.

#### Alternatives and Regulations

The Nuclear Regulatory Commission (NRC) provided general decommissioning guidance in the rule adopted on June 27, 1988.<sup>[1]</sup> In this rule the NRC set forth technical and financial criteria for decommissioning licensed nuclear facilities. The regulations addressed planning needs, timing, funding methods, and environmental review requirements for decommissioning. The rule also defined three decommissioning alternatives as being acceptable to the NRC - DECON, SAFSTOR, and ENTOMB.

<u>DECON</u> 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."<sup>[2]</sup>

TLG Services, Inc.

<sup>&</sup>lt;sup>1</sup> 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.

<sup>&</sup>lt;sup>2</sup> Ibid. Page FR24022, Column 3.

<u>SAFSTOR</u> 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."<sup>[3]</sup> Decommissioning is to be completed within 60 years, although longer time periods will be considered when necessary to protect public health and safety.

<u>ENTOMB</u> 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."<sup>[4]</sup> 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. As such, the NRC is currently re-evaluating this option and the technical requirements and regulatory actions that would be necessary for entombment to become a viable option.

In 1996, the NRC published revisions to the general requirements for decommissioning nuclear power plants to clarify ambiguities and codify procedures and terminology as a means of enhancing efficiency and uniformity in the decommissioning process. 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 describes the methods and procedures that are acceptable to the NRC staff for implementing the requirements of the 1996 revised rule that relate to the initial activities and the major phases of the decommissioning process. The costs and schedules presented in this analysis follow the general guidance and process described in the amended regulations.

#### Methodology

The methodology used to develop the estimates described within this document follows the basic approach originally presented in the cost estimating guidelines<sup>[5]</sup> developed by the Atomic Industrial Forum (now Nuclear Energy Institute). This reference

<sup>3</sup> Ibid.

<sup>4</sup> Ibid. Page FR24023, Column 2.

<sup>&</sup>lt;sup>5</sup> T.S. LaGuardia et al., "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates," AIF/NESP-036, May 1986.

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describes a unit factor method for determining decommissioning activity costs. The unit factors used in this analysis incorporate site-specific costs and the latest available information on worker productivity in decommissioning.

The estimates also reflect lessons learned from TLG's involvement in the Shippingport Station Decommissioning 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 technical challenges of decommissioning commercial nuclear units.

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

#### Contingency

Consistent with industry 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."<sup>[6]</sup> The cost elements in the estimates are based on ideal conditions; therefore, the types of unforeseeable events that are almost certain to occur in decommissioning, based on industry experience, are addressed through a percentage contingency applied on a line-item basis. This contingency factor is a nearly universal element in all large-scale construction and demolition projects. It should be noted that contingency, as used in this estimate, 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.

<sup>&</sup>lt;sup>6</sup> Project and Cost Engineers' Handbook, Second Edition, American Association of Cost Engineers, Marcel Dekker, Inc., New York, New York, p. 239.

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#### 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 Disposal Act" in 1980, and its Amendments of 1985,<sup>[7]</sup> the states became ultimately responsible for the disposition of radioactive waste generated within their own borders.

New Jersey is a member of the three-state Atlantic Interstate Low-Level Radioactive Waste Management Compact, formed after South Carolina formally joined the Northeast Regional Compact. The Barnwell Low-Level Radioactive Waste Management Facility, located in South Carolina, is expected to be available to PSEG Nuclear to support the decommissioning of the Salem Station. It is also assumed that PSEG Nuclear could access other disposal sites should it prove cost effective. As such, rate schedules for both the Barnwell and the Envirocare facility in Utah were used to generate disposal costs.

#### High-Level Radioactive Waste Management

Congress passed the "Nuclear Waste Policy Act"<sup>[8]</sup> in 1982, assigning the responsibility for disposal of spent nuclear fuel created by the commercial nuclear generating plants to the DOE. This legislation also created a Nuclear Waste Fund to cover the cost of the program, which is funded by the sale of electricity from nuclear reactors since 1993, and an estimated equivalent value for assemblies irradiated prior to 1983. The Nuclear Waste Policy Act, along with the individual disposal contracts with 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. Operation of DOE's yet-to-be constructed geologic repository is currently scheduled for the year 2010, assuming that the licensing could be completed expeditiously and a national transportation system established. The agency has no plans for receiving spent fuel from commercial nuclear plant sites prior to this date and startup operations may be phased in, creating additional delays.

The NRC requires licensees to 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. For estimating purposes, PSEG Nuclear has assumed that the high-level waste repository, or some interim storage facility, will be fully

<sup>&</sup>lt;sup>7</sup> "Low-Level Radioactive Waste Policy Amendments Act of 1985," Public Law 99-240, 1/15/86.

<sup>&</sup>quot;Nuclear Waste Policy Act of 1982 and Amendments," U.S. Department of Energy's Office of Civilian Radioactive Management, 1982.

operational by 2015. Interim storage of the fuel, until the DOE has completed the transfer, will be in an independent facility located on the Artificial Island site. This will allow PSEG Nuclear to proceed with decommissioning and terminate its operating licenses in the shortest time possible.

The spent fuel storage facility, which is independently licensed and operated, will be sized to accommodate the inventory of spent fuel residing in the plant's storage pools at the cessation of operations, in addition to any operational inventory already in residence. When emptied, the station could be dismantled without maintaining the wet storage pools. Based upon this scenario, and an anticipated rate of transfer, spent fuel is projected to remain on site for approximately 30 years following the cessation of Unit 1 operations.

#### Site Restoration

The efficient removal of the contaminated materials at the site may result in damage to many of the site structures. Blasting, coring, drilling, and the other decontamination activities will substantially damage power block structures, potentially weakening the footings and structural supports. Prompt demolition once 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 study assumes that site structures will be removed to a nominal depth of three feet below the local grade level wherever possible. The site will then be graded and stabilized.

#### Summary

The DECON decommissioning alternative involves the prompt removal of the contaminated and activated plant components, including structural materials, from the site following permanent shutdown. The facility operator may then have unrestricted use of the site with no further requirement for a license. This study assumes that the remainder of the non-essential plant systems and structures, not previously removed in support of license termination, are dismantled and the site restored.

The scenario analyzed for the purpose of generating the estimates 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

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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.

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# COST SUMMARY (Thousands of 2002 Dollars)

Activity	Unit 1	Unit 2	Station
Decontamination	13,463	13,577	27,040
Removal	79,587	100,874	180,461
Packaging	11,726	11,746	23,473
Transportation	11,632	11,734	23,366
Waste Disposal	80,911	82,039	162,950
Off-site Waste Processing	16,802	17,175	33,977
Program Management	233,535	272,325	505,860
(including Engineering and Security)	200,000	212,020	000,000
Spent Fuel Pool Isolation	9,060	6,040	15,101
ISFSI Related (including capital)	67,207	53,776	120,983
Insurance and Regulatory Fees	11,464	9,209	20,672
Energy	8,046	7,344	15,390
Characterization and Licensing Surveys	6,440	6,440	12,880
Misc. Equipment and Site Services	6,026	6,423	12,449
Total <sup>1</sup>	555,899	598,702	1,154,601
			•
License Termination <sup>2</sup> Site Restoration	523,818 32,081	544,985 53,717	1,068,803 85,798

[1] Columns may not add due to rounding.

<sup>[2]</sup> Includes spent fuel management expenditures.

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#### 1. INTRODUCTION

This decommissioning analysis is designed to provide PSEG Power with sufficient information to prepare the financial planning documents for decommissioning, as required by the Nuclear Regulatory Commission (NRC or Commission). It is not a detailed assessment, but a financial analysis prepared in advance of the engineering and planning that will be required to carry out the decommissioning of the Salem Generating Station (Salem Station).

#### **1.1 OBJECTIVES OF STUDY**

The objectives of this study are to prepare comprehensive estimates of the costs to decommission Salem Station for the scenario outlined in Section 2, to define a sequence of events, and project the volume of waste produced from the decontamination and dismantling activities.

The Salem Station is jointly owned by PSEG Power, LLC (57%) and Exelon Generation Corporation (43%). However, for purposes of this study, only the undivided decommissioning costs (100%) are presented, since the division of ownership has no effect on the total expenditures required. PSEG Nuclear operates the station.

The Station is comprised of two identical units, constructed concurrently, with the construction permits being issued on the same date. For the purposes of this study, the shutdown dates were taken as August 13, 2016, and April 18, 2020, for Units 1 and 2, respectively. This time frame, which reflects 40 years of operating life for each unit, was used as an input for scheduling the decommissioning activities.

#### **1.2 SITE DESCRIPTION**

The Salem Station is located on the southern part of Artificial Island on the east bank of the Delaware River in Lower Alloways Creek Township, Salem County, New Jersey. The site is 15 miles south of the Delaware Memorial Bridge, 18 miles south of Wilmington, Delaware, 30 miles southwest of Philadelphia, Pennsylvania, and 7½ miles southwest of Salem, New Jersey.

The Nuclear Steam Supply System (NSSS) consists of a pressurized water reactor and a four-loop Reactor Coolant System (RCS). The system was supplied by the Westinghouse Electric Corporation. The licensed ratings for each of the two units is 3,411 MWt. The corresponding net dependable electrical output is 1,115 MWe.

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The NSSS is housed within a "containment structure," a seismic Category I, reinforced-concrete, dry structure. The containment is a cylinder with a hemispherical dome and a flat, reinforced-concrete foundation mat. A welded steel liner plate anchored to the inside face of the containment serves as a leak-tight membrane.

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 steam generators into mechanical shaft power and then into electrical energy. The plant's turbine-generators are each tandemcompound, four-element units. They consist of one high-pressure, double-flow, and three low-pressure, double-flow elements driving a direct-coupled generator at 1,800 rpm. The turbines are operated in a closed feedwater cycle that condenses the steam; the heated feedwater is returned to the steam generators. Heat rejected in the main condensers is removed by the circulating water system.

The circulating water system provides the heat sink required for removal of waste heat in the power plant's thermal cycle. The system has the principal function of removing heat by absorbing this energy in the main condenser. Water is withdrawn from the Delaware River by the circulating water pumps located at the intake structure. After passing through the plant condensers, the discharge is routed back into the Delaware estuary.

#### **1.3 REGULATORY GUIDANCE**

The NRC provided initial decommissioning guidance in its rule "General Requirements for Decommissioning Nuclear Facilities," issued in June 1988.<sup>[1]\*</sup> This rule set forth technical and financial criteria for decommissioning licensed nuclear 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 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

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<sup>\*</sup> Annotated references for citations in Sections 1-6 are provided in Section 7.

content and form of the financial assurance mechanisms indicated in the rule amendments.

The rule defined three decommissioning alternatives as being acceptable to the NRC: DECON, SAFSTOR, and ENTOMB. It 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 could 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 definition of unrestricted release and 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 reevaluated this alternative. The resulting feasibility study, based upon an assessment by Pacific Northwest National Laboratory, concluded that the method did have conditional merit for some if not most reactors. However, the staff also found that additional rulemaking would be needed before this option could be treated as a generic alternative. The NRC is considering rulemaking to alter the 60-year time for completing decommissioning and to clarify the use of engineered barriers for reactor entombments. Pending completion of such rulemaking, entombment requests will be handled on a case-by-case basis.

In 1996, the NRC published revisions to the general requirements for decommissioning nuclear power plants.<sup>[3]</sup> When the decommissioning regulations were adopted in 1988, it was assumed that the majority of licensees would decommission at the end of the operating license life. Since that time, several licensees permanently and prematurely ceased operations without having submitted a decommissioning plan. In addition, these licensees requested exemptions from certain operating requirements as being unnecessary once the reactor is defueled. 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 would submit written certification to the NRC within 30 days after the decision to cease operations. Certification would also be required once the fuel was permanently removed from the reactor vessel. Submittal of these notices would 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 would be 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 would be required to submit an application to the NRC to terminate the license, along with a license termination plan (LTP).

#### 1.3.1 Nuclear Waste Policy Act

Congress passed the Nuclear Waste Policy Act<sup>[4]</sup> in 1982, assigning the responsibility for disposal of spent nuclear fuel from the commercial nuclear generating plants to the Department of Energy (DOE). Two permanent disposal facilities were envisioned, as well as an interim facility. To recover the cost of permanent spent fuel disposal, this legislation created a Nuclear Waste Fund through which money was to be collected from the consumers of the electricity generated by commercial nuclear power plants. The Nuclear Waste Policy Act, along with the individual disposal contracts with utilities, specified that the DOE was to begin accepting spent fuel by January 31, 1998.

After pursuing a national site selection process, the Act 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 in the opening date for the repository, from 1998 to 2003. Two years later, in 1989, an additional 7-year delay was announced, primarily due to problems in obtaining the required permits 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 a recent decision, the U.S. Court of Appeals for the Federal Circuit reaffirmed the utility position that

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DOE had breached its contractual obligation. However, even with the August 2000 ruling,<sup>[5]</sup> 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, DOE has no plans to receive spent fuel from commercial U.S. reactors before the year 2010.

The NRC requires licensees to establish a program to manage and provide funding for the management of all irradiated fuel at the reactor until title of the fuel is transferred to the Secretary of Energy in 10 CFR 50.54 (bb).<sup>[6]</sup> This funding requirement is fulfilled through inclusion of certain high-level waste cost elements within the estimates, as described below.

For estimating purposes, PSEG Nuclear has assumed that the high-level waste repository, or some interim storage facility, will be fully operational by 2015. Interim storage of the fuel, until the DOE has completed the transfer, will be in an independent facility located on the Artificial Island site. This will allow PSEG Nuclear to proceed with decommissioning and terminate its operating licenses in the shortest time possible.

Based upon the projected capacity of the spent fuel storage pools, supplemental storage will be required before the current operating licenses expire so as to maintain full core off-load capability. Therefore, this analysis assumes that an on-site independent spent fuel storage installation (ISFSI) will be constructed to support plant operations and will be available to support decommissioning

The spent fuel storage facility, which is independently licensed and operated, will be sized to accommodate the inventory of spent fuel residing in the plant's storage pools at the cessation of operations, in addition to any operational inventory already in residence. When emptied, the station could be dismantled without maintaining the wet storage pools. Based upon this scenario, and an anticipated rate of transfer, spent fuel is projected to remain on site for approximately 30 years following the cessation of Unit 1 operations.

Expenditures are included in the analysis for the isolation and continued operation of the spent fuel pools throughout the first five years of decommissioning. Expenses are also included for loading the spent fuel assemblies remaining in the storage pools after the

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cessation of plant operations into multi-purpose canisters, for canister costs and overpacks, and for the operation of the ISFSI through the year 2046, when all the fuel is expected to be transferred to the DOE.

#### 1.3.2 Low-Level Radioactive Waste Policy Amendments Act

Congress passed the "Low-Level Radioactive Waste Disposal Act" in 1980, 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. With little progress, the "Amendments Act" of 1985<sup>[7]</sup> extended the target, with specific milestones and stiff sanctions for non-compliance.

New Jersey is a member of the three-state Atlantic Interstate Low-Level Radioactive Waste Management Compact, formed after South Carolina formally joined the Northeast Regional Compact. The Barnwell Low-Level Radioactive Waste Management Facility, located in South Carolina, is expected to be available to PSEG Nuclear to support the decommissioning of the Salem Station. It is also assumed that PSEG Nuclear could access other disposal sites should it prove cost-effective. As such, rate schedules for both the Barnwell and the Envirocare facility in Utah were used to generate disposal costs.

#### 1.3.3 Radiological Criteria for License Termination

In 1997, the NRC published Subpart E, "Radiological Criteria for License Termination,"<sup>[8]</sup> amending Part 20 of Title 10 of the Code of Federal Regulations (10 CFR §20). This subpart provided radiological criteria for releasing a facility for unrestricted use. The regulation provides that the site could 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 residual radioactivity has been reduced to levels that are As Low As Reasonably Achievable (ALARA). The decommissioning estimate for the Salem Station assumes 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). An additional limit of 4 millirem per year, as defined in 40 CFR Part 141.16, is applied to drinking water.

On October 9, 2002, the NRC signed an agreement with the EPA on the radiological decommissioning and decontamination of NRClicensed sites. The Memorandum of Understanding (MOU) 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 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 EPA. However, if there are other hazardous materials on the site, EPA may be involved in the cleanup. As such, the possibility of dual regulation remains for certain licensees.

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# 2. DECOMMISSIONING ALTERNATIVE

The following section describes the basic activities associated with the DECON 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 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 estimates developed for the Salem Station are also divided into phases or periods; however, demarcation of the phases is based upon major milestones within the project or significant changes in the projected expenditures.

#### 2.1 PERIOD 1 – PREPARATIONS

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

## 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

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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 Greater-than-Class C waste (GTCC), as defined by 10 CFR §61. Major components are further defined as comprising the reactor vessel and internals, large bore reactor 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 bounded by previously evaluated environmental assessments or impact statements. In this instance, the licensee would have to submit a license amendment for the specific activity and update the environmental report.

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

### 2.1.2 <u>Site Preparations</u>

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

- Characterization of the site and surrounding environs. This includes radiation surveys of work areas, major components (including the reactor vessel and its internals), sampling of internal piping contamination levels, and primary shield cores.
- Isolation of the spent fuel storage pool and fuel handling systems, such that decommissioning operations could commence on the balance of the plant. Decommissioning operations are scheduled around the fuel handling area to the greatest extent possible such that the overall project schedule is optimized. The fuel will be transferred to the DOE as it decays to the point that it meets the heat load criteria of the containers and, as such, it is assumed that the fuel pool will remain operational for a minimum of five years following the cessation of plant operations.
- Specification of transport and disposal requirements for activated materials and/or hazardous materials, including shielding and waste stabilization.
- Development of procedures for occupational exposure control, control and release of liquid and gaseous effluent, processing of radwaste (including dry-active waste, resins, filter media, metallic and nonmetallic components generated in decommissioning), site security and emergency programs, and industrial safety.

## 2.2 PERIOD 2 – DECOMMISSIONING OPERATIONS

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. Building

modifications may be required to the Reactor Building to facilitate access of large/heavy equipment. Modifications may also be required to the refueling area of the Reactor 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 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 a modified fuel canister for geologic disposal.
- Segmentation of the reactor vessel. Install shielded platform for segmentation of reactor vessel. Cutting operations are performed in-air using remotely operated equipment within a contamination control envelope, with the water level 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 controlled disposal. Decontaminate exterior surfaces, as required, and seal-weld openings (nozzles, inspection hatches, and other penetrations). These components can serve as their own burial containers provided that all penetrations are properly sealed and the internal contaminants are stabilized. Steel shields are added to those external areas of the steam generators necessary in order to meet transportation limits and regulations.

At least two years prior to the anticipated date of license termination, a LTP is required. Submitted as a supplement to the Final Safety Analysis Report (FSAR), or equivalent, the plan must include: a site characterization, description of the remaining dismantling activities, plans for site remediation, procedures for the final radiation survey, designation of the end use of the site, an updated cost estimate to complete the decommissioning, and any associated environmental concerns. The NRC will notice the receipt of the plan, make the plan available for public comment, and schedule a local hearing. LTP approval will be subject to any conditions and limitations as deemed appropriate by the Commission. The licensee may then commence with the final remediation of site facilities and services, including:

- Removal of remaining plant systems and associated components as they become nonessential to the decommissioning program or worker health and safety (e.g., waste collection and treatment systems, electrical power and ventilation systems).
- Removal of the steel liners from refueling canal, disposing of the activated and contaminated sections as radioactive waste. Removal of any activated/contaminated concrete.
- Surveys of the decontaminated areas of the containment structure.
- Removal of the contaminated equipment and material from the Auxiliary and Fuel Handling Building and any other contaminated facility. Radiation and contamination control techniques are used until radiation surveys indicate that the structures could 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 will facilitate

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surface decontamination and subsequent verification surveys required prior to obtaining release for demolition.

- Removal of the remaining components, equipment, and plant services in support of the area release survey(s).
- Routing of material removed in the decontamination and dismantling to a central processing area. Material certified to be free of contamination would be released for unrestricted disposition, e.g., as scrap, recycle, or general disposal. Contaminated material will be 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 NUREG/CR-1575, "Multi-Agency Radiation Survey and Site Investigation Manual" (MARSSIM).<sup>[9]</sup> 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.

#### 2.3 PERIOD 3 – SITE RESTORATION

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

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power block structures, including the Reactor, Auxiliary, and Fuel Handling Buildings. Verifying that subsurface radionuclide concentrations meet NRC site release requirements may 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 costeffective option. It is unreasonable to anticipate that these structures would be repaired and preserved after the radiological contamination is removed. The cost to dismantle site structures with a work force already mobilized on site is more efficient than if the process is deferred. Site facilities quickly degrade without maintenance, adding additional expense and creating potential hazards to the public and future workers. Abandonment creates a breeding ground for vermin infestation and other biological hazards.

This cost study presumes that non-essential structures and site facilities will be 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, and 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 demolition activities will processed to remove rebar and miscellaneous embedments. The processed material will then be used on-site to backfill voids. Excess materials are trucked off-site for disposal as construction debris.

## 2.4 **POST PERIOD 3 – ISFSI OPERATIONS**

The ISFSI will continue to operate under a separate and independent license (10 CFR §72) following the relocation of the spent fuel from the plant's storage pools. Transfer of spent fuel to a DOE or interim facility will be exclusively from the ISFSI once the fuel pools have been emptied and the structures released for decommissioning. Assuming initiation of the federal Waste Management System in 2015, transfer of spent fuel from Salem Station is anticipated to continue through the year 2046. Any delay in the transfer process, for example, due to a delay in the scheduled opening of the geologic repository, a slower acceptance rate, or a combination of a delayed start date and lower transfer

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rate, will result in a longer on-site residence time for the fuel discharge from the reactor and therefore additional caretaking expenses.

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 currently proposed design for the ISFSI is based upon the use of concrete overpacks 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 and the license for the facility terminated, the modules could 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 estimates prepared for decommissioning the Salem Station consider the unique features of the site, including the nuclear steam supply system, power generation systems, support services, site buildings, and ancillary facilities. The bases of the estimates, including the sources of information relied upon, the estimating methodology employed, site-specific considerations and other pertinent assumptions are described in this section.

### **3.1 BASIS OF ESTIMATE**

The current estimates were developed using the basic design information originally generated for the decommissioning analysis prepared in 1995-96.<sup>[10]</sup> The information was reviewed for the current estimate and updated, as deemed necessary. The site-specific considerations and assumptions used in the previous estimate 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 this cost estimate follows the basic approach originally presented in the AIF/NESP-036 study report, "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates,"<sup>[11]</sup> and the US DOE "Decommissioning Handbook."<sup>[12]</sup> 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 <u>activity-dependent</u> 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.<sup>[13]</sup>

This estimate 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 has provided additional insight into the process, the

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regulatory aspects, and 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	<sup>·</sup> 10% to 20%
Respiratory Protection Factor	10% to 50%
Radiation/ALARA Factor	10% to 37%
Protective Clothing Factor	10% to 30%
Work Break Factor	8.33%
Productivity	adjustable

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 relied 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

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engineering, equipment rental, and support services such as quality control and security. This systematic approach for assembling decommissioning estimates ensures a high degree of confidence in the reliability of the resulting costs.

## 3.3 FINANCIAL COMPONENTS OF THE COST MODEL

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

Inherent in any cost estimate that does not rely on historical data is the inability to specify the precise source of costs imposed by factors such as tool breakage, accidents, illnesses, weather delays, and labor stoppages. In TLG's 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"<sup>[14]</sup> 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 estimate 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 estimate, 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, could 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 will be the disposition of the reactor vessel and internal components, which have become highly radioactive after a lifetime of exposure to radiation produced in the core. The disposition of these highly radioactive components forms the basis for the critical path (schedule) for decommissioning operations. Cost and schedule are inter-dependent 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 risk and uncertainties associated with this task are that the expected optimization 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. 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 can range from 0% to 75%, depending on the degree of difficulty judged to be appropriate

from TLG's actual decommissioning experience. values used in this study are as follows:	The contingency
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 overall contingency, when applied to the appropriate components of the estimates on a line item basis, results in an average value of 18.3%.

#### 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:

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- 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.
- 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 much 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, it is recommended that the areas of

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uncertainty or risk be 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

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

The total inventory of assemblies that will need to be handled during decommissioning is based upon several assumptions. The pickup of commercial fuel is assumed to begin in the year 2015 and will proceed on an oldest fuel first basis. The rate at which the fuel is removed from the commercial sites is based upon an annual capacity at the geologic repository of 3,000 metric tonnes. A delay in the startup of the repository, or a decrease in the rate of acceptance rate, will correspondingly prolong the transfer process and extend the duration that the fuel remains at the site.

For estimating purposes, spent fuel will be removed from the Salem Station site beginning in the year 2020, with the transfer complete by the end of year 2046. Built to support continuing plant operations, an ISFSI will be available to support decommissioning, i.e., the fuel residing in the pools following the cessation of plant operations could be relocated to the ISFSI so that decommissioning can proceed on the Fuel Handling Buildings. The assemblies will be relocated to the ISFSI during the first five years following final shutdown. Costs are included for the purchase of the 94 canisters and overpacks required to empty the pool (an additional eight will be used to package the GTCC).

Operation and maintenance costs for the ISFSI are included within the estimates and address the cost for staffing the facility, security, insurance, and licensing fees. Costs are also provided for the final disposition of the facility once the transfer is complete.

### ISFSI Design Considerations

A multi-purpose (storage and transport) dry shielded storage canister with a vertical, reinforced concrete storage silo is used as a basis for the cost analyses. Approximately 50% of the silos 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 of the disposition of this material, as well as the demolition of the ISFSI facility, is included in the estimate.

### 3.4.2 <u>Reactor Vessel and Internal Components</u>

The NSSS (reactor vessel and reactor coolant system components) will be decontaminated using chemical agents prior to the start of cutting operations. A decontamination factor (average reduction) of 10 is presumed.

The reactor pressure vessel and internal components are segmented for disposal in shielded, reusable transportation casks. Segmentation will be performed in the refueling canal, where a turntable and remote cutter are installed. The vessel will be segmented in place, using a mastmounted 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 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, DOE has indicated it will accept title to this waste for disposal at the future high-level waste repository.<sup>[15]</sup> 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 DOE would accept this waste prior to completing the transfer of spent fuel. Therefore, until such time as the DOE is ready to accept GTCC waste, it is reasonable to assume that this material would remain in storage at Salem Station.

Intact disposal of the reactor vessel and internal components could 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, the location of the Trojan Nuclear Plant on the Columbia River simplified the transportation analysis since:

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

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

It is not known whether this option will be available when the Salem Station 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, as a bounding condition, the study assumes the reactor vessel will have to be segmented.

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### 3.4.3 <u>Primary System Components</u>

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, weight, and location within the Reactor Building will ultimately determine the removal strategy.

A potential method for removal (and the one used as the basis in this estimate) is the extraction of the generators through the existing equipment hatch. Sections of the steam generator cubicle walls, adjoining floor slabs, and floor grating may need to be removed to allow for the generators to be maneuvered to the hatch.

Grating within the work area will be decontaminated and removed. Next, a trolley crane will be set up for removal of the generators. By setting the trolley crane first, it can 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.

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 dolly. 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. The generators will be staged at an on-site storage area to await transport to the disposal facility. The pressurizer will be removed using the same technique. Each component will then be loaded onto a barge for transport to the disposal facility.

Reactor coolant piping will be 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) drops below the nozzle zone. The piping will be boxed and transported by shielded van. The reactor coolant pumps and motors will be 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 condenser will also be disassembled and moved to a laydown area. Material will then be prepared for transportation to an off-site recycling facility where it will be surveyed and designated for decontamination, volume reduction, or conventional 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 of the Code of Federal Regulations.<sup>[16]</sup> The contaminated material will be packaged in Industrial Packages (IP I, II, or III) 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.

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 are designed to meet these limits.

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

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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. Memphis, Tennessee will be used as the destination for off-site processing. Transportation costs are estimated using published tariffs from Tri-State Motor Transit.<sup>[17]</sup>

#### 3.4.6 Low-Level Radioactive Waste Disposal

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

Material requiring controlled disposal will be packaged and transported to one of two currently available burial facilities. Very low-level radioactive material, e.g., structural steel and contaminated concrete, will be sent to Envirocare. More highly contaminated and activated material will be 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 PSEG Nuclear's own future plans for the site, e.g., the electrical switchyard will remain in support of the electrical transmission and distribution system.

The large underground tunnels between the cooling water intake, Turbine Building, and discharge structure will be isolated, sealed, and abandoned in place. Site utility and service piping are abandoned in place. Electrical manholes are backfilled with suitable earthen material and abandoned. Asphalt surfaces in the immediate vicinity of site

buildings are broken up and the material used for backfill on site, if needed. The site access road will remain.

The estimate does 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.

Structures will be removed to a nominal depth of three feet below grade. Concrete rubble generated from demolition activities will be processed and made available as clean fill. The site will be graded following the removal of non-essential structures to conform to the adjacent landscape, and vegetation will be established to inhibit erosion. This degree of site restoration will constitute compliance with the CAFRA document dated July 9, 1976.

## 3.5 ASSUMPTIONS

The following are the major assumptions made in the development of the estimate for decommissioning the site. Decommissioning activities will be performed in accordance with the current regulations that are assumed to be in place at the time of decommissioning, including the Industrial Site Recovery Act (ISRA), which is mandatory under current New Jersey State Regulations.

### 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.

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## 3.5.2 Labor Costs

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. Costs for site administration, operations, construction, and maintenance personnel are based upon average salary information provided by PSEG Nuclear.

PSEG Nuclear, as the licensee, will oversee the decommissioning operations and provide site security, radiological controls, and overall site administration. PSEG Nuclear will provide contract management of the decommissioning labor force and subcontractors. Engineering services for preparing the activity specifications, work procedures, activation, and structural analyses, are provided by PSEG Nuclear personnel.

The costs associated for the transition of the operating organization to decommissioning, e.g., separation packages, retraining, severance, and incentives are not included in this estimate and are considered to be ongoing operating expenses.

#### 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., cesium-137, strontium-90, 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.<sup>[18]</sup> Actual estimates are derived from the curie/gram values in NUREG/CR-3474 and adjusted for the different mass of Salem Station components, projected operating life, and different periods of decay. Additional short-lived isotopes were derived from NUREG/CR-0130<sup>[19]</sup> and NUREG/CR-0672<sup>[20]</sup> and benchmarked to the long-lived values from NUREG/CR-3474.

Contamination has been found in the heat exchanger tube sheets at several shutdown U.S. pressurized water reactors (due to primary to secondary side leakage in the steam generators). For purposes of this estimate, selected secondary-side components are designated for off-site processing, including portions of the turbine and condenser.

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

### 3.5.4 <u>General</u>

#### Transition Activities

Existing warehouses will be cleared of non-essential material and remain for use by PSEG Nuclear and its subcontractors. The warehouses may be dismantled as they become surplus to the decommissioning program. 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.
- Excess acid, caustic, and all chemicals listed (at shutdown) in the New Jersey "Right to Know Report" will be removed and the storage container returned to the vendor. It is assumed that these chemicals will have some value; therefore, the cost for their removal will be compensated through their subsequent sale.

#### Scrap and Salvage

The existing plant equipment is considered obsolete and suitable for scrap as deadweight quantities only. PSEG Nuclear will make economically reasonable efforts to salvage equipment following final plant shutdown. However, dismantling techniques assumed by TLG for equipment in this estimate 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 estimate

does not attempt to quantify the value that PSEG Nuclear may realize based upon those efforts.

It is assumed, for purposes of this estimate, that any value received from the sale of scrap generated in the dismantling process would be more than offset by the on-site processing costs. The dismantling techniques assumed in the decommissioning estimate 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 from a facility currently being decommissioned has required the removal and disposition of the PCB-contaminated insulation, an added expense. With a volatile market, the potential profit margin in scrap recovery is highly speculative, regardless of the ability to free release this material. This assumption is an implicit recognition of scrap value in the disposal of clean metallic waste at no additional cost to the project.

Furniture, tools, mobile equipment such as forklifts, trucks, bulldozers, and other such items of personal property owned by PSEG Nuclear will be removed at no cost or credit to the decommissioning project. Disposition may include relocation to other generating 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.

#### <u>Insurance</u>

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." The NRC's financial protection requirements are based on various reactor (and spent fuel) configurations.

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## Property Taxes

Property tax payments will cease upon shutdown of each unit.

#### 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**

The costs projected for the decommissioning of Salem Station are provided in Tables 3.1 and 3.2. Decommissioning costs are reported in the year of projected expenditure; however, the values are provided in thousands of 2002 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. Since the common plant systems and services will be needed to support Unit 2 operations (with several needed to support post shutdown fuel storage and decommissioning), the cost to decontaminate, dismantle, and dispose of the common systems is included within the decommissioning cost for Unit 2.

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Year	Period 1 Preparations	Period 2 Decommissioning Operations	• Period 3 Site Restoration	Period 4 Dry Fuel Storage	Period 5 ISFSI Decommissioning	Totals
2016	19,764					19,764
2017	65,091					65,091
2018	10,691	87,654				98,345
2019		94,939			•	94,939
2020		77,754				77,754
2021		77,541				77,541
2022		35,518				35,518
2023		4,680				4,680
2024		4,693				4,693
2025		4,680				4,680
2026		15,889				15,889
2027		3,374	20,847			24,221
2028		·	9,434	332		9,766
2029				544		544
2030				544		544
2031				544		544
2032				545		545
2033				544		544
2034				544		544
2035				544		544
2036				545		545
2037				544		544
2038				544		544
2039	•			544	•	544
2040				545		545
2041				544		544
2042				544		544
2043			-	544	•	544
2044				545		545
2045				14,311		14,311
	95,546	406,722	30,281	23,350	[Unit 2]	555,899

TABLE 3.1SCHEDULE OF ANNUAL EXPENDITURES BY PERIOD<br/>UNIT 1<br/>(Thousands, 2002 Dollars)

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Salem Generating Station Decommissioning Cost Analysis TLG Services, Inc.

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Year	Period 1 Preparations	Period 2 Decommissioning Operations	Period 3 Site Restoration	Period 4 Dry Fuel Storage	Period 5 ISFSI Decommissioning
2020	24,791	······································			
2021	43,611	20,369			
2022		100,471			
2023	•	86,380	•		
2024		74,298			
2025		68,497			
2026		37,888			
2027	-	3,978	37,022		
2028		•	16,754	2,186	
2029			,	3,577	
2030				3,577	
2031				3,577	
2032				3,587	
2033				3,577	
2034				3,577	
2035				3,577	
2036				3,587	
2037				3,577	
2038				3,577	
2039				3,577	
2040			•	3,587	
2041				3,577	
2042				3,577	
2043	•			3,577	
2044				3,587	
2045				3,577	
2046			. ·	15,611	5,997
	68,402	391,880	53,775	78,648	5,997

# TABLE 3.2 SCHEDULE OF ANNUAL EXPENDITURES BY PERIOD UNIT 2 (Thousands, 2002 Dollars)

Totals

24,791 63,980 100,471 86,380 74,298 68,497 37,888 40,999 18,939 3,577 3,577 3,577 3,587 3,577 3,577 3,577

3,587 3,577

3,577 3,577 3,587 3,577 3,577 3,577 3,587 3,587 3,577

21,607

598,702

47

### 4. SCHEDULE ESTIMATE

The schedule for the decommissioning scenarios 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 required cooling period for the spent fuel.

A schedule or sequence of activities is presented in Figure 4.1. The schedule reflects the prompt decommissioning alternative and the start date consistent with a scheduled shutdown in 2016 for Unit 1 and 2020 for Unit 2. The sequence assumes that fuel will be removed from the spent fuel pool within the first five years. The key activities listed in the schedule do not reflect a one-to-one correspondence with those activities in the Appendix C cost table, but reflect dividing some activities for clarity and combining others for convenience. The schedule was prepared using the "Microsoft Project 2000" computer software.<sup>[21]</sup>

### 4.1 SCHEDULE ESTIMATE ASSUMPTIONS

The schedule was generated using a precedence network and associated software. Activity durations are based upon the actual man-hour estimates calculated for each area. The schedule was assembled by sequencing the work areas, considering work crew availability and material access/egress. The following assumptions were made in the development of the decommissioning schedule:

- The Fuel Handling Building will continue to serve as the spent fuel storage/transfer facility until such time that all spent fuel has been removed from site. The Fuel Handling Building is expected to operate for approximately five years after the cessation of operations.
- All work (except vessel and internals removal activities) will be 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

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and laydown space; and 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 Appendix C are based upon the durations developed in the schedule for the decommissioning of Salem Station. 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.

Project timelines are shown in this section as Figure 4.2. Milestone dates are based on a 40-year plant operating life from the issuance of the operating license, a five-year wet storage period for the last core discharge, and continued operation of the ISFSI until DOE can complete the transfer.

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# FIGURE 4.1

# DECOMMISSIONING ACTIVITY SCHEDULE

lask Name	'16 '17 '18 '19 '20 '21 '22 '23 '24 '25 '26 '27 '
alem Unit 1 & 2 schedule	
Shutdown Unit 1	
Period 1a Unit 1 - Shutdown through transition	
Certificate of permanent cessation of operations submitted	]♦ : : : : : : : : : : :
Fuel storage pool operations	
Dry fuel storage operations	
Reconfigure plant	
Prepare activity specifications	
Perform site characterization	
PSDAR submitted	
Written certificate of permanent removal of fuel submitted	
Site specific decommissioning cost estimate submitted	1 🔶
DOC staff mobilized	
Period 1b Unit 1 - Decommissioning preparations	
Fuel storage pool operations	
Reconfigure plant (continued)	
Dry fuel storage operations	
Prepare detailed work procedures	
Decon NSSS	
Isolate spent fuel pool	
Period 2a Unit 1 - Large component removal	
Fuel storage pool operations	
Dry fuel storage operations	
Preparation for reactor vessel removal	
Reactor vessel & internals	
Remaining large NSSS components disposition	
Non-essential systems	
Main turbine/generator	
Main condenser	
License termination plan submitted	
Period 2b Unit 1 - Decontamination (wet fuel)	
Fuel storage pool operations	
Dry fuel storage operations	

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• `\_

# FIGURE 4.1

# (continued)

sk Name	<b>'16</b>	17	18	19	20 2	21 2	2 23	24	25	'26	'27	12
Remove systems not supporting wet fuel storage				Ę	تىنى ر	⊐						
Decon buildings not supporting wet fuel storage			:	Ļ	,		-	:				
License termination plan approved			1			•		;				
Fuel storage pool available for decommissioning								-	1			
Period 2c Unit 1 - Decontamination following wet fuel storage						Z	1	-	-			
Dry fuel storage operations						Z	3					
Remove remaining systems							]					
Decon wet fuel storage area						Z	2					
Period 2d Unit 1 - Delay before license termination								M		2		
Unit 2 Operations		Ż	Ż	Ż								
Shutdown Unit 2			į				÷					
Period 1a Unit 2 - Shutdown through transition		ł		1								
Certificate of permanent cessation of operations submitted											-	
Fuel storage pool operations					Ø						:	
Dry fuel storage operations					$\square$		;	÷	:			
Reconfigure plant								1	:			•
Prepare activity specifications					$\square$		-		:			
Perform site characterization	-				$\Box$		ł					
PSDAR submitted								:				
Written certificate of permanent removal of fuel submitted				i			ł	:	1			
Site specific decommissioning cost estimate submitted	··  }			-			ł	:	-			
DOC staff mobilized			-	ł			÷	1	1			
Period 1b Unit 2 - Decommissioning preparations				i		7		:	:			
Fuel storage pool operations		÷		-		<u></u>	ł	:	:			
Reconfigure plant (continued)		ł				3	•	-	1		:	
Dry fuel storage operations	-	ł		-		ז	1		ł			
Prepare detailed work procedures		:	-	į	ľ	-			ł			
Decon NSSS		:				5		1	:			
Isolate spent fuel pool			-			Ξ.	-		-			
Period 2a Unit 2 - Large component removal								-	:			
Fuel storage pool operations							-					
Dry fuel storage operations						<u> </u>	<u> </u>					
Preparation for reactor vessel removal						ø						
	-l			'-	<u></u>	-7	•	•	•	<u> </u>	<u></u>	L
Milestone Summary task	1											
Critical Path Task	l											

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# FIGURE 4.1

# (continued)

Task Name	'16	'17	'18	'19	'20	'21 '2	2 23	'24	'25 '	26 2	7 28
Reactor vessel & internals						Z	Ø				
Remaining large NSSS components disposition							Ø			i	
Non-essential systems						Ļ				1	-
Main turbine/generator					1	Ļ				1	í
Main condenser						Ļ					
License termination plan submitted						ł	•			ł	
Period 2b Unit 2 - Decontamination (wet fuel)							E	Į			1
Fuel storage pool operations							E		<b>2</b>	ł	}
Dry fuel storage operations							E		$\mathbb{Z}$		1
Remove systems not supporting wet fuel storage							C	i			-
Decon buildings not supporting wet fuel storage							E	ني. ورويني			
License termination plan approved									۲		
Fuel storage pool available for decommissioning	1								•		
Period 2c Unit 2 - Decontamination following wet fuel storage							-		Ż	1	
Dry fuel storage operations									¢	3	
Remove remaining systems				-			;		Ċ	]	1
Decon wet fuel storage area					ł		ł		¢	3	
Period 2e Unit 1 & 2 - Plant license termination				-			1				:
Dry fuel storage operations									ł	Ø	
Final Site Survey							-			0	
NRC review & approval							:			Ø	
Part 50 license terminated											
Period 3b Unit 1 & 2 - Site restoration	*****						-			D	
Dry fuel storage operations			ĺ	į						e	$\square$
Building demolitions, backfill and landscaping	· · · · •									e	

Milestone 
Summary task
Critical Path Task

.

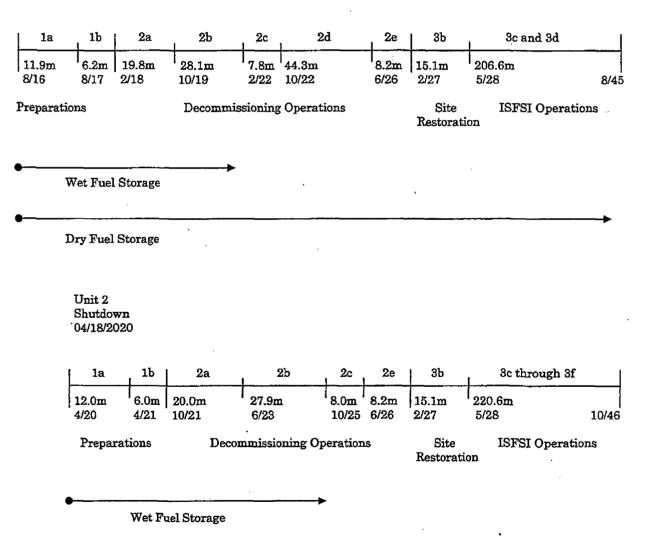
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# FIGURE 4.2

# DECOMMISSIONING TIMELINE (not to scale)

Unit 1 Shutdown 08/13/2016



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# 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,<sup>[22]</sup> 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, 10 CFR §71 defines radioactive material and 10 CFR §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). For this study, commercially available steel containers are presumed to be used for the disposal of piping, small components, and concrete. Larger components can serve as their own containers, with proper closure of all openings, access ways, and penetrations.

The volumes of radioactive waste generated during the various decommissioning activities at the site are shown on a line-item basis in Appendix C and summarized in Tables 5.1 and 5.2. The quantified waste volume summaries shown in these tables are consistent with §61 classifications. The volumes are calculated based on the exterior dimensions for containerized material. The volumes are calculated 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 and 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 <sup>137</sup>Cs will still control the disposition requirements.

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The waste material generated in the decontamination and dismantling of Salem Station will primarily be generated during Period 2. Material considered potentially contaminated when removed from the radiologically controlled area will be sent to processing facilities for conditioning and disposal at a unit cost of \$2.00 per pound. Heavily contaminated components and activated materials will be routed for controlled disposal. The disposal volumes reported in the tables reflect the savings resulting from reprocessing and recycling.

For purposes of constructing the estimate, 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 the majority of plant components and activated concrete deemed unsuitable for processing or recovery. An average disposal rate of \$415 per cubic foot 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 will be disposed of at the Envirocare facility. This includes lower activity material such as miscellaneous steel, metal siding, scaffolding and structural steel. A rate of \$298 per cubic foot was used for containerized waste, \$70 per cubic foot for disposal of DAW, and approximately \$20 per cubic foot for bulk material, e.g., concrete.

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### TABLE 5.1

#### **DECOMMISSIONING WASTE SUMMARY - UNIT 1**

	Waste Class <sup>1</sup>	Volume (cubic feet)	Weight (pounds)
Low-Level Radioactive Wa	ste		
Barnwell, South Carolina (	(contaminate	d/activated metalli	c waste and concrete)
	A B C	67,763 13,149 459	6,908,944 1,959,703 48,448
Envirocare, Utah (miscellaneous steel, contaminated/activated concrete)			
Containerized/DAW Bulk	A A	5,186 18,219	444,519 863,724
Geologic Repository (Great	er-than Clas	s C)	
•	>C	613	126,165
Total <sup>2</sup>		105,389	10,351,503
Processed Waste (Off-Site)		72,765	
Scrap Metal			96,278,000

<sup>1</sup> Waste is classified according to the requirements as delineated in Title 10 CFR, Part 61.55

<sup>2</sup> Columns may not add due to rounding.

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### TABLE 5.2

## **DECOMMISSIONING WASTE SUMMARY - UNIT 2**

	Waste Class <sup>1</sup>	<b>Volume</b> (cubic feet)	Weight (pounds)
Low-Level Radioactive Wa	ste		
Barnwell, South Carolina	(contaminate	ed/activated metalli	c waste and concrete)
	A B C	68,016 13,167 459	6,930,802 1,961,982 48,448
Envirocare, Utah (miscella	ineous steel,	contaminated/activ	ated concrete)
Containerized/DAW Bulk	A A	12,184 18,276	1,244,448 885,906
Geologic Repository (Great	ter-than Clas	ss C)	
	>C	613	126,165
Total <sup>2</sup>		112,714	11,197,751
Processed Waste (Off-Site)		74,384	· · ·
Scrap Metal			108,886,000

<sup>1</sup> Waste is classified according to the requirements as delineated in Title 10 CFR, Part 61.55

<sup>2</sup> Columns may not add due to rounding.

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### 6. RESULTS

Costs were developed to decommission the Salem Station following a scheduled cessation of plant operations. The analysis relied upon the site-specific, technical information developed for a previous analysis prepared in 1995-96, then updated to reflect current plant conditions and operating assumptions. While not an engineering study, the estimates do provide PSEG Power with sufficient information to assess its financial obligations as they pertain to the eventual decommissioning of the nuclear station.

The estimates described in this report are based on numerous fundamental assumptions, including regulatory requirements, project contingencies, low-level radioactive waste disposal practices, high-level radioactive waste management options, and site restoration requirements. The decommissioning scenario assumes continued operation of the plant's spent fuel pool for approximately five years following the cessation of operations for continued cooling of the assemblies. An ISFSI will be used to safeguard the spent fuel, once sufficiently cooled, until such time that the DOE can complete the transfer of the assemblies to its repository. The scenarios also include the costs for the dismantling of non-essential structures and limited restoration of the site.

The costs projected to promptly decommission Salem Station are estimated to be \$1,154.6 million. The majority of this cost (approximately 92.6%) is associated with the physical decontamination and dismantling of the nuclear units and caretaking of the spent fuel, so that the license could be terminated. The remaining 7.4% is for the demolition of the remaining structures and limited restoration of the site.

The primary cost contributors, identified in Tables 6.1 and 6.2, are either laborrelated 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 and the duration of the program. It is assumed, for purposes of this analysis, that PSEG Nuclear will oversee the decommissioning program, managing 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 licenses have been terminated, the staff is substantially reduced for the conventional demolition and restoration of the site, and the long-term care of the spent fuel.

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As described in this report, the spent fuel pools will remain operational for approximately five years following the cessation of plant operations. The pools will be isolated and independent spent fuel islands created. This will allow decommissioning operations to proceed in and around the Fuel Handling Building. Over the five-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 DOE is able to receive them. Dry storage of the fuel under a separate license provides additional flexibility in the event 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 incurred by PSEG Nuclear.

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, will be at the Envirocare facility. The more highly radioactive material will be 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 will be packaged for controlled disposal at one of the currently operating facilities. The costs identified for processing are all-inclusive, incorporating the ultimate disposition of the material.

Removal costs reflect the labor-intensive nature of the decommissioning process and 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

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could be more cost-effective than deferral, due to the ultimate deterioration of facilities (and therefore the working conditions).

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 estimate, material will be primarily moved overland by truck.

Decontamination will be used to reduce the plant's radiation fields and minimize worker exposure. Slightly contaminated material or material located within a contaminated area will be sent to an off-site processing center, i.e., this estimate does not assume that contaminated plant components and equipment could be economically decontaminated for uncontrolled release in-situ. Centralized processing centers have proven to be a more efficient 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 need to be confirmed and will add to the expense of surveying the facilities alone.

The remaining costs include allocations for heavy equipment and temporary services, and 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.

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## TABLE 6.1

### SUMMARY OF DECOMMISSIONING COST ELEMENTS UNIT 1

Work Category (	Cost 2002\$ thousands)	Percent of Total Costs
Decontamination	13,462.	7 2.4
Removal	79,587.	2 14.3
Packaging	11,726.	5 2.1
Transportation	11,632.	0 2.1
Waste Disposal	80,910.	9 14.6
Off-site Waste Processing	16,802.	4 3.0
Program Management (including Engineering and Securi	ty) 233,535.	0 42.0
Spent Fuel Pool Isolation	9,060.	3 1.6
ISFSI Related (including capital)	67,206.	7 12.1
Insurance and Regulatory Fees	11,463.	9 . 2.1
Energy	8,045.	7 1.4
Characterization and Licensing Surveys	6,439.	9 1.2
Misc. Equipment and Site Services	6,025.	8 1.1

Total

555,898.9

100.0

Note: Columns may not add due to rounding

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.

### **TABLE 6.2**

### SUMMARY OF DECOMMISSIONING COST ELEMENTS UNIT 2

thousands)	Percent of Total Costs
13,577	2.3
100,874	16.8
11,746	2.0
11,734	2.0
82,039	13.7
17,175	2.9
ty) 272,325	45.5
6,040	1.0
53,776	9.0
9,209	1.5
7,344	1.2
6,440	1.1
6,423	1.1
	13,577 100,874 11,746 11,734 82,039 17,175 ty) 272,325 6,040 53,776 9,209 7,344 6,440

Total

598,702

100.0

Note: Columns may not add due to rounding

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.

### APPENDIX A

## UNIT COST FACTOR DEVELOPMENT

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### 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	Activity	Activity	Critical
ID	Description	Duration	Duration
a	Remove insulation	60	(b)
b	Mount pipe cutters	60	60
с	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 in plastic, send to the waste processing area	<u>   60  </u>	<u>_60</u>
	Totals (Activity/Critical)	355	255
Duration adjustment(s):+ Respiratory protection adjustment (50% of critical duration)128+ Radiation/ALARA adjustment (37.08% of critical duration)95			
Adjusted work duration 478			478
+ Protective clothing adjustment (30% of adjusted duration) <u>143</u>			143
Productive work duration 621			621
+Wo	+ Work break adjustment (8.33 % of productive duration)52		
Total work duration min 673 m			673 min

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

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## APPENDIX A (continued)

## 3. LABOR REQUIRED

Crew	Number	Duration (hr)	Rate (\$/hr)	Cost
Laborers	3.00	11.217	40.61	1,366.57
Craftsmen	2.00	11.217	56.29	1,262.81
Foreman	1.00	11.217	60.17	674.93
General Foreman	0.25	11.217	67.66	189.74
Fire Watch	0.05	11.217	40.61	22.78
Health Physics Technician	1.00	11.217	45.90	<u>514.86</u>
Total labor cost				\$4,031.69
4. EQUIPMENT & CONS	SUMABLES	COSTS		
Equipment Costs	. ·			none
Consumables/Materials Costs -Gas torch consumables 1 @ \$4.57/hr x 1 hr {1} \$4.57				
-Blotting paper 50 @ \$0.47 sq	ft {2}			\$23.50
-Plastic sheets/bags 50@\$0.1	2/sq ft {3}			<u>\$6.00</u>
Subtotal cost of equipment and materials \$34.0				\$34.07
Overhead & sales tax on equipment and materials @ 16.00 %			\$5.45	
Total costs, equipment & material			\$39.52	
TOTAL COST:				
Removal of contamin	ated heat ex	changer <30	00 pounds:	<b>\$4,071.2</b> 1
Total labor cost:				\$4,031.69
Total equipment/material costs: \$39.5			\$39.52	
Total craft labor man-hours required per unit:81.884			81.884	

TLG Services, Inc.

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### 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. R.S. Means (2002) Division 01590, Section 400-6360 pg 24
  - 2. McMaster-Carr Ed. 106 pg 1778
  - 3. R.S. Means (2002) Division 01540, Section 800-0200 pg 17
- Material and consumable costs were adjusted using the regional indices for Wilmington, Delaware.

TLG Services, Inc.

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## **APPENDIX B**

## UNIT COST FACTOR LISTING (DECON: Power Block Structures Only)

TLG Services, Inc.

Cost/Unit(\$)

Salem Generating Station Decommissioning Cost Analysis Document P07-1425-003, Rev. 0 Appendix B, Page 2 of 7

### APPENDIX B

### UNIT COST FACTOR LISTING (Power Block Structures Only)

## Unit Cost Factor

Removal of clean instrument and sampling tubing, \$/linear foot	0.46
Removal of clean pipe 0.25 to 2 inches diameter, \$/linear foot	4.80
Removal of clean pipe $>2$ to 4 inches diameter, \$/linear foot	6.93
Removal of clean pipe >4 to 8 inches diameter, \$/linear foot	13.70
Removal of clean pipe >8 to 14 inches diameter, \$/linear foot	26.29
Removal of clean pipe >14 to 20 inches diameter, \$/linear foot	34.03
Removal of clean pipe >20 to 36 inches diameter, \$/linear foot	50.10
Removal of clean pipe >36 inches diameter, \$/linear foot	59.60
Removal of clean valves >2 to 4 inches	91.18
Removal of clean valves >4 to 8 inches	136.96
Removal of clean valves >8 to 14 inches	262.88
Removal of clean valves >14 to 20 inches	340.30
Removal of clean valves >20 to 36 inches	501.04
Removal of clean valves >36 inches	595.95
Removal of clean pipe fittings >2 to 4 in	101.25
Removal of clean pipe fittings >4 to 8 in	160.64
Removal of clean pipe fittings >8 to 14 in	262.88
Removal of clean pipe fittings >14 to 20	340.30
Removal of clean pipe fittings > 20 to 36	501.04
Removal of clean pipe hangers for small bore piping	28.12
Removal of clean pipe hangers for large bore piping	103.45
Removal of clean pumps, <300 pound	227.86
Removal of clean pumps, 300-1000 pound	640.33
Removal of clean pumps, 1000-10,000 pound	2,542.96
Removal of clean pumps, >10,000 pound	4,906.95

TLG Services, Inc.

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### APPENDIX B (continued)

**Unit Cost Factor** 

Cost/Unit(\$)

1

Removal of clean pump motors, 300-1000 pound	271.14
Removal of clean pump motors, 1000-10,000 pound	1,061.82
Removal of clean pump motors, >10,000 pound	2,389.10
Removal of clean turbine-driven pumps > 10,000 pounds	6,577.50
Removal of clean heat exchanger <3000 pound	1,363.81
Downeys) of along best such as any > 2000 mound	0 417 69
Removal of clean heat exchanger >3000 pound Removal of clean feedwater heater/deaerator	3,417.62
	9,646.37
Removal of clean moisture separator/reheater	19,849.31
Removal of clean tanks, <300 gallons	293.47
Removal of clean tanks, 300-3000 gallons	931.33
Removal of clean tanks, >3000 gallons, \$/square foot surface area	7.81
Removal of clean electrical equipment, <300 pound	126.22
Removal of clean electrical equipment, 300-1000 pound	441.45
Removal of clean electrical equipment, 1000-10,000 pound	882.90
Removal of clean electrical equipment, >10,000 pound	2,112.91
Removal of clean electrical transformers $< 30$ tons	1,467.39
Removal of clean electrical transformers > 30 tons	4,225.80
Removal of clean standby diesel-generator, <100 kW	1,498.81
Removal of clean standby diesel-generator, 100 kW to 1 MW	3,345.43
Removal of clean standby diesel-generator, >1 MW	6,925.72
itemoval of clean standby dieser generation, - 1 hitt	0,020.12
Removal of clean electrical cable tray, \$/linear foot	11.66
Removal of clean electrical conduit, \$/linear foot	5.08
Removal of clean mechanical equipment, <300 pound	126.22
Removal of clean mechanical equipment, 300-1000 pound	441.45
Removal of clean mechanical equipment, 1000-10,000 pound	882.90
Removal of clean mechanical equipment, >10,000 pound	2,112.91
Removal of clean HVAC equipment, <300 pound	126.22
inclusion of stour if the equipment, soor pound	140.22

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## APPENDIX B (continued)

**Unit Cost Factor** 

Cost/Unit(\$)

Removal of clean HVAC equipment, 300-1000 pound	441.45
Removal of clean HVAC equipment, 1000-10,000 pound	882.90
Removal of clean HVAC equipment, >10,000 pound	2,112.91
Removal of clean HVAC ductwork, \$/pound	0.48
Removal of contaminated instrument and sampling tubing, \$/linear foot	1.42
Removal of contaminated pipe 0.25 to 2 inches diameter, \$/linear foot	18.49
Removal of contaminated pipe >2 to 4 inches diameter, $/$ inear foot	32.88
Removal of contaminated pipe >4 to 8 inches diameter, \$/linear foot	52.70
Removal of contaminated pipe >8 to 14 inches diameter, \$/linear foot	103.92
Removal of contaminated pipe >14 to 20 inches diameter, \$/linear foot	125.17
Removal of contaminated pipe > 14 to 20 inches diameter, \$/linear foot	174.16
Removal of contaminated pipe >36 inches diameter, \$/linear foot	206.34
Removal of contaminated valves >2 to 4 inches	409.23
	400.20
Removal of contaminated valves >4 to 8 inches	491.64
Removal of contaminated valves >8 to 14 inches	1,004.93
Removal of contaminated valves >14 to 20 inches	1,279.12
Removal of contaminated valves >20 to 36 inches	1,707.42
Removal of contaminated valves >36 inches	2,029.16
Remerced of contaminated nine fittings > 2 to 4 inches	222.48
Removal of contaminated pipe fittings >2 to 4 inches Removal of contaminated pipe fittings > 4 to 8 inches	562.48
Removal of contaminated pipe fittings > 4 to 8 inches	
Removal of contaminated pipe fittings > 8 to 14 inches Removal of contaminated pipe fittings > 14 to 20 inches	1,004.93
Removal of contaminated pipe fittings > 14 to 20 inches Removal of contaminated pipe fittings > 20 to 26 in ches	1,279.12
Removal of contaminated pipe fittings >20 to 36 inches	1,707.42
Removal of contaminated pipe hangers for small bore piping	96.90
Removal of contaminated pipe hangers for large bore piping	317.71
Removal of contaminated pumps, <300 pound	872.56
Removal of contaminated pumps, 300-1000 pound	2,038.66
Removal of contaminated pumps, 1000-10,000 pound	6,721.04

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## APPENDIX B (continued)

**Unit Cost Factor** 

Cost/Unit(\$)

Removal of contaminated pumps, >10,000 pound	16,369.44	
Removal of contaminated pump motors, 300-1000 pound	856.70	
Removal of contaminated pump motors, 1000-10,000 pound	2,726.06	
Removal of contaminated pump motors, >10,000 pound	6,120.23	
Removal of contaminated turbine-driven pumps < 10,000 pounds	-18,918.88	•
Removal of contaminated heat exchanger <3000 pound	4,071.21	
Removal of contaminated heat exchanger >3000 pound	11,752.21	
Removal of contaminated feedwater heater / deaerator	28,760.26	
Removal of contaminated moisture separator / reheater	63,002.71	
Removal of contaminated tanks, <300 gallons	1,448.59	
	_,	
Removal of contaminated tanks, >300 gallons, \$/square foot	28.80	
Removal of contaminated electrical equipment, <300 pound	684.21	
Removal of contaminated electrical equipment, 300-1000 pound	1,664.73	
Removal of contaminated electrical equipment, 1000-10,000 pound	3,204.54	
Removal of contaminated electrical equipment, >10,000 pound	6,299.81	
Removal of electrical transformers < 30 tons	5,079.02	
Removal of electrical transformers > 30 tons		
	12,470.88	
Removal of standby diesel-generator, < 100 kW	4,387.47	
Removal of standby diesel-generator, 100 kW to 1 MW	9,471.87	
Removal of standby diesel-generator, >1 MW	20,474.76	
Removal of contaminated electrical cable tray, \$/linear foot	32.93	
Removal of contaminated electrical conduit, \$/linear foot	14.92	
Removal of contaminated mechanical equipment, <300 pound	761.89	
Removal of contaminated mechanical equipment, 300-1000 pound	1,841.14	
Removal of contaminated mechanical equipment, 1000-10,000 pound	3,538.42	
	-,	

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# APPENDIX B

## (continued)

**Unit Cost Factor** 

Cost/Unit(\$)

Removal of contaminated mechanical equipment, >10,000 pound	6,299.81
Removal of contaminated HVAC equipment, <300 pound	761.89
Removal of contaminated HVAC equipment, 300-1000 pound	1,841.14
Removal of contaminated HVAC equipment, 1000-10,000 pound	3,538.42
Removal of contaminated HVAC equipment, >10,000 pound	6,299.81
Removal of contaminated HVAC ductwork, \$/pound	3.03
Removal of clean standard reinforced concrete, \$/cubic yard	72.07
Removal of grade slab concrete, \$/cubic yard	204.33
Removal of clean heavily rein concrete w/#9 rebar, \$/cubic yard	211.46
Removal of clean heavily rein concrete w/#18 rebar, \$/cubic yard	267.46
Removal of clean heaving tem concrete wim to rebat, scubic yard	201.30
Removal of below-grade suspended floors, \$/cubic yard	316.55
Removal of clean monolithic concrete structures, \$/cubic yard	1,897.58
Removal of clean foundation concrete, \$/cubic yard	626.97
Removal of clean hollow masonry block wall, \$/cubic yard	75.24
Removal of clean solid masonry block wall, \$/cubic yard	75.24
Placement of concrete for below-grade voids, \$/cubic yard	<del>99.9</del> 0
Removal of subterranean tunnels/voids, \$/ linear foot	141.76
Backfill of below grade voids, \$/cubic yard	17.31
Excavation of clean material, \$cubic yard	3.05
Removal of clean building metal siding, \$/square foot	1.34
Removal of standard asphalt roofing, \$/square foot	2.15
Removal of Galbestos panels, \$/square foot	2.19
Scarifying contaminated concrete surfaces (drill & spall), \$/square foot	12.54
Scabbling contaminated concrete floors, \$/square foot	7.42
Scabbling contaminated concrete walls, \$/square foot	8.15
Scabbling contaminated ceilings, \$/square foot	73.38
Removal of clean overhead cranes/monorails < 10 ton capacity, each	623.14
Removal of contaminated overhead cranes/monorails < 10 ton capacity, ea.	1,734.71

**Unit Cost Factor** 

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Cost/Unit(\$)

### APPENDIX B (continued)

Removal of clean overhead cranes/monorails >10-50 ton capacity, each 1,495.51 Removal of contaminated overhead cranes/monorails >10-50 ton capacity, 4,162.61 each Removal of polar cranes > 50 ton capacity, each 6,286.50 Removal of gantry cranes > 50 ton capacity, each 26,411.28 Removal of clean structural steel, \$/pound 0.35 Removal of clean steel floor grating, \$/square foot 3.19 Removal of contaminated steel floor grating, \$/square foot 9.69 Removal of clean free-standing steel liner, \$/square foot 33.75 Removal of clean concrete-anchored steel liner, \$/square foot 5.85 Removal of contaminated concrete-anchored steel liner, \$/square foot 39.31 Placement of scaffolding in clean areas, \$/square foot 13.73 Placement of scaffolding in contaminated areas, \$/square foot 22.10Removal of chain link fencing, \$/linear foot 2.10 Removal of asphalt pavement, \$/square foot 1.05 Core drilling 2 to 4 inch diameter, linear foot 354.68

TLG Services, Inc.

## APPENDIX C

## DETAILED COST ANALYSES

	Page
Unit 1	C-2
Unit 2	C-12

#### TABLE C-1 SALEM GENERATING STATION - UNIT 1 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

a sub-state and the set of the se

r						Off-Site	LLRW				NRC	Canad Could									t
Activity		Decon	Removal	Packaolog	Transport	Processing	Disposal	Other	Total	Total	Lic, Term,	Spent Fuel Management	Site Restoration	Processed Volume	Class A	Class B	Class C	GTCC	Burial Weight	~ ~	Utility and
Index	Activity Description	Cost	Cost	Costs	Costs	Costs	Costs	Costs	Contingency	Casts	Costs	Costs	Costs	Cu. Feet	Cu. Feet	Cu. Feet		Cu. Feet	Weight Lbs.	Craft Manhours	Contractor Manhours
PERIOR	Ia - Shutdown through Transition																				
Period 1s	Direct Decommissioning Activities			•						•		•		•							
Ia.1.1	Prepare preliminary decommissioning cost	-	-	-	• ·	-	-	95	14	109	109		-	-			_	_	-		1.300
la.1.2	Notification of Cessation of Operations									a.							•	-	•	-	1,300
la.1.8	Remove fuel & source material									n/n											
la.l.4	Notification of Permanent Defueling									a											
1a.1,5	Deactivata plant systems & process waste									a											
la.1.6	Prepare and submit FSDAR	-	-	•	-	•	•	146	22	168	168	-	•	-		-	• •	-	-	-	2,000
Ia.1.7 1a.1.8	Review plant dwgs & specs. Perform detailed red survey	•	-	-	-	-	-	336	50	386	386	•	-	-	•	•	-		-	-	4,600
12.1.5	Estimate by product inventory									8											·
12.1.5	End product description	-	•		•	-	-	73 79	11	84	84	-	•	•	-	-	-	•	-	•	1,000
la.1.11	Detailed by product inventory		-	-	-	-	-	79 95	11 14	84 109	84 109	•	-	-	-	-	-	-	-	•	1,000
1.1.12	Define major work sequence	-	• •			-	-	547	82	629	629	•	•	•	-	-	•	-	-	•	1,300
14.1.13	Perform SER and BA			-			-	226	82	260	629 260	-	-	•	•	-	-	-	•	-	7,500
11.1.14	Perform Site-Specific Cost Study				-	•	-	365	04 55	420		-	•	•	-	-	•	•	-	-	3,100
Ja.1,15	Prepave/submit License Termination Plan	-					-	299	45	844	420 344		-	•	-	-	•	-	-	-	5,000
la.1.16	Receive NBC approval of termination plan					•		130	40	0-14 E	344	-	-		•	-	-	-	-	•	4,096
Activity &	pecifications																				
1a.1.17.1	Plant & temporary facilities	-						. 359	64	418	372		41				•				
	Plant systems		-	-		_		804	46	350	315		85	-	-	-	-	-	-	-	4,920
	NSSS Decontamination Flush	-	•	• •		-	-	30	8	42	42			-	•		-	-	•	•	4,167
14.1.17.4	Reactor internals	-	-	-		-	•	618	. 78	596	598					•		-	-	•	500
	Reactor vessel	-	-	-	-	-	-	474	71	545	545	-	-					-	-		7,100 6,500
	Biological shield	-	-	-	-	-		36	5	42	42	-	-	_	-	-	-		-		500
	Steam generators	•	-	-	-	•	•	228	34	262	262	-	· .	-			-	_			3,120
	Reinforced concrete	•	-	-	-	-	-	117	18	194	67	-	67	-		-	-	-	-	-	1,600
	Turbine & condenser	•	-	-	-	-		58	9	67	•	•	67	-		-	-	-	-	-	800
	) Plant structures & buildings	-	-	-	-	•	-	228	84	263	131	-	181	-	-	-	· •	-	-	-	3,120
	Waste management	-	•	•	-	-	-	836	50	366	386	-	-	-	-		-	-	-	· .	4,600
	2 Facility & site classout	•	-	-	-	•	-	66	10	76	38	•	38	-	•		-	-		-	900
1a.1.17	lotal	•	•	•	•	-	•	2,760	414	8,174	2,795	-	379	-	•	•	•	-	•	•	37,827
	& Site Preparations																				
	Prepare dismantling sequence	-		-	:	•	-	175	26	201	201	-		•	•	•	-	-	-	-	2,400
la.1.19	Plant prep. & temp. svces	•	-	-	·	•	•	2,904	346	2,650	2,660	-	•	-	-	۰.	-	-	-	•	
la.1.20	Design water clean-up system	•	•	•	-	-	•	102	15	117	117	-	•	•	-	•	•	-	-	-	1,400
19.1.21	Bigging/Cont. Cutrl Envips/tooling/etc.	•	•	•	-	-	•	1,950	293	2,243	2,243	-	-	-	-	-	-	-	-		•
1a.1.22 Ia.1	Procure casks/liners & containers	-	•	-	•	-	-	90	13	103	103	•	•	-	•	•	-	-	-	-	1,230
18.2	Subtatal Period 1a Activity Costs Subtatal Period 1a Additional Costs	:		:		:	-	9,635	1,445	11,080	10,701	-	879	-	-	-	•	-	•	•	78,753
	•	•										-	-	-	•	•	•	•	•	-	•
Period Ia 1a.4.1	Period-Dependent Costs Insurance									007		•									
18.4.1 1a.4.2	Insurance Property taxes	:	•	-	•		-	760	76	836	836	-	-	· •.	•	•	•	-	-	-	•
12.4.9	Health physics supplies		318	-	-	•	-	•	79	897	397	•	-	- '	•	•	•	-	•••	-	-
18.4.4	Heavy equipment rental		316	-			-	•	79	897	397 898	•	•	-	-	•	•	-	•	•	-
14.4.5	Disposal of DAW generated		-			-	- 26		. 10	590	59	•	-	-	515	•	•	-		-	-
14.4.6	Plant energy budget	•		- 10	. "	-	<del>د</del> ب	942	· 10 141	1.083	1,083				¢12	•	·	÷	10,315	128	•
18.4.7	NRC Fees		-	•	•		-	300	30	830	330			-		•	•	-	-	•	•
1a.4.6	Emergency Planning Fees			-		-	•	83	3	37	-	· 37		-				-	-	-	-
14.9	Spent Fuel Pool O&M	•	-	-	•	-	-	943	141	1,084		1.084	-	-				-	-	•	•
•															•	-	•	-	•	-	•

TLO Services, Inc.

#### TABLE C-1 SALEM GENERATING STATION - UNIT 1 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

	· · · · · · · · · · · · · · · · · · ·		·			00.00					4100		0.11-								
1		D	Dame to 1	0bb	Tenenet	Off-Site Processing	LLRW	Other	Tetal	Total	NRC Lic. Tem.	Spent Fuel Management	Sile Restoration	Processed Volume	Class A	Burial V Class B	Class C	CICO	Burial	014	Utility and
Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Costs	Disposal Costs	Costs	Contingency	Costs	Costa	Costs	Costs	Cu, Feet	Class A Cu. Feet		Class C Gu, Feet	GTCC Cu, Feet	Weight Lbs.	Craft Manhours	Contractor Manhours
Period 1a	Period-Dependent Costs (continued)																				
la.4.10	ISRA Compliance Staff	•	•	-	-	_•	•	807	121	928	928		-	•	•	-	•	•	•	•	-
18.4.11	Dry Fuel Storage OaM Costs	•	•	•	-	•	-	23 1,137	3 171	26 1,308	1,308	26	•	•	•	•	•	-	•	•	-
18.4.12	Security Staff Cost Utility Staff Cost	•	-	-	-	-	-	28,971	4,346	33,817	33,317			•	•	-		•	-	-	58,599 437,674
12.4.13 12.4	Subtotal Period 1a Period-Dependent Costs		664	10	3	-	86	83,916	5,174	39,803	85,655	1,147			515	-	-	:	10,815	. 126	496,273
1a.0	TOTAL PERIOD In COST		664	10	а	-	36	43,55L	6,620	50,883	49,857	1,147	879	•	515	-	-	•	10,815	126	570,025
PERIOI	1b - Decommissioning Preparations																				
Period 1	Direct Decommissioning Activities																				
Detailed	Work Proceduras																				
1b.1.1.1	Plant systems	-	•	•	-	-	-	345	52	897	357	-	40	•	-	-	-	-	•		4,733
1 <b>b.1.1.2</b>	NSSS Decontamination Flush	-	•	•	-	•	-	78	12	84	84	•	-	•	-	-	•	-	· •	• •	1,003
16.1.1.8	Reactor internals	-	•	-	-	-	•	182	27	210	710	•	· •	•	•	-	•	•	•	•	2,500
1b.1.1.4	Remaining buildings	•	-	•	-	-	•	98 78	15 11	113 84	28 84	•	86	•	•	-	•	•	•	•	1,350
16.1.1.5 <sup>.</sup> 16.1.1.6	CRD cooling assembly CRD bousings & ICI tubes	•	•	•	-	•	-	73	11	84 64	84 84	•	•	•	•		•	-	•	-	1,000
16.1.1.0	Incore instrumentation	:		-	-	-		73	11	84	84		-						-	-	1,000
1b.1.1.8	Beactor vesset	-			-	-		265	40	805	305	-	-		•••				•		3,630
1b.1.1.9	Facility closeout	-	-	• •	-	•	-	88	13	101	60	-	50	-	-	-	•	· .	-	· -	1,200
	Missile shields	· •	•	-	•	•	- 1	53	5	38	38	•	•	•	-	•	-	-	•		450
	Biological shield	-	•	-	-	-	-	88	13	. 101	101	•	•	•	•	-	-	-	•	-	1,200
	Steam generators	•	-	•	-	•	••	336	60	886	386	-		-	-	•	•	-	-	-	4,600
	Reinforced concrete	-	•	-	•	-	-	73 228	11 84	. 84 202	42	-	42 262	-	•	•	-	• .	-	-	1,000
	Turbine & condensers	-	-	•	-	-	•	228 199	24 30	204	- 206		252	•	-	-	•	-	•	-	3,120
10.1.1.10	Auxiliary building Reactor building	•	-	-	•	•		199	80	229	206	-	23	•		•	-	-	-	- '	2,730 2,730
16.1.1.1	Total	:	-	-			-	2,425	364	2,789	2,265		625	-				-	-	:	33,243
•		•	-	•	-	-	-	#13=0			-	-	010	-	-	-	-	-	-		00,240
15,1.2	Decon primary loop	1,184	-	•	-	•	-	-	567	1,701	1,701	•	•	-	•	•	-	-	•	1,067	•
16.1	Subtotal Period 1b Activity Costs	1,194	•	-	-	•	-	2,425	931	4,490	8,965	•	525	-		•	•.	-	-	1,067	88,249
	Additional Costs													-		•					
15.2.1	Spent Fuel Fool Isolation	•	•	-	-	-	-	7,879	1,182	9,060 800	9,090 800	•	•	-	•	-	-	•	-	-	-
1b.2.2	Site Characterization Subtotal Period 1b Additional Costs	•	-	•	-	•	-	696 8,574	104 1,285	9,860	9,860	•	•	•	•	•	•	•	-	-	•
1 <b>b.2</b>		•	. •	-	•	•	•	0,074	1,400	2,000	3,000	•	•	•	-	-	•	•	-	•	-
	b Collateral Costs		· · ·						101	817	817										
1b.3.1	Dacon equipment	719 57		- 503	- 496	•	4,796	•	107 1,852	7,204	7,204	•	•	-	-	5,919	•	-	- 581,369	210	. •
1b,3.2 1b.3.3	Process liquid waste Small tool allowance		• •		4270		4,196	-	1,692	1,101	1,204	:	:	:		0,919	:		201,303	210	•
16.3.5 1b.8.4	Pipe cutting equipment		911		-		-		137	1,048	1.048			-	-		-				-
16.5	Subtotal Period 1b Collateral Costa	767			496	-	4,796	•	1,598	9,070	9,070	-	•	•	-	5,919	•	-	981,389	210	-
	b Period Dependent Costs								•												
1b.4.1	Decon supplies	22	-	-	-	•	•	•	6	28 433	28	-	-	•	•	-	•	•	-	-	•
16.4.2	Insurance	-	•	•	-	-	-	393	39	4.53	493	•.	•	•		-	-	•	•	•	•
16.4.3	Property taxes	•	-	•	•	-	• •	-	42	211	211	•	•			-		•	-	-	•
1b.4.4 1b.4.5	Health physics supplies Heavy equipment rental	•	179		-	-	-	:	42 27	206	206		-					:	2	•	-
10.1.0			113	-		•	•					•			-	-			-	-	-

TLG Services, Inc.

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#### TABLE C-1 SALEM GENERATING STATION - UNIT 1 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

·	······					Off-Site	LLRW				NRC	Spent Fuel	Site	Processed		Burial V	lalumar		Developt		( (c)) (c) (c) (c) (c) (c) (c) (c) (c) (
Activity	,	Decon	Removal	Packaging	Transport	Processing	Disposal	Other	Total	Total	Lic, Terra,	Management	Restoration	Volume	Class A	Class B	Class C	GTCC	Burial Weight	Graft	Utility and Contractor
Index		Cost	Cost	Costs	Costs	Costs	Costs	Costs	Contingency	Costs	Costs	Costs	Costs	Cu, Feet	Cu. Feet	Cu. Feet		Cu, Feet	Lhs.		Manhours
Period 1	h Period-Dependent Costs (continued)																				
1b.4.6	Disposel of DAW generated	-	-	5	1	-	20		6	32	32	_		· · .	289				5,674		
1b.4.7	Plant energy budget	•	-					975	146	1,123	1,122				404	-	-	-	D,074	70	•
16.4.8	NRC Fees	-	-	-	-	· .		185	19	204	204		-	2		-	-	•	-	-	-
16.4.9	Emergency Planning Fers	-		-	-	-	-	17	2	19		19	-			-	-	•	-	•	-
1b.4.10	Spent Fuel Pool O&M	-		-	-	-		488	79	662		562		-	-			•	-	-	-
Ib.4.11	ISRA Compliance Staff	-		•	-	-		418	63	481	481		-		· .				•	-	-
15.4.12	Dry Fuel Storage O&M Costs	-	•	-	-	-	•	12	2	14		14			-	_	-	-	-	-	-
1 <b>b.4.13</b>	Security Staff Cost	. •		-	•		-	589	88	677	677		-				-	-	-	-	30,349
1b,4,14	Utility Staff Cost	-		-	-	•	-	15,004	2,251	17,255	17,255			-	-			-	-		226,674
1b.4	Subtotal Pariod 1b Period-Dependent Costs	22	348	· 5	1		20	18,083	2,763	21,243	20,649	594	•	-	263	-	-	-	5,674	70	257,023
1b.0	TOTAL PERIOD 15 COST	1,923	1,260	508	498	-	4,816	29,083	6,575	44,663	48,645	594	525	•	283	5,919		-	987.063	1,346	\$90,265
PERIO	D 1 TOTALS	1,923	1,924	518	501	-	4,852	72,634	13,195	95,546	92,901	1,742	904		798	5.919	-		997.378	1.473	860,291
																-			031,310	1,473	000,251
PERIO	0 3a - Large Component Removal															_		•			
Period 2	a Direct Decommissioning Activities																'				
Nuclear	Steam Supply System Removal																				
24.1.1.1		280	255	30	20	•	906		436	1,928	1,928				2,038				105 001		
2.112		80	26	5	3	-	179	-	67	810	310			:	2,038	-	-	-	185,321 36,553	10,107 527	-
2.1.1.8	Reactor Coolant Pumpa & Motors	81	90	43	1,843	107	8,376	-	1,204	6.744	6.744			248	8,192			-	690,870	3,580	•
28,1,1.4	Presentizer	44	56	371	460	-	1,487	-	514	2,933	2,933	•	-		2,589	-	-	-	804.295	2,845	
2a.1.1.5		873	2,186	870	5,391	-	16,902	100	6,842	81,618	31,613	-	-		31,467	-		-	3,458,553	13,321	•
2a.1.1.6		162	97	124	17	-	420	•	220	1,031	1,031	-	-	•	3,881	-	-	_	86.025	4,564	
2a.1.1.7	Reactor Vessel Internals	118	1,971	4,979	537	-	4,722	214	6,310	17,851	17,851	-	•	-	1,877	803	459		326,029	31,608	1,396
24.1.1.8		90	3,488	1,504	366	-	5,666	214	5,952	17,224	17,224	•		-	6,611	2,254	-	-	948,723	31,608	1,896
2a,1.1	Totals	1,168	8,064	7,926	8,636	107	33,658	6 <b>28</b>	19,645	79,639	79,633		-	248	51,384	8,166	459	•	6,036,370	98,161	2,793
	of Major Equipment				•																
24,1.2	Main Turbine/Generator	•	474	55	11	715	-	-	233	1,488	1,488	•	-	S, 573			-	-	-	9,244	
2.1.3	Main Condensers	•	1,607	53	11	669	-	•	612	2,872	2,872	-	-	3,446	-	•	•	-		31,571	
Disposal	of Plant Systems																				•
28.1.4.1		-	44	-	-	-	-		7	51	-	-	51	-	-					892	
2a.1.4.2		•	281	2	4	293	-	•	115	697	697	-	-	1,466		-	-		-	5.333	
2a.1.4.3		-	140	-	•	-	-		21	162	-	-	162		•	-	-			2,984	
2a.1.4.4		-	229	-	-	•	-	•	84	264	-		264			•		-		4,767	-
2a.1.4.5		•	904	6	12	761	-	•	345	2,025	2,025	-		3,806	-	-	-			17,777	
2a.1.4.6		-	125	•	•	-	-	•	19	144	-	-	144	-	•				-	2,693	
28.1.4.7		-	5	-	-	•	-	-	I	6	-	•	6	-	-	-	•	-	-	104	
2a.1.4.6	Containment Spray (BCA)		105	4	7	481	• .	-	100	699	699	•	-	2,403	-	-	•	-	-	2,075	-
24.1.4.9		-	6 27	0	٥	5	4	•	8	18	18	-		26	8	-	-	-	717	115	-
28.1.4.1		•	27 88	- 0	- 0	- 26	-	•	.4	31 72	-	-	31		•	-	-	-	-	568	•
28,1.4.1	Main & Reheat & Turbine By-Pass Steam	•	460	24	46	3,038	•	•	12 579	4,138	72	•	-	128	-	•	-	-	• -	660	-
	Main & Renear & Turnine Dy-rass South		101	24	40	9,038	-	•	679 15	4,188	4,138	•		15,141	•	-	•	•	-	9,843	•
	Miscellaneous Condensate		50	-		-	-	•	15	67	•	•	116	•	•	-	-	• .	-	3,099	-
	5 Moisture Separator Rehtra Steam & Drains	:	497	•	- 5	328		•	159	531	931		67	-	•.	•	•	•	-	1,051	•
	Steam Gen Drains & Blowdown	:	182	0	2	102			61	348	931 548	•	-	1,638	•	-	-	•	-	8,614	-
	7 Steam Gen Drains & Blowdown (RCA)		36	â	ā	102	-	• •	12	66	548 60	•	-	512	-	•	•	-	-	3,566	•
	B Steam Gen Feed Pump & Turbine Lube Oil	-	29				-	-	13	33	-	•	33	90.	-	•	· •	-	•	694	-
					-	-	-	-	•		-	-	33	-	-	•	. •	•	-	611	•

TLG Services, Inc.

#### TABLE C-1 SALEM GENERATING STATION - UNIT 1 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

						Off-Sile	LLRW				NRC	Spont Fuel	Site	Processed		Burtal \	alumes		Burial		Uplity and
Activity		Decon	Removal	Packaging	Transport	Processing	Disposal	Other	Total	Total	Lic, Term.	Management	Restoration	Volume	Class A	Class B	Class C	GTCC	Weight	Craft	Contractor
Index	Activity Description	Cost	Cost	Costs	Costs	Costs	Costa	Costs	Contingency	Costs	Costs	Costs	Costs	Cu. Feet	Cu, Feel	Cu. Feet	Cu, Feet	Cu. Feet	Lhs.	Manhours	Manhours
Dimosal e	of Plant Systems (continued)																				
	Steam Generator Feed & Condensate	•	844	-	-	-	•	-	52	396	•	-	396	-	-	-				7,121	-
	Turbine Auxiliaries Cooling	•	168	- `	-	-	-	-	25	193	-		193	-	-	-	•	•	-	3,594	•
	Turbine Drains	-	36	0	1	35	•	•	15	88	. 86	•	-	182	-	-	•	•	• •	724	-
	Turbine Electro-Hydraulic Control	-	4	-	-	• •	•	•	1	4	-	•	• 4	•	-	•	•	•	-	73	-
	Turbine Gland Sealing Steam & Leak-Off	-	75	• -		-	•	-	11	87	•	•	• 87	• •	•	•	•	•	-	1,654	-
	Waste Disposal - Gas	-	90 8,913	5	8 81	12B 5,205	\$9 103	•	67	892	393	-	-	640	233	•	•	•	20,293	1,805	-
2,1.4	Totals	-	8,810	40	81	6,205	103	-	1,667	11,016	9,473		1,543	26,032	241	•	•	•	21,010	78,907	•
21.1.5	Scaffolding in support of decommissioning		770	4	1	49	11	•	203	1,038	1,038	•	-	247	34	•	· •	-	3,069	17,807	-
24,1	Subtotal Period 2a Activity Costs	1,168	14,829	8,085	8,740	6,767	33,772	528	22,160	96,048	94,605		1,543	33,547	51,659	3,156	469	· •	6,060,448	235,191	2,793
Period 2a	Additiona) Costs																				
2.1	Curie Surcharge (Excluding RPV)	-	-	-		-	1,374	•	344	1,718	1,718		•	•	-	-				-	
22.2	Subtotal Period 2a Additional Costs	-	-	•	-	-	1,874	-	344	1,718	1,718	•	-	-	-	-	-				
	Collateral Costa			. •						-											
Period 2a 2a.3.1	Cointeral Costs Process Equid waste	. 73		28	65	-	314		127	606	606				_	510	_		64,228	100	
22.9.2	Small tool allowance		217	20		-			53	249	225	•	25		-				64.738		-
21.3	Subtotal Period 2a Collateral Costs	73	217	28	65		S14		160	856	831		25	-		510		-	64,928	100	-
	Determine a strong and constraining to be a					-		_	200			_			·	515	•	-	04,220	100	-
	Period Dependent Costs																				
24.4,1	Decon supplies	72	-	-	•	•	-	-	18	· 80	90	-	-	-	-	-	-	-	-	-	-
a.4.2	Losurance	-	-	• -	-	-	•	1,262	126	1,368	1,388	•	-	•	-	•	•	•	-	•	-
<b>b.4.3</b>	Property taxes	•		-	•	-	•	-	•	1.56 <del>6</del>		•		-	-	•	• .	•	-	•	-
a.4.4	Health physics supplies	•	1,339	-	-	-	•	-	399	2,555	1,666	•	. •	-	•	-	•	•	•	-	•
24.4.5	Heavy equipment rental Disposal of DAW generated	•	3,113		. 24	-	-	-	467 92	8,679 522	3,579 522	•	-	•		-	•	• •			•
2a_4.6 2a_4.7	Plant energy budget	-	•	<b>C</b> 8	24	•	<b>S</b> 21	1,486	. 223	1,709	1,709	•	•	-	4,586	•	•	•	91,909	1,126	-
ca.s.1 2a.4:8	NRC Fees	-	•	-	-	-	-	619	. 228	671	571		-	-	-	-	•	-	-	•	-
24.4.8 29.4.9	Emergency Planning Fees	-	-	•	•	-	-	56	. 6	61		61	•	-	-	-	-	•	•	-	-
24.4.10	Spent Fuel Pool O&M			-				1.566	235	1.801		1,801			-		-	-	•	• •	•
A.4.11	ISRA Compliance Staff	-	-		-	_		1,341	201	1.542	1,542	1,001						-		-	-
Za.4.12	Dry Fuel Storage O&M Costs	-			-	· .		88	6	44		44		-						-	
4.13	Security Staff Cost	-			-	-		2,367	854	2,710	2,710			-	-					-	121,461
24.4.14	Utility Staff Cost	-	-		-	-		44,233	6,635	60,888	50,868	-	-	-			-				665,023
21.4	Subtotal Period 2a Period-Dependent Costs	72	4,446	85	24	•	821	52,858	8,747	66,652	64,646	1,906	•	-	4,686	-	-	-	91,909	1,126	786,484
24.0	TOTAL PERIOD 28 COST	7,812	19,491	8,198	8,828	6,767	85,780	68,38 <i>8</i>	81,412	165,174	161,699	1,906	1,568	<b>93</b> ,547	56,246	3,666	459	-	6,216,586	236,417	789,277
PERIOD	2b - Site Decontamination																				
	Direct Decommissioning Activities																				
<b>.</b>																					
	of Plant Systems Building & Equipment Drains-Conventional		40			_	_		6	45			46								
25.1.1.2	Chem & Vol Ctrl - Boric Acid Recovery	519	40 507	41		- 218	845		636	2,774	2,774	-	40	1,088	2,376	-	-	-	172,868	850 19,343	-
26.1.1.2 26.1.1.3	Chem & Vol Ctrl - Frimary Water Recovery	853	347	28	6	158	565		432	1,890	1,690	•	•	1.088	1,690	-	:	:	172,868	18,343	-
	Chem & Vol Ctrl Operation	455	532	26	6	138	700		432	2,349	2,349	-	-	354	1,685	:	:	-	143,288	18,399	-
25.1.1.5	Component Cooling		16		- "	."		:	- 2	18	2,043	-	18			-		-	140,285	19,071	•
25.1.1.5 25.1.1.6	Companient Cooling (RCA)		355	. 8	15	986		•	240	1,603	1,603	-		4,928	-			-		6,635	-
26.1.1.7	Compressed Air		109			-			16	126			126		-			-	-	2,928	-
			78			35			25	139	139			174						20 ديه	

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#### TABLE C-1 SALEM GENERATING STATION ~ UNIT 1 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

							· ·			,											
·····						Olf-Site	LLRW				NRC	Spent Fuel	Sile	Processed		Burial V	olumes		Burial	_	Utility and
Activity		Decon	Removal	Packaging	Transport	Processing	Disposal	Other	Total	Total	Lic. Term.	Management	Restoration	Volume	Class A	Class B	Class C	GTCC	Weight	Craft	Contractor
Index	Activity Description	Cost	Cast	Costs	Costs	Costs	Costs	Costs	Contingency	Costs	Costs	Costs	Costs	Cu, Feet	Cu, Feet	Cu, Feet	Cu, Feet	Cu. Feet	Lbs.	Manhours	Manhours
															•						
	of Plant Systems (continued)				2	100															
Zh.1.1.9	Control Air - Auxiliary Building Control Air - Containment Building	-	131 42	1	1	128 40	•	-	52 17	815 99	315 99	-	-	640 200	•	-	•	•	-	2,673	• .
25.1.1.10		•	32		_ *	60	-		5	39	39	-	37	200	-	-	-	-	•	860 672	-
20.1.1.11 2b.1.1.12			46		-		-		7	52	-		52	-		-	-			965	-
26.1.1.13		-	41	- 0	0	28	-		. 15	85	85	-		141		• •	-		-	363 774	•
	Electrical	-	8,829			-	-	· .	499	8,828	-	-	8,626	-	-	-		-		67,956	-
26.1.1.15	Electrical (RCA - Clean)	· .	676	4	7	448	-		213	1,247	1,247	-	-	2,238		-		-	-	11,903	-
2b.1.1.16	Electrical (RCA)	-	180	1	8	164	-	-	70	418	418	-	-	820	-	-		-	· -	3,613	-
	Fire Protection		97	-	-		-	-	15	112	-		112	· -	-	-		•	-	2,115	
	Fire Protection (CO2)	-	14	-	-	-	-		2	16	-	-	16		-	-	-	-	-	305	-
	Fire Protection (BCA)	•	162	1	1	<b>5</b> 8	•	•	55	317	917	•	•	488	•	-		-	-	8,093	•
26.1.1.20	Floor Drains - Contaminated	-	165	8	1	16	163	•	85	439	439	-	-	81	372	-	-	-	33,319	3,228	-
	HVAC - Auxiliary Building	-	263 26	. 2	8	188	27	-	102	687	587	-	-	941	62	-	•	-	5,534	4,912	-
	HVAC - Control Area HVAC - Diesel Generator Area	-	26	•	•	•	•	•	4	29 T	•	•	29 7	•	•	•.	-	-	-	532	-
25.1.1.23	HVAC - Fuel Handling Area	• •	122	•,	1	91	. 19	-	1	277	277	-	4	455	- 30	-	-	-	2,676	126	•
	HVAC - Reactor Containment	-	678	-	ŝ	488	74	·	48 263	1.618	1.618	•	-	2,441	168	-	-	-	15,104	2,266 12,513	•
	Heating Water	-	94	_ `	-	-100		-	200	39	1,010		39		196	-	•	-	10,103	731	•
	Heating Water (RCA)		45	0	0	27		-	15	87	87	-		198			-			830	
	Miscellaneous Reactor Coolant		58	1	ŏ	. 11			19	55	98			56	20	-	-		1,814	1247	
	Residual Heat Removal	140	157	50	10	129	1,126		417	2.026	2.028	-	-	643	2.576	-	-	-	230,393	3,803	
	Safety Injection	526	664	49	10	225	997	-	694	3,068	3,068	-	-	1,125	2,718	-	-	-	204,105	20,512	•
26,1.1,81		•	122	8	1	63	72	•	67	\$10	310	•	-	267	164	•	-		14,718	2,623	-
25.1.1.32	Service Water - Nuclear Area	· •	856	21	39	2,621	-	•	600	4,037	4,037	-	-	12,604	-	-	-	-	-	16,744	•
2b.1.1.38		-	61	-	-	-	-	-	9	71	-	-	71	-	•	•	•	-	-	1,336	-
2h,1.1	Totale	1,995	9,793	263	125	6,121	4,691	•	5,176	28,065	23,683	-	4,381	30,606	11,790	•	-	-	939,462	229,400	•
2b. 1.2	Scaffolding in support of decommissioning	-	962	5	1	62	13		254	1,298	1,298	-	-	309	43	-	•	•	3,836	21,634	-
Deconter	nination of Site Buildings																				
2h.1.3.1		1,205	157	. 124	88	115	1,295	-	1,158	4,743	4,748	-	-	676	7,941	-	•	· -	788.859	37,887	
2b.1.3.2	Auxiliary Building	400		82	25	26	71	-	279	1,039	1,033	-	-	131	2,095	-			201,228	11,426	-
26.1.3.3	Steam Generator Removal	12	2	0	Ġ.	5	0		7	27	27	-		24	2	-	-	· •	142	288	
25,1.8	Totals	1,617	959	157	113	146	1,367		3,444	5,802	5,802	-	•	781	10,038	-	-	-	940,280	49,600	
2b.1	Subtotal Period 2b Activity Costs	3,611	11,714	425	239	6,929	5,972	•	6,874	95,166	80,784	-	4,381	31,647	21,870	•	-	-	1,889,627	\$00,634	-
Period 2)	Collateral Costs													1							
25.8.1	Process liquid waste	200	-	182	279	-	1,872		628	8,160	3,160	-	-	-	-	2,634	-	-	382,959	S11	
25.3.2	Small tool allowance	-	269	•	-	-			40	\$10	310	-	-		-	-	-	-		-	
2b.3	Subtotal Period 2b Collateral Costs	200	269	182	275	•	1,872	-	668	3,470	3,470	-	-	-	•	2,634	•	-	882,959	311	-
D	Period Dependent Costs																				
2b.4.1	Decon supplies	621		_	-				155	776	776			_							
20.4.1 2b.4.2	Insurance		-		-		:	- 586	105 69	644	644				-	-	-	-		-	•
2b.4.3	Property taxes	-	· .		-	-				-	-		-	-	-		-				
2b.4.4	Health physics supplies	•	1,778	-	-		•		444	2,222	2,222	-	-	-	-	-	-		· .	-	
26.4.5	Heavy equipment rental	-	4,595	-		-	• ·		689	5,285	5,785	-	-	-	-		-		• .		
25.4.6	Disposal of DAW generated	-	-	. 63	23	-	311	-	90	506	506	-	-	-	4,447				89,115	1,092	-
26.4.7	Plant energy budget.		-	•	-			1,662	249	1,911	1,911	-	-	-		-	-	-			
25.4.8	NRC Fees	-	•	-	-	•	•	664	68	752	752	-	-	•		-	-		-	•	-
25.4.9	Emergency Planning Fees	-	-	-	-	-	•	79	8	87	-	87	-	-	-	•	-	-		-	-
2b.4.10	ISFSI Transfer and Capital Costs	•	-	-	-	•	•	47,425	7,114	54,540	-	54,510	-	-	•	•	-	•	•	-	•
25.4.11	Spent Fuel Pool O&M	-	•	-	-	-	-	2,218	833	2,551	-	2,551	-	-	-	•	-	•	-	•	-

TLG Services, Inc.

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#### TABLE C-1 SALEM GENERATING STATION - UNIT 1 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

																<u> </u>					
						Off-Site	LLRW				NRC	Spent Fuel	Site	Processed			'olumes		Buriat		Utility and
Activity	• • • • • •	Decon	Removal	Packaging	Transport	Processing	Disposal	Other	Total	Total	Lic. Term.	Management	Restoration	Volume	Class A	Class B	Class C	GTCC	Weight	Craft	Contractor
Index	Activity Description	Cost	Cost	Costs	Costs	Costs	Costs	Costs	Contingency	Costs	Costs	Costs	Costs	Cu. Feet	Cu, Feel	Cu, Feet	CIL Feat	Cu. Feet	Lbs.	Manhours	Manhours
										-											
	h Period-Dependent Costs (continued)						•	421	. 63	481	484										
25.4.12	Radwaste Processing Equipment/Services	-	-	-	•		-	1,899	285	2,184	404 2,184	•	•	•	•	-	-	-	•	-	-
25.4.13	ISRA Compliance Staff Dry Fuel Storage O&M Costs	-	•	-	-	•	•	1,033	203	2,164	4,104	52		-		-	•	-	•	-	-
26.4.14	Security Staff Cost				-		-	2,477	372	2,849	2,849	44	-		-	•	-		-	-	127,661
2b.4.15	Utility Staff Cost				-		_	59,077	8,862	67,938	67,938		-	-	-	-	•	-	-	-	
26.4.16	Subtotal Period 2b Period-Dependent Costs	621	6.373	- 83	23	:	311	116,582	18,798	142,791	85,551	57,240		-	4,447	-			89,115	1,092	894,699 1,022,360
25.4	Support Ferior 20 Feriod Dependent Conta	4-1	4,010	~~		-			10,100	144,131	00,001	01,110	-	-	3,337	-	•	•	35,115	1.035	1,022,000
26.0	TOTAL PERIOD 25 COST	4,432	18,356	690	541	6,329	8,154	116,582	26,340	181,425	119,804	57,240	4,381	31,647	26,317	2,634	•	-	2,355,601	802,037	1,022,360
FERIOL	) 2c - Decontamination Following Wet Fuel &	Storage																			
	_ ·																				
	Direct Decommissioning Activities			·																	
2c.1.1	Remove spent fuel racks	505	62	132	11	416	144	-	379	1,638	1,638		•	2,061	- 467	-	•	-	41,012	1,189	-
<b>.</b>								••							•	•					
	of Plant Systems		186		9	197	851		294	1.675	1,575										
2c.1.2.1	Spent Fuel Cooling	352	851	. 55 45	9	197	934	-	294 630	2,401	2,402	•	•	986 901	1,941 2,407	-	•		174,052 191,109	8,764 12,951	-
2c.1.2.2	Waste Disposal - Liquid	852	637	6# EB	18	377	1,785	•	824	3,977	3,977	•	•	1,886	4,348	-	•	•	365,161		-
Zc.1.2	Totais	. 497	031	63	10		1,700	•	041	3,911	3,311	-	-	1,000	4,340	-	•	•	303,101	16,716	-
<b>D</b>	mination of Site Buildings																				
2c.1.3.1	Fuel Handling Building	657	<b>5</b> 15	9	7	169	26	_	466	1,848	1,848	_	_	843	468	_		_	45,684	22,423	
	- Totals	657	615	ă	7	169	26	-	466	1,848	1,84B	-		843	468	-	•		45,684	22,423	
20.1.9	Totals	0.01	· · · ·	•	•	203	. 20	•	400	1,040	1,010	-	-	045	400	-	•	-		24,460	-
2.14	Scaffolding in support of decommissioning	_	192	,	D	12	8		61	260	260			62	9				767	4,327	· _
· ·	Sexuality of subject or decommendation				•		-								-		•			-,	
2c1	Subtotal Period 2c Activity Costs	1.414	1,397	225	\$6	874	1,957	•	1,719	7,725	7,722		-	4,872	5,282	•		-	452,625	44,655	-
-	•			•																	
Period 2	c Collateral Costs		•																		
20.9.1	Process liquid waste	98	•	58	108		618	-	226	1,107	1,107	-	-	•	•	930	-	-	126,516	245	-
24.3.2	Small tool allowance	•	50	•	-	• •	-	-	8	58	5B	-	•	-	-	-	-	•	-	-	•
2-3.9	Decommissioning Equipment Disposition	-		48	13	640	- 117	-	117.	835	835	•	•	2,700	875	-	-	-	33,507	739	-
2c.3	Subtotal Period 2c Collateral Costa	.98	60	106	121	540	736	•	350	2,000	2,000	-	•	2,700	373	930	•	-	160,028	883	· -
Period 2	Period-Dependent Costs										100										
24.4.1	Decon supplies	36	-	•		-	•	-	24	120	120 140	-	•	-	-	•	-	-	•	-	
2c.4.2	Insurance	•	-	•	•	•	•	127	13	140	tan	. •	-	-	-	•	•	-	-	<b>-</b> .	•
2c.4.3	Property taxes	-	-	-	-	•	-	• •	-	454	454	•	-	•	•	•	-	-	۰.	•	-
20.4.4	Health physics supplies	-	363		•	-	•	•	91 191	434	1,467	-	-	-	•	-	•	•	-	•	-
2-4.6	Heavy equipment rental	•	1,275	•	· <b>-</b> "	-	99	-	27	1,467	150	•	•		1.821	-	-	-	26,474	824	-
2c.4.6	Disposal of DAW generated	-	-	. 23			31	246	37	283	263	-	•		1,061	-	-	-	20,414	441	-
2447	Plant energy budget	-	•		-	-	-	245	28	308	308	•	-	-	-		-	:			-
20.4.8	NEC Yess	-	. :	-	-	-		250	. 2	24	-	. 24		-						-	-
2c.4.9 2c.4.10	Emergency Planning Fees Radwaste Processing Equipment/Services	-	-	· -		-		22	35	269	269	41	-			:	-			-	-
20.4.11	ISRA Compliance Staff	- 1	-		:			527	79	605	606	2							:	-	
26.4.11	Dry Fuel Storage O&M Costs	-	-	-	-	-	-	15	2	17	-	17	-	-	-			-	-	-	-
	Security Staff Cost	-		-	-	-		835	<b>5</b> 0	.985	385	-	-	-		-		-	• ]	-	17,267
2c.4.13 2c.4.14	Utility Staff Cost	-	-	•	-	-		10,214	1,532	11,746	11.746			-	-			-	-	-	163,869
20.4	Subtutal Period 2c Period-Dependent Costa	96	1,639	25	7	-	92	12,000	2,111	16,970	16,929	41	-	-	1,321	•	-	-,	26,474	824	181,136
				-						-	-	•			-						-
2c.0	TOTAL PERIOD 2c COST	1,609	3,086	855	163	1,514	2,785	12,000	4,181	25,692	25,651	41	-	7,572	6,976	930	•	-	639, 122	45,884	181,186

LG Services, Inc.

#### TABLE C-1 SALEM GENERATING STATION - UNIT 1 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

						Off-Site	LLRW				NRC	Spent Fuel	Site	Processed	·		olumes		Buriai		Utility an
Activity Index	Activity Description	Decon Cost	Removal Cost	Packeging Costs	Transport Costs	Processing Costs	Disposal Costs	Other Costs	Total Contingency	Total Costs	Lic. Term. Costs	Management Costs	Restoration Costs	Volume Cu. Feet	Class A Cu. Feet	Class B Cul Feet	Class C Cu, Feet	GTCC Cu. Feet	Weight 1.bs.	Craft Manhours	Contracto Manhouz
ERIOD	2d - Delay before License Termination																				
riad 9d	Direct Decommissioning Activities				•																•
	et activities in this period																				
	Period-Degendent Costs							723	. 72	795	795									•	
	Insurance	•	-	•	-	-	-	120	72	195	193	•	•	-	•	•	-	•	•	•	-
4.2	Property taxes	-	-	-	-	•	-	-	-		869	-		•	•	•	-	•	-	-	-
1.8	Health physics supplies	-	295		• -	-	-	•	74	369		•	-	•	-	•	. *	-	-	•	
	Disposal of DAW generated	•	•	9	2	-	83		10	54	54	•	•	•	478	•	-	•	9,676	117	
4.5	Piant energy hudget	•	•	•	-	-	-	699	105	804	804	-	•	-	-	-	-	•	-	-	
4.6	NRC Fees	•	-	-	-	-	•	1,007	101	1,108	1,198	-	•	-	-	-	-	•	-	•	
4.7	Emergency Planning Fees	-	•	-	•	-	•	124	12	137	-	197	•	-	-	-	-	-	-	•	
4.8	ISRA Compliance Staff	•	-	-	-	-	-	2,998	450	8,448	3,448	-	•	-	-	-	•	-	-	-	-
1.9	Dry Fuel Storage O&M Costs	-	-	-	-	-	•	85	13	98	•	98	-	-	-	-	-	-		•	
	Security Staff Cost	-	-	-	-		-	1,345	202	1,547	1,647	-	-	-	-	-	•	-	-		69.5
4.11	Utility Staff Cost	-			-	•	-	7,760	1,164	8,924	8.924	-			-	-	-	•			109,7
4	Subtotal Period 2d Period-Dependent Costs	-	295	9	2	-	83	14,741	2,202	17,283	17,049	234	-	•	478	-	•	-	9,576	117	179,0
)	TOTAL PERIOD 2d COST		295	9	2		33	14,741	2,202	17,283	17,049	234		•	478	•		-	8,576	117	179,0
	2c - License Termination							•													
	Direct Decommissioning Activities	-		•				***	6.7	168	156										
L1	ORISE confirmatory survey	-	-	-	•	•	•	122	\$7		001	-	-	•	-	-		-	-	•	
1.2	Terminate license									B											
	Subtotal Period 2e Activity Costs	-	-	-	-	•	•	122	\$7	158	158	-	-	•	•	-	-	-	-	-	
	Additional Costs																				
	Final Site Survey	•	-		-	-	•	4,767	715	5,482	5,482	•	-	-	-	-	-	-	-	95,192	
	Subtotal Period 2s Additional Costs	-	•	-	•	-	•	4,767	715	5,482	6,482	-	-	-	•	•	•	•.	•	95, 192	
	Perind Dependent Costs								15	147	147										
1	Insurance	•	-	-		-	-	134	13	147	147	•	-	•	•	-	•	-	•	-	
2	Property taxes	-	-	•	-	-	-	-	-			•	-	-	-	-	-	-	-	•	•
3	Health physics supplies	-	644		٠,	•	•	•	186	680	680 40	•	-	•	•		•	-		•	
	Disposal of DAW generated	-	-	7	2	•	25	-	7	40		•	•	-	353	•	•	-	7,076	87	
.5	Plant energy budget	-	-	•	-	-	-	223	53	257	257	•	-	•	-	-	-	-	-	-	
.6	NRC Fees	-	-	-	-	•	-	288	28	317	317	-	•		•	-	-	-	-	•	
.7	Emergency Planning Fees	-	•	-	•	• •	-	23	2	25		25	•	-	-	-	•	-	•	•	
8	ISRA Compliance Staff	-	-	-	-	•	-	554	83	637	637	•	•	•	-	•	-	-	-	-	
9.	Dry Fuel Storage O&M Costa	•	•	-	-	•		16	2	18	•	18	-	-	-	-		•	•	-	
.10	Security Staff Cost	-	-	-	-	-	-	248	37	286	286	-		-	-	-		-	•	•	12
11	Utility Staff Cost		-	-	-	-	-	7,914	1,187	8,102	9,102			•	-		-	-	-	-	119
	Subtotal Period 2e Perind Dependent Costs	-	544	. 7	2	•	25	9,400	1,631	11,505	11,464	43	•	•	353	-	•	-	7,076	87	132
	TOTAL PERIOD 2: COST	-	544	7	2	•	25	14,288	2,282	17,147	17,104	49	•		858		•	-	. 7,076	95,279	132
-																					

TLG Services, Inc.

#### TABLE C-1 SALEM GENERATING STATION - UNIT 1 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

								(THOUSAL	us of 2002 De	Juaraj											
						Off-Site	LLRW				NRC	Spent Fuel	Site	Processed		Budal	Volumes		Burial		Utility and
Activity		Decon	Removal	Packaging	Transport	Processing	Disposal	Other	Total	Total	Lic. Term.	Management	Restoration	Volume	Class A	Class B	Class C	GICC	Weight	Craft	
Index		Cost	Cost	Costs	Costs	Costs	Costs	Costs	Contingency	Costa	Costs	Costs	Costs	Cu. Feet	Cil. Feet		Cu. Faet	Cu. Feet	Lbs.		Contractor Manhours
PERIOI	) 3b - Site Restoration																				
	b Direct Decommissioning Activities																				
Person 3	Direct Decommissioning Activities																				
	on of Remaining Site Buildings																				
36.1.1.1	Reactor Containment	-	5,755	-	-	•	-	-	863	6,618	993	-	5,626	•	•	•	-	-	•	72.497	-
3b.1.1.2	Auxiliary Building	•	1,735	-	-	-	-	-	260	1,995	200	-	1,796	-	. •	-	-	•	-	25.022	-
36,1.1.3	Auxiliary Building Control Area	-	329	•	-	-	-	-	-19	878	-	•	978	•	-	-	-	•	•	4.752	•
Sb.1.1.4	Auriliary Building Diesel Generator Area	•	108	-	•	-	•	-	16	124	•	-	124	-	. •	-	-	•	-	1,810	-
35.L.L.5	Circulating Water Intake Structure	• •	1,035	-	-	-	-	-	155	1,190	•	•	1,190	•	-	•	-	-	-	6,269	-
36.1.1.6	Condensate Polishing Building	•	85	-	-	-	-	-	19	98	-	-	98	-	•	-	-	•	-	1,214	• ·
86.1.L.7	Main Steam Isolation Structure	•	. 222	-	-	-	•	-	33	255	÷.	-	255	•	•	-	•	•	• •	3,160	-
35.1.1.8	Penetration Area	-	286	-	-	•	-	-	.43	829	•	-	829	-	•	-	· -	-	-	3,526	-
3b,1.1.9	Service Water Intake Structure	•	578	-	-	•	-	•	87	664	•	-	664	-	-	-	-	•	-	8,761	-
96, 1. I. IO		-	203	-	•	-	•	-	30	233	233	-	-	•	-	-	•		•	2,867	
35.1.1.11		-	. 18	+	•	-	-	•	3	20	-	-	20	•	•	·-	-	-	•	269	-
	Turbiae Building	-	9,887	-	-	•	-	-	506	3,895	-	-	3.695	•	•	-	-	•	-	58,128	
8b, 1, 1, 13		-	644	•	-	-	-	•	97	741	-	•	741	-	-	-	•	-	-	7.237	•
3h.1.1.14	Fuel Handling Building	-	2,238	-	•	-	-	•	836	2,574	257	-	2,317	•	•	-	-	-	•	28.638	-
3b.1.1	Totals	•	16,623	• -	-	-	•	-	2,493	19,116	1,683	-	17,433	-	-	•	-	-	-	218.659	-
	· · · · ·																				
	cout Activities					•	•				•										
9b, 1.2	Grade & leaderspe site	•	590	-	•	• •	-	•	89	679		• •	679	-	•	-	-	-	-	1,935	-
3h, 1.3	Final report to NRC		•	•	-	•	-	114	17	- 131	131	•	-	-	-	-	-	•	-	-	1,560
8b.1 .	Subtral Period Sb Activity Costs	-	17,213	-	-	-	-	- 114	2,599	19,925	1,814	-	18,112	•	•	-	•	• .	•	220,598	1,560
Period 3	Additional Costa							··													
3b.2.1	Concrete Crushing		•	-	•	•	-	331	50	381	•	-	381	-	-	-	-	-	· .	1,963	-
3b,2	Subtutel Period Sb Additional Costs	. •	-	-	•	•	•	331	60	381	-	-	381	-	-	•	-	•	-	1,963	-
Daried 3	Collateral Costs							•									•				
8h.3.1	Small tool allowance	_	205	_	_	_	-		. 91	236		_	236			•					
Sb.3	Subtotal Period 8b Collateral Costs	-	205		-	•	-	•	91 -	236	•	-	236	-	•	•	-	-	-	. •	•
80.3·	Suboga Perior ao Constera Costs	-	203	-	•	-	•	•	31	400	•	•	236	-		•	-	•	• •	•	-
Period 8	Period-Dependent Costs																				
36.4.1	Instigues	-	-	-	•	-	-	246	25	271	0	244	27	-	-	-	-	•	-		-
9b.4.2	Property taxes	-	· -	-	-	-	•	•	-	-	-	-	•	-			-	-	-	-	
Sb.4.3	Heavy equipment rental	-	8,344	•	-	-	• •		502	8,845	•	•	8,845		-		-	•	-		-
3b.4.4	Plant energy budget	. •		•	-	•	•	206	31	287	•	118	118	-	-	-	•	-	-	•	
Sb.4.5	NRC ISFSI Fees	-	-	-		-	-	100	10	110	· -	110	-		. <u>-</u>	-	-		-		-
8b.4.6	Emergency Planning Fees	•		-	•	•••	-	42	4	47	-	47	-	-	•	-	-	-	-		-
35.4.7	Dry Fuel Storage O&M Costa	-		-	-	-	-	29	4	33	•	33	-		-	-	-	•	-		-
Sb.4.8	Security Staff Cost	-		-			· .	458	69	527	•	853	174	-	-	-	-	-		-	23,606
3h.4.9	Utility Staff Cost	-	-	-	•	-	•	4,061	609	4.670	-	2,335	2.335	-				-			58,859
8b.4	Subtatal Period 3b Period-Dependent Costs		3,344	-		-		5,142	1,253	9,739	0	8,240	6,499	-	-	-		•	-		81,964
									-			•	•								
8b.O	TOTAL PERIOD 35 COST	•	29,761	•	•	•	·	5,687	3,933	30,281	1,814	3,240	25,228	•	-	-	-	-	. •	222.661	83,524

LG Services, Inc.

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#### TABLE C-1 SALEM GENERATING STATION - UNIT 1 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

						Off-Site	LLRW				NRC	Spent Fuel	Site	Processed		Burded &	/olumes		Burial		Utility and
Activity	tot the Deve total	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Processing Costs	Disposal	Other Costs	Total Contingency	Total Costs	Lic. Term. Costs	Management Costs	Restoration Costs	Volume Cu. Feet	Class A Cu. Feet	Class B Cu. Feet	Ciasa C	GTCC Cu. Feet	Weight Lbs.	Craft Manbours	Contractor Manhours
Index	Activity Description	COSE	COSI	Casts	· 60505	1-0505	COSIS	1-0515	Contingency	Casis	L0515	CUSIS	CUSIS	cu, reet	CO. Feet	GU, Feet	CU. FEEL	CU. FREL	LIB.	manuoura	mannours
PERIOD 3	ic - Fuel Storage Operations/Shipping																				
Period 3c D No direct	lirect Decommissioning Activities t activities in this period																				
	eriod Dependent Costs																				
	Insurance	•	-	-	-	-	-	2,922	292	3,214	•	3,214	•	•	•	·	-	-	-	-	•
	Property taxes	-	-	-	•		-	-	- 70	- 639	:	539		:	:		:	2	:		-
	Plant energy budget NRC ISFSI Fees					-		1,368	137	1,505		1,505		-	-		-	-		-	-
	Emergency Planning Fors		-	-	-	-		678	58	636	-	636	•			-	-	-	•		•
8c.4.6	ISFSI Transfer and Capital Costs	-		-	-	-	-	2,608	391	2,999	•	2,999	-		-	•	-	-	· •	-	-
Bc.4.7 1	Dry Fuel Storage O&M Costs	•	-	-	-	•	•	396	59	454	-	454	•	-	•	-	-	-	-	•	-
	Utility Staff Cost	-	-	-	-	-	-		-	-	-	9,348	-	-	-	-	•	-	-	-	-
Bc.4	Subtotal Period 3c Period Dependent Costs TOTAL PERIOD 3c COST	•	-	•	-	-	:	8,940 8,940	1,008	9,348 9,848		9,348		-	· ·	-		-		:	•
86.0	TOTAL PERIOD & COST	-	•	•	-	-	-	0,040	1,008	9,040	•	5,040	•			•			•	•	-
PERIOD 3	A - GTCC shipping																				
Period 8d I	Direct Decommissioning Activities								•												
Nuclear Ste	eam Supply System Removal																				
	Vessel & Internals GTCC Disposal	-	-	•	•	•	11,980 11,980	-	1,797 1,797	13,777 13,777	13,777 13,777	•		•	•	•	•	613 613	•	-	-
	Totals	-	•	-	-		11,980	-	1,797	13,777	13,777		-	-				613	:		-
8d-1 5	Subtotal Period 3d Activity Costs	-	•	•	-	-	11,960	-	1,131	LJ, / / /	10,771	-	-	-	•	•	•	010	-	•	•
Period 3d F	Period Dependent Costs																				
	Insurance	-	-	-	•	-	-	7	1	8	-	8	-		•	•	-		•	-	-
	Property taxes	•	-	-	•	•	-	۰.	• •	۰.	:	•,	•		-		-	-		-	-
	Plant energy budget NRC ISFSI Fees	-	-	•.		-	-	3	0	1	-	4						-	-	-	-
3d.4.4 8d.4.5	NRC ISFSI Fees Emergency Planning Fees		-	-	:	-		1	ă	2	-	2	-	-			-	-			-
3d.4.6	ISFSI Transfer and Capital Costs	•	-	-	•			183	27	210	-	310	-	-	•	-	-	-	•	-	-
	Dry Fuel Storage O&M Costs	-		•	-	- `	•	1	a	1	-	1	-	•	-	-	-	-	-	•	-
8d.4.8	Utility Staff Cost	-	•	-	-	-	-	-	•	•	-	·	-	•	•	-	•	•	-	-	-
3d.4	Subtotal Period 3d Period-Dependent Costa	•	•	-	•	•	-	197	29	226	-	226	-	-	-	•	-	-	-	•	-
8d.0	TOTAL PERIOD 3d COST	•	•	•	•	·	11,980	197	1,826	14,002	13,777	228	•	•	•	•	-	613	•	-	•
PERIOD 3	3 TOTALS	-	20,761	-	-	-	11,960	14,129	6,766	53,691	15,591	12,813	25,228	•	•	-	-	618	•	222,561	83,524
	ST TO DECOMMISSION	9,276	64,458	9.776	10.036	14.611	63,609	297.754	86.878	555,899	449,800	74,018	82.081	72,765	91,168	13.149	459	613	10,223,340	903,748	3.248.005

TLG Services, Inc.

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#### TABLE C-1 SALEM GENERATING STATION - UNIT 1 DETAILED COST ANALYSIS

(Thousands of 2002 Dollars)

						Off-Sile	LLRW														
rity ex			Removal	Packaging	Transport	Processing	Disposal	Olher		Total											
	Activity Description	Cost	Cost	Cosis	Costs	Costs	Costs	Cos	its	its Contingency	ts Contingency Costs	ts Conlingency Costs Costs	ts Contingency Costs Costs Costs	ts Contingency Costs Costs Costs Costs	ts Conlingency Costs Costs Costs Cu. Feet	its Contingency Costs Costs Costs Cu. Feet Cu. Feet	ts Contingency Costs Costs Costs Costs Cu. Feet Cu. Feet Cu. Feet	ns Contingency Costs Costs Costs Costs Cu. Feet Cu. Feet Cu. Feet Cu. Feet	is Contingency Costs Costs Costs Costs Cu, Feet Cu, Feet Cu, Feet Cu, Feet Cu, Feet	ns Contingency Costs Costs Costs Co. Feet Los.	ris Conlingency Costs Costs Costs Cu, Feet Cu, Fael Cu, Feet Cu, Feet Lbs. Manhours
									ล											-	-
TOTAL COST TO DEC	OMMISSION WITH 18.4% CONT	INGENOY	<b>7</b> :	\$555,899	thousands	of 2002 dol	iars														
TOTAL NRC LICENSE	TERMINATION COST IS 80.91	% OR		\$449,800	thousands	of 2002 dol	ars						•	•	•	•	•	•	•	•	
SPENT FUEL MANAG	EMENT COST IS 13.32% OR:	•		\$74,018	thousands	of 2882 dol	ars	-													
NON-NUCLEAR DEMO	LITION COST IS 5.77% OR:			\$82,081	(housands	of 2002 doll	ars														
TOTAL PRIMARY SIT	E RADWASTE VOLUME BURIE	D:		81,371	cubic feet														· · · ·	•	•
TOTAL SECONDARY S	HTE RADWASTE VOLUME BUR	UBD:		23,405	cubic feet																
TOTAL GREATER TH	AN CLASS C RADWASTE VOLU	ME GENE	RATED:	613	cubic feat																
TOTAL SCRAP METAL	REMOVED:			48,199	tons																
TOTAL CRAFT LABO	PROTERNAS.			043 7/9	man-hours																

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

TLG Services, Inc.

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#### TABLE C-2 SALEM GENERATING STATION - UNIT 2 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

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Off Sile I I DIM NRC Spent Fuel Site Processed **Burial Volumes** Duris Utility and Activity Removal Packaging Transport Decon Processing Disposal Other Total Total Lic. Term. Management Restoration Volume Class A Class B Class C GTCC Weight Craft Contractor Contingency index Activity Description Cost Cast Cocke Costs Costs Costs Costs Costs Costs Costs Costs Cu. Feet Cu. Feet Cu. Feet Gu. Feet Cu. Feet 1 bs Manhours Manhours PERIOD 1a - Shutdown through Transition Period 1a Direct Decommissioning Activities Prepare preliminary decommissioning cost Notification of Cessation of Operations 1.1.1 41 6 47 47 1.200 14.1.2 a la.1.3 Remove fuel & course material wa Notification of Permanent Defueling 1.1.4 Depetivate plant systems & process wasia 1=15 Prepare and submit PSDAR 62 11.16 ۵ 72 79 2,000 1.17 Review plant dwgs & specs. 144 165 00 165 4,600 14.1.8 Perform detailed rad survey a 14.1.9 Estimate by-product inventory 31 36 36 1 000 End product description Ia. 1. 10 91 5 36 36 1 000 Detailed by-product inventory 47 1a.1.11 41 Ġ. 47 1.900 Define major work sequence 934 1.119 35 269 269 7.500 la. I. 13 Perform SER and EA 07 15 111 111 8,100 Perform Site-Snecific Cost Study la 1.14 156 23 179 179 5.000 Prepare/submit License Termination Plan 128 147 Ia.1.15 19 147 4.096 LLL16 Receive NRC approval of termination plan . Activity Specifications la.L.17.1 Plant & temporary facilities 154 28 177 159 18 4 920 Is I 17.2 Plant systems 190 20 160 125 15 4.167 Is.1.17.3 NSSS Decontamination Flush 16 2 18 18 500 In 1.17.4 Reactor internals 83 30 265 255 7.100 203 Ia.1.17.5 Reactor vessel 233 233 6,500 1a.1.17.6 Biological shield 16 2 18 18 500 la.1.17.7 Steam generators 97 15 112 112 3,120 1a.1.17.8 Reinforced concrete 60 57 29 29 1,600 1a.1.17.9 Turbine & condenser 25 29 29 800 1a.L.17.10 Plant structures & buildings 97 15 112 66 56 3.120 In 1,17.11 Waste management 144 22 165 165 4 600 1a.1.17.12 Facility & aite closeout 28 4 32 16 16 900 1 180 La.1.17 Total 1.357 1,195 162 37.827 Planning & Site Preparations 1.1.18 Freuere dismantling sequence 75 11 86 86 2,400 Plant prep. & temp. svces 2.650 1a.1.19 2,804 346 2.650 . . 11.1.20 Design water clean-up system 7 50 44 60 . 1,400 la.1.21 Rigging/Cont. Catrl Envlos/tooling/etc. 1,950 293 2,243 2,243 . 1a.1.22 Procure casks/liners & containers 38 6 44 44 1 230 Subtotal Period 18 Activity Costs la.L 6,555 983 7,689 7,876 162 73,753 Subtatal Period 18 Additional Costs 1a 2 -Period In Period-Dependent Costs la.4.1 Insurance 73 804 731 804 . 14.4.2 Property taxes -. Health physics supplies 831 83 413 413 la.4.8 . la.4.4 Heavy equipment zental 349 62 401 401 ٠ la.4.5 Disposal of DAW generated 10 37 11 61 61 • 535 10,725 191 la.4.6 Plant energy budget 949 142 1,092 1,092 . 302 3a.4.7 NRC Fers 80 \$32 332 1448 **Emergency Planning Fees** 34 9 37 97

TLG Services, Inc.

#### TABLE C-2 SALEM GENERATING STATION - UNIT 2 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

						Off-Site	LLRW				NRC	Spent Fuel	Site	Processed			/olumes		Burial		Utility and
Activity	·	Decon	Removal	Packaging			Disposal	Other	Total	Total	Lic. Term.	Management	Restoration	Volume	Class A	Číass B	Class C	GTCC	Weight	Craft	Contractor
Index	Activity Description	Cost	Cost	Costs	Costs	Cosis	Costs	Costs	Contingency	Costs	Costs	Costa	Costs	Cu. Feet	Cu, Feét	Cu. Feet	Cu. Feel	Cu. Feet	Lbs.	Manhours	Manhours
	Period-Dependent Costs (continued)						•														
Ja.4.9	Spent Fuel Pool O&M	-	-	•	•	•	-	951	149	1,093	-	1,093	•	-	-	•	-	-		-	-
Ja.4,10	ISRA Compliance Staff	•	-	-	-	-	· -	814	192	936	936	•	•	-		•	· •	- 1	•	•	-
Ja.4.11	Dry Fuel Storage D&M Costs	-	-	-	-	-	-	23	3	28	-	20	-	•	-	-	-	-	•	-	-
<b>Ja.4.12</b>	Security Staff Cost	-		-	-	-		528	79	607	607	•	•	-	-	-	-	-	-	-	27,189
1a.4.18	Utility Staff Cost	-	-	-	•	-	-	18,980	2,847	21,627	21,827	•	•	•	-	-	-	-	-	•	296,983
144	Subtotal Period 1a Period-Dependent Costs		680	10	3	•	87	23,911	3,589	27,630	26,473	1,157	•	-	585	-	-	•	10,725	131	324,171
1a.0	TOTAL PERIOD 1a COST		680	10	8	-	37	29,866	4,572	35,168	33,849	-1,157	162	•	585	-	-	•	10,725	131	397,924
	··· - · · · · · · · · · · · · · · · · ·																				
PERIOD	) 1b - Decommissioning Preparations													•							
Period 1b	Direct Decommissioning Activities							•													
	Work Procedures							148	22	170	153		17								1500
12,1,1.1	Plant systems	-	-	•	-	-	-	148	22	36	36	•	17	-	•	-	•	-	-	•	4,733 1,000
	NSSS Decontamination Flush	-	-	•	-	•	-	78	12	38 90	50	•			-		-			-	2,500
	Reactor internals	. •	•	•	•	-	-	42	12 6	48	⊋0 12	-	36			•	-				2,500
16.1.1.4	Remaining buildings	-	. •	-	-	•	-	81	5		35		30		-	-	-		-	-	1,000
1b.1.1.5	CRD cooling assembly	-	-	•		•	-	31 91	0	36	36		•		· ·	-	-	-		-	1,000
	CRD housings & ICI tubes Incore instrumentation	•	-	•	•	-	•	31	5	36	36	-			-		•	-	-	•	1,000
15.1.1.7		-	-	-	•		-	113	17	130	150	-	•		•	-	• -			•	3.630
16.1.1.8	Reactor vessel	-	-	•	-	•	-	37	11	43	22		22		•	-	-	-		•	1,200
	Facility closeout	-	-	•	-	•	•.	14	2	40 16	16		15		-	•	-			•	450
	Missile shields	-	-	-		-	-	37	# 6	49	43		-		-	-	-	-		•	1.200
IFTT11	Biological shield	· •	-	-	-	-	-	144	- 22	165	165	•	-	•	-	•	-	-	. •	-	4,600
12.1.1.12	Steam generators	-	-	-	-	•	-		5	36	18	•		-	-	•	-	•	• •	•	1,000
	Reinforced concrete	•	•	•	-	•	•	31 97	15	112	. 10	-	10	-	-	-	-	-	•	•	8,120
16,1,1.14	Turbine & condensers	-	-	•	-	•	-	97 85	15	88	- 88	-	10	-	-	•	-	-	-	•	2,730
16,1,1.15	Auxiliary building			-	-	-	-	85 85	18	98	85	-	10	-	-	•	-	-	-	•	
	Reactor building	-	· •	-	-	-	-			1,193	968	•	· 224	-	-	-	•	•	-	•	2,730
15.1.1	Total	-	<b>-</b> .	-	-		-	1,037	. 156	1,193	360	•	224	•	-	-	•	•	•	•	33,243
1b.1.2	Decon primary loop	1,184	-	•	•	-	-	-	567	1,701	1,701	-	•	•	-	-	-	-	-	1,067	-
1b,1	Subtotal Period 1b Activity Costs	1,184	-	•	-	-	-	1,037	722	2,893	2,669	-	224	-	•	-	•	-	•	1,067	38,248
Period 1b	Additional Costs	•																			
1b.2.1	Spent Fuel Pool Isolation	-	•	-	-	•	-	5,952	788	6,040	6,040	•	-	-	•	-	•	-	-	-	-
1 <b>b.2.2</b>	Site Characterization	-	-	-	-		•	696	104	800	800	•	-	-	-	•		-	•	-	-
16.2	Subtotal Period 1b Additional Costs	-	•	-	-	•	-	5,948	892	6,840	6,840	•	-	-	-	-	•	-	•	•.	-
	Collateral Costa								107	817	817										
1b.S.1	Decon equipment	710			-	-		•	107	7,205	7,205	-	-		-	5,919	•	-	081 415		-
1b.3.2	Process liquid waste	- 57		. 503		-	4,796	-	1,352	7,205	1	-	•	-	-	9'313		-	981,415	210	•
1h.3,3	Small tool allowance	-	1 911		-	•	:	-	137	1.048	1,048	-	•		-	:		•	· :	:	
16.8.4 16.3	Pipe cutting equipment Subtotal Period 15 Collateral Costs	767				-	4,798	:	1,596	9,070	9,070	-	-		-	5,919	-	÷	981,415	210	
Pariod 16	Period-Dependent Costs																	-			
1h.4.1	Decon supplies	22		-		-	• - '	-	5	27	27		-			-		-	-	-	-
16.4.1 1b.4.2	Decon supplies. Insurance	-	· ·	-		-	-	- 365	57	402	402		-				-		· .	-	-
10.4.2	Property taxes	-	-			-	-		•	-	-		-	•	•	-		-	-		
	E IDDOLIN HAVES	•	-	-	-	-	-	-													

TLG Services, Inc.

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#### TABLE C-2 SALEM GENERATING STATION - UNIT 2 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

-						Off-Site	LLRW				NRC	Spent Fuel	Site	Processed		Busiels	/olumes		Burial		Blattic
Activity		Decon	Removal	Packaging	Transport	Processing	Disposal	Other	Total	Total	Lic. Term.	Management	Restoration	Volume	Class A	Class B	Class C	GTCC	Weight	Craft	Utility and Contractor
index	Activity Description	Cost	Cost	Costs	Costs	Costs	Costs	Costs	Contingency	Costs	Costs	Costs	Costs	Cu. Feet	Cu. Feet	Cu. Feet	Cu. Feet	Ca. Feet	Lhs,	Manbours	
																				_	
	Period Dependent Costs (continued)																				
1b.4.4	Health physics supplies	-	170	۰.	•	-	-	-	42	212	212	• •	-	-	•	-	•	-	-	-	-
1b.4.5	Heavy equipment rental.	-	174	-	-	-	-	-	26	201	201	-	-	-	-	-	•	•	•	-	-
1b.4.6	Disposal of DAW generated	-	-	5	1	-	20	•	6	32	32	-	-	-	284	-	•	-	5,694	70	-
15.4.7	Plant energy budget	-	-	•	•	-	-	949	142	1,092	1,092	•	-	-	-	-	-	-	-	-	-
15.4.8	NRC Fees	•	•		-	-	•	182	18	200	200	•	-	-	-	-	-	-	-	-	-
15.4.9	Emergency Planning Fees	-	•	-	-	•	-	17	2	19	-	39	-	-	-	-	-	-	-	-	-
15.4.10	Spent Fuel Pool O&M	•	-	-	-	-	-	475	71	547	•	547	-	-	-	•	-	-	· -		-
16.4.11	ISRA Compliance Staff	-	-	-	-	-	-	407	61	466	468		-	-	-	-	· •	-	•	-	•
16.4.12	Dry Fuel Storage O&M Costs	-	-	-	-	-	· .	12	2	13	-	13	-	-	-	-	-	-	-	•	
1b.4.13	Security Staff Cost	-	-	-	• •	-	-	264	40	303	303	-	-	-	-	-		-	-		18,594
1b.4.14	Utility Staff Cost	-	-	-	-	•	· -	9,490	1,423	10,913	10,913	-	-	· -	-	-	-	-	-	•	148,491
1h.4	Subtotal Period 1b Period-Dependent Costs	22	344	5	1	-	20	12,161	1,876	14,430	13,851 '	578	-	-	264	-	-	-	5,694	70	162,086
		1 0 0 7	1.850	608	498		1010		5 000	<b>GR 000</b>	50.403					5 01 A					
16.0	TOTAL PERIOD 16 COST	1,923	1,256	008	. 498	•	4,816	19,147	5,086	38,233	32,431	<b>378</b>	- 224	•	284	5,919	•	-	987,109	1,347	195,829
PERIOE	1 TOTALS	1,923	1,936	518	501	-	4,854	49,019	9,658	68,402	66,280	1,735.	386	•	819	5,919	-	-	997,834	1,478	693,253
PERIOD	) 2a - Large Component Removal														,						
Period 2s	Direct Decommissioning Activities																				
	0							•													
	Steam Supply System Removal Reactor Coolant Piping	280	255	· 50	20		906		435	1,928	1.928				2,038						
24,1,1,1		30	200	50	20	-	179	•	434 67	\$10	310	-	•	-	329	-		•	185,321	10,107	•
24.1.1.2	Pressurizer Relief Tank		21 <del>5</del> 90			107		•				•	-	-		-	-	-	36,553	527	-
21.1.1.9	Reactor Coolant Purops & Motors	81	90 56	43 371	1,843 460	. 107	3,376	. •	1,204	6,744	6,744	•	-	248	3,192	-	•	-	690,870	3,580	. •
2.1.1.4	Pressurizer	44		870		-	1,487		514	2,933	2,933	-	•	-	2,589	-	-	•	804,295	2,845	-
24.1.1.5	Steam Generators	379	2,136	870 124	5,391	•	16,902	100	5,842	81,618	81,613 1.031	-	•	-	31,467	-	-	-	3,458,553	13,321	-
21.1.1.6	CRDMs/ICls/Service Structure Removal	152	97		17	-	420	-	220	1,031	1,031	-	-	-	3,881	•	•	-	86,025	4,564	•
24.1.1.7	Reactor Vessel Internals	118	1,971	4,979	537	-	4,726	214	5,912	17,857		-	•	-	1,377	903	459	•	826,029	81,608	1,896
24.1.1.8	Reactor Vessel	90	3,433	1,604	365	·	6,672	214	5,956	17,233	17,233	-	-	•	6,511	2,254	-	-	948,723	51,608	1,396
2a.I.I	Totals	1,168	8,064	7,926	8,636	107	83,668	528	19,550	79,648	79,648	-	•	248	51,384	3,166	459	-	6,036,370	98,161	2,793
Removal	of Major Equipment																				
24.1.2	Main Turbine/Generator	-	474	55	11	715	-		233	1,488	1,488		-	3,573	-	-	_ ·		-	9,244	-
24.1.3	Main Condeosers	-	1,607	53	11	689	-	•	512	2,872	2,872	· -	-	3,446	-	-	-	-	-	91,571	-
Dienne-1	of Plant Systems														•						
2a.1.4.1	Auxiliary Feedwater		44	-	-		_		7	51	-	_	51	·			_			000	
24,1.4.2	Auxiliary Feedwater Auxiliary Feedwater (RCA)		251	- 2	- 4	293	-	•	115	697	697	•	51	1,466		-	-	•	-	692 5,333	
	Bleed Steam & Heater Drains	-	140	4			-	•	21	162		-	162	1,400	•	•	-	•	-	5,333 2,984	•
24.1.4.3		•	229		•	-	-	•	84	264	-	•	254	-	-	-	-	•	•		•
24.1.4.4	Circulating Water		225)	-	-	•	•	•	04 1	204	-	•		•	•	•	• .	•	-	4,757	-
28.1.4.5	Circulating Water Sampling	•			- 12	761	-	•	1 843	2,025	2,025	- 1	6	-	-	-	-	• .	•	104	•
2a.1.4.6	Condensate Polishing Condenser Air Removal & Priming	•	504 125		16	-01	-	•	. 19	2,025	2,023	•	- 144	3,806	•	•	-	•	•	17,777	•
2a.1.4.7		•	120	-	•	-	-	-	19	195	-	-	144	-	-	-	-	•	-	2,693	• .
2.1.4.8	Containment Spray	-	5 106	• • •	• 7	481		•	100	699	-	-	6		-	•	-	•	• •	104	•
2.1.4.9	Containment Spray (RCA) Equipment Vents & Drains - Contaminated	-	6		ó	<b>101</b> 5	· ·	-	100	18	18	-	-	2,403 26	- 8	•	-	•	717	2,075	-
24.1.4.10	Equipment Vents & Drains - Contaminaten Feedwater Chemical Treatment	-	9				•	-	3	10		-	10	26	8	•	-	-	717	115	-
24,1.4,11		-	27	-	•	-	-	-	4	31	-	-	10	-	•	•	-	•	-	182	•
2a.1.4.12		•	33			26		-	4	72	- 72	-	31		•	•	-	•	•	568	-
2a.1.4.19		•	33 11		U	20	-	-	2	12		-	- 13	128	-	-	-	•	•	660	-
XII.1.4.14	Hydrogen & Carbon Diaxide	-	460	24		8.028	•	•	Б79 Б	4,138	4,186	-	13	-	-	-	•	•	•	235	-
0.1415	Main & Reheat & Turbine By-Pass Steam													15,141						9,343	

TLC Services, Inc.

#### TABLE C-2 SALEM GENERATING STATION - UNIT 2 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

						Off-Site	LLRW				NRC	Spent Fuel	Site	Processed		Burial \	alumes		Burtal		Utility and
Activity		Decon	Removal	Packaging	Transport		Disposal	Other	Total	Total	Lic. Term.	Management	Restoration	Valume	Class A	Class B	Class C	GTCC	Weight	Craft	Contractor
Index	Activity Description	Cost	Cost	Costs	Costs	Costs	Costs	Costs	Contingency	Costs	Costs	Costs	Costs	Cu. Feet	Cu, Feet	Cu. Feet	Cu, Feet	Cu. Feet	Lbs.		Manhours
Disposal	f Plant Systems (continued)								_												
2a.1.4.16	Main Turbine Lubricating Oil	-	101	-	-	-	-	•	15	116	-	-	116	•	•	-	-	-	•.	2,099	-
	Miscellancous Condensate	-	50			-	-	-	7	57 931	•	-	57		-	-	-	-	•	1,051	-
	Moisture Separator Rehtrs Steam & Drains	-	437	3	0	- 828	•	•	159 7	931 51	931	•	·	1,638	-	-	•	-	-	8,614	•
2a.1.4.19	Oil Water Separator	-	44 182	-,	· ·	-	-	•	7 61	348	348	-	51	512	-	-	-	-	-	907	•
a.1.4.20	Steam Gen Drains & Blowdown	-	182	1	2	102	-	-	12	348 66	318	-	<u>.</u>	512	-	-	-	-		3,566	-
3.1.4.21	Steam Gen Drains & Blowdown (RCA) Steam Gen Feed Pump & Turbine Lube Oil	-	36 29	U	U	18	•	-	12	33	60	-	- 83	90	•	-	-	-	•	694 611	-
	Steam Generator Feed & Condensate	•	843	•	-	. •	•	-	ร้	53 594	•		894	-	•.	-	-	-	-	7.097	•
	Stenm Generator Feet & Contensate	•	831	-	· •	-	-	•	25	193	-	•	193	-	-	-	•	•	· -	3,594	•
	Turbine Drains	•	36			-	•	•	25 15	153	- 88		193	182	•	-	-	-	-	3,034 724	•.
	Turbine Drains Turbine Electro-Hydraulic Control	-	30	U	1	50	-	-	15	eo /	60	-	- ,	184	-	•	•		•	724	-
1.4.26	Turbine Gland Scaling Steam & Leak-Off	•	75	-	•	•	-	•	. n	87	•	•	87		-	•	-	•	•		-
		•	75 90	- 5	- 8	128	- 99	-	67	592	392	-		640	233	•	-	-	-	1,654	-
		•	50 8.981	46	81	5.206	103	•	1,678	11,095	9,473		1,622	26,032	241	-	-	-	20,293 21,010	1,805 80,912	-
.1.4	Totals	-	9,961	.40	-	0,200	103	-	7,010	11,093	3,413	•	1,023	20,032	Z41	•	-	-	21,010	60,812	•
a.1.5	Scaffolding in support of decommissioning	-	821	4	1	49	ш	•	, 216	1, 10S	1,103	-	· -	247	34	-	•	-	3,069	18,470	•
a.1	Subtocal Period 2a Activity Costs	1,168	14,948	8,085	8,740	6,767	33,781	528	22,188	<b>56,206</b>	94,584	-	1,622	83,547	51,659	3,156	459	·-	6,060,448	237,759	2,793
eriod 2a	Additional Costs																				
2.2.1	Curie Surcharge (Excluding RPV)	-	- <b>.</b>	-	-	•	1,374	-	344	1,718	1,718	•	•	-	-	-	-		-		•
32	Subtotal Period 2a Additional Costa	-	•	-	-	•	1,374	•	344	1,718	1,718	-	•	-	•	-	•	-	•	-	-
eriod 2a	Collateral Costa	•																			
4.3.1	Process liquid waste	73	•	28	65	-	914	-	127	606	606	•		•	-	510	•	-	64,257	100	-
1.8.2	Small tool allowance	-	219	-	-	-	-	-	83	252	227	•	25	-	-		-	-	-	•	-
⊾3	Subtotal Period 2a Collateral Costa	73	219	28	63	-	314	-	160	858	833	•	25	-	-	510	•	• ·	64,257	100	•
eriod 2a	Period-Dependent Costs																				
a.4.1	Decon supplies	72	-	•	•	-	-		18	90	90	-	•	•	-	-	-	-	-	-	-
4.2	Insurance		-	•	-	-	-	1,216	122	1,938	1,938	-	-	-	•	-	-	-	•		-
a.4.3	Property taxes	-	-	•	-	-	-	-	-	-	• •	-	-	•	-	-	-	-	. •	-	-
a.4.4	Health physics supplies	-	1,364	•	-	-	-	•	341	1,705	1,705	-	-	-	-	-	-	-	-	-	-
<b>1.</b> 15	Heavy equipment rental	•	8,144	-	-	-	-	-	472	8,615	3,615	-	-	•	•	-	-	-	-	-	-
s.4.6	Disposal of DAW generated	•	-	86	24	-	824	-	93	526	526	-	-	-	4,622	-	•	•	92,621	1,185	-
.4.7	Plant energy budget	•	-	-	-	-	-	1,601	225	1,726	1,726	-	-	•	•	-	-	-	-	-	•
a.4.8	NRC Fees	•	-	-	-	-	•	523	52	576	576	-	-	-	-	-	•	•	-	-	-
a49	Emergency Planning Fees	•	-	•	-	-	-	56	6	62	-	62	•	-	-	-	-	-	-	-	-
a.4.10	ISFSI Transfer and Capital Costs	•	-	•	-	-	-	1,464	220	1,684	-	1.684	-	-	-	-	•	•	-	-	-
.4.11	Spent Fuel Pool O&M	-	-	-	•	•	•	1,582	237	1,819	-	1,819	•	•	-	•	-	-	-	-	•
<b>14.12</b>	ISHA Compliance Staff		•	-	-	•	-	1,354	203	1,558	1,558	-	-	-	-	-	-	-	-	-	•
a.4.13	Dry Fuel Storage O&M Costs		-	-	•	•	•	38	6	44	-	44	•	-	-	-	•	•	-	-	•.
a. <b>1.</b> 14	Security Staff Cost	-	-	•	-	• .	-	2,380	357	2,737	2,737	-	-	-	-	•	•	. •	•	-	122,670
a.4.15	Utility Staff Cost		-	-	•	•	-	44,673	6,701	51,374	51,374		-	•	-	-	•	-	-	-	671,640
2.4	Subtotal Period 2a Period Dependent Costs	72	4,607	85	24	•	324	54,788	9,052	68,853	65,245	3,609	-	•	4,622	-	-	-	92,621	1,185	794,310
2a.0	TOTAL PERIOD 2a COST	1,313	19,675	8,199	8,828	6,767	35,793	55,816	31,744	167,635	162,379	3,609	1,647	83,547	56,281	3,666	459	-	6,217,926	238,994	797,103

TLG Services, Inc.

#### TABLE C-2 SALEM GENERATING STATION - UNIT 2 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

		_			<b></b> .	Off-Site	LLRW		-	<b>.</b>	NRC	Spent Fuel	Site	Processed			asmulo		Burtal	_	Utility and
Activity Index		Decon Cost	Removal Cost	Packaging Costs	Costs	Processing Costs	Disposal Costs	Other Costs	Total Contingency	Total Costs	Lic, Term. Casis	Management Costs	Restoration Costs	Volume Co. Feet	Class A Cu. Feel	Class B Cu. Feet	Class C Cu. Feel	GTCC Cu. Feat	Weight Lbs.	Craft Manhours	Contractor Manhours
ERIO	D 2b - Site Decontamination																				
eriod 2	b Direct Decommissioning Activities																				
	of Plant Systems																				
<b>b.1.1.1</b>		-	40	41	- 9	-		•	6	46	2,774	•	46	-	-	•	•	-	-	850	-
26.1.1.2	Chem & Vol Ctrl - Boria Acid Recovery Chem & Vol Ctrl - Primary Water Recovery	519 353	507 347	41 28	9	218 158	845 565	-	636 432	2,774 1,890	1,890	•	-	1,088 788	2,376 1,630	•	•	-	172,868	19,343	•
5.1.1.8 5.1.1.4		455	532	34	6	71	700	-	432	2,349	2,349		-	788 354	1,630	-	•	-	115,643 143,288	13,399 19,071	-
L115	Chilled Water	-100	185	-			144		28	213	2,343		- 213	004	1,000	•			143,400	4.017	-
b.1.1.6			197	1	2	198		-	70	408	408			689	-	-	-		-	8,683	-
ь.1.1.7		_	16			100			2	18			18			-		· ·	-	845	
26.1.1.8		-	355	8	15	986	-		240	1,603	1,603	-		4,928				-	-	6,638	
25.1.1.9	Compressed Air		111				-		17	128			128		-	-	_	-	-	2,869	
26.1.1.10			78	0	1	35	-		25	139	139			174	-	-	-		-	1,654	
26.1.1.11			131	ĩ	2	128	•		52	815	915	•.	-	640	_	-	-		_	2,673	-
25, 1, 1, 12		-	42	ō	1	40	-		17	99	99	-		200	-	-		-	_	860	-
26, 1, 1. 13		-	32	•			-	-	5	37	-	-	87	-	-	-	-		-	672	-
	Control Air - Turbine Generator Area	-	46	-	•	-	-	-	7	. 52	-		52	-	-	-	-	-	-	965	-
	Demineralized Water - Restricted Areas	-	59	0	1	46	-		22	129	129	-	-	232	-	-	-	-	-	1,123	-
	Demineralized Water Make-up		437		-	-	-	-	66	503	-	-	503	•	-	-	-	-	-	9.095	-
1.1.17	Diesel Engine Auxiliaries	•	· 128	-	•	-	-		19	148	-	-	148	-	-	-	-	-	-	2,602	-
1,1.1.18	Electrical	•	3,421	-	-	-	-	-	513	3,934	-	-	3,934	-	-	-		-	-	69,784	-
26, 1, 1, 19	Electrical (RCA - Clean)	•	576	4	7	448			213	1,247	1,247	-	-	2,238	•	-		-	-	11,303	-
	Electrical (RCA)	•	190	1	3	176	•	-	74	444	44-5	-	•	880	•		-	-	-	3,808	-
26,1,1.21	Fire Protection		256	-	-	-	-		38	294	-	-	294	•	• *	•	-	-	-	5,458	-
	Fire Protection (CO2)	•	. 14	-	-	-	•	•	2	16	•	-	16	-	•	-	•	-	-	805	-
	Fire Protection (RCA)	-	178	1	2	109	•	•	61	351	351	-	•	544	•	-	-	•	-	3,349	-
	Floor Drains - Contaminated	-	165	8	1	16	163	•	85	439	439	•	-	81	372	-	-	•	83,319	3,228	-
	i Fresh Water	-	284	-	-	-	•	•	43	327	•	-	327	•	-	-	-	•	•	5,906	-
	i Fuel Oil	-	220	•	-	-	-	-	33	253	•	-	253	-	-	-	-	-	-	4,453	
	HVAC - Auxiliary Building	-	265	2	\$	188	27	•	102	667	587	-	-	941	62	-	-	-	5,534	4,912	-
26.1.1.28		-	26	•	•	- •	-	-	. 4	29	-	-	29	-	-	-	-	-	-	532	-
26.1.1.29		-	6	۰.	• .	•	-	-	1	7	-	•	7	-	-	-	-	-	-	126	-
26.1.1.30		-	122	1	Ţ	91	18	•	48	277	277	-	-	435	30	-	•	-	2,676	2,268	-
	HVAC - Miscellaneous	•	178	-		-	•	•	27	205		-	205	•	-	-	-	-	•	3,948	-
	HVAC - Reactor Containment	-	678	6	8	485	74	-	263	1,518	1,518	-	-	2,441	168	-	•	•	15,104	12,513	-
<b>Щ.1.1.33</b>		-	159		•.	•	-	-	24	183	-	-	183	-	-	•	-	•	•	3,462	•
	Heating Steam & Cond Return (RCA)	-	128	1	· 1	86	-	-	45	261	261	-	-	432	•	•	-	-	•	2,898	•
	Heating Water	-	112	• .		•	•	•	17	128	126	•	128	· -	•	•	-	-	•	2,826	•
b.1.1.56		-	64	0	· 1	89	•	-	22	126 5	120	•		193	•	•	-	-	•	1,198	-
b.1.1.97		-	4 58	• •			•	-	19	98 	- 98	•	5	- 56	20	•	-	•		80	-
<b>Ъ,1.1.88</b>		-	50 521	1	U	11	9	-	48	369	20	-	-	90	20	-	•	•	1,814	1,247	-
26,1, <b>1,3</b> 5	Non-Radioactive Liquid Waste Disposal Plumbing - Hot and Cold Water		821 45	-	-		•	•	48	369 52	-	•	869 53	-	-	•	-		•	6,636 988	•
	Plumbing - Not and Cold water	•	45	-	-	-		-	1	34	-	-	34		•		•	-	-	988 623	•
	Residual Heat Removal	140	157	- 50	- 10	129	1,126	•	417	2.028	2,028	-	34	643	- 2,570	-		-	230,393	8,803	-
26.1.1.42 26.1.1.49		528	564	49	10	225	1,126	-	694	3.068	3,058	•	-	1,125	2,570	•	•	-	230,393 204,105	8,803 20,512	-
	Samely Injection	028	122	45	1	53	72	-	57	310	810	-		267	2,713	-	-	-	204,105	20,612	•
3.1.1.44 3.1.1.46		-	856	3 21	. 39	2,521	12	-	600	4,037	4,037	•	-	12,604	104	-	•	-	19,718	2,629	•
8.1.1.40 5.1.1.46		-	6L	-		120,0	-	-	900	1,031	-,	•	71	12,004	-			•	-		•
26.1.1.40 26.1.1	Totals	1.995	12,505	265	130	6,393	4,591	-	5.664	31,549	24,496	•	7,053	51,993	- 11,790	•	•	-	020 100	1,836	•
	196418	1,000	12,000	403	100	0'223	9,031	-	0,004	31,343	74*430	-	1,933	21'233	11,780	-	· -	-	939,462	285,358	

TLG Services, Inc.

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# TABLE C-2 SALEM GENERATING STATION - UNIT 2 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

· · · · · ·						Off-Site	LLRW				NRC	Spept Fuel	Site	Processed		Burial \	olumes	_	Burial		Lintela
Activity		Decon	Removal	Packaging	Transport	Processing	Disposal	Other	Total	Total	Lic. Term.	Management	Restoration	Volume	Class A	Class B	Class C	GTCC	Weight	Craft	Utility and
Index	Activity Description	Cost	Cost	Costs	Costs	Costs	Costs	Costs	Contingency	Costs	Costs	Costs	Casts	Cu. Feet	Cu. Feet		Cu. Feet		Lbs.	_Manhours	Contractor Manbours
Zb.1.2	Scaffolding in support of decommissioning	-	1,027	5	2	62	13	-	270	1,379	1,379	-	-	. 309	43	-		-	3,836	23.088	
D	nination of Site Buildings				•							•									
2b.1.3.1	Reactor Containment	1,205	757	124	88	115	1.295	_	1,158	4,743	4,743			576	7.941				738,859		
20.1.3.1 2h,1,3.2	Auxiliary Building	400	199	32	25	26	71		279	1,033	1,033	-	•	131	2,095	-	-	-		37.587	•
26.1.3.3	Controlled Facilities Building	55	23	4	ĩ	2	5		36	128	1,033	-	-	131		-	-	•	201,223	11.426	•
	Steam Generator Removal	12	2	ò	0	5	ő	•		27	27	-	-		265	-	•	-	26,374	1.474	-
25.1.3.4			982	161	116	148		•				•	-	24	2	-	-	. •	142	288	-
2b.1.3	Totals	1,672		431	247		1,373	• .	1,480	5,930	5,930	· ·		739	10,302	-	-	-	966,604	51.074	•
2b.1	Subtotal Period 2b Activity Costs	3,666	14,513	431	247	6,608	5,977	-	7,414	38,857	31,804	•	7,053	33,042	22,135	•	• ·	-	1,909,902	359.520	-
	Collateral Costs		•																		
26.3.1	Process liquid waste	202	-	183	281	•	1,883	-	632	8,181	8,181	-	-	-	-	2,652	-	-	385,235	315	
2b.3.2	Small tool allowance	•	321	-	-	-	-	-	48	369	369	-	-	-	-	-	•	•	-	-	-
26.3	Subtotal Period 2b Collateral Costa	202	321	183	281	-	1,883	•	680	8,550	3,550	-	-	-	-	2,652	-	•	385,235	315	• .
Period 2b	Period-Dependent Costs			· ·		•															
25.4.1	Decon supplies	642	-	•	-	-	-	- ·	161	803	803	-	-	•	•	· -	-	-	•	-	-
2b.4.2	Insurance	-		-	· -	-	-	687	69	756	756	-	-	-		-	-	-			
25.4.3	Property taxes	-	-	•	-	-	•	-	-	-	-	-		-	-	-		-			
2b.4.4	Health physics supplies	-	1,997	-		-	-		499	2,496	2,496	-		-	-	-		-		_	_
26.4.5	Heavy equipment rental	•	4,563	-	•	-	•	-	684	5.247	5,247	-	-			-		-			-
2b.4.6	Disposal of DAW generated	-		86	24	-	829		93	525	525	-		_	4.612	-		-	92,423	1,132	-
26.4.7	Plant energy budget		-			-	-	1,650	247	1.697	1,897		_	-	4,012		-	-	97,429	1,132	•
25.4.8	NRC Fees	_					-	680	68	748	748		-	-	•	-	•	-	•	•	•
20.4.9	Smargency Planning Fees	-			-		-	78	8	86	-	- 86	-	•	-	•	•	-	· -	•	-
2b.4.10	ISFSI Transfer and Capital Costa		-	-	-			83.955	5,093	39,048		39,048	•	•	-	•	•		-	-	-
2b.4.11	Spent Fuel Pool O&M	-	-	•	•	•	•	2,203	330	2,583	-	2,533	• .	-	-	•	•	•	-	-	-
	Radwaste Processing Equipment/Services	•	-	•	-	•	•			481	481	•	-	•	-	•	-	-	-	-	-
25.4.12		•	•	-	•	•	•	418	63			-	-	-	-	•	-	-	-	-	-
26.4.13	ISRA Compliance Staff	-	-	•	•	•	•	1,886	283	2,169	2,169	-	-	-	-	•	-	٠	-	-	-
26,4,14	Dry Fuel Storage O&M Costs	•	-	-	-	-	•	53	8	61	-	61	-	-	-	-	-	-	•	-	-
	Security Staff Cost	-	•	-	-	-	-	2,656	998	3,055	3,055	-	•	•	•	-	-	-	•	-	135.891
25.4.16	Utility Staff Cost	-	-	-	•	-	-	60,723	9,108	69,832	69,832	-	-	-	-	-	-	-	-	-	915,840
25.4	Subtotal Period 25 Period Degendent Costa	642	6,560	86	24	-	323	104,989	17,113	129,736	88,008	41,728	-	-	4,612	-	-	•	92,423	1.132	1,052,731
25.0	TOTAL PERIOD 25 COST	4,511	21,394	700	551	6,608	8,183	104,989	25,207	172,144	123,963	41,728	7,053	33,042	25,747	2,652	٠	-	2,387,559	860.967	1,052,731
PERIOD	2c - Decontamination Following Wet Fuel S	itorage											•								
Period 2c	Direct Decommissioning Activities													•.	•						
2c.1.1	Remove spent fuel racks	505	52	132	11	416	144	-	879	1,638	1,638	-	-	2,081	457	-	•	-	41,012	1.189	•
Disposal o	of Plant Systems																				
2-12.1	Spent Fuel Cooling	-	186	38	9	197	851	-	294	1,575	1,673	-	-	986	1,941	-	-	-	174,053	8.764	
	Waste Disposal - Liquid	352	951	45	9	180	934	•	530	2,402	2,402	-	-	901	2,407	-	-	-	191,109	12.951	-
	Waste Disposal - Solid	-	61	5	1	45	107	-	49	267	267	-	-	223	253	-	-	-	21.858	1.209	-
	Totals	352	598	88	19	422	1,891	-	874	4,244	4,244	•	-	2,110	4,601	•	-	-	387,019	17.925	-
Decontam	instion of Site Buildings										•								-		
2c.1.3.1	Fuel Handling Building	557	615	9	7	169	26	-	466	1,848	1,848		-	843	468	-	-	-	45,684	22,423	•
	Totals	557	615	9	7	169	26	-	466	1,848	1,848	- '	-	843	468	-	-	-	45,684	22.423	-
		_	205		~	12			54	276	276			62							
2c.1.4	Scaffolding in support of decommissioning	-	203	1	Ű	. 12	4	-	04	2/6	210	-	•.	92	а	•	•	•	767	4.518	-

LG Services, Inc.

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#### TABLE C-2 SALEM GENERATING STATION - UNIT 2 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

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Activity meet         Decon         Removal Packaging Transport Processing Disposal         Other         Total         Total         Total         Total         Total         Costs         Costs         Class A         Class A         Class A         Class C         G7C         We           2:1<         Subtral Period 2: Activity Costs         1.414         1.470         230         37         1.019         2.063         1.772         8.006         -         -         6.066         6.055         Cu Feet	pht Craft Co S. Manhours Ma 4,483 46,165 3,466 145 1,507 739 1,973 885   	Utility an Contract Maphout - - - - - - - - - - - - - - - - - - -
Inter         Activity Description         Goats         Coats         Coats </th <th>s. Manhours M2 4,483 46,155 9,466 145 9,677 739 9,973 685   </th> <th>Manhour - - - - - - - - - - - - - - - - - - -</th>	s. Manhours M2 4,483 46,155 9,466 145 9,677 739 9,973 685   	Manhour - - - - - - - - - - - - - - - - - - -
Priority 20 Calintarial Conta         Summary and the standard of the standard	3,465 145 1,507 739 1,973 685 	226,33
Prived 2: Odditaral Costs       22.1       Process liquid wate       98       58       108       -       618       -       22.8       1.007       1.107       -       -       930       -       1.2         22.2.1       Gallo allowanco       -       -       43       113       540       117       -       117       835       835       -       -       2,700       373       -       -       -       3         26.2.3       Deformational Bends 2 Caliman Departed       Bend 2 Caliman Departed       -       -       43       117       -       117       835       835       -       -       2,700       373       -       -       -       -       -       2,700       373       -       -       -       -       2,700       373       -       2,700       373       -       -       -       -       -       -       -       -       -       -       -       -       -       -	3,465 145 1,507 739 1,973 685 	226,33
2.3.1       Process liquid wate       98       -       53       108       -       618       -       223       1.107       -       -       -       930       -       123         22.3.2       Salk tool allowsee       59       -       -       -       8       66       59       -       2.00       2.00       2.00       2.00       2.00       2.00       2.00       2.00       2.00<	233 234 2.233 234 2.233 234	226,33
2.2.3       Snall total Alorance       -       63       -       2.001       2.001       -       -       -       -       -       2.001       2.001       2.001       2.001       2.001       2.001       2.001       2.001       2.001       2.001       2.001       2.001       2.001       2.001       2.001       2.	233 234 2.233 234 2.233 234	226,33
2x3       Decommissioning Equipment Dispansition       -       -       48       13       540       117       117       935       836       -       -       2,700       973       -       -       3       3       3       930       -       3       3       3       930       -       15         Pariad 2: Priod-Dependent Cost       2       2       0       7       -       -       -       2       111       112       2       -       -       -       -       -       -       15         2c.41       Decone explicis       97       -       -       -       -       2       111       112       121       - </td <td>1,607 739 1,973 685 </td> <td>226,33</td>	1,607 739 1,973 685 	226,33
2.3       Subtrail Pariod 2x Collataral Costs       98       62       106       121       640       785       -       350       2.01       2.01       -       -       2.700       373       930       -       185         Pariod 2x Collataral Costs       U       U       -       -       -       2.700       373       930       -       185         26.1       Decom applics       97       -       -       -       -       24       121       121       -       200       200       -       -       2,000       373       930       -       -       -       -       -       -       -       -	1,973 885  	226,33
2.4.1       Deconsurptice       97       -       -       -       2.4       121       121       -       2.5       -       2.5       -       - <td< td=""><td></td><td>226,33</td></td<>		226,33
22.4.1       Decoa supplies       97       -       -       -       24       121       121       -<		226,33
12.4.2       Insurance       -       -       -       111       11       12       12.2       -		226,33
ia. 43       Property taxes       -		226,33
2c.4.4       Halth bytaics supplies       .		226,33
2a.45       Havy-equipment ratal       -       1,808       -       -       -       196       1,504       1,504       -		226,33
22.6.6       Disposal of DAW generated       -       -       25       7       -       95       -       77       155       155       -       -       1,859       -       -       9         2c.4.7       Plant rangy budget       -       -       -       -       -       252       38       250       250       -       262       -       -       -       -       -       -       -       165       275       -       -       -       -       -       -       164       161       1622       622       -       -       -       -       -       26.412       575       5		226,33
2a.4.7       Plant energy hudget       -       -       -       222       38       290       290       -		226,33
2a.4.9       Energency Planning Fees       -       -       -       22       2       26       -       25       -	,233 834 .	226,33
Sz. (1)       Badwast Processing Equipment/Services       -       -       -       -       240       36       275       275       -	,233 834 .	226,33
2z.4.11       ISRA Compliance Staff       -       2       2       2	,233 834 .	226,33
2a,12       Dry Fuel Scorage O&M Costs       -       -       -       -       15       2       18       -       18       -	,233 834 .	226,33
2z.4.13       Scientify Staff Cost       -       -       -       -       761       114       875       875       -       2.855       2.855       2.855       2.856       2.8	,233 834 .	226,33
2z.4.14       U(ility Suff Cost       -       -       14,660       2.229       17,069       17,069       -       -       2.4         2z.4       Subiqual Period 2z Period-Dependent Costs       97       1,688       25       7       95       17,065       2,885       21,840       42       -       1,859       -       2         2a.0       TOTAL PERIOD 2z COST       1,609       9,210       361       165       1,859       2,634       17,085       5,007       31,889       31,847       42       -       7,796       7,267       930       -       66         PERIOD 2z - License Terminations         Period 2a Direct Decommissioning Activities         2z.1.0       OgliSE confirmatory survey       -       -       122       37       158       158       -       -       -       -       2         2z.1.0       Total tease       -       -       122       37       158       158       -	,233 834 .	226,33
2c.4       Subletal Period-Dependent Costs       97       1,683       25       7       -       96       17,085       2,885       21,840       42       -       1,859       -       .       2         2a.0       TOTAL PERIOD 2a COST       1,609       8,210       361       165       1,859       2,894       17,085       5,007       51,889       31,847       42       .       7,796       7,287       930       .       66         PERIOD 2a COST       1,609       8,210       361       165       1,859       2,894       17,085       5,007       31,889       31,847       42       .       7,796       7,287       930       .       66         PERIOD 2a - License Terminate/ination         24.1.1       OBLSE confirmatory auryey       .	,233 834 .	
2a.0       TOTAL PERIOD 2c COST       1,609       9,210       361       165       1,859       2,894       17,085       5,007       31,889       31,847       42       7,796       7,267       930       66         PERIOD 2c - License Termination       22.1.1       OUISE confirmatory survey       -       -       122       37       158       158       - <td></td> <td>265.55</td>		265.55
PERIOD 2e - License Termination Period 2e Direct Decommissioning Activities 2g.L.1 Of USE confirmatory survey 122 37 158 158	,688 47,373	
Period 2a Direct Decommissioning Activities 2z.L1 OGUSE confirmatory survey 122 37 158 158		265,56
2z.1.1 OffISE confirmatory survey		
2z.1.1 OffISE confirmatory survey		
22.1.2 Terminate licease a		
		•
	• -	-
Period 2s Additional Costs		
2a.2.1 Final Site Survey	- 95,192	
2e,2 Subtotal Period 2e Additional Costs 4.767 715 5,482 5,482	- 95,192	-
Period 26 Period-Dependent Costs		
22.4.1 Insurance 113 11 125 125		-
2a.4.2 Property taxes		
2a.4.3 Health physics supplies		-
2e.4.4 Disposal of DAW generated 7 2 - 25 - 7 41 41	297 89	-
2e.4.5 Plantenergy budget 223 83 257 257	• •	-
2a.4.5 NBC Fees 288 29 317 317		
2a.4.7 Entergency Planning Fees	• •	-
22.4.8 ISRA Compliance Staff 554 83 637 637	• •	•
22.4.9 Dry Fuel Storage Ods1 Costa - 16 2 18 - 18 -	• •	•
22.4.10 Security Staff Cost		22.05
2a.4.11 Utility Staff Cost - 10.411 1,562 11,972 - 22, 12,056 1,972 14,572 - 22, 12,056 1,932 14,572 14,572 43 - 284 - 2000		150,82
2e.4 Subtotal Period 2º Period-Dependent Costs 551 7 2 - 25 12,056 1,932 14,572 14,529 43 - 884 -		172.87

TLG Services, Inc.

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#### TABLE C-2 SALEM GENERATING STATION - UNIT 2 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

						Off-Site	LLRW				NRC	Spant Fuel	Site	Processed			alumes		Burial		Utility
Activity Index	Activity Description	Decon Cast	Removal Cost	Packaging . Costs	Transport Costs	Processing Costs	Disposal Costs	Other Costs	Toiai Contingency	Total Costs	Lic. Term. Costs	Management Costs	Restoration Costs	Volume Cu. Feet	Class A Cu. Feel	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu, Feet	Weight Lbs.	Craft <u>Manhours</u>	Contra <u>Manho</u>
.0	TOTAL PERIOD 2ª COST		551	7	2		25	16,944	2,684	20,212	20,169	43	-	-	364		-		7,297	95,281	172
				D 647	9.546	14 004	10 804	194,834		391,880	837,758	45,422	8,700	74,384	90 659	7,248	469		9,273,870	540.010	
ERIOD	2 TOTALS	7,433	44,830	9,267	5,546	14,934	46,895	134,034	64,642	231,000	337,100	40,425	0,700	14,009	30,635	1,240	403	-	8,213,810	742,616	2,388
ERIÓD	3b-Site Restoration																				
eriod 8b	Direct Decommissioning Activities																				
emolitio	n of Remaining Site Buildings	•									•										
.1,1.1	Reactor Containment	-	5,755	-	-	-	-	-	863	6,618	993	-	5,626	-	-	-	-	•	-	72,497	
61.1.2	Administration Building	-	660	-		-		-	99	759	-	•	759	•	-	-	•	•	-	10,176	
1.1.2.8	Auxiliary Building	-	1,735	-	-	-		-	260	1,995	200	-	1,796	-	-	•	• .	•	-	25,022	
.1.1.4	Auxiliary Building Control Area	-	329	•	-	•	-		49	378	-	-	378	-	-	-	-	•	-	4,752	
b.1.1.5	Auxiliary Building Diesel Generator Area	-	108		-	-	-	-	16	124	-	-	124		•	<b>-</b> .	-	-	-	1,810	
	Barge Slip	-	961	-	-	-	•	•	144	1,103	•	-	1,105	-	-	-	-	-	-	7,269	
1.1.7	Chromate Demineralizer Epclosure	-	6	•	-	-	•	-		7	-	-	7	-	•	-	-		-	92	
1.1.8	Circulating Water Intake Structure	-	1.038	-	-	-	-	-	156	1,194	-	•	1,194		-	-	-	•	-	6,310	
1.1.9	Circulating Water Piping		L873	-	-			-	281	2,154	-	-	2,154		-	-	-	-	-	36,524	
1.1.10		-	358	-	-		-		54	412	•	-	412	-		-			-	5.692	
		_	70		-		-	-	11	81		-	81	-		-	-	-	-	1,107	
1 1 19	Controlled Facilities Building		252						88	290		-	290	-			-	-	-	8,785	
	Fire Pump House		57		_				9	65		-	65	-				-	_	874	
1114		-	88			-	-	-	13	101	•		101				-	-		1,401	
1 1 16	Heating Boller Plant	-	63	-	-				12	95	-	_	95	-			-	-	_	1,138	
11.1.10	Main Steam Isolation Structure	-	184	-			-		28	211	-	_	211	_				-		2,551	
	Miscellancous Structures	-	1.884						283	2.167	-		2.167				_	_		24.441	
	Non-Rad Liquid Waste Chem Treatment Bldg	-	1,005						12	94	-	_	94			-		-		1,193	
1 1 10	Non-Rad Liquid Waste Disposal Basin	•	14	-		•	•	-	2	16	_		16				-			289	
1100	Non-Rad Liquid Waste Transfer House	•	14	-		•	•	-	1	8		-	6	-		-	-		-	84	
		•	286	-	•	-	•	•	43	329	-	-	329	•	•	-	•	-	-	3,526	
	Penetration Area	-	255	-	-	•	•	-	45	698	-	-	598	•	•	-	-	-	-		
	Service Building	-		-	-	-	•	•	78 87	664	-	-	098 664	-	•	•	•	-	•	8.811	
	Service Water Intake Structure	-	578	. •	-	- •	•	-		ç04 7	-	-	7	-	•	-	-	-	-	3,76L	
	Sewage Treatment Facilities	-	6	•	-	•	-	•	1		233	-	-	-	-	-	-	•	•	89	
	Steam Generator Removal	-	203	-	-	-	-	•	30	239	233	-		-	•	•	-	-	-	2,867	
	Trash and Fish Removal Building	-	18	-	•	-	-	-	8	20	-	-	20	-	•	-	-	-	-	269	
	Turbine Building	-	3,387	•	-	-	-	•	508	8,895	-	•	3,895	-	-	-	-	-	-	68,128	
	Turbine Pedestal	-	644	-	-	•	•	•	97	741	-	-	741		-	•	•	-	•	7,237	
.1.1.29	Water Pre-Treatment Building	-	122	-	-	•	-	-	18	140	•	•	140	-	•	-	-	-	•	1.629	
	Fuel Handling Building	-	2,238	-	•	•	-	-	336	2,674	257	-	2,317	•	-	•	•	-	-	28,638	
L1	Totals	-	23,544	-	-	-	-	-	8,532	27,076	1,683	•	25,393	•	-	•	-	-	-	821,415	
	sout Activities																				
1.1.2	Remove Rubble	•	5,970	-	•	-	• .	•	895	6,865	-	-	6,865	•	•	-	-	•	-	10,276	
.1.3	Grade & landscape site	-	590	-	-	•	- 1	-	89	679		-	679	-	•	•	-	-	-	1,938	
2.1.4 2.1	Final report to NRC Subtotal Period Sb Activity Costs	:	30,104	-	-	2	:	49 49	7 4,523	56 84,676	56 1,799	:	- 32,937	••••	-	:	-	-	:	333.629	
	Additional Costs																		•		
er100 30 5.2.1	Concrete Crushing	_	_	-	_	_	-	673	101	774	-	-	774						-	4.018	
	Subtotal Period 3b Additional Costs	•		-		-	-	673	101	774			774		-		•		-	4,018	
b.2	PROTOCAT LELIOO 20 WOOTTDOTT COPIE	-	-		-	-	•	0/3	101	11.4	-	•	114	-	•	•	-	-	•	4,018	

TLG Services, Inc.

#### TABLE C-2 SALEM GENERATING STATION - UNIT 2 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

Addity         Low         Event         Protect Protecting         Descent Protecting <thdescent prot<="" th=""><th></th><th></th><th></th><th></th><th></th><th></th><th>Off-Site</th><th>LLRW</th><th></th><th></th><th>-</th><th>NRC</th><th>Spent Fuel</th><th>Site</th><th>Processed</th><th></th><th>Burial V</th><th>alumes</th><th>··· -</th><th>Burial</th><th></th><th>Utility and</th></thdescent>							Off-Site	LLRW			-	NRC	Spent Fuel	Site	Processed		Burial V	alumes	··· -	Burial		Utility and
Linexe         Addag Mathyman         Cold         Conto         Casto												Lic. Term.	Management			Class A			GICC		Craft	
bill       Schuld Schlanz       937       -       -       4/4       931       - <th>Index</th> <th>Activity Description</th> <th>Cost</th> <th>Cast</th> <th>Casis</th> <th>Costs</th> <th>Costs</th> <th>Costs</th> <th>Costs</th> <th>Contingency</th> <th>Costs</th> <th>Costs</th> <th>Costs</th> <th>Costs</th> <th>Cu. Feet</th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th>Manhours</th>	Index	Activity Description	Cost	Cast	Casis	Costs	Costs	Costs	Costs	Contingency	Costs	Costs	Costs	Costs	Cu. Feet							Manhours
bill       Schuld Schlanz       937       -       -       4/4       931       - <td>Period 3b</td> <td>Collateral Costa</td> <td></td>	Period 3b	Collateral Costa																				
Dead B       Field Upper Number       Image of the field Upper Number<	36.3.1		-	805	-	-	-	-	-	46	351	-		851	_							
Park B         Park B<	36.3	Subtotal Pariod 3b Collateral Costs	-	905	•	-	-	-	•				•	851					•	•	•	-
bk.1       Lauranze       -       -       2.09       8.1       200       0       207       23       -																	-		-	-	-	-
bit 2       Figure Visate																						
bk.34       K.43       1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.			:	-	-	-				21	230	•		23	-	•	-	-	•	•	-	-
bit 41       Attal and and y badget       -       -       100       100       -				8.544		-		:		-	8815	. •		-	-	•	٠	-	•	•	-	-
bild B (SUSTS) Face       -	3b.4.4			-		•			206				-		•	-	•	-	-	-	-	-
bit 66       Encagency Flexible Pres.       - <t< td=""><td>3<b>b.4</b>.5</td><td></td><td>•</td><td>-</td><td>-</td><td>-</td><td></td><td>-</td><td></td><td></td><td></td><td>-</td><td></td><td></td><td></td><td></td><td>•</td><td>• •</td><td>•</td><td>-</td><td>-</td><td>•</td></t<>	3 <b>b.4</b> .5		•	-	-	-		-				-					•	• •	•	-	-	•
bit A1       0.97 Amil Servar CAM Colta       -	Sb.4.6		•	-	-	-	-					-			-		:		-		-	•
BAG 9 Utiling/BadT Cost       - <td></td> <td></td> <td>•</td> <td>-</td> <td>•</td> <td>-</td> <td>•</td> <td>• · ·</td> <td></td> <td>4</td> <td></td> <td>-</td> <td></td> <td>-</td> <td>-</td> <td>-</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>•</td>			•	-	•	-	•	• · ·		4		-		-	-	-						•
BAL       Superal Period Dependent Coats       1       1       1       1.028       1.281       2.028       1.291       0.071       1.028 <td></td> <td></td> <td>-</td> <td>-</td> <td>-</td> <td>•</td> <td>-</td> <td>-</td> <td></td> <td></td> <td></td> <td>(0)</td> <td></td> <td></td> <td>-</td> <td></td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>40 651</td>			-	-	-	•	-	-				(0)			-		-	-	-	-	-	40 651
And the control function of public control			•	-	-	•	÷.	•							-	•		-	-	•	-	
Control         Control <t< td=""><td>30.4</td><td>Subjects ferror an renor-Dependent Costs</td><td>-</td><td>3,344</td><td>-</td><td>-</td><td>-</td><td>-</td><td>12,802</td><td>2,329</td><td>17,976</td><td>(C)</td><td>7,406</td><td>10,669</td><td>-</td><td>-</td><td>• .</td><td>•</td><td>-</td><td>•</td><td>-</td><td></td></t<>	30.4	Subjects ferror an renor-Dependent Costs	-	3,344	-	-	-	-	12,802	2,329	17,976	(C)	7,406	10,669	-	-	• .	•	-	•	-	
Article S.D Direct Decomministing Activities Modern activities is this period Prind activities is this period Part activities Part activities Part activiti	35.0	TOTAL PERIOD 25 COST	•	33,753	-	-	•	-	19,024	6,999	53,775	1,789	7,406	44,631		•			•	-	337,647	198,930
No direct activities in this period         Varied & Period No.         11       Instructor       1       2,664       2,89       2,84       -	PERIOD	8a - Fuel Storage Operations/Shipping																				
bc11       Junuania       -       -       2,004       2,004       2,004       -       2,824       -																						
bc11       Junuania       -       -       2,004       2,004       2,004       -       2,824       -	Period Sc	Period-Dependent Costs																				
b.12       Property taxes			-	-	-		-	-	9 604	940	2 864		0.004									
k.4.3       Flant energy budget       -       -       488       73       561       .       611       -       <	8c.4.2			-	-							-		-	-	-	-		-	-	-	•
Let A. WRC1SFST Pers       -       -       1,443       143       1,533       -       -       -       -       -       1,533       -	3c.4.3	Plant energy budget	-	-	-	-		-	488	75	561	•				•	-	•	-	•	•	•
kc.46       LSFST Transfer and Capital Cents       -       -       1.967       958       2.962       - <t< td=""><td>8c.4.4</td><td></td><td>•</td><td>•</td><td>-</td><td>-</td><td>•</td><td>-</td><td></td><td></td><td></td><td>• •</td><td></td><td></td><td>-</td><td></td><td>• •</td><td></td><td>:</td><td>-</td><td>•</td><td>-</td></t<>	8c.4.4		•	•	-	-	•	-				• •			-		• •		:	-	•	-
hc.4.7       Dy Fuel Storage Odd/ Casts       -		Emergency Planning Fees	•	-	-	-	-	-	612	61		-	673	-	-	_	-	-	-	-	-	•
bc.4.6       Sciunty Staff Cast       -       -       7,594       1,139       8,733       -			-	-	•	٠	-	-				-		-	-	-	-	-		-	-	
ke.4.9       Utility Starff Coat       - </td <td></td> <td>Dry Fuel Storage O&amp;M Costs</td> <td>-</td> <td>-</td> <td>•</td> <td>-</td> <td>•</td> <td>•</td> <td></td> <td></td> <td></td> <td>-</td> <td></td> <td>- ·</td> <td>-</td> <td></td> <td></td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td></td>		Dry Fuel Storage O&M Costs	-	-	•	-	•	•				-		- ·	-			-	-	-	-	
24.3       0.110       46,770       -       -       -       -       66,770       -       -       -       -       66,770       -       -       -       -       66,770       -       -       -       -       66,770       -       -       -       -       66,770       -       -       -       -       -       66,770       -       -       -       -       -       66,770       -       -       -       -       -       66,770       -       -       -       -       -       66,770       -       -       -       -       -       66,770       -       -       -       -       -       66,770       -       -       -       -       -       66,770       -       -       -       -       -       66,770       -       -       -       -       -       66,770       -       -       -       66,770       -       -       -       66,770       -       -       -       66,770       -       -       -       -       66,770       -       -       -       -       -       -       -       -       -       -       -       -       -       -			-	•	-	-	-	•				•		-	-	•	-		•			391,380
k.0       TOTAL PERIOD 3c COST       -       -       -       56,793       8,136       63,929       -       -       -       987,769       987,769         PERIOD 3d - GTCC shipping       -       -       -       56,793       8,136       63,929       -       -       -       987,769       987,769         Period 3d Direct Decommissioning Activities       -       -       -       12,491       -       14,364       14,364       -       -       613       -       -       -       613       -       -       613       -       -       613       -       -       613       -       -       613       -       -       613       -       -       613       -       -       613       -       -       613       -       -       613       -       -       -       613       -       -       -       613       -       -       -       613       -       -       -       613       -       -       -       613       -       -       -       613       -       -       -       613       -       -       -       613       -       -       -       613       -       - <t< td=""><td>36.4.9</td><td>Cultury State Class</td><td>-</td><td>•</td><td>-</td><td>•</td><td>•</td><td>•</td><td></td><td></td><td></td><td>-</td><td></td><td>•</td><td>-</td><td>•</td><td>•</td><td>•</td><td>•</td><td>-</td><td>•</td><td></td></t<>	36.4.9	Cultury State Class	-	•	-	•	•	•				-		•	-	•	•	•	•	-	•	
PERIOD 8d - GTCC shipping       05,25       -       -       -       957,769         Period 9d Direct Decommissioning Activities         Vaciear Steam Supply System Removal         kd.1.1       -       -       -       12,491       1,874       14,364       14,364       -       -       613       -       -       -       613       -       -       -       613       -       -       -       613       -       -       -       613       -       -       -       613       -       -       -       613       -       -       -       613       -       -       -       613       -       -       -       -       -       -       613       -       -       -       -       -       -       -       -       613       -       -       -       -       -       -       -       613       -       -       -       -       -       -       -       613       -			-		-	•	-	•				-		•	-	•	•	•	-	•	-	
Paried 3d Direct Decommissioning Activities Vaclear Steam Supply System Removal 3d.1.1 Vessel & Internais OTCC Disposal 12,491 - 1,874 14,364 14,364 613			-	-	-	•	-	•	40,795	d, 130	63,323		68,929	-	•	-	-	•	-	-	•	987,769
Nachar Steam Supply System Removal kd.1.1 Vesel & Intervals GTICC Disposal 12,491 - 1,874 14,364 14,384 613	PERIOD	8d - GTCC shipping																				
kd.1.1       Vesel & Internals OTCC Disposal       -       -       -       12,491       1,874       14,364       14,364       -       -       613       -       614       14,364       14,364       14,364       14,364       14,364       14,364       14,364       14,364       14,364       14,364       14,364       1	Period 3d	Direct Decommissioning Activities																				
kd.1.1       Totals       -       -       -       -       -       -       613       -       -       613       -       -       613       -       -       613       -       -       613       -       -       613       -       -       613       -       -       613       -       -       613       -       -       613       -       -       613       -       -       613       -       -       613       -       -       613       -       614       -       613       -       -       614       613       -       -       614       613       -       -       -																						
dd.1.1       Totals       -       -       12,491       1,874       14,364       14,364       14,364       14,364       613       614       614       700       7	8d.1.1.1	Vessel & Internals GTCC Disposal	-		-	-	-	12,49L		1,874	14,364	14.364				-	_	_	612			
kd.1       Sabutal Period 3d Activity Casts       -       -       12,491       1,874       14,364			-	-	-	-	•	12,491	-	1,874	14,364	14,364		-	-	-		-		-	•	-
id.4.1       Insurance       -       -       -       6       1       6       -	3d.1	Subtotal Period 3d Activity Costs	-	•	-	•	•	12,491	•	1,874	14,364	14,364	-			•	-	-		-	:	-
id.4.1       Insurance       -       -       -       6       1       6       -	Period 84	Period-Dependent Costs																				
id.4.2       Property taxes       -       -       1       -			-	-	-	-	-		6	1	â	_										
id.4.8       Flant easrgy budget       -       1       1       1         id.4.8       NRC 13FS1 Fees       -       5       0       5         id.4.6       Energency Flanning Fees       -       2       0       2         id.4.5       SISS1 Transfer and Capital Costs       -       1B3       27       210       210	34.4.2			-	-	-	-		- "		- *	-		•	-	-	-	-	-	· -	•	•
id.4.4         NRC15FS1 Fers         -         -         -         6         5         -	3d.4.3	Plant energy budget	-	-	-	-	-	-	้า	- 0	1	-	•		-	-	-	-	-	•	-	-
dd.4.5 Emergency Planning Fees 2 0 2 2 dd.4.5 ISFSI Transfer and Capital Costs 183 27 210 210	3d.4.4	NRC ISFSI Fees	-	-	-	-	-	-	5		5					-	-	-	-	-	-	-
id.4.6 ISFSI Transfer and Capital Costs 183 27 210 210	3d. 4.6		-	-	-	-	•	-			2	-			· -		:	:			-	•
id 4.7 Dry Fuel Storage Class 1 0 1 1			-	-	•	•	•	•			210	-		-	-			-		-		-
	3d.4.7	Dry Fuel Storage O&M Costs	-	• •	•	•	-	•	1	0	1	-	1	-		· .	-	-	-	• .	-	-

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#### TABLE C-2 SALEM GENERATING STATION - UNIT 2 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

		Decon	Removal	Packaging	Transport	Off-Site Processing	LLRW Disposel	Other	Total	Total	NRC Lic. Term.	Spent Fuel Management	Site Restoration	Processed Volume	Class A	Burlal V Class B	olumes Class C	0700	Burlai		Utility and
Activity Index	Activity Description	Cost	Cost	Costs	Costs	Costs	Costs	Costs	Contingency	Costs	Costs	Costs	Costs	Cu. Feel	Class A Cu. Feet	Cu. Feet	Cu. Feet	GTCC Cu, Feet	Weight Lbs,	Craft Manhours	Contractor Manhours
Period Se	Period-Dependent Costs (continued)																				
8d.4.8	Security Staff Cost	-	-	-	-	-	•	17	8	20	•	20	-	-	•	-	•	-	-	-	900
3d.4.9	Utility Staff Cost	•	-	-	-	-	-	94	14	108	-	108	•	. •	•	-	-	-	-	-	1.371
Sd.4 Sd.0	Subtotal Period 3d Period-Dependent Costs TOTAL PERIOD 3d COST		-			-	- 12,491	309 809	46 1,919	355 14,719	14,864	865 855	-		•	-	•	613	-	-	2.271
		•	-	-	-	-	10,101	003	1,010	14.715	14,004	0.00	-	-	-	-	•	614		•	2.2(1
	) 8e - ISFSI Decontamination																				
	Direct Decommissioning Activities ect activities in this period											-									
Period 3a Se.2.1	Additional Costs ISFSI License Termination			10	70			050		2,855								•			
3e.2	Subtotal Period 3e Additional Costs	:	1,011 1,011	10			312 312	956 956	487 487	2,835	:	2,855 2,855		-	6,997 6,997	:		:	799,683 799,683	16.537 16.637	1.696 1.696
Period 34	Collateral Costs																				
3e.3.1	Smaft tool allowance	-	13	-		-		-	2	15		. 15		-		-	-	-		-	-
Se.S	Subtotal Period 3e Collateral Costs	-	19	-	•	-	-	-	2	15	-	15	•	-	•	•	-	-	•	•	-
	Pariod-Dependent Costs																				
3e.4.1 3e.4.2	Insurance Property taxes	-	•	•	•	-	-	45	6	50	-	50	-	•	-	-	-	-	•	•	•
3e.4.3	Heavy equipment rental	:	82		-	-	-		- 12	94	:	94			•	-	-	-	•	-	•
3e.4.4	Plant energy budget	-	-	-	-	-	-	52	8	59		59	-	-		-		-			:
Sc.4.5	NRC ISFSI Fera	· -	•	-	-	-	-	76	8	83	•	83	-	•		-	-	-		-	-
Se.4.6	Security Staff Cost	-	-	•	•	•	•	67	10	π	-	77	•	-	•	-	•	•	-	-	3,450
8c.4.7 3c.4	Utility Staff Cost Subtotal Period Se Period Dependent Costs	•	82	•	-	•	-	858 1.097	129 171	987 1,350	-	987 1,860	-	-	-	•	-	•	-	-	12.486
Se.0	TOTAL PERIOD 3e COST	-	1,106	10	78	-	312	2,053	660	4,220	-	4,220		-	6,997	:	-		799,883	16,537	16,936 17,632
PERIOI	8f - ISFSI Site Restoration																				
	Direct Decommissioning Activities ect activities in this period																				
	Additional Costs																	. '			
36.2.1	ISFSI Site Restoration	-	1,075	-	-	-	•	23	272	1,870	-	1,970	-	-	-	-	•	•	•	4,904	106
362 .	Subtotal Period Sf Additional Costs	-	1,076	-	•	-	•	23	272	1,370	-	1,970	-	-	•	-	-	•	•	4,904	106
	Collateral Costs									_				•							
3£8.1 8£9	Small tool allowance Subtotal Period SI Collateral Costs	-	· 4	-	:		:	:	1	5 5	-	5	:	-	:	:	:	:	-		:
	Period-Dependent Costs																				
\$£4.1	Insurance	-			-	•		25	2	27	-	27					-	-	-	_	_
S£4.2	Property taxes -	-	-	-	•	-	-			-	-		-			-	-		-	-	-
3E4.3	Heavy equipment rental	-	32	-	-	-	-	-	6	36	٠	56	-	•	-	•	· -	-	-	•	-
SE4.4	Plant energy budget Security Staff Cost	-	-	-	-	-	-	28 37	4	32 42		32 42	-	•	•	-	-	•	••	••	
3£4.5 3£4.6	Security Staff Cost Utility Staff Cost	:	-	:	-	:	:	37 229	6 34	42 264		42 264		:	:	:	:	· · ·	:	•	1.690 3.330
364	Subtotal Period 8f Period-Dependent Costa	-	52		-	•	-	319	51	402	-	402	-	-	-	-				:	3.330 5.920
3£0	TOTAL PERIOD 31 COST	-	1,110	-	-	•	• .	342	824	1,777	-	1,777	•	-	· •	•	-	•	•	4,904	5.326
PERIO	3 TOTALS	•	35,969	10	78	-	12,803	71,521	18,038	138,430	16,103	77,686	44,631		6,997	-		613	799,883	359,088	1.211.928
		•																			

TLG Services, Inc.

#### TABLE C-2 SALEM GENERATING STATION - UNIT 2 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

						Off-Site	LLRW				NRC	Spent Fuel	Site	Processed	-	Burial \	olumes		Burial		Utility and
Activity		Decon	Removal	Packaging	Transport	Processing	Disposal	Other	Total	Total	Lic. Term.	Management	Restoration	Volume	Class A	Class B	Class C	GTCC	Weight	Craft	Contractor
Index	Activity Description	Cost	Cost	Costs	Costs	Costs	Costs	Costs	Contingency	Costs	Costs	Costs	Costs	Cu. Feet	Cu. Feet	Cu. Feet	Co. Feet	Gu. Feet	Lbs.	Manhours	Manhours
lana and a state of the state o																					

TOTAL COST TO DECOMMISSION	9,956 82,735	9,795 10	1,125 14,934	64,651 314,868	92,838 598,702	420,141 124.844	63.717	74,384 98.	475 13,167	459	613 11,071,590 1,103,182	4,093,456

TOTAL COST TO DECOMDISSION WITH 18.24% CONTINGENCY:	\$598,702	thousands of 2002 dollars
TOTAL NRC LICENSE TERMINATION COST IS 70.18% OR	\$420,141	thousands of 2002 dollars
SPENT FUEL MANAGEMENT COST IS 20.85% OR:	\$124,844	thousands of 2002 dollars
NON-NUCLEAR DEMOLITION COST IS 8.97% OR:	\$53,717	thousands of 2002 dollars
TOTAL, PRIMARY SITE RADWASTE VOLUME BURIED;	81,642	cubic feet
TOTAL SECONDARY SITE RADWASTE VOLUME BURIED:	30,460	cubic feet
total greater than class c badwaste volume generated:	613	cubic feet
TOTAL SCRAP METAL REMOVED:	54,443	tons
TOTAL CRAFT LABOR REQUIREMENTS:	1,103,182	man-bours

End Notes: D/a - Indicates that this activity not charged as decommissioning expense. a - indicates that this activity performed by decommissioning staff. O - indicates that this value is less than 0.5 hut is non-zero. a cell containing ".-" indicates a zero value

#### TLG Services, Inc.

# **PSEG Nuclear LLC**

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# Forty-Year Safstor Decommissioning Cost Analysis

for

# Peach Bottom Atomic Power Stations, Unit 2 and 3

September 15, 2011

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## I. Summary

This report presents estimates of the cost to decommission the Peach Bottom Atomic Power Stations Units 2 and 3 (together, "Peach Bottom") following the end of their current licensed operating period ending on August 8, 2033 and July 2, 2034, respectively.<sup>1</sup>

This report relies in part on a December 2002 report by TLG Services entitled *Decommissioning Cost Analysis for the Peach Bottom Atomic Power Station, Unit 2 and 3* ("TLG Report"), with updates to account for the time value of money and a change in decommissioning method from DECON to a forty-year SAFSTOR. The TLG Report is included in its entirety in Appendix B to this report.

This report is based on two fundamental assumptions: (1) spent nuclear fuel ("SNF") management costs will be borne by the United States Government; and (2) Peach Bottom Units 2 and 3 will be placed in a forty-year period of safe storage following end of license in 2033 and 2034, respectively.

While spent fuels management costs are discussed in this report and its appendices, those costs are contractually the responsibility of the Government of the United States<sup>2</sup>, and are therefore not considered a liability that must be funded by the Peach Bottom Decommissioning Trust Fund. The Peach Bottom site has an Independent Spent Fuel Storage Installation ("ISFSI").

PSEG Nuclear considered the following three decommissioning options for Peach Bottom:

- DECON: The equipment, structures, and portions of the facility and site that contain radioactive contaminants are removed or decontaminated to a level that permits termination of the license after cessation of operations. Until 2008, this was the strategy that was to be used to decommission Peach Bottom.
- SAFSTOR: The facility is placed in a safe stable condition and maintained in that state until it is subsequently decontaminated and dismantled to levels that permit license termination. During SAFSTOR, a facility is left intact, but the fuel has been removed from the reactor vessel and radioactive liquids have been drained from systems and components and then processed. Radioactive decay occurs during the SAFSTOR period, thus reducing the levels of radioactivity in and on the material and potentially the quantity of material that must be disposed of during

<sup>&</sup>lt;sup>1</sup> The Peach Bottom facility also had a Unit 1 reactor. This reactor was not owned or operated by PSEG Nuclear; therefore, PSEG Nuclear has no reporting requirement for this reactor.

<sup>&</sup>lt;sup>2</sup> See US Department of Energy Contract No. DE-CR01-83NE44405, Peach Bottom Atomic Power Station Nos. 2 and 3 Units Contract for Disposal of Spent Fuel and/or High-Level Radioactive Waste (Jun. 13, 1983), as amended.

decontamination and dismantlement. This is the method PSEG will use to evaluate decommission Peach Bottom.

• ENTOMB: involves encasing radioactive structures, systems, and components in a structurally long-lived substance, such as concrete. The entombed structure is appropriately maintained, and continued surveillance is carried out until the radioactivity decays to a level that permits termination of the license. Because most power reactors will have radionuclides in concentrations exceeding the limits for unrestricted use even after 100 years, this option will generally not be feasible and was not deemed to be viable for Peach Bottom.

This report assumes a forty-year period of safe storage for each Peach Bottom unit after end of its current licensed operating period<sup>3</sup>. PSEG Nuclear LLC, the non-operating owner of Peach Bottom, has chosen a forty year SAFSTOR evaluation period (approximately 7.6 half-lives of the radioactive isotope Cobalt 60) as a prudent measure to reduce overall radiation exposure to workers during the decommissioning period. An added benefit of the SAFSTOR method is that worker efficiency will be greater due to fewer radiological restrictions during performance of the work. However, economic benefits from gains in efficiency will be partially off-set by maintenance and security costs during the SAFSTOR period, and these costs have been explicitly addressed in this report.

### **II. Methodology**

The TLG Report provided in Appendix B to this report provided the primary source of information related to costs associated with decommissioning Peach Bottom. PSEG personnel used the information in that report to develop the estimate applicable to SAFSTOR described in this report.

Because costs were reported in the TLG Report in 2002 dollars, the first step in the process was to escalate the 2002 costs to 2010 dollars. This re-evaluation produced an increase adjustment of 21.3% for 2010 Labor & Equipment Costs over the 2002 TLG Report. The Pennsylvania labor rates from 2003 through 2010 as well as Construction Equipment Costs over the same time frame were used to develop the overall adjustment. The SAFSTOR Decommissioning value was arrived at by taking the 2010 immediate decommissioning cost and adjusting it to reflect significant reduction in residual radioactivity thereby reducing/eliminating the radiation hazards during the dismantling and demolition. This expected improvement will lead to a reduction in overall decommissioning cost, and that improvement is reflected in this study. Details of the adjustment factors used are provided in Table 2.

Aside from the conversion from 2002 to 2010 dollars, two other significant changes were made to update the 2002 TLG Report to address the current forty-year SAFSTOR strategy for Peach Bottom. The first change involved shifting the initial costs for

<sup>&</sup>lt;sup>3</sup> The forty-year SAFSTOR period will begin after a three-year period during which systems are drained, fuel is removed, and the plants are readied for safe storage.

preparing the plant for decommissioning from the start of the seven-year decommissioning and dismantlement period assumed in the DECON scenario to prior to the start of the SAFSTOR period. These up-front costs are incurred in three years immediately following termination of operations. The second major change was adding a forty-year period of safe storage prior to final decommissioning. A timeline of these activities is shown in Appendix A to this report. Detailed information showing cash flows, major events, and assumptions is contained in a one-page summary in Table 5 of this report.

Peach Bottom Atomic Power Station Decommissioning Cost Analysis Document P07-1425-004, Rev. 0 Appendix A, Page 1 of 4

# APPENDIX A

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# UNIT COST FACTOR DEVELOPMENT

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III. Tables

Work Category <sup>4</sup>	Cost 2002\$ (thousands)	Cost 2010\$ (thousands)	Percent of Total Costs
Decontamination	14,484	17,578	2.5%
Removal	69,674	84,557	11.8%
Packaging	14,487	17,581	2.5%
Transportation	4,741	5,754	0.8%
Waste Disposal	116,518	141,407	19.8%
Off-Site Waste Processing	36,916	44,801	6.3%
Program Management (incl.			
Eng. and Security)	188,969	229,333	32.1%
Spent Fuel Pool Isolation	9,060	10,995	1.5%
ISFSI Related (including capital)	80,074	97,178	14.6%
Insurance and Regulatory Fees	8,773	10,647	1.5%
Energy	18,617	22,594	3.2%
Characterization and Licensing Surveys	5,676	6,888	1.0%
Misc. Equipment and Site Services	21,000	25,486	3.6%
Total	588,990	714,799	100.0%
License termination (10 CFR § 50.75 decommissioning activities) <sup>5</sup>	565,501	686,294	
Site Restoration (non- 50.75 activities)	23,489	28,506	

# Table 1A: Summary of Decommissioning Cost Elements- Peach Bottom 2

<sup>4</sup> Includes contingencies.

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<sup>&</sup>lt;sup>5</sup> This total includes spent fuel management.

Work Category <sup>6</sup>	Cost 2002\$ (thousands)	Cost 2010\$ (thousands)	Percent of Total Costs
Decontamination	17,010	20,643	2.4%
Removal	102,950	124,940	14.6%
Packaging	14,934	18,124	2.1%
Transportation	5,247	6,338	0.7%
Waste Disposal	123,946	150,421	17.6%
Off-Site Waste Processing	41,441	50,293	5.9%
Program Management (incl.			
Eng. and Security)	257,180	312,115	36.5%
Spent Fuel Pool Isolation	6,040	7,330	0.9%
ISFSI Related (including capital)	81,571	98,995	11.6%
Insurance and Regulatory Fees	8,348	10,131	1.2%
Energy	18,470	22,415	2.6%
Characterization and Licensing Surveys	6,363	7,722	0.9%
Misc. Equipment and Site Services	21,579	26,188	3.1%
Total	705,080	855,686	5 100.0%
License termination (10 CFR § 50.75 decommissioning activities) <sup>7</sup>	653,300	) 792,84	7
Site Restoration (non- 50.75 activities)	51,780	) 62,84	0

# Table 1B: Summary of Decommissioning Cost Elements- Peach Bottom 3

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<sup>&</sup>lt;sup>6</sup> Includes contingencies.

<sup>&</sup>lt;sup>7</sup> This total includes spent fuel management.

# Table 2A: Summary of Cost Efficiency Adjustments- Peach Bottom 2

					Adjustment	Factors	
						Cost	
						Reduction	
					Cost	Adjustment	
					Efficiency	Contam. To	
					Factor	Decontam.	
		Factors					
			TLG	TLG			SAFSTOR
			2002\$	2010\$			2010\$
			(thousands)	(thousan	ds)		(thousands)
Decomm	issioning						
	Non Contaminated	71%	\$ 252,345	\$ 306,247	7 90%	0%	\$ 276,929
	Contaminated	29%	\$ 103,071	\$ 125,087	/ 0%	25%	\$ 94,260
	Spent Fuel Mgmt	100%	\$ 93,469	\$ 113,97	2 100%	0%	\$ 113,972
	Other Fixed	100%	\$ 44,732	\$ 54,544	100%	0%	\$ 54,544
	Sub-Total		\$ 493,617	\$ 599,850	)		\$ 539,706
Continge	ncv		\$ 95,373	\$ 115,745	;		\$ 104,278
			\$ 20,070	<i><i>w</i> 110,712</i>	•		¥ 107,270
Total Pe	ach Bottom 2 <sup>8</sup>		\$ 588,990	\$ 715,595	5		\$ 643,984

SAFSTOR

<sup>&</sup>lt;sup>8</sup> Individual line items are rounded so totals may vary slightly due to round-off error.

				SAFSTOR Adjustment	<u>Factors</u> Cost Reduction	
				Cost Efficiency Factor	Adjustment Contam. To Decontam.	
	Factors					
		TLG 2002\$ (thousands)	TLG 2010\$ (thousand	is)		SAFSTOR 2010\$ (thousands)
Decommissioning		<b>`</b>	,	,		
Non Contaminated		\$ 293,867	\$ 356,638		0%	\$ 322,496
Contaminated	29%	\$ 120,030	\$ 145,669		25%	\$ 109,770
Spent Fuel Mgmt	100%	\$ 142,431	\$ 173,674		0%	\$ 173,674
Other Fixed	100%	\$ 36,656	\$ 44,697	100%	0%	\$ 44,697
Sub-Total		\$ 592,984	\$ 720,679			\$ 650,637
Contingency		\$ 112,096	\$ 136,040			\$ 122,995
Total Peach Bottom 3 <sup>9</sup>		\$ 705,080	\$ 856,718			\$ 773,631

<sup>&</sup>lt;sup>9</sup> Individual line items are rounded so totals may vary slightly due to round-off error.

Location:Peach Bottom Generating Station Unit 2 and 3Project:Decommissioning of Nuclear Plants After Safe Storage

Decommissioning Cost For Peach Bottom Nuclear Power Plant After Forty Years of Safe Storage

#### Analysis:

#### Bases of Cost - TLG Cost 2002

Plant Prep & Temp Service Rigging Construction Control & Tooling Security Staff (except Spent Fuel Mgt.) Utility Staff (except Spent Fuel Mgt.) Final Site Survey

Based on the cost of items to be decontaminated (from TLG estimate), determined that Contaminated Factors represent approx. 29% of the total cost to decommission a Nuclear Plant. Therefore, Non - contaminated factors represent approx. 71% of the total cost.

#### **Cost Efficiency Factors:**

The 2002 TLG Estimate was based on single unit demolition basis for Peach Bottom, and in our review we acknowledge an economy scale should be applied since Peach Bottom Unit 2 and 3 will be done in tandem. We will reference EPRI study ESC-4685 SIA 83-420 a Nuclear Power Construction study prepared by United & Construction Inc. that supports multi unit construction has efficiency reduction (summarized below).

Station	Reactor Type	Multi Unit Efi Direct Craft L	5
Peach Bottom	BWR	1-2 11%-22%	1-3 28%-36% Data Source EPRI p. 3-79 & 3-80

#### **Cost Assumptions:**

#### Peach Bottom -

In consideration of the EPRI study, efficiency reduced the variable costs. Fixed cost elements (see base cost allocation above) remain constant on a per unit basis. The TLG cost was reduced by 10% since this will be a mass demolition (non contaminated) vs. controlled demolition (contaminated)

The Spent Fuel will follow the same fact pattern and cash flow pattern as in the 2002 TLG Study for Peach Bottom.

Since decommissioning after 40 yrs would be equivalent to normal demolition work in a Fossil Plant an additional allowance of 15% savings has been made to contaminated portion of the work only. (Working in a contaminated area can account for a loss of productivity of an additional 25% or 2 Man Hrs/Day). The breakdown of unproductive time is listed below, is based on field observations made at the nuclear sites.

Security:	0.5 MH	6.25%
Suit Up requirements (two times/day)	1 MH	12.5%
Clean up at the end of day	0.5 MH	6.3%
Total	2 MH	25.0%

The other factors affecting productivity in a contaminated area physical restrictions congestion, height adjustment in work space (crawl space or 40ft. In the air), outage schedule (comprised time line) and

ALARA (level of allowance radiation) & proximity of other on going projects. The cost assumptions correspond to present circumstances and to the present status & availability of technology.

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# Table 3A: Peach Bottom Unit 2 SAFSTOR vs. Non-SAFSTOR Summary of Costs 2010\$ (millions)

	Non SAFSTOR		
Description	TLG 2002	TLG (esc.) 2010	PSEG 2010
Site Specific Cost			
Lic. Termination	468.6	569.4	497.8
Spent Fuel Mgmt.	96.9	117.6	117.6
Site Restoration	23.5	28.6	28.6
Total (100% Share)	589.0	715.6	644.0
PSEG Share (w/Spent Fuel) <sup>10</sup>	294.5	357.8	322.0
Spent Fuel Costs	(48.5)	(58.8)	(58.8)
PS share (w/o Spent Fuel)	246.0	299.0	263.2
Site Restoration (PSEG Share)	(11.8)	(14.2)	(14.3)
PS share (w/o Site Restoration & Spent Fuel)	234.2	284.8	248.9

 $<sup>^{10}</sup>$  The spent fuel management cost include an allocation from the contingency shown on table 2.

# Table 3B: Unit 3 SAFSTOR vs. Non-SAFSTOR Summary of Costs 2010\$ (millions)

	Non SAFSTOR		
Description	TLG 2002	TLG (esc.) 2010	PSEG 2010
Site Specific Cost			
Lic. Termination	492.8	599.1	515.9
Spent Fuel Mgmt.	160.5	194.8	194.8
Site Restoration	51.8	62.9	62.9
Total (100% Share)	705.1	856.7	773.6
PSEG Share (w/Spent Fuel) <sup>11</sup>	352.6	427.9	386.8
Spent Fuel Costs	(80.3)	(97.4)	(97.4)
PS share (w/o Spent Fuel)	272.3	330.5	289.4
Site Restoration (PSEG Share	(25.9)	(31.4)	(31.4)
PS share (w/o Site Restoration & Spe Fuel)	ent 246.4	299.1	258.0

<sup>&</sup>lt;sup>11</sup> The spent fuel management cost include an allocation from the contingency shown on table 2.

		(*		<b>Iu</b> I <i>Sy</i>			
Year	Labor	Equipment & Materials	Energy	Burial	Other	Total	O&M Security During SAFSTOR
2033 2034	5.6 28.7	0.1 3.3	0.2 0.9	0.0 0.7	0.4 3.1	6.4 36.8	
2034	8.4	1.5	0.8	0.9	4.1	15.6	
2035	0.7	1.5	0.0	0.9	7.1	15.0	2.6
2030							2.6
2037							2.6
2038							2.6
2039							2.6
2040							2.6
							2.6
2042							2.6
2043							2.6
2044							
2045							2.6
2046							2.6
2047							2.6
2048							2.6
2049							2.6
2050							2.6
2051							2.6
2052							2.6
2053							2.6
2054							2.6
2055							2.6
2056							2.6
2057							2.6
2058							2.6
2059							2.6
2060							2.6
2061							2.6
2062							2.6
2063							2.6 2.6
2064							2.6
2065 2066							2.6
							2.6
2067							2.6
2068 2069							2.6
2009							2.6
2071 2072							2.6 2.6
2072							2.6 2.6
							2.6
2074 2075							2.6
	117	0.6	0.3	0.0	0.5	12.2	2.0
2076	11.7	0.6		0.0	0.5	13.2 26.3	
2077	11.6	3.8	0.3	7.4	3.1		
2078	17.4	5.2	0.4	11.9	4.6	39.5	
2079	42.8 33.9	5.7	1.0	12.2 8.9	4.1	65.8	
2080	55.9	4.2	1.1	0.7	4.5	52.6	

# TABLE 4A: SCHEDULE OF ANNUAL EXPENDITURES Peach Bottom Unit 2 - SAFSTOR (millions, 2010 dollars)

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2081	33.0	4.7	0.3	0.0	1.5	39.5	
2082	17.6	7.5	0.2	0.0	1.1	26.3	
Total	210.7	36.7	5.5	42.1	27.0	322.0	130.0

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total	O&M Security During SAFSTOR
2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055 2056 2057 2058 2055 2056 2057 2058 2059 2060 2061 2062 2063 2064 2065 2066 2067 2068 2066 2067 2068 2069 2070 2071 2072 2073 2074 2075 2076 2077 2078 2079 2080 2081	9.3 47.6 13.9 12.8 12.8 19.1 47.1 37.3	0.2 5.5 2.5 0.7 4.2 5.7 6.2 4.7	0.3 1.5 1.3 0.3 0.3 0.5 1.1 1.2	0.1 1.2 1.4 0.0 8.2 13.1 13.5 9.8	0.7 5.2 6.9 0.6 3.4 5.1 4.5 4.9	10.5 61.0 25.9 14.5 28.9 43.4 72.4 57.9	2.6 2.6

## TABLE 4B: SCHEDULE OF ANNUAL EXPENDITURES Peach Bottom Unit 3 - SAFSTOR (millions, 2010 dollars)

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2082 2083	36.3 19.4		0.3 0.2	0.0 0.0	1.6 1.2	43.4 28.9	
Total	255.5	43.0	7.1	47.2	34.0	386.8	130.0

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## Table 5A Peach Bottom 2 Cash Flows

Year	Annual Expenditures thousands 2010	DTF Fund Balance 2% Real Rate of Return dollars less expenditures	SAFSTOR Year	Notes
		216,330		Balance as of 12/31/2010
0011		000 / 57		
2011		220,657		
2012		225,070		E 11.1 1
2013		229,571		Fund balances escalates at 2%
2014 2015		234,162		per annum during remaining
2013		238.846 243,623		period of operation
2018		243,025 248,495		
2017		253,465		
2018		258,534		
2020		263,705		
2021		268,979		
2022		274,359		
2023		279,846		
2024		285,443		
2025		291,151		
2026		296,975		
2027		302,914		
2028		308,972		
2029		315,152		
2030		321,455		
2031		327,884		
2032 2033	6,400	334,442 334,731		Expenses to put plant in
2033	36,800	304,625		SAFSTOR Condition, includes
2034	15,600	295,118		security and O&M
2036	15,000	298,420	1	Annual Security and O&M
2037		301,788	2	cost during SAFSTOR is
2038		305,224	3	\$2.6MM (PSEG Share)
2039		308,729	4	
2040		312,304	5	
2041		315,950	6	
2042		319,669	7	
2043		323,462	8	
2044		327,331	9	
2045		331,278	10	
2046 2047		335,303 339,409	11 12	
2047		343,598	12	
2049		347,870	14	
2050		352,227	15	
2051		356,672	16	
2052		361,205	17	
2053		365,829	18	
2054		370,545	19	
2055		375,357	20	
2056		380,364	21	
2057		385,269	22	
2058		390,374	23	
2059 2060		395,582	24 25	
2060		400,894 406,311	25 26	
2062		411,838	20	
2062		417,474	28	
2064		423,224	29	
2065		429,088	30	
2066		435,070	31	

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2067		441,171	32
2068		447,395	33
2069		453.743	34
2070		460,218	35
2071		466,822	36
2072		473,558	37
2073		480,430	38
2074		487,438	39
2075		494,587	40
2076	13,200	491,279	
2077	26,300	474,804	
2078	39,500	444,800	
2079	65,800	387,896	
2080	52,600	343,054	
2081	39,500	310,415	
2082	26,300	290,324	

Costs during 7-year decommissioning period includes security and O&M

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## Table 5B Peach Bottom 3 Cash Flows

Year	Annual Expenditures thousands 2010	DTF Fund Balance 2% Real Rate of Return dollars less expenditures	SAFSTOR Year	Notes			
		219,251		Balance as of 12/31/2010			
2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027		223,636 228,109 232,671 237,327 242,324 246,912 251,850 256,887 262,025 267,266 272,611 278,063 283,625 289,297 295,083 300,985		Balance as of 12/31/2010 Fund balances escalates at 2% per annum during remaining period of operation			
2027 2028		307,004 313,144					
2029 2030 2031 2032		319,407 325,795 332,312 338,958		,			
2033		345,737					
2034 2035 2036 2037	10,500 61,000 25,900	342,152 287,995 267,855 270,612	1	Expenses to put plant in SAFSTOR Condition, includes security and O&M Annual Security and O&M			
2038 2039		273,424 276,293	2 3	cost during SAFSTOR is \$2.6MM (PSEG Share)			
2040		279,219	4				
2041 2042		282,203 285,247	5 6				
2043		288,352	7				
2044 2045		291,519 294,749	8 9				
2046		298,044	10				
2047		301,405	11				
2048 2049		304,833 308,330	12 13				
2050		311,897	14				
2051		315,535	15				
2052 2053		319,245	16				
2053		323,030 326,891	17 18				
2055		330,829	19				
2056		334,845	20				
2057 2058		338,942 343,121	21 22				
2058		347,383	22				
2060		351,731	24				
2061		356,166	25				
2062 2063		360,689 365,166	26 27				
2063		370,009	27 28				
2065		374,809	29				
2066		379,705	30				
2067		384,699	31				

2068		389,793	32
2069		394,989	33
2070		400,288	34
2071		405,695	35
2072		411,209	36
2073		416,833	37
2074		422,569	38
2075		428,421	39
2076		434,389	40
2077	14,500	428,577	
2078	28,900	408,248	
2079	43,400	373,013	
2080	72,400	308.074	
2081	57,900	256,335	
2082	43,400	218,062	
2083	28,900	193,523	

Costs during 7-year decommissioning period includes security and O&M

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Table 6: Decommissioning Waste SummaryPlease see Table 5.1, Decommissioning Waste Summary, in the TLG Report, attached asAppendix B to this report.

**Table 7: Detailed Cost Analysis**Please see Appendix C in the TLG Report, attached as Appendix B to this report.

IV. AppendicesA. Time LineB. December 2002 TLG Decommissioning Cost Analysis

Appendix A: Time Line

Peach Bottom 2

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Activity	2033 2	2034	2035 20	)36 - 2075	5 2076 2	2077 2	2078 2	2079 :	2080 2	081 2	082
Shutdown through Transition	x	x	x								
Safe storage p	eriod			x							
Decommission and Site Resto					x	x	x	x	x	x	x
Peach Bottom 3											
Activity	2034 2	2035	2036 20	)37 - 2076	5 2077 2	2078 2	2079 2	2080 :	2081 2	082 2	083
Shutdown through Transition	x	x	x								
Safe Storage period				x							
Decommissioning and Site Restoration				x	x	x	x	x	x	x	

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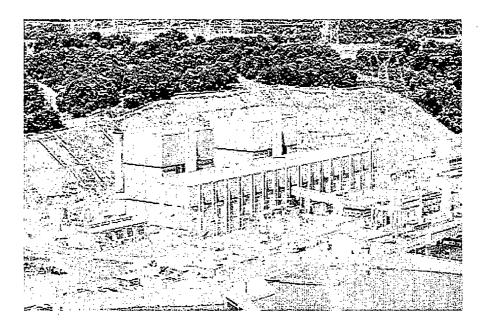
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Appendix B: December 2002 TLG Decommissioning Cost Analysis

# DECOMMISSIONING COST ANALYSIS

for the

# PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3



prepared for

# PSEG NUCLEAR, LLC

prepared by

TLG Services, Inc. Bridgewater, Connecticut

December 2002

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# **APPROVALS**

**Project Manager** 

**Project Engineer** 

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William A. Cloutier.

Palmer

12/4/02 Date

<u>12/4/02</u> Date

<u>12/4/02</u> Date <u>12/05/02</u>

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TLG Services, Inc.

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# **REVISION LOG**

No.	CRA No.	Date	Item Revised	Reason for Revision
0		12-05-02		Original Issue
		-		
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## **EXECUTIVE SUMMARY**

This report presents the costs to promptly decommission (decontaminate and dismantle) the Peach Bottom Atomic Power Station, Units 2 and 3 (Peach Bottom) following a scheduled cessation of plant operations. The analysis relies upon the site-specific, technical information developed for a previous evaluation prepared in 1995-96, updated to reflect current plant conditions and operating assumptions. The estimates are designed to provide PSEG Power with sufficient information to assess its financial obligations as they pertain to the eventual decommissioning of the nuclear station.

The estimates are based on numerous fundamental assumptions, including regulatory requirements, project contingencies, low-level radioactive waste disposal practices, high-level radioactive waste management options, and site restoration requirements. The estimates incorporate a cooling period of approximately five years for the spent fuel that resides in the plant's storage pools when operations cease. Any residual fuel remaining in the pools after the five-year period will be relocated to an on-site, interim storage facility to await the transfer to a DOE facility. The estimates also include the dismantling of non-essential structures and limited restoration of the site.

#### <u>Alternatives and Regulations</u>

The Nuclear Regulatory Commission (NRC) provided general decommissioning guidance in the rule adopted on June 27, 1988.<sup>[1]</sup> In this rule the NRC set forth technical and financial criteria for decommissioning licensed nuclear facilities. The regulations addressed planning needs, timing, funding methods, and environmental review requirements for decommissioning. The rule also defined three decommissioning alternatives as being acceptable to the NRC - DECON, SAFSTOR, and ENTOMB.

<u>DECON</u> 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."<sup>[2]</sup>

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<sup>&</sup>lt;sup>1</sup> 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.

<sup>&</sup>lt;sup>2</sup> Ibid. Page FR24022, Column 3.

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<u>SAFSTOR</u> 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."<sup>[3]</sup> Decommissioning is to be completed within 60 years, although longer time periods will be considered when necessary to protect public health and safety.

<u>ENTOMB</u> 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."<sup>[4]</sup> 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. As such, the NRC is currently re-evaluating this option and the technical requirements and regulatory actions that would be necessary for entombment to become a viable option.

In 1996, the NRC published revisions to the general requirements for decommissioning nuclear power plants to clarify ambiguities and codify procedures and terminology as a means of enhancing efficiency and uniformity in the decommissioning process. 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 describes the methods and procedures that are acceptable to the NRC staff for implementing the requirements of the 1996 revised rule that relate to the initial activities and the major phases of the decommissioning process. The costs and schedules presented in this analysis follow the general guidance and process described in the amended regulations.

#### Methodology

The methodology used to develop the estimates described within this document follows the basic approach originally presented in the cost estimating guidelines<sup>[5]</sup> developed by the Atomic Industrial Forum (now Nuclear Energy Institute). This reference

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<sup>&</sup>lt;sup>3</sup> <u>Ibid.</u>

<sup>4 &</sup>lt;u>Ibid.</u> Page FR24023, Column 2.

<sup>&</sup>lt;sup>5</sup> T.S. LaGuardia et al., "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates," AIF/NESP-036, May 1986.

describes a unit factor method for determining decommissioning activity costs. The unit factors used in this analysis incorporate site-specific costs and the latest available information on worker productivity in decommissioning.

The estimates also reflect lessons learned from TLG's involvement in the Shippingport Station Decommissioning 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 technical challenges of decommissioning commercial nuclear units.

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

## Contingency

Consistent with industry 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."<sup>[6]</sup> The cost elements in the estimates are based on ideal conditions; therefore, the types of unforeseeable events that are almost certain to occur in decommissioning, based on industry experience, are addressed through a percentage contingency applied on a line-item basis. This contingency factor is a nearly universal element in all large-scale construction and demolition projects. It should be noted that contingency, as used in this estimate, 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.

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<sup>&</sup>lt;sup>6</sup> Project and Cost Engineers' Handbook, Second Edition, American Association of Cost Engineers, Marcel Dekker, Inc., New York, New York, p. 239.

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#### 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 Disposal Act" in 1980, and its Amendments of 1985,<sup>[7]</sup> the states became ultimately responsible for the disposition of radioactive waste generated within their own borders.

Pennsylvania is a member of the four-state Appalachian States Low-Level Radioactive Waste Compact, formed in response to the waste legislation. Since Pennsylvania generators produced approximately 75% of the waste in the Compact, the state was selected as the initial host state. The Pennsylvania Low-Level Radioactive Waste Disposal Act (1988) granted the Department of Environmental Resources the responsibility for governing the development, operation, maintenance, and eventual closure of the disposal facility. The siting process was suspended in 1998 following a significant decrease in the waste volume produced by Pennsylvania generators and the continued availability of disposal capacity at two out-of-state facilities.

While the generators in the four states are currently able to access the disposal facility in Barnwell, South Carolina, the situation is expected to be much different in the future. A state law passed in July 2000 limits the annual volume of waste that can be accepted at the Barnwell site through mid-year 2008. After that date, the site can only accept waste generated within the Atlantic Compact region. Therefore, it is reasonable to assume that additional disposal capacity will be required to support reactor decommissioning, particularly for the isolation of the more highly radioactive material that is not suitable for disposal elsewhere.

This analysis presumes that new disposal facilities will be available by the time the station ceases operation. However, for estimating purposes, rate schedules for the currently operating Barnwell and Envirocare facilities were used to generate disposal costs.

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<sup>&</sup>quot;Low-Level Radioactive Waste Policy Amendments Act of 1985," Public Law 99-240, 1/15/86.

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## High-Level Radioactive Waste Management

Congress passed the "Nuclear Waste Policy Act"<sup>[8]</sup> in 1982, assigning the responsibility for disposal of spent nuclear fuel created by the commercial nuclear generating plants to the DOE. This legislation also created a Nuclear Waste Fund to cover the cost of the program, which is funded by the sale of electricity from nuclear reactors since 1993, and an estimated equivalent value for assemblies irradiated prior to 1983. The Nuclear Waste Policy Act, along with the individual disposal contracts with 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. Operation of DOE's yet-to-be constructed geologic repository is currently scheduled for the year 2010, assuming that the licensing could be completed expeditiously and a national transportation system established. The agency has no plans for receiving spent fuel from commercial nuclear plant sites prior to this date and startup operations may be phased in, creating additional delays.

The NRC requires licensees to 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. For estimating purposes, Exelon Generation has assumed that the high-level waste repository, or some interim storage facility, will be fully operational by 2015. Interim storage of the fuel, until the DOE has completed the transfer, will be in an independent facility located on the Peach Bottom site. This will allow the licensee to proceed with decommissioning and terminate its operating licenses in the shortest time possible.

The spent fuel storage facility, which is independently licensed and operated, will be sized to accommodate the inventory of spent fuel residing in the plant's storage pools at the cessation of operations, in addition to any operational inventory already in residence. When emptied, the station could be dismantled without maintaining the wet storage pools. Based upon this scenario, and an anticipated rate of transfer, spent fuel is projected to remain on site for approximately 26 years following the cessation of Unit 2 operations.

#### Site Restoration

The efficient removal of the contaminated materials at the site may result in damage to many of the site structures. Blasting, coring, drilling, and the other decontamination activities will substantially damage power block structures, potentially weakening the footings and structural supports. Prompt demolition once

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<sup>&</sup>lt;sup>8</sup> "Nuclear Waste Policy Act of 1982 and Amendments," U.S. Department of Energy's Office of Civilian Radioactive Management, 1982.

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 study assumes that site structures will be removed to a nominal depth of three feet below the local grade level wherever possible. The site will then be graded and stabilized.

#### Summary

The DECON decommissioning alternative involves the prompt removal of the contaminated and activated plant components, including structural materials, from the site following permanent shutdown. The facility operator may then have unrestricted use of the site with no further requirement for a license. This study assumes that the remainder of the non-essential plant systems and structures, not previously removed in support of license termination, are dismantled and the site restored.

The scenario analyzed for the purpose of generating the estimates 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.

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# COST SUMMARY (Thousands of 2002 Dollars)

Activity	Unit 2	Unit 3	Station
Decontamination	14,484	17,010	31,495
Removal	69,674	102,950	172,624
Packaging	14,487	14,934	29,422
Transportation	4,741	5,247	9,988
Waste Disposal	116,518	123,946	240,463
Off-site Waste Processing	36,916	41,441	78,358
Program Management	188,969	257,180	446,149
(including Engineering and Security)	·	-	
Spent Fuel Pool Isolation	9,060	6,040	15,101
ISFSI Related (including capital)	80,074	81,571	161,645
Insurance and Regulatory Fees	8,773	8,348	17,121
Energy	18,617	18,470	37,087
Characterization and Licensing Surveys	5,676	6,363	12,039
Misc. Equipment and Site Services	21,000	21,579	42,579
Total 1	588,990	705,080	1,294,070
			•
License Termination <sup>2</sup> Site Restoration	565,501 23,489	653,300 51,780	1,218,801 75,269

<sup>[1]</sup> Columns may not add due to rounding.

[2] Includes spent fuel management expenditures.

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## 1. INTRODUCTION

This decommissioning analysis is designed to provide PSEG Power with sufficient information to prepare the financial planning documents for decommissioning, as required by the Nuclear Regulatory Commission (NRC or Commission). It is not a detailed assessment, but a financial analysis prepared in advance of the engineering and planning that will be required to carry out the decommissioning of the Peach Bottom Atomic Power Station, Units 2 and 3 (Peach Bottom).

## 1.1 **OBJECTIVES OF STUDY**

The objectives of this study are to prepare comprehensive estimates of the costs to decommission Peach Bottom for the scenario outlined in Section 2, to define a sequence of events, and project the volume of waste produced from the decontamination and dismantling activities.

Peach Bottom is jointly owned by PSEG Power, LLC (50%) and Exelon Generation Corporation (50%). However, for purposes of this study, only the undivided decommissioning costs (100%) are presented, since the division of ownership has no effect on the total expenditures required. PSEG Nuclear oversees PSEG Power's ownership interest in Peach Bottom, while Exelon Nuclear operates the station.

Operating licenses were issued on August 8, 1973, for Unit 2 and July 2, 1974, for Unit 3. For the purposes of this study, the shutdown dates were taken as August 8, 2013, for Unit 2 and July 2, 2014, for Unit 3. This time frame, which reflects 40 years of operating life for each unit, was used as an input for scheduling the decommissioning activities.

#### **1.2 SITE DESCRIPTION**

Peach Bottom is located about 38 miles north-northeast of Baltimore, Maryland, and 63 miles west-southwest of Philadelphia, Pennsylvania. Units 2 and 3 are two essentially identical boiling water reactors with supporting facilities. Unit 1 was a 40-megawatt experimental, high-temperature, helium-cooled and graphite-moderated reactor. It was shutdown in 1974 and its disposition is not addressed in this analysis.

The Nuclear Steam Supply Systems (NSSS) for Units 2 and 3 consist of a boiling water reactor and a two-loop recirculation system. A generating unit has a rated core thermal power of 3,293 Megawatts thermal (MWt). The

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corresponding net electrical output is approximately 1,126 Megawatts electric (MWe).

The two-loop reactor recirculation system contains two, vertical centrifugal pumps and is located within the "primary containment structure." This structure consists of the drywell, the suppression system, and interconnecting vent system. The drywell is a steel pressure vessel in the shape of a light bulb. The pressure suppression chamber is a torus-shaped steel pressure vessel located below and encircling the drywell.

This chamber is connected to the drywell by equally spaced vent pipes. These vent pipes are connected to a common header within the suppression chamber. Downcomers, connected to the header, terminate below the water level of the suppression pool. As a system, the drywell, suppression chamber, and interconnecting piping, acts to reduce the pressure increase in the event of a local process system piping failure.

Heat produced in the reactor is converted to electrical energy by the power conversion system. A turbine-generator system converts the thermal energy of steam produced in the reactor vessel into mechanical shaft power and then into electrical energy. The turbine consists of a high-pressure, double-flow turbine element, and three, double-flow, low-pressure turbine elements aligned in tandem. The generator is driven at 1,800 rpm and rated at 1,280 MVA. The exhaust steam from the turbine is condensed and deaerated in the main condenser. The heat rejected to the main condenser is removed by the circulating water system.

The circulating water system provides the heat sink required for removal of waste heat in the power plant's thermal cycle. The system has the principal function of removing heat by absorbing this energy in the main condenser. Water is withdrawn from the Susquehanna River via the intake tunnels by the circulating water pumps. After passing through the plant condensers, the discharge is routed back through five mechanical draft cooling towers, then back to the river.

## **1.3 REGULATORY GUIDANCE**

The NRC provided initial decommissioning guidance in its rule "General Requirements for Decommissioning Nuclear Facilities," issued in June 1988.<sup>[1]\*</sup> This rule set forth technical and financial criteria for decommissioning licensed nuclear facilities. The regulation addressed

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<sup>\*</sup> Annotated references for citations in Sections 1-6 are provided in Section 7.

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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,"<sup>[2]</sup> which provided 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 amendments.

The rule defined three decommissioning alternatives as being acceptable to the NRC: DECON, SAFSTOR, and ENTOMB. It 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 could 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 definition of unrestricted release and 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 reevaluated this alternative. The resulting feasibility study, based upon an assessment by Pacific Northwest National Laboratory, concluded that the method did have conditional merit for some if not most reactors. However, the staff also found that additional rulemaking would be needed before this option could be treated as a generic alternative. The NRC is considering rulemaking to alter the 60-year time for completing decommissioning and to clarify the use of engineered barriers for reactor entombments. Pending completion of such rulemaking, entombment requests will be handled on a case-by-case basis.

In 1996, the NRC published revisions to the general requirements for decommissioning nuclear power plants.<sup>[3]</sup> When the decommissioning regulations were adopted in 1988, it was assumed that the majority of licensees would decommission at the end of the operating license life. Since

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that time, several licensees permanently and prematurely ceased operations without having submitted a decommissioning plan. In addition, these licensees requested exemptions from certain operating requirements as being unnecessary once the reactor is defueled. 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 would submit written certification to the NRC within 30 days after the decision to cease operations. Certification would also be required once the fuel was permanently removed from the reactor vessel. Submittal of these notices would 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 would be 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 would be required to submit an application to the NRC to terminate the license, along with a license termination plan (LTP).

#### 1.3.1 Nuclear Waste Policy Act

Congress passed the Nuclear Waste Policy  $Act^{[4]}$  in 1982, assigning the responsibility for disposal of spent nuclear fuel from the commercial nuclear generating plants to the Department of Energy (DOE). Two permanent disposal facilities were envisioned, as well as an interim facility. To recover the cost of permanent spent fuel disposal, this legislation created a Nuclear Waste Fund through which money was to be collected from the consumers of the electricity generated by commercial nuclear power plants. The Nuclear Waste Policy Act, along with the individual disposal contracts with utilities, specified that the DOE was to begin accepting spent fuel by January 31, 1998.

After pursuing a national site selection process, the Act 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 in the opening date for the repository, from 1998 to 2003. Two years later, in 1989, an additional

7-year delay was announced, primarily due to problems in obtaining the required permits 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 a recent decision, the U.S. Court of Appeals for the Federal Circuit reaffirmed the utility position that DOE had breached its contractual obligation. However, even with the August 2000 ruling,<sup>[5]</sup> 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, DOE has no plans to receive spent fuel from commercial U.S. reactors before the year 2010.

The NRC requires licensees to establish a program to manage and provide funding for the management of all irradiated fuel at the reactor until title of the fuel is transferred to the Secretary of Energy in 10 CFR 50.54 (bb).<sup>[6]</sup> This funding requirement is fulfilled through inclusion of certain high-level waste cost elements within the estimates, as described below.

For estimating purposes, it has been assumed that the high-level waste repository, or some interim storage facility, will be fully operational by 2015. Interim storage of the fuel, until the DOE has completed the transfer, will be in an independent facility located on the Peach Bottom site. This will allow Exelon Generation to proceed with decommissioning and terminate its operating licenses in the shortest time possible.

An Independent Spent Fuel Storage Installation (ISFSI) has been constructed at the site so as to maintain full core off-load capability for the operating units. This analysis assumes that the ISFSI will also be available to support decommissioning and will be able to accommodate the inventory of spent fuel residing in the plant's storage pools at the cessation of operations. When emptied, the station could be dismantled without maintaining the wet storage pools. Based upon this scenario, and an anticipated rate of transfer, spent fuel is projected to remain on site for approximately 26 years following the cessation of Unit 2 operations.

Expenditures are included in the analysis for the isolation and continued operation of the spent fuel pools throughout the first five

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years of decommissioning. Expenses are also included for loading the spent fuel assemblies remaining in the storage pools after the cessation of plant operations into multi-purpose canisters, for canister costs and overpacks, and for the operation of the ISFSI through the year 2039, when all the fuel is expected to be transferred to the DOE.

#### 1.3.2 Low-Level Radioactive Waste Policy Amendments Act

Congress passed the "Low-Level Radioactive Waste Disposal Act" in 1980, 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. With little progress, the "Amendments Act" of 1985<sup>[7]</sup> extended the target, with specific milestones and stiff sanctions for non-compliance.

Pennsylvania is a member of the four-state Appalachian States Low-Level Radioactive Waste Compact, formed in response to the waste legislation. Since Pennsylvania generators produced approximately 75% of the waste in the Compact, the state was selected as the initial host state. The Pennsylvania Low-Level Radioactive Waste Disposal Act (1988) granted the Department of Environmental Resources the responsibility for governing the development, operation, maintenance, and eventual closure of the disposal facility. The siting process was suspended in 1998 following a significant decrease in the waste volume produced by Pennsylvania generators and the continued availability of disposal capacity at two out-of-state facilities.

While the generators in the four states are currently able to access the disposal facility in Barnwell, South Carolina, the situation is expected to be much different in the future. A state law passed in July 2000 limits the annual volume of waste that can be accepted at the Barnwell site through mid-year 2008. After that date, the site can only accept waste generated within the Atlantic Compact region. Therefore, it is reasonable to assume that additional disposal capacity will be required to support reactor decommissioning, particularly for the isolation of the more highly radioactive material that is not suitable for disposal elsewhere.

This analysis presumes that new disposal facilities will be available by the time the station ceases operation. However, for estimating purposes, rate schedules for the currently operating Barnwell and Envirocare facilities were used to generate disposal costs.

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#### 1.3.3 <u>Radiological Criteria for License Termination</u>

In 1997, the NRC published Subpart E, "Radiological Criteria for License Termination,"<sup>[8]</sup> amending Part 20 of Title 10 of the Code of Federal Regulations (10 CFR §20). This subpart provided radiological criteria for releasing a facility for unrestricted use. The regulation provides that the site could 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 residual radioactivity has been reduced to levels that are As Low As Reasonably Achievable (ALARA). The decommissioning estimate for Peach Bottom assumes 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). An additional limit of 4 millirem per year, as defined in 40 CFR Part 141.16, is applied to drinking water.

On October 9, 2002, the NRC signed an agreement with the EPA on the radiological decommissioning and decontamination of NRClicensed sites. The Memorandum of Understanding (MOU) 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 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 EPA. However, if there are other hazardous materials on the site, EPA may be involved in the

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cleanup. As such, the possibility of dual regulation remains for certain licensees.

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# 2. DECOMMISSIONING ALTERNATIVE

The following section describes the basic activities associated with the DECON 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 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 estimates developed for Peach Bottom are also divided into phases or periods; however, demarcation of the phases is based upon major milestones within the project or significant changes in the projected expenditures.

#### 2.1 PERIOD 1 – PREPARATIONS

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

#### 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

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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 Greater-than-Class C waste (GTCC), as defined by 10 CFR §61. Major components are further defined as comprising the reactor vessel and internals, large bore reactor 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 bounded by previously evaluated environmental assessments or impact statements. In this instance, the licensee would have to submit a license amendment for the specific activity and update the environmental report.

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

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# 2.1.2 <u>Site Preparations</u>

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

- Characterization of the site and surrounding environs. This includes radiation surveys of work areas, major components (including the reactor vessel and its internals), sampling of internal piping contamination levels, and primary shield cores.
- Isolation of the spent fuel storage pool and fuel handling systems, such that decommissioning operations could commence on the balance of the plant. Decommissioning operations are scheduled around the fuel handling area to the greatest extent possible such that the overall project schedule is optimized. The fuel will be transferred to the DOE as it decays to the point that it meets the heat load criteria of the containers and, as such, it is assumed that the fuel pool will remain operational for a minimum of five years following the cessation of plant operations.
- Specification of transport and disposal requirements for activated materials and/or hazardous materials, including shielding and waste stabilization.
- Development of procedures for occupational exposure control, control and release of liquid and gaseous effluent, processing of radwaste (including dry-active waste, resins, filter media, metallic and nonmetallic components generated in decommissioning), site security and emergency programs, and industrial safety.

# 2.2 PERIOD 2 – DECOMMISSIONING OPERATIONS

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. Building

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modifications may be required to the Reactor Building to facilitate access of large/heavy equipment. Modifications may also be required to the refueling area of the Reactor 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.
- Disconnection of the control blades from the drives on the vessel lower head. Blades are transferred to the spent fuel pool for packaging.
- Transfer of the steam separator and dryer assemblies to the dryer-separator pool for segmentation. 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, segmentation and packaging of the core shroud and in-core guide tubes. Some of the material is expected to exceed Class C disposal requirements. As such, those segments will be packaged in a modified fuel canister for geologic disposal. Interim storage can be in the pool, as space permits, or in the ISFSI.
- Removal and segmentation of the remaining internals including the jet pump assemblies, fuel support castings and core plate assembly.
- Draining and decontamination of the reactor well and permanently sealing of the spent fuel transfer gate. Install shielded platform for segmentation of reactor vessel. Cutting operations are performed in-air using remotely operated equipment within a contamination control envelope, with the water level maintained just below the cut to minimize the working area dose rates.

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Sections are transferred to the dryer-separator pool for packaging and interim storage.

- Disconnection of the control rod drives and instrumentation tubes from reactor vessel lower head. The lower reactor head and vessel supporting structure will then be segmented.
- Removal of the reactor recirculation pumps. Exterior surfaces are decontaminated and openings covered. Components can serve as their own burial containers provided that all penetrations are properly sealed.
- Demolition of the sacrificial shield activated concrete by controlled demolition.

At least two years prior to the anticipated date of license termination, a LTP is required. Submitted as a supplement to the Final Safety Analysis Report (FSAR), or equivalent, the plan must include: a site characterization, description of the remaining dismantling activities, plans for site remediation, procedures for the final radiation survey, designation of the end use of the site, an updated cost estimate to complete the decommissioning, and any associated environmental concerns. The NRC will notice the receipt of the plan, make the plan available for public comment, and schedule a local hearing. LTP approval will be subject to any conditions and limitations as deemed appropriate by the Commission. The licensee may then commence with the final remediation of site facilities and services, including:

- Removal of remaining plant systems and associated components as they become nonessential to the decommissioning program or worker health and safety (e.g., waste collection and treatment systems, electrical power and ventilation systems).
- Removal of the steel liners from the drywell, disposing of the activated and contaminated sections as radioactive waste. Removal of any activated/ contaminated concrete.
- Removal of the steel liners from the steam separator and dryer pool, reactor well, and spent fuel storage pool.
- Surveys of the decontaminated areas of the containment structure.
- Removal of the contaminated equipment and material from the Turbine and Radwaste Buildings and any other contaminated facility. Use radiation and

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contamination control techniques until radiation surveys indicate that the structures could 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 will facilitate surface decontamination and subsequent verification surveys required prior to obtaining release for demolition.

- Removal of the remaining components, equipment, and plant services in support of the area release survey(s).
- Routing of material removed in the decontamination and dismantling to a central processing area. Material certified to be free of contamination would be 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 NUREG/CR-1575, "Multi-Agency Radiation Survey and Site Investigation Manual" (MARSSIM).<sup>[9]</sup> 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.

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# 2.3 PERIOD 3 – SITE RESTORATION

Following completion of decommissioning operations, site restoration activities may begin. Efficient removal of the contaminated materials and verification that residual radionuclide concentrations are below the NRC limits may result in substantial damage to many of the structures. Although performed in a controlled and safe manner, blasting, coring, drilling, scarification (surface removal), and the other decontamination activities will substantially degrade power block structures, including the Reactor, Radwaste, and Turbine Buildings. Verifying that subsurface radionuclide concentrations meet NRC site release requirements may 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 costeffective option. It is unreasonable to anticipate that these structures would be repaired and preserved after the radiological contamination is removed. The cost to dismantle site structures with a work force already mobilized on site is more efficient than if the process is deferred. Site facilities quickly degrade without maintenance, adding additional expense and creating potential hazards to the public and future workers. Abandonment creates a breeding ground for vermin infestation and other biological hazards.

This cost study presumes that non-essential structures and site facilities will be 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, and 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 demolition activities is processed to remove rebar and miscellaneous embedments. The processed material is then used on-site to backfill voids. Excess materials are trucked off-site for disposal as construction debris.

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# 2.4 POST PERIOD 3 – ISFSI OPERATIONS

The ISFSI will continue to operate under a separate and independent license (10 CFR §72) following the relocation of the spent fuel from the plant's storage pools. Transfer of spent fuel to a DOE or interim facility will be exclusively from the ISFSI once the fuel pools have been emptied and the structures released for decommissioning. Assuming initiation of the federal Waste Management System in 2015, transfer of spent fuel from Peach Bottom is anticipated to continue through the year 2039. Any delay in the transfer process, for example, due to a delay in the scheduled opening of the geologic repository, a slower acceptance rate, or a combination of a delayed start date and lower transfer rate, will result in a longer on-site residence time for the fuel discharge from the reactor, and therefore additional caretaking expenses.

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 currently proposed design for the ISFSI is based upon the use of concrete overpacks 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 and the license for the facility terminated, the modules can be dismantled using conventional techniques for the demolition of reinforced concrete. The concrete storage pad is then removed, and the area graded and landscaped to conform to the surrounding environment.

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#### **3. COST ESTIMATE**

The cost estimates prepared for decommissioning Peach Bottom consider the unique features of the site, including the nuclear steam supply system, power generation systems, support services, site buildings, and ancillary facilities. The bases of the estimates, including the sources of information relied upon, the estimating methodology employed, site-specific considerations and other pertinent assumptions are described in this section.

## **3.1 BASIS OF ESTIMATE**

The current estimates were developed using the basic design information originally generated for the decommissioning analysis prepared in 1995-96.<sup>[10]</sup> The information was reviewed for the current estimates and updated, as deemed necessary. The site-specific considerations and assumptions used in the previous estimates 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 this cost estimate follows the basic approach originally presented in the AIF/NESP-036 study report, "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates,"<sup>[11]</sup> and the US DOE "Decommissioning Handbook."<sup>[12]</sup> 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 <u>activity-dependent</u> 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.<sup>[13]</sup>

This estimate 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 has provided additional insight into the process, the

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regulatory aspects, and 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%
<ul> <li>Radiation/ALARA Factor</li> </ul>	10% to 37%
Protective Clothing Factor	10% to 30%
Work Break Factor	8.33%
Productivity	adjustable

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 relied upon productivity information available from the "Building Construction Cost Data" publication.

An activity duration critical path is used to determine the total decommissioning program schedule. The schedule is relied upon in calculating the carrying costs, which include program management, administration, field

engineering, equipment rental, and support services such as quality control and security. This systematic approach for assembling decommissioning estimates ensures a high degree of confidence in the reliability of the resulting costs.

# 3.3 FINANCIAL COMPONENTS OF THE COST MODEL

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

Inherent in any cost estimate that does not rely on historical data is the inability to specify the precise source of costs imposed by factors such as tool breakage, accidents, illnesses, weather delays, and labor stoppages. In TLG's 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"<sup>[14]</sup> 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 estimate 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 estimate, 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

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process.

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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, could disrupt the orderly progression of events and jeopardize a successful conclusion to the decommissioning

For example, the most technologically challenging task in decommissioning a commercial nuclear station will be the disposition of the reactor vessel and internal components, which have become highly radioactive after a lifetime of exposure to radiation produced in the core. The disposition of these highly radioactive components forms the basis for the critical path (schedule) for decommissioning operations. Cost and schedule are inter-dependent 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 risk and uncertainties associated with this task are that the expected optimization 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. 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 can range from 0% to 75%, depending on the degree of difficulty judged to be appropriate

from TLG's actual decommissioning experience. values used in this study are as follows:	The contingency
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 overall contingency, when applied to the appropriate components of the estimates on a line item basis, results in an average value of 19.1%.

#### 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:

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- 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.
- 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 much 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, it is recommended that the areas of

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uncertainty or risk be 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

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

The total inventory of assemblies that will need to be handled during decommissioning is based upon several assumptions. The pickup of commercial fuel is assumed to begin in the year 2015 and will proceed on an oldest fuel first basis. The rate at which the fuel is removed from the commercial sites is based upon an annual capacity at the geologic repository of 3,000 metric tons. A delay in the startup of the repository, or a decrease in the rate of acceptance rate, will correspondingly prolong the transfer process and extend the duration that the fuel remains at the site.

For estimating purposes, spent fuel will be removed from the Peach Bottom site during, and following decommissioning, with the transfer complete by the end of year 2039. Built to support continuing plant operations, an ISFSI will be available to support decommissioning, i.e., the fuel residing in the pool following the cessation of plant operations could be relocated to the ISFSI so that decommissioning can proceed on the Reactor Building. The assemblies will be relocated to the ISFSI during the first five years following final shutdown. Costs are included

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for the purchase of the 112 canisters and overpacks required to empty the pool (an additional eight will be used to package the GTCC).

Operation and maintenance costs for the ISFSI are included within the estimates and address the cost for staffing the facility, security, insurance, and licensing fees. Costs are also provided for the final disposition of the facility once the transfer is complete.

## ISFSI Design Considerations

A multi-purpose (storage and transport) dry shielded storage canister with a vertical, reinforced concrete storage silo is used as a basis for the cost analyses. Approximately 50% of the silos 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 of the disposition of this material, as well as the demolition of the ISFSI facility, is included in the estimate.

## 3.4.2 <u>Reactor Vessel and Internal Components</u>

The NSSS (reactor vessel and reactor recirculation system components) will be decontaminated using chemical agents prior to the start of cutting operations. A decontamination factor (average reduction) of 10 is presumed.

The reactor pressure vessel and internal components are segmented for disposal in shielded, reusable transportation casks. Segmentation will be performed in the dryer-separator pool, where a turntable and remote cutter will be installed. The vessel will be 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 well. Transportation cask specifications and transportation regulations will dictate segmentation and packaging methodology.

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, DOE has indicated it will accept title to this waste for disposal at the future high-level waste repository.<sup>[15]</sup> 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

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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 DOE would accept this waste prior to completing the transfer of spent fuel. Therefore, until such time as the DOE is ready to accept GTCC waste, it is reasonable to assume that this material would remain in storage at Peach Bottom.

Intact disposal of the reactor vessel and internal components could 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, the location of the Trojan Nuclear Plant 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 Peach Bottom 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, as a bounding condition, the study assumes the reactor vessel will have to be segmented.

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### 3.4.3 Primary System Components

Reactor recirculation 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 shipped by shielded van. The reactor recirculation pumps and motors are lifted out intact, packaged, and transported for processing or 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 condenser will also be disassembled and moved to a laydown area. Material will then be prepared for transportation to an off-site recycling facility where it will be surveyed and designated for decontamination, volume reduction, or 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 of the Code of Federal Regulations.<sup>[16]</sup> The contaminated material will be packaged in Industrial Packages (IP I, II, or III) 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.

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.

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The segmentation scheme for the vessel and internal segments are designed to meet these limits.

The transport of large intact components, e.g., large heat exchangers and other oversized components, will be by a combination of truck, barge, 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. Memphis, Tennessee will be used as the destination for off-site processing. Transportation costs are estimated using published tariffs from Tri-State Motor Transit.<sup>[17]</sup>

#### 3.4.6 Low-Level Radioactive Waste Disposal

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

Material requiring controlled disposal will be packaged and transported to one of two currently available burial facilities. Very low-level radioactive material, e.g., structural steel and contaminated concrete, will be sent to Envirocare. More highly contaminated and activated material will be 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 Exelon Generation's own

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future plans for the site, e.g., the electrical switchyard will remain in support of the electrical transmission and distribution system.

The large underground tunnels between the cooling water intake, Turbine Building, and cooling tower will be isolated, sealed, and abandoned in place. Site utility and service piping are abandoned in place. Electrical manholes are backfilled with suitable earthen material and abandoned. Asphalt surfaces in the immediate vicinity of site buildings are broken up and the material used for backfill on site, if needed. The site access road will remain.

The estimate does 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.

Structures will be removed to a nominal depth of three feet below grade. Concrete rubble generated from demolition activities will be processed and made available as clean fill. The site will be graded following the removal of non-essential structures to conform to the adjacent landscape, and vegetation will be established to inhibit erosion.

### 3.5 ASSUMPTIONS

The following are the major assumptions made in the development of the estimate for decommissioning the site. Decommissioning activities will be performed in accordance with the current regulations that are assumed to be in place at the time of decommissioning.

### 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.

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#### 3.5.2 Labor Costs

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. Costs for site administration, operations, construction, and maintenance personnel are based upon average salary information provided by Exelon Nuclear.

Exelon Generation, as the licensee, will oversee the decommissioning operations and provide site security, radiological controls, and overall site administration. Exelon Nuclear will provide contract management of the decommissioning labor force and subcontractors. Engineering services for preparing the activity specifications, work procedures, activation, and structural analyses, are provided by Exelon Nuclear personnel.

The costs associated for the transition of the operating organization to decommissioning, e.g., separation packages, retraining, severance, and incentives are not included in this estimate and are considered to be ongoing operating expenses.

#### 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., cesium-137, strontium-90, 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.<sup>[18]</sup> Actual estimates are derived from the curie/gram values in NUREG/CR-3474 and adjusted for the different mass of Peach Bottom components, projected operating life, and different periods of decay. Additional short-lived isotopes were derived from NUREG/CR-0130<sup>[19]</sup> and NUREG/CR-0672<sup>[20]</sup> and benchmarked to the long-lived values from NUREG/CR-3474.

The disposal cost for the control blades removed from the vessel with the final core load is included within the estimate. Disposition of any blades stored in the pools from operations is considered an operating expense and therefore not accounted for in the estimates.

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

### 3.5.4 General

### **Transition Activities**

Existing warehouses will be cleared of non-essential material and remain for use by Exelon Nuclear and its subcontractors. The warehouses may be dismantled as they become surplus to the decommissioning program. 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.
- Excess acid, caustic, and all chemicals listed will be removed.

#### Scrap and Salvage

The existing plant equipment is considered obsolete and suitable for scrap as deadweight quantities only. Exelon Nuclear will make economically reasonable efforts to salvage equipment following final plant shutdown. However, dismantling techniques assumed by TLG for equipment in this estimate 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 estimate does not attempt to quantify the value that Exelon Nuclear may realize based upon those efforts.

It is assumed, for purposes of this estimate, that any value received from the sale of scrap generated in the dismantling process would be

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more than offset by the on-site processing costs. The dismantling techniques assumed in the decommissioning estimate 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 from a facility currently being decommissioned has required the removal and disposition of the PCB-contaminated insulation, an added expense. With a volatile market, the potential profit margin in scrap recovery is highly speculative, regardless of the ability to free release this material. This assumption is an implicit recognition of scrap value in the disposal of clean metallic waste at no additional cost to the project.

Furniture, tools, mobile equipment such as forklifts, trucks, bulldozers, and other such items of personal property owned by Exelon Nuclear will be removed at no cost or credit to the decommissioning project. Disposition may include relocation to other generating 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." The NRC's financial protection requirements are based on various reactor (and spent fuel) configurations.

#### Property Taxes

Property tax payments are assume to continue after the shutdown of the generating station and are based upon land value only.

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#### 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

The costs projected for the decommissioning of Peach Bottom are provided in Tables 3.1 and 3.2. Decommissioning costs are reported in the year of projected expenditure; however, the values are provided in thousands of 2002 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.

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Year	Period 1 Preparations	Period 2 Decommissioning Operations	Period 3 Site Restoration	Period 4 Dry Fuel Storage	Period 5 ISFSI Decommissioning	Totals
2013	20,225					20,225
2014	61,845					61,845
2015	8,416	102,029				110,446
2016		100,653				100,653
2017		78,520				78,520
2018		78,520				78,520
2019		52,569				52,569
2020		11,077				11,077
2021		11,946	6,134			18,080
2022			14,082			14,082
2023			8,796	467		9,264
2024			-,	1,248	•	1,248
2025				1,245		1,245
2026				1,245		1,245
2027				1,245		1,245
2028				1,248		1,248
2029				1,245		1,245
2030				1,245		1,245
2031				1,245		1,245
2032				1,248		1,248
2033				1,245		1,245
2034		•		1,245		1,245
2035				1,245		1,245
2036		<b>`</b>		1,248		1,248
2030				1,245		1,245
2038				1,245		1,240
2039				15,027		15,027
	90,486	435,314	29,013	34,177	[Unit 3]	588,99

TABLE 3.1SCHEDULE OF ANNUAL EXPENDITURES BY PERIOD, UNIT 2(Thousands, 2002 Dollars)

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Year	Period 1 Preparations	Period 2 Decommissioning Operations	Period 3 Site Restoration	Period 4 Dry Fuel Storage	Period 5 ISFSI Decommissioning	Totals
2014	17,759					17,759
2015	46,994					46,994
2016	- 808	95,409				96,218
2017		96,466				96,466
2018		103,883				103,883
2019		104,382				104,382
2020		70,794				70,794
2021		14,847	13,164			28,011
2022			30,219			30,219
2023			18,877	1,579		20,456
2024			•	4,218		4,218
2025				4,207	4	4,207
2026				4,207		4,207
2027				4,207		4,207
2028				4,218		4,218
2029				4,207		4,207
2030				4,207		4,207
2031				4,207		4,207
2032				4,218		4,218
2033				4,207		4,207
2034				4,207		4,207
2035		1		4,207		4,207
2036	•			4,218		4,218
2037				4,207		4,207
2038				4,207		4,207
2039				18,045	96	18,141
2040	·			· · -	8,608	8,608
	65,562	485,782	62,260	82,773	8,704	705,080

TABLE 3.2SCHEDULE OF ANNUAL EXPENDITURES BY PERIOD, UNIT 3<br/>(Thousands, 2002 Dollars)

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### 4. SCHEDULE ESTIMATE

The schedule for the decommissioning scenarios 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 required cooling period for the spent fuel.

A schedule or sequence of activities is presented in Figure 4.1. The schedule reflects the prompt decommissioning alternative and the start date consistent with a scheduled shutdown in 2013 for Unit 2 and 2014 for Unit 3. The sequence assumes that fuel will be removed from the spent fuel pool within the first five years. The key activities listed in the schedule do not reflect a one-to-one correspondence with those activities in the Appendix C cost table, but reflect dividing some activities for clarity and combining others for convenience. The schedule was prepared using the "Microsoft Project 2000" computer software.<sup>[21]</sup>

### 4.1 SCHEDULE ESTIMATE ASSUMPTIONS

The schedule was generated using a precedence network and associated software. Activity durations are based upon the actual man-hour estimates calculated for each area. The schedule was assembled by sequencing the work areas, considering work crew availability and material access/egress. The following assumptions were made in the development of the decommissioning schedule:

- The Reactor Building will continue to serve as the spent fuel storage/ transfer facility until such time that all spent fuel has been removed from site. The Reactor Building is expected to operate for approximately five years after the cessation of operations.
- All work (except vessel and internals removal activities) will be 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

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and laydown space; and 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 Appendix C are based upon the durations developed in the schedule for the decommissioning of Peach Bottom. 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.

Project timelines are shown in this section as Figure 4.2. Milestone dates are based on a 40-year plant operating life from the issuance of the operating license, a five-year wet storage period for the last core discharge, and continued operation of the ISFSI until DOE can complete the transfer.

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# FIGURE 4.1

# DECOMMISSIONING ACTIVITY SCHEDULE

ask Name	'13	'14	'15	16	17	'18	19	20	21	22'	12
each Bottom Unit 2 & 3 schedule	E		) i i i i							1516	
Shutdown Unit 2	•										
Period 1a Unit 2 - Shutdown through transition		77								•	
Certificate of permanent cessation of operations submitted	" ♦						ļ				
Fuel storage pool operations	[ e		ĺ	ĺ						Í	1
Dry fuel storage operations	1 C										-
Reconfigure plant		$\mathbb{Z}$									
Prepare activity specifications	1 C										
Perform site characterization											ł
PSDAR submitted		•									ł
Written certificate of permanent removal of fuel submitted							Ì				
Site specific decommissioning cost estimate submitted	·										-
DOC staff mobilized		٠									į
Period 1b Unit 2 - Decommissioning preparations	1	ľ	Ż								ł
Fuel storage pool operations			à								ł
Reconfigure plant (continued)		E	Ż								į
Dry fuel storage operations	-	E	j								i
Prepare detailed work procedures		Γ	j								ļ
Decon NSSS		Ē	j								-
Isolate spent fuel pool		Ē	j					1			
Period 2a Unit 2 - Large component removal	1										
Fuel storage pool operations											
Dry fuel storage operations											-
Preparation for reactor vessel removal			Ø						1		ł
Reactor vessel & internals	-		Ø								
Remaining large NSSS components disposition											
Non-essential systems	-										-
Main turbine/generator								1			ł
Main condenser											
License termination plan submitted				•				Ì	İ		
Period 2b Unit 2 - Decontamination (wet fuel)	-		ļ	Г	-		1	1			
Fuel storage pool operations					<u> </u>	<u> </u>	j				ł
Dry fuel storage operations			1	i r	-	<u> </u>	ή.	1	i	i -	

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# FIGURE 4.1

### (continued)

sk Name	'13	14	15	'16	'17	'18	<u>19</u>	20	21	'22	'29
Remove systems not supporting wet fuel storage				Ë			]		, , ,		
Decon buildings not supporting wet fuel storage				E	·		]				
License termination plan approved				r 1 1		•					
Fuel storage pool available for decommissioning		;		•				1			
Period 2c Unit 2 - Decontamination following wet fuel storage				•		•	T	1			
Dry fuel storage operations		!			:	•		]	1 1 1		
Remove remaining systems		1		•	;		<b></b>	1			
Decon wet fuel storage area		-	1		1			1	:		
Period 2d Unit 2 - Delay before license termination											
Unit 3 Operations		$\mathbb{Z}$									
Shutdown Unit 3		•								1. 1.	
Period 1a Unit 3 - Shutdown through transition											
Certificate of permanent cessation of operations submitted	1	•									
Fuel storage pool operations		E				•					
Dry fuel storage operations	1	έc			i i		;				
Reconfigure plant								i			
Prepare activity specifications				•	•	, ,					
Perform site characterization		i r	5			,					
PSDAR submitted		!	٠		}			-			
Written certificate of permanent removal of fuel submitted		:	•		-	•	•	;	{	;	
Site specific decommissioning cost estimate submitted			٠		1	) ) 	*		·	:	
DOC staff mobilized		1			ł	:			:		
Period 1b Unit 3 - Decommissioning preparations	1	:		İ				1	-		
Fuel storage pool operations		-	P		1	:	:	1	:	:	
Reconfigure plant (continued)	ļ	1		à	-			-	1	]	-
Dry fuel storage operations		}	ÌĒ	i				:	1	1	:
Prepare detailed work procedures			÷Ē	i	-	:	•	1	:	-	
Decon NSSS	·			i							
Isolate spent fuel pool	1			1				ĺ			
Period 2a Unit 3 - Large component removal		-	<u> </u>	1							
Fuel storage pool operations					411	1			1		
Dry fuel storage operations						። 1	;			-	
Preparation for reactor vessel removal		-	-		;	ļ	:	1	•	-	;
	<u> </u>	<u>:</u>	<u>}</u>	Ø	<u> </u>	!	:	:	:	<u>:</u>	
Milestone 🔶 Summary task											
Critical Path Task											

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# FIGURE 4.1

# (continued)

sk Name	'13	114	'15	'16 '17	1'18	'19	'20	21	'22	'2:
Reactor vessel & internals		-		(	3					
Remaining large NSSS components disposition					ļ	:				
Non-essential systems				ļ	Ĵ					•
Main turbine/generator		1				-				
Main condenser		1	,		⊐	1				
License termination plan submitted		:			<b>\</b>	;				
Period 2b Unit 3 - Decontamination (wet fuel)		-					ļ			
Fuel storage pool operations		1	•		Z	777				
Dry fuel storage operations		1	•			 	1			
Remove systems not supporting wet fuel storage		-					1			;
Decon buildings not supporting wet fuel storage		-				-i	1			}
License termination plan approved										
Fuel storage pool available for decommissioning		-								
Period 2c Unit 3 - Decontamination following wet fuel storage	,	-			-					;
Dry fuel storage operations		-								:
Remove remaining systems		1								-
Decon wet fuel storage area		-								;
Period 2e Unit 2 & 3 - Plant license termination		-					I	77		1
Dry fuel storage operations										
Final Site Survey						1		ġ.		1
NRC review & approval		1					1	Ø	:	:
Part 50 license terminated						:	<u>.</u>	•		-
Period 3b Unit 2 & 3 - Site restoration								E	Į	$\overline{Z}$
Dry fuel storage operations								E		Ż
Building demolitions, backfill and landscaping										7

Milestone 

Summary task

Critical Path Task

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# FIGURE 4.2

# DECOMMISSIONING TIMELINE (not to scale)

Unit 2 Shutdown 08/08/2013

la	, 1b	2a	2b	2c	2d	2e	3b	3c and 3d	j
12.0m 08/13	6.1m 08/14	18.1m 02/15	29.9m 08/16	11.6m 02/19	8.8m 01/20	9.1m 10/20	24.7m 07/21	196.4m 08/23	12/39
Prepara	tions		Decommiss	ioning Operat	tions		Site Restoratio	ISFSI Operat	ions
<b>)</b>	Wet Fuel	Storage							
•	Dry Fuel	Storage	·						>
	Unit 3 Shutdo . 07/02/2	wn							
	1a	, 1b	2a	2b	2c	2e	Sb	3c through 3	f
	12.1m 7/14	6.0m 7/15	24.6m 01/16	23.9m 01/18	9.7m 01/20			202.5m 08/23	07/40
	Prepa	rations	Decom	missioning O	peratio	ns .	Site Restorati	ISFSI Opera on	tions
	•	Wet Fr	el Storage				·		

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### 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,<sup>[22]</sup> 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, 10 CFR §71 defines radioactive material and 10 CFR §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). For this study, commercially available steel containers are presumed to be used for the disposal of piping, small components, and concrete. Larger components can serve as their own containers, with proper closure of all openings, access ways, and penetrations.

The volumes of radioactive waste generated during the various decommissioning activities at the site are shown on a line-item basis in Appendix C and summarized in Table 5.1. The quantified waste volume summary shown in this table is consistent with §61 classifications. The volumes are calculated based on the exterior dimensions for containerized material. The volumes are calculated 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 and 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 <sup>137</sup>Cs will still control the disposition requirements.

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The waste material generated in the decontamination and dismantling of Peach Bottom will primarily be generated during Period 2. Material considered potentially contaminated when removed from the radiologically controlled area will be sent to processing facilities for conditioning and disposal at a unit cost of \$2.00 per pound. Heavily contaminated components and activated materials will be routed for controlled disposal. The disposal volumes reported in the table reflects the savings resulting from reprocessing and recycling.

For purposes of constructing the estimate, 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 the majority of plant components and activated concrete deemed unsuitable for processing or recovery. An average disposal rate of \$433 per cubic foot 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 will be disposed of at the Envirocare facility. This includes lower activity material such as miscellaneous steel, metal siding, scaffolding and structural steel. A rate of \$298 per cubic foot was used for containerized waste, \$70 per cubic foot for disposal of DAW, and approximately \$20 per cubic foot for bulk material, e.g., concrete.

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# TABLE 5.1

## DECOMMISSIONING WASTE SUMMARY UNIT 2

	Waste Class <sup>1</sup>	Volume (cubic feet)	Weight (pounds)
Low-Level Radioactive Wa	iste		
Barnwell, South Carolina	(contaminate	ed/activated metalli	c waste and concrete
	A B C	77,882 17,783 804	6,798,729 2,763,680 50,930
Envirocare, Utah (miscella	aneous steel,	contaminated/activ	ated concrete)
Containerized/DAW Bulk	A A	43,219 29,345	3,832,401 1,497,241
Geologic Repository (Grea	ter-than Clas	ss C)	
	>C	748	155,911
Total <sup>2</sup>		169,779	15,098,892
Processed Waste (Off-Site)	)	160,500	
Scrap Metal			63,534,000

<sup>1</sup> Waste is classified according to the requirements as delineated in Title 10 CFR, Part 61.55

<sup>2</sup> Columns may not add due to rounding.

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### TABLE 5.2

# DECOMMISSIONING WASTE SUMMARY UNIT 3

	Waste Class <sup>1</sup>	(cubic feet)	(pounds)
Low-Level Radioactive Wa	aste		
Barnwell, South Carolina	(contaminate	ed/activated metalli	c waste and concrete)
	A B C	87,810 19,103 804	7,568,011 2,939,360 50,930
Envirocare, Utah (miscell	aneous steel,	contaminated/activ	ated concrete)
Containerized/DAW Bulk	A A	55,853 37,983	5,246,234 2,049,815
Geologic Repository (Grea	ter-than Clas	ss C)	· · ·
•	>C	748	155,911
Total <sup>2</sup>		202,300	18,010,261
Processed Waste (Off-Site	)	180,173	
Scrap Metal			93,730,000

<sup>1</sup> Waste is classified according to the requirements as delineated in Title 10 CFR, Part 61.55

<sup>2</sup> Columns may not add due to rounding.

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### 6. RESULTS

Costs were developed to decommission Peach Bottom following a scheduled cessation of plant operations. The analysis relied upon the site-specific, technical information developed for a previous analysis prepared in 1995-96, then updated to reflect current plant conditions and operating assumptions. While not an engineering study, the estimate does provide PSEG Power 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 approximately five years following the cessation of operations for continued cooling of the assemblies. An ISFSI will be used to safeguard the spent fuel, once sufficiently cooled, until such time that the DOE can complete the transfer of the assemblies to its repository. The scenario also includes the costs for the dismantling of non-essential structures and limited restoration of the site.

The cost projected to promptly decommission Peach Bottom is estimated to be \$1.294 billion. The majority of this cost (approximately 94.2%) is associated with the physical decontamination and dismantling of the nuclear unit and caretaking of the spent fuel, so that the license could be terminated. The remaining 5.8% is for the demolition of the remaining 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 and the duration of the program. It is assumed, for purposes of this analysis, that Exelon Nuclear will oversee the decommissioning program, managing 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 licenses have been terminated, the staff is substantially reduced for the conventional demolition and restoration of the site, and the long-term care of the spent fuel.

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As described in this report, the spent fuel pool will remain operational for approximately five years following the cessation of plant operation. The pool will be isolated and an independent spent fuel island created. This will allow decommissioning operations to proceed in and around the Reactor Building. Over the five-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 DOE is able to receive them. Dry storage of the fuel under a separate license provides additional flexibility in the event 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 incurred by Exelon Nuclear.

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, will be at the Envirocare facility. The more highly radioactive material will be 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 will be packaged for controlled disposal at one of the currently operating facilities. The costs identified for processing are all-inclusive, incorporating the ultimate disposition of the material.

Removal costs reflect the labor-intensive nature of the decommissioning process and 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

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could be more cost-effective than deferral, due to the ultimate deterioration of facilities (and therefore the working conditions).

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 estimate, material will be primarily moved overland by truck.

Decontamination will be used to reduce the plant's radiation fields and minimize worker exposure. Slightly contaminated material or material located within a contaminated area will be sent to an off-site processing center, i.e., this estimate does not assume that contaminated plant components and equipment could be economically decontaminated for uncontrolled release in-situ. Centralized processing centers have proven to be a more efficient 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 need to be confirmed and will add to the expense of surveying the facilities alone.

The remaining costs include allocations for heavy equipment and temporary services, and 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.

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# TABLE 6.1

### SUMMARY OF DECOMMISSIONING COST ELEMENTS UNIT 2

Work Category	Cost 2002\$ (thousands)	Percent of Total Costs
Decontamination	14,484.	4 2.5
Removal	69,674.	0 11.8
Packaging	14,487.	4 2.5
Transportation	4,740.	9 0.8
Waste Disposal	116,517.	7 19.8
Off-site Waste Processing	36,916.	5 6.3
Program Management (including Engineering and Secu	rity) 188,969.	1 32.1
Spent Fuel Pool Isolation	9,060.	3 1.5
ISFSI Related (including capital)	. 80,073.	9 13.6
Insurance and Regulatory Fees	8,772.	8 1.5
Energy	18,616.	6 3.2
Characterization and Licensing Surveys	5,676.	0 1.0
Misc. Equipment and Site Services	20,999.	9 3.6

Total

583,989.5

100.0

Note: Columns may not add due to rounding

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### TABLE 6.2

# SUMMARY OF DECOMMISSIONING COST ELEMENTS UNIT 3

Work Category (	Cost 2002\$ thousands)	Percent of Total Costs
Decontamination	17,010.	1 2.4
Removal	102,950.	1 14.6
Packaging	14,934.	5 2.1
Transportation	5,246.	9 0.7
Waste Disposal	123,945.	7 17.6
Off-site Waste Processing	41,441.	3 5.9
Program Management (including Engineering and Securi	ty) 257,180.	4 36.5
Spent Fuel Pool Isolation	6,040.	2 0.9
ISFSI Related (including capital)	81,571.	1 11.6
Insurance and Regulatory Fees	8,348.	1 1.2
Energy	18,470.	1 2.6
Characterization and Licensing Surveys	6,363.	3 0.9
Misc. Equipment and Site Services	21,578.	6 3.1
Total	705,080.	4 100.0

Note: Columns may not add due to rounding

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- 14. Project and Cost Engineers' Handbook, Second Edition, p. 239, American Association of Cost Engineers, Marcel Dekker, Inc., New York, New York, 1984.
- 15. "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.
- 16. U.S. Department of Transportation, Section 49 of the Code of Federal Regulations, "Transportation," Parts 173 through 178, 1996.
- 17. Tri-State Motor Transit Company, published tariffs, Interstate Commerce Commission (ICC), Docket No. MC-109397 and Supplements, 2000.
- 18. 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.
- 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.
- 20. 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.

TLG Services, Inc.

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## 7. REFERENCES (continued)

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

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## 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	Critical Duration			
ш 	Description		Duration			
a	Remove insulation	60	(b)			
b	Mount pipe cutters	60	60			
с	Install contamination controls	20	(b)			
d	Disconnect inlet and outlet lines	60	60			
е	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 in plastic, send to the waste processing area	<u>    60</u>	<u>    60</u>			
	Totals (Activity/Critical)	355	255			
Duration adjustment(s): + Respiratory protection adjustment (50% of critical duration) + Radiation/ALARA adjustment (37.08% of critical duration)						
Adjus	ted work duration		478			
+Pro	ptective clothing adjustment (30% of adjusted duration)		143			
Produ	active work duration		621			
+ Work break adjustment (8.33 % of productive duration)						
Total	work duration min		673 min			

### \*\*\* Total duration = 11.217 hr \*\*\*

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# APPENDIX A (continued)

# 3. LABOR REQUIRED

Crew	Number	Duration (hr)	Rate (\$/hr)	Cost					
Laborers	3.00	11.217	22.50	757.15					
Craftsmen	2.00	11.217	34.13	765.67					
Foreman	1.00	11.217	36.29	407.06					
General Foreman	0.25	11.217	43.54	122.10					
Fire Watch	0.05	11.217	22.50	12.62					
Health Physics Technician	1.00	11.217	40.48	<u>454.06</u>					
Total labor cost	\$2,518.66								
4. EQUIPMENT & CONSUMABLES COSTS									
Equipment Costs nor									
Consumables/Materials Costs									
-Gas torch consumables 1 @	\$4.23/hr x 1 hr	: {1}		\$4.23					
-Blotting paper 50 @ \$0.44 so				\$22.00					
-Plastic sheets/bags 50 @ \$0.	11/sq ft {3}			\$5.50					
Subtatal cast of againment on	d motoriolo			\$31.73					
Subtotal cost of equipment an Overhead & sales tax on equip		toriale @ 16 0	0 %	\$51.75 <u>\$5.08</u>					
Overneau & sales tax on equi			0 /0	<u>\$9.00</u>					
Total costs, equipment & mat	erial			\$36.81					
TOTAL COST: Removal of contamin	\$2,555.47								
Total labor cost:				\$2,518.66					
Total equipment/material cost	ts:			\$36.81					
Total craft labor man-hours re		it:		81.88					

### 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. R.S. Means (2002) Division 01590, Section 400-6360 pg 24
  - 2. McMaster-Carr Ed. 106 pg 1778
  - 3. R.S. Means (2002) Division 01540, Section 800-0200 pg 17
- Material and consumable costs were adjusted using the regional indices for Lancaster, Pennsylvania.

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### APPENDIX B

# UNIT COST FACTOR LISTING (DECON: Power Block Structures Only)

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TLG Services, Inc.

**Unit Cost Factor** 

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### **APPENDIX B**

### UNIT COST FACTOR LISTING (Power Block Structures Only)

Removal of clean instrument and sampling tubing, \$/linear foot Removal of clean pipe 0.25 to 2 inches diameter, \$/linear foot Removal of clean pipe >2 to 4 inches diameter, \$/linear foot Removal of clean pipe >4 to 8 inches diameter, \$/linear foot Removal of clean pipe >8 to 14 inches diameter, \$/linear foot

Removal of clean pipe >14 to 20 inches diameter, \$/linear foot19.71Removal of clean pipe >20 to 36 inches diameter, \$/linear foot29.01Removal of clean pipe >36 inches diameter, \$/linear foot34.49Removal of clean valves >2 to 4 inches53.14Removal of clean valves >4 to 8 inches79.97Removal of clean valves >8 to 14 inches152.02

Removal of clean valves >8 to 14 inches Removal of clean valves >14 to 20 inches Removal of clean valves >20 to 36 inches Removal of clean valves >36 inches Removal of clean pipe fittings >20 to 36 Removal of clean pipe hangers for small bore piping

Removal of clean pipe hangers for large bore piping59.39Removal of clean pumps, <300 pound</td>133.61Removal of clean pumps, 300-1000 pound378.15Removal of clean pumps, 1000-10,000 pound1,493.10Removal of clean pumps, >10,000 pound2,883.03Removal of clean pump motors, 300 – 1000 pound159.71Removal of clean pump motors, 1000 – 10,000 pound622.86Removal of clean pump motors, >10,000 pound1,401.46

Removal of clean pump motors, >10,000 pound Removal of clean turbine-driven pumps >10,000 pounds

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Cost/Unit(\$)

0.26 2.72

3.98

8.00 15.20

197.05

290.09

344.92

290.09

16.57

3.863.30

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### **APPENDIX B**

# UNIT COST FACTOR LISTING (Power Block Structures Only)

Unit Cost Factor

Cost/Unit(\$)

Removal of clean heat exchanger < 3000 pound	802.43
Removal of clean heat exchanger > 3000 pounds	2,013.56
Removal of clean feedwater heater/deaerator	5,671.40
Removal of clean moisture separator/reheater	11,654.37
Removal of clean tanks, < 300 gallons	172.04
	E 4 4 9 0
Removal of clean tanks, 300 – 3000 gallons	544.89
Removal of clean tanks, >3000 gallons, \$/square foot surface	4.62
Removal of clean electrical equipment, <300 pound	73.65
Removal of clean electrical equipment, 300 – 1000 pound	260.01
Removal of clean electrical equipment, 1000 – 10,000 pound	520.02
Removal of clean electrical equipment, >10,000 pound	1,251.39
Removal of clean electrical transformers $< 30$ tons	2,502.79
Removal of clean electrical cable tray, \$/linear foot	6.83
Removal of clean electrical conduit, \$/linear foot	2.98
Removal of clean mechanical equipment, <300 pound	73.65
Removal of clean mechanical equipment, ~500 pound	15.00
Removal of clean mechanical equipment, 300-1000 pound	260.01
Removal of clean mechanical equipment, 1000 – 10,000 pound	520.02
Removal of clean mechanical equipment, > 10,000 pound	1,251.39
Removal of clean HVAC equipment, <300 pound	73.65
Removal of clean HVAC equipment, 3000 – 1000 pound	260.01
	F90.09
Removal of clean HVAC equipment, 1000 – 10,000 pound	520.02
Removal of clean HVAC equipment, >10,000 pound	1,251.39
Removal of clean HVAC ductwork, \$/pound	0.28
Removal of contaminated instrument and sampling tubing, \$/linear foot	0.94
Removal of contaminated pipe 0.25 to 2 inches diameter \$/linear foot	12.59

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## APPENDIX B

## UNIT COST FACTOR LISTING (Power Block Structures Only)

Unit Cost Factor

# Cost/Unit(\$)

·	
Removal of contaminated pipe $>2$ to 4 in	21.50
Removal of contaminated pipe $>4$ to 8 in	35.05
Removal of contaminated pipe $>8$ to 14 in	67.60
Removal of contaminated $>14$ to 20	81.02
Removal of contaminated $> 20$ to 36	111.93
Removal of contaminated pipe > 36 inches diameter \$/linear foot	132.21
Removal of contaminated values $>2$ to 4 inches	270.37
Removal of contaminated values $> 4$ to 8 inches	321.80
Removal of contaminated valves >8 to 14 inches	644.05
Removal of contaminated values $> 14$ to 20 inches	817.20
Removal of contaminated valves >20 to 36	1,087.36
Removal of contaminated valves > 36 inches	1,290.22
Removal of contaminated pipe fittings > 20 inches	1,087.36
Removal of clean pipe hangers for small bore piping	64.49
Removal of clean pipe hangers for large bore piping	202.80
Removal of contaminated pumps, <300 pound	572.71
Removal of contaminated pumps, 300-1000 pound	1,31 <del>9</del> .27
Removal of contaminated pumps, 1000-10,000 pound	4,164.52
Removal of contaminated pumps, >10,000 pound	10,139.82
Removal of contaminated pump motors, $300-1000$ pound	566.16
Removal of contaminated pump motors, 1000-10,000 pound	1,702.07
Removal of contaminated pump motors, >10,000 pound	3,821.38
Removal of contaminated turbine-driven pumps > 10,000 pounds	11,711.22
Removal of contaminated heat exchanger <3000 pound	2,555.47
Removal of contaminated heat exchanger >3000 pound	7,411.35

TLG Services, Inc.

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### APPENDIX B

### UNIT COST FACTOR LISTING (Power Block Structures Only)

**Unit Cost Factor** Cost/Unit(\$) Removal of contaminated feedwater heater/deaerator 17,907.11 Removal of contaminated moisture separator/reheater 38,753.69 Removal of contaminated tanks, <300 gallons 953.84 Removal of contaminated tanks, >300 gallons, \$/square foot surface 18.44 Removal of contaminated electrical equipment, <300 pound 442.37 Removal of contaminated electrical equipment, 300 - 1 000 pound 1.064.85 Removal of contaminated electrical equipment, 1000 - 10,000 pound 2,050.06 Removal of contaminated electrical equipment, >10,000 pound 4,015.20 Removal of electrical transformers > 30 tons 7,909.43 Removal of contaminated electrical cable tray, \$/linear foot 21.289.82 Removal of contaminated electrical conduit, \$/linear foot Removal of contaminated mechanical equipment, <300 pound 492.50 Removal of contaminated mechanical equipment, 300-1000 pound 1,177.26 Removal of contaminated mechanical equipment, 1000-10,000 pound 2,262.87 Removal of contaminated mechanical equipment, > 10,000 pound 4,015.20 Removal of contaminated HVAC equipment, <300 pound 492.50 Removal of contaminated HVAC equipment, 300-1000 pound 1,177.26 Removal of contaminated HVAC equipment, 1000-10,000 pound 2,262.87 Removal of contaminated HVAC equipment, >10,000 pound 4,015.20 Removal of contaminated HVAC ductwork, \$/pound 2.03Removal of clean standard reinforced concrete, \$/cubic yard 46.64Removal of grade slab concrete, \$/cubic yard 144.88 Removal of clean heavily rein concrete w/#9 rebar. \$/cubic vard 154.60 Removal of clean heavily rein concrete w/#18 rebar, \$/cubic yard 195.56 Removal of below-grade suspended floors, \$/cubic yard 222.85

TLG Services, Inc.

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## APPENDIX B

# UNIT COST FACTOR LISTING (Power Block Structures Only)

Removal of contaminated monolithic concrete structures, \$/cubic yard1,272.46Removal of wooden structures, \$/cubic foot0.48Removal of clean hollow masonry block wall, \$/cubic yard51.02Removal of clean solid masonry block wall, \$/cubic yard51.02Placement of concrete for below-grade voids, \$/cubic yard87.31Backfill of below grade voids, \$/cubic yard14.77Excavation of clean material, \$cubic yard0.48Removal of clean building by volume, \$/cubic foot0.19Removal of clean building metal siding, \$/square foot0.81Removal of standard asphalt roofing, \$/square foot1.23Removal of transite panels, \$/square foot5.72Scabbling contaminated concrete surfaces (drill & spall), \$/square foot5.72Removal of clean overhead cranes/monorails < 10 ton capacity, each371.63Removal of contaminated overhead cranes/monorails >10-50 ton capacity, each1,30.24Removal of clean structural steel, \$/pound0.23Removal of clean structural steel, \$/pound0.23Removal of clean structural steel floor grating, \$/square foot1.89Removal of clean structural steel floor grating, \$/square foot1.89Removal of clean structural steel floor grating, \$/square foot1.89Removal of clean structural steel floor grating, \$/square foot6.31Removal of contaminated free-standing steel liner, \$/square foot6.31Removal of clean structural steel liner, \$/square foot3.46	Unit Cost Factor	Cost/Unit(\$)
Removal of clean hollow masonry block wall, \$/cubic yard51.02Removal of clean solid masonry block wall, \$/cubic yard51.02Placement of concrete for below-grade voids, \$/cubic yard87.31Backfill of below grade voids, \$/cubic yard2.45Removal of clean material, \$cubic yard0.19Removal of clean building metal siding, \$/square foot0.81Removal of standard asphalt roofing, \$/square foot0.81Removal of transite panels, \$/square foot1.23Removal of transite panels, \$/square foot5.21Scabbling contaminated concrete surfaces (drill & spall), \$/square foot9.43Scabbling contaminated concrete floors, \$/square foot5.72Removal of clean overhead cranes/monorails < 10 ton capacity, each	Removal of contaminated monolithic concrete structures, \$/cubic yard	1,272.46
Removal of clean solid masonry block wall, \$/cubic yard51.02Placement of concrete for below-grade voids, \$/cubic yard87.31Backfill of below grade voids, \$/cubic yard14.77Excavation of clean material, \$cubic yard2.45Removal of building by volume, \$/cubic foot0.19Removal of clean building metal siding, \$/square foot0.81Removal of standard asphalt roofing, \$/square foot1.23Removal of transite panels, \$/square foot1.51Scarifying contaminated concrete surfaces (drill & spall), \$/square foot9.43Scabbling contaminated concrete floors, \$/square foot5.72Removal of clean overhead cranes/monorails < 10 ton capacity, each	Removal of wooden structures, \$/cubic foot	0.48
Placement of concrete for below-grade voids, \$/cubic yard87.31Backfill of below grade voids, \$/cubic yard14.77Excavation of clean material, \$cubic yard2.45Removal of building by volume, \$/cubic foot0.19Removal of clean building metal siding, \$/square foot0.81Removal of standard asphalt roofing, \$/square foot1.23Removal of transite panels, \$/square foot1.51Scarifying contaminated concrete surfaces (drill & spall), \$/square foot9.43Scabbling contaminated concrete floors, \$/square foot5.21Scabbling contaminated concrete walls, \$/square foot5.72Removal of clean overhead cranes/monorails < 10 ton capacity, each	Removal of clean hollow masonry block wall, \$/cubic yard	51.02
Backfill of below grade voids, \$/cubic yard14.77Excavation of clean material, \$cubic yard2.45Removal of building by volume, \$/cubic foot0.19Removal of clean building metal siding, \$/square foot0.81Removal of standard asphalt roofing, \$/square foot1.23Removal of transite panels, \$/square foot1.51Scarifying contaminated concrete surfaces (drill & spall), \$/square foot9.43Scabbling contaminated concrete floors, \$/square foot5.21Scabbling contaminated concrete walls, \$/square foot5.72Removal of clean overhead cranes/monorails < 10 ton capacity, each	Removal of clean solid masonry block wall, \$/cubic yard	51.02
Excavation of clean material, \$cubic yard2.45Removal of building by volume, \$/cubic foot0.19Removal of clean building metal siding, \$/square foot0.81Removal of standard asphalt roofing, \$/square foot1.23Removal of transite panels, \$/square foot1.51Scarifying contaminated concrete surfaces (drill & spall), \$/square foot9.43Scabbling contaminated concrete floors, \$/square foot5.21Scabbling contaminated concrete walls, \$/square foot5.72Removal of clean overhead cranes/monorails < 10 ton capacity, each	Placement of concrete for below-grade voids, \$/cubic yard	87.31
Removal of building by volume, \$/cubic foot0.19Removal of clean building metal siding, \$/square foot0.81Removal of standard asphalt roofing, \$/square foot1.23Removal of transite panels, \$/square foot1.51Scarifying contaminated concrete surfaces (drill & spall), \$/square foot9.43Scabbling contaminated concrete floors, \$/square foot5.21Scabbling contaminated concrete walls, \$/square foot5.72Removal of clean overhead cranes/monorails < 10 ton capacity, each	Backfill of below grade voids, \$/cubic yard	14.77
Removal of clean building metal siding, \$/square foot0.81Removal of standard asphalt roofing, \$/square foot1.23Removal of transite panels, \$/square foot1.51Scarifying contaminated concrete surfaces (drill & spall), \$/square foot9.43Scabbling contaminated concrete floors, \$/square foot5.21Scabbling contaminated concrete walls, \$/square foot5.72Removal of clean overhead cranes/monorails < 10 ton capacity, each	Excavation of clean material, \$cubic yard	2.45
Removal of standard asphalt roofing, \$/square foot1.23Removal of transite panels, \$/square foot1.51Scarifying contaminated concrete surfaces (drill & spall), \$/square foot9.43Scabbling contaminated concrete floors, \$/square foot5.21Scabbling contaminated concrete walls, \$/square foot5.72Removal of clean overhead cranes/monorails < 10 ton capacity, each	Removal of building by volume, \$/cubic foot	0.19
Removal of transite panels, \$/square foot1.51Scarifying contaminated concrete surfaces (drill & spall), \$/square foot9.43Scabbling contaminated concrete floors, \$/square foot5.21Scabbling contaminated concrete walls, \$/square foot5.72Removal of clean overhead cranes/monorails < 10 ton capacity, each	Removal of clean building metal siding, \$/square foot	0.81
Scarifying contaminated concrete surfaces (drill & spall), \$/square foot9.43Scabbling contaminated concrete floors, \$/square foot5.21Scabbling contaminated concrete walls, \$/square foot5.72Removal of clean overhead cranes/monorails < 10 ton capacity, each	Removal of standard asphalt roofing, \$/square foot	1.23
Scabbling contaminated concrete floors, \$/square foot5.21Scabbling contaminated concrete walls, \$/square foot5.72Removal of clean overhead cranes/monorails < 10 ton capacity, each	Removal of transite panels, \$/square foot	1.51
Scabbling contaminated concrete walls, \$/square foot5.72Removal of clean overhead cranes/monorails < 10 ton capacity, each	Scarifying contaminated concrete surfaces (drill & spall), \$/square foot	9.43
Removal of clean overhead cranes/monorails < 10 ton capacity, each371.63Removal of contaminated overhead cranes/monorails < 10 ton capacity, each	Scabbling contaminated concrete floors, \$/square foot	5.21
Removal of contaminated overhead cranes/monorails < 10 ton capacity, ea.	Scabbling contaminated concrete walls, \$/square foot	5.72
Removal of clean overhead cranes/monorails >10-50 ton capacity, each891.91Removal of contaminated overhead cranes/monorails >10-50 ton capacity, each2,712.12Removal of gantry cranes > 50 ton capacity, each15,642.42Removal of clean structural steel, \$/pound0.23Removal of clean steel floor grating, \$/square foot1.89Removal of contaminated steel floor grating, \$/square foot6.31Removal of contaminated free-standing steel liner, \$/square foot21.52Removal of clean concrete-anchored steel liner, \$/square foot3.46	Removal of clean overhead cranes/monorails < 10 ton capacity, each	371.63
Removal of contaminated overhead cranes/monorails >10-50 ton capacity, each Removal of gantry cranes > 50 ton capacity, each Removal of clean structural steel, \$/pound15,642.42 0.23Removal of clean steel floor grating, \$/square foot Removal of contaminated steel floor grating, \$/square foot1.89 6.31 21.52 8.21.52 8.21.52	Removal of contaminated overhead cranes/monorails < 10 ton capacity, ea	. 1,130.24
each Removal of gantry cranes > 50 ton capacity, each Removal of clean structural steel, \$/pound15,642.42 0.23Removal of clean steel floor grating, \$/square foot1.89 6.31 Removal of contaminated steel floor grating, \$/square foot6.31 21.52 8.46	Removal of clean overhead cranes/monorails >10-50 ton capacity, each	891.91
Removal of gantry cranes > 50 ton capacity, each15,642.42Removal of clean structural steel, \$/pound0.23Removal of clean steel floor grating, \$/square foot1.89Removal of contaminated steel floor grating, \$/square foot6.31Removal of contaminated free-standing steel liner, \$/square foot21.52Removal of clean concrete-anchored steel liner, \$/square foot3.46	- •	2,712.12
Removal of clean structural steel, \$/pound0.23Removal of clean steel floor grating, \$/square foot1.89Removal of contaminated steel floor grating, \$/square foot6.31Removal of contaminated free-standing steel liner, \$/square foot21.52Removal of clean concrete-anchored steel liner, \$/square foot3.46		15.642.42
Removal of contaminated steel floor grating, \$/square foot6.31Removal of contaminated free-standing steel liner, \$/square foot21.52Removal of clean concrete-anchored steel liner, \$/square foot3.46		•
Removal of contaminated steel floor grating, \$/square foot6.31Removal of contaminated free-standing steel liner, \$/square foot21.52Removal of clean concrete-anchored steel liner, \$/square foot3.46	Removal of clean steel floor grating, \$/square foot	1.89
Removal of contaminated free-standing steel liner, \$/square foot21.52Removal of clean concrete-anchored steel liner, \$/square foot3.46		
Removal of clean concrete-anchored steel liner, \$/square foot 3.46		
	Removal of contaminated concrete-anchored steel liner, \$/square foot	25.07

TLG Services, Inc.

Peach Bottom Atomic Power Station Decommissioning Cost Analysis

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## **APPENDIX B**

## UNIT COST FACTOR LISTING (Power Block Structures Only)

Unit Cost Factor	Cost/Unit(\$)
Placement of scaffolding in clean areas, \$/square foot	11.46
Placement of scaffolding in contaminated areas, \$/square foot	17.05
Removal of chain link fencing, \$/linear foot	1.16
Removal of railroad track, \$/linear foot	34.40
Removal of asphalt pavement, \$/square foot	0.74
Core drilling 2 to 4 inch diameter, linear foot	239.50

Peach Bottom Atomic Power Station Decommissioning Cost Analysis Document P07-1425-004, Rev. 0 Appendix C, Page 1 of 21

## APPENDIX C

## DETAILED COST ANALYSES

	Page
Unit 2	
Unit 3	C-11

TLG Services, Inc.

#### TABLE C-1 PEACH BOTTOM ATOMIC POWER STATION - UNIT 2 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

						Olf-Sile	LLRW				NRC	Spant Fuel	Site	Processed			/olumes		Burial		Utility an
Activity		Decon	Removal		Transport				Total	Total	Llc. Term.	Management	Restoration	Veturne	Class A	Class 8	Class C	GICC	Weight	Craft	Contracto
adex	Activity Description	Cost	Cost	Costs	Costs	Cosis	Costs	Cosis	Contingency	Costa	Costs	Costs	Cosis	Cu. Feet	Cu. Feet	Cu. Feet	Gu. Feet	Cu. Feel	Lbs,	Manhours	Manbour
10D la - Si	nutdown through Transition							-													
iod Ia Direct	Decommissioning Activities																				
	re preliminary decommissioning cost	-	-	-	•	-	•	94	14	108	108	-	-	•	•	-	-	-	· •	•	1,8
	cation of Ceasation of Operations									a 15/8											
	ve fuel & source material cation of Permanent Defueling									8											
	ivais plant systems & process waste									a									•		
	re and submit PSDAR			-				145	. 29,	167	167		-	-	-	-				-	2,0
	w plant dwgs & specs.	-			•	-	-	833	50	383	383		-	-		-	•	•	-		4,
.8 Perfor	in detailed rad survey									a											
L9 Estim	nte by-product inventory	· -	-	-	•	•	-	73	11	83	63	•	-	-	•.	-	-	-	-	•	1,
	roduct description	•	-	-	-	•	•	72	11	83	83	-	•	-	•	•	-	-	•		1,
	led by-product inventory	•	-	-	-	•	•	94	14	108	108	-	-	•	•	-	•	•	•	•	1, 7,
	e major wark sequence	•	•	-	-	-	•	543 225	62 34	625 258	625 258	-	•	•	•	•	•	-	•	-	8.
	m SER and EA	•	-	•	•	-	•	225 263		258	258	-	•	•	•	•	•	•	-	•	a. 6.
	m Site Specific Cost Study	-	-	-	-	-	-	203	54 45	341	341	•			· -	-			•		4,
	refeabrait License Termination Fian ve NRC approval of termination plan	•	•	•	•	•	•	297	43	241			-	-	•	•	-	-	-	•	-,
vity Specific								ï													
	& temporary facilities	-			-	-		857	53	410	869		41	-							4,
17.2 Plant						-	-	302	45	847	312	-	85	-	•		-	-	-	-	4
173 NSSS	Decontamination Flush		-				-	36	5	42	42	•	-	-			-	-		-	
	tor internals	-	-	-	•	•	•	514	77	692	592	-	-	•	-	-	•	•	•	•	7
17.5 Read	tor vessel	•	-	-	-	-	•	471	71	542	642	•	-	-	-	-	-	-	-	-	6
.17.6 Gacri	ficial shield	•		-	-	-	-	36	5	42	42	•	•	•	•	-	-	-	-	•	
	ture separators/relieaters	•	-	•	•	•	•	72	11	83	83	-	-	•	-	-	-	•	-	-	1
	iorced concrete	· · · -	-	-	-	-	-	116	17	193	67	•	. 67	•	•.	•	-	-	•	-	1
	ine & condenser	-	-	-	-	-	-	302	45	847	347	•	•	-	•	-	•	-	-	-	4
	ure suppression structure	-	-	•	•	-		145	22	167 133	167	•	-	-	•	•	•	-	-	-	2
.17.11 Dryw		-	•	-	-	-	•	116 226	17 84	260	193 180	-	- 130	-	-		-	-	-	-	2
	t structures & buildings	•	-	•	•	-	-	226	50	260	883	-	130	-		-		•	•		4
	e management		•	-		•	-	65 65	10	303 75	37	•	37	-		•					•
	ity & site closeout	-	-	-	-	-	•	8,092	464	3,856	8.246		810		-						42
1.17 Total		•	•	-	-	•	•	20,032	101	0,000	0,410	-	810	-	-	-	-	-	•	-	-1-
ming & Site	Preparations							174	26	200	200										2
	are dismantling sequence	-	•	-	•	•	•	2,804	346	2,650	2,650	-	•	-			-	-		-	
	t prep. & temp. svors in water clean-up system	-	-	-		-		101	15	117	117			_		-	•_				,
	in water chem. up system ing/Cont. Catrl Envips/tocling/stc.	-				-		1,950	293	2,243	2,243			-				-		-	
L22 Proce	are casks/liners & containers							69	19	105	102	-		-			_	-	-		3
	stal Period 1a Activity Costa	-	-	-	-	-	-	9,949	1,492	11,442	11,132	•	810	-			•	-	-	-	78
lad in Perior	d-Dependent Costs																				
	Alle			-	-			1,292	129	1,421	1,421	•	-	•	-	۰.	-		-	-	
	unty taxes	-		-	-	• •		510	61	661	661	-	-	•		•	-	-	-	-	
	th physics supplies	-	30		•	-		-	76	882	382	-	-	-	•	•	•	-	· •	•	
4 Heav	y conforment rontal	-	82	2 .	-	•	•	-	48	871	371	•	•	-	•	· •	-	-	-	•	
	osal of DAW generated	-	-	5		3 -	37		31	60	60	•	•	-	534	-	•	•	10,69	6 19	1
6 Plan	t energy budget	-	-	-	•	-	•	2,446	367	2,818	2,813	-		-	-	-	•	•	•	-	
	Frees		•	•	-	-	-	801	. 30	331	331	•	•	-•	-	-	-	-	-	•	
	rgency Planning Fees .	•	•	•	•	•	· ·	50	5	56	-	56		•	•	·	•	-	•	-	
	t Fuel Paul O&M	-	-	-	-	•		948	142	1,090	•	1,090		-	-	•	•	•	•	•	
4.10 Dryl	Fuel Storage O&M Costs	•	-	-	-	-	-	34	5	40	•	40	J -	-	-	-	-	-	•	-	

TLG Services, Inc.

#### TABLE C-1 PEACH BOTTOM ATOMIC POWER STATION - UNIT 2 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

						Off-Site	LLRW				NRC	Spent Foel	Site	Processed			/olumes		Buriat		Utility and
Activity		Decon	Removal					Other	Total	Total	Lic. Term.	Management	Restoration	Volume	Class A	Class B		GTCC	Weight	Craft	Contractor
Index	Activity Description	Cost	Cost	Costs	Costs	Cosis	Costs	Costs	Contingency	Cosis	Costs	Costs	Casis	Cu. Feet	Cu. Feet	Gu. Feet	Çu, Feet	Cu. Feel	Lbs.	Manhours	Manhours
	a Period-Dependent Costs (continued)																				
124.11	Security Staff Cost	-	-	•	-	-	•	1,494	224	1,718	1,718	-	-	-	-		-		-	-	68,931
la.4.12	Utility Staff Cost	•	•	-	•	•	•	26,328	8,949	30,278	30,278	•	-	-	•	•	-	•	-	-	4-10,086
12.4	Subtotal Period 1a Period-Dependent Costa	•	628	9	8	•	37	33,405	5,038	39,120	37,935	1,185	•	-	634	-	-	•	10,696	131	499,007
18.0	TOTAL PERIOD 12 COST	•	628	9	3	•	37	43,355	6,531	60,562	49,067	1,185	310	•	534	-	•	•	10,696	131	577,601
PERIOD	1b - Decommissioning Preparations																				
Period 1b	Direct Decommissioning Activities																				
Detailed	Work Procedures																				
		-	-	-	-		-	848	51	894	855		59	-					-		4,733
16.1.1.2	NSSS Decontamination Flush	-		-	-	-		72	11	83	83		-	-					-		1,000
15.L1.S				-	-	-	-	290	43	833	835	-		-	-		-		-		4,000
1b.L.1.4		•	-	-	-	-	-	<b>9</b> 8	15	112	28	-	84		-			-	-	-	1.350
16. <b>1.1.5</b>		-	-	-	•		-	72	11	83	83	-	-	-	-		-	-	-	-	1,600
15.1,1.6	Incore instrumentation	•	-		-			72	11	83	83	•				-		-	-	-	1,000
1b.1.1.7		-	-	-	-	-	-	11	2	12	12	-	-	-	-	•	-	•	-	-	145
1b,1.1.8		· •	-	-	•	-	-	263	89	802	303	-	-	-		-	-	-	•		9,630
lb.1.1.9	Facility closeout	•	-	•	•	•	•	87	19	100	50	-	50	-	•		-	-	-	-	1,200
15.1.1.10		•	-	-	-	-	-	87	13	100	100	•	•	•	•	•	-	•	· •		1,200
	Reinforced concrete	•	-	-	-	-	-	72	11	83	43	-	42	-	-	-	-	•	-		1,000
1h.1.1.12	Turbine & condensera	.•	•	•	•	•	-	302	45	347	847		-	-		-	-	-	•		4,167
16.1.1.13			•	-			-	145	22	167	167	-	-	-	-			•	-	-	2,000
1b.1.L.14	Radwasts building	•	•	-	-	-	-	198	30	227	205	-	28	-	-	-	-	•	-	•	2,730
	Reactor building	•	•	-	•	•	•	198	80	227	205	•	23	-	-	-	•		•	-	2,730
16.1.1	Total	-	•	-	•	-	•	2,310	847	2,857	2,996	-	261	-	•	•	-	•.	•	•	31,685
Ib.1.2	Decon NSSS	492	-	•	•		•	•	246	737	737	-	-	-	• '	-	•	•	-	1,067	•
1 <b>b.1</b>	Subtatal Period 1b Activity Costs	492	•	•		-	-	2,310	592	3,394	3,133	-	261	-	-	•	•	•	-	1,067	31,88
	b Additional Costs																				
16.2.1	Spent Fuel Pool Isolation	•	•	•	•	-	-	7,879	1,182	9,060	9,060	-	•	-	-	-	-	-		-	-
1b.2.9	Site Characterization	-	•	-		-	-	823	138	1,062	1,062	-	-		-	-	-	-		-	-
1 <b>b.2</b>	Subtotal Period 1b Additional Costa	-	-	-	•	•	•	8,802	1,320	10,123	10,122	•	•	•	•	•	-	•	-	•	•
Pacied II	b Collateral Costs																				
16.3.1	Decon equipment	658	•	•	•	-	-	-	99	757	757	•	-		-	-	-	-			-
Ib.8.2	Process liquid waste	17	-	208	202	•	2,237	•	619	8,283	5,263	-	-	-		2,632	-		438,813	84	
Ib.3.3	Small tool allowance	•	1		-	-	-	-	0	.1	1		-	-	•		-	-	-	-	
ib. <b>S.4</b>	Fine cutting equipment	•	911		-	-	•	-	137	1,048	1,048	•.	•	•	-	· •	•	-		-	
1b.9	Subtotal Period 1b Collateral Costs	675	912	208	203	•	2,237	• .	854	5,088	5,088	•	-	-	-	2,632	-	-	438,813	84	· -
	h Period-Dependent Costs	•																•			
1b.4.1	Decon supplies	20	•	-	-	-	-	-	5	25	25	-	-	-	-	•		•	-	-	
16.4.2	Insurance	•	•	•	-	-	•	636	65	720	720	-	-	-	-	•	-	• `	-	-	-
16.A.S	Property taxes	-	•	•	•	•	-	259	26	284	284	• .	-	-	-	•	-	•	-		-
1b,4.4	Health physics supplies	-	158	•	•	•	-	-	40	196	195	· •	-	-	•		-	-		•	-
16.4.5	Heavy equipment rental	•	163	-		-	•	-	25	188	188	•	•	•	•	•	•	•	-	•	-
1b.4.6	Disposal of DAW generated	•	-	δ	1	-	30	•	6	82	32	-	-	-	287	•	•	•	6,753	50	) -
1b.4.7	Plant energy budget	•	•	-	-	-	-	2,480	372		2,852		•	-	•	•	-	•	-		-
1b.4.8	NRC Fees	•	•	-	-	•	-	183	18		202	•	•	-	•		•	•	-	•	•
1h.4.9	Emergency Planning Pees Spent Fuel Fool O&M	•	•	•	-	-	•	26 .481	8 72	26	-	28		-	•	•	-	-	-	-	-
1b.4.10										663		558									

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#### TABLE C-1 PEACH BOTTOM ATOMIC POWER STATION - UNIT 2 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

						Olf-Site	LLRW				NRC	Spant Fuel	Sile	Processed		Burial V	Volumes		Burial		Utility and
Activity		Decon	Removal	Packaging	Transport		Disposal	Other	Total	Total	Lic. Term.	Management	Restoration	Volume	Class A	Class B	Class C	GTCC	Weight	Craft	Contractor
Index	Activity Description	Cost	Cost	Costs	Costs	Costs	Costs	Costs	Contingency	Costs	Costs	Costs	Costs	Cu, Feet	Cu. Feet	Cu. Feet	Cu. Feet	Cu. Feel	Lbs.	Manhours	Manhours
																	-				
	Feriad Dependent Costs (continued)								_			20									
	Dry Fuel Storage Oahl Costs	•	•	-	-	•	-	17 757	8	20 871	·		•	-	-	•	•	•		•	29.864
15,4.12	Security Staff Cost	-	-	· ·	•	-			114		871	•	-	-	-	-		-	-	•	223,057
16.4.13	Utility Staff Cost	-	-		• •	-	- 20	13,344 18,202	2,002 2,749	16,846	15,346 20,719	601	-	-	287		:	-	5.753	- 70	252,921
1b.4	Subtotal Period 1b Period-Dependent Costs	20	322	a	1	•	20	10,404	2,743	21,820	20,713	601	-	•	194	-	-	-	0,100		
1b.C	TOTAL PEBIOD 15 COST	1.187	1,234	212	204	-	2,257	29,314	6,516	39.924	39,062	601	261	-	287	2,632	•	•	141,566	1,231	284,805
PERIOD	1 TOTALS	1,187	1,661	221	207	-	2,294	72,669	12,047	90,486	88,129	1,786	571	•	821	2,682	-	•	465,263	1,352	863,413
PERIOD	) 2a - Larga Camponent Removal																•				
Period 2a	a Direct Decommissioning Activities																				
Nodep- S	Steam Supply System Removal																				
2a.1.1.1	Recirculation System Piping & Valves	62	69	16	11	•	572		190	900	500	•		•	1,227	•	-	-	112,271	3,330	-
29.1.1.2	Recirculation Pumps & Motors	26		. 12	ц		766	-	219	1,092	1,092	-	-	146	1,412			-	150,250	1,763	-
29.113	CRDMs & NIs Removal	138	108	297	48		705	•	308	1,598	1,698	•	•	•	6,179	•	•	-	138,255	6,971	-
Za.L.14	Reactor Vessel Internals	137	1,851	6,063	1,212	•	12,569	212	9,696	31,659	81,659	•	•	•	751	2,526	804	-	453,410	37,665	1,439
20.1.1.5	Reactor Vessel	61	3,574	1,543	425	-	9,350	212	7,909	23,073	23,073	-	-	•	10,735	2,254	-	•	1,408,691	32.665	1,439
28.1.1	Totals	424	5,608	7,951	1,703	30	23,962	423	18,222	58,823	58,323	•	-	146	19,334	4,779	804	•	2,262,849	77,394	2,877
Remound.	of Major Equipment																				
28.1.2	Main Turbine/Generator	•	311	552	198	5.653	3,684	-	1.933	12,848	12,848	-		28,275	11,732	-	-	•	1,052,676	9,758	
22.1.3	Main Condensers	•	. 793	417	142	5,595	1,931	-	1,590	10,530	10,530	•	•	27,989	6,148	•	•	•	551,650	25,487	•
Disposal	of Plant Systems																				
		-	. 199	10	5	232	250	-	147	834	834	-	-	1,112	548	-	-		49,086	6,219	-
2a.1.4.2	Circulating Water	-	19		•	•			3	22	-		22		-	-		•	-	673	-
2a.1,4.9	Circulating Water (RCA)		52	9	8	202	-	-	44	303	802	-	-	1,008		-	-	-	-	1,617	
24.1.4.4			887	82	24	702	2,347	-	801	4,943	4,848	-	•	3,510	5,136	-	-	-	460,603	12,428	-
24.14.5	Condensate Filter Demineralizer	-	505	39	11		1.062	-	444	2,870	2,870		-	1,545	2,388	-	-	•	208,271	15,656	•
21146		-	600	40	8		922		414	2,178	2,173			948	2,018	•	-	-	160,812		-
24.1.4.7	Electrohydraulic Control	-	41	1	L	81	•	-	23	147	147	-		406		-	•	-	-	1,231	-
2a.1.4.8	Emargancy & HP Sarvice Water	-	46	-	•				. 7	52	-	-	53		-	-	-	•	•	1,653	
28.1.4.9		-	258	4	8	620	-	· •	144	933	933	•	-	2,600	-	-	-	-	•	7,614	
22.1.4.10		-	603	76	24	724	2,262	-	836	4,526	4,526	-	-	3,621	4,963	-	-	•	413,851	19,161	•
22.14.11			514	54	20	675	1,683		659	9,604	8,604	-		3,875	8,679	-	-	-	330,060		
	generator Hydrogen & Carbon Dioxide	-	24	0	1	41	-	-	12	78	78	-		203	-	-	-	-		721	
	Instrument Nitrogen		21	0	1	53		-	13	68	88	•	•	264	-	-	•		-	600	-
20 1 4 14	Main Steam & Bypass & Crossaround		456	26	20		977		508	2,953	2,952	•	-	4,775	2,136	-	-	-	191,636	14,503	-
	5 Offgas Recombiner		186	9	3	116	227	•	110	601	601	-	-	581	498	-	-		44,558	4,136	
	5 Post Accident Sampling		11	ň	ō		6	-	5	25	25	-		32	14		•	-	1,270	353	-
	7 Primary Containment Leak Testing		` <u>'</u>	ñ	ā	1 1	ī	-	i	7	7	•	•	1	3		-		246	111	
	8 Process Sampling	-	300	18	3	65	544	-	173	903	903			325	753	-			67,479	8,768	. <b>.</b>
	9 Stator Water Cooling				1				8	53	53		-	176		-	-	-		282	
20.1.2.13 20.1.5.00	0 Traveling Water Screens	-	16						2	18	-	-	18					-	-	581	
20 14 91	1 Traversing Incore Probe		23	2	1	. 26	71		28	151	151		•	128	156	•		· .	14,012	739	
7-14-50	2 Turbine & Extraction Steam		673	127	51				1,445	6,066	6,066	-	-	9,324			-	-	766,278		
20.1.4.23			217	9	5			-	110	701	701	-		1.825					-	6,608	
28.1.4	Totals		5,116	503	168			-	6,936	32,951	32,858	-	93			-	-	-	2,768,050		
28.1.5	Scaffolding in support of decommissioning	•	711	9	S	115	26	- '	203	1,070	1,070	-		591	82	-			7,838	25,082	-
2a.1	Subtotal Period 24 Activity Costs	424	12.539	9,502	2,232	18,550	49,660	423	57,884	115,216	115,123		93	92,746	68,131	4,779	804		6,632,664	297,124	2,877
											•			-						-	

TLG Services, Inc.

#### TABLE C-1 PEACH BOTTOM ATOMIC POWER STATION - UNIT 2 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

																	•				
· · · · ·	·····	<u> </u>				O(f-Sile	LLRW				NRC	Spent Fuet	Site	Processed		<b>Burial</b>	Volumes		Burlat		Utility and
Activity		Decon	Removal	Packaging	Transport	Processing	Disposal	Other	Total	Total	Lic. Term.	Management	Restoration	Volume	Class A	Class B	Class C	GTCC	Weight	Craft	Contractor
Index	Activity Description	Cost	Cost	Costs	Costa	Costs	Costs	Costs	Contingency	Costs	Costs	Costs	Costs	Cu. Feet	Cu. Feet	Cu. Feet	Cu. Feet	Cu. Feet		Manhours	Manhours
	a Additional Costa																				
24.3.1	Curie Surcharge (Excluding EPV)	•	-	•	-	-	1,681	-	408	2,038	2,038	•	-	-	-	-	-	-	-	-	-
2a.2	Subtotal Period 2a Additional Costs	•	•	-		-	1,631	•	408	2,038	2,038	•	-	•	•	•	-	-	•	-	-
Period 2:	Collateral Costa																				
22.3.1	Process liquid waste	81		10	26	-	187		54	258	258		-			214			26,932	43	
28.5.2	Small tool allowance		172		•	-			26	197	178		20								
28.5	Subtotal Period 2a Collateral Costs	51	172	10	26	•	137	-	80	455	436	-	30	-	-	2(4	-	-	26,932	42	
	Period-Dependent Costs												-								
2a.4.1	Decon supplies	61								76	~										
24.4.2	Inturance	01	-		-	•	-	451	15 45	496	76 496	•	-	•	•	-		•	•	•	-
24.4.8	Property taxes	•	-	•	-	-	•	769	40	846	490	•	-	-	-	-	•	-	•	-	-
24.4.6	Health physics supplies		1,402		-		-	103	851	1,753	1.753	•	80	•	-	-	-	-	•	-	-
24.4.5	Heavy equipment rental	-	2,630	•	•	-	•	•	395	3.023	3,025	•	•	-	•	-	•	-	•	-	•
	Disposal of DAW generated	•	1,630	104	- 51	•	-	•				•	-	-		-	•	-			•
2a.4.6		-	-	104	31	-	436		124	698	695	•	•	-	6,292	-	-	-	124,876	1,630	•
2a.4.7	Plant energy budget NRC Fees	-	•	•	•	•	-	3.602	525	4,027 533	4.037	•	•	•	-	•	-	•	-	-	-
28,4.6		-	-	•	•	-	-	485	48		533	•	-		•	-	-	-	•	•	•
21.4.9	Emergency Planning Fees Spent Fuel Pool O&M	-	-	•	•	•	•	76	8	84	-	81	-		-	-	-	•	•	•	-
22.4.10		•	•	•	•	-	-	1,429	214	1,643	•	1.643	-	•	•	-	-	-	•	•	•
20.4.11	Dry Fuel Storage O&M Costs	•	-	-	-	•	-	52	8	60	-	60	-	•	•	•	•	- '	•	-	•
28.4.12	Security Staff Cost	-	•	•	-	-	-	2,319	352	2,701	2,701	•	•	•	-	-	•	-	-	•	92,651
20.4.13	Utility Staff Cost	•	• •	•	•	-	-	93,467	5,020	98,487	88,487	•	-	•	•	-	•	-	-	-	560,277
23.4	Subtotal Period 2a Period-Dependent Casts	6L	4,033	104	81	•	436	42,579	7,182	64,425	62,654	1,786	85	-	6,222	-	•	•	124,876	1,530	652,929
24.0	TOTAL PERIOD 2a COST	515	16,743	9,616	2,289	16,550	45,865	43,002	35,654	172,185	170,152	1,785	197	92,746	74,863	4,993	804	•	6,784,878	288,696	655,806
PERIOI	) 2b-Site Decontamination																				
Feriod 2	b Direct Decommissioning Activities																				
w	of Plant Systems																				
25.1.1.I			803	2						733	600										
25.1.1.2	Cleanup Filter Demineralizer	121	142	u n	2	344 20	270	•	118 168	734	793 734	•	-	1,723	·	-	-	-		7,694	-
26.1.1.3	Condensate & Refueling Wtr Strg & Trusfr	121	219	18	6	20	439	•	205	1,137	734	•	•	99	516	-	-	· ·	52,951	7,664	•
2b.1.1.4		400	375	103	22	837	439 2,841	-	1,068	5.146	1,137 5,14G	•	•	1,250 1,685	1,092	•	-	-	86,186	6,798	-
26,1.1.5	High Pressure Coolant Injection	405	306	56	14	225	3,641	-	785	3.650	3,650	•	-		6,215	-	-	-	657,294	14,615	-
20.1.L.5 2b.1.L.6	Reactor Core Leolation Cooling	405	81		11	225	1,858 361	•	146	a.cov 696	3,650 696	•	•	1,126 184	4,064		-	•	364,612	11,559	•
25.1.1.5	Reactor Water Cleanup	70	102		1	a/ 9	201	-	140	605	505	-	•		790		-	•	70,885	3,228	-
26.1.1.8	Regizo Pump M/G Set Lube Oil		86	8	3	18G	201	•	50	826	326	-	-	45	440	-	-	-	99,443	4,846	-
25.1.1.8	Residual Heat Removal	1,036	634	171	40	607	5.170	•	2,088	6.30 9,742	8,742	•	-	928		-	-	-		2,635	•
2h.1.1.10		3,000	81	1/1	1	48		-		3,742	8,743	•	•	9,037	11,809	-	-	•	1,014,361	24,663	•
2b.1.1	Totals	2.088	2,240	365	97	2.058	11,141		14 4,761	22,758	22,758	-	•	214 10,291	24,526	•	-	-		941	-
		2,000		680		2,010	11,111	•	4,101	22,100	×, 100	-	•.	10,231	24,020	•	•	•	2,185,782	84,643	·
2b.1.3	Scaffolding in support of decommissioning	· ·	889	12	8	148	32	•	254	1,837	1,337	-	-	759	102	•	-	•	9,179	\$1,827	•
Deconta	mination of Site Buildings																				
25.1.8.1	Reactor Building	8,339	1,749	· 489	231	2,992	5,961	-	4,180	18,692	18,892			14,959	21,740	-		-	1,935,619	149.340	-
2b.1.3.2	Turbins Building	692	373	77	66	188	127	-	517	2,041	2,041			941				-	542,911	80,653	-
2b.1.3	Totals	4.032	2,123	560	297	3,180	6,088	-	4,647	20,932	20,932	-	-	15,900	27,201	•	-	-	2,478,630	179,993	-
55.1	Subtotal Period 2b Activity Costs	6,120	5.251	861	397	5.386	17.261		9,652	45.028	45,028			26,930	61,829						
		0,1.0		901		0,000	11,601	•	5,001	-3,020	40,0.30	•	•	26,930	01,629	•	·	-	1,673,434	296,163	-

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#### TABLE C-1 PEACH BOTTOM ATOMIC POWER STATION - UNIT 2 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

Activity					<b>.</b> .	Off-Site	LLRW	<i></i>			NRC	Spent Fuel	Site	Processed		Burial V			Burial		Utility and
index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Processing Costs	Disposal Costa	Other Costs	Total	Total	Lic. Term.	Management	Restoration	Voluma	Class A		Class C	GICC	Weight	Craft	Contractor
Index	Activity Description	COSL	Cost	COSTS	Casts	Gosts	COSIS	Costs	Contingency	Costs	Costs	Cosia	Costs	Cu. Feet	Cu. Feel	Cil Feet	Cu. Feet	Cu. Feet	Lbs.	Manhours	Manhours
riod 2b	Collateral Costs																				
5.B.1	Process liquid waste	69	-	751	732	-	8,083	-	2,238	11.872	11.872		-			9,522			1,587,683	302	
.3.2	Small tool allowance	• ·	160	-	•			-	24	184	184		-		-		-	-	1,001,000	302	-
.8	Subtotal Period 2h Collateral Costs	59	160	751	. 792	-	8,092	-	2,263	12,056	12,056	-				9,522	-	-	1,587,683	802	:
rind Sh	Period-Dependent Costs																				
.4.1	Decon supplies	899																			
4.2	Insurance	075	•	-	•	•	-	- 746	225 75	1,123	1,128	-	•	-	•	-	-	-	-	•	•
1.4.3	Property texes	-			•	•		1.272	75 127	. 821	821	•	-	•	-	-	•	•	•	•	•
1.4.4	Health physics supplies	-	1.701		•	-		1,212	425	2,127	1,399 2,127	•	•	-	-	-	•	•	-	•	•
.4.5	Heavy equipment rental	-	4,637	-	•	•	•		661	2,127	2,127	•	-	•	-	•	•	•	•	-	-
.4.6	Disposal of DAW generated	-	4,037	102	- 81		480	•	122	685	5,217 685	•	•	•		•	-	•			-
.4.7	Plant energy budget	-		104	31		440	4.574	686	5.261	5,261	•	-	-	6,136	•	-	-	122,959	1,507	-
.4.8	NRC Fees			•		-	•	9,87%	72	5,281 792	5,251 792	•	•	•	· •	-	-	-	•	•	-
.4.9	Emergency Planning Fees			-	-		-	126	13	192	792	-	•	-	•	•		-	•		-
.4.10	ISFSI Transfer and Capital Costs			-	-	-		56.000	8,400	64.400	:	64.400	•.	•	•	•	•	-	•	-	-
4.11	Spent Fuel Pool O&M					•	-	2,364	355	2,718	-		-	-	-	-	•	•	•	-	-
4.12	Radwaste Processing Equipment/Services	•	•	•	-	-	-		355	516		2,718	-	-	-	•	-	-	-	-	•
4.13	Dry Fuel Storage O&M Costs	•	-	•	•	•	•	418			516	•	•	-	-	•	••	-	-	-	-
	Security Staff Cost	•	-	•	•	-	•	86	' 13	99		99	•	•	•	-	-	-	•	•	•
4.14	Utility Staff Cost	•	•	•	•		• •	1,681	252	1,933	1,933	•	•	•	•	-	-	-	-	-	66,30
,4.15	Subtotal Pariod 2b Period-Dependent Costs	•			•	-	•	44,785	6,711	51,449	51,449	-	•	-	-	•	•	•	•	-	764,40
.4	Sublotal Period 2b Period-Dependent Costs	699	6,238	102	91	-	430	112,756	18,223	136,678	71,992	67,365	-	•	6,136	-	•	-	122,959	1,607	880,70
0	TOTAL PERIOD 26 COST	7,078	11,649	1,614	1,160	5,886	25,783	112,756	30,136	195,762	128,406	67,855	-	26,930	57,965	9,522	-		6,384,076	297.971	830.70
	Direct Decommissioning Activities Remove spent fuel racks	506	45	117	82	1,260	434	-	676	2,972	2,972	-	-	6,298	1,363	-	-		124,133	1,547	-
11		506	45	117	32	1,260	434	-	576	2,972	<u>9</u> ,972	-	-	6,298	1,563		-	•	124,133	1,547	-
1.1 iposal	Remove spent fuel racks	506		117	32 6		434	•		•		•	-		1,363	•		·	124,133		-
.1.1 sposal .1.2.1	Remove spent fuel racks of Plant Systems Compressed Air	<b>3</b> 03 -	861	8	6	412	434	•	153	935	- 985		-	2,059	1,363	•		 -	124,123	10,123	-
1.1 specal 1.2.1 1.2.2	Remove spent fuel racks of Plant Systems Compressed Air Conlainment Atmosphere Control	506 - -	861 184		6	412 488	434	•	153 119	935 745	- 985 745	:	-	2,059 2,191	1,963	:	-		124,123 - -	10,123 5,735	-
1.1 spaani 1.2.1 1.2.2 1.2.3	Remove spent fuel racks of Plant Systems Compressed Air Conlainment Atmosphere Control Cooling Water - Resctor Building	506 - - -	861 184 87	9 3	6	412 438 182	434 - - -		163 113 . 49	935 745 322	985 745 822	•	•	2,059 2,191 910	1,583 - -	•	-	-	124,133 - -	10,123 5,735 9,524	-
1.1 1.2.1 1.2.2 1.2.3 1.2.3 1.2.4	Remove spent fuel racks of Plant Systems Compressed Air Conlaineent Atmosphere Control Cooling Water - Reactor Building Cooling Water - Turbine Building	808 - - - -	861 184 87 87	9 3 1	6	412 488	434 - - -	-	163 119 . 49 41	935 745 322 257	985 745 822 257	•	:	2,059 2,191 910 632	1,583 - -		-	 - - -		10,123 6,736 9,524 2,463	- - - -
1.1 iposal 1.2.1 1.2.9 1.2.3 1.2.4 1.2.5	Remove spent fuel racks of Plant Systema Compressed Air Containeent Atmasphere Cantrol Cooling Water - Reactor Building Cooling Water - Turbine Building Electrical	506 - - - -	861 184 87 87 87	9 3 1 . 1	6 6 8 2	412 488 182 126	•	-	153 119 . 49 41 54	935 745 329 267 417	935 745 322 257	-	- 417	2,059 2,191 910 632			-	- - - - -	-	10,123 5,736 9,524 2,463 12,503	-
1.1 posal 1.2.1 1.2.3 1.2.3 1.2.4 1.2.5 1.2.6	Remove spent fuel racks of Plant Systems Compressed Air Containent Atmosphere Control Cooling Water - Reactor Building Cooling Water - Turkine Building Electrical Electrical (BCA)	506 - - - - -	861 184 87 87 852 399	9 3 1 1 - 2	6 6 8 2 - 5	412 488 182 126 296	434	-	153 119 . 49 41 54 156	935 745 329 267 417 904	935 745 322 257 904	-	417	2,059 2,191 910 632 1,479	1,363	- - - - -		- - - - - -	8,853	10,123 5,736 9,524 2,483 12,503 13,165	-
11 posal 121 129 123 124 125 126 127	Remove spent fuel racks of Flant Systems Compressed Air Containment Atmasphere Control Cooling Water - Rescher Building Electrical Electrical (RCA) Electrical (RCA)	506	961 184 87 87 352 399 2,451	9 3 1 1 2 21	6 6 9 2 - 5 41	412 488 182 126 296 2,802	•		153 119 . 49 41 54 166 1,041	935 745 322 267 417 904 6,356	935 745 322 257 904 6,356	-	- 417	2,059 2,191 910 632 1,479 14,010			-	- - - - - - - - - - - - - - - - - - -	-	10,123 5,736 9,524 2,483 12,503 13,165 72,424	-
11 121 129 123 123 124 125 126 127 128	Remove spent fuel racks of Plant Systems Compressed Air Conteinment Atmosphere Control Cooling Water - Reactor Building Cooling Water - Turbine Building Electrical Electrical (BCA) Electrical (BCA) Electrical (BCA)	506	861 184 87 87 862 399 2,451 188	9 3 1 1 2 21 21	6 6 9 2 5 41 3	412 488 182 126 296 2,802 206		-	153 113 49 41 54 156 1,041 55	935 745 322 257 417 904 6,356 415	935 745 322 257 904 6,356 415	-	417	2,059 2,191 910 632 1,479 14,010 1,032	97	-	•	- - - - - - - - - - - - - - - - - - -	8,693	10,123 6,736 9,524 2,483 12,503 12,165 72,424 4,105	-
11 121 129 123 123 124 125 126 127 128 129	Remove spent fuel racks of Plant Systams Compressed Air Containment Atmosphere Control Cooling Water - Reactor Building Cooling Water - Turbine Building Electrical Electrical (BCA) Electrical (BCA) Fire Protection (ECA) Free Protection (ECA)	506 - - - - - - - - - - - - - - -	861 184 87 852 399 2,451 188 251	9 3 1 1 2 21	6 6 9 2 - 5 41	412 488 182 126 296 2,802	•		153 113 49 41 54 186 1,041 55 238	935 745 329 257 417 904 6,356 415 1,273	935 745 322 267 804 6,355 415 1,273	•	- 417 - -	2,059 2,191 910 692 1,479 14,010 1,032 823		-	-	-	8,853	10, 123 6, 736 9, 524 2, 463 12, 503 13, 165 72, 424 4, 105 7, 788	
1.1 1.2.1 1.2.9 1.2.3 1.2.4 1.2.5 1.2.6 1.2.7 1.2.8 1.2.9 1.2.10	Remove spent fuel racks of Flant Systems Compressed Air Containment Atmosphere Control Cooling Water - Reactor Building Cooling Water - Turbine Building Electrical Electrical (BCA) Electrical (BCA) Fire Protection (BCA) Fuel Pool Cooling & Cleanop FMAC - Battory & Emergency Suger Bldg	506	861 184 87 862 399 2,451 188 251 0	9 3 1 1 2 21 21	6 6 9 2 5 41 3 6	412 488 182 126 2.902 206 165	- - - - 592		153 113 . 49 . 41 . 54 1.66 1.041 . 55 238 0	935 745 329 267 417 904 6,356 415 1,273 0	935 745 322 227 904 6,365 415 1,273	•	417	2,059 2,191 910 632 1,479 14,010 1,032 823	97 1,315		-	-	8,893 116,158	10,123 5,736 9,624 2,463 12,603 13,165 72,424 4,105 7,788 14	-
1.1 spcsal 1.21 1.29 1.2.3 1.2.4 1.2.5 1.2.6 1.2.7 1.2.8 1.2.9 1.2.10 1.2.11	Remove spent fuel racks of Plant Systems Compressed Air Containment Atmosphere Control Cooling Water - Reactor Building Cooling Water - Turbine Building Electrical Electrical Electrical (BCA) Electrical (BCA) Electrical (BCA) Fire Protection (BCA) Fire Protection (BCA) Fire Protection (BCA) Fire Protection (BCA) Fire Protection (BCA)	506 - - - - - - - - - - - - - - -	861 184 87 862 399 2,451 188 251 0 0	3 3 1 1 2 21 7 22 -	6 6 2 2 5 41 3 5 5 5	412 438 182 126 2,802 206 165 - 339	- - 44 - 592 - 51	-	163 113 49 41 54 186 1.041 58 238 0 78	935 745 322 257 417 904 6,356 415 1,273 0 519	935 745 322 257 904 6,355 415 1,273 519	-	417 - - 0	2,059 2,191 910 632 1,479 14,010 1,032 823 -	97 - 1,316 111	-	-		8,853 116,158 9,973	10,123 6,736 9,524 2,463 12,503 13,165 72,424 4,105 7,788 14 1,345	-
1.1 1.2.1 1.2.2 1.2.3 1.2.3 1.2.4 1.2.5 1.2.5 1.2.7 1.2.8 1.2.9 1.2.10 1.2.11 1.2.12	Remove spent fuel racks of Flant Systems Compressed Air Containment Atmasphere Cantrol Cooling Water - Rescher Building Cooling Water - Turbine Building Electrical (BCA) Electrical (BCA) Electrical (BCA) Fire Protection (BCA) Fuel Pool Cooling & Cleaonp EVAC - Battery & Emargency Swgr Bldg HVAC - Drywell HVAC - Drywell	506 - - - - - - - - - - - - - - - - - - -	861 184 87 352 399 2,451 188 251 0 44	3 3 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	6 6 2 2 5 41 3 6 5 8	412 438 182 126 296 2,802 206 165 - 339 164	- - - - 592 - 51 25		163 113 49 41 56 1,041 56 238 0 76 68	935 745 329 257 417 904 6,356 415 1,273 0 519 407	935 745 322 257 904 6,356 415 1,273 519 407	•	- 417 - -	2,059 2,191 910 632 1,479 14,010 1,032 823 - 1,697 821	97 97 1,315 111 54	•	-		8,893 116,158 9,973 4,825	10,123 6,736 9,524 2,463 12,603 12,165 72,424 4,105 7,788 14 1,545 4,834	-
1.1 sposal 1.2.1 1.2.2 1.2.3 1.2.4 1.2.5 1.2.6 1.2.7 1.2.8 1.2.9 1.2.10 1.2.11 1.2.12 1.2.13	Remove spent fuel racks of Plant Systems Compressed Air Containent Atmosphere Control Cooling Water - Reactor Building Cooling Water - Turkine Building Electrical Electrical (BCA) Electrical (BCA) Electrical (BCA) Fire Protection (BCA) Fire Protection (BCA) Fire Protection (BCA) Fire Protection (BCA) Fire Protection (BCA) Fire Protection (BCA) Fire Protection (BCA) Fire Protection (BCA) Fire Protection (BCA) Fire Protection (BCA) Fire Protection (BCA) Fire Protection (BCA) Fire Protection (BCA)		861 184 87 852 399 2,451 188 251 0 44 146 149	8 3 1 1 2 81 2 2 2 2 2 2 4 2 3	6 6 8 2 5 41 3 6 5 8 3	412 488 182 126 2,802 206 165 - 339 164 2,20	- - - 592 - 51 265 44		163 113 49 41 54 156 1,041 65 238 0 76 68 90	935 745 322 257 417 904 6,356 415 1,273 0 519 407 540	935 745 322 267 904 6,366 415 1,273 519 407 540	-	417 - - -	2,059 2,191 910 682 - 1,479 14,010 1,032 823 - 1,697 821 1,099	97 - 1,316 - 111 54 97			· · · · · · · · · · · · · · · · · · ·	8,853 116,158 9,973 4,825 8,707	10,123 6,736 9,624 2,463 12,603 12,165 72,424 4,105 7,788 14 1,545 4,834 6,286	-
1.1 sposni 1.2.1 1.2.9 1.2.3 1.2.4 1.2.5 1.2.7 1.2.8 1.2.9 1.2.10 1.2.11 1.2.12 1.2.13 1.2.14	Remove spent fuel racks of Plant Systams Compressed Air Containment Atmosphere Control Cooling Water - Reactor Building Electrical Electrical (BCA) Electrical (BCA) Fire Protection (BCA) Fuel Pool Cooling & Cleasoup HVAC - Battary & Ecourgency Swgr Bildg HVAC - Dryvell HVAC - Tarbina Building (Contaminated) Liquid Radwates Collection	506 - - - - - - - - - - - - - - - - - - -	861 184 87 862 399 2,451 188 251 0 44 146 179 124	3 3 1 1 2 21 2 22 22 4 2 2 3 10	6 6 2 5 41 3 6 5 8 3 1	412 488 182 296 2,802 206 165 	- - - - 592 - 51 25		153 113 49 41 54 1.041 1.041 56 235 0 76 68 90 198	935 745 322 257 417 904 6,356 415 1,273 0 519 407 540 597	935 745 322 257 904 6356 415 1,273 519 407 540 597		417	2,059 2,191 910 682 - 1,479 14,010 1,032 823 - 1,697 821 1,099 46	- 97 - 1,316 - 111 54 97 461			-	8,893 116,158 9,973 4,825	10,123 6,736 9,824 2,463 12,603 13,165 72,424 4,105 7,788 14 1,345 4,834 6,286 6,726	-
1.1 sposal 1.21 1.29 1.23 1.24 1.25 1.25 1.27 1.28 1.29 1.210 1.211 1.212 1.213 1.2.14 1.2.15	Remove spent fuel racks of Plant Speiana Compressed Air Containent Atmosphere Control Cooling Water - Reactor Building Cooling Water - Turkine Building Electrical Electrical (BCA) Fuel Pool Cooling & Cleanup HVAC - Devel HVAC - Devel HVAC - Reactor Building HVAC - Aractor Building HVAC - Aractor Building HVAC - Stater Building (Contaminated) Liquid Radwaste Collection Plant Hesting & Auxillary Steam (BCA)		861 184 87 852 399 2,451 188 251 0 4 4 146 179 124 107	8 3 1 1 2 81 2 2 2 2 2 2 4 2 3	6 6 8 2 5 41 3 6 5 8 3	412 438 182 296 2,802 206 165 - 339 164 230 9 105	- - - 592 - 51 265 44		163 113 49 41 54 156 1.041 65 238 0 0 76 63 90 198 43	935 745 322 267 417 904 6,356 418 1,273 0 519 407 540 597 261	935 745 322 267 - - - - - - - - - - - - - - - - - - -	-	417	2,059 2,191 910 682 - 1,479 14,010 1,032 823 - 1,697 821 1,099	97 - 1,316 - 111 54 97				8,853 116,158 9,973 4,825 8,707 41,268	10,123 6,736 9,524 2,463 12,563 13,165 77,424 4,105 7,788 14 1,545 4,834 6,286 6,729 2,884	-
1.1 spcsal 1.2.1 1.2.2 1.2.3 1.2.4 1.2.5 1.2.6 1.2.7 1.2.8 1.2.9 1.2.10 1.2.11 1.2.12 1.2.13 1.2.14 1.2.14 1.2.16	Remove spent fuel racks of Plant Systams Compressed Air Containment Atmosphere Control Cooling Water - Reactor Building Electrical Electrical (BCA) Electrical (BCA) Fire Protection (BCA) Fuel Pool Cooling & Cleasoup HVAC - Battary & Ecourgency Swgr Bildg HVAC - Dryvell HVAC - Tarbina Building (Contaminated) Liquid Radwates Collection		861 184 87 862 399 2,451 188 251 0 44 146 179 124	3 3 1 2 2 2 2 2 2 2 2 2 1 0 1 0	6 6 9 2 41 3 5 41 3 5 5 41 3 5 5 1 2 2	412 488 182 126 296 2,602 206 165 - - - - - - - - - - - - - - - - - - -	- - - 592 - 51 265 44		163 113 49 41 54 1,041 1,041 66 238 0 76 68 90 188 43 5	935 745 322 257 417 904 6,355 415 1,273 0 619 407 597 540 597 261 41	935 746 322 257 - 904 6,356 415 1,273 519 407 540 597 261		- 417 - - 0 - - - - 41	2,059 2,191 910 682 - 1,479 14,010 1,032 823 - 1,697 821 1,099 46 541	- 97 - 1,316 - 111 54 97 461				8,853 116,158 9,973 4,825 8,707	10,123 6,736 9,524 2,463 12,503 13,105 72,424 4,105 7,788 14 1,345 4,834 6,266 6,728 2,864 1,299	-
1.1 spcsal 1.2.1 1.2.2 1.2.3 1.2.4 1.2.5 1.2.6 1.2.7 1.2.8 1.2.9 1.2.10 1.2.11 1.2.12 1.2.13 1.2.14 1.2.14 1.2.16 1.2.17	Remove spent fuel racks of Plant Systams Compressed Air Containment Atmosphere Control Cooling Water - Reactor Building Electrical Electrical (BCA) Electrical (BCA) Fire Protection (ECA) Free Pool Cooling & Cleasoup HVAC - Battary's & Emergency Swgr Bildg HVAC - Darwy ell HVAC - Turbins Building (Contaminated) Liquid Radwate Collection Planc Heating & Auxillary Steam (BCA) Envice Water		361 184 87 362 399 2,451 138 251 138 251 138 251 138 251 138 251 138 41 107 36 419	3 3 1 1 2 21 2 2 2 2 3 10 1 1 5	6 6 8 2 5 41 3 6 8 8 3 1 2 2 , 10	412 438 182 296 2,802 206 165 - 339 164 220 9 164 230 - 9 108 - 704	44 592 51 25 41 210		163 113 41 54 1,041 66 238 0 76 68 90 76 68 90 198 43 5 212	935 745 322 257 417 904 6,356 418 1,273 0 640 597 261 407 540 597 261 41,351	935 715 822 267 6,356 415 1,273 519 407 519 697 261		- 417 - - - - - - - - - - 41	2,059 2,191 910 682 14,010 1,032 823 - 1,697 821 1,099 46 541 - -	97 - 1,316 111 64 97 461			•	8,853 116,158 9,973 4,825 8,707 41,268	10,123 6,736 9,634 2,463 12,603 13,165 72,424 4,105 7,788 14 1,345 4,834 6,286 6,726 2,884 1,299 12,383	
1.1 1.21 1.23 1.24 1.25 1.26 1.27 1.28 1.29 1.210 1.211 1.212 1.213 1.2.14 1.2.15 1.2.16 1.2.18 1.2.18	Remove spent fuel racks of Plant Systems Compressed Air Containent Atmosphere Control Cooling Water - Reactor Building Cooling Water - Turbine Building Electrical Electrical (BCA) Electrical (BCA) Electrical (BCA) Fire Port Cooling & Cleaoup Fire Port Cooling & Cleaoup FivAC - Drywell HVAC - Buttry'& Examptony Swgr Bldg HVAC - Parator Building (Contaminated) Liquid Radwasts Collection Plant Hessing & AuzBary Steam (BCA) Ervice Water Service Water (BCA) Solid Radwasts Process & Disposel		861 184 87 852 399 2,451 188 251 0 44 146 179 124 124 127 36	3 3 1 2 2 22 22 4 2 2 2 2 2 2 2 2 2 2 2 2 2	6 6 8 2 3 41 8 6 5 8 8 3 1 1 2 2 10	412 488 182 296 296 200 165 339 164 220 9 108 704 77	- - - - - - - - - - - - - - - - - - -		163 113 41 54 1,041 55 238 0 76 68 90 138 49 5 212 154	935 745 322 267 417 904 6,356 415 1,273 0 519 407 640 597 407 640 591 407 41 41 1,351 812	935 745 222 904 6,355 1,273		- 417 - - - - - - - - - - 41	2,059 2,191 910 632 1,479 14,010 1,032 823 	- - - - - - - - - - - - - - - - - - -				8,653 9,973 4,825 8,707 41,269 79,937	10,123 6,736 9,834 2,643 12,653 72,424 4,105 7,742 4,105 7,7424 4,105 7,7424 4,105 7,7424 4,105 1,345 4,834 1,259 12,883 4,814	-
L1 posal ( 2.1 2.2 1.2,3 1.2,4 1.2,5 1.2,6 1.2,16 1.2,10 1.2,11 1.2,12 1.2,13 1.2,14 1.2,15 1.2,16 1.2,17 1.2,18 1.2,18 1.2,18 1.2,19 1.2,119 1	Remove spent fuel racks of Plant Speiana Compressed Air Containent Atmasphere Control Cooling Water - Reactor Building Cooling Water - Turkine Building Electrical Electrical (BCA) Electrical (BCA) Fuel Pool Cooling & Cleanany Fuel Pool Cooling & Cleanany HVAC - Dryvell HVAC - Reactor Building HVAC - Reactor Building HVAC - Anator Building HVAC - Turkine Building (Contaminated) Liquid Esdwarts Collection Plant Hesting & Auxiliary Steam (BCA) Service Water Service Water (BCA)		861 184 87 352 399 2,451 188 251 188 251 10 44 146 107 36 36 419 153	3 3 1 1 2 21 2 2 2 2 3 10 1 1 5	6 6 8 2 5 41 3 6 8 8 3 1 2 2 , 10	412 438 182 296 2,802 206 165 - 339 164 220 9 164 230 - 9 108 - 704	44 592 51 25 41 210		163 113 41 54 1,041 66 238 0 76 68 90 76 68 90 198 43 5 212	935 745 322 257 417 904 6,356 418 1,273 0 640 597 261 407 540 597 261 41,351	935 715 822 267 6,356 415 1,273 519 407 519 697 261		- 417 - - - - - - - - - - 41	2,059 9,191 9,10 652 1,479 14,010 1,032 823 823 1,697 821 1,099 46 541 541 541 3,520 387 23	97 - - - - - - - - - - - - - - - - - - -				8,853 116,158 9,973 4,825 8,907 41,258 79,937 1,811	10,123 8,753 9,854 2,463 12,863 13,165 72,424 4,155 7,768 14 1,345 4,834 6,286 6,728 6,728 9,864 1,239 12,883 4,014 2,259	
1.1 posal ( 1.2) 1.2,3 1.2,4 1.2,5 1.2,6 1.2,7 1.2,10 1.2,11 1.2,12 1.2,10 1.2,13 1.2,14 1.2,15 1.2,16 1.2,17 1.2,15 1.2,17 1.2,15 1.2,17 1.2,15 1.2,17 1.2,15 1.2,17	Remove spent fuel racks of Plant Systams Compressed Air Containment Atmosphere Control Cooling Water - Reactor Building Electrical Electrical (BCA) Electrical (BCA) Fire Protection (ECA) Free Pool Cooling & Cleanup HVAC - Battary & Emergency Swgr Bildg HVAC - Daywell HVAC - Turbins Building (Contaminated) Liquid Radwaste Collection Plant Heating & Auxillary Steam (BCA) Earvice Water Service Water Service Water (BCA) Solid Radwaste Process & Disposal Ventilation Radiation Monitoring Totals	-	861 184 87 352 399 2,451 188 251 188 251 188 251 148 146 179 124 107 36 419 153 9	3 3 1 1 2 21 2 2 2 2 2 2 0 0 1 1 5 17 0	6 6 8 2 5 411 3 3 6 5 8 8 3 5 8 3 1 2 2 10 4 0 0	412 488 182 296 2,802 206 - - 339 165 - - 339 164 - - 339 164 - - - 704 77 4 77 5	- - - - - - - - - - - - - - - - - - -		163 113 41 54 1.041 86 238 0 76 66 90 198 49 8 49 8 212 154 5	935 745 322 267 417 904 6,356 415 1,273 0 0 519 407 540 597 261 41 1,351 812 229	935 746 322 267 - 904 6,356 415 1,273 519 407 540 597 261 - ,,351 812 29		417 - - - - - - - - - - - - - - - - - - -	2,059 2,191 910 632 1,479 14,010 1,032 823 	- - - - - - - - - - - - - - - - - - -				8,653 9,973 4,825 8,707 41,269 79,937	10,123 6,736 9,834 2,643 12,653 72,424 4,105 7,742 4,105 7,7424 4,105 7,7424 4,105 7,7424 4,105 1,345 4,834 1,259 12,883 4,814	-
1.1 apcasl 1 1.2,1 1.2,2 1.2,3 1.2,4 1.2,5 1.2,6 1.2,7 1.2,8 1.2,7 1.2,10 1.2,11 1.2,12 1.2,13 1.2,14 1.2,15 1.2,17 1.2,18 1.2,19 1.2,19 1.2,19 1.2,10 1.2,11 1.2,11 1.2,11 1.2,11 1.2,11 1.2,11 1.2,21 1.2,11 1.2,21 1.2,12 1.2,12 1.2,12 1.2,13 1.2,14 1.2,15 1.2,1	Remove spent fuel racks of Plant Systems Compressed Air Containment Atmosphere Control Cooling Water - Reactor Building Electrical Electrical (BCA) Electrical (BCA) Fuel Protocons (BCA) Fuel Proto Cooling & Cleanup HVAC - Draves (BCA) Fuel Proto Cooling & Cleanup HVAC - Draves (BCA) Fuel Proto Cooling & Cleanup HVAC - Traine Building HVAC - Traine Building (Contaminated) Liquid Radwaste Collection Planet Heating & AudiBary Steam (BCA) Service Water Service Water Service Water Service Mater (BCA) Solid Radwaste Process & Disposal Ventilation Radiation Monitoring Totab	- - - - - - - - - - - - - - - - - - - -	861 184 87 352 2399 2,451 138 251 0 44 146 179 124 107 36 419 9 153 9 9 5,538	3 3 1 1 2 2 2 2 2 2 2 3 10 1 1 7 17 0 99	6 6 8 2 5 41 3 6 5 8 8 3 1 1 2 7 100	412 488 182 296 206 165 - 339 164 2270 9 108 - 704 77 70 5,254	- - - - - - - - - - - - - - - - - - -		163 113 41 56 1.041 66 238 0 76 68 90 198 43 5 212 154 6 2,705	935 745 322 257 417 904 6,356 415 4273 407 640 597 261 407 261 1,551 812 29 16,183	935 746 322 267 - 904 6356 415 1,273 - 519 407 540 697 261 1,351 812 29 15,725		417 - - - - - - - - - - - - - - - - - - -	2,059 2,191 910 652 - 1,479 14,010 1,032 823 - 1,697 821 1,099 46 541 - 3,520 3,877 3,1271	97 - 1,316 - 111 - 54 - - - - - - - - - - - - - - - - -				8,633 116,158 9,973 4,825 8,707 41,268 79,937 1,811 271,862	10,123 4,735 9,854 2,463 12,503 77,244 4,105 7,788 14 1,345 4,854 4,854 6,286 6,728 2,864 1,259 1,2883 2,864 4,814 2,259 169,005	-
111 isposal 4 121 122 123 123 124 125 126 127 128 127 128 121 121 121 121 121 121 121	Remove spent fuel racks of Plant Systams Compressed Air Containment Atmosphere Control Cooling Water - Reactor Building Electrical Electrical (BCA) Electrical (BCA) Fire Protection (ECA) Free Pool Cooling & Cleanup HVAC - Battary & Emergency Swgr Bildg HVAC - Daywell HVAC - Turbins Building (Contaminated) Liquid Radwaste Collection Plant Heating & Auxillary Steam (BCA) Earvice Water Service Water Service Water (BCA) Solid Radwaste Process & Disposal Ventiation Radiation Monitoring Totals	-	861 184 87 352 399 2,451 188 251 188 251 188 251 148 146 179 124 107 36 419 153 9	3 3 1 1 2 21 2 2 2 2 2 2 0 0 1 1 5 17 0	6 6 8 2 5 411 3 3 6 5 8 8 3 5 8 3 1 2 2 10 4 0 0	412 488 182 296 2,802 206 - - 339 165 - - 339 164 - - 339 164 - - - 704 77 4 77 5	- - - - - - - - - - - - - - - - - - -		163 113 41 54 1.041 86 238 0 76 66 90 198 49 8 49 8 212 154 5	935 745 322 267 417 904 6,356 415 1,273 0 0 519 407 540 597 261 41 1,351 812 229	935 746 322 267 - 904 6,356 415 1,273 519 407 540 597 261 - ,,351 812 29		417 - - - - - - - - - - - - - - - - - - -	2,059 9,191 9,10 652 1,479 14,010 1,032 823 823 1,697 821 1,099 46 541 541 541 3,520 387 23	97 - - - - - - - - - - - - - - - - - - -				8,853 116,158 9,973 4,825 8,707 41,258 79,937 1,811	10,123 8,753 9,854 2,463 12,863 13,165 72,424 4,155 7,768 14 1,345 4,834 6,286 6,728 6,728 9,864 1,239 12,883 4,014 2,259	-

TLG Services, Inc.

#### TABLE C-1 PEACH BOTTOM ATOMIC POWER STATION - UNIT 2 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

r						Olf-Sile	LLRW			•	NRC	Spent Fuel	Site	Processed		Burial	Volumes		Burial		Litility and
Activity	,	Decon	Removal	Packaging	Transport		Disposal	Other	Total	Tota)	Lic. Terms	Management	Restoration	Volume	Class A	Class B		GTCC	Weight	Craft	Contractor
Index		Cost	Cost	Cosis	Costs	Costs	Costs	Cosis	Conlingency	Costs	Costs	Costs	Costs	Cil. Feet	Cu, Feet		Cu. Feet		Lbs.		Manhours
2c.1.4	Scaffolding in support of decommissioning	-	178	2	L	50	6	•	51	267	267	-	•	148	20	-	-	-	1,835	6,265	
2c.1	Subtotal Period 2c Artivity Costs	1,009	6,342	. 825	214	7,625	3,146		4,045	22,705	22,247,	-	458	38,124	12,138	-	-	-	1,107,940	205, 195	•
Period 2	Collateral Costs											•									
2c.3.1	Process liquid waste	81	-	31	74	-	<b>419</b>	•	159	764	764	•	-	-	•	636	-		81,917	118	
2c.3.2	Small tool allowance	-	116	-	· •	-	•	•	17	133	195	•		-		-	-	•		. •	••••
20.3.3	Decommissioning Equipment Disposition	•_	•	43	12		117	•	116	829	829	-	-	2,700	373	•	•	•	33,507	739	-
2c.3	Subtotal Period 20 Collateral Costa	81.	116	74	87	540	535	-	293	1,726	1,726	-	•	2,700	373	636	·	•	115,424	857	-
Period 2	Period-Dependent Costs			۰.													•				
26.4.1	Deran supplies	124	-	•	-	-	-	-	\$1	154	154	-	-	-	•	•	•	•	-	•	-
2c.4.2 2c.4.3	Insurance Property taxes	•	-	-	•	•	•	193 495	19 49	213 544	219 544	-	-	• •	-	•	-	•	•	•	-
26.4.4	Realth physics applies		949	-		:		490	237	1,386	1.186	-			•		•	•	•	•	•
20.4.5	Heavy equipment rental	-	1,765	-		-			265	2,030	2,030	-		-					-		
24.4.6	Disposal of DAW generated	•		'n	21		800		85	478	478			-	4,284	-	-	-	85,848	1,052	
2c.4.7	Plant energy budget	•	•	•	•		•	949	142	1,091	1,091	-			•		-			•	
2c.4.8	NEC Fees	-	-	-	÷	-	-	856	86	392	392	-	-	-	-	-	-	-	•		
26.4.9	Emergency Planning Fees	-	-	-	•	-	•	49	6	54	-	64	•		•	-	-	•	-	-	-
20.4.10	Radwasta Processing Equipment/Services Dry Fuel Storage O&M Costs	-	-	-	•	-	-	849	62 5	401	401		-	-	-	•	-	-	-	-	•
2c.4.11 2c.4.12	Security Staff Cost	-	-	-	•	-	•	83 654	98	38 752	- 753	88	•	•	•	•	•	•	-	-	
20.4.12	Utility Staff Cost	-	-	•	-	-	•	14,169	2,125	16,294	16,294	•	-	-	•	-	-	-	•	•	25,791 244,765
20,4	Subtotal Pariod 2c Pariod Dependent Costs	124	2,714	71	21	-	800	17,247	3,151	28,628	28,536	92			4,284	-	-	-	55, <b>54</b> 8	1,052	270,557
2c.0	TOTAL PERIOD 2c COST	1,214	9,172	470	322	8,165	9 <b>,98</b> 0	17,947	7,489	48,060	47,509	92	458	40,824	16,795	636		. •	1,309,212	207,035	270,557
PERIO	<b>) 2d - Dulay before License Termination</b>																				
	d Direct Decommissioning Activities est activities in this period					•															
Paried 9	d Period-Dependent Costs																				
24.4.1	Insurance	-		-	-			73	7	81	81		-	-							
24.4.2	Property taxes		-					876	38	414	414	-	-	-			-	-		_	-
2d.4.8	Health physics supplies	•	66	•		•			14	70	70	-	-	-	-	-	-	-			• •
24.4.4	Disposal of DAW generated	•	-	2	0	-	7		2	11	11	•	•	-	98	-	•	-	1,971	24	-
2d.4.5	Plant energy budget	-	-	•	-	-	-	361	54	415	415	•	•	-	•	•	•	•	•	•	•
2d.4.6	NRC Fres	-	-	•	•	-	•	301	30	331	351	•	•	-	•	•	-	-	-	-	-
2d.4.7 2d.4.8	Emergency Planning Fees Dry Fuel Storege O&M Costs	•	•	•	-	-	•	87	4	41 29	-	41 29		-	•	-	-	•	•	•	-
2d.4.9	Security Staff Cost	•	•	•	•	-	-	25 351	. 4	403	- 403	79	-	-	•	•	•	-	-	-	19,834
24.4.10	Utility Staff Cost		-	:				1.855	203	1.658	1,558		-	•	•	•	•	•	•	•	23,834 21,904
2d.4	Subiatal Period 2d Period-Dependent Costs	•	56	2	0	•	7	2,879	408	8,852	3,282	70	-	•	98			-	1,971	24	
9d.0	TOTAL PERIOD 24 COST	•	66	2	0	-	7	2,879	408	* 3,352	3,282	70	-		98				L.971	24	35,739
PERIO	D 2e - License Termination																				
	a Direct Decommissioning Activities																				
2c.1.1	ORISE confirmatory survey	-	· •	-	-	-	-	116	86	16-1	154					-				-	
2e.1.2	Terminate license									а											
26.1	Subtotal Period 2e Activity Costs	. •	•	•	-	-	-	116	36	154	154	•	-	•	•	-	-	-		-	-

TLG Services, Inc.

#### TABLE C-1 PEACH BOTTOM ATOMIC POWER STATION - UNIT 2 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

						Oll-Site	LLRW				NRC	Spent Fuel	Site	Processed			/olumes		Burial		Utility and
Activity Index	Activity Description	Decon Cost	Remova) Cost	Packaging Costs	Transport Cosis	Processing Costs	Disposal Costs	Other Costs	Totat Contingency	Total Costs	Lic. Torm. Casts	Managament Costa	Restoration Costs	Volume Cu. Feet	Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu, Feet	Weight	Craft	Contractor
Index	Activity Destapoon	Gust	COSL	LOSIS	LOSIS	GUALS	CUSIS	COSIS	Contradency	41515	04515	Casts	Casts	LU. F86(	Cu. Peet	GO. FOCT		Cu, reel	Lus.	Manhours	Manhours
	dditional Costs																				
	Final Site Survey Subtotal Period 2a Additional Casta	-	-	-	-	•	•	3,879	682	4,460	4,460	•	-	•	•	-	•	-	-	110,544	•
3	Subiotal Period 24 Additional Costs	-	-	•	-	-	-	3,879	582	4,460	4,460	•	-	-	•	-	•	-	. •	110,544	-
	arind-Dependent Costs																				
	nsurance	•	•	-	-	-	-	75	8	83	83	-	•	-	•	-	•	-	-	• '	-
	Property taxes Health physics supplies	-	581	•	•	-	•	386 -	39 145	424 727	424 727	-	-	-	•	•	•	•	-	-	-
	Disposal of DAW generated	•	281	• •		-	- 28	:	145	45	45	-	-	-	404	•	-	-	8,088	-	-
Lő	Plant energy budgat	-						970	65	425	425					:		-	6,086	39	
6	NRC Fart				-	-	-	305	81	336	836		-	-	-						
	Emergency Planning Fers	•	-	-	-	-	-	38	4	43	-	42		-				-			
	Dry Fuel Storage O&M Coata	-	· -	•	-	•		26	4	90	-	30	-	-	•			-	•	-	-
1.9	Security Staff Cost	· · · ·	-	•	-	-	•	\$60	54	414	414	-	-	-		-	-	-	-	-	14,19
	Itility Staff Cost	•	-	•	-	-	-	7,709	1,156	8,863	8,865	•	•	-	-	•	•	-	-	-	132,48
	Subtotal Feriod 2e Period-Dependent Costs	-	681	7	2	•	28	9,269	1,504	11,391	11,319	72	-	•	404	•	•	•	8,088	99	145,67
)	TOTAL PERIOD 2e COST	•	581	7	2		28	18,266	९,121	15,005	15,934	72	-		404		-	-	8,068	110,643	146,67
נסנו	TOTALS	6,806	36,903	11,909	3.774	\$2,101	78.663	189,150	75,708	435,314	365.283	69.376	656	160,500	149.625	15,151	804	-	14,487,720	914,869	1,939,47
	-																				-1
10D S	b-Site Restoration																				
	• •																				
00,301	Birect Decommissioning Activities																				
	of Remaining Site Buildings																				
	Reactor Building	-	5,903		-	-	•	•	885	6,788	1,018	-	5,770	-	-	•	-	-	-	109,307	-
.1.2	Switchgenr Building & Transformer Yard	-	58		-	٠	-	-	9	67	•	-	67	-	•	•	-		-	1,263	•
	Turbine Building Turbine Pedestal	-	8,583		-	-	•	-	537	4,120	412	-	8,708	•	• .	•	•		-	72,947	-
	Turbine Pedestal Totals	•	940 10,483		-	-	•	-	141 1.572	1,081	1.430	•	1,081	-	•	•	•	•	•	15,197	-
-1	Totals	•	10,483	-	•		•	-	1,672	12,050	1,430	-	10,626	-	•	-	-	-	-	198,714	•
Closer	ut Activities														•						
1.2	Grade & Inndscape site				-			_					-							•	
	Final report to NRC	-	-	-	-			119	17	130	130	-							-	:	1,64
	Subtatal Period Sk Activity Costs	-	10,483		•			113	1,589	12,186	1,660	-	10,626							198,714	1,56
u ah	Additional Costs																	•			
	Concrete Crushing	-	-				-	323	46	370			370					_		2,320	
	Subtotal Period 3b Additional Costs	•	-	-				322	48	370		-	570		-	-			-	2,320	
	7-11-1 1 <b>0</b> -14-																				
	Collateral Costa Small tool allowance		100						15												
	Subtotal Period 8b Collateral Costa	•	100 100		-	-	•	•	· 15 15	116 115	-	•	115 116	•	•	•	•	•	-		•
,	Subigest Fernal of Constraint Costs		100	•	-	•	-	•	15	110	-	•	116	-	•	•	-	•	•	•	•
	Period-Dependent Costs																				
	Insurance	•	•	•	-	-	-	205	21	226	0	203		•	•	•	•	-	-	-	•
	Property taxes	-		-	•	-	-	1,051	105	I,156	•	•	1,156	-	•	•	-	-		•	•
	Heavy equipment rental Plant energy budget		5,076	-	-	-	-	-	761 76	5,837 580	-	- 290	5,837	•	•	-	•	•	•	· •	•
	LINIT CHELEN DANGER	•	•	-	•	-	·	504 246	76	580 271	-	290 271		•	• ·	•	•	•	-	•	•
L4	NRC IEFEI Form		-	•	•	-	•		10	2/1 114	•	271		-	-	-	•	-	•	•	
1.4 4.5	NRC ISFSI Fesa Emergency Planning Fesa	-																			
L4 L5 L6	Emergency Planning Fees	-	-	•	-	•	•	104			-			-	-	-	-	•	-	•	-
1.4 4.5 4.6 4.7	Emergency Planning Fees Dry Fuel Storage O&M Costs	-	-	:	-	•	÷	71	11	82	-	82	•		-	•	•			:	-
4.4 4.5 4.6 4.7 4.8	Emergency Planning Fees	-	-	•	-	-					-		872			-	-	:	-	:	38,67 95.61

#### TLG Services, Inc.

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#### TABLE C-1 PEACH BOTTOM ATOMIC POWER STATION - UNIT 2 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

						Off-Site	LLRW				NRC	Spent Fuel	Site	Processed		Buriat	/olumes		Burial		Ulility and
Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Processing Costs	Disposal Costs	Ciliur Costs	Total Contingency	Total Costs	Lic. Terro. Costs	Nanagement Costs	Restoration Costs	Volume Cut, Feet	Class A Cu. Feet	Class B Cu, Feet	Class C	GTCC Cu. Feet	Weight Lbs.	Craft Manhoura	Contractor
1 <b>5.</b> 0	TOTAL PERIOD 85 COST	-	15,659	-	•	-	•	9.640	3,714	39,013	1,560	5,190	22,263	•		-			-	202.034	135,846
PERIOL	) 3c - Fuel Storage Operatious/Shipping																				
eriod 3a No dir	Direct Decommissioning Activities act activities in this period																				
Period 80	Period Dependent Costs																				
c,4,1	Insurance	-	-	-	-	-		1,627	163	1,790	-	1,790		-	-	-		-	-	-	-
36.4.3	Property taxes	-	-	-	•	-	-	6,333	833	9,166	-	9,166	-	-	-	-	-		-	-	-
8c.4.8	Plant energy budget	•	-	-	-	· -	-	999	150	1,149	-	1,149			-	•	-	•		•	-
8c.4.4	NBC ISFSI Fees	-	-	-	-	•	•	1,951	195	2,146	•	2,146	•	-	-	-	-	•	-		-
Sc.4.5	Emergency Planning Feas	•	-	-	•	•	•	824	82	907	•	907	•	-	-	•	-	-	-	•	
3 <b>c.4.6</b>	ISFSI Transfer and Capital Costs	-	-	-	•	-	•	8,935	690	4,525		4,523	•	-	-	•	•	-	-	-	•
3c.4.7	Dry Fuel Storage O&M Costs	-	-	-	•	-	-	563	84	617	-	647	•	•	•	•	-	-	-	-	•
3c.4.8	Utility Staff Cost	-	-	-	-	•	•	•	-	-	-	•	-	-	-	•	-	-	-	•	-
3c.4	Subtotal Period 3a Period Dependent Costs	•	-	-	•	•	•	18,231	2,098	20,329	-	20,329	-	-	•	•	-	-	-	-	-
3c.0	TOTAL PERIOD & COST	•	•	-	•	-	·	18,231	2,098	20,829	-	20,329	•	-	-	-	•	•	-	-	•
PERIOI	) 3d - GTCC shipping																				
Period 3	Direct Decommissioning Activities											·									
Nuclear	Steam Supply System Removal																				
3d.1.I.1	Vescel & Internals GTCC Disposal	•	-	-	-	-	11,819	•	1,773	13,592	18,592	•	•	-	-	•	-	746	-	-	
34.1.1	Totals	-	• '	· •	-	-	11,819	•	1,778	19,592	13,592		-	-	-		-	748	-	-	
3d.1	Subtatal Period 3d Activity Costs	•	•	-	-	•	11,819	•	1,773	13,592	13,693	•	-	-	•	•	•	748	•	•	•
Period 3	d Period-Dependent Costs																				
3d.4.1	Insurance	-	-	•	-	•		5	0	5	-	5	-	-			-	-	-		-
34.4.9	Property taxes	-		-	-	-	-	24	2	26	-	26	-	-	•		-	-	-	-	
34.4.9	Plant energy budget	-	•	-	-	•	-	9	0	3	-	9	•	-	•	-		-	-	-	•
3d.4.4	NRC ISFSI Fees	-	-	-	-	-	-	6	1	6	•	6	-	•		-	-	•	-	-	•
3d.4.5	Emergency Planning Free	-	•	-	-	· ·	•	2	. O <sup>.</sup>	3	-	3	-	-	-	-	-	-	•	-	-
Sd.4.6	ISFSI Transfer and Capital Costs	•	-	-	-	-	•	183	27	210	•	210	•	-	•	•	-	-	-	•	-
84.4.7	Dry Fuel Sincaga O&M Costs	-	-	-	-	•	•	2	٥	2	-	2	-	-	•	-		•	-	•	-
3d.4.8	Utility Staff Cost	-	-	•	•	-	•	•	•	•	-	•	-	-		•	-	•		-	
3d.4	Subtotal Period 3d Period-Dependent Costs	-	-	-	-	-	•	224	82	256	•	256	-	-	-	-	•	•	•	-	-
84.0	TOTAL PERIOD 3d COST	•	-	-	-	•	11,819	224	1,805	13,847	13,692	256	•	•	•••	-	-	748	•	-	-
PERIO	8 TOTALS		15,659		•		11,819	28,095	7,617	63,189	15,152	25,775	23,263	•			•	. 748		201,034	135,846
	COST TO DECOMMISSION	9.994	55,723	12,130	8.980	32,101	89.776	289,913	95,372	588,990	468,564	96,937	23,489	160,500			804				2,937,73

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#### TABLE C-1 PEACH BOTTOM ATOMIC POWER STATION - UNIT 2

DETAILED COST ANALYSIS .

(Thousands of 2002 Dollars)

						Off-Site	LLRW				NRC	Spent Fuel	Sile	Processed		Burlat	Volumes		Burial		Utility and
Activity		Decon	Removal	Packaging	Transport	Processing	Disposal	Other	Total	Tolat	Lic. Tenn.	Management	Restoration	Volume	Class A	Class B	Class C	GTCC	Weight	Craft	Contractor
Index	Activity Description	Cost	Cost	Costs	Costs	Costs	Costs	Costs	Contingency	Costs	Costs	Costs	Costs	Cu, Feet	Cu. Feel	Gu. Fest	Cu. Feet	Cu. Feet	Lba.	Manhours	Manhours
	· · · ·																				and a second second

TOTAL COST TO DECOMMISSION WITH 18.32% CONTINGENCY:	\$588,990 thousands of 2002 dollars
TOTAL NRC LICENSE TERMINATION COST IS 79.51% OR	\$456,564 thousands of 2002 dollars
SPENT FUEL MANAGEMENT COST IS 16.45% OR:	\$96,937 thousands of 2002 dollars
NON-NUCLEAR DEMOLITION COST IS 3.99% OF-	\$23,489 thousands of 2002 dollars
TOTAL PRIMARY SITE RADWASTE VOLUME BURIED:	96,468 cubic feet
TOTAL SECONDARY SITE RADWASTE VOLUME BURIED:	72,563 cubic feet
TOTAL GREATER THAN CLASS C RADWASTE VOLUME GENERATED:	746 cubie feet
TOTAL SCRAP METAL REMOVED:	31,767 tons
TOTAL CRAFT LABOR REQUIREMENTS:	1,116,755 man-hours

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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

#### TABLE C-2 PEACH BOTTOM ATOMIC POWER STATION - UNIT 8 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

			<u> </u>			Off-Site	LLRW				NRC	Spent Fuel	Site	Processed			Volumes		Gurial		Utility and
Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Processing Costs	Disposal Cosis	Other Casis	Total Contingency	Total Cosis	Lic. Term. Costs	Management Costs	Restoration Costs	Volume Cu. Fest	Class A Cu. Feat	Class 8 Cu. Feet	Class C Cu. Feet	GTCC Cu. Feel	Weight Lbs.	Craft Manhours	Contracts Manhour:
	-Shutdown through Transition																				
	irect Decommissioning Activities																				
	repars proliminary decommissioning cost		-	-	-		-	89	6	45	45	•	•	-	-	-	•	-	•		1,30
2 1	Intification of Cessation of Operations									۵											
	temove fuel & source material									n/a											
	inification of Permanent Defueling				•					a											
	eactivate plant systems & process wasta									a											
.6 F	repare and submit PSDAR	-		-	-	•	-	61	9	70	70	-	-	-	•	-	-	-	-	•	2.0
	leview plant dwgs & specs.	• •	-	-	-	•	-	140	21	161	161	•	-	-	-	•	-	•	•	-	4.6
1.8 5	erform detailed rad survey									n											· · ·
	stimate by-product inventory	•	•	-	-	•		80	5	88	35	-	•	-	-	-	-	-	-	-	1,1
	and product description	•	-		•	-	-	30	5	85	35	•	· · ·	-	•	-	-	•	•	•	1,0
	etailed by-product inventory			-	-	•	-	39	6	45	45	•	-	-	-	-	-	-	•	-	1,3
12 I	eine major work sequence	•	-	-		-	-	228	8-1	262	262	•	-	-	-	-	-	•	-	-	7,
L13 H	erform SER and EA	•	-	-	-	-	-	94	14	108	108	-	-	•	-	-	•	•	-	•	S.1
	erform Site-Specific Cost Study		-	-	-	-	-	152	23	175	175	•	-	-	-	•	-	-	•	-	5,0
	repare/submit License Termination Plan		-	-			-	124	19	148	143	•	-	-	-	•	-	-	-	-	4.0
	Receive NRC approval of terminstion plan						-			a											
ivity Spa	cifications																				
.17.1 1	Plant & temporary facilities		-		-	•	•	149	22	172	153	•	17	-	•	•	-	•	-	-	4,:
	lant systems	•	•	•	-	-	-	127	19	145	131	•	16	-	-		•	-	-	-	4,
.17.8 1	NSSS Decontamination Flush	•	•	•	-	•	•	15	• 2	17	17	-	•	-	-	-	-	•	•	•	_ (
.17.4 1	leactor internals		-	-	•	-	-	216	35	248	248		-	-	-	-	-	•	•	-	7,1
.17.5 ]	leactor vessel		-	- '	-	-	•	197	80	227	227	-	-	-	•	-	-	- '	-	-	6,5
	Sacrificial shield	•		•	•	-	•	16	2	17	17	-	-	•	•	•	-		-	-	_
17.7	foisture separators/reheaters	•	-	-	•	-	-	30	6	35	85	-	-	-	-	•	-	•	-	-	1,
17.8 1	Reinfarced concrete	-	•	•	•	-		49	Ţ	56	28	•	28	•	-	-	-	•	•	•	3,1
	furbine & condenser	•	•	-	-	•	•	127	19	145	145	•	•	•	•	•	-	-	•	•	4
17.101	ressure suppression structure		•			•		61	9	70	70	-	-	-	-	-	-	-	-	-	2,
.17.11 ]		-	-	-	-	-		49	7	56	56	-	•	•	•	•	-	-	-	-	1,
17.12	Plant structures & buildings			-	-	-	-	95	14	109	54	-	54	-	-	-	-	-	-	· •	3,
	Waste management	-	•	•	-		-	140	21	161	161	-	-	-	-	· •	-	-	•	-	4,
1.17.14	Facility & site closeout	-	-	-		· .	•	27	4	31	- 16	•	16		-		•	-	-	•	
1.17 '		•	-	-	-	-	-	1,296	194	1,490	1,860	•	180	-	•	•	•	-	-	•	42.0
nning &	Sits Preparations																				
1.18	Prepare dismantling sequence	-	•	-	-	-	•	73	11	84	84	•		-	•	•	-		-	-	2,
1.19	Plant prep. & temp. svors	•	-	-	•	-	-	2,304	846	2,650	2,650	-	-	-	-	•	•	•	•	-	1.
1.20	Design water clean up system	-	•	•	-	-	-	43	6	49	49	-	-	•	•	-	•	-	-	•	4.
1.21	Rigging/Cont. Catri Envlpationing/etc.	-	•	•	-	•	•	1,950		2,248 43	2,243 43	-	•	•	•	-	-	-	•	-	L
	Procure casks/liners & containers	-	-	-	-	•	-	37	6	43 7,687		•	180	•	-	-	•	-	•	•	78
1	Subtoinl Period 1a Activity Costs	-	•	-	• •	-	•	6,640	896	1,687	7,607	•	130	•	-	• •	•	-	-		16,1
	erind Dependent Costs						•		181	1,437	1,487								-	_	
	Insurance .	•	-	•	•	-	-	1,308		567	1,487 567	-	-	-	•	-	-	•	-	-	
	Property taxes	-	-	•	•	-	-	515	52 87	433	433	-	•	-	•	•		-		•	
	Health physics supplies	•	846		-		•	-		433	433	-	-	-	•	•	•		•	•	
	Heavy equipment rental	•	326	i -	•	-	-	•	49			-	-	-	- 605	•	•	-			
	Disposal of DAW generated	•	-	10	3	3.	49		13	68 2.644	68 3,844	-	•	•	605	•	•	-	12,12	<b>i</b> 14	
	Plant energy budget	•	. •	•	•	•	•	2,478	371			•	•	•	•	•	•	•	•		
	NRC Fees	•	-	-	-	-	-	804	30	334	384	•		-	-	•	•		-	-	
	Emergency Planning Fees .	-	-	-	•	-	•	51		68	-	50		•	•	•	•	• •	•	•	
4.9	Spent Fuel Pool O&M	-	-	•	•	-	-	958		1,102	-	1,10		-	-	•	. · ·	•	-	•	
4.10	Dry Fuel Storage O&M Costs		•	•				35	5	40	-	-40	j -	•	-	•	•	•	•		

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#### TABLE C-2 PEACH BOTTOM ATOMIC POWER STATION - UNIT 3 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

						·····			· ·												
		B		On size size -	*	Off-Site	LLRW	Other	<b>T</b> - 1 - 1	w-1-1	NRC	Spent Fuel	Site	Processed			/olumes		Ourial		Utility and
Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Costs	Processing Costs	Disposai Costs	Other Costs	Total Contingency	Total Cosis	Lic. Term. Costs	Management Costs	Restoration Costs	Volume Cu. Feet	Class A Cu. Feet	Class B Cu. Feel	Class C Cu. Feet	GTCC Cu. Feet	Weight Lhs.	Craft Manhours	Contractor Manhours
enon 12 a.4.11	Period Dependent Costs (continued) Becurity Staff Cost	_				_		695	104	799	799	_				_	_				27,411
a.4.12	Utility Staff Cost						-	17,493	2,624	20,117	20,117	-			-					-	299,417
12.4.15 12.4	Subtotal Period 1a Period Dependent Costa		672	10	- 9	-	42	28,831	3,613	28,179	26,974	1,198			605		-		12,124	- 149	
	-	-													005						-
18.0	TOTAL PERIOD 12 COST	-	679	10	8	•	42	30,472	4,609	35,809	84,481	1,198	130	•	605	•	-	•	12,124	149	405,428
PERIOD	th - Decommissioning Preparations														•						
Period Ib	Direct Decommissioning Activities																				
	Vorie Procedures													•							
ib.11.1	Plant systems	•	-	-	-	-	•	144	22	166	149	-	17	-	-	•	-	-	•	•	4,733
	NSSS Decontamination Flush	-	-	-	-	-	-	30	6	35	35	-	-	-	-	•	-	-	-	-	1,000
lb.1.1.3	Reactor internals	-		•	-	•	-	121	18	140	140	•	•	-	•	-	-	•	-	-	4,000
lb.1.1.4	Remaining buildings	•	-	-	-	-	-	41	6	47	12	-	35	-	-	•	-	•	-	-	1,350
ib. L 1.5	CRD housings & NIs	-	•	•	•	-	-	30	5	35	35	•	•	-	-	-	-	•	•	•	1,000
lb.1.1.6	Incore instrumentation	-	-	•	-	-	•	· SO	5	35	35	•		-	-	-	•	•	-	-	1,000
lb, 1.1.7	Removal primary containment	-	•	-	•	•	-	2	0	2	2	-	•	-	-	-	· •	-	-	-	61
1b.1.1.8	Reactor vessel	•	•	-	-	-	•	110	17	127	127	-	•	-	•	-	-	•	-	-	3,630
lb. <b>1.1.9</b>	Facility closeout	-	•	•	•	-	-	36	5	42	21	-	21	-	-	•	-	-	-	-	1,200
	Sacrificial shield	-	-	-	•	-	•	36	5	42	43	-	-	-	-	-	-	•	-	-	1,200
	Reinforced concrete *	•	•	-	-	•	•	80	5	35	17	-	17	•	-	-	-	-	•	-	1,000
	Turbine & condensers	•	-	-	-	-	-	127	19	145	145	-	-	-	-	-	•		-	•	4,167
Lb.1.L.13	Moisture separators & mhasters	-	-	-	•	-	•	61	9	70	70	•	•	-	-	•	•	-	-	•	2,000
	Radwaste building	-	-	-	-	-	. •	83	12	95	86	•	10	•	-	-	-	-	-	•	2,730
	Reactor building	-	-	-	-	-	-	83	12	98	86	-	10	•	· •	•	-	-	-	-	2,730
15.1.1	Total	-	•	•	•	•	-	965	145	1,110	1,001	-	109	-	-	-	-	•.	-	•	31,601
16,1.2	Decon NSSS	492	-	-	-	•	-	-	245	787	737	-	•	•	- '	-	-	-	-	1,067	•
lb.1	Subtotal Period 1b Activity Costs	492	-	•	-	•	-	966	891	1,848	1,738	-	109		-	•	•	•	-	1,067	31,803
	Additional Costa					,															
1b.21	Spent Fuel Fool Isolation	-	-	-	-	•	-	5,252	788	6,040	6,040	•	•	•	-	-	-	•		-	•
16.2.2	Site Characterization	-	-	•	•	-	•	923	138	1,062	1,062	-	•	-	-	-	-	-	-		-
15.2	Subtotal Period 1b Additional Costs	-	-	-	•	•	-	6,176	926	7,102	7,302	-	-	-		•	-	•	•	•	•
	Collateral Costs																				
16.9.1	Decon aquipment	658		•	-	-	•	-	99	767	757	•	-	-	-	-	•	-	-	-	•
16,2,2	Process liquid waste	39	-	215	221	•	2,334	•	657	3, 165	3,465	-	•	-	-	2,763	-	•	457,832	113	-
1b.S.8	Small tool allowance	-	1	-	-	•	-	-	0	1	1	•	-	-	-	-	•	-	-	•	•
1h.3.4	Pipe cutting equipment	-	911		-	-	-	•	187	1,048	1,048	•	•	-	-	•	-	•	-	-	•
16.A	Subtotal Period th Collateral Costs	697	912	215	221	•	2,884		893	5,271	5,271	-	•	-	-	2,783	•	-	457,832	118	-
Period 1b	Period-Dependent Costs																				
1 <b>b.4.1</b>	Decon supplies	20	-	•	•	-	-	•	5	25	25	•	•	-	•	•	•	-	-	-	-
16.4.2	Insurance	-	•	-	-	-	•	651	65	717	717	-	•	•	-	-	•	-	-	-	-
16.4.9	Property taxes	•	•	•	•	•	-	257	26	283	263	-	-	•	•	-	-	•	•	•	•
1b.4.4	Health physics supplies	-	176	-	•	-	-	•	44	220	220	-	-	-	•	-	•	-	-	-	•
	Heavy equipment rental	•	163	-	-	-	-	•	24	187	187	-	-	-	-	•	-	-	-	-	-
	Disposal of DAW generated	•	•	5	2	-	22	•	6	36	36	-	•	-	918	•	•	-	6,377	78	
1b.1.6								2,467	370	2,636	2,836										
1b.4.6 1b.4.7	Plant energy budget	-	-	-	-		•					•	-	-	•	-	-	•	-	•	-
1b.4.6 1b.4.7 1b.4.8	Plant energy budget NRC Fees	-	-	-		:	-	183	18	201	2,536			-	:	-	-	:	:	:	
1b.4.5 1b.4.6 1b.4.7 1b.4.8 1b.4.9 1b.4.9 1b.4.10	Plant energy budget	-	-	-								28		-	:	-	-	-		-	:

TLG Services, Inc.

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#### TABLE C-2 PEACH BOTTOM ATOMIC POWER STATION - UNIT 3 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

	······································			···· ·		Olf-Site	LLRW	_			NRC	Spent Fuel	Site	Processed		Burial V	chunes		Burial		Utility and
Activity		Decon	Removal	Packaging	Transport.		Disposal	Other	Total	Total	Lis. Term.	Management	Restoration	Volume	Class A	Class 8	Class C	GTCC	Weight	Craft	Contractor
Index	Activity Description	Cost	Cost	Costs	Costs	Costs	Costs	Costs	Contingency	Costs	Costs	Casis	Costs	Cu. Feet	Cu. Feet	Cu, Feet	Cu. Feet	Cu. Feet	Lbs.	Manhours	Manhours
wind 1L	Period Dependant Costs (continued)																				
.4.11	Dry Furl Storage O&M Costs	-	-	-				17	3	20	-	20	-						-		
.4.12	Security Staff Cost			· _	-			347	62	899	399		-		-	-		-			13.66
5.4.10	Utility Staff Cost	-	-	· .	-	-	-	8,723	1,308	10,031	10,032						-				149,30
b.4	Subtotal Period 1b Period-Dependent Costs	20	339	5	2		22	19,148	1,996	15,533	14,935	598	-	-	818	-		-	6,377	78	162,97
<b>b</b> .0	TOTAL PERIOD IN COST	1,209	1,251	220	232		2,366	20,289	4,205	29,753	29,046	598	109	-	318	2,783			464,209	1,258	194,779
ERION	1 TOTALS	1,209	1.923	230	225		2,858	50,761	8.816	65,662	63.527	1.796	239		923	2,763			476,833	1,407	600,200
			1,0	200		,	-,	,	0,010	00,000		1,100		•					10,000		0.0,200
ERIOD	Ra - Large Component Removal																				
eriod 22	Direct Decommissioning Activities																				
luclesr S	iteam Supply System Removal																				
a.1.1.1	Recirculation System Piping & Valvas	63	49	16	11		572	•	190	500	900	•	•	•	1,227	-	•	-	112,271	8,350	•
all2	Recirculation Pumps & Motors	26	28	12	11	30	765	-	219	1,092	1,092	-	-	146	1,442	-	•	•	150,250	1,763	•
a.1.1.3	CRDMs & NIs Removal	138	108	297	43	•	705	-	308	1,598	1,598	-	•	•	5,179	-	-	•	138,258	6,971	•
a.1.1.4	Reactor Vessel Internals	137	1;851	6,083	1,212	•	12,569	212	8,596	31,659	91,659	•	-	•	761	2,526	804	-	453,410	32,665	1,43
a.1.1.5	Reactor Vescel	61	3,674	1,548	425	-	9,350	212	7,909	28,074	23,074	-	-	•	10,735	2,254	-	-	1,408,631	32,665	1,49
all	Totals	424	5,608	7,951	1,702	30	23,962	423	18,222	68,823	58,323	-	•	146	19,334	4,779	804	•	2,262,849	77,394	2,87
	of Major Equipment																				
a.1.2	Main Turhine/Generator	-	311	562	198	5,655	\$,684	-	1,933	12,343	12,943	-	-	28,275	11,732			-	1,052,676	9,753	
2.1.8	Main Condensers	•	. 793	477	142	6,698	1,931	-	1,590	10,530	10,630	-	•	27,989	6,148	-	-	•	651,650	25,487	-
ispotal	of Plant Systems																				
1.41	Air Ejection & Oligas	-	199	10	5	222	250	-	147	834	834	-	-	1,112	548	-		- '	49,086	6,219	
2.1.42	Circulating Water	-	20						9	22			32							692	
113	Circulating Water (ECA)		52	2	. 8	202		-	44	802	802			1,008	2.1	-		• •		1,517	
1.4.4	Condensata		867	82	- 24		2,847	-	801	4.943	4.343	-	-	3,510	5,136		-		460,503	12,429	
a.1.4.5	Condensate Filter Demineralizer	-	505	89	11				414	2,870	2.370			1.545	2,388				208,271	15,656	
1.1.4.5	Control Rod Drive Hydraulic	-	600	40	8	190		-	414	2,173	2.173		-	948	2,018				180.813	17,803	
1.1.4.7	Cooling Towers		22						8	26	-,		25		-,		_	-	100,010	749	
.1.4.8	Electrohydrautic Control		41		1	81			23	147	147			406				-		1,231	
a.1.4.9	Emergency & HP Service Water		69			-			10	79			79	100						2,482	
	. Emergency & HP Service Water (RCA)		242	- 4	- 7	476			183	861	661			2,979		-				5,114	
- 1 4 11	Emergency Cooling Water & Tower		108	-	•	410	-	-	16	125			125	2,315	-	-	•	•	•	4,020	•
. 1 4 18	Feedwatar & Feed Pumps	-	603	76	24	724	2.262	•	636	4,525	4,625	-	-	3,620	4,963	-	-	•	443,828	4,020 J9,179	•
	Feedwater Heater Vents & Drains	-	614	54	20			•	659	3,604	3,604	•	•	3,620	3,679	•	-	-	330,052	16.983	-
	Generator Hydrogen & Carbon Dioride		24	6	1	41		-	12	3,001	78			203	9,913	-	-	-	200,001	10,203	-
	Instrument Nitrogen	-	21	о 0	i	53		•	13	88	88	-		264	•	•	-	•	-	600	•
	Main Steam & Bypass & Crosspround	•	456	36	20			•	508	2,952	2,952		•	4,775	2,136	-	-	-	191.635	14,503	-
	Offgas Recombiner	· ·	152	9	20	121		-	119	655	655	-	•	4,775	±,135 535		-	-	47.844	4,630	-
	Post Accident Sampling	•	102	3	а П	121		-	115	80	30	•	-	930 12			•	•	47,844 1.504		
				0		-		-	•	11		-	-			-	-	-		447	
	Primary Containment Leak Testing	-	4 913	-0 1.9	0	3		•	- 2 178	932	11 932	-	· ·	14		-	-	•	337	140	
	Process Sampling	-		19	-	71		•	178 B	939 53	53	•	-	353	764	-	•	•	68,423	9,185	
	Stator Water Cooling	•	9	0	1	35	-	-	-			•		176	•		•	-	-	282	
	Traveling Water Screens	•	26	• .	•.	•	•	•	4	80	<u>.</u>	-	80	•	-	-	-	-		935	
1.4.23		•	23	2	1			-	28	151	151	-	-	128			-	•	14,012	739	
	Turbine & Extraction Steam	•	673	127	51			-	1,445	8,066	8,066	•	-	9,324		•	-	-	766,273	21,651	
	Turbina Luba Oil	•	223	3	5			-	112	711	711	-	•	1,843		-	•	•		6,766	
al4	Totals	•	6,801	504	168	7,126	14,051	-	5,969	33,169	32,688	•	281	95,682	30,886	-	-	•	2,762,580	166,052	•
	Scaffolding in support of decommissioning		1,011	13		169	37		289	1,623	1,623			845	117				10.491	35,612	

TLG Services, Inc.

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#### TABLE C-2 PEACH BOTTOM ATOMIC POWER STATION - UNIT 8 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

						Off-Site	LLRW				NRC	Spent Fuel	Site	Processed		Burtal	/olumes		Burial		Utility and
Activity		Decon	Removal	Packaging		Processing	Disposal	Other	Tolai	Total	Lic. Term,	Management	Restoration	Volume	Class A	Class B	Class C	GTCC	Weight	Craft	Contractor
Index	Activity Description	Cosi	Cost	Costs	Costs	Costs	Costs	Costs	Contingency	Costs	Costs	Costs	Costs	Cu. Feet	Cu. Feet	Cu. Feet	Cu. Faat	Cu. Feet	Lbs.	Manhours	Manhotra
28.1	Subtotal Period 2a Activity Costa	424	19,024	9,607	2,233	18,579	43,695	423	28,003	115,887	115.606	•	281	92,887	68,217	4,779	804		6,640,246	314,298	2,877
	Additional Costs																				
2a.2.1	Curie Sorcharge (Excluding RPV)	. •	-	-	-	•	1,631	-	408	2,038	2,038	-	-	•	-	-	•	•	-		
2a.2	Subtotal Period 2a Additional Costs	- ·.	-	•	-	•	1,631	•	408	2,038	2,038	-	-	•	-	-	•	•.	•	-	-
Period 2:	Collateral Costa																				
21.3.1	Process liquid waste	64	•	21	54	•	291	•	115	647	547	•	•	-	-	453	-	•	57,160	89	•
20.3.2	Small tool allowance	· •	180	· •	•	•	•	-	27	207	186	-	21	۰.	•	-	•	-	-	•	•
2a_3	Subtotal Period 2a Collateral Costs	64	150	21	64	·	291	•	142	754	• 733	•	21	-	-	453	•	•	57,160	89	-
	Period Dependent Costs																				
2a.4.1	Decon supplies	82	-	-	-	-			31	103	103	•	•	-	-	•	•	•	-	•	-
28.4.2	Insurance	-	-	-	•	-	•	614	61	675	676	-	· .	•	-	•	•	-	•	-	-
22.4.9	Property taxes Health physics supplies.	•	1.699	•	•	-	•	1,047	105 425	1,152	1,035	•	115	-	-	•	-	•.	-	-	•
2a.4.4 2a.4.5	Heavy equipment matal	-	1,635	-	-	-	•	-	425	2,124	2,124 4,119	•	•	•	-	-	•	-	-	-	•
23.4.6	Disposal of DAW generated	-	0,002	116			495	-	537 [4]	789	4,119	-	-	-	7,075	•	•	•	141.770	1,737	•
20.4.7	Plant energy budget	-		110	-		130	4,769	715	5,485	5.485	-	•	•	7,015		-	•	141,770	1,787	•
24.4.8	NRC Fees		-			-	-	615	61	676	676						-		-	•	-
2a, 4,9	Emergency Planning Fees	_	-	-	•	•		104	10	114	-	114		-					-		:
24.4.10	Spent Fuel Pool O&M	-		-	-	-	-	L945	292	2.237	-	2,237					-	-			-
24.4.11	Bry Fuel Storage O&M Costs	-	-	-		-	· .	71	11	81	-	81		-			· .	-		-	-
23.4.12	Security Staff Cost	-	-	•	•	-	-	3,825	574	4,399	4,399	· .			-	•	-				150.870
22.4.13	Utility Staff Cost	-	-	-	-		•	49,813	7,476	57,320	57,320	-			•	•		-	-	•	826,040
2a.4	Subtotal Period 2a Period-Dependent Costa	82	5,281	118	35	-	495	62,833	10,430	79,275	76,727	2,432	115	•	7,075	•	-	-	141,770	1,737	876,910
2a.0	TOTAL PERIOD 2a COST	671	18,485	9,648	2,323	18,579	48,112	63,256	86,982	197,954	195,105	2,432	417	92,887	75,291	5,233	804	-	6,839,176	316,124	979,787
PERIO	2b - Site Decontamination																				
Period 2	Direct Decommissioning Activities					•															
Disposed	of Plant Systems																				
26,1.1.1		-	252	2	5	844		-	118	783	733	•	-	1,722					-	7,894	-
26.1.1.2	Cleanup Filter Demineralizer	191	142	11	2	20	270	•	168	734	734	-		99	616	-		• .	52,951	7,664	-
25.1.1.8	Condensate & Refueling Wtr Strg & Trasfr	+	910	74	28	1,207	1,772	•	811	4,893	4,693	•	-	6,036		-			347,750	29,457	-
25.1.1.4	Core Spray Cooling	400	376	103	22	337	2,841	-	1,058	5,146	5,146	•	-	1,685	6,215	-	•	-	557,294	14,615	-
25.1.1.5	High Pressure Coolant Injection	405	206	- 56	14	225	1,858	•	785	3,650	8,650	•	-	1,125	4,061	-	•	•	364,612	11,659	-
24.1.1.6 21.1.17	Reactor Core Isolation Cooling Reactor Water Cleanup	56 70	8L 102	19 A	9 1	87 9	361	•	146	696 605	696 505	-	•	184	790	-	-	-	70,885	8,228	-
25.1.1.7	Recirc Pump M/G Set Lube Oil	10	85	8	3	9 186	201	•	113 50	826	905 826	-	•	45	440	•	-	-	39,443	4.846	-
2b.1.1.9	Residual Heat Removal	1035	634	171	· 40	607	5,170		2,083	9,742	9,742	•		928 3.037		-	-	-		2,635	-
	Standby Liquid Control	1,000	22		10	43	0,110	•	13	3, 144	78	-	•	214	11,309	•	•	•	1,014,561	24,663 645	-
26.1.1	Totals	2,058	2,953	439	119	3,015	12,474	-	5,415	26,503	26,503		:	15,077	26,042	-		:	2,417,996	643 107, <del>2</del> 07	•••
26,1,2	Scattolding in support of decommissioning	•	1,263	17	5	211	46		361	1,903	1,903	-		1,057	146	-			13,113	44,615	-
Deconta	mination of Site Buildings																				
25.1.3.1	Reactor Building	5,939	1,749	489	231	2,992	5,961	-	4,180	15,692	18,892	•	-	14,959	21,740		-	-	1.935.619	£49,840	
	Administration Buildings	36	1	0	0		0		18	56	65	-	-	-	11		-		1,030,019	1,160	
2b.1.3.2		127	76	15	13	47	26	-	100	404	404	-	-	237	1.056				104,363	6,823	-
26.1.3.2 26,1,3.3	Low Level Redwasta Storage Building	141																			
26,1,3.3 26,1.8.4	Offgas Filter Building	4	3	0	0	2	1	•	9	13	13		•	- 8	23		-		2,924	207	-
25,1,3.3 25,1.3.4 25,1.3.6	Offges Filter Building Radwaste Building	-1 385	3 240	0 41	0 93	2 56	146	:	307	1,209	1,209	:	:	279	2.991	:	:	• -			-
25,1,3.3 25,1,3.4 25,1,3.6 25,1,3.6	Offges Filter Building Radwaste Building	4	3 240 61	0	0	2	-	-				•	:		2.991	:	:		2,924	207	-

TLG Services, Inc.

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#### TABLE C-2 PEACH BOTTOM ATOMIC POWER STATION - UNIT 3 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

							40														
					-	Off-Site	LLRW				NRC	Spont Fuel	Síte	Processed			(olumes		Burial	•	Utility and
Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Processing Costs	Disposal Costs	Other Costs	Total Contingency	Total Cosis	Lic. Term. Costs	Management Costs	Restoration Costs	Volume Cu. Feet	Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet	Weight Lbs.	Craft Manhours	Contracto Manhours
INDEX	ALUTAY DESCRIPTION								Guittingeney	00010											
	ination of Site Buildings (continued)		_				-		-												
26.1.8.8	Basin Dewatering Facility	10	6 3	1	1	4	2	•	8	31 16	31 16	•	•	20 8	78 42	-	-	-	7,723 4,113	445 243	·
2h, 1.3.9 26.1.3.10	Stack Turbing Building	5 692	873	77	66	189	127	-	517	2.041	2,041	•	• •	941	5,461			•	542,911	30,653	
26.1.3.10 26.1.3	Totals	4,735	2,637	643	360	3,393	6,849	-	5,207	23,162	23,162	:		16,658	82,674	:		-	3,000,490	212,383	-
26.1	Subtotal Period 25 Activity Costs	6,823	6,753	1,099	483	6,558	15,869	-	10,983	51,569	51,569			32,791	60.862	-			5,460,900	364,104	-
Davied %	Collateral Costs						•														
2h.S.1	Process liquid waste	97		764	765		8,268		2,307	12,200	12,200				-	9,795			1,622,091	856	
2b.3.2	Small tool allowance	-	195	-	-	•	•	•	29	224	224	•		-	-	•	-	-	-	-	•
2b.S	Subtotal Period 2b Collateral Costs	97	195	764	765	-	8,268	•	2,335	12,424	12,424	-	-	•	•	9,793	•	•	1,622,091	856	•
Period 2b	Period-Dependent Costs			•																	
2Ь.4.1	Decon supplies	1,273		-	-				318	1,592	1,592	-	•	-	•	-	-	-	-	•	•
2b. <b>4.2</b>	Insurance	•	-	-	٠	•	•	581	58	539	639	•	•	•	•	-	-	•	-	-	•
25.4.3	Property taxes	•	-	-	-	-	•	991	99	1,090	1,050	•	•	•	•	-	-	-	-	-	•
26.4.4	Health physics supplies	•	1,820	•	•	-	-	-	455	2,276	2,276	•	-	-	-	-	•	-	-	-	-
26.4.5	Neavy equipment rental	•	3,535	-	-	-	-	•	530	4,065	4,065	•	-	-	-	•	•	•			-
2b.4.6	Disposal of DAW generated	•	•	120	36	•	50 <del>5</del>	-	144 535	806 4,099	806 4.099	-	-	•	7,221	•	-	-	144,708	1,773	•
25.4.7	Plant energy budget NRC Fees	•	-	•	-	•	-	3,664 589	535 59	4,099	4.099	•	-	•	•	-	-	-	•	-	-
26,4.8 26,4.9	Received Frees		•		-	-	•	689 98	10	646 108	018	108		-	•	•		-	-		-
25.4.5 25.4.10	ISFSI Transfer and Capital Costs			-				56.000	8,400	64,400		64,400				-				•	
25.4.11	Spent Fuel Pool O&M		-		-	-	-	1,842	276	2,118		2,118				-	-				
2b.4.12	Radwaste Processing Equipment/Services				-			849	52	403	402	-,	-	-	-	-					
25.4.13	Dry Fuel Storage O&M Costs				-	-	-	67	10	17		77		-	-	-	-		-		
25,4,14	Security Staff Cost	-	•	•	-		-	2,902	435	3.337	3.337	-		-	· •	-		•			114,45
25.4.15	Utility Staff Cost	-	-	-	-			46,189	6,927	53,111	53,111	-		-	-						765,72
2 <b>b.4</b>	Subtotal Period 2b Period-Dependent Casts	1,273	5,355	120	36	-	505	113,166	18,309	138,766	72,063	65,703	-	-	7,221	-	-	•	144,708	1,773	
2b.0	TOTAL PERIOD 25 COST	8,193	19,303	1,983	1,284	6,558	27,642	113,166	91,628	202,759	136,056	66,703		82,791	68,084	9,795	. •	•	7,227,698	866,233	880,17
PERIOD	2c - Decontamination Following Wet Fuel Stor	agn																		'	
Period 20	Direct Decommissioning Activities								•												
\$c.1.1	Remove spent fuel racks	606	-15	117	32	1,260	434	-	578	2,972	2,972	•	-	6,298	1,383	•	-	· •	124,123	1,547	-
	of Plant Systems																				
Sc 1 8 1	Auxiliary Boiler Fuel Oll	•	35		•	-	-	-	6	40	•	-	40	•	-	-	•	-	•	1,216	
2:1.2.2	Auxiliary Steam	•	239		4	267	-	-	101	613	613		-	1,337	•	-	•	-	-	6,998	
2:128	Breathing Air	-	116		1	79		•	41	298	238		-	895	•	-	•	-	•	3,245	
2:1.2.4	Compressed Air	-	426	4	8	517		•	185	1,139	L,139		-	2,583		•	•	•	-	12,066	
20.1.2.5	Containment Atmosphere Control	•	237	4	8	522		-	139 18	909 114	909 114		•	2,608	•	•	•	-	•	7,359	
2c.1.2.6 2c.1.2.7	Containment Atmosphere Dilution Control & Admin Cooling & Heating		40 67		1	. 55	•	-	10	77	114	•		275	•	-	•	-	-	1,185	
20.1.2.8	Cooling Water - Reactor Building	•	87	· .		182	•	•	10	\$22	822	-		910	-	-	-	•	-	2,505	
20.1.2.9	Cooling Water - Turkina Building	-	68 	-	2	128		•	42	260	280			510 640		•	•	•	•	2,534	
20.1.2.10		•	152			110		-	23	174	200	-	174	-		-	:	-	-	2,503	
201.2.11			1,186			:		-	178	1.366	-	-	1,366			-	:	-		41,246	
201.2.12			565			409	61		219	1,265	1.265			2.044	134			-	12,018		
			3.455		67				1,459	8,884	8,684		•	19.368						102.099	
2c.1.2.13			96				_	-	14	111			111	10,000	-				-	3,550	
2c.1.2.13	Fire Protection	•																			
	Fire Protection Fire Protection (RCA)	:	225		- 4	296		:	101	628	62.8			1,479						6,510	
201214				2	4			:					:	1,479 850		-			123,995	6,510	) -

TLG Services, Inc.

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# TABLE C-2 PEACH BOTTOM ATOMIC POWER STATION - UNIT 8 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

						Off-Sile	LLRW				NRC	Spent Fuel	Sile	Processod		Burtal V	ohmes		Burial		Utility and
Activity		Decon	Removal		Transport	Processing	Disposal	Other	Total	Totat	Lic. Term.	Management	Restoration	Volume	Class A	Class B	Class C	GTCC	Weight	Craft	Contractor
Index	Activity Description	Cost	Cost	Costs	Costs	Costs	Costs	Costs	Contingency	Costs	Costa	Costs	Costs	Cu. Feel	Cu. Feet	Cu. Feet	Cu. Feet	Cu. Feet	Lbs	Manhours	
Disposal	of Plant Systems (continued)																				
	HVAC - Administration Facility		6	•	-	-	-	-	1	7	-		7		_		_			226	
	HVAC - Auxiliary Boiler Building	-	1		•	-	-		ā	i	-					-			•	25	-
2c.1.3.20	HVAC - Battery & Emergency Swgr Bldg	-	8		-	-	-	-	ī	Ā		-				-	-		-	117	-
	HVAC - Diesel Generator Building	-	2	-	-		-	-	ō	8			3		-				•	85	-
	HVAC - Drywell	-	44	4	5	339	61	-	76	619	519	-		1.697	in	-			9,973	1,845	•
	HVAC - Maintenance Hot Shop		12	0	0	12	2		6	31	31			62			_	-	362	356	-
	HVAC - Miscellaneous		8	-	-	-	-	-	ā	3			3			-	_	_	-	107	•
	HVAC - Pump Structure	-	. 5	-	-	-	•		ī	6		-	6	-				-		193	•
	HVAC - Redwaste Building	-	103	1	1	95	15		44	259	259	-		475	32	-	-	-	2,889	8.037	•
	HVAC - Radwaste Storage Facility	•	72	1	1	66	10		81	182	182	-	-	338	29			-	1,958	1.988	-
	HVAC - Reactor Building	-	157	2	8	174	26	-	72	434	434			869	57				6,107	4,677	-
24.1.2.29		-	20	0	Ð	26	4		12	73	73	-		132	9				258	505	•
2c.1.2.80		•	12	•	-	-	-	-	2	15	-	-	16	-			-		-	459	-
	HVAC - Turbine Building (Contaminated)	•	160	3	3	220	44	-	90	641	5 <b>4</b> 1	-	-	1,101	97			-	6,717	5,301	•
	Hypachlorite	•	17	-	-	•	-		. 9	20	•	-	20					_		646	•
	Liquid Radwaste Collection	243	269	27	6	135	614		366	1,660	1.660	-		675	1,615		-	-	120,493	15.072	
	Liquid Radwaste Process & Disposal	263	410	36	8	159	921	-	542	2,438	2.438	-	-	794	2,339		-		160,624	22,401	-
20.1.2.35		•	69	-	-	•			10	79			79		-,000				100,824	2,531	-
2c.1.2.86	Flant Heating & Auxiliary Steam	-	28	-			-	-	4	82	-	-	82						•	1,055	-
2c.1.2.37	Plant Heating & Auxiliary Steam (RCA)	-	125	· 1	2	149			54	331	331			746	_			_	•	3,407	•
2c.1,2.38	Eaw Water	-	115	-	•	-	-		17	182	-		132			•	-	-	•	4.114	-
2c.1.2.39	Service Water	-	89		-	-	-		6	45			45	_	•	-	•	-	-	1,405	•
201.2.40	Service Water (RCA)	-	495	6	12	661	-	<u> </u>	254	1.619	1,619		10	4,255	-	•	-	-	•		-
Sc.1.2.41	Service Water Chemical Injection	-							0	1			· · ·	4,600 -	•	-	•	-	-	14,654	•
Sc.1.2.42	Sewage Treatment	-	. 20	-					3	23		-	23	-	•		-	-	-	15 702	-
2-1.2.48	Solid Radwaste Process & Disposal		404	47	10	193	1,254		450	2,357	2,857		20	964	3.025	•	-				-
2-1.2.44	Ventilation Radiation Monitoring	· · .	10	ü	0	5	9		6	30	30		-	24	3,025	-	. •	•	246,060	12,375	-
201.2	Totala	605	10,082	513	165	8,976	3,948	•	6,015	28,994	26,855		2,139	41,878	9,548			-	1,847 774,550	28 f 326,089	
Decemtra	mination of Site Buildings													•							
2c.1.3.1		999	582	105	82	83	1,322		711	9,283	3,283										
201.3	Totals	399	582	106	82	82	1,322		711	3,283	3.283	•	•	408	7,547	•	-	-	710,620	28,309	-
		000		104	05	62	1,332	-	111	0,203	3,283	-	-	408	7,547	-	-	-	710,620	28,809	•
2c.1.4	Sciffolding in support of decommissioning	-	259	8	• 1	42	9	-	72	381	381	•	-	211	29	•		-	2,623	8,903	
2c.1	Subtotal Pariod 2c Activity Costs	1,510	10,961	440	270	10,359	5,713	-	6,376	35,629	83,490		2,139	61,795	18,508	-	-	-	1,611,917	364,848	
Period 2	c Collateral Costs																	•			
2c.8.1	Process liquid wasta	142	-	70	143	-	887		321	1,562	1.562	-				1 000			140.0 **		
20.3.2	Small tool ellowance	•	198		-				30	228	226		•	-	-	1,293	-	-	173,943	205	-
2c.8,3	Decommissioning Equipment Disposition	-		43	12	5-10	117		116	829	829	-	-	2,700	373		-	-		•	-
2c.9	Subtotal Pariod 2c Collateral Costa	142	198	112	155	540	1,004		467	2,619	2,619			2,700	373	1,293	:	:	33,507 207,449	739 949	
Parlada	c Period-Dependent Costs																				
20.4.1	Decon supplies	117																			
20.4.2	Losurance		-		•	-	•	-	29	146	146	•	-	•	•	•	•	-	•	-	-
2.4.3	Property taxes	•	•	•	•	•	•	160	16	177	177	-	-	-	•	-	•	-	-		-
20.4.4	Health physics supplies	•	1,485	•	•	•	•	411	41	452	452	•	-	-	-	•	•		-	•	
20.4.5	Heavy equipment rantal	•	1,485	•	• •	-	•	•	359 220	1,794	1,794	•	•	•	•	-	-	-	-		-
26.4.6	Disposal of DAW generated	•	1,465	•	•	•	•	-		1,686	1,680	•	-	-	-	•	-	-	-	-	
20.4.7	Plant energy budget	-	-	103	31	-	434		123	691	691	-	-	•	6,196	•	-	-	124,160	1,521	-
20.4.8	NBC Fees	•	-	•	•	•	•	788	118	906	906	-	•	-	•	-		-	-	-	•
20.4.9	Emergency Planning Fees	-	-	-	•	-	•	317	82	349	349	•	-	-	•	•	-	•	-	-	-
20.4.10	Radwaste Processing Equipment/Services	•	•	•	•	•	•	41	4	-45	•	45	-	-	-	•	•	•	-		-
	Radwaste Processing Equipment/Services Dry Fuel Storage O&M Costs	-	-	-	•	-	:	290	43	333	333	. •	•	-	-				-	-	-
2~4.11 2~4.12	Security Staff Cost	•	-	-	•	-	-	28 1.203	4 160	32 1.384	1.584	32	•	-	•	•	•	•	-	-	
																					47,460

### TLO Services, Inc.

#### TABLE C-2 PEACH BOTTOM ATOMIC POWER STATION - UNIT 8 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

						Off-Sile	LLRW				NRC	Spent Fuel	Site	Processed		Runlal V	oumes		Burlat		Utility and
Activity		Decon	Removal	Packaging	Transport	Processing	Disposal	Other	Total	Total	Lic, Jerm.	Management		Volume	Class A	Class 9		GTCC	Weight	Craft	Contractor
Index	Activity Description	Cost	Cost	Costs	Costs	Costs	Cosis	Cests	Contingency	Costs_	Costs	Costs	Costs	Cu. Feel	Cu. Feet		· Cu. Feel	Cu. Feet	Lbs.	Manhours	
Period 2c	Feriod-Dependent Costs (continued)																				
2c.4.18	Utility Staff Cost	-	-	-	-	•	•	16,464	2,470	18,934	18,934	-	-	-	•	•	-	-	•		273,840
Zc.4	Subtotal Pariod 2c Period-Dependent Costs	117	2,901	105	- 81	-	434	19,702	3,640	26,928	26,852	77	•	-	6,195	•	•	-	124,160	1,521	321,300
20.0	TOTAL PERIOD 2c COST	1,769	14,060	665	456	10,899	7,151	19,702	10,483	68,177	62,961	77	2,139	54,495	25,077	1,293		•	1,948,525	867,318	821,300
PERIOE	24 - License Termination																				
Period 2:	Direct Decommissioning Activities																				
26.1.1	<b>QRISE</b> confirmatory survey	•••	-	•	-	•	•	118	36	354	154	-	-	-	•	•	•	-	-	•	•
2e.1.2 2e.1	Terminate license Subtotal Period 2a Activity Costs				•			118	36	a 164	154	-				-	-	-			
40.1	difficial femorize network costs	-	•	•	-	•		110	00												
	Additional Costs								671	5,148	5,148									127,578	
2e,2.1 2e,2	Final Site Survey Subtatal Period 2e Additional Costs		:	-	-	:		4,476 4,476	671	5,148	5,148		•	-		-		-	:	127,578	:
										••	-10-02										
	Period-Depandent Costs									63	83										
2e.4.1 2e.4.2	Insurance Property taxes	•	•	-	•	·	:	75 386	8 39	6J 424	424	• •	:		-	:	:	-	:	:	:
2e.4.2 2e.4.3	Health physics supplies		-		:		-		166	829	629	-		-		-			-		
24.4.4	Disposal of DAW generated		-		2	-	32		9	50	60	-	-	-	459	-	-	-	9,068	111	
24.4.5	Plant energy budget	-	-	•	•			370	65	425	425	-		-	•	-		•	•	•	•
24.4.6	NRC Frees	-	-	-			•	305	31	336	936	-	-	-	-	-		•	-		-
Ze.4.7	Emergency Planning Fees	· -	-	•	-	•	•	38	4	42	-	43	-	•	•	-	-	-	•	•	-
2a.4.8	Dry Fuel Storage O&M Costs	-	•	-	-	•	•	26	4	80	• .	30	-	-	-	-	-	•	-	•	•.
2c.4.9	Security Staff Cost	-	-	•	-	-	•	620	93	713	713	•	•	•	•	•	-	•	•	-	24,446
28.4.10	Utility Staff Cost	•	- 663	• •		-	•	10,137	1,521 1,928	11,658 14,591	11,658 14,619	- 72	-	•	-	-	•	•	-		167,177 191,623
20.4	Subtotal Period 2s Period Dependent Costs	-	653	8	2	•	82	11,958	1,928	14,591	14,619		•	•	153	-	-	-	9,068	191	191,622
2e.0	TOTAL PERIOD 2: COST	-	663	9	2	-	32	16,552	2,635	19,892	19,820	72	•	•	453	•	٠	-	9,068	127,689	191,623
PERIOD	TOTALS .	10,533	45,512	12,293	4,085	86,036	80,937	212,677	89,729	485,782	413,943	69,284	2,856	180,173	168,905	16,320	804	-	16,019,470	1,177,863	2,372,883
PERIOI	986 - Site Restoration	-																			
Period 3	b Direct Decommissioning Activities	•																			
	on of Remaining Site Buildings																				
35.1.1.1		-	5,903	•	•	•	•	•	885	6,788	1,018	•	5,770	-	•	•	•	٠	. •	109,807	-
3b.1.1.2		. •	463	-	-	•	•	-	69	632	-	-	532 58	•	•	-	•	-	•	10,790	
35.1.1.3		•	51	-	•	•	-	•	8 240	58 1,838	•	-	1,638	-	-	. •	•	-	-	1,154	
35.1.1.4			1,598	-	•	•	•	•	240	1,851	•	•	1,638	•	-	•	•	•	-	27,214 14,843	
35.1.1.5 35. <i>1</i> .1.6			1,619 2, <i>1</i> 29	•	•	•	·	-	469	3,598	-		3.598	-	•	-		-	•	67,415	
36.L.1.8 Sb.1.1.7	Emergency Cooling Tower		168	-	-	· •			25	193			193				:			3,413	
35.1.1.8			351						53	404	-		404	-				-	-	7,962	
\$6,1,1,9			69	-		-	-		10	79	-	· -	79	-		-		•	-	1,595	
86.1.1.10	Hazardous Waste Storage Area	-	98	-	•	•	•	-	16	113	•	-	1)3	•	•	•	•	-	•	1,915	
	L Low Level Redwaste Storage Building	-	457	•	-	-	-	-	69	526	26	•	500	٠	-	-	•	-	•	10,611	
	Miscellaneous Yard Structures	•	1,287	-	-	-	-	-	193	1,480	•	•	1,480	-	-	-	•	-	•	24,889	
	Mods Building	-	109	-	-	-	•	•	16 8	125	· · ·	-	125 21	-	•	•		•	•	2,425	
	4 Offgas Filter Building 5 Plant Access Building	-	20 119	-	•	-		-	8 16	187	1		137	•	•	•		:	:	341 2.892	
	5 Plant Services Building	-	48	•	-	•	-	-	1	65		-	. 65		-	-		-	-	1,191	

TLG Services, Inc.

TLG Services, Inc.

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#### TABLE C-2 PEACH BOTTOM ATOMIC POWER STATION - UNIT 3 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

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						Off-Site	LLRW				NRC	Spent Fuel	Site	Processed		Burial	Volumes		Burtal		Utility and
Activity		Decon	Removal	Packaging	Transport				Total	Total	Lic. Term.	Management	Restoration	Volume	Class A	Class B	Class C	GTCC	Weight	Crait	Contractor
Index	Activity Description	Cost	Cost	Costs	Costs	Costs	Costs	Costs	Contingency	Costs	Costs	Costs	Costs	Cu. Feet	Cu. Feet	Cu, Feet	Cu. Feel	Cu, Feel	Lbs.	Mashours	Manhours
Bernfret	on of Remaining Site Buildings (continued)																				
	Radwaste Building		1,820						198	C517	153		1,366								
		-	1,520	. •	•	-	•	•	22	166	183	-	1,355	-	-	-	•	•	-	23,189	
35.1.1.18	Eadwaste Building Extension Radwaste Service Enclosure	•	144	•	•	•	-	•	22	14	11	-		•	-	-	•	•	-	3,293	
30.1.1.19	Recombiner Building	-	508	-	•	-	-	-	70	585	- 29	-	14 555	-	-	-	•	•	•	210	
	Resin Dewatering Facility	•	22	-	•		-	-	3	25	25	•	24	-	•	•	-	-	-	7,753	-
35.1.1.21	Secondary Alarm Station	•	17	-	-	•	-	•	3	20	1	-	21	•	-	•	•	•	-	493 983	-
	Site Management Building & Shop	•	239	-	-	-	-	-	36	20	-	-	20	-	-	-	-	-	-	383 5,839	•
30,11,23	Saubber Rebuild Facility	•	38	-			•	-		44	•	-	44	•	-	•	•	-	•	a,639 995	•
30.1.1.25		-	299	•	-	•	-	•	45	344	-	-	344	-	-	•	-	-	-	1,322	-
	Switchgear Building & Transformer Yard		67						10	77	•	•	77	•	•		•	•	•	1,404	
	Training Center		184	-	-			-	29	229	•	-	223	-	•	-	-	•	•	4.819	
	Turbine Building		3,582	-			-	-	537	4.120	412	-	3.708		-			-	-	1,010	
8b.1.1.29			940	-	-			-	141	1.081			1,081				_	-		15,197	•
36.1.1.30			209	-					81	240		-	240			-			-	5,044	•
9b:1.1.91			60		_	_		-	9	69			69		-					1.306	
Sb.L.1	Totals		23,138	-		-			3,471	26,609	1,655		24,952	-	-	-	-	-	-	458,071	
00.1.1	IDIZIS	•	A0, 100	-	•	•	-	-	0,471	20,003	1,000	-	21,303	-	•		•	•	•	400,011	-
Sita Cha-	aout Activities																				
8b.1.2	Remove Rubble		4,165	_	-	_			623	4,779	_		4,779					_		7,964	
3b.1.3	Grade & inniscope site	•	585	-	-	-	•	-	88	673	-	-	673		•	•	-	-	-		
30.1.3 3b.1.4	Final report to NRC			•	•		•	47		54	- 64	-	-	•	-	-	•	-	-	2,209	1,560
36.1	Subtotal Period 3b Activity Costa		27,879	-	•	-	•	47	4.189	32,115	1,711	-	30,404	•	-	•	•	•	-	468,244	
00.1	and the second of the second o	-	A1,072	-	-	•	-		9,103	32,113	4/11	•	30,404	•	-	-	-	-	-	100,293	1,060
Period 9	Additional Costs										-										
3b.2.1	Concrete Crushing	_	-	-		-		927	139	1.066	_	_	1.065	_				-	_	6,739	
56.2	Subtatal Period Sh Additional Costs	_		-				927	139	1,066			1,068	-			-	-	-	6,739	
00,0								021	100	1,000	•	•	1,000	•	. •	•	-	-	•	0,735	-
Pavind 3	b Collateral Costs																				
35.3.1	Small tool allowance	-	231	-		-		-	35	266			265	_	_	_	-		_	-	
36.8	Subtotal Period 3b Collateral Costa		231						85	266			266			_	-		-		
													200							-	-
Period 3	Period Dependent Costs																				
3b.4.1	Insurance	-		-		-		205	21	226	a	203	23			_	_	-		_	_
8b.4.2	Freperty taxes	-	-	-	-	• •		1,051		1,166	•		1,156	-		_			_		-
3b,4.3	Heavy equipment rental		6,076	-			-		761	5,837	-		5,837	-							-
3b.4.4	Flant emergy budget	-		-	-			504	76	680		290						_		_	_
3b.4.5	NRC ISFSI Fees		-	-	-			246	25	271	-	271						-	-	-	
35.4.5	Bmergenry Planning Fees		•					104	10	114	-	114									
3b.4.7	Dry Fuel Storage O&M Costs	-		-	-			71	11	82		82			-	_	-	_			
35,4.8	Security Staff Cost	-	-	-	-		-	1,689	253	1,942	. (0)	1,901		_						-	66,606
35.4.9	Utility Staff Cost	-	-	-	· .			16,179		18,606		9,303		-	-				•		256,764
36.4	Subtotal Period Sb Period-Dependent Costs	-	5,076	•		-		20,049	9,688	28,815	(0)					_	-		-		323,360
			•						-				-								
3b.0	TOTAL PERIOD 35 COST		33,186	-	-	•	-	21,023	8,051	62,260	1,711	11,564	46,985	-			-			474,983	824,920
		•																			
PERIO	D Sc - Fuel Storage Operations/Shipping																				
Davied 9	c Direct Decommissioning Activities																				
	ect activities in this period																				
	c Period Dependent Costs																				
3c.4.1	Insurance	•	•	-	-	.•	•	1,627	163	1,790	-	1,790		•	•	•	•	-	•	-	•
Sc.4.2	Property taxes	•	-	-	•	-	. •	8,333	833	9,166	-	9,166	i •	-	-	•	-	-	-	· -	•
8=4.5	Plant energy budget	•	-	-	•	-	· -	999		1,149	-	1,149		-	-	•	•	•	-	-	-
Sc.4.4	NEC ISFSI Fees	•	-	-	-	•	•	1,951	195	2,146	•	2,146	i •	-	-	•	-	-	•	-	-
														-							
	•																				

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#### TABLE C-2 PEACH BOTTOM ATOMIC POWER STATION - UNIT 3 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

r			-				Off-Site	LLRW	· · · · · ·			NRC	Spent Fuel	Site	Processed		Burial	Volumes		Burial		Utility and
Activity			Dason	Removal	Packaging	Transport	Processing	Disposal	Other	Total	Total	Lla. Term.	Management	Restoration	Volume	Class A	Class B	Class C	GTCC	Weight	Craft	Contractor
Index	Activity Description		Cost	Cast	Costs	Costs	Costa	Costa	Costs	Contingency	Costs	Costs	Casts	Costs	Cu. Feet	Gu, Feet	Cu, Feet	Cu, Feet	Cu. Feet	Lbs.	Manhours	Manhours
Period Se	Period-Dependent Costs (continued)																					
Sc.4.5	Emergency Planning Fees		-	-					824	82	907		907	-	-			-		-		•
3c.4.6	ISFSI Transfer and Capital Costs			•		•	-		3,797	570	4,367		4,367	•	-		-		-		•	-
8c.4.7	Dry Fuel Sinrage Ochl Costs		. •	-	-	•	-	•	563	84	647	•	647	-	•	•	•	•	•	-	•	•
3c.4.8 8c.4.9	Security Staff Cost Utility Staff Cost		-	-	•	-	-	•	9,070 33,143	1,360 4,971	10,430 38,114	:	10,430 38,114	-	-	-	-	-	-	•	٠	857,720 545,097
3e.4	Subtotal Period 3c Period Dependent Costs							:	60,306	8,409	68,716	2	68,716	-	:	:	:	:				902.817
30.0	TOTAL PERIOD at COST		-	-		-	· •	-	60,306	8,409	68,710	-	68,715	-	•	-	-			-		902,817
PERIOD	3d - GTCC shipping																	_				
Period 3d	Direct Decommissioning Activities																					
Nuclear	Steam Supply System Removal										•											
34.1.1.1	Vessel & Internals GTCC Disposal		-	-	-	•	•	11,881	•	1,782	13,653	13,663	•	•	-	-	-	-	748	-	•	-
84.1.1 34.1	Totals Subtatal Period 3d Activity Costs		•	•	-	•	•.	11,881 11,881	:	1,783 1,782	13,663 13,663	13,663 18,663	•	•	•	-	-	-	748 748	•	-	
30.1	Sustaini Period 34 Activity Costs		-	-	•	•	•	11,601	•	1,702	13,003	18,603	•	-	•	-	•	•	148	•	•	•
	Period-Dependent Costs																					
3d.4.1	Insurâncă	• .	•	•	•	-	· •	-	6	02	5 26	-	5 26	-	•	•	•	-	•	•	•	-*
8d.4.2 3d.4.8	Property taxes Plant energy budget		-	-	· ·	÷		:	24	2	20		26	-	:	-	:	-	-		•	:
84.4.4	NRC ISFSI Fees				-	-	-	-	6	ĩ	Ğ	-	ő				-				-	-
3d.4.6	Emergency Planning Fees		-	-	-	-		•	2	0	3	-	8	-	-	-	-	-	•	-	•	
8d.4.6	ISFSI Transfer and Capital Costa		-	-	-	•	-	•••	183	27	210	-	210	-	•	•	-	•	-	•	•	•
3d.4.7 3d.4.8	Dry Fuel Storage O&M Costs Security Staff Cost		-	• •	-	-	-	•	2 26	a 4	2 30		2 30	•	•	-	-	-	•	•	-	1,020
34.4.9	Utility Staff Cost		-		-		-	:	20 95	14	109		109	-		-	:	-			:	1,554
84.4	Subtotal Period 3d Period Dependent Costs		-		-		•	•	914	50	394	•	394	-		-			-			2,574
84,0	TOTAL PERIOD 34 COST		•	•	•	•	-	11,881	544	1,832	14,057	13,653	394	-	-	• .	-	-	748	•	•	2,574
PERIO	Se - ISFSI Decontamination																					
	e Direct Decommissioning Activities ect activities in this period					-																
Period 3c	a Additional Costa																					
Se.2.1	ISFSI License Termination		-	1,242	14	130	-	508	1,438	674	4,005	•	4,005	-	•	11,818	-	•	-	1,358,549	27,799	3.560
Sc.2	Subtatal Feriod 3e Additional Costs		•	1,242	14	. 130	-	508	1,438	674	4,005	-	4,005	-	-	11,818	•	-	٠	1,358.649	27,799	2,560
Perind 3	a Collataral Costg																					
3e.3.1	Small tool allowance		-	12 12	-	-	-	•	•	2	14	-	14	•	•	•	•	•	•	-	·	-
3e.8	Subtotal Period 3e Collateral Costs		-	12	•	.*	•	•	•	2	14	•	14	•	-	•	-	•	•	•	-	-
	e Period-Dependent Costs									-												
Se.4.1	Insurance		•	•	-	•	· •	•	84	8	- 87	•	37	-	-	-	-	-	-	•	-	-
Se.4.2 Se.4.3	Property taxea Heavy equipment rental	,	-	24D	•	-		-	344	34 36	378 276	-	878 275	-	-	-	•	-	-	•	-	-
3e.4.3 8s.4.4	Fient energy budget		:	240	:	:	:	:	- 82	36	276 95	:	276 95	:	:	:	-	-	-	:	-	•
3e.4.5	NRC ISFSI Free		-			-	•	•	40	4	44	•.	44	•	-	-		-	•		-	
Se.4.6	Security Staff Cost		•	-	•	•	•	-	94	14	108	•	108	-	•	•	•	-	•	•	•	8,690
Se.4.7	Utility Staff Cost Subtotal Period 3a Period-Dependent Costs		•	240	•	-	-	-	835	125 239	960 1.898	-	960 1,898	•	-	•	-	-		•	•	13,854
3e.4 3e.0	TOTAL PERIOD 38 COST			240 L494	. 14	- 180	-	508	1,428 2,866	219	5,916	:	5,916	2	-	- 11,818	-		:	• 1,358,649	27,799	17,044 19,604
				4101	**		-	000	2,030	346	-,-10		0,010	-	-		-	-	-	1,000,040	71,199	10,004

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#### TABLE C-2 PEACH BOTTOM ATOMIC POWER STATION - UNIT 3 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

						Olf-Site	LLRW				NRC	Spent Fuel	Site	Processed		Burial V	olumes		Burial		Utility and
Activity		Decon	Removal	Packaging	Transport	Processing	Disposal	Other	Total	Total	Lie. Term,	Management	Restoration	Volume	Class A		Class C	GTCC	Weight	Craft	Contractor
Index	Activity Description	Cost	Cost	Costa	Cosis	Cesis	Costs	Costs	Contingency	Costs	Costs	Costs	Costs	Cc. Feet	Cu. Feet	Cu. Feet	Cu, Feet	Cu. Feet	Lbs.	Manhours	Manhours
PERIOD af - ISFSI Site	a Restoration																				
Period 3f Direct Decomm No direct activities in	nissioning Activities this period																				
Period 3f Additional Cos	ita												•								
312.1 ISFSI Pad Re		-	1,757	•	-	•	-	35	269	2,061	-	3'08T	-	-	-	-	•	-	-	10,817	160
3(2.2 ISFSI Bridge		-	55	-	-	•	•	-	8	63	-	63	• •	-	-	-	-	-		1,176	
	neat Building Restoration	-	1	-	-	•	•	•	0	2	-	2	-	-	•	-	•	-	-	26	-
	arn Restoration	•	12	-	-	•	-	•	2	. 14	-	14	•	-	-	-	-	•	-	217	-
8£2 Subtotal Perio	ed Sf Additional Costs	-	1,826	•	•	-	•	35	279	2,140	•	2,140	-	-	•	-	•	•	•	12,235	160
Period 3f Collateral Cost																					
3f.3.1 Small tool alls		-	6	•	•	•	•	•	1	7	-	т	•	-		-	-	-	-	-	
SLS Subtotal Ferie	od 31 Collateral Costs	•	6	-	-	•	•	-	ĩ	7	-	7	•	-	-	•	•	-	-	•	-
Pariod 3f Pariod-Depend	lent Costa																				
SE4.1 Insurance		-	-	•	-	-	-	17	2	19	-	19	•	•				•	-	-	-
3£4.2 Property taxe		-	-	-	-		-	173	17	191	•	191	-		•	-	•	-	-		•
3f.4.5 Heavy equipe		-	85	•	•	-	•	•	13	98	-	98	-	· •	•	-	-	-	-	-	-
31.4.4 Plant energy		-	-	-	•	•	•	42	6	48	-	48	•	•	•	•	-	-	-	•	-
SL4.5 Security Staff		-	-	-	-	-	-	47	7	64	-	54	•	-	-	•	-	-	•	-	1,860
SL4.6 Utility Staff (		-	-	-	-	-	-	202	30	232	•	232	•	-	-	-	•	-	-	-	3,277
	nd Sf Period Dependent Costs	•	85	-	-	-	-	461	75	642	-	642	-	-	•	-	•	•	•.		5,137
alo total peri	IOD 31 COST	-	1,517	•	-	-	-	616	355	2,788	-	2,788	-	-	•	-	-	-	-	12,236	5,297
PERIOD 3 TOTALS	•	-	36,597	14	190	-	12,588	85,055	19,653	158,737	15,374	89,378	48,985	•	11,818	•	-	748	1,358,549	515,018	1,255,213
TOTAL COST TO DECO	MISSION	11,743	84,032	12,537	4,420	56,036	95,723	348,493	112,097	705,080	492,843	160.457	51,780	180.173	· 181.646	19,103	804	748	17,854,350	1.693.789	4.228.235

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## TABLE C-2 PEACH BOTTOM ATOMIC POWER STATION - UNIT 3 DETAILED COST ANALYSIS (Thousands of 2002 Dollars)

						Off-Site	LLRW				NRC	Spent Fuel	Site	Processed		Rurial V	Volumes		Burial		Utility and
8-45-48-		Decos	Demousl	Dealerstern	Transmost	Processing		Olline	Total	Total		Management	Partoration		Class 4			GICC	Weight	0	
 Acumiy															Class A					Crail	Contractor
 Activity Index	Activity Description	Cast	Cost	Costs	Costs	Costs	Costs	Casts	Contingency	Costs	Costs	Costs	Costs	Cu. Feet	Cu. Feet	Cu. Feet	Cu. Feet	Cu. Feet	Lbş.	Manhours	Manhours
											-										

TOTAL COST TO DECOMBILSSION WITH 18.9% CONTINGENCY.	\$705,080	thousands of 2002 dollars
TOTAL NRC LICENSE TERMINATION COST IS 69.9% OR	\$492,843	thousands of 2002 dollars
SPENT FUEL MANAGEMENT COST IS 22.76% OR:	\$160,457	thousands of 2042 dollars
NON-NUCLEAR DEMOLITION COST IS 7.34% OR-	\$51,780	thousands of 2002 dollars
TOTAL PRIMARY STITE BADWASTE VOLUME BURIED:	107,717	cubic feat
FOTAL SECONDARY SITE RADWASTE VOLUME BURIED:	<b>31,83</b> 6	cubic feat
TOTAL GREATER THAN CLASS C RADWASTE VOLUME GENERATED:	748	cubic fest
TOTAL SCRAP METAL REMOVED:	46,865	tons
TOTAL CRAFT LABOR REQUIREMENTS:	1,698,789	man-hours

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

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