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PRELIMINARY DECOMMISSIONING COST ESTIMATE

for the

CRYSTAL RIVER UNIT 3 NUCLEAR GENERATING PLANT

prepared for

Progress Energy Florida, Inc.

prepared by

TLG Services, Inc.
Bridgewater, Connecticut

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APPROVALS

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No.	CRA No.	Date	Item Revised	Reason for Revision
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SUMMARY

Florida Power Corporation, doing business as Progress Energy Florida, Inc. (Progress Energy), a subsidiary of Progress Energy, Inc., is seeking renewal of the operating license for the Crystal River Unit 3 Nuclear Generating Plant (Crystal River), currently set to expire at midnight on December 3, 2016. An application for the renewal of Facility Operating License No. DPR-72, for an additional 20-year period, was submitted to the Nuclear Regulatory Commission (NRC) on December 16, 2008. The application is currently under review.

However, pursuant to 10 CFR 50.75(f)(3), each power reactor licensee shall at or about 5 years prior to the projected end of operations submit a preliminary decommissioning cost estimate which includes an up-to-date assessment of the major factors that could affect the cost to decommission. This report presents an estimate of the cost to decommission the Crystal River assuming a cessation of operations after a nominal 40-year operating life in 2016. The cost estimate includes an assessment of the major factors that could affect the cost to decommission the Crystal River nuclear unit.

Progress Energy is submitting this estimate to comply with the requirements of 10 CFR 50.75(f)(3). Progress Energy has not determined or committed to a specific decommissioning approach for Crystal River at this time. However, it is Progress Energy's current plan for purposes of demonstrating the adequacy of funding to meet regulatory requirements to use the SAFSTOR decommissioning option based on the current license expiration date. License renewal is likely to require a need to revise this preliminary plan.

The currently projected total cost to decommission the nuclear unit, assuming the SAFSTOR alternative, is estimated at $1,077.6 million, as reported in 2011 dollars. The cost includes the monies anticipated to be spent for operating license termination, spent fuel storage and site remediation activities. The cost is based on several key assumptions in areas of regulation, component characterization, high-level radioactive waste management, low-level radioactive waste disposal, performance uncertainties (contingency) and site remediation and restoration requirements. The assumptions are discussed in more detail in this document.

<u>Decommissioning Alternatives and Regulations</u>

The ultimate objective of the decommissioning process is to reduce the inventory of contaminated and activated material to levels at or below the site release criteria so that the license can be terminated. The Nuclear Regulatory Commission (NRC or Commission) provided initial decommissioning requirements in its rule adopted on

June 27, 1988.[1] In this rule, the NRC set forth financial criteria for decommissioning licensed nuclear power facilities. The regulations addressed planning needs, timing, funding methods, and environmental review requirements for decommissioning. The rule also defined three decommissioning alternatives as being acceptable to the NRC: DECON, SAFSTOR, and ENTOMB.

> DECON is defined as "the alternative in which the equipment, structures, and portions of a facility and site containing radioactive contaminants are removed or decontaminated to a level that permits the property to be released for unrestricted use shortly after cessation of operations."[2]

> SAFSTOR is defined as "the alternative in which the nuclear facility is placed and maintained in a condition that allows the nuclear facility to be safely stored and subsequently decontaminated (deferred decontamination) to levels that permit release for unrestricted use."[3] Decommissioning is to be completed within 60 years, although longer time periods will be considered when necessary to protect public health and safety.

> ENTOMB is defined as "the alternative in which radioactive contaminants are encased in a structurally long-lived material, such as concrete; the entombed structure is appropriately maintained and continued surveillance is carried out until the radioactive material decays to a level permitting unrestricted release of the property."[4] As with the SAFSTOR alternative, decommissioning is currently required to be completed within 60 years.

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

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

2 Ibid. Page FR24022, Column 3.

3 Ibid.

4 Ibid. Page FR24023, Column 2.

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

and content of the estimate is also consistent with the recommendations of Regulatory Guide 1.202, issued in February 2005.[6]

Bases of the Cost Estimate

For the purpose of the analysis, Crystal River was assumed to cease operations in December 2016, after 40 years of operations. The unit would then be placed into safe-storage (SAFSTOR), with the spent fuel relocated to an Independent Spent Fuel Storage Installation (ISFSI) to await transfer to a Department of Energy (DOE) facility. Based upon a 2020 start date for the pickup of spent fuel from the commercial nuclear power generators, Progress Energy anticipates that the removal of spent fuel from the site could be completed by the year 2057. For purposes of this analysis, the plant remains in safe-storage until 2071, at which time it will be decommissioned and the site released for alternative use without restriction, i.e., the license is terminated within the required 60-year time period.

The analysis relies upon site-specific, technical information from an evaluation prepared in 2008,[7] updated to reflect current assumptions pertaining to the disposition of the nuclear unit and relevant industry experience in undertaking such projects. The economic basis was reviewed for the current analysis and updated to reflect current site costs and budgets. The site-specific considerations and assumptions used in the previous evaluation were also revisited. Modifications were incorporated where new information was available.

Methodology

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

The estimate is based on numerous fundamental assumptions, including regulatory requirements, low-level radioactive waste disposal practices, high-level radioactive waste management options, project contingencies, and site restoration requirements. The estimate incorporates a minimum cooling period for the spent fuel that resides in the storage pool when operations cease. Any residual fuel

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

7 "Decommissioning Cost Analysis for the Crystal River Plant, Unit 3," Document No. P23-1597-002, Rev. 0, TLG Services, Inc., October 2008

remaining in the pool after the cooling period is relocated to the ISFSI to await transfer to a DOE facility. The estimate also includes the dismantling of site structures and non-essential facilities and the limited restoration of the site.

The methodology used to develop the estimate followed the basic approach originally presented in the AIF/NESP-036 study report, "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates,"[8] and the DOE "Decommissioning Handbook."[9] These documents present a unit cost factor method for estimating decommissioning activity costs that simplifies the calculations. Unit factors for concrete removal ($/cubic yard), steel removal ($/ton), and cutting costs ($/inch) were developed using local labor rates. The activity-dependent costs were then 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.[10]

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.

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 analysis reflected lessons learned from TLG's involvement in the Shippingport Station decommissioning, 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, Connecticut Yankee, and San Onofre-1 nuclear units have provided additional insight into the process, the regulatory aspects, and the technical challenges of decommissioning commercial nuclear units.

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

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

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

Contingency

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

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

Low-Level Radioactive Waste Disposal

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

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

11 Project and Cost Engineers' Handbook, Second Edition, American Association of Cost Engineers, Marcel Dekker, Inc., New York, New York, p. 239.
12 "Low-Level Radioactive Waste Policy Act of 1980," Public Law 96-573, 1980.
13 "Low-Level Radioactive Waste Policy Amendments Act of 1985," Public Law 99-240, 1986.

decommissioning Crystal River (the Texas facility has limited the importation of waste from outside the Texas Compact).

For the purpose of this analysis, Progress Energy's "Life of Plant Agreement" with Energy*Solutions* is used as the basis for estimating the disposal cost for the majority of the radioactive waste (Class A [14]). Energy*Solutions* does not have a license to dispose of the more highly radioactive waste (Classes B and C), for example, generated in the dismantling of the reactor vessel.

The Texas Commission on Environmental Quality (TCEQ), the environmental agency for the state, is responsible for the licensing of a low-level radioactive waste disposal facility for the Texas Compact. The agency granted Waste Control Specialists (WCS) a disposal license in 2009 and approval to commence construction in early 2011. Construction of the disposal facility is now essentially complete and the facility was declared operational in November 2011. However, to date, the TCEQ has only published interim disposal rates for the facility, in advance of the formal disposal rate-setting process, and only for Compact generators. As a proxy, disposition of the Class B and C waste is based upon the last published rate schedule for non-compact waste for the Barnwell facility.

The dismantling of the components residing closest to the reactor core generates radioactive waste that may be considered unsuitable for shallow-land disposal (i.e., low-level radioactive waste with concentrations of radionuclides that exceed the limits established by the NRC for Class C radioactive waste (Greater-than-Class C or GTCC)). The Low-Level Radioactive Waste Policy Amendments Act of 1985 assigned the federal government the responsibility for the disposal of this material. The Act also stated that the beneficiaries of the activities resulting in the generation of such radioactive waste bear all reasonable costs of disposing of such waste. However, to date, the federal government has not identified a cost for disposing of GTCC or a schedule for acceptance.

For purposes of this study, GTCC is packaged in the same canisters used for spent fuel. The GTCC material is shipped directly to a DOE facility as it is generated.

A significant portion of the waste material generated during decommissioning may only be potentially contaminated by radioactive materials. This waste can be analyzed on site or shipped off site to licensed facilities for further analysis, for processing and/or for conditioning/recovery. Reduction in the volume of low-level radioactive waste requiring disposal in a licensed low-level radioactive waste disposal facility can be accomplished through a variety of methods, including analyses and surveys or

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

decontamination to eliminate the portion of waste that does not require disposal as radioactive waste, compaction, incineration or metal melt. The estimate for Crystal River reflects the savings from waste recovery/volume reduction.

High-Level Radioactive Waste Management

Congress passed the "Nuclear Waste Policy Act"[15] (NWPA) in 1982, assigning the federal government's long-standing responsibility for disposal of the spent nuclear fuel created by the commercial nuclear generating plants to the DOE. The NWPA provided that DOE would enter into contracts with utilities in which DOE would promise to take the utilities' spent fuel and high-level radioactive waste and utilities would pay the cost of the disposition services for that material. NWPA, along with the individual contracts with the utilities, specified that the DOE was to begin accepting spent fuel by January 31, 1998.

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

Completion of the decommissioning process is dependent upon the DOE's ability to remove spent fuel from the site in a timely manner. DOE's repository program assumes that spent fuel allocations will be accepted for disposal from the nation's commercial nuclear plants, with limited exceptions, in the order (the "queue") in which it was discharged from the reactor. Progress Energy's current spent fuel management plan for the Crystal River spent fuel is based in general upon: 1) a 2020 start date for DOE initiating transfer of commercial spent fuel to a federal facility and 2) expectations for spent fuel receipt by the DOE for the Crystal River fuel. Fuel could be completely removed from the site as early as 2057, based on an oldest fuel first priority, and the DOE achieving an annual rate of transfer (3,000 metric tons of uranium year) as reflected in DOE's latest Acceptance Priority Ranking and Annual Capacity Report dated June 2004 (DOE/RW-0567).

The assumed 2020 DOE start date is nominally based on the last position stated by the DOE. On July 15, 2008, the then-Director of the DOE's Office of Civilian Radioactive Waste Management testified before Congress that DOE "could be ready to begin accepting spent nuclear fuel by 2020," but his statement was based on continued program funding.[16] The current administration has cut the budget for the geological

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

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

repository program, but the administration has also appointed a Blue Ribbon Commission on America's Nuclear Future to make recommendations for a new plan for nuclear waste disposal. That Commission's charter includes a requirement that the Commission consider "options for safe storage of used nuclear fuel while final disposition pathways are selected and deployed." Progress Energy believes that one or more monitored retrievable storage facilities could be put into place following a Blue Ribbon Commission recommendation for the same, within a relatively short time frame, at least by 2020. For example, a facility such as that licensed by the NRC to Private Fuel Storage could be used by the DOE to store fuel until a final disposition is determined.

It is generally necessary that spent fuel be cooled and stored for a minimum period at the generating site prior to transfer. As such, the NRC requires that licensees establish a program to manage and provide funding for the management of all irradiated fuel at the reactor site until title of the fuel is transferred to the Secretary of Energy, pursuant to 10 CFR Part 50.54(bb).[17] This requirement is prepared for through inclusion of certain cost elements in the decommissioning estimate, for example, associated with the isolation and continued operation of the spent fuel pool and the ISFSI.

The spent fuel pool is expected to contain freshly discharged assemblies (from the most recent refueling cycles) as well as the final reactor core at shutdown. Over the following six and one half years the assemblies are packaged into multipurpose canisters for transfer to the DOE or to the ISFSI for interim storage. It is assumed that this period provides the necessary cooling for the final core to meet the transport and/or storage requirements for decay heat.

An ISFSI, operated under a Part 50 General License (in accordance with 10 CFR 72, Subpart K[18]), is in the process of being constructed to support continued plant operations. The facility is assumed to be available to support future decommissioning operations. Once the wet storage pool is emptied, the auxiliary building can be prepared for long-term storage.

Progress Energy's position is that the DOE has a contractual obligation to accept Crystal River's fuel earlier than the projections set out above consistent with its contract commitments. No assumption made in this study should be interpreted to be inconsistent with this claim. However, at this time, including the cost of storing spent fuel in this study is the most reasonable approach because it insures the availability of

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Energy and Commerce U.S. House of Representatives, July 15, 2008.

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

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

sufficient decommissioning funds at the end of the station's life if, contrary to its contractual obligation, the DOE has not performed earlier.

Site Restoration

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

Decommissioning Trust Funds

As of September 30, 2011, the aggregate trust fund balance for Crystal River was approximately $578.0 million. The total includes Progress Energy Florida's share (91.8%), as well as that of the nine minority owners.[19]

Financial Assurance

Progress Energy intends to fund the expenditures for license termination (comprising approximately 70% of the total cost) from the decommissioning trust fund currently held by Progress Energy as well as the nine minority owners. The management of the spent fuel, until it can be transferred to the DOE, may be funded from excess trust fund earnings and from proceeds from spent fuel litigation against the Department of Energy (DOE). Expenditures from the trust fund for the management of the spent fuel will not reduce the value of the decommissioning trust fund to below the amount necessary to place and maintain the reactor in safe storage. The licensee would make the appropriate submittals for an exemption, in accordance with 10 CFR 50.12, from the requirements of 10 CFR 50.82(a)(8)(i)(A) in order to use the decommissioning trust funds for non-decommissioning related expenses, as defined by 10 CFR 50.2.

The total cost projected for license termination (in accordance with 10 CFR 50.75) for the deferred decommissioning alternative (SAFSTOR) is shown at the bottom of Table

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19 Total decommissioning funds available include Progress Energy Florida's share (91.8%) as well as that of the nine minority owners: City of Alachua, City of Bushnell, City of Gainesville, City of Kissimmee, City of Leesburg, City of Ocala, Orlando Utilities Commission, Seminole Electric Cooperative, and City of New Smyrna Beach

1 ($753.717million). The schedule of expenditures for license termination activities is provided in Table 2. Table 3 provides the details of the proposed funding plan for decommissioning Crystal River based on a 2% real rate of return on the decommissioning trust fund. As shown in Table 3, the current trust funds (as of September 30, 2011) are sufficient to accomplish the intended tasks and terminate the operating license for Crystal River. The analysis also shows a surplus in the fund at the completion of decommissioning. This surplus could be made available to fund other activities at the site (e.g., spent fuel management and/or restoration activities), recognizing that the licensee would need to make the appropriate submittals for an exemption in accordance with 10 CFR 50.12 from the requirements of 10 CFR 50.82(a)(8)(i)(A) in order to use the decommissioning trust funds for non-decommissioning related expenses, as defined by 10 CFR 50.2.

<u>Summary</u>

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

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

The decommissioning scenario 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. The major cost components are also identified in the cost summary provided at the end of this section.

The cost elements in the estimate are assigned to one of three subcategories: NRC License Termination, Spent Fuel Management, and Site Restoration. The subcategory "NRC License Termination" is used to accumulate costs that are consistent with "decommissioning" as defined by the NRC in its financial assurance regulations (i.e., 10 CFR Part 50.75). In situations where the long-term management of spent fuel is not an issue, the cost reported for this subcategory is generally sufficient to terminate the unit's operating license.

The "Spent Fuel Management" subcategory contains costs associated with the containerization and transfer of spent fuel to the ISFSI and the management of the

ISFSI until such time that the transfer of all fuel from this facility to an off-site location (e.g., geologic repository) is complete.

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

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

As noted within this document, the estimate is developed and costs are presented in 2011 dollars. As such, the estimate does not reflect the escalation of costs (due to inflationary and market forces) over the remaining operating life of the reactor or during the decommissioning period.

TABLE 1
DECOMMISSIONING COST ELEMENTS
(thousands of 2011 dollars)

Cost Element	Cost [1]
Decontamination	12,409
Removal	101,075
Packaging	22,681
Transportation	11,922
Waste Disposal	46,245
Off-site Waste Processing	23,246
Program Management [2]	306,020
Site Security	183,679
Spent Fuel Pool Isolation	11,822
Spent Fuel Management [3]	129,013
Insurance and Regulatory Fees	61,040
Energy	13,491
Characterization and Licensing Surveys	15,110
Property Taxes	87,216
Utility Site Indirect	19,326
Corporate Allocations	14,257
Miscellaneous Equipment	19,045
Total [4]	1,077,596

Cost Element	
License Termination	753,717
Spent Fuel Management	271,910
Site Restoration	51,969
Total [4]	1,077,596

[1] Total costs reported (i.e., there is no cost allocation by ownership share)
[2] Includes engineering and security costs
[3] Excludes program management costs (staffing) but includes costs for spent fuel loading/packaging/spent fuel pool O&M and EP fees
[4] Columns may not add due to rounding

TABLE 2
SCHEDULE OF LICENSE TERMINATION EXPENDITURES
(thousands, 2011 dollars)

Year	Labor	Equipment & Materials	Energy	LLRW Disposal	Other	Total
2016	3,035	103	94	3	823	4,058
2017	38,811	2,388	1,179	418	10,610	53,405
2018	19,075	3,990	568	1,335	18,447	43,415
2019	2,862	438	118	14	2,175	5,607
2020	2,870	439	118	14	2,181	5,622
2021	2,862	438	118	14	2,175	5,607
2022	2,862	438	118	14	2,175	5,607
2023	2,862	362	118	10	2,174	5,525
2024	2,869	307	118	7	2,179	5,479
2025	2,862	306	118	7	2,173	5,465
2026	2,862	306	118	7	2,173	5,465
2027	2,862	306	118	7	2,173	5,465
2028	2,869	307	118	7	2,179	5,479
2029	2,862	306	118	7	2,173	5,465
2030	2,862	306	118	7	2,173	5,465
2031	2,862	306	118	7	2,173	5,465
2032	2,869	307	118	7	2,179	5,479
2033	2,862	306	118	7	2,173	5,465
2034	2,862	306	118	7	2,173	5,465
2035	2,862	306	118	7	2,173	5,465
2036	2,869	307	118	7	2,179	5,479
2037	2,862	306	118	7	2,173	5,465
2038	2,862	306	118	7	2,173	5,465
2039	2,862	306	118	7	2,173	5,465
2040	2,869	307	118	7	2,179	5,479
2041	2,862	306	118	7	2,173	5,465
2042	2,862	306	118	7	2,173	5,465
2043	2,862	306	118	7	2,173	5,465
2044	2,869	307	118	7	2,179	5,479
2045	2,862	306	118	7	2,173	5,465
2046	2,862	306	118	7	2,173	5,465
2047	2,862	306	118	7	2,173	5,465
2048	2,869	307	118	7	2,179	5,479
2049	2,862	306	118	7	2,173	5,465
2050	2,862	306	118	7	2,173	5,465
2051	2,862	306	118	7	2,173	5,465

TABLE 2 (continued)
SCHEDULE OF LICENSE TERMINATION EXPENDITURES
(thousands, 2011 dollars)

Year	Labor	Equipment & Materials	Energy	LLRW Disposal	Other	Total
2052	2,869	307	118	7	2,179	5,479
2053	2,862	306	118	7	2,173	5,465
2054	2,862	306	118	7	2,173	5,465
2055	2,862	306	118	7	2,173	5,465
2056	2,869	307	118	7	2,179	5,479
2057	2,862	306	118	7	2,173	5,464
2058	2,862	298	118	6	2,150	5,434
2059	2,862	298	118	6	2,150	5,434
2060	2,869	299	118	6	2,156	5,448
2061	2,862	298	118	6	2,150	5,434
2062	2,862	298	118	6	2,150	5,434
2063	2,862	298	118	6	2,150	5,434
2064	2,869	299	118	6	2,156	5,448
2065	2,862	298	118	6	2,150	5,434
2066	2,862	298	118	6	2,150	5,434
2067	2,862	298	118	6	2,150	5,434
2068	2,869	299	118	6	2,156	5,448
2069	2,862	298	118	6	2,150	5,434
2070	2,862	298	118	6	2,150	5,434
2071	4,621	472	176	8	2,276	7,553
2072	35,366	3,622	1,182	32	4,470	44,672
2073	43,439	21,970	1,146	18,390	13,820	98,766
2074	44,947	23,086	1,014	24,109	14,794	107,949
2075	43,442	8,421	884	12,763	6,699	72,209
2076	28,520	2,641	327	2,189	3,239	36,916
2077	121	0	0	0	0	121
2078	74	0	0	0	0	74
Total	410,355	83,088	12,703	59,624	187,946	753,717

Note: Total costs reported (i.e., there is no cost allocation by ownership share)

TABLE 3
FUNDING REQUIREMENTS FOR LICENSE TERMINATION
2016 SHUTDOWN

Basis Year		2011	
Fund Balance (9/30/2011)		$578.026	(millions)
Annual Escalation		0.00%	
Annual Earnings		2.00%	
	A	B	C
Year	License Termination Cost (millions)	Escalated License Termination Cost Escalated at 0% (millions)	Decommissioning Trust Fund Escalated at 2% (minus expenses) (millions)
2011	-	-	$ 578.026
2012	-	-	$ 589.586
2013	-	-	$ 601.378
2014	-	-	$ 613.406
2015	-	-	$ 625.674
2016	4.058	4.058	$ 634.129
2017	53.405	53.405	$ 593.407
2018	43.415	43.415	$ 561.859
2019	5.607	5.607	$ 567.490
2020	5.622	5.622	$ 573.217
2021	5.607	5.607	$ 579.074
2022	5.607	5.607	$ 585.049
2023	5.525	5.525	$ 591.225
2024	5.479	5.479	$ 597.570
2025	5.465	5.465	$ 604.057
2026	5.465	5.465	$ 610.674
2027	5.465	5.465	$ 617.423
2028	5.479	5.479	$ 624.292
2029	5.465	5.465	$ 631.313
2030	5.465	5.465	$ 638.475
2031	5.465	5.465	$ 645.780
2032	5.479	5.479	$ 653.216
2033	5.465	5.465	$ 660.816
2034	5.465	5.465	$ 668.567
2035	5.465	5.465	$ 676.474
2036	5.479	5.479	$ 684.524

TABLE 3 (continued)
FUNDING REQUIREMENTS FOR LICENSE TERMINATION
2016 SHUTDOWN

Basis Year		2011	
Fund Balance (9/30/2011)		$578.026	(millions)
Annual Escalation		0.00%	
Annual Earnings		2.00%	
	A	B	C
Year	License Termination Cost (millions)	Escalated License Termination Cost Escalated at 0% (millions)	Decommissioning Trust Fund Escalated at 2% (minus expenses) (millions)
2037	5.465	5.465	$ 692.750
2038	5.465	5.465	$ 701.141
2039	5.465	5.465	$ 709.699
2040	5.479	5.479	$ 718.413
2041	5.465	5.465	$ 727.317
2042	5.465	5.465	$ 736.399
2043	5.465	5.465	$ 745.662
2044	5.479	5.479	$ 755.096
2045	5.465	5.465	$ 764.734
2046	5.465	5.465	$ 774.564
2047	5.465	5.465	$ 784.591
2048	5.479	5.479	$ 794.803
2049	5.465	5.465	$ 805.234
2050	5.465	5.465	$ 815.875
2051	5.465	5.465	$ 826.728
2052	5.479	5.479	$ 837.783
2053	5.465	5.465	$ 849.074
2054	5.465	5.465	$ 860.591
2055	5.465	5.465	$ 872.338
2056	5.479	5.479	$ 884.305
2057	5.464	5.464	$ 896.527
2058	5.434	5.434	$ 909.024
2059	5.434	5.434	$ 921.771
2060	5.448	5.448	$ 934.758
2061	5.434	5.434	$ 948.019
2062	5.434	5.434	$ 961.546

TABLE 3 (continued)
FUNDING REQUIREMENTS FOR LICENSE TERMINATION
2016 SHUTDOWN

Basis Year		2011	
Fund Balance (9/30/2011)		$578.026	(millions)
Annual Escalation		0.00%	
Annual Earnings		2.00%	
	A	B	C
Year	License Termination Cost (millions)	Escalated License Termination Cost Escalated at 0% (millions)	Decommissioning Trust Fund Escalated at 2% (minus expenses) (millions)
2063	5.434	5.434	$ 975.344
2064	5.448	5.448	$ 989.402
2065	5.434	5.434	$ 1,003.757
2066	5.434	5.434	$ 1,018.398
2067	5.434	5.434	$ 1,033.333
2068	5.448	5.448	$ 1,048.551
2069	5.434	5.434	$ 1,064.088
2070	5.434	5.434	$ 1,079.936
2071	7.553	7.553	$ 1,093.982
2072	44.672	44.672	$ 1,071.190
2073	98.766	98.766	$ 993.848
2074	107.949	107.949	$ 905.775
2075	72.209	72.209	$ 851.682
2076	36.916	36.916	$ 831.799
2077	0.121	0.121	$ 848.313
2078	0.074	0.074	$ 865.206
Total	753.717	753.717	

Note: Total costs reported (i.e., there is no cost allocation by ownership share)
September 30, 2011 balance also used as year-end 2011 balance

Calculations:

Column B = (A)*(1+.00)^(current year – 2011) or for 0%, B = A

Column C = (Previous year's fund balance) * (1 + .02) – B (current year's decommissioning expenditures)

1. INTRODUCTION

This report presents an estimate of the cost to decommission the Crystal River Unit 3 Nuclear Generating Plant, (Crystal River) following a scheduled cessation of plant operations. The analysis relies upon site-specific, technical information from an earlier evaluation prepared in 2008,[1]* updated to reflect current assumptions pertaining to the disposition of the nuclear unit and relevant industry experience in undertaking such projects.

Pursuant to 10 CFR 50.75(f)(3),[2] each power reactor licensee shall at or about 5 years prior to the projected end of operations submit a preliminary decommissioning cost estimate which includes an up-to-date assessment of the major factors that could affect the cost to decommission. Progress Energy Florida, Inc. (Progress Energy) is submitting this estimate to comply with the requirements of 10 CFR 50.75(f)(3).

Progress Energy has not determined or committed to a specific decommissioning approach for Crystal River at this time. However, it is Progress Energy's current plan for purposes of demonstrating the adequacy of funding to meet regulatory requirements to use the SAFSTOR decommissioning option based on the current license expiration date. License renewal is likely to require a need to revise this preliminary plan.

The current estimate is designed to provide Progress Energy, the plant's majority owner, with sufficient information to assess its financial obligations, as they pertain to the eventual decommissioning of the nuclear station. It is not a detailed engineering document, but a financial analysis prepared in advance of the detailed engineering that will be required to carry out the decommissioning.

1.1 OBJECTIVES OF STUDY

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

The plant was issued its operating license in December 1976. The license currently expires in 2016. An application for the renewal of Facility Operating License No. DPR-72, for an additional 20-year period, was submitted to the Nuclear Regulatory Commission (NRC) on December 16, 2008. The application is currently under review. So, for the purposes of this study, the final

* References provided in Section 7 of the document

shutdown date (license expiration) is assumed to on December 3, 2016 or 40 years from the original license issue.

1.2 SITE DESCRIPTION

The Crystal River site is located in Citrus County, Florida, approximately 70 miles north of Tampa on the shore of the Gulf of Mexico. The generating site is comprised of four fossil-fired units and one nuclear unit. The Gulf of Mexico provides the heat sink for both Units 1 and 2 fossil-fired units, and the nuclear unit (natural draft towers provide the cooling for Units 4 and 5).

The nuclear steam supply system (NSSS) consists of a pressurized water reactor and a two-loop reactor coolant system, designed by Babcock & Wilcox. The generating unit has a reference core design of 2609 MWt (thermal), with a corresponding net dependable capability electrical rating of 860 megawatts (electric) with the reactor at rated power.

The reactor coolant system is comprised of the reactor vessel and two heat transfer loops, each loop containing a vertical once-through type steam generator, and two single speed centrifugal reactor coolant pumps. In addition, the system includes an electrically heated pressurizer, a reactor coolant drain tank and interconnected piping. The system is housed within the reactor containment building or reactor building, a seismic Category I reinforced concrete structure. The reactor building is a reinforced concrete structure composed of a vertical cylinder with a shallow dome and flat circular foundation slab. The cylinder wall is prestressed with a post-tensioning system in the vertical and horizontal directions. The dome roof is prestressed utilizing a three-way post-tensioning system. The foundation slab is reinforced with conventional mild steel. The inside surface of the reactor building is lined with a carbon steel liner to ensure a high degree of leak tightness during operating and accident conditions.

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 unit's turbine generator consists of high-pressure and low-pressure turbine sections driving a direct-coupled generator at 1800 rpm. The turbines are operated in a closed feedwater cycle, which 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 condenser circulating water is taken from and returned to the Gulf of Mexico through the intake and discharge canals, respectively.

1.3 REGULATORY GUIDANCE

The NRC provided initial decommissioning requirements in its rule "General Requirements for Decommissioning Nuclear Facilities," issued in June 1988.[3] This rule set forth financial criteria for decommissioning licensed nuclear power facilities. The regulation addressed decommissioning planning needs, timing, funding methods, and environmental review requirements. The intent of the rule was to ensure that decommissioning would be accomplished in a safe and timely manner and that adequate funds would be available for this purpose. Subsequent to the rule, the NRC issued Regulatory Guide 1.159, "Assuring the Availability of Funds for Decommissioning Nuclear Reactors,"[4] which provided additional guidance to the licensees of nuclear facilities on the financial methods acceptable to the NRC staff for complying with the requirements of the rule. The regulatory guide addressed the funding requirements and provided guidance on the content and form of the financial assurance mechanisms indicated in the rule.

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

The ENTOMB alternative has not been viewed as a viable option for power reactors due to the significant time required to isolate the long-lived radionuclides for decay to permissible levels. With rulemaking permitting the controlled release of a site,[5] the NRC has re-evaluated this alternative. The resulting feasibility study, based upon an assessment by Pacific Northwest National Laboratory, concluded that the method did have conditional merit for some, if not most reactors. The staff also found that additional rulemaking would be needed before this option could be treated as a generic alternative. The NRC had considered rulemaking to alter the 60-year time for completing decommissioning and to clarify the use of engineered barriers for reactor entombments.[6] However, the NRC's staff has recommended that rulemaking be deferred, based upon several factors, e.g., no licensee has committed to pursuing the entombment option, the unresolved issues associated with the disposition of greater-than-Class C material (GTCC), and the NRC's current priorities, at least until after the additional research studies are complete. The Commission concurred with the staff's recommendation.

In 1996, the NRC published revisions to the general requirements for decommissioning nuclear power plants.[7] When the decommissioning regulations were adopted in 1988, it was assumed that the majority of licensees would decommission at the end of the facility's operating licensed life. Since that time, several licensees permanently and prematurely ceased operations. Exemptions from certain operating requirements were required once the reactor was defueled to facilitate the decommissioning. Each case was handled individually, without clearly defined generic requirements. The NRC amended the decommissioning regulations in 1996 to clarify ambiguities and codify procedures and terminology as a means of enhancing efficiency and uniformity in the decommissioning process. The amendments allow for greater public participation and better define the transition process from operations to decommissioning.

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

1.3.1 Nuclear Waste Policy Act

Congress passed the "Nuclear Waste Policy Act"[8] (NWPA) in 1982, assigning the federal government's long-standing responsibility for disposal of the spent nuclear fuel created by the commercial nuclear generating plants to the DOE. The NWPA provided that DOE would enter into contracts with utilities in which DOE would promise to take the utilities' spent fuel and high-level radioactive waste and utilities would pay the cost of the disposition services for that material. NWPA, along with the individual contracts with the utilities, specified that the DOE was to begin accepting spent fuel by January 31, 1998.

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

Completion of the decommissioning process is dependent upon the DOE's ability to remove spent fuel from the site in a timely manner. DOE's repository program assumes that spent fuel allocations will be accepted for disposal from the nation's commercial nuclear plants, with limited exceptions, in the order (the "queue") in which it was discharged from the reactor. Progress Energy's current spent fuel management plan for the Crystal River spent fuel is based in general upon: 1) a 2020 start date for DOE initiating transfer of commercial spent fuel to a federal facility and 2) expectations for spent fuel receipt by the DOE for the Crystal River fuel. Fuel could be completely removed from the site as early as 2057, based on an oldest fuel first priority, and the DOE achieving an annual rate of transfer (3,000 metric tons of uranium year) as reflected in DOE's latest Acceptance Priority Ranking and Annual Capacity Report dated June 2004 (DOE/RW-0567).

The assumed 2020 DOE start date is nominally based on the last position stated by the DOE. On July 15, 2008, the then-Director of the DOE's Office of Civilian Radioactive Waste Management testified before Congress that DOE "could be ready to begin accepting spent nuclear fuel by 2020," but his statement was based on continued program funding.[9] The current administration has cut the budget for the geological repository program, but the administration has also appointed a Blue Ribbon Commission on America's Nuclear Future to make recommendations for a new plan for nuclear waste disposal. That Commission's charter includes a requirement that the Commission consider "options for safe storage of used nuclear fuel while final disposition pathways are selected and deployed." Progress Energy believes that one or more monitored retrievable storage facilities could be put into place following a Blue Ribbon Commission recommendation for the same, within a relatively short time frame, at least by 2020. For example, a facility such as that licensed by the NRC to Private Fuel Storage could be used by the DOE to store fuel until a final disposition is determined.

It is generally necessary that spent fuel be cooled and stored for a minimum period at the generating site prior to transfer. As such, the NRC requires that licensees establish a program to manage and provide funding for the management of all irradiated fuel at the reactor site until title of the fuel is transferred to the Secretary of Energy, pursuant to 10 CFR Part 50.54(bb).[10] This requirement is prepared for through inclusion of certain cost elements in the decommissioning estimate, for example, associated with the isolation and continued operation of the spent fuel pool and the ISFSI.

The spent fuel pool is expected to contain freshly discharged assemblies (from the most recent refueling cycles) as well as the final reactor core at shutdown. Over the following six and one half years the assemblies are packaged into multipurpose canisters for transfer to the DOE or to the ISFSI for interim storage. It is assumed that this period provides the necessary cooling for the final core to meet the transport and/or storage requirements for decay heat.

An ISFSI, operated under a Part 50 General License (in accordance with 10 CFR 72, Subpart K [11]), is in the process of being constructed to support continued plant operations. The facility is assumed to be available to support future decommissioning operations. Once the wet storage pool is emptied, the auxiliary building can be prepared for long-term storage.

Progress Energy's position is that the DOE has a contractual obligation to accept Crystal River's fuel earlier than the projections set out above consistent with its contract commitments. No assumption made in this study should be interpreted to be inconsistent with this claim. However, at this time, including the cost of storing spent fuel in this study is the most reasonable approach because it insures the availability of sufficient decommissioning funds at the end of the station's life if, contrary to its contractual obligation, the DOE has not performed earlier.

1.3.2 Low-Level Radioactive Waste Acts

The contaminated and activated material generated in the decontamination and dismantling of a commercial nuclear reactor is classified as low-level (radioactive) waste, although not all of the material is suitable for "shallow-land" disposal. With the passage of the "Low-Level Radioactive Waste Policy Act" in 1980,[12] and its Amendments of 1985,[13] the states became ultimately responsible for the disposition of low-level radioactive waste generated within their own borders.

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

For the purpose of this analysis, Progress Energy's "Life of Plant Agreement" with Energy*Solutions* is used as the basis for estimating the disposal cost for the majority of the radioactive waste (Class A [14]). Energy*Solutions* does not have a license to dispose of the more highly radioactive waste (Classes B and C), for example, generated in the dismantling of the reactor vessel.

The Texas Commission on Environmental Quality (TCEQ), the environmental agency for the state, is responsible for the licensing of a low-level radioactive waste disposal facility for the Texas Compact. The agency granted Waste Control Specialists (WCS) a disposal license in 2009 and approval to commence construction in early 2011. Construction of the disposal facility is now essentially complete and the facility was declared operational in November 2011. However, to date, the TCEQ has only published interim disposal rates for the facility, in advance of the formal disposal rate-setting process, and only for Compact generators. As a proxy, disposition of the Class B and C waste is based upon the last published rate schedule for non-compact waste for the Barnwell facility.

The dismantling of the components residing closest to the reactor core generates radioactive waste that may be considered unsuitable for shallow-land disposal (i.e., low-level radioactive waste with concentrations of radionuclides that exceed the limits established by the NRC for Class C radioactive waste (Greater-than-Class C or GTCC)). The Low-Level Radioactive Waste Policy Amendments Act of 1985 assigned the federal government the responsibility for the disposal of this material. The Act also stated that the beneficiaries of the activities resulting in the generation of such radioactive waste bear all reasonable costs of disposing of such waste. However, to date, the federal government has not identified a cost for disposing of GTCC or a schedule for acceptance.

For purposes of this study, GTCC is packaged in the same canisters used for spent fuel. The GTCC material is shipped directly to a DOE facility as it is generated.

A significant portion of the waste material generated during decommissioning may only be potentially contaminated by radioactive materials. This waste can be analyzed on site or shipped off site to licensed facilities for further analysis, for processing and/or for conditioning/recovery. Reduction in the volume of low-level radioactive waste requiring disposal in a licensed low-level radioactive waste disposal facility can be accomplished through a variety of methods, including analyses and surveys or decontamination to eliminate the portion of waste that does not require disposal as radioactive waste, compaction, incineration or metal melt. The estimate for Crystal River reflects the savings from waste recovery/volume reduction.

1.3.3 Radiological Criteria for License Termination

In 1997, the NRC published Subpart E, "Radiological Criteria for License Termination,"[15] amending 10 CFR Part 20. This subpart provides radiological criteria for releasing a facility for unrestricted use. The regulation states that the site can be released for unrestricted use if radioactivity levels are such that the average member of a critical group would not receive a Total Effective Dose Equivalent (TEDE) in excess of 25 millirem per year, and provided that residual radioactivity has been reduced to levels that are As Low As Reasonably Achievable (ALARA).

The decommissioning estimate assumes that the Crystal River site will be remediated to the levels specified in 10 CFR 20.1402, "Radiological criteria for unrestricted use," although the remediation measures included in this estimate are believed to be sufficient to result in substantially lower levels than required by the foregoing regulation.

It should be noted that the NRC and the Environmental Protection Agency (EPA) differ on the amount of residual radioactivity considered acceptable in site remediation. The EPA has two limits that apply to radioactive materials. An EPA limit of 15 millirem per year is derived from criteria established by the Comprehensive Environmental

Response, Compensation, and Liability Act (CERCLA or Superfund).[16] An additional and separate limit of 4 millirem per year, as defined in 40 CFR §141.16, is applied to drinking water.[17]

On October 9, 2002, the NRC signed an agreement with the EPA on the radiological decommissioning and decontamination of NRC-licensed sites. The Memorandum of Understanding (MOU)[18] provides that EPA will defer exercise of authority under CERCLA for the majority of facilities decommissioned under NRC authority. The MOU also includes provisions for NRC and EPA consultation for certain sites when, at the time of license termination, (1) groundwater contamination exceeds EPA-permitted levels; (2) NRC contemplates restricted release of the site; and/or (3) residual radioactive soil concentrations exceed levels defined in the MOU.

The MOU does not impose any new requirements on NRC licensees and should reduce the involvement of the EPA with NRC licensees who are decommissioning. Most sites are expected to meet the NRC criteria for unrestricted use, and the NRC believes that only a few sites will have groundwater or soil contamination in excess of the levels specified in the MOU that trigger consultation with the EPA. However, if there are other hazardous materials on the site, the EPA may be involved in the cleanup. As such, the possibility of dual regulation remains for certain licensees. The present study does not include any costs for this occurrence.

2. SAFSTOR DECOMMISSIONING ALTERNATIVE

A detailed cost estimate was developed to decommission the Crystal River nuclear unit for the SAFSTOR decommissioning alternative. The following narrative describes the basic activities associated with the alternative. Although detailed procedures for each activity identified are not provided, and the actual sequence of work may vary, the activity descriptions provide a basis not only for estimating but also for the expected scope of work, i.e., engineering and planning at the time of decommissioning.

The conceptual approach that the NRC has described in its regulations divides decommissioning into three phases. The initial phase commences with the effective date of permanent cessation of operations and involves the transition of both plant and licensee from reactor operations (i.e., power production) to facility de-activation and closure. During the first phase, notification is to be provided to the NRC certifying the permanent cessation of operations and the removal of fuel from the reactor vessel. The licensee is then prohibited from reactor operation.

The second phase encompasses activities during the storage period or during major decommissioning activities, or a combination of the two. The third phase pertains to the activities involved in license termination. The decommissioning estimate developed for Crystal River is also divided into phases or periods; however, demarcation of the phases is based upon major milestones within the project or significant changes in the projected expenditures.

2.1 PERIOD 1 - PREPARATIONS

The NRC defines SAFSTOR as "the alternative in which the nuclear facility is placed and maintained in a condition that allows the nuclear facility to be safely stored and subsequently decontaminated (deferred decontamination) to levels that permit release for unrestricted use." The facility is left intact (during the dormancy period), with structures maintained in a sound condition. Systems that are not required to support the spent fuel pool or site surveillance and security are drained, de-energized, and secured. Minimal cleaning/removal of loose contamination and/or fixation and sealing of remaining contamination is performed. Access to contaminated areas is secured to provide controlled access for inspection and maintenance.

Preparations for long-term storage include the planning for permanent defueling of the reactor, revision of technical specifications appropriate to the operating conditions and requirements, a characterization of the facility and major components, and the development of the PSDAR.

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

- Defueling of the reactor vessel.
- Isolation of the spent fuel pool and fuel handling systems so that safe-storage operations may commence on the balance of the plant. The pool will remain operational for approximately six and one-half years following the cessation of operations before the inventory resident at shutdown can be completely transferred to the ISFSI. This activity may be carried out by plant personnel in accordance with existing operating technical specifications. Activities are scheduled around the fuel handling systems to the greatest extent possible.
- Draining and de-energizing of the non-contaminated systems not required to support continued site operations or maintenance.
- Disposing of contaminated filter elements and resin beds not required for processing wastes from layup activities or for future dormancy operations.
- Draining of the reactor vessel, with the internals left in place and the vessel head secured.
- Draining and de-energizing non-essential, contaminated systems with decontamination as required for future maintenance and inspection.
- Preparing lighting and alarm systems whose continued use is required; de-energizing portions of fire protection, electric power, and HVAC systems whose continued use is not required.
- Cleaning of the loose surface contamination from building access pathways.
- Performing an interim radiation survey of plant, posting warning signs where appropriate.
- Erecting physical barriers and/or securing all access to radioactive or contaminated areas, except as required for inspection and maintenance.
- Installing security and surveillance monitoring equipment and relocating security fence around secured structures, as required.

2.2 PERIOD 2 - DORMANCY

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

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

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

The spent fuel storage pool is emptied within six and one-half years of the cessation of operations. The transfer of the spent fuel from the ISFSI to a DOE facility begins in 2024 and continues throughout the dormancy period until completed in 2057. Once emptied, the ISFSI is secured for storage and decommissioned along with the power block structures in Period 4.

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

2.3 PERIOD 3 - PREPARATIONS FOR DECOMMISSIONING

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

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

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

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

2.4 PERIOD 4 - DEFERRED DECOMMISSIONING

This period includes the physical decommissioning activities associated with the removal and disposal of contaminated and activated components and structures, including the successful termination of the 10 CFR §50 operating license. Although the initial radiation levels due to ^{60}Co will decrease during the dormancy period, the internal components of the reactor vessel will still exhibit sufficiently high radiation dose rates to require remote sectioning under water due to the presence of long-lived radionuclides such as ^{94}Nb, ^{59}Ni, and ^{63}Ni. Therefore, the remote dismantling procedures would still be employed during this scenario. Portions of the biological shield will still be radioactive due to the presence of activated trace elements with long half-lives (^{152}Eu and ^{154}Eu). Decontamination will require controlled removal and disposal. It is assumed that radioactive corrosion products on inner surfaces of piping and components will not have decayed to levels that will permit unrestricted use or allow conventional removal. These systems and components will be surveyed as they are removed and disposed of in accordance with the existing radioactive release criteria.

Significant decommissioning activities in this phase include:

- Construction of temporary facilities and/or modification of existing facilities to support dismantling activities. This may include a centralized processing area to facilitate equipment removal and component preparations for off-site disposal.
- Reconfiguration and modification of site structures and facilities as needed to support decommissioning operations. This may include the upgrading of roads (on- and off-site) to facilitate hauling and transport. Modifications may be required to the 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 for the disposition of low-level radioactive waste.
- Decontamination of components and piping systems as required to control (minimize) worker exposure.
- Removal of piping and components no longer essential to support decommissioning operations.
- Removal of control rod drive housings and the head service structure from the reactor vessel head. Segmentation of the vessel closure head.
- Removal and segmentation of the upper internals assemblies. Segmentation will maximize the loading of the shielded transport casks, i.e., by weight and activity. The operations are conducted under water using remotely operated tooling and contamination controls.
- Disassembly and segmentation of the remaining reactor internals, including the core shroud and lower core support assembly. Some material is expected to exceed Class C disposal requirements. As such, the segments will be packaged in modified fuel storage canisters for geologic disposal.
- Segmentation of the reactor vessel. A shielded platform is installed for segmentation as cutting operations are performed in-air using remotely operated equipment within a contamination control envelope. The water level is maintained just below the cut to minimize the working area dose rates. Segments are transferred in-air to containers that are stored under water, for example, in an isolated area of the refueling canal.
- Removal of the activated portions of the concrete biological shield and accessible contaminated concrete surfaces. If dictated by the steam generator and pressurizer removal scenarios, those portions of the

associated cubicles necessary for access and component extraction are removed.

- Removal of the steam generators and pressurizer for material recovery and controlled disposal. The generators will be moved to an on-site processing center and prepared for transport to the disposal site. To facilitate transport, the generators are cut in half, across the tube bundle. The exposed ends are capped and sealed. The segments can serve as their own burial containers provided that all penetrations are properly sealed and the internal contaminants are stabilized. A similar process will be used to prepare the retired units for disposal. The pressurizer is disposed of intact.
- 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 reactor building.
- Remediation and removal of the contaminated equipment and material from the auxiliary building and any other contaminated facility. Radiation and contamination controls will be utilized until residual levels indicate that the structures and equipment can be released for unrestricted access and conventional demolition. This activity may necessitate the dismantling and disposition of most of the systems and components (both clean and contaminated) located within these buildings. This activity facilitates surface decontamination and subsequent verification surveys required prior to obtaining release for demolition.
- Routing of material removed in the decontamination and dismantling to a central processing area. Material certified to be free of contamination is released for unrestricted disposition, e.g., as scrap, recycle, or general disposal. Contaminated material is characterized and segregated for additional off-site processing (disassembly, chemical cleaning, volume reduction, and waste treatment), and/or packaged for controlled disposal at a low-level radioactive waste disposal facility.

Incorporated into the LTP is the Final Survey Plan. This plan identifies the radiological surveys to be performed once the decontamination activities are completed and is developed using the guidance provided in the "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)."[19] This document incorporates the statistical approaches to survey design and data interpretation used by the EPA. It also identifies state-of-the-art, commercially available instrumentation and procedures for conducting radiological surveys. Use of this guidance ensures that the surveys are conducted in a manner that provides a high degree of confidence that applicable NRC criteria are satisfied. Once the survey is complete, the results are provided to the NRC in a format that can be verified. The NRC then reviews and evaluates the information, performs an independent confirmation of radiological site conditions, and makes a determination on the requested change to the operating license (that would release the property, exclusive of the ISFSI, for unrestricted use).

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

2.5 PERIOD 5 - SITE RESTORATION

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

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

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

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

3. COST ESTIMATE

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

3.1 BASIS OF ESTIMATE

The estimate was developed using the site-specific, technical information from the 2008 analysis. This information was reviewed for the current analysis and updated as deemed appropriate. The site-specific considerations and assumptions used in the previous evaluation were also revisited. Modifications were incorporated where new information was available or experience from ongoing decommissioning programs provided viable alternatives or improved processes.

3.2 METHODOLOGY

The methodology used to develop the estimate follows the basic approach originally presented in the AIF/NESP-036 study report, "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates,"[20] and the DOE "Decommissioning Handbook."[21] These documents present a unit factor method for estimating decommissioning activity costs, which simplifies the estimating calculations. Unit factors for concrete removal ($/cubic yard), steel removal ($/ton), and cutting costs ($/inch) are developed using local labor rates. The activity-dependent costs are estimated with the item quantities (cubic yards and tons), developed from plant drawings and inventory documents. Removal rates and material costs for the conventional disposition of components and structures rely upon information available in the industry publication, "Building Construction Cost Data," published by R.S. Means.[22]

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

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

Work Difficulty Factors

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

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

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

Scheduling Program Durations

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

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

3.3 FINANCIAL COMPONENTS OF THE COST MODEL

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

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

3.3.1 Contingency

The activity- and period-dependent costs are combined to develop the total decommissioning cost. A contingency is then applied on a line-item basis, using one or more of the contingency types listed in the AIF/NESP-036 study. "Contingencies" are defined in the American Association of Cost Engineers "Project and Cost Engineers' Handbook"[23] as "specific provision for unforeseeable elements of cost within the defined project scope; particularly important where previous experience relating estimates and actual costs has shown that unforeseeable events which will increase costs are likely to occur." The cost elements in this analysis are based upon ideal conditions and maximum efficiency; therefore, consistent with industry practice, contingency is included. In the AIF/NESP-036 study, the types of unforeseeable events that are likely to occur in decommissioning are discussed and guidelines are provided for percentage contingency in each category. It should be noted that contingency, as used in this analysis, does not account for price escalation and inflation in the cost of decommissioning over the remaining operating life of the station.

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

• Decontamination	50%
• Contaminated Component Removal	25%
• Contaminated Component Packaging	10%
• Contaminated Component Transport	15%
• Low-Level Radioactive Waste Disposal	25%
• Reactor Segmentation	75%
• NSSS Component Removal	25%
• Reactor Waste Packaging	25%
• Reactor Waste Transport	25%
• Reactor Vessel Component Disposal	50%
• GTCC Disposal	15%
• Non-Radioactive Component Removal	15%
• Heavy Equipment and Tooling	15%
• Supplies	25%
• Engineering	15%
• Energy	15%
• Characterization and Termination Surveys	30%
• Construction	15%
• Taxes and Fees	10%
• Insurance	10%
• Staffing	15%

The contingency values are applied to the appropriate components of the estimate on a line item basis. A composite value is then reported at the end of the detailed estimate (Appendix C). For example, the composite contingency value reported in Appendix C is approximately 16.1%.

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:

- Transition activities and costs: ancillary expenses associated with eliminating 50% to 80% of the site labor force shortly after the cessation of plant operations, added cost for worker separation packages throughout the decommissioning program, national or company-mandated retraining, and retention incentives for key personnel.
- Delays in approval of the decommissioning plan due to intervention, public participation in local community meetings, legal challenges, and national and local hearings.
- Changes in the project work scope from the baseline estimate, involving the discovery of unexpected levels of contaminants, contamination in places not previously expected, contaminated soil previously undiscovered (either radioactive or hazardous material contamination), variations in plant inventory or configuration not indicated by the as-built drawings.
- Regulatory changes, for example, affecting worker health and safety, site release criteria, waste transportation, and disposal.
- Policy decisions altering national commitments (e.g., in the ability to accommodate certain waste forms for disposition), or in the timetable for such, for example, the start and rate of acceptance of spent fuel by the DOE.
- Pricing changes for basic inputs such as labor, energy, materials, and disposal. Items subject to widespread price competition (such as materials) may not show significant variation; however, others such as waste disposal could exhibit large pricing uncertainties, particularly in markets where limited access to services is available.

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

3.4 SITE-SPECIFIC CONSIDERATIONS

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

3.4.1 Spent Fuel Management

The cost to dispose the spent fuel generated from plant operations is not reflected within the estimate to decommission Crystal River. 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 below.

Completion of the decommissioning process is highly dependent upon the DOE's ability to remove spent fuel from the site. The timing for removal of spent fuel from the site is based upon the DOE's most recently published annual acceptance rates of 400 MTU/year for year 1, 3,800 MTU total for years 2 through 4 and 3,000 MTU/year for year 5 and beyond.[24] The DOE contracts provide mechanisms for altering the oldest fuel first allocation scheme, including emergency deliveries, exchanges of allocations amongst utilities and the option of providing priority acceptance from permanently shutdown nuclear reactors. Because it is unclear how these mechanisms may operate once DOE begins accepting spent fuel from commercial reactors, this study assumes that DOE will accept spent fuel in an oldest fuel first order.

<u>ISFSI</u>

The ISFSI, constructed to support plant operations, will continue to operate until such time that the transfer of spent fuel to the DOE can be completed. Assuming that DOE commences repository operation in

2020, Crystal River fuel is projected to be first removed from the site beginning in 2024. The process is expected to be completed by the year 2057, based upon the current shutdown date. Based upon the expected completion date for fuel transfer, the ISFSI will be emptied prior to the commencement of decommissioning operations.

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

Storage Canister Design

DOE has not identified any cask systems it may use. As such, for the purpose of this analysis, the design and capacity of the ISFSI is based upon the NUHOMS system, with a 32 fuel assembly capacity. A unit cost of approximately $1.46 million is used for pricing the internal multi-purpose canister (MPC) and the horizontal concrete storage module.

Canister Loading and Transfer

An average cost of $700,000 is used for the labor and equipment to seal each spent fuel canister once it is loaded and to load/transport the spent fuel from the pool to the ISFSI pad. For estimating purposes, $100,000 is used to estimate the unit cost to transfer the fuel from the ISFSI into a DOE transport cask.

Operations and Maintenance

An annual cost (excluding labor) of approximately $764,000 and $89,000 are used for operation and maintenance of the spent fuel pool and the ISFSI, respectively. Pool operations are expected to continue approximately six and one-half years after the cessation of operations. ISFSI operating costs are based upon a 41 year period of operations following plant shutdown.

ISFSI Design Considerations

A multi-purpose (storage and transport) dry shielded storage canister with a horizontal, reinforced concrete storage module is used as a basis for the cost analysis. The final core off load, equivalent to 6 modules, 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). The steel support structure is assumed to be removed from these modules 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.

GTCC

The dismantling of the reactor internals generates radioactive waste considered unsuitable for shallow land disposal (i.e., low-level radioactive waste with concentrations of radionuclides that exceed the limits established by the NRC for Class C radioactive waste (GTCC)). The Low-Level Radioactive Waste Policy Amendments Act of 1985 assigned the Federal Government the responsibility for the disposal of this material. The Act also stated that the beneficiaries of the activities resulting in the generation of such radioactive waste bear all reasonable costs of disposing of such waste. Although there are strong arguments that GTCC waste is covered by the spent fuel contract with DOE and the fees being paid pursuant to that contract, DOE has taken the position that GTCC waste is not covered by that contract or its fees and that utilities, including Progress Energy, will have to pay an additional fee for the disposal of their GTCC waste. However, to date, the Federal Government has not identified a cost for disposing of GTCC or a schedule for acceptance. For purposes of this estimate, the GTCC radioactive waste has been assumed to be packaged in the same canisters used to store spent fuel and disposed of as high-level waste, at a cost equivalent to that envisioned for the spent fuel.

The GTCC material is assumed to be shipped directly to a DOE facility as it is generated from the segmentation of the reactor vessel internals.

3.4.2 Reactor Vessel and Internal Components

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

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

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

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

It is not known whether this option will be available when the Crystal River unit ceases operation. Future viability of this option will depend upon the ultimate location of the disposal site, as well as the disposal site licensee's ability to accept highly radioactive packages and effectively isolate them from the environment. Consequently, the study assumes the reactor vessel will require segmentation, as a bounding condition. With lower levels of activation, the vessel shell can be packaged more efficiently than the curie-limited internal components. This will allow the use of more conventional waste packages rather than shielded casks for transport.

3.4.3 Primary System Components

Due to the natural decay of radionuclides over the dormancy period, a chemical decontamination is not included.

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

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

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

The generators are segmented on-site to facilitate transportation. Each unit is cut in half, across the tube bundle. The exposed ends are capped and sealed. The interior volume is filled with low-density cellular concrete for stabilization of the internal contamination. Each component is then loaded onto a rail car for transport to the disposal facility.

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

3.4.4 Retired Components

The estimate includes the cost to dispose of the retired reactor closure head expected to be in storage at the site upon the cessation of plant operations. The component is segmented, with the segments placed in sea-land containers or custom containers for disposal. The retired steam generators, currently in storage at the site, will be segmented to facilitate transportation.

3.4.5 Main Turbine and Condenser

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

3.4.6 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.[25] The contaminated material will be packaged in Industrial Packages (IP-1, IP-2, or IP-3, as defined in subpart 173.411) for transport unless demonstrated to qualify as their own shipping containers. The reactor vessel and internal components are expected to be transported in accordance with Part 71, as Type B. It is conceivable that the reactor, due to its limited specific activity, could qualify as LSA II or III. However, the high radiation levels on the outer surface would require that additional shielding be incorporated within the packaging so as to attenuate the dose to levels acceptable for transport.

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

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

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

Transportation costs for material requiring controlled disposal are based upon the mileage to the Energy*Solutions* facility in Clive, Utah and the Waste Control Specialist facility in Andrews County, Texas. Transportation costs for off-site waste processing are based upon the mileage to Memphis, Tennessee. Truck transport costs are estimated using published tariffs from Tri-State Motor Transit.[26]

3.4.7 Low-Level Radioactive Waste Disposal

To the greatest extent practical, metallic material generated in the decontamination and dismantling processes is processed to reduce the total cost of controlled disposal. Material meeting the regulatory and/or site release criterion, is released as scrap, requiring no further cost consideration. Conditioning (preparing the material to meet the waste acceptance criteria of the disposal site) and recovery of the waste stream is performed off site at a licensed processing center. Any material leaving the site is subject to a survey and release charge, at a minimum.

The mass of radioactive waste generated during the various decommissioning activities at the site is shown on a line-item basis in Appendix C, and summarized in Section 5. The quantified waste summaries shown in these tables are consistent with 10 CFR Part 61 classifications. Commercially available steel containers are presumed to be used for the disposal of piping, small components, and concrete. Larger components can serve as their own containers, with proper closure of all openings, access ways, and penetrations. The volumes are calculated based on the exterior package dimensions for containerized material or a specific calculation for components serving as their own waste containers.

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

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

3.4.8 Site Conditions Following Decommissioning

The NRC will terminate the site license if it determines that site remediation has been performed in accordance with the license termination plan, and that the terminal radiation survey and associated documentation demonstrate that the facility is suitable for release. The NRC's involvement in the decommissioning process will end at this point. Local building codes and state environmental regulations will dictate the next step in the decommissioning process, as well as the owner's own future plans for the site.

Non-essential structures or buildings severely damaged in decontamination process are removed to a nominal depth of three feet below grade. Concrete rubble generated from demolition activities is processed and made available as clean fill for the power block foundations. Excess construction debris is trucked off site as an alternative to onsite disposal. The excavations will be regraded such that the power block area will have a final contour consistent with adjacent surroundings. Certain facilities, which have continued use or value (e.g., the switchyard) are left intact.

The estimate includes the remediation of the west settling pond (approximately (500 cubic yards). This assumption may be affected by continued plant operations and/or future regulatory actions, such as the development of site-specific release criteria. Costs are also included for the remediation of the firing range (i.e., removal of soil containing lead residue).

3.5 ASSUMPTIONS

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

3.5.1 Estimating Basis

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

3.5.2 Labor Costs

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

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

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

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

3.5.3 Design Conditions

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

The curie contents of the vessel and internals at final shutdown are derived from those listed in NUREG/CR-3474.[27] Actual estimates are derived from the curie/gram values contained therein and adjusted for the different mass of the Crystal River components, projected operating life, and period of decay. Additional short-lived isotopes were derived from NUREG/CR-0130[28] and NUREG/CR-0672,[29] and benchmarked to the long-lived values from NUREG/CR-3474.

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

Activation of the reactor building is confined to the biological shield. More extensive activation (at very low levels) of the interior structures within reactor buildings 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, as well as the designated end use for the site.

3.5.4 General

Transition Activities

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

- Drain and collect fuel oils, lubricating oils, and transformer oils for recycle and/or sale.
- Drain and collect acids, caustics, and other chemical stores for recycle and/or sale.
- Process operating waste inventories, i.e., the estimate does not address the disposition of any legacy wastes; the disposal of operating wastes during this initial period is not considered a decommissioning expense.

Scrap and Salvage

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

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

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

Energy

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

Insurance

Costs for continuing coverage (nuclear liability and property insurance) following cessation of plant operations and during decommissioning are included and based upon current operating premiums. Reductions in premiums, throughout the decommissioning process, are based upon the guidance and the limits for coverage defined in the NRC's proposed rulemaking "Financial Protection Requirements for Permanently Shutdown Nuclear Power Reactors."[30] The NRC's financial protection requirements are based on various reactor (and spent fuel) configurations.

Taxes

The tax model is based upon the current tax obligation by the owers. Taxes on plant systems and structures are included (at a reduced level) and further reduced as dismantling operations proceed. Taxes are included on the land and the ISFSI (during its operation), throughout the decommissioning timeframe.

Site Modifications

The perimeter fence and in-plant security barriers will be moved, as appropriate, to conform to the Site Security Plan in force during the various stages of the project.

3.6 COST ESTIMATE SUMMARY

Schedules of expenditures are provided in Tables 3.1 through 3.4. The tables delineate the cost contributors by year of expenditures as well as cost contributor (e.g., labor, materials, and waste disposal).

The cost elements are also assigned to one of three subcategories: "License Termination," "Spent Fuel Management," and "Site Restoration." The subcategory "License Termination" is used to accumulate costs that are consistent with "decommissioning" as defined by the NRC in its financial assurance regulations (i.e., 10 CFR §50.75). In situations where the long-term management of spent fuel is not an issue, the cost reported for this subcategory is generally sufficient to terminate the unit's operating license.

The "Spent Fuel Management" subcategory contains costs associated with the construction of an ISFSI, the containerization and transfer of spent fuel to the ISFSI over the six and one-half years of post-shutdown pool operations, and the management of the ISFSI until such time that the transfer of all fuel from this facility to an off-site location (e.g., geologic repository) is complete.

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

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

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

Year	Labor	Equipment & Materials	Energy	LLRW Disposal	Other	Total
2016	3,035	103	94	3	969	4,204
2017	38,811	2,388	1,179	418	12,447	55,243
2018	24,371	6,630	636	1,335	28,746	61,718
2019	12,067	5,027	236	14	18,718	36,062
2020	12,100	5,040	236	14	18,769	36,160
2021	12,067	5,027	236	14	18,718	36,062
2022	12,067	5,027	236	14	18,718	36,062
2023	8,019	2,367	168	10	9,719	20,281
2024	5,078	426	118	7	3,159	8,788
2025	5,064	425	118	7	3,150	8,764
2026	5,064	425	118	7	3,150	8,764
2027	5,064	425	118	7	3,150	8,764
2028	5,078	426	118	7	3,159	8,788
2029	5,064	425	118	7	3,150	8,764
2030	5,064	425	118	7	3,150	8,764
2031	5,064	425	118	7	3,150	8,764
2032	5,078	426	118	7	3,159	8,788
2033	5,064	425	118	7	3,150	8,764
2034	5,064	425	118	7	3,150	8,764
2035	5,064	425	118	7	3,150	8,764
2036	5,078	426	118	7	3,159	8,788
2037	5,064	425	118	7	3,150	8,764
2038	5,064	425	118	7	3,150	8,764
2039	5,064	425	118	7	3,150	8,764
2040	5,078	426	118	7	3,159	8,788
2041	5,064	425	118	7	3,150	8,764
2042	5,064	425	118	7	3,150	8,764
2043	5,064	425	118	7	3,150	8,764
2044	5,078	426	118	7	3,159	8,788
2045	5,064	425	118	7	3,150	8,764
2046	5,064	425	118	7	3,150	8,764
2047	5,064	425	118	7	3,150	8,764
2048	5,078	426	118	7	3,159	8,788
2049	5,064	425	118	7	3,150	8,764
2050	5,064	425	118	7	3,150	8,764
2051	5,064	425	118	7	3,150	8,764

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

Year	Labor	Equipment & Materials	Energy	LLRW Disposal	Other	Total
2052	5,078	426	118	7	3,159	8,788
2053	5,064	425	118	7	3,150	8,764
2054	5,064	425	118	7	3,150	8,764
2055	5,064	425	118	7	3,150	8,764
2056	5,078	426	118	7	3,159	8,788
2057	5,058	425	118	7	3,148	8,755
2058	2,862	298	118	6	2,150	5,434
2059	2,862	298	118	6	2,150	5,434
2060	2,869	299	118	6	2,156	5,448
2061	2,862	298	118	6	2,150	5,434
2062	2,862	298	118	6	2,150	5,434
2063	2,862	298	118	6	2,150	5,434
2064	2,869	299	118	6	2,156	5,448
2065	2,862	298	118	6	2,150	5,434
2066	2,862	298	118	6	2,150	5,434
2067	2,862	298	118	6	2,150	5,434
2068	2,869	299	118	6	2,156	5,448
2069	2,862	298	118	6	2,150	5,434
2070	2,862	298	118	6	2,150	5,434
2071	4,656	472	176	8	2,276	7,587
2072	36,052	3,622	1,182	32	4,470	45,358
2073	45,234	22,009	1,146	18,390	13,878	100,657
2074	46,421	23,157	1,014	24,118	15,270	109,980
2075	44,354	8,495	884	12,783	7,629	74,145
2076	30,089	3,499	337	2,193	3,450	39,568
2077	17,331	10,279	118	0	655	28,382
2078	10,541	6,252	72	0	398	17,263
Total	566,727	127,742	13,491	59,657	309,979	1,077,596

Note: Columns may not add due to rounding

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

Year	Labor	Equipment & Materials	Energy	LLRW Disposal	Other	Total
2016	3,035	103	94	3	823	4,058
2017	38,811	2,388	1,179	418	10,610	53,405
2018	19,075	3,990	568	1,335	18,447	43,415
2019	2,862	438	118	14	2,175	5,607
2020	2,870	439	118	14	2,181	5,622
2021	2,862	438	118	14	2,175	5,607
2022	2,862	438	118	14	2,175	5,607
2023	2,862	362	118	10	2,174	5,525
2024	2,869	307	118	7	2,179	5,479
2025	2,862	306	118	7	2,173	5,465
2026	2,862	306	118	7	2,173	5,465
2027	2,862	306	118	7	2,173	5,465
2028	2,869	307	118	7	2,179	5,479
2029	2,862	306	118	7	2,173	5,465
2030	2,862	306	118	7	2,173	5,465
2031	2,862	306	118	7	2,173	5,465
2032	2,869	307	118	7	2,179	5,479
2033	2,862	306	118	7	2,173	5,465
2034	2,862	306	118	7	2,173	5,465
2035	2,862	306	118	7	2,173	5,465
2036	2,869	307	118	7	2,179	5,479
2037	2,862	306	118	7	2,173	5,465
2038	2,862	306	118	7	2,173	5,465
2039	2,862	306	118	7	2,173	5,465
2040	2,869	307	118	7	2,179	5,479
2041	2,862	306	118	7	2,173	5,465
2042	2,862	306	118	7	2,173	5,465
2043	2,862	306	118	7	2,173	5,465
2044	2,869	307	118	7	2,179	5,479
2045	2,862	306	118	7	2,173	5,465
2046	2,862	306	118	7	2,173	5,465
2047	2,862	306	118	7	2,173	5,465
2048	2,869	307	118	7	2,179	5,479
2049	2,862	306	118	7	2,173	5,465
2050	2,862	306	118	7	2,173	5,465
2051	2,862	306	118	7	2,173	5,465

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

Year	Labor	Equipment & Materials	Energy	LLRW Disposal	Other	Total
2052	2,869	307	118	7	2,179	5,479
2053	2,862	306	118	7	2,173	5,465
2054	2,862	306	118	7	2,173	5,465
2055	2,862	306	118	7	2,173	5,465
2056	2,869	307	118	7	2,179	5,479
2057	2,862	306	118	7	2,173	5,464
2058	2,862	298	118	6	2,150	5,434
2059	2,862	298	118	6	2,150	5,434
2060	2,869	299	118	6	2,156	5,448
2061	2,862	298	118	6	2,150	5,434
2062	2,862	298	118	6	2,150	5,434
2063	2,862	298	118	6	2,150	5,434
2064	2,869	299	118	6	2,156	5,448
2065	2,862	298	118	6	2,150	5,434
2066	2,862	298	118	6	2,150	5,434
2067	2,862	298	118	6	2,150	5,434
2068	2,869	299	118	6	2,156	5,448
2069	2,862	298	118	6	2,150	5,434
2070	2,862	298	118	6	2,150	5,434
2071	4,621	472	176	8	2,276	7,553
2072	35,366	3,622	1,182	32	4,470	44,672
2073	43,439	21,970	1,146	18,390	13,820	98,766
2074	44,947	23,086	1,014	24,109	14,794	107,949
2075	43,442	8,421	884	12,763	6,699	72,209
2076	28,520	2,641	327	2,189	3,239	36,916
2077	121	0	0	0	0	121
2078	74	0	0	0	0	74
Total	410,355	83,088	12,703	59,624	187,946	753,717

Note: Columns may not add due to rounding

TABLE 3.3
SCHEDULE OF SPENT FUEL MANAGEMENT EXPENDITURES
(thousands, 2011 dollars)

Year	Labor	Equipment & Materials	Energy	LLRW Disposal	Other	Total
2016	0	0	0	0	146	146
2017	0	0	0	0	1,838	1,838
2018	5,296	2,640	68	0	10,298	18,302
2019	9,205	4,589	118	0	16,543	30,455
2020	9,231	4,601	118	0	16,588	30,538
2021	9,205	4,589	118	0	16,543	30,455
2022	9,205	4,589	118	0	16,543	30,455
2023	5,157	2,005	50	0	7,545	14,757
2024	2,208	120	0	0	980	3,309
2025	2,202	120	0	0	978	3,300
2026	2,202	120	0	0	978	3,300
2027	2,202	120	0	0	978	3,300
2028	2,208	120	0	0	980	3,309
2029	2,202	120	0	0	978	3,300
2030	2,202	120	0	0	978	3,300
2031	2,202	120	0	0	978	3,300
2032	2,208	120	0	0	980	3,309
2033	2,202	120	0	0	978	3,300
2034	2,202	120	0	0	978	3,300
2035	2,202	120	0	0	978	3,300
2036	2,208	120	0	0	980	3,309
2037	2,202	120	0	0	978	3,300
2038	2,202	120	0	0	978	3,300
2039	2,202	120	0	0	978	3,300
2040	2,208	120	0	0	980	3,309
2041	2,202	120	0	0	978	3,300
2042	2,202	120	0	0	978	3,300
2043	2,202	120	0	0	978	3,300
2044	2,208	120	0	0	980	3,309
2045	2,202	120	0	0	978	3,300
2046	2,202	120	0	0	978	3,300
2047	2,202	120	0	0	978	3,300
2048	2,208	120	0	0	980	3,309
2049	2,202	120	0	0	978	3,300
2050	2,202	120	0	0	978	3,300
2051	2,202	120	0	0	978	3,300

TABLE 3.3 (continued)
SCHEDULE OF SPENT FUEL MANAGEMENT EXPENDITURES
(thousands, 2011 dollars)

Year	Labor	Equipment & Materials	Energy	LLRW Disposal	Other	Total
2052	2,208	120	0	0	980	3,309
2053	2,202	120	0	0	978	3,300
2054	2,202	120	0	0	978	3,300
2055	2,202	120	0	0	978	3,300
2056	2,208	120	0	0	980	3,309
2057	2,196	119	0	0	975	3,290
2058	0	0	0	0	0	0
2059	0	0	0	0	0	0
2060	0	0	0	0	0	0
2061	0	0	0	0	0	0
2062	0	0	0	0	0	0
2063	0	0	0	0	0	0
2064	0	0	0	0	0	0
2065	0	0	0	0	0	0
2066	0	0	0	0	0	0
2067	0	0	0	0	0	0
2068	0	0	0	0	0	0
2069	0	0	0	0	0	0
2070	0	0	0	0	0	0
2071	0	0	0	0	0	0
2072	124	82	0	29	1,347	1,583
2073	0	0	0	0	0	0
2074	0	0	0	0	0	0
2075	0	0	0	0	0	0
2076	156	435	0	3	193	788
2077	0	0	0	0	0	0
2078	79	239	0	0	20	338
Total	122,583	27,839	589	32	120,866	271,910

Note: Columns may not add due to rounding

TABLE 3.4
SCHEDULE OF SITE RESTORATION EXPENDITURES
(thousands, 2011 dollars)

Year	Labor	Equipment & Materials	Energy	LLRW Disposal	Other	Total
2016	0	0	0	0	0	0
2017	0	0	0	0	0	0
2018	0	0	0	0	0	0
2019	0	0	0	0	0	0
2020	0	0	0	0	0	0
2021	0	0	0	0	0	0
2022	0	0	0	0	0	0
2023	0	0	0	0	0	0
2024	0	0	0	0	0	0
2025	0	0	0	0	0	0
2026	0	0	0	0	0	0
2027	0	0	0	0	0	0
2028	0	0	0	0	0	0
2029	0	0	0	0	0	0
2030	0	0	0	0	0	0
2031	0	0	0	0	0	0
2032	0	0	0	0	0	0
2033	0	0	0	0	0	0
2034	0	0	0	0	0	0
2035	0	0	0	0	0	0
2036	0	0	0	0	0	0
2037	0	0	0	0	0	0
2038	0	0	0	0	0	0
2039	0	0	0	0	0	0
2040	0	0	0	0	0	0
2041	0	0	0	0	0	0
2042	0	0	0	0	0	0
2043	0	0	0	0	0	0
2044	0	0	0	0	0	0
2045	0	0	0	0	0	0
2046	0	0	0	0	0	0
2047	0	0	0	0	0	0
2048	0	0	0	0	0	0
2049	0	0	0	0	0	0
2050	0	0	0	0	0	0
2051	0	0	0	0	0	0

TABLE 3.4 (continued)
SCHEDULE OF SITE RESTORATION EXPENDITURES
(thousands, 2011 dollars)

Year	Labor	Equipment & Materials	Energy	LLRW Disposal	Other	Total
2052	0	0	0	0	0	0
2053	0	0	0	0	0	0
2054	0	0	0	0	0	0
2055	0	0	0	0	0	0
2056	0	0	0	0	0	0
2057	0	0	0	0	0	0
2058	0	0	0	0	0	0
2059	0	0	0	0	0	0
2060	0	0	0	0	0	0
2061	0	0	0	0	0	0
2062	0	0	0	0	0	0
2063	0	0	0	0	0	0
2064	0	0	0	0	0	0
2065	0	0	0	0	0	0
2066	0	0	0	0	0	0
2067	0	0	0	0	0	0
2068	0	0	0	0	0	0
2069	0	0	0	0	0	0
2070	0	0	0	0	0	0
2071	34	0	0	0	0	34
2072	686	0	0	0	0	686
2073	1,794	38	0	0	58	1,890
2074	1,436	46	0	0	58	1,540
2075	827	17	0	0	0	844
2076	1,544	815	10	0	51	2,420
2077	17,079	9,886	118	0	622	27,705
2078	10,388	6,013	72	0	378	16,850
Total	33,789	16,814	199	0	1,167	51,969

Note: Columns may not add due to rounding

4. SCHEDULE ESTIMATE

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

A schedule or sequence of activities for the deferred decommissioning portion of the SAFSTOR alternative is presented in Figure 4.1. The scheduling sequence assumes that fuel has been removed from the site prior to the start of decontamination and dismantling activities. The key activities listed in the schedule do not reflect a one-to-one correspondence with those activities in the cost tables, but reflect dividing some activities for clarity and combining others for convenience. The schedule was prepared using the "Microsoft Project Professional 2010" computer software.[31]

4.1 SCHEDULE ESTIMATE ASSUMPTIONS

The schedule reflects the results of a precedence network developed for the site decommissioning activities, i.e., a PERT (Program Evaluation and Review Technique) Software Package. The work activity durations used in the precedence network reflect the actual person-hour estimates from the cost table, adjusted by stretching certain activities over their slack range and shifting the start and end dates of others. The following assumptions were made in the development of the decommissioning schedule:

- The spent fuel handling area in the auxiliary building is isolated until such time that all spent fuel has been discharged from the spent fuel pool to the ISFSI.
- All work (except vessel and internals removal) is performed during an 8-hour workday, 5 days per week, with no overtime. There are eleven paid holidays per year.
- Reactor and internals removal activities are performed by using separate crews for different activities working on different shifts, with a corresponding backshift charge for the second shift.
- Multiple crews work parallel activities to the maximum extent possible, consistent with optimum efficiency, adequate access for cutting, removal and laydown space, and with the stringent safety measures necessary during demolition of heavy components and structures.

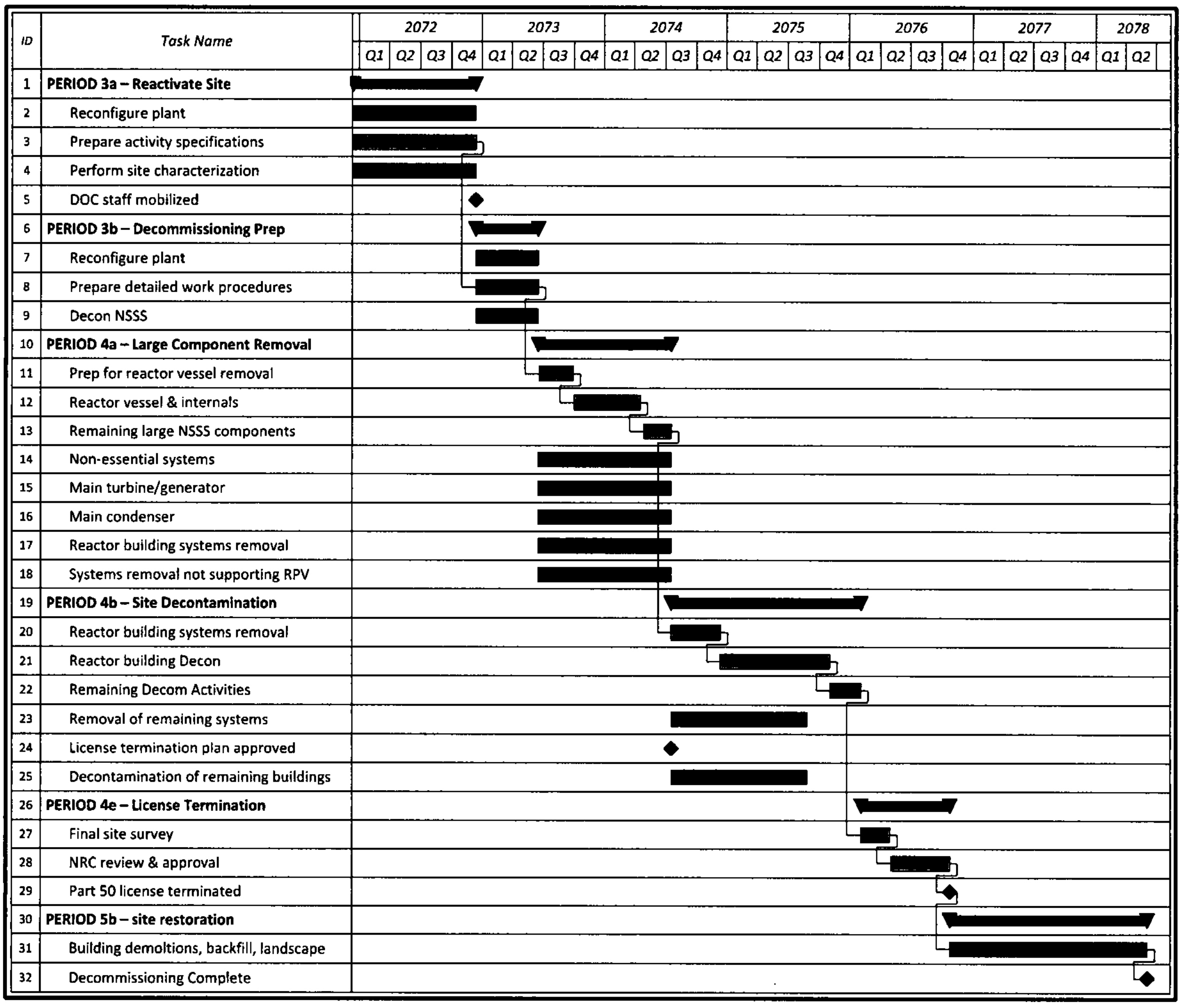
- For plant systems removal, the systems with the longest removal durations in areas on the critical path are considered to determine the duration of the activity.

4.2 PROJECT SCHEDULE

The period-dependent costs presented in the detailed cost tables are based upon the durations developed in the schedules for decommissioning. Durations are established between several milestones in each project period; these durations are used to establish a critical path for the entire project. In turn, the critical path duration for each period is used as the basis for determining the period-dependent costs.

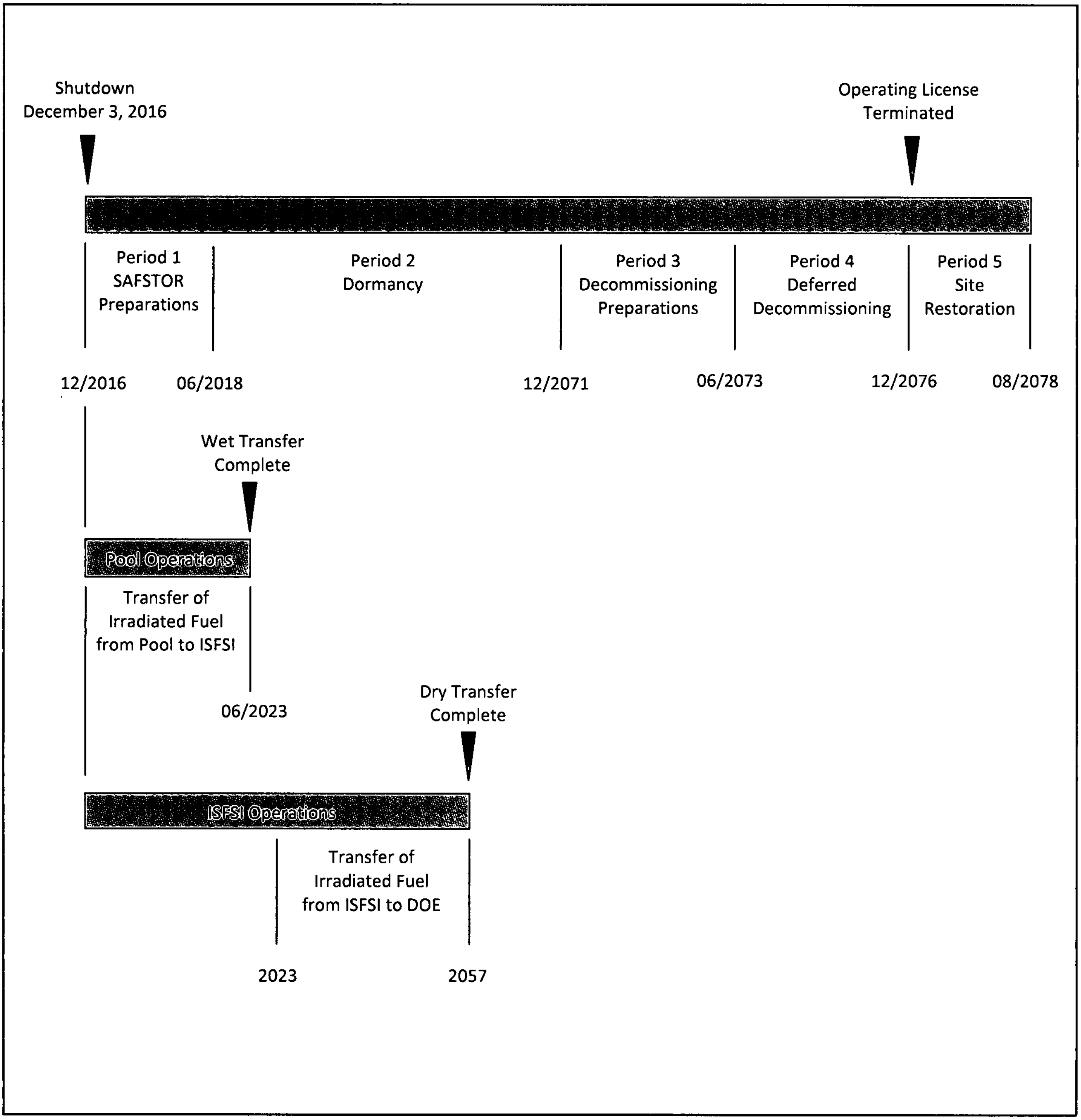
The project timeline is provided in Figure 4.2 with milestone dates based on a 2016 shutdown date. The fuel pool is emptied approximately six and one-half years after shutdown, while ISFSI operations continue until the DOE can complete the transfer of assemblies to its geologic repository. Deferred decommissioning is assumed to commence so that the operating license is terminated within a 60-year period from the cessation of plant operations.

FIGURE 4.1
ACTIVITY SCHEDULE



Legend:
1. Blue bars indicate overall duration of activity
2. Red bars indicate critical path activities
3. Diamond symbols indicate major milestones

FIGURE 4.2
DECOMMISSIONING TIMELINE
(not to scale)



5. RADIOACTIVE WASTES

The objectives of the decommissioning process are the removal of all radioactive material from the site that would restrict its future use and the termination of the NRC license. This currently requires the remediation of all radioactive material at the site in excess of applicable legal limits. Under the Atomic Energy Act,[32] the NRC is responsible for protecting the public from sources of ionizing radiation. Title 10 of the Code of Federal Regulations delineates the production, utilization, and disposal of radioactive materials and processes. In particular, Part 71 defines radioactive material as it pertains to transportation and Part 61 specifies its disposition.

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

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

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

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

The waste material produced in the decontamination and dismantling of the nuclear unit is primarily generated during Period 4. The assumed disposition of waste material is shown in Figure 5.1. Material that is considered potentially contaminated when removed from the radiological controlled area is sent to processing facilities in Tennessee for conditioning and disposal. Heavily contaminated components and activated materials are routed for controlled disposal. The disposal volumes reported in the tables reflect the savings resulting from reprocessing and recycling.

Disposal fees are based upon estimated charges, with surcharges added for the highly activated components, for example, generated in the segmentation of the reactor vessel. The cost to dispose of the majority of the material generated from the decontamination and dismantling activities is based upon the current cost for disposal at Energy*Solutions* facility in Clive, Utah. Separate rates were used for containerized waste and large components, including the steam generators and reactor coolant pump motors. Demolition debris including miscellaneous steel, scaffolding, and concrete was disposed of at a bulk rate. The decommissioning waste stream also included resins and dry active waste. As a proxy, disposition of the Class B and C waste is based upon the last published rate schedule for non-compact waste for the Barnwell facility.

FIGURE 5.1
DECOMMISSIONING WASTE DISPOSITION

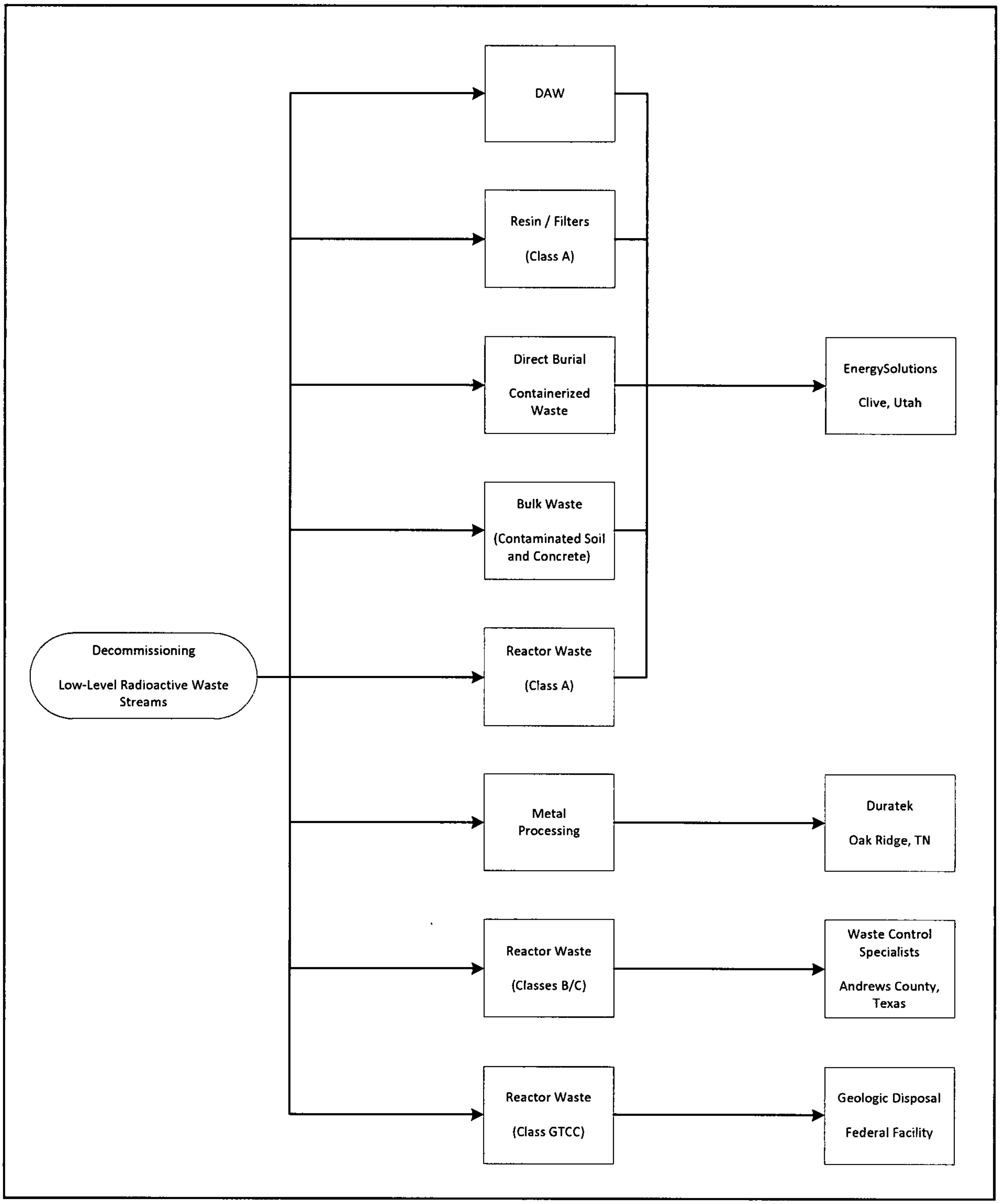


TABLE 5.1
DECOMMISSIONING WASTE SUMMARY

Waste	Cost Basis	Class [1]	Waste Volume (cubic feet)	Mass (pounds)
Low-Level Radioactive Waste (near-surface disposal)	Energy*Solutions*	A	133,758	9,951,211
	Barnwell	B	250	27,400
	Barnwell	C	501	57,900
Greater than Class C (geologic repository)	Spent Fuel Equivalent	GTCC	2,142	423,646
Processed/Conditioned (off-site recycling center)	Recycling Vendors	A	234,503	11,217,670
Total [2]			371,154	21,677,830

[1] Waste is classified according to the requirements as delineated in Title 10 CFR, Part 61.55

[2] Columns may not add due to rounding.

6. RESULTS

The analysis to estimate the cost to decommission Crystal River relied upon the site-specific, technical information developed for a previous analysis prepared in 2008. While not an engineering study, the estimate provides Progress Energy with sufficient information to assess their 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 scenarios assume continued operation of the station's spent fuel pool for a minimum of six and one half 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 cost projected for deferred decommissioning (SAFSTOR) is estimated to be $1,077.6 million. The majority of this cost (approximately 70.0%) is associated with placing the unit in storage, ongoing caretaking of the unit during dormancy, and the eventual physical decontamination and dismantling of the nuclear unit so that the operating license can be terminated. Another 25.2% is associated with the management, interim storage, and eventual transfer of the spent fuel. The remaining 4.8% is for the demolition of the designated structures and limited restoration of the site.

The primary cost contributors, identified in Table 6.1, are either labor-related or associated with the management and disposition of the radioactive waste. Program management is the largest single contributor to the overall cost. The magnitude of the expense is a function of both the size of the organization required to manage the decommissioning, as well as the duration of the program. It is assumed, for purposes of this analysis, that Progress Energy will oversee the decommissioning program, using a DOC to manage the decommissioning labor force and the associated subcontractors. The size and composition of the management organization varies with the decommissioning phase and associated site activities. However, once the operating license is terminated, the staff is substantially reduced for the conventional demolition and restoration of the site.

As described in this report, the spent fuel pool will remain operational for a minimum of six and one half years following the cessation of operations. The pool will be isolated and an independent spent fuel island created. Over the six and one-half-year period, the spent fuel will be packaged into transportable steel canisters for interim storage at the ISFSI. Dry storage of the fuel provides additional flexibility in the event the DOE is not able to meet the current timetable for completing the transfer of assemblies to an off-site facility and minimizes the associated caretaking expenses.

The cost for waste disposal includes only those costs associated with the controlled disposition of the low-level radioactive waste generated from decontamination and dismantling activities, including plant equipment and components, structural material, filters, resins and dry-active waste. As described in Section 5, the Energy*Solutions* facility in Utah is the assumed destination for the majority of the low-level radioactive material required controlled disposal, with the remaining, high-activity waste destined for the newly opened Waste Control Specialists facility in Texas. Components, requiring additional isolation from the environment (i.e., GTCC), are packaged for geologic disposal. The cost of geologic disposal is based upon a cost equivalent for spent fuel.

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

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

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

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

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

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

TABLE 6.1
DECOMMISSIONING COST ELEMENT CONTRIBUTION
(thousands of 2011 dollars)

Cost Element	Total	Percentage
Decontamination	12,409	1.2
Removal	101,075	9.4
Packaging	22,681	2.1
Transportation	11,922	1.1
Waste Disposal	46,245	4.3
Off-site Waste Processing	23,246	2.2
Program Management [1]	306,020	28.4
Site Security	183,679	17.0
Spent Fuel Pool Isolation	11,822	1.1
Spent Fuel Management [2]	129,013	12.0
Insurance and Regulatory Fees	61,040	5.7
Energy	13,491	1.3
Characterization and Licensing Surveys	15,110	1.4
Property Taxes	87,216	8.1
Utility Site Indirect	19,326	1.8
Corporate Allocations	14,257	1.3
Miscellaneous Equipment	19,045	1.8
Total [3]	1,077,596	100

Cost Element	Total	Percentage
License Termination	753,717	70.0
Spent Fuel Management	271,910	25.2
Site Restoration	51,969	4.8
Total [3]	1,077,596	100

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

7. REFERENCES

1. "Decommissioning Cost Analysis for the Crystal River Plant, Unit 3," Document No. P23-1597-002, Rev. 0, TLG Services, Inc., October 2008

2. U.S. Code of Federal Regulations, Title 10, Part 50.75, "Reporting and recordkeeping for decommissioning planning," Subpart (f)(3)

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

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

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

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

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

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

9. Testimony of Edward Sproat, Director, Office of Civilian Radioactive Waste Management, before a U.S. House of Representatives subcommittee on the status of Yucca Mountain, July 15, 2008

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

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

7. REFERENCES
(continued)

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

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

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

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

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

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

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

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

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

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

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

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

7. REFERENCES
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24. Civilian Radioactive Waste Management System Waste Acceptance System Requirements Document, Revision 5" (DOE/RW-0351) issued May 31, 2007

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

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

27. 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

28. 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

29. 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

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

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

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

APPENDIX A

UNIT COST FACTOR DEVELOPMENT

APPENDIX A
UNIT COST FACTOR DEVELOPMENT

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

1. SCOPE

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

2. CALCULATIONS

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

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

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

* alpha designators indicate activities that can be performed in parallel

APPENDIX A
(continued)

3. LABOR REQUIRED

Crew	Number	Duration (hours)	Rate ($/hr)	Cost
Laborers	3.00	11.217	$28.05	$943.91
Craftsmen	2.00	11.217	$51.72	$1,160.92
Foreman	1.00	11.217	$60.83	$682.33
General Foreman	0.25	11.217	$63.09	$176.92
Fire Watch	0.05	11.217	$28.05	$15.73
Health Physics Technician	1.00	11.217	$44.00	$493.55
Total Labor Cost				$3,472.73

4. EQUIPMENT & CONSUMABLES COSTS

Equipment Costs	none
Consumables/Materials Costs	
-Universal Sorbent 50 @ $0.62 sq ft [1]	$31.00
-Tarpaulins (oil resistant/fire retardant) 50 @ $0.46/sq ft [2]	$23.00
-Gas torch consumables 1 @ $11.84/hr x 1 hr [3]	$11.84
Subtotal cost of equipment and materials	$65.84
Overhead & profit on equipment and materials @ 16.00 %	$10.53
Total costs, equipment & material	$76.37

TOTAL COST:

Removal of contaminated **heat exchanger <3000 pounds:**	**$3,549.10**
Total labor cost:	$3,472.73
Total equipment/material costs:	$76.37
Total craft labor man-hours required per unit:	81.88

5. NOTES AND REFERENCES

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

- References for equipment & consumables costs:

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

- Material and consumable costs were adjusted using the regional indices for Tampa, Florida.

APPENDIX B

UNIT COST FACTOR LISTING
(SAFSTOR: Power Block Structures Only)

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Removal of clean instrument and sampling tubing, $/linear foot	0.36
Removal of clean pipe 0.25 to 2 inches diameter, $/linear foot	3.62
Removal of clean pipe >2 to 4 inches diameter, $/linear foot	5.50
Removal of clean pipe >4 to 8 inches diameter, $/linear foot	11.41
Removal of clean pipe >8 to 14 inches diameter, $/linear foot	21.18
Removal of clean pipe >14 to 20 inches diameter, $/linear foot	27.56
Removal of clean pipe >20 to 36 inches diameter, $/linear foot	40.54
Removal of clean pipe >36 inches diameter, $/linear foot	48.16
Removal of clean valve >2 to 4 inches	76.72
Removal of clean valve >4 to 8 inches	114.08
Removal of clean valve >8 to 14 inches	211.82
Removal of clean valve >14 to 20 inches	275.56
Removal of clean valve >20 to 36 inches	405.40
Removal of clean valve >36 inches	481.61
Removal of clean pipe hanger for small bore piping	24.48
Removal of clean pipe hanger for large bore piping	82.23
Removal of clean pump, <300 pound	192.65
Removal of clean pump, 300-1000 pound	550.51
Removal of clean pump, 1000-10,000 pound	2,149.11
Removal of clean pump, >10,000 pound	4,156.91
Removal of clean pump motor, 300-1000 pound	230.87
Removal of clean pump motor, 1000-10,000 pound	894.31
Removal of clean pump motor, >10,000 pound	2,012.19
Removal of clean heat exchanger <3000 pound	1,164.56
Removal of clean heat exchanger >3000 pound	2,932.13
Removal of clean feedwater heater/deaerator	8,191.42
Removal of clean moisture separator/reheater	16,745.08
Removal of clean tank, <300 gallons	247.78
Removal of clean tank, 300-3000 gallon	780.85
Removal of clean tank, >3000 gallons, $/square foot surface area	6.76

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Removal of clean electrical equipment, <300 pound	104.76
Removal of clean electrical equipment, 300-1000 pound	375.90
Removal of clean electrical equipment, 1000-10,000 pound	751.80
Removal of clean electrical equipment, >10,000 pound	1,841.91
Removal of clean electrical transformer < 30 tons	1,279.18
Removal of clean electrical transformer > 30 tons	3,683.82
Removal of clean standby diesel generator, <100 kW	1,306.57
Removal of clean standby diesel generator, 100 kW to 1 MW	2,916.36
Removal of clean standby diesel generator, >1 MW	6,037.46
Removal of clean electrical cable tray, $/linear foot	9.82
Removal of clean electrical conduit, $/linear foot	4.29
Removal of clean mechanical equipment, <300 pound	104.76
Removal of clean mechanical equipment, 300-1000 pound	375.90
Removal of clean mechanical equipment, 1000-10,000 pound	751.80
Removal of clean mechanical equipment, >10,000 pound	1,841.91
Removal of clean HVAC equipment, <300 pound	126.69
Removal of clean HVAC equipment, 300-1000 pound	451.67
Removal of clean HVAC equipment, 1000-10,000 pound	900.18
Removal of clean HVAC equipment, >10,000 pound	1,841.91
Removal of clean HVAC ductwork, $/pound	0.38
Removal of contaminated instrument and sampling tubing, $/linear foot	1.19
Removal of contaminated pipe 0.25 to 2 inches diameter, $/linear foot	18.15
Removal of contaminated pipe >2 to 4 inches diameter, $/linear foot	30.28
Removal of contaminated pipe >4 to 8 inches diameter, $/linear foot	49.50
Removal of contaminated pipe >8 to 14 inches diameter, $/linear foot	93.16
Removal of contaminated pipe >14 to 20 inches diameter, $/linear foot	110.95
Removal of contaminated pipe >20 to 36 inches diameter, $/linear foot	151.69
Removal of contaminated pipe >36 inches diameter, $/linear foot	178.39
Removal of contaminated valve >2 to 4 inches	370.40
Removal of contaminated valve >4 to 8 inches	437.70

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Removal of contaminated valve >8 to 14 inches	868.96
Removal of contaminated valve >14 to 20 inches	1,098.06
Removal of contaminated valve >20 to 36 inches	1,454.27
Removal of contaminated valve >36 inches	1,721.27
Removal of contaminated pipe hanger for small bore piping	115.54
Removal of contaminated pipe hanger for large bore piping	370.99
Removal of contaminated pump, <300 pound	783.33
Removal of contaminated pump, 300-1000 pound	1,841.28
Removal of contaminated pump, 1000-10,000 pound	5,810.90
Removal of contaminated pump, >10,000 pound	14,145.54
Removal of contaminated pump motor, 300-1000 pound	810.42
Removal of contaminated pump motor, 1000-10,000 pound	2,394.87
Removal of contaminated pump motor, >10,000 pound	5,376.99
Removal of contaminated heat exchanger <3000 pound	3,549.10
Removal of contaminated heat exchanger >3000 pound	10,358.57
Removal of contaminated tank, <300 gallons	1,310.02
Removal of contaminated tank, >300 gallons, $/square foot	25.36
Removal of contaminated electrical equipment, <300 pound	596.45
Removal of contaminated electrical equipment, 300-1000 pound	1,488.20
Removal of contaminated electrical equipment, 1000-10,000 pound	2,867.82
Removal of contaminated electrical equipment, >10,000 pound	5,776.36
Removal of contaminated electrical cable tray, $/linear foot	28.72
Removal of contaminated electrical conduit, $/linear foot	14.91
Removal of contaminated mechanical equipment, <300 pound	662.99
Removal of contaminated mechanical equipment, 300-1000 pound	1,641.54
Removal of contaminated mechanical equipment, 1000-10,000 pound	3,158.03
Removal of contaminated mechanical equipment, >10,000 pound	5,776.36
Removal of contaminated HVAC equipment, <300 pound	662.99
Removal of contaminated HVAC equipment, 300-1000 pound	1,641.54
Removal of contaminated HVAC equipment, 1000-10,000 pound	3,158.03

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Removal of contaminated HVAC equipment, >10,000 pound	5,776.36
Removal of contaminated HVAC ductwork, $/pound	1.80
Removal/plasma arc cut of contaminated thin metal components, $/linear in.	3.23
Additional decontamination of surface by washing, $/square foot	6.53
Additional decontamination of surfaces by hydrolasing, $/square foot	31.91
Decontamination rig hook up and flush, $/ 250 foot length	5,548.30
Chemical flush of components/systems, $/gallon	19.54
Removal of clean standard reinforced concrete, $/cubic yard	129.38
Removal of grade slab concrete, $/cubic yard	162.13
Removal of clean concrete floors, $/cubic yard	341.10
Removal of sections of clean concrete floors, $/cubic yard	995.12
Removal of clean heavily rein concrete w/#9 rebar, $/cubic yard	229.00
Removal of contaminated heavily rein concrete w/#9 rebar, $/cubic yard	1,919.93
Removal of clean heavily rein concrete w/#18 rebar, $/cubic yard	289.56
Removal of contaminated heavily rein concrete w/#18 rebar, $/cubic yard	2,536.65
Removal heavily rein concrete w/#18 rebar & steel embedments, $/cubic yard	429.87
Removal of below-grade suspended floors, $/cubic yard	341.10
Removal of clean monolithic concrete structures, $/cubic yard	817.52
Removal of contaminated monolithic concrete structures, $/cubic yard	1,904.47
Removal of clean foundation concrete, $/cubic yard	643.51
Removal of contaminated foundation concrete, $/cubic yard	1,774.63
Explosive demolition of bulk concrete, $/cubic yard	29.38
Removal of clean hollow masonry block wall, $/cubic yard	77.50
Removal of contaminated hollow masonry block wall, $/cubic yard	265.37
Removal of clean solid masonry block wall, $/cubic yard	77.50
Removal of contaminated solid masonry block wall, $/cubic yard	265.37
Backfill of below-grade voids, $/cubic yard	34.32
Removal of subterranean tunnels/voids, $/linear foot	96.84
Placement of concrete for below-grade voids, $/cubic yard	137.89
Excavation of clean material, $/cubic yard	3.36

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Excavation of contaminated material, $/cubic yard	40.38
Removal of clean concrete rubble (tipping fee included), $/cubic yard	24.09
Removal of contaminated concrete rubble, $/cubic yard	23.97
Removal of building by volume, $/cubic foot	0.29
Removal of clean building metal siding, $/square foot	0.86
Removal of contaminated building metal siding, $/square foot	3.17
Removal of standard asphalt roofing, $/square foot	1.70
Removal of transite panels, $/square foot	1.88
Scarifying contaminated concrete surfaces (drill & spall), $/square foot	11.67
Scabbling contaminated concrete floors, $/square foot	6.61
Scabbling contaminated concrete walls, $/square foot	17.02
Scabbling contaminated ceilings, $/square foot	57.99
Scabbling structural steel, $/square foot	5.54
Removal of clean overhead crane/monorail < 10 ton capacity	551.82
Removal of contaminated overhead crane/monorail < 10 ton capacity	1,560.67
Removal of clean overhead crane/monorail >10-50 ton capacity	1,324.37
Removal of contaminated overhead crane/monorail >10-50 ton capacity	3,744.98
Removal of polar crane > 50 ton capacity	5,680.92
Removal of gantry crane > 50 ton capacity	23,023.90
Removal of structural steel, $/pound	0.19
Removal of clean steel floor grating, $/square foot	4.27
Removal of contaminated steel floor grating, $/square foot	12.24
Removal of clean free standing steel liner, $/square foot	10.13
Removal of contaminated free standing steel liner, $/square foot	29.57
Removal of clean concrete-anchored steel liner, $/square foot	5.06
Removal of contaminated concrete-anchored steel liner, $/square foot	34.44
Placement of scaffolding in clean areas, $/square foot	17.33
Placement of scaffolding in contaminated areas, $/square foot	25.14
Landscaping with topsoil, $/acre	31,052.99
Cost of CPC B-88 LSA box & preparation for use	2,330.58

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Cost of CPC B-25 LSA box & preparation for use	2,128.87
Cost of CPC B-12V 12 gauge LSA box & preparation for use	1,720.00
Cost of CPC B-144 LSA box & preparation for use	12,064.98
Cost of LSA drum & preparation for use	198.16
Cost of cask liner for CNSI 8 120A cask (resins)	8,331.49
Cost of cask liner for CNSI 8 120A cask (filters)	8,734.69
Decontamination of surfaces with vacuuming, $/square foot	0.68

APPENDIX C

DETAILED COST ANALYSIS

Table C
Crystal River Unit 3 Nuclear Generating Plant
SAFSTOR Decommissioning Cost Estimate
(thousands of 2011 dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
PERIOD 1a - Shutdown through Transition																					
Period 1a Direct Decommissioning Activities																					
1a.1.1	SAFSTOR site characterization survey	-	-	-	-	-	-	347	104	451	451	-	-	-	-	-	-	-	-	-	-
1a.1.2	Prepare preliminary decommissioning cost	-	-	-	-	-	-	149	22	171	171	-	-	-	-	-	-	-	-	-	1,300
1a.1.3	Notification of Cessation of Operations									a											
1a.1.4	Remove fuel & source material									n/a											
1a.1.5	Notification of Permanent Defueling									a											
1a.1.6	Deactivate plant systems & process waste									a											
1a.1.7	Prepare and submit PSDAR	-	-	-	-	-	-	229	34	263	263	-	-	-	-	-	-	-	-	-	2,000
1a 1 8	Review plant dwgs & specs	-	-	-	-	-	-	149	22	171	171	-	-	-	-	-	-	-	-	-	1,300
1a 1 9	Perform detailed rad survey									a											
1a 1 10	Estimate by-product inventory	-	-	-	-	-	-	114	17	132	132	-	-	-	-	-	-	-	-	-	1,000
1a 1.11	End product description	-	-	-	-	-	-	114	17	132	132	-	-	-	-	-	-	-	-	-	1,000
1a 1 12	Detailed by-product inventory	-	-	-	-	-	-	172	26	197	197	-	-	-	-	-	-	-	-	-	1,500
1a.1.13	Define major work sequence	-	-	-	-	-	-	114	17	132	132	-	-	-	-	-	-	-	-	-	1,000
1a 1 14	Perform SER and EA	-	-	-	-	-	-	355	53	408	408	-	-	-	-	-	-	-	-	-	3,100
1a.1.15	Perform Site-Specific Cost Study	-	-	-	-	-	-	572	86	658	658	-	-	-	-	-	-	-	-	-	5,000
Activity Specifications																					
1a.1.16.1	Prepare plant and facilities for SAFSTOR	-	-	-	-	-	-	563	84	648	648	-	-	-	-	-	-	-	-	-	4,920
1a.1.16 2	Plant systems	-	-	-	-	-	-	477	72	549	549	-	-	-	-	-	-	-	-	-	4,167
1a.1.16.3	Plant structures and buildings	-	-	-	-	-	-	357	54	411	411	-	-	-	-	-	-	-	-	-	3,120
1a.1.16.4	Waste management	-	-	-	-	-	-	229	34	263	263	-	-	-	-	-	-	-	-	-	2,000
1a.1.16.5	Facility and site dormancy	-	-	-	-	-	-	229	34	263	263	-	-	-	-	-	-	-	-	-	2.000
1a 1.16	Total	-	-	-	-	-	-	1,855	278	2.133	2.133	-	-	-	-	-	-	-	-	-	16.207
Detailed Work Procedures																					
1a 1.17.1	Plant systems	-	-	-	-	-	-	135	20	156	156	-	-	-	-	-	-	-	-	-	1,183
1a.1.17.2	Facility closeout & dormancy	-	-	-	-	-	-	137	21	158	158	-	-	-	-	-	-	-	-	-	1.200
1a 1.17	Total	-	-	-	-	-	-	273	41	314	314	-	-	-	-	-	-	-	-	-	2.383
1a 1.18	Procure vacuum drying system	-	-	-	-	-	-	11	2	13	13	-	-	-	-	-	-	-	-	-	100
1a 1.19	Drain/de-energize non-cont systems									a											
1a 1.20	Drain & dry NSSS									a											
1a.1.21	Drain/de-energize contaminated systems									a											
1a 1.22	Decon/secure contaminated systems									a											
1a 1	Subtotal Period 1a Activity Costs	-	-	-	-	-	-	4,455	720	5 175	5.175	-	-	-	-	-	-	-	-	-	35.890
Period 1a Collateral Costs																					
1a.3.1	Florida LLRW Inspection Fee	-	-	-	-	-	-	1	0	1	1	-	-	-	-	-	-	-	-	-	-
1a 3	Subtotal Period 1a Collateral Costs	-	-	-	-	-	-	1	0	1	1	-	-	-	-	-	-	-	-	-	-
Period 1a Period-Dependent Costs																					
1a 4.1	Insurance	-	-	-	-	-	-	1,334	133	1,467	1,467	-	-	-	-	-	-	-	-	-	-
1a 4 2	Property taxes	-	-	-	-	-	-	3,715	372	4 087	4,087	-	-	-	-	-	-	-	-	-	-
1a.4.3	Health physics supplies	-	501	-	-	-	-	-	125	627	627	-	-	-	-	-	-	-	-	-	-
1a.4.4	Heavy equipment rental	-	490	-	-	-	-	-	73	563	563	-	-	-	-	-	-	-	-	-	-
1a.4.5	Disposal of DAW generated	-	-	14	10	-	30	-	10	65	65	-	-	-	610	-	-	-	12,190	20	-
1a 4.6	Plant energy budget	-	-	-	-	-	-	1,025	154	1.179	1,179	-	-	-	-	-	-	-	-	-	-
1a.4.7	NRC Fees	-	-	-	-	-	-	769	77	846	846	-	-	-	-	-	-	-	-	-	-
1a.4.8	Emergency Planning Fees	-	-	-	-	-	-	779	78	857	-	857	-	-	-	-	-	-	-	-	-
1a.4.9	Utility Site Indirect	-	-	-	-	-	-	1,871	281	2 152	2,152	-	-	-	-	-	-	-	-	-	-
1a.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	763	114	878	-	878	-	-	-	-	-	-	-	-	-
1a.4.11	ISFSI Operating Costs	-	-	-	-	-	-	89	13	103	-	103	-	-	-	-	-	-	-	-	-
1a.4.12	Corporate Allocations	-	-	-	-	-	-	1,428	214	1,642	1,642	-	-	-	-	-	-	-	-	-	-
1a.4.13	INPO Fees	-	-	-	-	-	-	135	20	156	156	-	-	-	-	-	-	-	-	-	-
1a.4 14	Security Staff Cost	-	-	-	-	-	-	6,598	990	7,588	7,588	-	-	-	-	-	-	-	-	-	157,471
1a 4.15	Utility Staff Cost	-	-	-	-	-	-	22,197	3,330	25,526	25,526	-	-	-	-	-	-	-	-	-	423,400
1a.4	Subtotal Period 1a Period-Dependent Costs	-	991	14	10	-	30	40,705	5 985	47,735	45,897	1,838	-	-	610	-	-	-	12,190	20	580,871
1a.0	TOTAL PERIOD 1a COST	-	991	14	10	-	30	45,161	6 705	52,911	51,074	1,838	-	-	610	-	-	-	12,190	20	616,761

Table C
Crystal River Unit 3 Nuclear Generating Plant
SAFSTOR Decommissioning Cost Estimate
(thousands of 2011 dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
PERIOD 1b - SAFSTOR Limited DECON Activities																					
Period 1b Direct Decommissioning Activities																					
Decontamination of Site Buildings																					
1b.1.1.1	Reactor	980	-	-	-	-	-	-	490	1,470	1,470	-	-	-	-	-	-	-	-	21,630	-
1b.1.1.2	Auxiliary Building	329	-	-	-	-	-	-	164	493	493	-	-	-	-	-	-	-	-	7,527	-
1b.1.1.3	Fuel Handling Area (Aux Bldg)	803	-	-	-	-	-	-	401	1,204	1,204	-	-	-	-	-	-	-	-	16,150	-
1b.1.1.4	Intermediate Bldg	67	-	-	-	-	-	-	34	101	101	-	-	-	-	-	-	-	-	1,557	-
1b.1.1.5	Machine Shop - Hot	46	-	-	-	-	-	-	23	69	69	-	-	-	-	-	-	-	-	1,038	-
1b.1.1.6	RM Warehouse	29	-	-	-	-	-	-	14	43	43	-	-	-	-	-	-	-	-	649	-
1b.1.1.7	RVCH Storage Building	4	-	-	-	-	-	-	2	6	6	-	-	-	-	-	-	-	-	91	-
1b.1.1	Totals	2,258	-	-	-	-	-	-	1,129	3,386	3,386	-	-	-	-	-	-	-	-	48,641	-
1b.1	Subtotal Period 1b Activity Costs	2,258	-	-	-	-	-	-	1,129	3,386	3,386	-	-	-	-	-	-	-	-	48,641	-
Period 1b Additional Costs																					
1b.2.1	Misc Waste	-	-	422	643	681	-	-	241	1,987	1,987	-	-	2,343	-	-	-	-	1,548,253	2,892	-
1b.2	Subtotal Period 1b Additional Costs	-	-	422	643	681	-	-	241	1,987	1,987	-	-	2,343	-	-	-	-	1,548,253	2,892	-
Period 1b Collateral Costs																					
1b.3.1	Decon equipment	964	-	-	-	-	-	-	145	1,109	1,109	-	-	-	-	-	-	-	-	-	-
1b.3.2	Process decommissioning water waste	133	-	58	344	-	318	-	204	1,057	1,057	-	-	-	841	-	-	-	50,433	164	-
1b.3.4	Small tool allowance	-	41	-	-	-	-	-	6	47	47	-	-	-	-	-	-	-	-	-	-
1b.3.5	Florida LLRW Inspection Fee	-	-	-	-	-	-	7	1	8	8	-	-	-	-	-	-	-	-	-	-
1b.3	Subtotal Period 1b Collateral Costs	1,097	41	58	344	-	318	7	355	2,222	2,222	-	-	-	841	-	-	-	50,433	164	-
Period 1b Period-Dependent Costs																					
1b.4.1	Decon supplies	901	-	-	-	-	-	-	225	1,126	1,126	-	-	-	-	-	-	-	-	-	-
1b.4.2	Insurance	-	-	-	-	-	-	336	34	370	370	-	-	-	-	-	-	-	-	-	-
1b.4.3	Property taxes	-	-	-	-	-	-	638	64	701	701	-	-	-	-	-	-	-	-	-	-
1b.4.4	Health physics supplies	-	366	-	-	-	-	-	92	458	458	-	-	-	-	-	-	-	-	-	-
1b.4.5	Heavy equipment rental	-	123	-	-	-	-	-	19	142	142	-	-	-	-	-	-	-	-	-	-
1b.4.6	Disposal of DAW generated	-	-	14	10	-	30	-	10	64	64	-	-	-	602	-	-	-	12,041	20	-
1b.4.7	Plant energy budget	-	-	-	-	-	-	258	39	297	297	-	-	-	-	-	-	-	-	-	-
1b.4.8	NRC Fees	-	-	-	-	-	-	194	19	213	213	-	-	-	-	-	-	-	-	-	-
1b.4.9	Emergency Planning Fees	-	-	-	-	-	-	196	20	216	-	216	-	-	-	-	-	-	-	-	-
1b.4.10	Utility Site Indirect	-	-	-	-	-	-	472	71	542	542	-	-	-	-	-	-	-	-	-	-
1b.4.11	Spent Fuel Pool O&M	-	-	-	-	-	-	192	29	221	-	221	-	-	-	-	-	-	-	-	-
1b.4.12	ISFSI Operating Costs	-	-	-	-	-	-	23	3	26	-	26	-	-	-	-	-	-	-	-	-
1b.4.13	Corporate Allocations	-	-	-	-	-	-	360	54	414	414	-	-	-	-	-	-	-	-	-	-
1b.4.14	Security Staff Cost	-	-	-	-	-	-	1,663	249	1,913	1,913	-	-	-	-	-	-	-	-	-	39,691
1b.4.15	Utility Staff Cost	-	-	-	-	-	-	5,595	839	6,434	6,434	-	-	-	-	-	-	-	-	-	106,720
1b.4	Subtotal Period 1b Period-Dependent Costs	901	490	14	10	-	30	9,927	1,767	13,138	12,675	463	-	-	602	-	-	-	12,041	20	146,411
1b.0	TOTAL PERIOD 1b COST	4,256	531	495	997	681	348	9,934	3,491	20,734	20,270	463	-	2,343	1,443	-	-	-	1,610,727	51,716	146,411
PERIOD 1c - Preparations for SAFSTOR Dormancy																					
Period 1c Direct Decommissioning Activities																					
1c.1.1	Prepare support equipment for storage	-	425	-	-	-	-	-	64	489	489	-	-	-	-	-	-	-	-	3,000	-
1c.1.2	Install containment pressure equal. lines	-	36	-	-	-	-	-	5	42	42	-	-	-	-	-	-	-	-	700	-
1c.1.3	Interim survey prior to dormancy	-	-	-	-	-	-	733	220	953	953	-	-	-	-	-	-	-	-	15,678	-
1c.1.4	Secure building accesses									a											
1c.1.5	Prepare & submit interim report	-	-	-	-	-	-	67	10	77	77	-	-	-	-	-	-	-	-	-	583
1c.1	Subtotal Period 1c Activity Costs	-	461	-	-	-	-	800	299	1,560	1,560	-	-	-	-	-	-	-	-	19,378	583
Period 1c Additional Costs																					
1c.2.1	Spent Fuel Isolation	-	-	-	-	-	-	10,280	1,542	11,822	11,822	-	-	-	-	-	-	-	-	-	-
1c.2	Subtotal Period 1c Additional Costs	-	-	-	-	-	-	10,280	1,542	11,822	11,822	-	-	-	-	-	-	-	-	-	-
Period 1c Collateral Costs																					
1c.3.1	Process decommissioning water waste	161	-	71	418	-	386	-	247	1,283	1,283	-	-	-	1,020	-	-	-	61,230	199	-
1c.3.3	Small tool allowance	-	4	-	-	-	-	-	1	4	4	-	-	-	-	-	-	-	-	-	-
1c.3.4	Florida LLRW Inspection Fee	-	-	-	-	-	-	2	0	3	3	-	-	-	-	-	-	-	-	-	-
1c.3	Subtotal Period 1c Collateral Costs	161	4	71	418	-	386	2	248	1,290	1,290	-	-	-	1,020	-	-	-	61,230	199	-

Table C
Crystal River Unit 3 Nuclear Generating Plant
SAFSTOR Decommissioning Cost Estimate
(thousands of 2011 dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Period 1c Period-Dependent Costs																					
1c.4.1	Insurance	-	-	-	-	-	-	336	34	370	370	-	-	-	-	-	-	-	-	-	-
1c.4.2	Property taxes	-	-	-	-	-	-	931	93	1,024	1 024	-	-	-	-	-	-	-	-	-	-
1c.4.3	Health physics supplies	-	217	-	-	-	-	-	54	272	272	-	-	-	-	-	-	-	-	-	-
1c.4.4	Heavy equipment rental	-	123	-	-	-	-	-	19	142	142	-	-	-	-	-	-	-	-	-	-
1c.4.5	Disposal of DAW generated	-	-	4	3	-	8	-	3	16	16	-	-	-	154	-	-	-	3 073	5	-
1c.4.6	Plant energy budget	-	-	-	-	-	-	258	39	297	297	-	-	-	-	-	-	-	-	-	-
1c.4.7	NRC Fees	-	-	-	-	-	-	194	19	213	213	-	-	-	-	-	-	-	-	-	-
1c.4.8	Emergency Planning Fees	-	-	-	-	-	-	196	20	216	-	216	-	-	-	-	-	-	-	-	-
1c.4.9	Utility Site Indirect	-	-	-	-	-	-	472	71	542	542	-	-	-	-	-	-	-	-	-	-
1c.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	192	29	221	-	221	-	-	-	-	-	-	-	-	-
1c.4.11	ISFSI Operating Costs	-	-	-	-	-	-	23	3	26	-	26	-	-	-	-	-	-	-	-	-
1c.4.12	Corporate Allocations	-	-	-	-	-	-	360	54	414	414	-	-	-	-	-	-	-	-	-	-
1c.4.13	Security Staff Cost	-	-	-	-	-	-	1,663	249	1,913	1,913	-	-	-	-	-	-	-	-	-	39,691
1c.4.14	Utility Staff Cost	-	-	-	-	-	-	5,595	839	6 434	6 434	-	-	-	-	-	-	-	-	-	106,720
1c.4	Subtotal Period 1c Period-Dependent Costs	-	341	4	3	-	8	10,220	1,526	12 100	11,637	463	-	-	154	-	-	-	3 073	5	146 411
1c.0	TOTAL PERIOD 1c COST	161	806	74	420	-	394	21,302	3 614	26 772	26,309	463	-	-	1 174	-	-	-	64,303	19 582	146 995
PERIOD 1 TOTALS		4,417	2,328	584	1 428	681	772	76,397	13,811	100,417	97,653	2,764	-	2 343	3,226	-	-	-	1,687 220	71 318	910 168
PERIOD 2a - SAFSTOR Dormancy with Wet Spent Fuel Storage																					
Period 2a Direct Decommissioning Activities																					
2a.1.1	Quarterly Inspection									a											
2a.1.2	Semi-annual environmental survey									a											
2a.1.3	Prepare reports									a											
2a.1.4	Bituminous roof replacement	-	-	-	-	-	-	247	37	284	284	-	-	-	-	-	-	-	-	-	-
2a.1.5	Maintenance supplies	-	-	-	-	-	-	675	169	843	843	-	-	-	-	-	-	-	-	-	-
2a.1	Subtotal Period 2a Activity Costs	-	-	-	-	-	-	922	206	1,127	1,127	-	-	-	-	-	-	-	-	-	-
Period 2a Collateral Costs																					
2a.3.1	Spent Fuel Capital and Transfer	-	-	-	-	-	-	26,600	3,990	30,590	-	30,590	-	-	-	-	-	-	-	-	-
2a.3.2	ISFSI Capital Expenditures	-	-	-	-	-	-	59,128	8,869	67,997	-	67,997	-	-	-	-	-	-	-	-	-
2a.3.3	Florida LLRW Inspection Fee	-	-	-	-	-	-	2	0	2	2	-	-	-	-	-	-	-	-	-	-
2a.3	Subtotal Period 2a Collateral Costs	-	-	-	-	-	-	85,730	12,859	98,590	2	98,587	-	-	-	-	-	-	-	-	-
Period 2a Period-Dependent Costs																					
2a.4.1	Insurance	-	-	-	-	-	-	3,508	351	3,859	3,487	372	-	-	-	-	-	-	-	-	-
2a.4.2	Property taxes	-	-	-	-	-	-	9,881	988	10,869	5,236	5,632	-	-	-	-	-	-	-	-	-
2a.4.3	Health physics supplies	-	1,005	-	-	-	-	-	251	1,257	1,257	-	-	-	-	-	-	-	-	-	-
2a.4.4	Disposal of DAW generated	-	-	27	20	-	56	-	20	123	123	-	-	-	1,150	-	-	-	23,008	38	-
2a.4.5	Plant energy budget	-	-	-	-	-	-	1,025	154	1,179	589	589	-	-	-	-	-	-	-	-	-
2a.4.6	NRC Fees	-	-	-	-	-	-	1,102	110	1,212	1,212	-	-	-	-	-	-	-	-	-	-
2a.4.7	Emergency Planning Fees	-	-	-	-	-	-	999	100	1 099	-	1,099	-	-	-	-	-	-	-	-	-
2a.4.8	Utility Site Indirect	-	-	-	-	-	-	1,732	260	1,992	524	1,468	-	-	-	-	-	-	-	-	-
2a.4.9	Spent Fuel Pool O&M	-	-	-	-	-	-	3,816	572	4,388	-	4,388	-	-	-	-	-	-	-	-	-
2a.4.10	ISFSI Operating Costs	-	-	-	-	-	-	447	67	514	-	514	-	-	-	-	-	-	-	-	-
2a.4.11	Corporate Allocations	-	-	-	-	-	-	1,389	208	1,597	354	1,244	-	-	-	-	-	-	-	-	-
2a.4.12	Security Staff Cost	-	-	-	-	-	-	23,743	3 561	27,304	9 018	18,286	-	-	-	-	-	-	-	-	555,321
2a.4.13	Utility Staff Cost	-	-	-	-	-	-	21,911	3,287	25,198	5,104	20,093	-	-	-	-	-	-	-	-	411,929
2a.4	Subtotal Period 2a Period-Dependent Costs	-	1,005	27	20	-	56	69,553	9 930	80,591	26,905	53,686	-	-	1,150	-	-	-	23,008	38	967,250
2a.0	TOTAL PERIOD 2a COST	-	1,005	27	20	-	56	156,205	22,995	180,308	28,035	152,273	-	-	1,150	-	-	-	23,008	38	967,250
PERIOD 2b - SAFSTOR Dormancy with Dry Spent Fuel Storage																					
Period 2b Direct Decommissioning Activities																					
2b.1.1	Quarterly Inspection									a											
2b.1.2	Semi-annual environmental survey									a											
2b.1.3	Prepare reports									a											
2b.1.4	Bituminous roof replacement	-	-	-	-	-	-	1 711	257	1,967	1,967	-	-	-	-	-	-	-	-	-	-
2b.1.5	Maintenance supplies	-	-	-	-	-	-	4,668	1,167	5,835	5 835	-	-	-	-	-	-	-	-	-	-
2b.1	Subtotal Period 2b Activity Costs	-	-	-	-	-	-	6 379	1,424	7,802	7,802	-	-	-	-	-	-	-	-	-	-
Period 2b Collateral Costs																					
2b.3.1	Spent Fuel Capital and Transfer	-	-	-	-	-	-	4 800	720	5,520	-	5,520	-	-	-	-	-	-	-	-	-
2b.3.2	ISFSI Capital Expenditures	-	-	-	-	-	-	3,000	450	3,450	-	3,450	-	-	-	-	-	-	-	-	-
2b.3.3	Florida LLRW Inspection Fee	-	-	-	-	-	-	7	1	8	8	-	-	-	-	-	-	-	-	-	-

Table C
Crystal River Unit 3 Nuclear Generating Plant
SAFSTOR Decommissioning Cost Estimate
(thousands of 2011 dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
2b 3	Subtotal Period 2b Collateral Costs	-	-	-	-	-	-	7,807	1,171	8,978	8	8,970	-	-	-	-	-	-	-	-	-
	Period 2b Period-Dependent Costs																				
2b 4.1	Insurance	-	-	-	-	-	-	22,478	2,248	24,726	24,132	594	-	-	-	-	-	-	-	-	-
2b 4 2	Property taxes	-	-	-	-	-	-	45,845	4,585	50,430	36,236	14,193	-	-	-	-	-	-	-	-	-
2b 4 3	Health physics supplies	-	3,375	-	-	-	-	-	844	4,219	4,219	-	-	-	-	-	-	-	-	-	-
2b.4.4	Disposal of DAW generated	-	-	90	65	-	187	-	66	408	408	-	-	-	3,824	-	-	-	76,481	125	-
2b 4.5	Plant energy budget	-	-	-	-	-	-	3,546	532	4,078	4,078	-	-	-	-	-	-	-	-	-	-
2b 4.6	NRC Fees	-	-	-	-	-	-	7,625	762	8,387	8,387	-	-	-	-	-	-	-	-	-	-
2b 4.7	Emergency Planning Fees	-	-	-	-	-	-	6,915	692	7,607	-	7,607	-	-	-	-	-	-	-	-	-
2b 4 8	Utility Site Indirect	-	-	-	-	-	-	5,238	786	6,024	3,630	2,395	-	-	-	-	-	-	-	-	-
2b 4.9	ISFSI Operating Costs	-	-	-	-	-	-	3,095	464	3,559	-	3,559	-	-	-	-	-	-	-	-	-
2b 4.10	Corporate Allocations	-	-	-	-	-	-	3,894	584	4,478	2,449	2,029	-	-	-	-	-	-	-	-	-
2b 4.11	Security Staff Cost	-	-	-	-	-	-	88 783	13,318	102,101	62,402	39,699	-	-	-	-	-	-	-	-	1,948,474
2b 4.12	Utility Staff Cost	-	-	-	-	-	-	61,251	9,188	70,438	35,321	35,117	-	-	-	-	-	-	-	-	1,154,651
2b 4	Subtotal Period 2b Period-Dependent Costs	-	3,375	90	65	-	187	248,670	34,067	286,455	181,262	105,194	-	-	3,824	-	-	-	76,481	125	3,103,126
2b.0	TOTAL PERIOD 2b COST	-	3,375	90	65	-	187	262,857	36,661	303,236	189,072	114,164	-	-	3,824	-	-	-	76,481	125	3,103,126
	PERIOD 2c - SAFSTOR Dormancy without Spent Fuel Storage																				
	Period 2c Direct Decommissioning Activities																				
2c.1.1	Quarterly Inspection									a											
2c.1.2	Semi-annual environmental survey									a											
2c 1.3	Prepare reports									a											
2c.1.4	Bituminous roof replacement	-	-	-	-	-	-	690	104	794	794	-	-	-	-	-	-	-	-	-	-
2c.1.5	Maintenance supplies	-	-	-	-	-	-	1,883	471	2,353	2,353	-	-	-	-	-	-	-	-	-	-
2c.1	Subtotal Period 2c Activity Costs	-	-	-	-	-	-	2,573	574	3,147	3,147	-	-	-	-	-	-	-	-	-	-
	Period 2c Collateral Costs																				
2c.3.1	Florida LLRW Inspection Fee	-	-	-	-	-	-	3	0	3	3	-	-	-	-	-	-	-	-	-	-
2c.3	Subtotal Period 2c Collateral Costs	-	-	-	-	-	-	3	0	3	3	-	-	-	-	-	-	-	-	-	-
	Period 2c Period-Dependent Costs																				
2c.4.1	Insurance	-	-	-	-	-	-	8,849	885	9,734	9,734	-	-	-	-	-	-	-	-	-	-
2c.4.2	Property taxes	-	-	-	-	-	-	13,287	1,329	14,616	14,616	-	-	-	-	-	-	-	-	-	-
2c.4.3	Health physics supplies	-	1,281	-	-	-	-	-	320	1,601	1,601	-	-	-	-	-	-	-	-	-	-
2c.4.4	Disposal of DAW generated	-	-	34	24	-	70	-	24	152	152	-	-	-	1,421	-	-	-	28,412	46	-
2c.4.5	Plant energy budget	-	-	-	-	-	-	1,430	215	1,645	1,645	-	-	-	-	-	-	-	-	-	-
2c.4.6	NRC Fees	-	-	-	-	-	-	2,787	279	3,065	3,065	-	-	-	-	-	-	-	-	-	-
2c.4.7	Utility Site Indirect	-	-	-	-	-	-	1,273	191	1,464	1,464	-	-	-	-	-	-	-	-	-	-
2c.4.8	Corporate Allocations	-	-	-	-	-	-	859	129	988	988	-	-	-	-	-	-	-	-	-	-
2c 4.9	Security Staff Cost	-	-	-	-	-	-	21,887	3,283	25,170	25,170	-	-	-	-	-	-	-	-	-	436,629
2c 4.10	Utility Staff Cost	-	-	-	-	-	-	12,389	1,858	14,247	14,247	-	-	-	-	-	-	-	-	-	254,700
2c.4	Subtotal Period 2c Period-Dependent Costs	-	1,281	34	24	-	70	62,761	8,513	72,681	72,681	-	-	-	1,421	-	-	-	28,412	46	691,329
2c.0	TOTAL PERIOD 2c COST	-	1,281	34	24	-	70	65,337	9,087	75 831	75,831	-	-	-	1,421	-	-	-	28,412	46	691,329
	PERIOD 2 TOTALS	-	5,661	151	109	-	313	484 398	68,743	559,376	292,939	266,437	-	-	6,395	-	-	-	127,901	209	4,761,704
	PERIOD 3a - Reactivate Site Following SAFSTOR Dormancy																				
	Period 3a Direct Decommissioning Activities																				
3a.1.1	Prepare preliminary decommissioning cost	-	-	-	-	-	-	149	22	171	171	-	-	-	-	-	-	-	-	-	1,300
3a.1.2	Review plant dwgs & specs.	-	-	-	-	-	-	527	79	606	606	-	-	-	-	-	-	-	-	-	4,600
3a.1 3	Perform detailed rad survey									a											
3a.1.4	End product description	-	-	-	-	-	-	114	17	132	132	-	-	-	-	-	-	-	-	-	1,000
3a.1.5	Detailed by-product inventory	-	-	-	-	-	-	149	22	171	171	-	-	-	-	-	-	-	-	-	1,300
3a.1.6	Define major work sequence	-	-	-	-	-	-	859	129	987	987	-	-	-	-	-	-	-	-	-	7,500
3a.1.7	Perform SER and EA	-	-	-	-	-	-	355	53	408	408	-	-	-	-	-	-	-	-	-	3,100
3a.1 8	Perform Site-Specific Cost Study	-	-	-	-	-	-	572	86	658	658	-	-	-	-	-	-	-	-	-	5,000
3a.1.9	Prepare/submit License Termination Plan	-	-	-	-	-	-	469	70	539	539	-	-	-	-	-	-	-	-	-	4,096
3a.1.10	Receive NRC approval of termination plan									a											
	Activity Specifications																				
3a.1.11.1	Re-activate plant & temporary facilities	-	-	-	-	-	-	844	127	970	873	-	97	-	-	-	-	-	-	-	7,370
3a.1.11.2	Plant systems	-	-	-	-	-	-	477	72	549	494	-	55	-	-	-	-	-	-	-	4,167
3a 1.11 3	Reactor internals	-	-	-	-	-	-	813	122	935	935	-	-	-	-	-	-	-	-	-	7,100

Table C
Crystal River Unit 3 Nuclear Generating Plant
SAFSTOR Decommissioning Cost Estimate
(thousands of 2011 dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Activity Specifications (continued)																					
3a.1.11.4	Reactor vessel	-	-	-	-	-	-	744	112	856	856	-	-	-	-	-	-	-	-	-	6,500
3a 1 11 5	Biological shield	-	-	-	-	-	-	57	9	66	66	-	-	-	-	-	-	-	-	-	500
3a.1.11.6	Steam generators	-	-	-	-	-	-	357	54	411	411	-	-	-	-	-	-	-	-	-	3,120
3a 1 11.7	Reinforced concrete	-	-	-	-	-	-	183	27	211	105	-	105	-	-	-	-	-	-	-	1,600
3a.1.11.8	Main Turbine	-	-	-	-	-	-	46	7	53	-	-	53	-	-	-	-	-	-	-	400
3a.1.11.9	Main Condensers	-	-	-	-	-	-	46	7	53	-	-	53	-	-	-	-	-	-	-	400
3a 1.11.10	Plant structures & buildings	-	-	-	-	-	-	357	54	411	205	-	205	-	-	-	-	-	-	-	3,120
3a.1.11.11	Waste management	-	-	-	-	-	-	527	79	606	606	-	-	-	-	-	-	-	-	-	4,600
3a 1 11.12	Facility & site closeout	-	-	-	-	-	-	103	15	118	59	-	59	-	-	-	-	-	-	-	900
3a 1 11	Total	-	-	-	-	-	-	4,553	683	5,236	4,609	-	627	-	-	-	-	-	-	-	39,777
Planning & Site Preparations																					
3a.1.12	Prepare dismantling sequence	-	-	-	-	-	-	275	41	316	316	-	-	-	-	-	-	-	-	-	2,400
3a.1 13	Plant prep & temp svces	-	-	-	-	-	-	2,800	420	3,220	3,220	-	-	-	-	-	-	-	-	-	-
3a.1 14	Design water clean-up system	-	-	-	-	-	-	160	24	184	184	-	-	-	-	-	-	-	-	-	1,400
3a.1.15	Rigging/Cont. Cntrl Envlps/tooling/etc	-	-	-	-	-	-	2,200	330	2,530	2,530	-	-	-	-	-	-	-	-	-	-
3a.1 16	Procure casks/liners & containers	-	-	-	-	-	-	141	21	162	162	-	-	-	-	-	-	-	-	-	1,230
3a.1	Subtotal Period 3a Activity Costs	-	-	-	-	-	-	13,322	1,998	15,321	14,694	-	627	-	-	-	-	-	-	-	72,703
Period 3a Additional Costs																					
3a.2.1	Site Characterization Survey	-	-	-	-	-	-	2,771	831	3,602	3,602	-	-	-	-	-	-	-	-	19,100	7,852
3a.2	Subtotal Period 3a Additional Costs	-	-	-	-	-	-	2,771	831	3,602	3,602	-	-	-	-	-	-	-	-	19,100	7,852
Period 3a Collateral Costs																					
3a.3 1	Florida LLRW Inspection Fee	-	-	-	-	-	-	1	0	1	1	-	-	-	-	-	-	-	-	-	-
3a.3	Subtotal Period 3a Collateral Costs	-	-	-	-	-	-	1	0	1	1	-	-	-	-	-	-	-	-	-	-
Period 3a Period-Dependent Costs																					
3a.4 1	Insurance	-	-	-	-	-	-	634	63	697	697	-	-	-	-	-	-	-	-	-	-
3a.4.2	Property taxes	-	-	-	-	-	-	950	95	1,045	1,045	-	-	-	-	-	-	-	-	-	-
3a.4 3	Health physics supplies	-	438	-	-	-	-	-	110	548	548	-	-	-	-	-	-	-	-	-	-
3a.4.4	Heavy equipment rental	-	490	-	-	-	-	-	73	563	563	-	-	-	-	-	-	-	-	-	-
3a.4 5	Disposal of DAW generated	-	-	12	9	-	25	-	9	55	55	-	-	-	514	-	-	-	10,287	17	-
3a.4 6	Plant energy budget	-	-	-	-	-	-	1,025	154	1,179	1,179	-	-	-	-	-	-	-	-	-	-
3a.4 7	NRC Fees	-	-	-	-	-	-	272	27	299	299	-	-	-	-	-	-	-	-	-	-
3a.4 8	Utility Site Indirect	-	-	-	-	-	-	1,215	182	1,397	1,397	-	-	-	-	-	-	-	-	-	-
3a.4.9	Corporate Allocations	-	-	-	-	-	-	872	131	1,003	1,003	-	-	-	-	-	-	-	-	-	-
3a.4 10	Security Staff Cost	-	-	-	-	-	-	2,919	438	3,357	3,357	-	-	-	-	-	-	-	-	-	65,179
3a.4.11	Utility Staff Cost	-	-	-	-	-	-	13,625	2,044	15,669	15,669	-	-	-	-	-	-	-	-	-	258,629
3a.4	Subtotal Period 3a Period-Dependent Costs	-	928	12	9	-	25	21,513	3,326	25,813	25,813	-	-	-	514	-	-	-	10,287	17	323,807
3a 0	TOTAL PERIOD 3a COST	-	928	12	9	-	25	37,608	6,156	44,737	44,110	-	627	-	514	-	-	-	10,287	19,117	404,362
PERIOD 3b - Decommissioning Preparations																					
Period 3b Direct Decommissioning Activities																					
Detailed Work Procedures																					
3b.1.1.1	Plant systems	-	-	-	-	-	-	542	81	623	561	-	62	-	-	-	-	-	-	-	4,733
3b.1.1.2	Reactor internals	-	-	-	-	-	-	286	43	329	329	-	-	-	-	-	-	-	-	-	2,500
3b.1.1 3	Remaining buildings	-	-	-	-	-	-	155	23	178	44	-	133	-	-	-	-	-	-	-	1,350
3b.1.1 4	CRD cooling assembly	-	-	-	-	-	-	114	17	132	132	-	-	-	-	-	-	-	-	-	1,000
3b.1.1.5	CRD housings & ICI tubes	-	-	-	-	-	-	114	17	132	132	-	-	-	-	-	-	-	-	-	1,000
3b.1.1 6	Incore instrumentation	-	-	-	-	-	-	114	17	132	132	-	-	-	-	-	-	-	-	-	1,000
3b.1.1.7	Reactor vessel	-	-	-	-	-	-	416	62	478	478	-	-	-	-	-	-	-	-	-	3,630
3b.1.1.8	Facility closeout	-	-	-	-	-	-	137	21	158	79	-	79	-	-	-	-	-	-	-	1,200
3b.1.1.9	Missile shields	-	-	-	-	-	-	52	8	59	59	-	-	-	-	-	-	-	-	-	450
3b.1.1.10	Biological shield	-	-	-	-	-	-	137	21	158	158	-	-	-	-	-	-	-	-	-	1,200
3b.1.1.11	Steam generators	-	-	-	-	-	-	527	79	606	606	-	-	-	-	-	-	-	-	-	4,600
3b.1.1.12	Reinforced concrete	-	-	-	-	-	-	114	17	132	66	-	66	-	-	-	-	-	-	-	1,000
3b.1.1.13	Main Turbine	-	-	-	-	-	-	179	27	205	-	-	205	-	-	-	-	-	-	-	1,560
3b 1.1.14	Main Condensers	-	-	-	-	-	-	179	27	205	-	-	205	-	-	-	-	-	-	-	1,560
3b 1.1.15	Auxiliary building	-	-	-	-	-	-	313	47	359	323	-	36	-	-	-	-	-	-	-	2,730
3b.1.1.16	Reactor building	-	-	-	-	-	-	313	47	359	323	-	36	-	-	-	-	-	-	-	2,730
3b 1.1	Total	-	-	-	-	-	-	3,691	554	4,244	3,421	-	823	-	-	-	-	-	-	-	32,243
3b 1	Subtotal Period 3b Activity Costs	-	-	-	-	-	-	3,691	554	4,244	3,421	-	823	-	-	-	-	-	-	-	32,243

Table C
Crystal River Unit 3 Nuclear Generating Plant
SAFSTOR Decommissioning Cost Estimate
(thousands of 2011 dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Period 3b Collateral Costs																					
3b.3.1	Decon equipment	964	-	-	-	-	-	-	145	1,109	1,109	-	-	-	-	-	-	-	-	-	-
3b.3.2	DOC staff relocation expenses	-	-	-	-	-	-	1,258	189	1,446	1,446	-	-	-	-	-	-	-	-	-	-
3b.3.3	Pipe cutting equipment	-	1,100	-	-	-	-	-	165	1,265	1,265	-	-	-	-	-	-	-	-	-	-
3b.3.4	Florida LLRW Inspection Fee	-	-	-	-	-	-	1	0	1	1	-	-	-	-	-	-	-	-	-	-
3b.3	Subtotal Period 3b Collateral Costs	964	1,100	-	-	-	-	1,258	498	3,821	3,821	-	-	-	-	-	-	-	-	-	-
Period 3b Period-Dependent Costs																					
3b.4.1	Decon supplies	30	-	-	-	-	-	-	7	37	37	-	-	-	-	-	-	-	-	-	-
3b.4.2	Insurance	-	-	-	-	-	-	356	36	391	391	-	-	-	-	-	-	-	-	-	-
3b.4.3	Property taxes	-	-	-	-	-	-	483	48	531	531	-	-	-	-	-	-	-	-	-	-
3b.4.4	Health physics supplies	-	245	-	-	-	-	-	61	306	306	-	-	-	-	-	-	-	-	-	-
3b.4.5	Heavy equipment rental	-	248	-	-	-	-	-	37	285	285	-	-	-	-	-	-	-	-	-	-
3b.4.6	Disposal of DAW generated	-	-	7	5	-	14	-	5	31	31	-	-	-	295	-	-	-	5,898	10	-
3b.4.7	Plant energy budget	-	-	-	-	-	-	519	78	597	597	-	-	-	-	-	-	-	-	-	-
3b.4.8	NRC Fees	-	-	-	-	-	-	138	14	152	152	-	-	-	-	-	-	-	-	-	-
3b.4.9	Utility Site Indirect	-	-	-	-	-	-	616	92	708	708	-	-	-	-	-	-	-	-	-	-
3b.4.10	Corporate Allocations	-	-	-	-	-	-	442	66	508	508	-	-	-	-	-	-	-	-	-	-
3b.4.11	Security Staff Cost	-	-	-	-	-	-	1,480	222	1,702	1,702	-	-	-	-	-	-	-	-	-	33,036
3b.4.12	DOC Staff Cost	-	-	-	-	-	-	5,049	757	5,806	5,806	-	-	-	-	-	-	-	-	-	59,200
3b.4.13	Utility Staff Cost	-	-	-	-	-	-	6,906	1,036	7,942	7,942	-	-	-	-	-	-	-	-	-	131,086
3b.4	Subtotal Period 3b Period-Dependent Costs	30	493	7	5	-	14	15,988	2,460	18,998	18,998	-	-	-	295	-	-	-	5,898	10	223,321
3b.0	TOTAL PERIOD 3b COST	994	1,593	7	5	-	14	20,937	3,512	27,063	26,240	-	823	-	295	-	-	-	5,898	10	255,564
PERIOD 3 TOTALS		994	2,521	19	14	-	40	58,545	9,668	71,801	70,350	-	1,450	-	809	-	-	-	16,185	19,126	659,926
PERIOD 4a - Large Component Removal																					
Period 4a Direct Decommissioning Activities																					
Nuclear Steam Supply System Removal																					
4a.1.1.1	Reactor Coolant Piping	26	97	27	24	126	175	-	106	580	580	-	-	564	597	-	-	-	130,847	2,774	-
4a.1.1.2	Pressurizer Relief Tank	3	12	4	4	21	27	-	15	86	86	-	-	94	94	-	-	-	20,849	310	-
4a.1.1.3	Reactor Coolant Pumps & Motors	22	74	47	235	-	2,000	-	569	2,947	2,947	-	-	-	7,016	-	-	-	1,122,318	2,705	80
4a.1.1.4	Pressurizer	7	52	412	162	-	748	-	269	1,649	1,649	-	-	-	2,624	-	-	-	353,599	1,499	1,500
4a.1.1.5	Steam Generators	36	4,703	1,072	2,304	-	6,834	-	3,355	18,304	18,304	-	-	-	23,968	-	-	-	1,469,167	10,254	2,250
4a.1.1.6	Retired Steam Generator Units	-	-	1,072	2,323	-	6,834	-	2,164	12,392	12,392	-	-	-	23,968	-	-	-	1,889,167	5,100	2,250
4a.1.1.7	CRDMs/ICIs/Service Structure Removal	29	86	312	79	56	163	-	128	853	853	-	-	753	3,106		-	-	91,378	2,371	-
4a.1.1.8	Reactor Vessel Internals	36	2,316	12,373	470	-	2,104	182	6,045	23,525	23,525	-	-	-	1,329	250	501	-	217,620	18,750	882
4a.1.1.9	Vessel & Internals GTCC Disposal	-	-	-	-	-	7,869	-	1,180	9,049	9,049	-	-	-	-	-	-	2,142	423,646	-	-
4a.1.1.10	Reactor Vessel	-	5,341	1,058	536	-	2,167	182	5,515	14,798	14,798	-	-	-	9,626	-	-	-	978,790	18,750	882
4a.1.1	Totals	157	12,680	16,376	6,137	204	28,920	364	19,346	84,184	84,184	-	-	1,411	72,327	250	501	2,142	6,697,382	62,933	7,844
Removal of Major Equipment																					
4a.1.2	Main Turbine/Generator	-	244	181	26	521	-	-	161	1,133	1,133	-	-	2,931	-	-	-	-	257,966	6,378	-
4a.1.3	Main Condensers	-	774	128	25	493	-	-	284	1,704	1,704	-	-	5,419	-	-	-	-	243,865	17,268	-
Cascading Costs from Clean Building Demolition																					
4a.1.4.1	Reactor	-	690	-	-	-	-	-	104	794	794	-	-	-	-	-	-	-	-	8,169	-
4a.1.4.2	Auxiliary Building	-	170	-	-	-	-	-	26	196	196	-	-	-	-	-	-	-	-	2,064	-
4a.1.4.3	Fuel Handling Area (Aux Bldg)	-	108	-	-	-	-	-	16	124	124	-	-	-	-	-	-	-	-	1,252	-
4a.1.4.4	Intermediate Bldg	-	46	-	-	-	-	-	7	53	53	-	-	-	-	-	-	-	-	569	-
4a.1.4.5	Machine Shop - Hot	-	3	-	-	-	-	-	1	4	4	-	-	-	-	-	-	-	-	57	-
4a.1.4.6	RM Warehouse	-	1	-	-	-	-	-	0	1	1	-	-	-	-	-	-	-	-	13	-
4a.1.4	Totals	-	1,020	-	-	-	-	-	153	1,173	1,173	-	-	-	-	-	-	-	-	12,124	-
Disposal of Plant Systems																					
4a.1.5.1	Auxiliary Steam	-	53	-	-	-	-	-	8	61	-	-	61	-	-	-	-	-	-	1,391	-
4a.1.5.2	Auxiliary Steam - RCA	-	31	1	2	31	-	-	13	76	76	-	-	376	-	-	-	-	15,255	605	-
4a.1.5.3	Chemical Addition - Cont	-	56	1	2	49	-	-	22	130	130	-	-	596	-	-	-	-	24,217	1,127	-
4a.1.5.4	Chemical Addition - Cont - Insulated	-	9	0	0	5	-	-	3	17	17	-	-	61	-	-	-	-	2,461	169	-
4a.1.5.5	Chemical Addition - Insulated - RCA	-	7	0	0	5	-	-	3	15	15	-	-	61	-	-	-	-	2,461	124	-
4a.1.5.6	Chemical Addition - RCA	-	48	1	3	54	-	-	21	126	126	-	-	658	-	-	-	-	26,704	903	-
4a.1.5.7	Chemical Feed Secondary Cycle	-	12	-	-	-	-	-	2	14	-	-	14	-	-	-	-	-	-	331	-
4a.1.5.8	Chemical Feed Secondary Cycle - RCA	-	6	0	0	4	-	-	2	13	13	-	-	51	-	-	-	-	2,067	107	-
4a.1.5.9	Chilled Water	-	59	-	-	-	-	-	9	68	-	-	68	-	-	-	-	-	-	1,520	-
4a.1.5.10	Chilled Water - RCA	-	64	1	3	55	-	-	25	148	148	-	-	672	-	-	-	-	27,273	1,225	-
4a.1.5.11	Circulating Water	-	90	-	-	-	-	-	14	104	-	-	104	-	-	-	-	-	-	2,318	-

Table C
Crystal River Unit 3 Nuclear Generating Plant
SAFSTOR Decommissioning Cost Estimate
(thousands of 2011 dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Disposal of Plant Systems (continued)																					
4a.1.5.12	Cond Demin Regeneration	-	43	-	-	-	-	-	6	49	-	-	49	-	-	-	-	-	-	1,049	-
4a.1.5.13	Condensate	-	109	-	-	-	-	-	16	125	-	-	125	-	-	-	-	-	-	2,868	-
4a.1.5.14	Condensate & Demin Water Supply	-	23	-	-	-	-	-	4	27	-	-	27	-	-	-	-	-	-	606	-
4a.1.5.15	Condensate & Demin Water Supply - Cont	-	63	1	2	40	-	-	22	127	127	-	-	483	-	-	-	-	19,601	1,284	-
4a.1.5.16	Condensate & Demin Water Supply - RCA	-	93	1	4	72	-	-	35	205	205	-	-	875	-	-	-	-	35,538	1,773	-
4a.1.5.17	Condensate - Cont	-	161	5	14	265	-	-	83	528	528	-	-	3,236	-	-	-	-	131,415	3,586	-
4a.1.5.18	Condensate Demineralizer	-	94	-	-	-	-	-	14	108	-	-	108	-	-	-	-	-	-	2,482	-
4a.1.5.19	Condensate Demineralizer - Cont	-	134	3	7	132	-	-	55	330	330	-	-	1,604	-	-	-	-	65,131	2,800	-
4a.1.5.20	Condenser Air Removal & Priming	-	91	-	-	-	-	-	14	104	-	-	104	-	-	-	-	-	-	2,308	-
4a.1.5.21	Cycle Makeup Demin Water	-	60	-	-	-	-	-	9	69	-	-	69	-	-	-	-	-	-	1,472	-
4a.1.5.22	Cycle Makeup Demin Water - RCA	-	60	1	2	42	-	-	22	126	126	-	-	513	-	-	-	-	20,841	1,125	-
4a.1.5.23	Cycle Startup	-	8	-	-	-	-	-	1	10	-	-	10	-	-	-	-	-	-	222	-
4a.1.5.24	Cycle Startup - RCA	-	20	1	2	35	-	-	11	68	68	-	-	431	-	-	-	-	17,510	401	-
4a.1.5.25	Diesel Jacket Coolant	-	26	-	-	-	-	-	4	29	-	-	29	-	-	-	-	-	-	613	-
4a.1.5.26	Diesel-Air Cooler Coolant	-	4	-	-	-	-	-	1	5	-	-	5	-	-	-	-	-	-	108	-
4a.1.5.27	EDG FO & Compressed Air & Exhaust	-	42	-	-	-	-	-	6	48	-	-	48	-	-	-	-	-	-	1,028	-
4a.1.5.28	EDG Lube Oil	-	4	-	-	-	-	-	1	5	-	-	5	-	-	-	-	-	-	111	-
4a.1.5.29	EFP-3 Compressed and Starting Air	-	11	-	-	-	-	-	2	12	-	-	12	-	-	-	-	-	-	302	-
4a.1.5.30	EFP-3 Fuel Oil Transfer	-	17	-	-	-	-	-	2	19	-	-	19	-	-	-	-	-	-	441	-
4a.1.5.31	EFPB Sump Discharge	-	7	-	-	-	-	-	1	9	-	-	9	-	-	-	-	-	-	225	-
4a.1.5.32	Emergency Feedwater	-	69	-	-	-	-	-	10	80	-	-	80	-	-	-	-	-	-	1,668	-
4a.1.5.33	Emergency Feedwater - RCA	-	124	3	7	135	-	-	52	320	320	-	-	1,640	-	-	-	-	66,593	2,413	-
4a.1.5.34	Extraction Steam	-	113	-	-	-	-	-	17	130	-	-	130	-	-	-	-	-	-	2,916	-
4a.1.5.35	FW Heater Relief Vents & Drains	-	46	-	-	-	-	-	7	53	-	-	53	-	-	-	-	-	-	1,225	-
4a.1.5.36	FW Heater Relief Vents & Drains - Cont	-	56	1	2	30	-	-	19	107	107	-	-	366	-	-	-	-	14,864	1,187	-
4a.1.5.37	Feedwater	-	88	-	-	-	-	-	13	101	-	-	101	-	-	-	-	-	-	2,106	-
4a.1.5.38	Feedwater - Insulated	-	45	-	-	-	-	-	7	52	-	-	52	-	-	-	-	-	-	1,222	-
4a.1.5.39	Feedwater - Insulated - RCA	-	97	4	10	188	-	-	54	353	353	-	-	2,293	-	-	-	-	93,138	1,961	-
4a.1.5.40	Feedwater - RCA	-	23	1	2	47	-	-	13	86	86	-	-	572	-	-	-	-	23,243	453	-
4a.1.5.41	HVAC-Misc Outbldgs	-	17	-	-	-	-	-	2	19	-	-	19	-	-	-	-	-	-	469	-
4a.1.5.42	LP & HP Feedwater Drains & Vents	-	191	-	-	-	-	-	29	219	-	-	219	-	-	-	-	-	-	5,048	-
4a.1.5.43	LP & HP Feedwater Drains & Vents - Cont	-	209	4	10	192	-	-	83	498	498	-	-	2,346	-	-	-	-	95,269	4,444	-
4a.1.5.44	Liquid Sampling - Cont	-	64	1	1	26	-	-	20	112	112	-	-	313	-	-	-	-	12,721	1,396	-
4a.1.5.45	Liquid Sampling - RCA	-	54	1	1	28	-	-	18	102	102	-	-	336	-	-	-	-	13,655	1,100	-
4a.1.5.46	Lube Oil	-	11	-	-	-	-	-	2	12	-	-	12	-	-	-	-	-	-	256	-
4a.1.5.47	Main & Reheat Steam	-	84	-	-	-	-	-	13	96	-	-	96	-	-	-	-	-	-	2,230	-
4a.1.5.48	Main & Reheat Steam - Cont	-	546	36	95	1,869	-	-	435	2,981	2,981	-	-	22,779	-	-	-	-	925,077	11,999	-
4a.1.5.49	Main & Reheat Steam - RCA	-	14	0	1	19	-	-	6	40	40	-	-	226	-	-	-	-	9,182	279	-
4a.1.5.50	Misc Turbine Room Steam Drains	-	47	-	-	-	-	-	7	54	-	-	54	-	-	-	-	-	-	1,332	-
4a.1.5.51	Misc Turbine Room Steam Drains - Cont	-	193	2	6	115	-	-	67	383	383	-	-	1,405	-	-	-	-	57,049	3,733	-
4a.1.5.52	Nitrogen/Hydrogen/Carbon Dioxide	-	26	-	-	-	-	-	4	30	-	-	30	-	-	-	-	-	-	736	-
4a.1.5.53	Nuc Serv & Decay Heat Sea Water	-	46	-	-	-	-	-	7	53	-	-	53	-	-	-	-	-	-	1,172	-
4a.1.5.54	Nuc Serv & Decay Heat Sea Water - Cont	-	65	6	16	307	-	-	65	459	459	-	-	3,740	-	-	-	-	151,890	1,438	-
4a.1.5.55	Nuc Serv & Decay Heat Sea Water - RCA	-	70	4	10	205	-	-	50	340	340	-	-	2,504	-	-	-	-	101,697	1,455	-
4a.1.5.56	RC & Misc Waste Evaporator	-	358	20	36	498	73	-	190	1,176	1,176	-	-	6,075	368	-	-	-	275,377	7,952	-
4a.1.5.57	RC & Misc Waste Evaporator - Insulated	-	34	3	4	5	22	-	16	84	84	-	-	62	92	-	-	-	11,030	633	-
4a.1.5.58	Screen Wash Water	-	41	-	-	-	-	-	6	47	-	-	47	-	-	-	-	-	-	989	-
4a.1.5.59	Seal & Spray Water	-	4	-	-	-	-	-	1	4	-	-	4	-	-	-	-	-	-	99	-
4a.1.5.60	Seal & Spray Water - Cont	-	96	1	3	67	-	-	35	202	202	-	-	814	-	-	-	-	33,044	1,877	-
4a.1.5.61	Seal & Spray Water - RCA	-	76	1	3	64	-	-	29	174	174	-	-	783	-	-	-	-	31,811	1,379	-
4a.1.5.62	Secondary Cycle Sampling	-	21	-	-	-	-	-	3	25	-	-	25	-	-	-	-	-	-	622	-
4a.1.5.63	Secondary Cycle Sampling - Cont	-	9	0	0	5	-	-	3	17	17	-	-	60	-	-	-	-	2,419	169	-
4a.1.5.64	Secondary Cycle Sampling - Cont - Ins	-	3	0	0	2	-	-	1	6	6	-	-	20	-	-	-	-	810	57	-
4a.1.5.65	Secondary Cycle Sampling - Insulated	-	6	-	-	-	-	-	1	7	-	-	7	-	-	-	-	-	-	180	-
4a.1.5.66	Secondary Serv Closed Cycle Cooling	-	190	-	-	-	-	-	29	219	-	-	219	-	-	-	-	-	-	4,978	-
4a.1.5.67	Turb Bldg Sump & Oily Water Separator	-	19	-	-	-	-	-	3	22	-	-	22	-	-	-	-	-	-	491	-
4a.1.5.68	Turbine Generator Seal Oil	-	23	-	-	-	-	-	3	26	-	-	26	-	-	-	-	-	-	621	-
4a.1.5.69	Turbine Gland Steam & Drains	-	15	-	-	-	-	-	2	17	-	-	17	-	-	-	-	-	-	391	-
4a.1.5.70	Turbine Lube Oil	-	44	-	-	-	-	-	7	51	-	-	51	-	-	-	-	-	-	1,107	-
4a.1.5.71	Waste Drumming	-	15	1	1	2	9	-	7	35	35	-	-	26	39	-	-	-	4,667	268	-
4a.1.5.72	Waste Gas Disposal	-	260	19	26	195	109	-	127	736	736	-	-	2,374	481	-	-	-	138,892	5,324	-
4a.1.5	Totals	-	5,017	124	276	4,787	213	-	1,889	12,306	10,123	-	2,184	58,350	980	-	-	-	2,452,901	113,990	-
4a.1.6	Scaffolding in support of decommissioning	-	784	21	5	71	5	-	211	1,097	1,097	-	-	784	87	-	-	-	39,211	22,214	-
4a.1	Subtotal Period 4a Activity Costs	157	20,518	16,830	6,469	6,076	29,138	364	22,045	101,597	99,413	-	2,184	68,896	73,394	250	501	2,142	9,691,324	233,907	7,844

Table C
Crystal River Unit 3 Nuclear Generating Plant
SAFSTOR Decommissioning Cost Estimate
(thousands of 2011 dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
	Period 4a Additional Costs																				
4a.2.1	RVCH Segmentation and Disposal	-	-	158	498	-	655	-	254	1,565	1,565	-	-	-	2,478	-	-	-	308,903	2,092	2,000
4a.2.2	OTSG Hot legs	-	-	-	47	-	838	-	217	1,102	1,102	-	-	-	2,940	-	-	-	172,000	-	-
4a.2	Subtotal Period 4a Additional Costs	-	-	158	545	-	1,493	-	471	2,667	2,667	-	-	-	5,418	-	-	-	480,903	2,092	2,000
	Period 4a Collateral Costs																				
4a.3.1	Process decommissioning water waste	3	-	4	23	-	21	-	11	63	63	-	-	-	56	-	-	-	3,379	11	-
4a.3.3	Small tool allowance	-	194	-	-	-	-	-	29	223	200	-	22	-	-	-	-	-	-	-	-
4a.3.4	Florida LLRW Inspection Fee	-	-	-	-	-	-	315	32	347	347	-	-	-	-	-	-	-	-	-	-
4a.3	Subtotal Period 4a Collateral Costs	3	194	4	23	-	21	315	71	632	610	-	22	-	56	-	-	-	3,379	11	-
	Period 4a Period-Dependent Costs																				
4a.4.1	Decon supplies	65	-	-	-	-	-	-	16	81	81	-	-	-	-	-	-	-	-	-	-
4a.4.2	Insurance	-	-	-	-	-	-	773	77	850	850	-	-	-	-	-	-	-	-	-	-
4a.4.3	Property taxes	-	-	-	-	-	-	1,049	105	1,154	1,039	-	115	-	-	-	-	-	-	-	-
4a.4.4	Health physics supplies	-	1,640	-	-	-	-	-	410	2,050	2,050	-	-	-	-	-	-	-	-	-	-
4a.4.5	Heavy equipment rental	-	2,346	-	-	-	-	-	352	2,698	2,698	-	-	-	-	-	-	-	-	-	-
4a.4.6	Disposal of DAW generated	-	-	82	59	-	171	-	60	372	372	-	-	-	3,483	-	-	-	69,667	114	-
4a.4.7	Plant energy budget	-	-	-	-	-	-	1,072	161	1,233	1,233	-	-	-	-	-	-	-	-	-	-
4a.4.8	NRC Fees	-	-	-	-	-	-	790	79	869	869	-	-	-	-	-	-	-	-	-	-
4a.4.9	Utility Site Indirect	-	-	-	-	-	-	1,347	202	1,550	1,550	-	-	-	-	-	-	-	-	-	-
4a.4.10	Liquid Radwaste Processing Equipment/Services	-	-	-	-	-	-	427	64	491	491	-	-	-	-	-	-	-	-	-	-
4a.4.11	Corporate Allocations	-	-	-	-	-	-	968	145	1,113	1,113	-	-	-	-	-	-	-	-	-	-
4a.4.12	Security Staff Cost	-	-	-	-	-	-	3,215	482	3,698	3,698	-	-	-	-	-	-	-	-	-	71,786
4a.4.13	DOC Staff Cost	-	-	-	-	-	-	12,969	1,945	14,914	14,914	-	-	-	-	-	-	-	-	-	158,503
4a.4.14	Utility Staff Cost	-	-	-	-	-	-	15,096	2,264	17,361	17,361	-	-	-	-	-	-	-	-	-	287,143
4a.4	Subtotal Period 4a Period-Dependent Costs	65	3,987	82	59	-	171	37,707	6,364	48,435	48,319	-	115	-	3,483	-	-	-	69,667	114	517,431
4a.0	TOTAL PERIOD 4a COST	226	24,698	17,075	7,096	6,076	30,823	38,387	28,951	153,331	151,009	-	2,321	68,896	82,352	250	501	2,142	10,245,270	236,124	527,275
	PERIOD 4b - Site Decontamination																				
	Period 4b Direct Decommissioning Activities																				
4b.1.1	Remove spent fuel racks	339	37	175	87	-	580	-	354	1,573	1,573	-	-	-	2,447	-	-	-	226,532	989	-
	Disposal of Plant Systems																				
4b.1.2.1	ACC Diesel Gen.	-	16	-	-	-	-	-	2	18	-	-	18	-	-	-	-	-	-	369	-
4b.1.2.2	Chemical Cleaning Steam Gen - Cont	-	22	0	1	12	-	-	8	43	43	-	-	151	-	-	-	-	6,141	152	-
4b.1.2.3	Chemical Cleaning Steam Gen - RCA	-	21	0	1	15	-	-	8	45	45	-	-	188	-	-	-	-	7,642	399	-
4b.1.2.4	Containment Monitoring	-	54	1	1	29	-	-	18	103	103	-	-	351	-	-	-	-	14,268	1,068	-
4b.1.2.5	Core Flooding	-	90	2	6	113	-	-	40	250	250	-	-	1,373	-	-	-	-	55,743	1,836	-
4b.1.2.6	Decay Heat Closed Cycle Cooling	-	311	14	36	710	-	-	191	1,261	1,261	-	-	8,651	-	-	-	-	351,308	6,555	-
4b.1.2.7	Decay Heat Removal	-	278	36	65	600	230	-	231	1,441	1,441	-	-	7,317	982	-	-	-	387,145	6,068	-
4b.1.2.8	Diesel Fuel Oil Tanks-UST's	-	22	-	-	-	-	-	3	25	-	-	25	-	-	-	-	-	-	493	-
4b.1.2.9	Domestic Water	-	37	-	-	-	-	-	6	42	-	-	42	-	-	-	-	-	-	985	-
4b.1.2.10	Domestic Water - RCA	-	61	1	2	43	-	-	22	129	129	-	-	525	-	-	-	-	21,339	1,106	-
4b.1.2.11	Electrical - Clean	-	548	-	-	-	-	-	82	630	-	-	630	-	-	-	-	-	-	13,208	-
4b.1.2.12	Electrical - Contaminated	-	504	7	18	360	-	-	183	1,073	1,073	-	-	4,394	-	-	-	-	178,459	10,259	-
4b.1.2.13	Electrical - Decontaminated	-	3,548	69	175	3,420	-	-	1,433	8,644	8,644	-	-	41,690	-	-	-	-	1,693,054	68,485	-
4b.1.2.14	Fire Service Water	-	271	-	-	-	-	-	41	312	-	-	312	-	-	-	-	-	-	6,727	-
4b.1.2.15	Fire Service Water - RCA	-	497	12	30	585	-	-	218	1,340	1,340	-	-	7,126	-	-	-	-	289,375	9,742	-
4b.1.2.16	Floor & Equip Drains - Aux & Reac Bldg	-	167	20	32	214	143	-	117	694	694	-	-	2,614	604	-	-	-	162,020	3,472	-
4b.1.2.17	HVAC - Auxiliary Bldg	-	209	7	17	342	-	-	107	683	683	-	-	4,174	-	-	-	-	169,500	4,279	-
4b.1.2.18	HVAC - Clean Machine Shop	-	8	-	-	-	-	-	1	9	-	-	9	-	-	-	-	-	-	196	-
4b.1.2.19	HVAC - Control Complex	-	38	-	-	-	-	-	6	44	-	-	44	-	-	-	-	-	-	944	-
4b.1.2.20	HVAC - Diesel Gen Bldg	-	7	-	-	-	-	-	1	8	-	-	8	-	-	-	-	-	-	168	-
4b.1.2.21	HVAC - Fire Pump House	-	3	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	72	-
4b.1.2.22	HVAC - Fuel Handling Area	-	192	5	13	246	-	-	87	543	543	-	-	3,001	-	-	-	-	121,884	3,690	-
4b.1.2.23	HVAC - Hot Machine Shop	-	33	1	2	42	-	-	15	93	93	-	-	511	-	-	-	-	20,735	662	-
4b.1.2.24	HVAC - Intermediate Bldg	-	63	3	8	148	-	-	39	260	260	-	-	1,799	-	-	-	-	73,076	1,291	-
4b.1.2.25	HVAC - Maintenance Support	-	6	-	-	-	-	-	1	7	-	-	7	-	-	-	-	-	-	162	-
4b.1.2.26	HVAC - Office Bldg	-	7	-	-	-	-	-	1	8	-	-	8	-	-	-	-	-	-	176	-
4b.1.2.27	HVAC - Reactor Bldg	-	391	12	32	636	-	-	199	1,271	1,271	-	-	7,751	-	-	-	-	314,790	7,743	-
4b.1.2.28	HVAC - Turbine Bldg	-	109	-	-	-	-	-	16	125	-	-	125	-	-	-	-	-	-	3,059	-
4b.1.2.29	ICI Instrumentation	-	103	1	3	61	-	-	35	204	204	-	-	740	-	-	-	-	30,061	1,883	-
4b.1.2.30	Industrial Cooler Water	-	31	-	-	-	-	-	5	36	-	-	36	-	-	-	-	-	-	731	-
4b.1.2.31	Industrial Cooler Water - RCA	-	190	4	10	190	-	-	78	472	472	-	-	2,320	-	-	-	-	94,222	3,708	-
4b.1.2.32	Instrument & Station Service Air	-	69	-	-	-	-	-	10	80	-	-	80	-	-	-	-	-	-	1,884	-
4b.1.2.33	Instrument & Station Service Air - Cont	-	150	2	5	95	-	-	53	305	305	-	-	1,160	-	-	-	-	47,115	3,121	-

Table C
Crystal River Unit 3 Nuclear Generating Plant
SAFSTOR Decommissioning Cost Estimate
(thousands of 2011 dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Disposal of Plant Systems (continued)																					
4b.1.2.34	Instrument & Station Service Air - RCA	-	271	3	8	165	-	-	94	542	542	-	-	2,012	-	-	-	-	81,728	5,162	-
4b 1.2.35	Leak Rate Test - Cont	-	84	1	3	59	-	-	31	178	178	-	-	723	-	-	-	-	29,355	1,775	-
4b 1.2.36	Leak Rate Test - RCA	-	77	2	4	78	-	-	32	192	192	-	-	945	-	-	-	-	38,385	1,566	-
4b 1.2.37	Liquid Waste Disposal	-	827	52	73	289	392	-	364	1,998	1,998	-	-	3,528	1,675	-	-	-	296,566	17,036	-
4b.1.2.38	Makeup & Purification	-	570	7	18	357	-	-	200	1,152	1,152	-	-	4,355	-	-	-	-	176,876	11,685	-
4b.1.2.39	Makeup & Purification - Insulated	-	144	2	4	77	-	-	48	274	274	-	-	941	-	-	-	-	38,212	2,994	-
4b 1.2.40	Nitrogen/Hydrogen/Carbon Dioxide - Cont	-	22	0	1	12	-	-	7	42	42	-	-	148	-	-	-	-	6,028	419	-
4b.1.2.41	Nitrogen/Hydrogen/Carbon Dioxide - RCA	-	80	1	3	53	-	-	29	166	166	-	-	644	-	-	-	-	26,153	1,402	-
4b 1.2.42	Noble Gas Effluent Monitoring - Cont	-	19	0	1	12	-	-	7	40	40	-	-	152	-	-	-	-	6,172	389	-
4b 1.2.43	Noble Gas Effluent Monitoring - RCA	-	16	0	1	12	-	-	6	35	35	-	-	152	-	-	-	-	6,172	299	-
4b.1.2.44	Nuc Serv Closed Cycle Cooling - Cont	-	645	20	52	1,010	-	-	322	2,049	2,049	-	-	12,315	-	-	-	-	500,136	13,503	-
4b.1.2.45	Nuc Serv Closed Cycle Cooling - RCA	-	566	26	65	1,281	-	-	346	2,284	2,284	-	-	15,611	-	-	-	-	633,983	11,323	-
4b.1.2.46	PASS Containment Monitoring - Cont	-	7	0	0	4	-	-	2	14	14	-	-	44	-	-	-	-	1,777	147	-
4b.1.2.47	PASS Containment Monitoring - RCA	-	16	0	1	11	-	-	6	33	33	-	-	128	-	-	-	-	5,207	306	-
4b.1 2.48	Post Accident Sampling - Cont	-	29	0	1	17	-	-	10	57	57	-	-	205	-	-	-	-	8 339	579	-
4b.1.2.49	Post Accident Sampling - RCA	-	27	0	1	19	-	-	10	58	58	-	-	237	-	-	-	-	9,629	520	-
4b.1.2 50	Post Accident Venting - Cont	-	33	1	2	34	-	-	14	83	83	-	-	411	-	-	-	-	16,678	680	-
4b.1.2 51	Post Accident Venting - RCA	-	12	0	1	13	-	-	5	32	32	-	-	162	-	-	-	-	6,581	234	-
4b.1.2.52	RB Penetration Cooling - RCA	-	111	2	4	79	-	-	40	235	235	-	-	960	-	-	-	-	39,005	2,178	-
4b.1.2.53	RCP Lube Oil - Cont	-	4	0	0	5	-	-	2	11	11	-	-	58	-	-	-	-	2,361	85	-
4b.1.2 54	RCP Lube Oil - RCA	-	3	0	0	5	-	-	2	10	10	-	-	58	-	-	-	-	2,361	66	-
4b.1.2.55	Radwaste Demineralizer	-	29	2	3	15	13	-	13	74	74	-	-	177	54	-	-	-	12,173	581	-
4b.1 2 56	Reac Bldg Pressure Sensing & Test	-	2	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	55	-
4b.1 2 57	Reac Bldg Pressure Sensing & Test - RCA	-	38	0	1	24	-	-	13	78	78	-	-	293	-	-	-	-	11,905	673	-
4b.1.2.58	Reactor Building Spray	-	210	4	12	226	-	-	89	540	540	-	-	2,752	-	-	-	-	111,740	4,454	-
4b.1 2 59	Refueling Equipment	-	129	7	14	116	54	-	66	387	387	-	-	1,412	230	-	-	-	78,597	3,003	-
4b.1.2.60	Sewage	-	11	-	-	-	-	-	2	13	-	-	13	-	-	-	-	-	-	282	-
4b.1 2 61	Spent Fuel Cooling	-	459	30	51	323	233	-	232	1,328	1,328	-	-	3,938	985	-	-	-	251,108	10,091	-
4b.1 2.62	Waste Gas Sampling	-	62	1	2	36	-	-	21	122	122	-	-	443	-	-	-	-	18,005	1,190	-
4b.1 2 63	Wet Layup/N2 Blanketing	-	4	-	-	-	-	-	1	4	-	-	4	-	-	-	-	-	-	112	-
4b.1 2 64	Wet Layup/N2 Blanketing - Cont	-	7	0	0	3	-	-	2	12	12	-	-	40	-	-	-	-	1,626	132	-
4b 1 2 65	Wet Layup/N2 Blanketing - RCA	-	3	0	0	2	-	-	1	7	7	-	-	24	-	-	-	-	978	61	-
4b 1 2	Totals	-	12,573	359	782	12,199	1,067	-	5,274	32,254	30,888	-	1,366	148,708	4,630	-	-	-	6,455,713	257,974	-
4b 1 3	Scaffolding in support of decommissioning	-	1,176	31	8	107	7	-	316	1,646	1,646	-	-	1,176	131	-	-	-	58,817	33,321	-
Decontamination of Site Buildings																					
4b 1 4 1	Reactor	897	686	36	309	186	1,080	-	968	4,161	4,161	-	-	2,269	9,759	-	-	-	828,288	32,510	-
4b.1.4.2	Auxiliary Building	308	100	4	42	41	55	-	206	757	757	-	-	497	1,103	-	-	-	114,373	8,770	-
4b 1 4 3	Fuel Handling Area (Aux Bldg)	729	563	17	48	359	48	-	580	2,344	2,344	-	-	4,376	947	-	-	-	251,090	27,183	-
4b.1.4.4	Intermediate Bldg	63	23	1	10	17	12	-	44	170	170	-	-	208	242	-	-	-	28,998	1,822	-
4b 1 4 5	Machine Shop - Hot	48	10	0	7	0	9	-	30	104	104	-	-	3	181	-	-	-	15,752	1,236	-
4b 1 4 6	RB Maintenance Bldg and HP Office	6	4	0	2	-	2	-	5	19	19	-	-	-	49	-	-	-	4,260	199	-
4b.1.4.7	RM Warehouse	30	6	0	4	-	6	-	19	65	65	-	-	-	114	-	-	-	9,900	773	-
4b 1 4 8	RVCH Storage Building	4	2	0	1	2	1	-	3	13	13	-	-	27	13	-	-	-	2 176	130	-
4b 1.4	Totals	2,084	1,395	59	422	605	1,213	-	1,854	7,633	7,633	-	-	7,380	12,408	-	-	-	1,254 837	72,622	-
4b 1	Subtotal Period 4b Activity Costs	2,424	15,182	624	1,299	12,911	2,867	-	7,799	43,105	41,739	-	1,366	157,264	19,517	-	-	-	7,995,898	364,906	-
Period 4b Additional Costs																					
4b.2.1	License Termination Survey Planning	-	-	-	-	-	-	1,445	434	1,879	1,879	-	-	-	-	-	-	-	-	-	12,480
4b.2.2	Asbestos Removal Program	-	35	18	19	-	136	-	47	256	256	-	-	-	500	-	-	-	25,000	940	-
4b 2.3	ISFSI License Termination	-	180	5	33	-	26	1,276	248	1 768	-	1,768	-	-	577	-	-	-	96,514	5,133	2,560
4b.2.4	West Settling Pond	-	22	0	65	-	770	-	208	1,065	1,065	-	-	-	13,500	-	-	-	1,053,000	309	-
4b 2	Subtotal Period 4b Additional Costs	-	237	23	117	-	932	2,722	937	4,968	3,200	1,768	-	-	14,577	-	-	-	1,174,514	6,383	15,040
Period 4b Collateral Costs																					
4b 3.1	Process decommissioning water waste	10	-	11	67	-	62	-	32	182	182	-	-	-	164	-	-	-	9,825	32	-
4b.3.3	Small tool allowance	-	296	-	-	-	-	-	44	341	341	-	-	-	-	-	-	-	-	-	-
4b.3.4	Decommissioning Equipment Disposition	-	-	158	48	545	38	-	114	903	903	-	-	6,000	667	-	-	-	300,000	88	-
4b.3.5	Florida LLRW Inspection Fee	-	-	-	-	-	-	373	37	410	410	-	-	-	-	-	-	-	-	-	-
4b.3.6	On-site survey and release of 134.9 tons clean metallic waste	-	-	-	-	-	-	148	15	163	163	-	-	-	-	-	-	-	-	-	-
4b.3	Subtotal Period 4b Collateral Costs	10	296	169	115	545	100	521	242	1,999	1,999	-	-	6,000	830	-	-	-	309,825	120	-
Period 4b Period-Dependent Costs																					
4b.4.1	Decon supplies	982	-	-	-	-	-	-	245	1,227	1,227	-	-	-	-	-	-	-	-	-	-
4b.4 2	Insurance	-	-	-	-	-	-	1,136	114	1,250	1,250	-	-	-	-	-	-	-	-	-	-
4b.4.3	Property taxes	-	-	-	-	-	-	1,449	145	1,594	1,594	-	-	-	-	-	-	-	-	-	-

Table C
Crystal River Unit 3 Nuclear Generating Plant
SAFSTOR Decommissioning Cost Estimate
(thousands of 2011 dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Period 4b Period-Dependent Costs (continued)																					
4b.4.4	Health physics supplies	-	2,513	-	-	-	-	-	628	3,142	3,142	-	-	-	-	-	-	-	-	-	-
4b.4.5	Heavy equipment rental	-	3,421	-	-	-	-	-	513	3,935	3,935	-	-	-	-	-	-	-	-	-	-
4b.4.6	Disposal of DAW generated	-	-	135	97	-	279	-	98	609	609	-	-	-	5,701	-	-	-	114,015	186	-
4b.4.7	Plant energy budget	-	-	-	-	-	-	1,245	187	1,431	1,431	-	-	-	-	-	-	-	-	-	-
4b.4.8	NRC Fees	-	-	-	-	-	-	1,161	116	1,278	1,278	-	-	-	-	-	-	-	-	-	-
4b.4.9	Utility Site Indirect	-	-	-	-	-	-	1,887	283	2,170	2,170	-	-	-	-	-	-	-	-	-	-
4b.4.10	Liquid Radwaste Processing Equipment/Services	-	-	-	-	-	-	628	94	722	722	-	-	-	-	-	-	-	-	-	-
4b.4.11	Corporate Allocations	-	-	-	-	-	-	1,344	202	1,545	1,545	-	-	-	-	-	-	-	-	-	-
4b.4.12	Security Staff Cost	-	-	-	-	-	-	4,727	709	5,436	5,436	-	-	-	-	-	-	-	-	-	105,536
4b.4.13	DOC Staff Cost	-	-	-	-	-	-	18,601	2,790	21,391	21,391	-	-	-	-	-	-	-	-	-	226,269
4b.4.14	Utility Staff Cost	-	-	-	-	-	-	21,089	3,163	24,253	24,253	-	-	-	-	-	-	-	-	-	398,503
4b.4	Subtotal Period 4b Period-Dependent Costs	982	5,935	135	97	-	279	53,266	9,287	69,981	69,981	-	-	-	5,701	-	-	-	114,015	186	730,307
4b.0	TOTAL PERIOD 4b COST	3,415	21,650	951	1,627	13,457	4,178	56,509	18,266	120,054	116,919	1,768	1,366	163,264	40,625	-	-	-	9,594,252	371,595	745,347
PERIOD 4f - License Termination																					
Period 4f Direct Decommissioning Activities																					
4f.1.1	ORISE confirmatory survey	-	-	-	-	-	-	154	46	200	200	-	-	-	-	-	-	-	-	-	-
4f.1.2	Terminate license									a											
4f.1	Subtotal Period 4f Activity Costs	-	-	-	-	-	-	154	46	200	200	-	-	-	-	-	-	-	-	-	-
Period 4f Additional Costs																					
4f.2.1	License Termination Survey	-	-	-	-	-	-	6,048	1,815	7,863	7,863	-	-	-	-	-	-	-	-	123,073	6,240
4f.2	Subtotal Period 4f Additional Costs	-	-	-	-	-	-	6,048	1,815	7,863	7,863	-	-	-	-	-	-	-	-	123,073	6,240
Period 4f Collateral Costs																					
4f.3.1	DOC staff relocation expenses	-	-	-	-	-	-	1,258	189	1,446	1,446	-	-	-	-	-	-	-	-	-	-
4f.3.2	Florida LLRW Inspection Fee	-	-	-	-	-	-	1	0	1	1	-	-	-	-	-	-	-	-	-	-
4f.3	Subtotal Period 4f Collateral Costs	-	-	-	-	-	-	1,258	189	1,447	1,447	-	-	-	-	-	-	-	-	-	-
Period 4f Period-Dependent Costs																					
4f.4.1	Insurance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4f.4.2	Property taxes	-	-	-	-	-	-	608	61	669	669	-	-	-	-	-	-	-	-	-	-
4f.4.3	Health physics supplies	-	654	-	-	-	-	-	163	817	817	-	-	-	-	-	-	-	-	-	-
4f.4.4	Disposal of DAW generated	-	-	8	6	-	17	-	6	37	37	-	-	-	350	-	-	-	6,999	11	-
4f.4.5	Plant energy budget	-	-	-	-	-	-	154	23	177	177	-	-	-	-	-	-	-	-	-	-
4f.4.6	NRC Fees	-	-	-	-	-	-	577	58	635	635	-	-	-	-	-	-	-	-	-	-
4f.4.7	Utility Site Indirect	-	-	-	-	-	-	436	65	501	501	-	-	-	-	-	-	-	-	-	-
4f.4.8	Corporate Allocations	-	-	-	-	-	-	251	38	288	288	-	-	-	-	-	-	-	-	-	-
4f.4.9	Security Staff Cost	-	-	-	-	-	-	935	140	1,076	1,076	-	-	-	-	-	-	-	-	-	18,789
4f.4.10	DOC Staff Cost	-	-	-	-	-	-	5,064	760	5,823	5,823	-	-	-	-	-	-	-	-	-	57,149
4f.4.11	Utility Staff Cost	-	-	-	-	-	-	4,442	666	5,108	5,108	-	-	-	-	-	-	-	-	-	74,371
4f.4	Subtotal Period 4f Period-Dependent Costs	-	654	8	6	-	17	12,466	1,980	15,131	15,131	-	-	-	350	-	-	-	6,999	11	150,309
4f.0	TOTAL PERIOD 4f COST	-	654	8	6	-	17	19,926	4,029	24,641	24,641	-	-	-	350	-	-	-	6,999	123,085	156,549
PERIOD 4 TOTALS		3,641	47,002	18 034	8,729	19,532	35,019	114,822	51,246	298,025	292,570	1,768	3,687	232,160	123,327	250	501	2,142	19,846,530	730,804	1,429,171
PERIOD 5b - Site Restoration																					
Period 5b Direct Decommissioning Activities																					
Demolition of Remaining Site Buildings																					
5b.1.1.1	Reactor	-	4,063	-	-	-	-	-	609	4,672	-	-	4,672	-	-	-	-	-	-	47,823	-
5b.1.1.2	AAC Diesel Generator Building	-	19	-	-	-	-	-	3	22	-	-	22	-	-	-	-	-	-	223	-
5b.1.1.3	AWS Ready Warehouse	-	154	-	-	-	-	-	23	177	-	-	177	-	-	-	-	-	-	2,786	-
5b.1.1.4	Auxiliary Building	-	1,550	-	-	-	-	-	232	1,782	-	-	1,782	-	-	-	-	-	-	19,011	-
5b.1.1.5	Central Alarm Station	-	2	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	46	-
5b.1.1.6	Chemical Storage	-	57	-	-	-	-	-	9	66	-	-	66	-	-	-	-	-	-	858	-
5b.1.1.7	Control Complex	-	760	-	-	-	-	-	114	874	-	-	874	-	-	-	-	-	-	9,432	-
5b.1.1.8	Diesel Fuel Oil Tanks UST's	-	15	-	-	-	-	-	2	17	-	-	17	-	-	-	-	-	-	133	-
5b.1.1.9	Diesel Generator Bldg	-	294	-	-	-	-	-	44	338	-	-	338	-	-	-	-	-	-	4,335	-
5b.1.1.10	EFW Pump Building	-	128	-	-	-	-	-	19	147	-	-	147	-	-	-	-	-	-	1,711	-
5b.1.1.11	Fire Pumphouse	-	16	-	-	-	-	-	2	18	-	-	18	-	-	-	-	-	-	315	-
5b.1.1.12	Fuel Handling Area (Aux Bldg)	-	1,020	-	-	-	-	-	153	1,173	-	-	1,173	-	-	-	-	-	-	12,445	-
5b.1.1.13	Intake & Discharge Structures	-	431	-	-	-	-	-	65	496	-	-	496	-	-	-	-	-	-	6,051	-
5b.1.1.14	Intermediate Bldg	-	737	-	-	-	-	-	111	848	-	-	848	-	-	-	-	-	-	5,866	-

Table C
Crystal River Unit 3 Nuclear Generating Plant
SAFSTOR Decommissioning Cost Estimate
(thousands of 2011 dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
	Demolition of Remaining Site Buildings (continued)																				
5b 1.1.15	Machine Shop - Cold	-	81	-	-	-	-	-	12	93	-	-	93	-	-	-	-	-	-	1,460	-
5b 1 1 16	Machine Shop - Hot	-	77	-	-	-	-	-	11	88	-	-	88	-	-	-	-	-	-	1,396	-
5b.1.1.17	Misc Yard Structures & Foundations	-	1,460	-	-	-	-	-	219	1,678	-	-	1,678	-	-	-	-	-	-	12,067	-
5b 1 1 18	OTSG Storage Building	-	489	-	-	-	-	-	73	562	-	-	562	-	-	-	-	-	-	6,060	-
5b.1.1.19	RB Maintenance Bldg and HP Office	-	54	-	-	-	-	-	8	62	-	-	62	-	-	-	-	-	-	1,077	-
5b.1.1 20	RM Warehouse	-	37	-	-	-	-	-	6	43	-	-	43	-	-	-	-	-	-	445	-
5b 1.1 21	RVCH Storage Building	-	74	-	-	-	-	-	11	86	-	-	86	-	-	-	-	-	-	1,090	-
5b.1.1 22	Rusty Bldg	-	228	-	-	-	-	-	34	263	-	-	263	-	-	-	-	-	-	3,770	-
5b.1.1 23	Turbine Building	-	2,101	-	-	-	-	-	315	2,416	-	-	2,416	-	-	-	-	-	-	27,791	-
5b.1.1 24	Turbine Pedestal	-	442	-	-	-	-	-	66	509	-	-	509	-	-	-	-	-	-	4,730	-
5b.1.1	Totals	-	14,288	-	-	-	-	-	2,143	16,431	-	-	16,431	-	-	-	-	-	-	170,921	-
	Site Closeout Activities																				
5b 1.2	BackFill Site	-	830	-	-	-	-	-	125	955	-	-	955	-	-	-	-	-	-	1,451	-
5b.1 3	Grade & landscape site	-	186	-	-	-	-	-	28	214	-	-	214	-	-	-	-	-	-	316	-
5b.1.4	Final report to NRC	-	-	-	-	-	-	179	27	205	205	-	-	-	-	-	-	-	-	-	1,560
5b.1	Subtotal Period 5b Activity Costs	-	15,304	-	-	-	-	179	2,322	17,806	205	-	17,600	-	-	-	-	-	-	172,688	1,560
	Period 5b Additional Costs																				
5b 2.1	Concrete Crushing	-	563	-	-	-	-	5	85	654	-	-	654	-	-	-	-	-	-	2,514	-
5b.2.2	ISFSI Demolition and Restoration	-	770	-	-	-	-	48	123	940	-	940	-	-	-	-	-	-	-	4,410	160
5b 2.3	Intake & Discharge Structure Cofferdams	-	518	-	-	-	-	-	78	596	-	-	596	-	-	-	-	-	-	4,436	-
5b.2.4	Firing Range Closure	-	782	-	-	-	-	-	117	899	-	-	899	-	-	-	-	-	-	-	-
5b.2	Subtotal Period 5b Additional Costs	-	2,633	-	-	-	-	53	403	3,089	-	940	2,149	-	-	-	-	-	-	11,360	160
	Period 5b Collateral Costs																				
5b.3.1	Small tool allowance	-	161	-	-	-	-	-	24	186	-	-	186	-	-	-	-	-	-	-	-
5b.3.2	Corporate Allocations	-	-	-	-	-	-	232	35	267	-	-	267	-	-	-	-	-	-	-	-
5b.3.3	Utility Site Indirect	-	-	-	-	-	-	246	37	283	-	-	283	-	-	-	-	-	-	-	-
5b.3	Subtotal Period 5b Collateral Costs	-	161	-	-	-	-	478	96	736	-	-	736	-	-	-	-	-	-	-	-
	Period 5b Period-Dependent Costs																				
5b.4.1	Insurance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5b.4 2	Property taxes	-	-	-	-	-	-	451	45	496	-	-	496	-	-	-	-	-	-	-	-
5b.4.3	Heavy equipment rental	-	5,119	-	-	-	-	-	768	5,887	-	-	5,887	-	-	-	-	-	-	-	-
5b 4 4	Plant energy budget	-	-	-	-	-	-	173	26	199	-	-	199	-	-	-	-	-	-	-	-
5b.4.5	Security Staff Cost	-	-	-	-	-	-	2,106	316	2,422	-	-	2,422	-	-	-	-	-	-	-	42,309
5b.4.6	DOC Staff Cost	-	-	-	-	-	-	11,038	1,656	12,693	-	-	12,693	-	-	-	-	-	-	-	119,874
5b 4 7	Utility Staff Cost	-	-	-	-	-	-	4,044	607	4,650	-	-	4,650	-	-	-	-	-	-	-	68,751
5b.4	Subtotal Period 5b Period-Dependent Costs	-	5,119	-	-	-	-	17,811	3,417	26,348	-	-	26,348	-	-	-	-	-	-	-	230,934
5b.0	TOTAL PERIOD 5b COST	-	23,218	-	-	-	-	18,521	6,238	47,978	205	940	46,832	-	-	-	-	-	-	184,048	232,654
	PERIOD 5 TOTALS	-	23,218	-	-	-	-	18,521	6,238	47,978	205	940	46,832	-	-	-	-	-	-	184,048	232,654
	TOTAL COST TO DECOMMISSION	9,052	80,730	18,788	10,280	20,214	36,143	752,683	149,706	1,077,596	753,717	271,910	51,969	234,503	133,758	250	501	2,142	21,677,830	1,005,505	7,993,623

TOTAL COST TO DECOMMISSION WITH 16.13% CONTINGENCY:	$1,077,596	thousands of 2011 dollars
TOTAL NRC LICENSE TERMINATION COST IS 69.94% OR:	$753,717	thousands of 2011 dollars
SPENT FUEL MANAGEMENT COST IS 25.23% OR:	$271,910	thousands of 2011 dollars
NON-NUCLEAR DEMOLITION COST IS 4.82% OR:	$51,969	thousands of 2011 dollars
TOTAL PRIMARY SITE RADWASTE VOLUME BURIED:	134,509	cubic feet
TOTAL GREATER THAN CLASS C RADWASTE VOLUME GENERATED:	2,142	cubic feet
TOTAL SCRAP METAL REMOVED:	39,300	tons
TOTAL CRAFT LABOR REQUIREMENTS:	1,005,505	man-hours

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