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Florida Power

A **Progress Energy** Company

CRYSTAL RIVER NUCLEAR PLANT

2000
NUCLEAR DECOMMISSIONING
COST STUDY

FLORIDA POWER CORPORATION
2000 NUCLEAR DECOMMISSIONING COST STUDY

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FLORIDA POWER CORPORATION
2000 NUCLEAR DECOMMISSIONING COST STUDY
DECOMMISSIONING STUDY SUMMARY

A site specific decommissioning cost study has been prepared by TLG Services, Inc. (TLG) for Crystal River Unit No. Three (CR3) which estimates the cost of decommissioning to be $493,940,000 in 1999 dollars. Florida Power has escalated these cost study amounts to 2000 dollars of $515,770,000. The costs can be categorized as follows:

	(in 000's)		%
	1999 $'s	2000 $'s	of Total
Decontamination	$ 12,546	$ 13,086	2.5%
Removal	68,079	71,006	13.8%
Packaging	6,359	6,632	1.3%
Shipping	5,841	6,016	1.2%
Burial	72,306	77,729	15.1%
Staffing	153,685	160,293	31.1%
Other	175,124	181,008	35.0%
	$ 493,940	$ 515,770	100.0%

The cost estimate includes updated decommissioning assumptions from the cost study that was approved by the Florida Public Service Commission (FPSC) in 1995. The most significant changes are in the areas of staffing and high level waste costs. Comparative analyses detailing the factors that contributed to most significant cost changes since the last study are contained in Section H.

ESCALATION RATE

The future cost of decommissioning CR3 is forecast by analyzing the individual cost categories from TLG's cost study as described above. The 2000 cost of each category is divided into components of labor, material, burial, transportation and other. These components are escalated by the estimated inflationary rates for wages, material, transportation and Gross Domestic Product (Implicit Price Deflator no longer reported) as projected by Standard & Poor's DRI Review to the U.S. Economy, Long-Range Focus. Burial costs are escalated by a growth rate specific to low level radioactive waste burial costs. Section C contains schedules, which indicate the percentage allocations for each category and the applicable escalation rates. The cost estimate obtained by applying these rates yields the future cost of decommissioning CR3 using currently available technology and procedures.

The methodology used to determine the escalation rate for converting the current estimated decommissioning cost to future estimated decommissioning cost is the same as that approved in FPSC Order No. PSC-95-1531-FOF-EI dated December 12, 1995. An additional index was added in that study to capture the rate of escalation in low level radioactive waste burial cost, because burial cost had historically increased at a much faster rate than the other inflation indices that were used in the cost forecast. The resulting composite escalation rate is 5.56%.

The rate of increase in nuclear decommissioning costs has generally exceeded inflation. This is attributable primarily to increasing burial rates for low level radioactive waste and the impact of the delayed acceptance of high level radioactive waste by the Department of Energy. The delayed acceptance will, among other things, require FPC to design, license and construct an independent spent fuel storage installation (ISPSI), including a dry cask storage pad, the purchase of multi purpose canisters, and the provision of on site management of the high level waste.

MINIMUM FUND EARNINGS RATE

The minimum fund earnings rate was determined using the same methodology specified in Order No. 21928 (long-term CPI over the next 25 years), which results in a minimum fund earnings rate, net of taxes and all other administrative costs charged to the trust fund, of 3.40%. See Section D for the detailed calculation.

Florida Power Corporation (FPC) has developed an assumed fund earnings rate which recognizes that securities with higher risk and return are used in both the FPSC and FERC jurisdictional portions of the qualified fund. FPC has determined that an appropriate assumed earnings rate for the next five year review period would be 6.00% based on the projected long-term earnings rate of the current investment strategy, the expected taxes and administrative expenses of the trust, and market volatility over the next ten years. See Section D for the calculation of the assumed fund earnings rate, and Section E for a summary of historical returns earned by the fund for the past five years compared to CPI and other indices.

CONTINGENCY ALLOWANCE

The overall contingency allowance of 25% approved in Order No. 21928 was reduced to 17% in the 1994 cost study. The contingency factor used in the 2000 study remains at 17%. The reductions in the earlier contingency factor are based on improved study methodology and industry experience over those used in Order No. 21928. A detailed explanation of the contingency allowance is contained in Subsection 3.3.1 of the TLG cost study Section G.

CONCLUSION

The annual accrual amount requested for FPC's retail share of total decommissioning costs is $8,637,228. This is based on the assumptions of a total cost in 2000 dollars of $515,770,000 an escalation rate of 5.56%, and an assumed fund earnings rate of 6.00%. FPC requests that the annual accrual be adjusted effective January 1, 2001. Section B of this report provides the related assumptions and calculations. Section F contains a cash flow schedule, which shows that funding at the requested level would satisfy the future cost of decommissioning.

PARTIES OWNING AN INTEREST IN CR3

There are 9 participants other than FPC in the ownership of the CR-3 nuclear unit. The total participant's share is 8.2194%. Participants are responsible for funding their individual portion of the total cost of decommissioning.

In 1990, FPC and the co-owners submitted a certification to the Nuclear Regulatory Commission (FPC letter 3F0790-05) that funds will be available to decommission the nuclear facility. Assurance was provided that FPC and each participant would fund their pro rata share of the decommissioning cost liability using an external trust fund. The NRC requires biennially that FPC and the participants provide an update on the funding status of the external trust fund. In the March 2000 report, FPC and the participants reported current funding balances, accrual rates, assumed cost escalation rates, and assumed fund earnings rates. FPC reported that funds were being accrued at a rate sufficient to meet the site specific cost study approved by the FPSC.

Participants	% Share	Decomm. Costs in 1999 $'s	Amount Required at 12/31/99 *	Fund Balance at 12/31/99 **
City of Alachua	0.0779%	$ 384,779	$ 221,248	$ 167,394
City of Bushnell	0.0388%	191,649	110,198	91,354
City of Gainsville	1.4079%	6,954,181	3,998,654	2,678,641
Kissimmee Utility Authority	0.6754%	3,336,071	1,918,241	1,323,289
City of Leesburg	0.8244%	4,072,041	2,341,424	1,617,571
City of Ocala	1.3333%	6,585,702	3,786,779	2,486,809
City of New Smyrna Beach	0.5608%	2,770,016	1,592,759	1,959,114
Orlando Utilities Commission	1.6015%	7,910,449	4,548,508	4,557,825
Seminole Electric Coop. Inc.	1.6994%	8,394,016	4,826,559	4,342,157
Total - Participants	8.2194%	40,598,904	$ 23,344,370	$ 19,224,154
Florida Power Corporation	91.7806%	453,341,096		
Total	100.0000%	$ 493,940,000		

* At 12/31/99, the funded amount should approximate 57.5% (23years / 40 years) of the decomm costs.
** Current funding based on 1994 decommissionong study.

IRS REQUIRED ISSUES

The following items require specific FPSC rulings to obtain Internal Revenue Service (IRS) approval of FPC's treatment of decommissioning costs for tax purposes. FPC seeks approval of:

1) Prompt Removal/Dismantling method of decommissioning, which is consistent with the last filing

2) Estimated cost of $515,770,000 in 2000 dollars needed to decommission CR3. This cost includes a contingency allowance of 17% for which we also seek approval

3) Estimated cost of decommissioning of $1,733,482,211 in future dollars based on the 17% contingency, FPC's assumed escalation rate of 5.56%, and an operating license termination date of December 3, 2016

4) Expenditure of funds accumulated in the Nuclear Decommissioning Trust in the years 2016 – 2038

5) Estimated future costs of decommissioning in each year in which decommissioning funds will be expended:

Year of Decomm.	Estimated Future Cost Crystal River Unit No. 3	Year of Decomm.	Estimated Future Cost Crystal River Unit No. 3
2016	$ 15,544,096	2028	13,553,954
2017	231,582,848	2029	14,267,918
2018	195,060,849	2030	15,061,214
2019	160,922,329	2031	15,898,617
2020	168,942,650	2032	16,829,203
2021	177,620,865	2033	17,715,692
2022	180,351,063	2034	18,700,685
2023	83,355,867	2035	19,740,443
2024	80,523,415	2036	20,895,899
2025	22,533,406	2037	204,052,888
2026	12,130,046	2038	35,393,787
2027	12,804,477		$ 1,733,482,211

6) Methodology of converting the estimated cost of decommissioning in current dollars to estimated cost of decommissioning in future dollars is accomplished by multiplying each year's expenditures by the composite escalation factor of 5.56% compounded by the number of years between 2000 and the year of expenditure

7) The assumed after-tax, net of administrative expenses, rate of return of 6.00%, to be earned by the amounts collected for decommissioning

8) Inclusion of $8,637,228 in cost of service each year, beginning January 1, 2001, until expiration of the operating license on December 3, 2016

9) Projected date Crystal River Unit No. 3 will no longer be included in rate base for ratemaking purposes of December 3, 2016, which is consistent with the last filing

10) Affirmative statement that decommissioning costs in the amount of $8,637,228 be included in FPC's cost of service for ratemaking purposes.

OTHER ISSUES

In the previous cost study, filed in 1994, there was a response to a request by the FPSC staff to specifically address the implication of FERC's decision regarding maintaining Black Lung investment guidelines. The investment guidelines contained in Section 18 of the Code of Federal Regulations, Part 35, were amended in 1995, and are discussed below. The FPSC staff also requested that the 1994 filing contain discussion regarding the influence that the Department of Energy's delay in providing storage for spent fuel may have on decommissioning costs.

Implication of FERC Investment Guidelines Changes on Prospective Fund Investments

The Black Lung investment restrictions applicable to nuclear decommissioning trust assets subject to FERC jurisdiction were eliminated through formal action by FERC, effective July 31, 1995. These investment restrictions were the same as those imposed on Black Lung Disability Trusts and limited investments to public debt securities of the United States, obligations of a state or local government which are not in default, and time or demand deposits in a bank or an insured credit union located in the United States. Throughout the FERC's proposed rulemaking process, FPC actively supported the use of a "reasonable person" standard with no restrictions. In its final rule, FERC adopted the "reasonable person" standard with no restrictions for nuclear decommissioning trust fund investments subject to FERC jurisdiction.

The investment guidelines that govern FPC's nuclear decommissioning trust investments continue to be in compliance with FERC investment guidelines with respect to revenues generated by FERC jurisdictional customers. The company currently manages the qualified and nonqualified trusts based on an investment strategy which presently dictates that 50% of fund assets be invested in U. S. Treasury and municipal securities with the remaining 50% invested in domestic and non-U.S. equity securities. The changes approved by FERC were incorporated into the investment guidelines for the trust funds in order to remain in compliance with FERC investment guidelines with respect to revenues generated by FERC jurisdictional customers and deposited to the decommissioning trust funds.

Spent Nuclear Fuel Storage Costs

The Department of Energy's delay in acceptance of spent nuclear fuel has impacted the overall cost of decommissioning. Additional costs will be incurred to fund, among other things, the design, licensing and construction of an independent spent fuel storage installation including the construction of a dry spent fuel storage pad, the purchase of multi purpose storage casks, and staffing to monitor the fuel during storage prior to DOE acceptance of the fuel. Section G of this document contains the CR-3 decommissioning cost study which addresses the necessity of on-site spent fuel storage and its impact of the cost of decommissioning (Section G, Executive Summary, page x and Subsections1.3.1 and 3.4.1).

FLORIDA POWER CORPORATION
ESTIMATED COST OF DECOMMISSIONING
(COST INCLUDES 17% CONTINGENCY)

2000 RETAIL
DETERMINATION OF ANNUAL ACCRUAL FOR DECOMMISSIONING

CRYSTAL RIVER #3 - NUCLEAR PLANT

YEAR	% OF 2000 COST TO BE SPENT	ESTIMATED 100% COST IN 2000 DOLLARS	(1) ESTIMATED COST IN YEAR INCURRED	(2) FPC SHARE IN YEAR INCURRED	78.12% * (2) QUALIFIED PLAN AMOUNT	21.88% * (2) NONQUALIFIED PLAN AMOUNT PRE-TAX	TAX SAVINGS NQ * .38575	NONQUALIFIED PLAN AMOUNT NET OF TAX	(3) 2000 NPV OF NONQUALIFIED FUND NET OF TAX	(3) 2000 NPV OF QUALIFIED FUND
2016	1.2680%	$ 6,539,964	$ 15,544,096	$ 13,670,056	$ 10,679,048	$ 2,991,008	$ 1,153,781	$ 1,837,227	$ 723,218	$ 4,203,768
2017	17.8962%	92,303,231	231,582,848	203,662,568	159,101,198	44,561,370	17,189,548	27,371,822	10,164,921	59,084,524
2018	14.2799%	73,651,440	195,060,849	171,543,764	134,009,988	37,533,776	14,478,654	23,055,122	8,077,219	46,949,567
2019	11.1602%	57,560,964	160,922,329	141,521,080	110,556,268	30,964,812	11,944,676	19,020,136	6,286,402	36,540,285
2020	11.0993%	57,246,860	168,942,650	148,574,449	116,066,360	32,508,089	12,539,995	19,968,094	6,226,146	36,190,040
2021	11.0548%	57,017,342	177,620,865	156,206,394	122,028,435	34,177,959	13,184,148	20,993,811	6,175,443	35,895,323
2022	10.6335%	54,844,403	180,351,063	158,607,432	123,904,126	34,703,306	13,386,800	21,316,506	5,915,439	34,384,026
2023	4.6558%	24,013,220	83,355,867	73,306,249	57,266,842	16,039,407	6,187,201	9,852,206	2,579,281	14,992,302
2024	4.2607%	21,975,412	80,523,415	70,815,286	55,320,901	15,494,385	5,976,959	9,517,426	2,350,600	13,663,076
2025	1.1295%	5,825,622	22,533,406	19,816,715	15,480,818	4,335,897	1,672,572	2,663,325	620,551	3,607,009
2026	0.5760%	2,970,835	12,130,046	10,667,614	8,333,540	2,334,074	900,369	1,433,705	315,143	1,831,796
2027	0.5760%	2,970,835	12,804,477	11,260,733	8,796,885	2,463,848	950,429	1,513,419	313,835	1,824,192
2028	0.5776%	2,979,088	13,553,954	11,919,851	9,311,788	2,608,063	1,006,060	1,602,003	313,400	1,821,666
2029	0.5760%	2,970,835	14,267,918	12,547,738	9,802,293	2,745,445	1,059,055	1,686,390	311,235	1,809,079
2030	0.5760%	2,970,835	15,061,214	13,245,392	10,347,300	2,898,092	1,117,939	1,780,153	309,943	1,801,570
2031	0.5760%	2,970,835	15,898,617	13,981,835	10,922,610	3,059,225	1,180,096	1,879,129	308,656	1,794,092
2032	0.5776%	2,979,088	16,829,203	14,800,227	11,561,937	3,238,290	1,249,170	1,989,120	308,229	1,791,608
2033	0.5760%	2,970,835	17,715,692	15,579,838	12,170,969	3,408,869	1,314,971	2,093,898	306,099	1,779,228
2034	0.5760%	2,970,835	18,700,685	16,446,078	12,847,676	3,598,402	1,388,084	2,210,318	304,828	1,771,843
2035	0.5760%	2,970,835	19,740,443	17,360,480	13,562,007	3,798,473	1,465,261	2,333,212	303,563	1,764,488
2036	0.5776%	2,979,088	20,895,899	18,376,631	14,355,824	4,020,807	1,551,026	2,469,781	303,143	1,762,045
2037	5.3433%	27,559,138	204,052,888	179,451,698	140,187,666	39,264,032	15,146,100	24,117,932	2,792,692	16,232,776
2038	0.8780%	4,528,460	35,393,787	31,126,612	24,316,109	6,810,503	2,627,152	4,183,351	456,984	2,656,264
	100.0000%	$ 515,770,000	$ 1,733,482,211	$ 1,524,488,720	$ 1,190,930,588	$ 333,558,132	$ 128,670,046	$ 204,888,086	$ 55,766,970	$ 324,150,567

	NONQUALIFIED	QUALIFIED	TOTAL
NPV @ 12/31/00RETAIL	$ 55,766,970	$ 324,150,567	$ 379,917,537
LESS EST. BOOK VALUE @ 12/31/00			
FLORIDA POWER CORPORATION	$ 52,183,308	$ 240,605,967	$ 292,789,275
CITY OF TALLAHASSEE	0	0	0
	$ 52,183,308	$ 240,605,967	$ 292,789,275
PV OF FUND REQUIREMENTS	$ 3,583,662	$ 83,544,600	$ 87,128,262
MONTHLY FUND REQUIREMENT (4)	$ 28,859	$ 672,787	$ 701,646
ANNUAL FUND REQUIREMENT	$ 346,308	$ 8,073,444	$ 8,419,752
MONTHLY ACCRUAL (5)	$ 46,982	$ 672,787	$ 719,769
ANNUAL ACCRUAL - SYSTEM	$ 563,784	$ 8,073,444	$ 8,637,228

Date: 12/12/00

(1) ESTIMATED COST IN 2000 DOLLARS X (1 + INFLATION RATE) ^ (YEAR OF EXPENDITURE - 2000)
(2) QUAL. AND NONQUAL. PLAN AMOUNTS X (.904473) X (.97232)
(3) ESTIMATED ANNUAL DOLLARS / (1 + EARNINGS RATE) ^ (YEAR OF DECOMMISSIONING - CURRENT YEAR (2000))
(4)=PMT(.05841061 / 12, 191 (mos.), - $3,583,662), (EXCEL FORMULA)
(5) FOR THE NONQUALIFIED FUND, $28,859 / (1 - .38575)

ASSUMPTIONS:		
	2000 COST -	$ 515,770,000
	COST ESCALATION RATE -	5.560000%
	EARNINGS RATE (AFTER TAX) - ANNUAL	6.000000%
	EARNINGS RATE (AFTER TAX) - MONTHLY	5.841061%
	FEDERAL TAX RATE	35.000000%
	STATE TAX RATE	5.500000%

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Preparer: R.H. Blake

FLORIDA POWER CORPORATION
ESTIMATED COST OF DECOMMISSIONING
(COST INCLUDES 17% CONTINGENCY)

2000 SYSTEM
DETERMINATION OF ANNUAL ACCRUAL FOR DECOMMISSIONING

CRYSTAL RIVER #3 - NUCLEAR PLANT

YEAR	% OF 2000 COST TO BE SPENT	ESTIMATED 100% COST IN 2000 DOLLARS	(1) ESTIMATED COST IN YEAR INCURRED	(2) FPC SHARE IN YEAR INCURRED	78.12% * (2) QUALIFIED PLAN AMOUNT	21.88% * (2) NONQUALIFIED PLAN AMOUNT PRE-TAX	TAX SAVINGS NQ * .38575	NONQUALIFIED PLAN AMOUNT NET OF TAX	(3) 2000 NPV OF NONQUALIFIED FUND NET OF TAX	(3) 2000 NPV OF QUALIFIED FUND
2016	1.2680%	$ 6,539,964	$ 15,544,096	$ 14,266,465	$ 11,144,962	$ 3,121,503	$ 1,204,120	$ 1,917,383	$ 754,771	$ 4,387,173
2017	17.8962%	$ 92,303,231	231,582,848	212,548,127	166,042,597	46,505,530	17,939,508	28,566,022	10,608,404	61,662,312
2018	14.2799%	$ 73,651,440	195,060,849	179,028,018	139,856,688	39,171,330	15,110,341	24,060,989	8,429,618	48,997,922
2019	11.1602%	$ 57,560,964	160,922,329	147,695,479	115,379,708	32,315,771	12,465,809	19,849,962	6,560,671	38,134,495
2020	11.0993%	$ 57,246,860	168,942,650	155,056,578	121,130,199	33,926,379	13,087,101	20,839,278	6,497,785	37,768,969
2021	11.0548%	$ 57,017,342	177,620,865	163,021,496	127,352,393	35,669,103	13,759,356	21,909,747	6,444,870	37,461,394
2022	10.8335%	$ 54,844,403	180,351,063	165,527,288	129,309,917	36,217,371	13,970,851	22,246,520	6,173,523	35,884,161
2023	4.6558%	$ 24,013,220	83,355,867	76,504,515	59,765,327	18,739,188	6,457,142	10,282,046	2,691,811	15,646,399
2024	4.2607%	$ 21,975,412	80,523,415	73,904,873	57,734,487	16,170,388	6,237,726	9,932,660	2,453,154	14,259,180
2025	1.1295%	$ 5,825,622	22,533,406	20,681,295	16,156,228	4,525,067	1,745,545	2,779,522	647,625	3,764,379
2026	0.5760%	$ 2,970,835	12,130,046	11,133,029	8,697,122	2,435,907	939,651	1,496,256	328,892	1,911,715
2027	0.5760%	$ 2,970,835	12,804,477	11,752,026	9,180,683	2,571,343	991,896	1,579,447	327,527	1,903,779
2028	0.5776%	$ 2,979,088	13,553,954	12,439,900	9,718,050	2,721,850	1,049,954	1,671,896	327,073	1,901,144
2029	0.5760%	$ 2,970,835	14,267,918	13,095,181	10,229,955	2,865,226	1,105,261	1,759,965	324,813	1,888,007
2030	0.5760%	$ 2,970,835	15,061,214	13,823,273	10,798,741	3,024,532	1,166,713	1,857,819	323,465	1,880,170
2031	0.5760%	$ 2,970,835	15,898,617	14,591,846	11,399,150	3,192,696	1,231,582	1,961,114	322,122	1,872,366
2032	0.5776%	$ 2,979,088	16,829,203	15,445,943	12,066,371	3,379,572	1,303,670	2,075,902	321,676	1,869,773
2033	0.5760%	$ 2,970,835	17,715,692	16,259,568	12,701,975	3,557,593	1,372,341	2,185,252	319,454	1,856,854
2034	0.5760%	$ 2,970,835	18,700,685	17,163,601	13,408,205	3,755,396	1,448,644	2,306,752	318,128	1,849,146
2035	0.5760%	$ 2,970,835	19,740,443	18,117,897	14,153,701	3,964,196	1,529,189	2,435,007	316,807	1,841,470
2036	0.5776%	$ 2,979,088	20,895,899	19,178,381	14,982,151	4,196,230	1,618,696	2,577,534	316,369	1,838,921
2037	5.3433%	$ 27,559,138	204,052,888	187,280,965	146,303,890	40,977,075	15,806,907	25,170,168	2,914,534	16,940,993
2038	0.8780%	$ 4,528,460	35,393,787	32,484,630	25,376,993	7,107,637	2,741,771	4,365,866	476,922	2,772,154
	100.0000%	$ 515,770,000	$ 1,733,482,211	$ 1,591,000,374	$ 1,242,889,493	$ 348,110,881	$ 134,283,774	$ 213,827,107	$ 58,200,014	$ 338,292,876

	NONQUALIFIED	QUALIFIED	TOTAL
NPV @ 12/31/00	$ 58,200,014	$ 338,292,876	$ 396,492,890
CITY OF TALLAHASSEE'S PERMANENT RE-ALLOCATION (6)	$ 3,779,502	($ 3,779,502)	$ 0
ADJUSTED NET PRESENT VALUE	$ 61,979,516	$ 334,513,374	$ 396,492,890
LESS EST. BOOK VALUE @ 12/31/00			
FLORIDA POWER CORPORATION	$ 53,668,862	$ 247,455,536	$ 301,124,398
CITY OF TALLAHASSEE	5,232,201	0	5,232,201
	$ 58,901,063	$ 247,455,536	$ 306,356,599
PV OF FUND REQUIREMENTS	$ 3,078,453	$ 87,057,838	$ 90,136,291
MONTHLY FUND REQUIREMENT (4)	$ 24,791	$ 701,079	$ 725,870
ANNUAL FUND REQUIREMENT	$ 297,492	$ 8,412,948	$ 8,710,440
MONTHLY ACCRUAL (5)	$ 40,360	$ 701,079	$ 741,439
ANNUAL ACCRUAL - SYSTEM	$ 484,320	$ 8,412,948	$ 8,897,268

(1) ESTIMATED COST IN 2000 DOLLARS X (1 + INFLATION RATE) ^ (YEAR OF EXPENDITURE - 2000)
(2) QUAL. AND NONQUAL. PLAN AMOUNTS * 91.7806%
(3) ESTIMATED ANNUAL DOLLARS / (1 + EARNINGS RATE) ^ (YEAR OF DECOMMISSIONING - CURRENT YEAR (2000))
(4) PMT(.05841061 / 12, 191 (mos.), - $3,078,453), (EXCEL FORMULA)
(5) FOR THE NONQUALIFIED FUND, $24,791 / (1 - .38575)
(6) RE-ALLOCATION OF THE THEORETICAL QUAL PORTION OF THE CITY OF TALLAHASSEE'S ACQUIRED NDC FUND BALANCE OF $4,838,072.30

ASSUMPTIONS:		
	2000 COST -	$ 515,770,000
	COST ESCALATION RATE -	5.560000%
	EARNINGS RATE (AFTER TAX) - ANNUAL	6.000000%
	EARNINGS RATE (AFTER TAX) - MONTHLY	5.841061%
	FEDERAL TAX RATE	35.000000%
	STATE TAX RATE	5.500000%

Date: 12/12/00

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Preparer: R.H. Blake

FLORIDA POWER CORPORATION INDICES
(COST INCLUDES 17% CONTINGENCY)

FLORIDA POWER CORPORATION
2000 NUCLEAR DECOMMISSIONING COST STUDY
CALCULATION OF INFLATION INDICES

INFLATION INDICES (1)						DECONTAMINATION			REMOVAL			PACKAGING			SHIPPING	BURIAL	STAFFS	OTHER				CURRENT	Annual	Compound
Year	Labor	Material	Burial	Trans portation	Other	Labor 51%	Material 49%	Total ($000)	Labor 44%	Material 56%	Total ($000)	Labor 7%	Material 93%	Total ($000)	Transport. (100%)	Burial (100%)	Labor (100%)	Labor 35%	Material 18%	Other 47%	TOTAL ($000)	DOLLAR TOTAL	Weigted Inflation Rate	Average Annual Growth Rate
1999	Base	Base	Base	Base	Base	$6,457	$6,089	$12,546	$30,047	$38,032	$68,079	$444	$5,915	$6,359	$5,841	$72,306	$153,685	$61,293	$31,522	$82,309	$175,124	$493,940		
2000	4.3%	4.3%	7.5%	3.0%	2.3%	6,735	6,351	13,086	31,339	39,667	71,006	463	6,169	6,632	6,016	77,729	160,293	63,929	32,877	84,202	181,008	515,770		
2001	5.4%	0.0%	7.5%	2.5%	2.1%	7,099	6,351	13,450	33,031	39,667	72,698	488	6,169	6,657	6,166	83,559	168,949	67,381	32,877	85,970	186,228	537,707	4.25%	4.25%
2002	5.0%	-0.5%	7.5%	1.7%	1.4%	7,454	6,319	13,773	34,683	39,469	74,152	512	6,138	6,650	6,271	89,826	177,396	70,750	32,713	87,174	190,637	558,705	3.91%	4.08%
2003	4.9%	0.7%	7.5%	2.2%	1.7%	7,819	6,363	14,182	36,382	39,745	76,127	537	6,181	6,718	6,409	96,563	186,088	74,217	32,942	88,656	195,815	581,902	4.15%	4.10%
2004	5.0%	1.0%	7.5%	2.7%	2.1%	8,210	6,427	14,637	38,201	40,142	78,343	564	6,243	6,807	6,582	103,805	195,392	77,928	33,271	90,518	201,717	607,283	4.36%	4.17%
2005	4.8%	0.9%	7.5%	3.0%	2.3%	8,604	6,485	15,089	40,035	40,503	80,538	591	6,299	6,890	6,779	111,590	204,771	81,669	33,570	92,600	207,839	633,496	4.32%	4.20%
2006	4.7%	1.0%	7.5%	3.1%	2.4%	9,008	6,550	15,558	41,917	40,908	82,825	619	6,362	6,981	6,989	119,959	214,395	85,507	33,906	94,822	214,235	660,942	4.33%	4.22%
2007	4.6%	0.9%	7.5%	3.1%	2.5%	9,422	6,609	16,031	43,845	41,276	85,121	647	6,419	7,066	7,206	128,956	224,257	89,440	34,211	97,193	220,844	689,481	4.32%	4.23%
2008	4.5%	1.1%	7.5%	3.0%	2.4%	9,846	6,682	16,528	45,818	41,730	87,548	676	6,490	7,166	7,422	138,628	234,349	93,465	34,587	99,526	227,578	719,219	4.31%	4.24%
2009	4.5%	1.2%	7.5%	2.9%	2.4%	10,289	6,762	17,051	47,880	42,231	90,111	706	6,568	7,274	7,637	149,025	244,895	97,671	35,002	101,915	234,588	750,581	4.36%	4.26%
2010	4.6%	1.3%	7.5%	3.0%	2.4%	10,762	6,850	17,612	50,082	42,780	92,862	738	6,653	7,391	7,866	160,202	256,160	102,164	35,457	104,361	241,982	784,075	4.46%	4.28%
2011	4.9%	1.5%	7.5%	3.2%	2.5%	11,289	6,953	18,242	52,536	43,422	95,958	774	6,753	7,527	8,118	172,217	268,712	107,170	35,989	106,970	250,129	820,903	4.70%	4.32%
2012	5.2%	1.8%	7.5%	3.6%	2.8%	11,876	7,078	18,954	55,268	44,204	99,472	814	6,875	7,689	8,410	185,133	282,685	112,743	36,637	109,965	259,345	861,688	4.97%	4.37%
2013	5.3%	2.1%	7.5%	3.7%	3.0%	12,505	7,227	19,732	58,197	45,132	103,329	857	7,019	7,876	8,721	199,018	297,667	118,718	37,406	113,264	269,388	905,731	5.11%	4.43%
2014	5.6%	2.5%	7.5%	4.1%	3.4%	13,205	7,408	20,613	61,456	46,260	107,716	905	7,194	8,099	9,079	213,944	314,336	125,366	38,341	117,115	280,822	954,609	5.40%	4.50%
2015	5.9%	2.7%	7.5%	4.4%	3.7%	13,984	7,608	21,592	65,082	47,509	112,591	958	7,388	8,346	9,478	229,990	332,882	132,783	39,376	121,448	293,587	1,008,466	5.64%	4.57%
2016	6.1%	2.9%	7.5%	4.6%	4.0%	14,837	7,829	22,666	69,052	48,887	117,939	1,016	7,602	8,618	9,914	247,239	353,188	140,862	40,518	126,306	307,686	1,067,250	5.83%	4.65%
2017	6.2%	2.9%	7.5%	4.7%	4.1%	15,757	8,056	23,813	73,333	50,305	123,638	1,079	7,822	8,901	10,380	265,782	375,086	149,595	41,693	131,485	322,773	1,130,373	5.91%	4.72%
2018	6.2%	2.8%	7.5%	4.7%	4.1%	16,734	8,282	25,016	77,880	51,714	129,594	1,146	8,041	9,187	10,868	285,716	398,341	158,870	42,860	136,876	338,606	1,197,328	5.92%	4.79%
2019	6.1%	2.7%	7.5%	4.6%	4.1%	17,755	8,506	26,261	82,631	53,110	135,741	1,216	8,258	9,474	11,368	307,145	422,640	168,561	44,017	142,488	355,066	1,267,695	5.88%	4.85%
2020	6.1%	2.7%	7.5%	4.5%	4.0%	18,838	8,736	27,574	87,671	54,544	142,215	1,290	8,481	9,771	11,880	330,181	448,421	178,843	45,205	148,188	372,236	1,342,278	5.88%	4.90%
2021	6.1%	2.8%	7.5%	4.5%	4.1%	19,987	8,981	28,968	93,019	56,071	149,090	1,369	8,716	10,087	12,415	354,945	475,775	189,752	46,471	154,264	390,487	1,421,767	5.92%	4.95%
2022	6.2%	3.0%	7.5%	4.6%	4.1%	21,226	9,250	30,476	98,786	57,753	156,539	1,454	8,980	10,434	12,986	381,566	505,273	201,517	47,865	160,589	409,971	1,507,245	6.01%	5.00%
2023	6.3%	3.1%	7.5%	4.7%	4.2%	22,563	9,537	32,100	105,010	59,543	164,553	1,546	9,258	10,804	13,596	410,183	537,105	214,213	49,349	167,334	430,896	1,599,237	6.10%	5.04%
2024	6.4%	3.2%	7.5%	4.8%	4.4%	24,007	9,842	33,849	111,731	61,448	173,179	1,645	9,554	11,199	14,249	440,947	571,480	227,923	50,928	174,697	453,548	1,698,451	6.20%	5.09%
2025	6.5%	3.3%	7.5%	5.0%	4.5%	25,567	10,167	35,734	118,994	63,476	182,470	1,752	9,869	11,621	14,961	474,018	608,626	242,738	52,609	182,558	477,905	1,805,335	6.29%	5.14%
2026	6.5%	3.3%	7.5%	5.0%	4.5%	27,229	10,503	37,732	126,729	65,571	192,300	1,866	10,195	12,061	15,709	509,569	648,187	258,516	54,345	190,773	503,634	1,919,192	6.31%	5.18%
2027	6.5%	3.3%	7.5%	5.0%	4.5%	28,999	10,850	39,849	134,966	67,735	202,701	1,987	10,531	12,518	16,494	547,787	690,319	275,320	56,138	199,358	530,816	2,040,484	6.32%	5.23%
2028	6.5%	3.3%	7.5%	5.0%	4.5%	30,884	11,208	42,092	143,739	69,970	213,709	2,116	10,879	12,995	17,319	588,871	735,190	293,216	57,991	208,329	559,536	2,169,712	6.33%	5.26%
2029	6.5%	3.3%	7.5%	5.0%	4.5%	32,891	11,576	44,469	153,082	72,279	225,361	2,254	11,238	13,492	18,185	633,036	782,977	312,275	59,905	217,704	589,884	2,307,404	6.35%	5.30%
2030	6.5%	3.3%	7.5%	5.0%	4.5%	35,029	11,960	46,989	163,032	74,664	237,696	2,401	11,609	14,010	19,094	680,514	833,871	332,573	61,882	227,501	621,956	2,454,130	6.36%	5.34%
2031	6.5%	3.3%	7.5%	5.0%	4.5%	37,306	12,355	49,661	173,629	77,128	250,757	2,557	11,992	14,549	20,049	731,553	888,073	354,190	63,924	237,739	655,853	2,610,495	6.37%	5.37%
2032	6.5%	3.3%	7.5%	5.0%	4.5%	39,731	12,763	52,494	184,915	79,673	264,588	2,723	12,388	15,111	21,051	786,419	945,798	377,212	66,033	248,437	691,682	2,777,143	6.38%	5.40%
2033	6.5%	3.3%	7.5%	5.0%	4.5%	42,314	13,184	55,498	196,934	82,302	279,236	2,900	12,797	15,697	22,104	845,400	1,007,275	401,731	68,212	259,617	729,560	2,954,770	6.40%	5.43%
2034	6.5%	3.3%	7.5%	5.0%	4.5%	45,064	13,619	58,683	209,735	85,018	294,753	3,089	13,219	16,308	23,209	908,805	1,072,748	427,844	70,463	271,300	769,607	3,144,113	6.41%	5.46%
2035	6.5%	3.3%	7.5%	5.0%	4.5%	47,993	14,068	62,061	223,368	87,824	311,192	3,290	13,655	16,945	24,369	976,965	1,142,477	455,654	72,788	283,509	811,951	3,345,960	6.42%	5.49%
2036	6.5%	3.3%	7.5%	5.0%	4.5%	51,113	14,532	65,645	237,887	90,722	328,609	3,504	14,106	17,610	25,587	1,050,237	1,216,738	485,272	75,190	296,267	856,729	3,561,155	6.43%	5.51%
2037	6.5%	3.3%	7.5%	5.0%	4.5%	54,435	15,012	69,447	253,350	93,716	347,066	3,732	14,571	18,303	26,866	1,129,005	1,295,826	516,815	77,671	309,599	904,085	3,790,598	6.44%	5.54%
2038	6.5%	3.3%	7.5%	5.0%	4.5%	57,973	15,507	73,480	269,818	98,809	366,827	3,975	15,052	19,027	28,209	1,213,680	1,380,055	550,408	80,234	323,531	954,173	4,035,251	6.45%	5.56%
COMPOUND ANNUAL GROWTH RATE FROM 2000								4.65%			4.41%			2.81%	4.15%	7.50%	5.83%				3.61%	5.56%		

(1) SOURCES OF INFORMATION TO COMPLETE THE INFLATION INDICIES:
INFLATION INDICES SOURCE: STANDARD & POOR'S DRI, THE U.S. ECONOMY, THE 25-YEAR FOCUS, SUMMER ISSUE 2000

LABOR: TABLE 15 - Wages and Productivity in the Nonfarm Business Sector - Compensation per Hour
MATERIAL: TABLE 16 - Producer Price Indexes - Stage of Processing - Intermediate Materials, Supplies, and Components
TRANSPORTATION: TABLE 15 - Chain-Weighted Price Indexes - Gross Domestic Product, Domestic Demand, Consumption, Services, Transportation
OTHER: TABLE 15 - Chain-Weighted Price Indexes - Gross Domestic Product (Implicit Price Deflator no longer reported)

BURIAL INDICES SOURCE: NUREG-1307 Revision 9 - Report on Waste Burial Charges, August 2000

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FLORIDA POWER CORPORATION
2000 NUCLEAR DECOMMISSIONING COST STUDY
CALCULATION OF INFLATION INDICES
LOW-LEVEL WASTE BURIAL ESCALATION RATE ASSUMPTION

Burial costs at the South Carolina Site - Reference PWR*

	Total Burial Costs	Annual Growth Rate	Average Annual Growth Rate
1986	$30,180,304		
1988	36,107,945	9.38%	9.38%
1991	44,856,386	7.50%	8.25%
1993	110,726,654	57.11%	20.41%
1994	119,077,693	7.54%	18.72%
1995	230,689,031	93.73%	25.36%
1996	229,741,255	-0.41%	22.50%
1997	285,156,187	24.12%	22.65%
1998	285,771,187	0.22%	20.60%
2000	326,122,431	6.83%	18.53%

Projected Growth Rates

2000 (1)	7.50%
2001 - 2041	7.50%

* Source: NUREG-1307, Revision 9, "Report on Waste Burial Charges".

(1) 7.5% is the approximate minimum escalation rate for the Barnwell, S. C. site during the years 1986 through 2000 and is a better reflection of the rate of cost increases for the burial site than is CPI.

FLORIDA POWER CORPORATION
2000 NUCLEAR DECOMMISSIONING COST STUDY
MINIMUM FUND EARNINGS RATE

LONG-TERM AVERAGE CPI

YEAR	ANNUAL PERCENT CHANGE
2001	2.0%
2002	1.3%
2003	1.6%
2004	2.1%
2005	2.4%
2006	2.6%
2007	2.7%
2008	2.6%
2009	2.6%
2010	2.6%
2011	2.8%
2012	3.0%
2013	3.2%
2014	3.6%
2015	4.0%
2016	4.3%
2017	4.5%
2018	4.6%
2019	4.5%
2020	4.5%
2021	4.5%
2022	4.6%
2023	4.7%
2024	4.8%
2025	5.0%

25 year average CPI = 3.40%

Source: Standard & Poor's DRI, The U.S. Economy, The 25-Year Focus, Summer Issue 2000
Table 15 - Consumer Price Indexes - All Urban Consumers

FLORIDA POWER CORPORATION
2000 NUCLEAR DECOMMISSIONING COST STUDY
ASSUMED FUND EARNINGS RATE

	COMBINED	QUALIFIED	NONQUALIFIED
WILSHIRE STUDY AFTER-TAX RETURN (1)	7.14%	7.21%	6.89%
ESTIMATED EXPENSES:			
MANAGEMENT FEES			
FIXED INCOME	0.09%		
EQUITY	0.10%		
TRUSTEE FEES	0.04%		
OUTSIDE PROFESSIONAL SERVICES	0.03%		
TOTAL EXPENSES	0.26%		
NET RETURN AFTER TAXES AND FEES	6.88%		
LONG TERM CPI (page D.1)	3.40%		
DIFFERENCE	3.48%		
PROPOSED AFTER-TAX, AFTER EXPENSES ASSUMED FUND EARNINGS RATE	6.00% (2)		

(1) 2000 ESTIMATE OF EXPECTED AFTER-TAX RETURNS WAS DEVELOPED BY WILSHIRE ASSOCIATES INCORPORATED. RETURNS ARE FOR A TEN YEAR TIMEFRAME. THE ESTIMATED AFTER-TAX EXPENSES ARE BASED ON ESTIMATED MARKET VALUE AT 12/31/00 PER SCHEDULE B-1.

(2) AVERAGE OF NET RETURN AFTER TAXES AND FEES AND LONG TERM CPI (ROUNDED TO 6.00 %).
Formula = Long Term CPI + ((Net Return after Taxes and Fees - Long Term CPI) x 75%) +/- Rounding Factor

FLORIDA POWER CORPORATION
TOTAL NUCLEAR DECOMMISSIONING TRUST FUND
TIME WEIGHTED RETURNS FOR THE PERIODS ENDED
DECEMBER 31, 1999

	Quarter	Year To-Date	One Year	Annualized Three Years	Annualized Five Years
Nuc Decom Trust Fund -Total*					
Before Tax Total Fund	6.50%	8.07%	8.07%	14.60%	15.44%
After Tax Total Fund	6.50%	8.04%	8.04%	13.80%	14.30%
Indices					
Lehman Govt/Corp Bonds	(0.41%)	(2.15%)	(2.15%)	5.54%	7.60%
S&P 500	14.88%	20.99%	20.99%	27.56%	28.56%
CPI	0.24%	2.68%	2.68%	1.99%	2.37%

TIME WEIGHTED RETURNS FOR THE PERIODS ENDED
SEPTEMBER 30, 2000

	Quarter	Year To-Date	One Year	Annualized Three Years	Annualized Five Years
Nuc Decom Trust Fund -Total*					
Before Tax Total Fund	(0.20%)	1.90%	8.50%	9.90%	12.40%
After Tax Total Fund	(0.40%)	1.10%	7.70%	9.10%	11.50%
Indices					
Lehman Govt/Corp Bonds	2.87%	7.16%	6.72%	5.81%	6.29%
S&P 500	(0.95%)	(1.39%)	13.28%	16.47%	21.70%
CPI	0.75%	3.20%	3.45%	2.52%	2.54%

* Fund returns are net of investment management fees

FLORIDA POWER CORPORATION
2000 NUCLEAR DECOMMISSIONING COST STUDY
CASH FLOW SCHEDULE

CURRENT YEAR	2000	2001	2002	2003	2004	2005	2006	2007	2008
YEARS REMAINING	16	15	14	13	12	11	10	9	8
ESTIMATED COST OF DECOMMISSIONING									
ESTIMATED 100% COST IN 2000 DOLLARS	$ 515,770,000								
OWNERSHIP PERCENT	90.4473%								
	466,500,039								
RETAIL SEPARATION PERCENT	97.2320%								
RETAIL - CURRENT DOLLARS (1)	$ 453,587,318	$ 478,806,773	$ 505,428,430	$ 533,530,251	$ 563,194,533	$ 594,508,149	$ 627,562,802	$ 662,455,294	$ 699,287,808
SOURCE OF DECOMMISSIONING FUNDS									
FROM QUALIFIED FUND									
FROM NONQUALIFIED FUND									
FROM TAX SAVINGS									
ANNUAL EXPENDITURES		0	0	0	0	0	0	0	0
ADJUSTED ESTIMATED COST OF DECOMMISSIONING - RETAIL		$ 478,806,773	$ 505,428,430	$ 533,530,251	$ 563,194,533	$ 594,508,149	$ 627,562,802	$ 662,455,294	$ 699,287,808
FUNDED RESERVE BEGINNING OF YEAR BALANCE - RETAIL		$ 292,789,275	$ 319,005,491	$ 346,794,681	$ 376,251,222	$ 407,475,156	$ 440,572,526	$ 475,655,738	$ 512,843,943
ANNUAL EARNINGS ON BEGINNING FUND BALANCE (COMPOUNDED MONTHLY)		17,567,357	19,140,331	20,807,682	22,575,075	24,448,511	26,434,353	28,539,346	30,770,638
ANNUAL PRINCIPAL DEPOSITS		8,419,752	8,419,752	8,419,752	8,419,752	8,419,752	8,419,752	8,419,752	8,419,752
EARNINGS ON MONTHLY DEPOSITS COMPOUNDED MONTHLY		229,107	229,107	229,107	229,107	229,107	229,107	229,107	229,107
FUNDS WITHDRAWN FOR DECOMMISSIONING									
FUND RESERVE END OF YEAR BALANCE		$ 319,005,491	$ 346,794,681	$ 376,251,222	$ 407,475,156	$ 440,572,526	$ 475,655,738	$ 512,843,943	$ 552,263,440
ASSUMPTIONS									
ESCALATION RATE	5.560000%								
EARNINGS RATE - ANNUAL	6.000000%								
EARNINGS RATE - MONTHLY	5.841061%								

(1) PRIOR YEAR BALANCE X (1 + ESCALATION RATE), FPC RETAIL ONLY.

F.1

FLORIDA POWER CORPORATION
2000 NUCLEAR DECOMMISSIONING COST STUDY
CASH FLOW SCHEDULE

CURRENT YEAR	2009	2010	2011	2012	2013	2014	2015	2016	2017
YEARS REMAINING	7	6	5	4	3	2	1	0	-1
ESTIMATED COST OF DECOMMISSIONING									
ESTIMATED 100% COST IN 2000 DOLLARS									
OWNERSHIP PERCENT									
RETAIL SEPARATION PERCENT									
RETAIL - CURRENT DOLLARS (1)	$ 738,168,210	$ 779,210,362	$ 822,534,458	$ 868,287,374	$ 918,543,040	$ 967,502,833	$ 1,021,295,991	$ 1,078,080,048	$ 1,123,591,188
SOURCE OF DECOMMISSIONING FUNDS									
FROM QUALIFIED FUND								10,679,048	159,101,198
FROM NONQUALIFIED FUND								1,837,227	27,371,822
FROM TAX SAVINGS								1,153,781	17,189,548
ANNUAL EXPENDITURES	0	0	0	0	0	0	0	13,670,056	203,662,568
ADJUSTED ESTIMATED COST OF DECOMMISSIONING - RETAIL	$ 738,168,210	$ 779,210,362	$ 822,534,458	$ 868,267,374	$ 916,543,040	$ 967,502,833	$ 1,021,295,991	$ 1,064,409,992	$ 919,928,620
FUNDED RESERVE BEGINNING OF YEAR BALANCE - RETAIL	$ 552,263,440	$ 594,048,107	$ 638,339,854	$ 685,289,106	$ 735,055,314	$ 787,807,494	$ 843,724,805	$ 902,997,155	$ 952,607,925
ANNUAL EARNINGS ON BEGINNING FUND BALANCE (COMPOUNDED MONTHLY)	33,135,808	35,642,888	38,300,393	41,117,349	44,103,321	47,268,452	50,623,491	54,179,832	57,156,479
ANNUAL PRINCIPAL DEPOSITS	8,419,752	8,419,752	8,419,752	8,419,752	8,419,752	8,419,752	8,419,752	7,718,106	
EARNINGS ON MONTHLY DEPOSITS COMPOUNDED MONTHLY	229,107	229,107	229,107	229,107	229,107	229,107	229,107	229,107	
FUNDS WITHDRAWN FOR DECOMMISSIONING								(12,516,275)	(186,473,020)
FUND RESERVE END OF YEAR BALANCE	$ 594,048,107	$ 638,339,854	$ 685,289,106	$ 735,055,314	$ 787,807,494	$ 843,724,805	$ 902,997,155	$ 952,607,925	$ 823,291,384

ASSUMPTIONS
ESCALATION RATE
EARNINGS RATE - ANNUAL
EARNINGS RATE - MONTHLY

(1) PRIOR YEAR BALANCE X (1 + ESCALATION RATE), FPC RETAIL ONLY.

F.2

FLORIDA POWER CORPORATION
2000 NUCLEAR DECOMMISSIONING COST STUDY
CASH FLOW SCHEDULE

CURRENT YEAR	2018	2019	2020	2021	2022	2023	2024	2025	2026
YEARS REMAINING	-2	-3	-4	-5	-6	-7	-8	-9	-10
ESTIMATED COST OF DECOMMISSIONING									
ESTIMATED 100% COST IN 2000 DOLLARS									
OWNERSHIP PERCENT									
RETAIL SEPARATION PERCENT									
RETAIL - CURRENT DOLLARS (1)	$ 971,076,651	$ 843,986,916	$ 741,522,936	$ 625,916,423	$ 495,825,907	$ 355,967,822	$ 298,377,556	$ 240,214,732	$ 232,652,147
SOURCE OF DECOMMISSIONING FUNDS									
FROM QUALIFIED FUND	134,009,988	110,556,268	116,066,360	122,028,435	123,904,126	57,266,842	55,320,901	15,480,818	8,333,540
FROM NONQUALIFIED FUND	23,055,122	19,020,136	19,968,094	20,993,811	21,316,506	9,852,206	9,517,426	2,663,325	1,433,705
FROM TAX SAVINGS	14,476,654	11,944,676	12,539,995	13,184,148	13,386,800	6,187,201	5,976,959	1,672,572	900,369
ANNUAL EXPENDITURES	171,543,764	141,521,080	148,574,449	156,206,394	158,607,432	73,306,249	70,815,286	19,816,715	10,667,614
ADJUSTED ESTIMATED COST OF DECOMMISSIONING - RETAIL	$ 799,532,887	$ 702,465,836	$ 592,948,487	$ 469,710,029	$ 337,218,475	$ 282,661,573	$ 227,562,270	$ 220,398,017	$ 221,984,533
FUNDED RESERVE BEGINNING OF YEAR BALANCE - RETAIL	$ 823,291,384	$ 715,623,760	$ 628,984,784	$ 530,689,419	$ 419,508,540	$ 299,458,422	$ 250,306,880	$ 200,486,967	$ 194,372,043
ANNUAL EARNINGS ON BEGINNING FUND BALANCE (COMPOUNDED MONTHLY)	49,397,486	42,937,428	37,739,089	31,841,367	25,170,514	17,967,506	15,018,414	12,029,219	11,662,323
ANNUAL PRINCIPAL DEPOSITS									
EARNINGS ON MONTHLY DEPOSITS COMPOUNDED MONTHLY									
FUNDS WITHDRAWN FOR DECOMMISSIONING	(157,065,110)	(129,576,404)	(136,034,454)	(143,022,246)	(145,220,632)	(67,119,048)	(64,838,327)	(18,144,143)	(9,767,245)
FUND RESERVE END OF YEAR BALANCE	$ 715,623,760	$ 628,984,784	$ 530,689,419	$ 419,508,540	$ 299,458,422	$ 250,306,880	$ 200,486,967	$ 194,372,043	$ 196,267,121

ASSUMPTIONS
ESCALATION RATE
EARNINGS RATE - ANNUAL
EARNINGS RATE - MONTHLY

(1) PRIOR YEAR BALANCE X (1 + ESCALATION RATE), FPC RETAIL ONLY.

F.3

FLORIDA POWER CORPORATION
2000 NUCLEAR DECOMMISSIONING COST STUDY
CASH FLOW SCHEDULE

CURRENT YEAR	2027	2028	2029	2030	2031	2032	2033	2034	2035
YEARS REMAINING	-11	-12	-13	-14	-15	-16	-17	-18	-19
ESTIMATED COST OF DECOMMISSIONING									
ESTIMATED 100% COST IN 2000 DOLLARS									
OWNERSHIP PERCENT									
RETAIL SEPARATION PERCENT									
RETAIL - CURRENT DOLLARS (1)	$ 234,326,873	$ 235,468,617	$ 235,978,077	$ 235,853,066	$ 234,984,661	$ 233,290,583	$ 230,638,420	$ 227,015,839	$ 222,277,440
SOURCE OF DECOMMISSIONING FUNDS									
FROM QUALIFIED FUND	8,796,885	9,311,788	9,802,293	10,347,300	10,922,610	11,561,937	12,170,969	12,847,676	13,562,007
FROM NONQUALIFIED FUND	1,513,419	1,602,003	1,686,390	1,780,153	1,879,129	1,989,120	2,093,898	2,210,318	2,333,212
FROM TAX SAVINGS	950,429	1,006,060	1,059,055	1,117,939	1,180,096	1,249,170	1,314,971	1,388,084	1,465,261
ANNUAL EXPENDITURES	11,260,733	11,919,851	12,547,738	13,245,392	13,981,835	14,800,227	15,579,838	16,446,078	17,360,480
ADJUSTED ESTIMATED COST OF DECOMMISSIONING - RETAIL	$ 223,066,140	$ 223,548,766	$ 223,430,339	$ 222,607,674	$ 221,002,826	$ 218,490,356	$ 215,058,582	$ 210,569,761	$ 204,916,960
FUNDED RESERVE BEGINNING OF YEAR BALANCE - RETAIL	$ 196,267,121	$ 197,732,845	$ 198,683,025	$ 199,115,324	$ 198,934,791	$ 198,069,140	$ 196,402,232	$ 193,921,500	$ 190,498,797
ANNUAL EARNINGS ON BEGINNING FUND BALANCE (COMPOUNDED MONTHLY)	11,776,028	11,863,971	11,920,982	11,946,920	11,936,088	11,884,149	11,784,135	11,635,291	11,429,928
ANNUAL PRINCIPAL DEPOSITS									
EARNINGS ON MONTHLY DEPOSITS COMPOUNDED MONTHLY									
FUNDS WITHDRAWN FOR DECOMMISSIONING	(10,310,304)	(10,913,791)	(11,488,683)	(12,127,453)	(12,801,739)	(13,551,057)	(14,264,867)	(15,057,994)	(15,895,219)
FUND RESERVE END OF YEAR BALANCE	$ 197,732,845	$ 198,683,025	$ 199,115,324	$ 198,934,791	$ 198,069,140	$ 196,402,232	$ 193,921,500	$ 190,498,797	$ 186,033,506
ASSUMPTIONS									
ESCALATION RATE									
EARNINGS RATE - ANNUAL									
EARNINGS RATE - MONTHLY									

(1) PRIOR YEAR BALANCE X (1 + ESCALATION RATE), FPC RETAIL ONLY.

F.4

FLORIDA POWER CORPORATION
2000 NUCLEAR DECOMMISSIONING COST STUDY
CASH FLOW SCHEDULE

CURRENT YEAR	2036	2037	2038	
YEARS REMAINING	-20	-21	-22	
ESTIMATED COST OF DECOMMISSIONING				
ESTIMATED 100% COST IN 2000 DOLLARS				
OWNERSHIP PERCENT				
RETAIL SEPARATION PERCENT				
RETAIL - CURRENT DOLLARS (1)	$ 216,310,343	$ 208,938,826	$ 31,126,612	
SOURCE OF DECOMMISSIONING FUNDS				
FROM QUALIFIED FUND	14,355,824	140,187,666	24,316,109	$ 1,190,930,588
FROM NONQUALIFIED FUND	2,469,781	24,117,932	4,163,351	204,888,086
FROM TAX SAVINGS	1,551,026	15,146,100	2,627,152	128,670,046
ANNUAL EXPENDITURES	18,376,631	179,451,698	31,126,612	$ 1,524,488,720
ADJUSTED ESTIMATED COST OF DECOMMISSIONING - RETAIL	$ 197,933,712	$ 29,467,128	$ 0	
FUNDED RESERVE BEGINNING OF YEAR BALANCE - RETAIL	$ 186,033,506	$ 180,369,912	$ 26,886,509	
ANNUAL EARNINGS ON BEGINNING FUND BALANCE (COMPOUNDED MONTHLY)	11,162,011	10,822,195	1,612,951	$ 965,349,301
ANNUAL PRINCIPAL DEPOSITS				$ 134,014,386
EARNINGS ON MONTHLY DEPOSITS COMPOUNDED MONTHLY				$ 3,665,712
FUNDS WITHDRAWN FOR DECOMMISSIONING	(16,825,605)	(164,305,598)	(28,499,460)	($ 1,395,818,674)
FUND RESERVE END OF YEAR BALANCE	$ 180,369,912	$ 26,886,509	$ 0	

ASSUMPTIONS
ESCALATION RATE
EARNINGS RATE - ANNUAL
EARNINGS RATE - MONTHLY

(1) PRIOR YEAR BALANCE X (1 + ESCALATION RATE), FPC RETAIL ONLY.

F.5

FLORIDA POWER CORPORATION

DECOMMISSIONING COST STUDY

For The

CRYSTAL RIVER PLANT – UNIT 3

November 2000

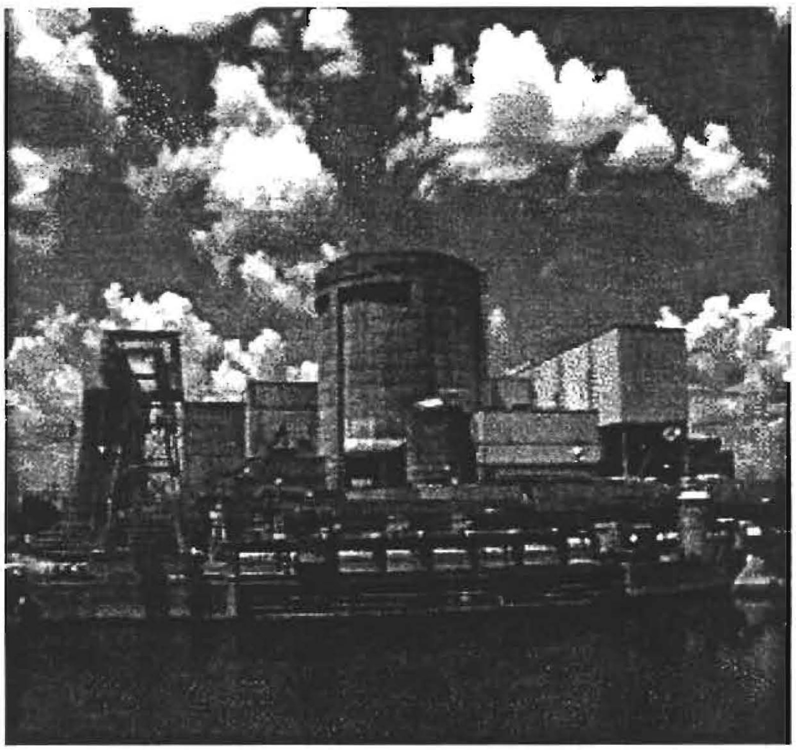
TLG Services, Inc.

Bridgewater, Connecticut

DECOMMISSIONING COST STUDY

for the

CRYSTAL RIVER PLANT - UNIT 3



prepared for

Florida Power Corporation

prepared by

TLG Services, Inc.
Bridgewater, Connecticut

November 2000

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No.	CRA No.	Date	Item Revised	Reason for Revision
0		11-27-00		Issue Final Report

EXECUTIVE SUMMARY

This study, prepared for Florida Power Corporation (Florida Power) by TLG Services, Inc. (TLG), provides a cost in 1999 dollars to decommission the Crystal River Plant, Unit 3, following the final cessation of plant operations. TLG used the site-specific technical database developed in 1994 in this updated decommissioning study. Florida Power provided the updated site-specific information which was used to prepare the cost study in 1999 dollars. Estimates were prepared for the NRC-approved decommissioning alternatives of prompt dismantlement (DECON) and SAFSTOR. The projected costs to decommission the station are estimated in 1999 dollars as $493.940 million for the DECON alternative, and $713.355 million for the SAFSTOR alternative. The major cost contributors to the overall decommissioning cost are labor, high and low level radioactive waste management and disposal, and other removal related activities (e.g., engineering, support equipment). A complete discussion of the assumptions used in this estimate is presented in Section 3.

Consistent with the 1994 model, the current cost estimate includes the operation of the Auxiliary Building as an interim wet fuel storage facility for approximately five years after operations cease. In addition, the 1999 estimate includes the costs to construct an independent, supplemental spent fuel storage facility at the site such that the residual inventory of spent fuel can be relocated from the nuclear unit spent fuel pool. This will permit the decontamination and dismantling of the facility to be completed and the operating license terminated in the shortest time possible. The independent spent fuel storage installation (ISFSI) is expected to be operational until the year 2037, when it is anticipated that the DOE will be able to complete the transfer of the fuel to a federal facility.

<u>Alternatives and Regulations</u>

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

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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+), June 27, 1988.

DECON was 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 was 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 required to be completed within 60 years, although longer time periods will be considered when necessary to protect public health and safety.

ENTOMB was 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, although longer time periods will also be considered when necessary to protect public health and safety.

The 60-year restriction has limited the practicality of this alternative at commercial reactors that generate significant amounts of long-lived radioactive material. However, the NRC is currently re-evaluating this option and the technical requirements and regulatory actions that would be necessary for entombment to become a viable option.

In 1996, the NRC published revisions to the general requirements for decommissioning nuclear power plants to clarify ambiguities and codify procedures and terminology as a means of enhancing efficiency and uniformity in the decommissioning process. The amendments allow for greater public participation and better define the transition process from operations to decommissioning. Regulatory Guide 1.184, issued in July 2000, further describes the methods and procedures that are acceptable to the NRC staff for implementing the requirements of the 1996 revised rule that relate to the initial activities and the major phases of the

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

decommissioning process. The costs and schedules presented in this estimate follow the general guidance and sequence in the amended regulations.

Methodology

The methodology used to develop the decommissioning cost estimate for Crystal River follows the basic approach originally presented in the cost estimating guidelines [5] developed by the Atomic Industrial Forum (now Nuclear Energy Institute). This reference describes a unit cost factor method for estimating decommissioning activity costs. The unit cost factors used in this study reflect site-specific costs, as well as the latest available information about worker productivity in decommissioning.

The estimates reflect lessons learned from the Shippingport Station Decommissioning Project, completed in 1989, and the decommissioning of the Cintichem reactor, hot cells and associated facilities, completed in 1997, as well as from TLG's involvement in the decommissioning 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.

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

Contingency

Consistent with industry practice, contingencies are applied to the decontamination and dismantling costs developed as "specific provision for unforeseeable elements of cost within the defined project scope, particularly important where previous experience relating estimates and actual costs has shown that unforeseeable events which will increase costs are likely to occur." [6] The cost elements in this 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 estimate, does not

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

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

account for price escalation and inflation in the cost of decommissioning over the remaining operating life of the unit.

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

Low-Level Radioactive Waste Disposal

The contaminated and activated material generated in the decontamination and dismantling of a commercial nuclear reactor is classified as low-level radioactive waste, although not all of the material is suitable for shallow-land disposal. With the passage of the "Low-Level Radioactive Waste Disposal Act" in 1980 and its Amendments of 1985, [7] the states became ultimately responsible for the disposition of low-level radioactive waste generated within their own borders.

Florida was a member of the original eight-state Southeast Compact, formed in response to the waste legislation and currently has access to the Barnwell facility in South Carolina for disposal of low-level radioactive waste. South Carolina was to serve as the host state until a new facility could be developed in North Carolina. However, as a result of a funding dispute with the Southeast Compact Commission, North Carolina legislators effectively halted development of the disposal facility. Subsequently, both South Carolina and North Carolina withdrew from the Southeast Compact. In June 2000, South Carolina formally joined with Connecticut and New Jersey to form the Atlantic Compact. The legislation allows South Carolina to gradually limit access to the Barnwell disposal facility with only Atlantic Compact members having access after the year 2009. Therefore, it is reasonable to assume that additional disposal capacity will be required to support reactor decommissioning, particularly for the isolation of the more highly radioactive material that is not suitable for disposal elsewhere. This analysis further presumes that the new disposal facilities would be available by the time the Crystal River unit ceases operation in 2016.

A majority of the radioactive waste generated from decontamination and dismantling operations is routed off-site for additional processing. Low-level radioactive material, not suitable for recycling, is transported to the Envirocare facility in Clive, Utah. More highly radioactive material is designated for disposal at a licensed facility located within the present Southeast Compact region. The rate

[7] "Low-Level Radioactive Waste Policy Amendments Act of 1985," Public Law 99-240, 1/15/86.

structure for the currently operating Barnwell facility in South Carolina is used as a proxy for future disposal facilities.

High-Level Waste

Congress passed the "Nuclear Waste Policy Act" [8] in 1982, assigning the responsibility for disposal of spent nuclear fuel created by the commercial nuclear generating plants to the DOE. This legislation also created a Nuclear Waste Fund to cover the cost of the program, which is funded by the sale of electricity from nuclear reactors. The Nuclear Waste Policy Act, along with the individual disposal contracts with utilities, specified that the DOE was to begin accepting spent fuel by January 31, 1998.

When the DOE attempted to absolve itself of the responsibility to begin accepting spent fuel in 1998, and any adverse impacts on utilities resulting from its failure to meet this date, utilities sought relief in the federal courts. In a series of rulings the courts have upheld the fact that the DOE has an unconditional obligation to begin accepting spent fuel beginning in 1998. The courts have also ruled that the DOE cannot argue that the delays were unavoidable in fulfilling this obligation.

Despite these facts, the DOE continues to link initial acceptance of commercial spent fuel to the schedule for a geologic repository, which it currently projects to begin operating in 2010 at the earliest. However, in addition to failing to meet the 1998 date, the DOE has failed to communicate to utilities a revised schedule for acceptance of spent fuel. Thus, spent fuel logistics supporting this cost update are based on available information and projections related to the DOE's initial performance, acceptance rates, and use of spent fuel acceptance allocations assigned to Florida Power. These projections indicated that Crystal River fuel would not begin to be accepted by the DOE until 2013. While the cost of high-level waste disposal is ultimately the responsibility of the DOE, Florida Power expects to develop supplemental fuel storage at the Crystal River site in support of decommissioning operations in order to minimize the total decommissioning costs.

Once the pool is emptied, decommissioning operations can be concluded and the operating license terminated. Costs are included within the estimate to construct and operate an independent storage facility. This facility will operate at the site until the year 2037, when the DOE is expected to complete the fuel transfer.

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

Site Restoration

The efficient removal of the contaminated materials at the site may result in damage to many of the site structures. Blasting, coring, drilling, and the other decontamination activities will substantially damage power block structures, potentially weakening the footings and structural supports. Prompt demolition is clearly the most appropriate and cost-effective option to return the site to a reusable configuration. 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 and less costly than if the process were deferred. Experience at shutdown generating stations has shown that plant facilities quickly degrade without continual maintenance, adding additional expense and creating potential hazards to the public, as well as to the demolition work force. Consequently, this study assumes that site structures will be removed to a nominal depth of three feet below the local grade level whenever possible. The site will then be graded and stabilized.

Summary

This study provides estimates for decommissioning the Crystal River nuclear unit under current regulatory requirements. The estimates are based on present-day costs and available technology. A timeline for each of the alternatives is available in Section 4. A summary of the costs and schedules is provided at the end of this section, with the major cost contributors identified in Section 6. Detailed cost reports are provided in Appendix C.

COST AND SCHEDULE ESTIMATE SUMMARY

	Costs 99$[1] (thousands)	Schedule (months)
DECON		
ISFSI Capital Expenditures	57,436	--
Preparations	76,193	18.0
Decommissioning Operations[2]	286,550	60.3
Site Restoration	35,650	20.4
Post Decommissioning ISFSI Operations	38,110	160.2
	493,940	**258.9**
SAFSTOR		
ISFSI Capital Expenditures	57,436	--
Preparations	53,096	18.0
52.6 year Maintenance Cost	279,055	631.3
Delayed Decommissioning[2]	292,935	70.8
Site Restoration	30,833	20.3
	713,355	**740.4**

1 Column may not add due to rounding
2 Includes GTCC disposal

1. INTRODUCTION

This cost estimate analysis, prepared by TLG Services, Inc., (TLG) is designed to provide Florida Power Corporation with sufficient information to prepare financial planning documents required by the Public Service Commission. It is not an engineering analysis, but a cost estimate prepared in advance of the detailed preparations required to carry out the decommissioning of the Crystal River Plant, Unit 3.

1.1 OBJECTIVE OF STUDY

The objective of this study was to prepare an estimate of the cost, schedule, and waste volume generated to decommission the nuclear unit at Crystal River, including all common and supporting facilities. An operating license was granted in December of 1976. For the purpose of this study, cessation of plant operations was assumed as 40 years from the date the operating license was issued. This time frame was used as input in scheduling decommissioning activities.

1.2 SITE DESCRIPTION

The Crystal River Plant 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 units and one nuclear unit. The Gulf of Mexico provides the heat sink for both Units 1 and 2 fossil units, and the nuclear unit.

The Nuclear Steam Supply System (NSSS) consists of a pressurized water reactor and a two-loop Reactor Coolant System. Babcock & Wilcox supplied the system. The generating unit has a reference core design of 2544 MWt (thermal), with a corresponding net dependable capability electrical rating of 821 megawatts (electric) with the reactor at rated power.

The Reactor Coolant System (RCS) 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, a seismic Category I reinforced concrete structure. The reactor containment 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. Nominal liner plate thickness is 3/8 inch for the cylinder and dome and 1/4 inch for the base. The pressurizer is located in an area behind the steam generator.

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 decommissioning guidance in the rule "General Requirements for Decommissioning Nuclear Facilities," June 27, 1988. [1]* This rule amended NRC regulations to set forth technical and financial criteria for decommissioning licensed nuclear facilities. The regulation addressed decommissioning planning needs, timing, funding methods, and environmental review requirements. The intent of the rule was to ensure that decommissioning would be accomplished in a safe and timely manner and that adequate licensee funds would be available for this purpose. Subsequent to the rule, the NRC issued Regulatory Guide 1.159, "Assuring the Availability of Funds for Decommissioning Nuclear Reactors,"[2] which provided guidance to the licensees of nuclear facilities on methods acceptable to the NRC staff for complying with the requirements of the rule. The regulatory guide addressed the funding requirements and provided guidance on the content and form of the financial assurance mechanisms indicated in the rule amendments.

The rule defined three decommissioning alternatives as being acceptable to the NRC: DECON, SAFSTOR, and ENTOMB. It also placed limits on the time allowed to complete the decommissioning process. For SAFSTOR, the process is restricted in overall duration to 60 years unless it can be shown that a longer

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

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 conditions for release and license termination.

The ENTOMB alternative has not been viewed as a viable option for power reactors due to the significant time required to isolate the long-lived radionuclides for decay to permissible levels. However, with recent rulemaking permitting the release of a site for controlled use, the NRC is re-evaluating 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. For purposes of this study, the ENTOMB alternative was not evaluated since the regulatory-approved entombment process is yet undefined.

In 1996 the NRC published revisions to the general requirements for decommissioning nuclear power plants.[3] When the decommissioning regulations were adopted in 1988, it was assumed that the majority of licensees would decommission at the end of the operating license life. Since that time, several licensees have prematurely and permanently ceased operations without having submitted a decommissioning plan. In addition, these licensees requested exemptions from certain operating requirements as being unnecessary once the reactor is defueled. Each case has been handled individually without clearly defined generic requirements. The NRC amended the decommissioning regulations in 1996 to clarify ambiguities and codify procedures and terminology as a means of enhancing efficiency and uniformity in the decommissioning process. The new amendments allow for greater public participation and better define the transition process from operations to decommissioning.

Under the revised regulations, licensees would submit written certification to the NRC within 30 days after the decision to cease operations. Certification would also be required once the fuel was permanently removed from the reactor vessel. Submittal of these notices would entitle the licensee to a fee reduction and eliminate the obligation to follow certain requirements needed only during operation of the reactor. Prior to or within two years following, permanent cessation of operations, the licensee would be required to submit a

Post-Shutdown Decommissioning Activities Report (PSDAR) to the NRC. The PSDAR describes the planned decommissioning activities, the associated sequence and schedule, and an estimate of expected costs. Prior to completing decommissioning, the licensee would be required to submit an application to the NRC to terminate the license, along with a license termination plan.

1.3.1 Nuclear Waste Policy Act

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

After pursuing a national site selection process, the Act was amended in 1987 to designate Yucca Mountain, Nevada, as the only site to be evaluated for geologic disposal of high-level waste. Also in 1987, the DOE announced a five-year delay in the opening date for the repository, from 1998 to 2003. Two years later, in 1989, an additional 7-year delay was announced, primarily due to problems in obtaining the required permits from the state of Nevada to perform the required characterization of the site. There is a strong potential for additional delays.

Utilities have responded to this impasse by initiating legal action and constructing supplemental storage as a means of maintaining operating margins. In two related decisions, the U.S. Court of Appeals for the Federal Circuit reaffirmed the utility position that DOE had breached its contractual obligation. However, even with the August 2000 rulings, DOE's position has remained unchanged. The agency continues to maintain that its delayed performance is unavoidable because it does not have an operational repository and does not have authority to provide storage in the interim. Consequently, DOE has no plans to receive spent fuel before the year 2010.

DOE's generator allocation/receipt schedules are based upon the oldest fuel receiving the highest priority. The information available on the projected rate of transfer and the backlogged national queue indicates that the oldest fuel at the Crystal River Plant would not be eligible for pickup until 2013.

Once the pool is emptied, decommissioning operations can be concluded and the operating license terminated. The NRC establishes requirements in 10 CFR 50.54 (bb) for 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 (within the DOE). This funding requirement is fulfilled through inclusion of high-level waste cost elements in the decommissioning cost study, and subsequent funding accruals approved by the PSC. Cost elements include constructing an Independent Spent Fuel Storage Installation (ISFSI), purchasing multi-purpose canisters for fuel storage, and long-term caretaking costs through 2037, when all the fuel is expected to be transferred to the DOE.

1.3.2 Low-Level Radioactive Waste Policy Amendments Act

Congress passed the "Low-Level Radioactive Waste Disposal Act" in 1980, declaring the states as being ultimately responsible for the disposition of low-level radioactive waste generated within their own borders. The federal law encouraged the formation of regional groups or compacts to implement this objective safely, efficiently and economically, and set a target date of 1986. With little progress, the "Amendments Act" of 1985 [5] extended the target, with specific milestones and stiff sanctions for non-compliance.

Florida was a member of the original eight-state Southeast Compact, formed in response to the waste legislation, and currently has access to the Barnwell facility in South Carolina for disposal of low-level radioactive waste. However, in June 2000, South Carolina formally joined with Connecticut and New Jersey to form the Atlantic Compact. The legislation allows South Carolina to gradually limit access to the Barnwell disposal facility, with only Atlantic Compact members having access after the year 2009. Therefore, it is reasonable to assume that additional disposal capacity will be required to support reactor decommissioning, particularly for the isolation of the more highly radioactive material that is not suitable for disposal elsewhere. This analysis further presumes that the new disposal facilities would be available by the time the Crystal River unit ceases operation in 2016.

A majority of the radioactive waste generated from decontamination and dismantling operations is routed off-site for additional processing. Low-level radioactive material, not suitable for recycling, is transported to the Envirocare facility in Clive, Utah. More highly radioactive material is designated for disposal at a licensed facility located within the present Southeast Compact region. The rate structure for the currently operating Barnwell facility in South Carolina is used as a proxy for future disposal facilities.

1.3.3 Radiological Criteria for License Termination

In 1997, 10 CFR 20, Subpart E, "Radiological Criteria for License Termination,"[6] was published. This subpart provided radiological criteria for releasing a facility for unrestricted use. The regulation provides 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 residual radioactivity has been reduced to levels that are As Low As Reasonably Achievable (ALARA).

It should be noted that the NRC and the Environmental Protection Agency (EPA) differ on the amount of residual radioactivity considered acceptable in site remediation. The EPA has two limits that apply to radioactive materials. An EPA limit of 15 millirem per year is derived from criteria established by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund). An additional limit of 4 millirem per year, as defined in 40 CFR Part 141.16, is applied to drinking water.

The Congress has prohibited the EPA from spending funds to enforce cleanup requirements at sites under the jurisdiction of the NRC. However, the mandate is not legally binding and the possibility exists that a site, once released from its NRC license, could be subject to EPA regulation.

2. DECOMMISSIONING ALTERNATIVES

Cost studies were developed to decommission the Crystal River Plant for each of the approved decommissioning alternatives: DECON and SAFSTOR. Although the alternatives differ with respect to technique, process, cost, and schedule, they attain the same result: the ultimate release of the site for alternative use.

The following sections describe the basic activities associated with each alternative. Although detailed procedures for each activity identified are not provided, and the actual sequence of work may vary, these 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.

2.1 DECON

The DECON alternative, as defined by the NRC, is "the alternative in which the equipment, structures, and portions of a facility and site containing radioactive contaminants are removed or decontaminated to a level that permits the property to be released for unrestricted use shortly after cessation of operations." This study does not address the cost to dispose of the spent fuel residing at the site; such costs are funded through a surcharge on electrical generation. However, the study does estimate the costs incurred with the interim on-site storage of the fuel pending shipment by the DOE to a disposal facility.

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

The second phase encompasses activities during the storage period or during major decommissioning activities, or a combination of the two. The third phase pertains to the activities involved in license termination. TLG's methodology divides the decommissioning project into periods, based upon major milestones in the project. The NRC's initial phase corresponds to TLG's Period 1, with phases two and three subsets of Period 2. TLG's Period 3, Site Restoration and Post-Period 3, ISFSI Operations and Decommissioning, have no corresponding NRC phases. However, the NRC does require licensees to have a funding and high-level waste management plan under 10CFR50.54(bb).

2.1.1 Period 1 - Preparations

In anticipation of the cessation of plant operations, detailed preparations are undertaken to provide a smooth transition from plant operations to site decommissioning. A significant amount of decommissioning planning and preparations can be conducted in the two years prior to shutdown. The organization required to manage the decontamination and dismantling activities is assembled from the available plant staff and outside resources, as required. Preparations include the planning for permanent defueling of the reactor, revision of technical specifications relating to the decommissioning conditions and requirements, a characterization of the facility and major components, and the development of the PSDAR.

Engineering and Planning

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

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

Consequently, in conjunction with the development of the PSDAR, activity specifications, cost-benefit and safety analyses, work packages and procedures, etc. must be assembled in support of the proposed decontamination and dismantling activities.

The decommissioning program outlined in the PSDAR will be designed to accomplish the required tasks within the ALARA guidelines (as defined in 10 CFR §20) for protection of personnel from exposure to radiation hazards. It will also address the continued protection of the health and safety of the public and the environment during the dismantling activity.

The NRC recognizes that the existing operational technical specifications will require review and modifications to reflect plant conditions and the safety concerns associated with permanent cessation of operations. The environmental impact associated with the planned decommissioning activities must also be considered. A licensee will not be allowed to proceed if the consequences of a particular decommissioning activity are greater than bounded by previously issued environmental assessments or impact statements. In this instance the licensee would have to submit a license amendment for the specific activity and update the environmental report.

Much of the work in preparing the PSDAR is also relevant to the development of the detailed engineering plans and procedures. This work includes, but is not limited to:

1. Site preparation plans for the proposed decommissioning activities;

2. Detailed procedures and removal sequences for plant systems and components;

3. Evaluation of the disposition alternatives for the reactor vessel and its internals;

4. Plans for decontamination of structures and systems;

5. Design/procurement and testing of tooling and equipment;

6. Identification/selection of specialty contractors;

7. Procedures for removing and disposing of radioactive materials; and

8. Sequential planning of activities to minimize conflicts with simultaneous tasks.

Site Preparations

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

1. Prepare site support and storage facilities, as required.

2. Perform site characterization study to determine extent of site contamination.

3. Isolate spent fuel storage services and fuel handling systems located in the Auxiliary Building from the power block such that decommissioning operations can commence on the balance of the plant. Decommissioning operations are scheduled around the fuel handling area to the greatest extent possible such that the overall project schedule is optimized. Current dry storage cask designs are licensed for spent fuel with a core discharge decay time averaging approximately five years or longer. As the spent fuel decays to the point that it meets the heat load criteria of the dry storage casks, it will be transferred to the ISFSI. It is assumed that all fuel is transferred from the Auxiliary Building within six years of the cessation of plant operations.

4. Clean all plant areas of loose contamination and process all liquid and solid wastes.

5. Conduct radiation surveys of work areas, major components (including the reactor vessel and its internals), sampling of internal piping contamination levels, and primary shield cores.

6. Correlate survey data and normalize for development of packaging and transportation procedures.

7. Determine transport and disposal container requirements for activated materials and/or hazardous materials, including shielding and stabilization. Fabricate or procure such containers.

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

Following the certification of permanent fuel removal from the reactor vessel, and 90 days after submittal of the PSDAR, the licensee may commence major decommissioning activities. The licensee may use up to 23 percent of the amount (as determined using the 10 CFR 50.75 methodology) of the decommissioning trust funds for decommissioning activities prior to submitting a site-specific decommissioning cost estimate. Included in this 23 percent is an initial 3 percent that can be used by the licensee, even prior to permanent cessation of operation, for planning the decommissioning. Full access to the decommissioning fund will require the preparation of a detailed site-specific cost estimate for submittal to the NRC.

2.1.2 Period 2 – Decommissioning Operations & License Termination

Decommissioning involves the following activities:

1. Prepare existing site facilities needed to support the dismantling activities. Modify and/or upgrade, if needed, changing rooms and contaminated laundry facilities for the increased work force. Provide protected and open laydown areas to facilitate equipment removal and shipping operations. Evaluate road improvements to facilitate hauling and transportation, and building modifications to facilitate both the movement of heavy equipment into the power block structures and the extraction of large components out of these buildings.

2. Design, procure, and install a water cleanup system for removal of cutting residues and crud deposits from the reactor vessel and the refueling canal.

3. Design and fabricate special shielding and contamination control envelopes, special tooling and remotely operated equipment. Modify the refuel canal to support segmentation activities and prepare rigging for segmentation and removal of piping sections and components, including the reactor vessel and its internals.

4. Procure required shipping casks, liners, and industrial packages from suppliers.

5. Conduct decontamination of components and piping systems as required. Remove, package and dispose of piping and components, as they are no longer required to support the decommissioning process.

6. Remove control rod drive housings and the head service structure from reactor vessel head and package for controlled disposal.

7. Segment reactor vessel closure head and vessel flange for shipment in cask liners. Load overpack liners into shielded casks or place in shielded vans for transport.

8. Segment upper internals assemblies; package segments in shielded casks. These operations are performed remotely by cutting equipment located under water in the refueling facilities.

9. Disassemble/segment remaining reactor internals. The operations are also conducted under water using remotely operated tooling and contamination controls. Isolate components or subcomponents that exceed the limits established for Class C waste as defined by 10 §CFR 61. Transfer GTCC material to the fuel storage pool. Package GTCC for interim storage in the ISFSI. It is assumed that the DOE will dispose of the GTCC along with the spent fuel.

10. Section the reactor vessel. This operation is accomplished in air using remotely operated equipment within a contamination control envelope. Sections are placed in containers under water (for example, in the refueling canal) or in air with the crane operator protected by a shielded envelope.

11. Remove reactor coolant pumps. Decontaminate exterior surfaces, as required, and seal-weld all openings. These components can serve as their own burial containers provided that all penetrations are properly sealed.

12. Maintain station diesel generator operation to provide emergency power to the spent fuel cooling and cleanup systems during the required heat decay phase for the last core off load. The fuel

handling equipment, supporting the transfer of the assemblies off site, may also require the station diesel generators to be available.

13. Remove activated concrete biological shield and accessible contaminated concrete (excluding steam generator and pressurizer cubicles). If dictated by the steam generator and pressurizer removal scenarios, remove those portions of the associated cubicles necessary for access and component extraction.

14. Remove steam generators and pressurizer for shipment and controlled disposal. Decontaminate exterior surfaces, as required, and seal-weld openings (nozzles, inspection hatches, and other penetrations). These components can serve as their own burial containers provided that all penetrations are properly sealed and the internal contaminants are stabilized. Add steel shields to those external areas of the steam generators to meet transportation limits and regulations.

15. Remove steel liners from the refueling canal. Package contaminated material, including any contaminated concrete, for off-site processing and/or disposal.

16. Remove systems and associated components as they become non-essential to the support of vessel disposition, other decommissioning operations or worker health (e.g., decommissioning waste processing systems, HVAC systems, water systems, etc.).

17. Perform radiation survey to ensure that the remaining portions of the containment structure are free of surface contamination.

18. Remove contaminated equipment and material from the Auxiliary and Intermediate buildings, and any other contaminated areas. Use radiation and contamination control techniques until radiation surveys indicate that the structures 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. Removal of the installed inventory will facilitate surface decontamination and subsequent verification surveys required prior to obtaining release for demolition.

License Termination

The preparation of a termination plan is required at least two years prior to the anticipated date of license termination. 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 any reuse of the site, an updated cost estimate to complete the decommissioning, and any associated environmental concerns. The NRC will publish notice of a receipt of the plan and make the plan available for public comment. A local hearing will also be scheduled. Plan approval may be subject to conditions and limitations as deemed appropriate by the NRC. The licensee may then commence with the final remediation of site facilities and services, including the following activities:

1. Remove contaminated equipment and material from the Auxiliary Building following the transfer of all residual spent fuel to either an on-site storage facility or an off-site federal facility. Remediate affected areas until the structure can be released for unrestricted access.

2. Decontaminate remaining structures and facilities. Material removed in the decontamination and dismantling of the nuclear unit will be routed 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 will be characterized and segregated for additional on-site decontamination, off-site processing (disassembly, chemical cleaning, volume reduction, waste treatment, etc.) and/or packaged for controlled disposal at the low-level radioactive waste disposal facility.

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

4. Conduct final radiation survey to ensure that all radioactive materials in excess of permissible residual levels have been remediated. This survey may coincide with final NRC site inspection.

Incorporated into the License Termination Plan is the Final Survey Plan. This plan identifies the radiological surveys to be performed once the decontamination activities are completed and is developed using the guidance provided in NUREG/CR-1575, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)"[7]. This document incorporates the statistical approaches to survey design and data interpretation used by the EPA. It also identifies state-of-the-art, commercially available, instrumentation and procedures for conducting radiological surveys. Use of this guidance ensures that the surveys are conducted in a manner that provides a high degree of confidence that applicable NRC criteria are satisfied. Once the survey is complete, the results are provided to the NRC in a format that can be verified. The NRC then reviews and evaluates the information, performs an independent confirmation of radiological site conditions, and makes a determination on final termination of the license.

The NRC will terminate the nuclear plant 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.

2.1.3 Period 3 – Site Restoration

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

Prompt dismantling of site structures is clearly the most appropriate and 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 continual 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 will be dismantled as a continuation of the decommissioning activity. Foundations and exterior walls are assumed to be removed to a nominal depth of three feet below grade. The three-foot depth allows for the placement of both gravel for drainage, as well as topsoil so that vegetation can be established for erosion control. Site areas affected by the dismantling activities are cleaned and the plant area graded as required to prevent ponding and inhibit the refloating of subsurface materials. Activities include:

1. Demolition of the remaining portions of the containment structure and interior portions of the Reactor Building. Internal floors and walls are removed from the lower levels upward, using controlled blasting techniques. Concrete rubble and clean fill produced by demolition activities are used on-site to backfill voids. Suitable materials can be used on site for fill; otherwise the rubble is trucked off-site for disposal as construction debris.

2. Removal of the remaining buildings using conventional demolition techniques for above ground structures, including the Reactor, Auxiliary and Turbine Generator buildings.

3. Preparation of a final dismantling program report.

2.1.4 Post-Period 3 - ISFSI Operations and Decommissioning

The ISFSI will continue to operate under a separate and independent license (10 CFR §72) following the relocation of the residual spent fuel from the Auxiliary Building. Transfer of spent fuel to a DOE or interim facility will be exclusively from the ISFSI once the fuel pool has been emptied and the structure released for decommissioning. Assuming initiation of the federal Waste Management System in 2010, transfer of spent fuel from Crystal River is anticipated to start in the year 2013 and is assumed to continue with the final spent fuel shipment presumed to occur in the year 2037.

The NRC will terminate the 10 CFR §72 license if it determines that site remediation has been performed in accordance with a license termination plan, and the terminal radiation survey and associated documentation demonstrate that the facility is suitable for release. Once these requirements have been satisfied, the NRC can terminate the license for the ISFSI.

The reinforced concrete dry storage modules are then demolished and disposed of as clean fill. The concrete storage pad is removed, and the area graded and landscaped to conform to the surrounding environment.

2.2 SAFSTOR

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

The engineering and planning requirements are similar to those for the DECON alternative, although a shorter time period is expected for these activities due to the more limited work scope. Site preparations are also similar to those for the DECON alternative. However, with the exception of the required radiation surveys and site characterizations, the mobilization and preparation of site facilities is less extensive.

2.2.1 Period 1 - SAFSTOR Operations

In anticipation of the cessation of plant operations, detailed preparations are undertaken to provide a smooth transition from plant operations to site decommissioning. Through implementation of the staffing transition plan, the organization required to manage the intended decommissioning program is assembled from available plant staff and outside resources. Preparations 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 program outlined in the PSDAR will be designed to accomplish the required tasks within the ALARA guidelines for protection of personnel from exposure to radiation hazards. It also addresses the continued protection of the health and safety of the public and the environment.

The NRC recognizes that the existing operational technical specifications will require review and modifications to reflect plant conditions and the safety concerns associated with permanent cessation of operations. The environmental impact associated with the planned decommissioning activities must be considered; an environmental report on those concerns not already assessed must be submitted to the NRC for consideration and possible preparation of an environmental impact statement.

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

1. Isolate spent fuel storage services and fuel handling systems located in the fuel handling facility from the power block so that safe-storage operations may commence on the balance of the plant. This activity may be carried out by plant personnel in accordance with existing operating technical specifications. Activities are assumed to be scheduled around the fuel handling systems to the greatest extent possible. All remaining spent fuel on site will be stored in the existing spent fuel pool until transferred off-site.

2. Drain/de-energize/secure all non-contaminated systems not required to support dormancy operations.

3. Dispose of contaminated filter elements and resin beds not required for processing wastes from decontamination activities.

4. Drain reactor vessel; leaving internals in place.

5. Drain, de-energize, and secure all contaminated systems. Decontaminate systems as required for future maintenance and inspection.

6. Prepare lighting and alarm systems whose continued use is required. De-energize and/or secure portions of fire protection, electric power, and HVAC systems whose continued use is not required.

7. Clean loose surface contamination from building access pathways.

8. Perform an interim radiation survey of plant; post warning signs as appropriate.

9. Erect physical barriers and/or secure all access to radioactive or contaminated areas, except as required for controlled access, i.e., inspection and maintenance.

10. Install security and surveillance monitoring equipment and relocate security fence around secured structures, as required.

11. Delay the demolition of those structures located outside the secured area until after the termination of the license.

2.2.2 Period 2 - SAFSTOR 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 alternative SAFSTOR. 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 a termination plan (described in Section 2.1.2), thereby initiating the third phase.

Activities required during the planned dormancy period for the SAFSTOR alternative include a 24-hour guard 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.

Equipment maintenance, inspection activities, and routine service are performed by resident maintenance personnel. This work force will maintain the structures in a safe condition, provide adequate lighting, heating, and ventilation, and perform periodic preventive maintenance on essential site services.

An environmental surveillance program is carried out during the dormancy period to ensure that potential releases of radioactive material to the environment are 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. Security is provided by the security fence, sensors, alarms, surveillance equipment, etc., which must be maintained in good condition for the duration of this period. Fire and radiation alarms are also to be monitored and maintained. While remote surveillance is an option, it does not offer the immediate response time of a physical presence.

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. While there will be a decrease in the contamination levels present on all surfaces due to radioactive decay over an increased dormancy duration, it is not expected that any material that is non-releasable at the time of shutdown will decay to a releasable state over the permissible time frame (i.e., 60 years maximum). It is not possible to make any further assumptions concerning contamination levels without detailed characterization information.

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 waste volume in delaying decommissioning). In fact, SAFSTOR estimates can show a slight increase in the total projected waste volume, due primarily to initial preparation activities for placing the unit in safe-storage, as well as from follow-up housekeeping tasks over the caretaking period for the station.

The delay in decommissioning yields lower working area radiation levels. As such, the difference between the prompt and delayed scenarios is moderated by reduced ALARA controls for the SAFSTOR's lower occupational exposure potential. Because this alternative provides a period of decay for the residual radioactive material, lower radiation fields are encountered than with the DECON alternative. Some of the dismantling activities may employ manual techniques rather than remote procedures. Thus, dismantling operations may be simplified for some tasks. However, this study does not attempt to quantify this effect, because it would have an immaterial impact on overall costs.

2.2.3 Periods 3 and 4 – SAFSTOR Deferred Decommissioning

A termination plan must be prepared at least two years prior to the anticipated date of license termination. Submitted as a supplement to the FSAR, or equivalent, the plan must include a site characterization, description of the remaining dismantling activities, plans for site remediation, detailed plans 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 publish notice of a receipt of the plan and make the plan available for public comment. A local hearing will also be scheduled. Plan approval will be subject to any conditions and limitations deemed appropriate by the NRC. The licensee may then commence with the final remediation of site facilities and plant services.

Although the initial radiation levels due to ^{60}Co will decrease significantly during the dormancy period, the internal components of the reactor vessel will still exhibit sufficiently high radiation dose rates to require remote sectioning under water due to the presence of long-lived radionuclides such as ^{94}Nb, ^{59}Ni, and ^{63}Ni. Therefore, the dismantling procedures described for the DECON alternative would still be employed during SAFSTOR. 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.

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

Much of the work in developing a termination plan is relevant to the development of the detailed engineering plans and procedures. The activities associated with this phase, as well as the follow-on decontamination and dismantling processes are detailed in Sections 2.1.1 and 2.1.2. The primary difference between the sequences anticipated for the DECON and SAFSTOR scenarios is the absence, in the latter, of any constraint on the availability of the fuel handling facilities for decommissioning. The timing for the SAFSTOR scenario is such that the spent fuel inventory has been removed from the site prior to the initiation of decontamination and dismantling activities, eliminating a significant scheduling hindrance. Any GTCC material generated in the segmentation of the reactor vessel internals is assumed to be directly routed to the DOE's geological facility without the need to provide for interim storage on site.

2.2.4 Period 5 – SAFSTOR Site Restoration

Following completion of decommissioning operations, site-restoration activities may begin. Dismantling of the site structures as a continuation of the decommissioning process is clearly the most appropriate and cost-effective option, as described in Section 2.1.3. The basis for the dismantling cost in the SAFSTOR scenario is consistent with that described for DECON, presuming the removal of structures and site facilities to a nominal depth of three feet below grade and the limited restoration of the site.

3. COST ESTIMATE

The site-specific cost estimate prepared for decommissioning the Crystal River nuclear unit considers the unique features of the site, including the nuclear steam supply system, power generation system, support services, site buildings, and ancillary facilities. The basis of the estimate and its sources of information, methodology, site-specific considerations, assumptions, and derived costs are described in this section.

3.1 BASIS OF ESTIMATE

The current estimate was developed using the basic inventory and design information originally generated for the 1994 decommissioning study. For example, a detailed accounting of the plant inventory was generated for the 1994 study. Components were inventoried from the mechanical and electrical piping and instrument diagrams. Estimates of concrete volume, steel quantities, and plant areas to be addressed in remediation of the site were developed from plant general arrangement drawings, structural details, and construction design documents. This information was reviewed for the current estimate and updated, as deemed necessary.

The site-specific considerations and assumptions used in the 1994 estimate were also revisited. Modifications were incorporated where new information was available or experience from ongoing decommissioning programs dictated an alteration.

3.2 METHODOLOGY

The methodology used to develop this cost estimate follows the basic approach originally presented in the AIF/NESP-036 study report, "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates,"[8] and the US DOE "Decommissioning Handbook."[9] These documents present a unit cost factor method for estimating decommissioning activity costs, which simplifies the estimating calculations. Unit cost factors for concrete removal ($/cubic yard), steel removal ($/ton), and cutting costs ($/inch) were developed using local labor rates provided by Florida Power. The activity-dependent costs were estimated with the item quantities (cubic yards, tons, inches, etc.) developed from plant drawings and inventory documents.

The unit cost factors used in this study reflect the site-specific costs, as well as the latest available information on worker productivity in decommissioning.

Lessons learned from the Shippingport Station Decommissioning Project, completed in 1989, the decommissioning of the Cintichem reactor, hot cells and associated facilities, completed in 1997, and TLG's involvement in the decommissioning 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 are reflected within this estimate.

The unit cost factor method provides a demonstrable basis for establishing reliable cost estimates. The detail of activities provided in the unit cost factors for activity time, labor costs (by craft), and equipment and consumable costs provides assurance that cost elements have not been omitted. These detailed unit cost factors, coupled with the plant-specific inventory of piping, components and structures, provide a high degree of confidence in the reliability of the cost estimates.

Work Difficulty Factors (WDFs) were assigned to each unit cost factor set, 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 15%
- Protective Clothing Factor 10% to 30%

These factors and their associated range of values were developed in conjunction with the Atomic Industrial Forum's Guideline Study. The factors (and their suggested application) are discussed in more detail in this publication.

An activity duration critical path was used to determine the total decommissioning program schedule. The program schedule is used to determine the period-dependent costs for program management, administration, field engineering, equipment rental, quality assurance, and security. The estimate incorporates an organization, and associated cost, provided by Florida Power for program management. Costs for the conventional removal of components/structures relied upon information available from "Building Construction Cost Data," published by R. S. Means.[10] Examples of unit cost factor development are presented in the AIF/NESP-036 study. Appendix A of this report presents the detailed development of a typical site-specific unit cost factor. Appendix B provides the values contained within one set of factors developed for the analyses.

3.3 FINANCIAL COMPONENTS OF THE COST MODEL

TLG's proprietary decommissioning cost model, DECCER, is composed of a number of distinct cost line items. 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, labor stoppages, etc. 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 monies to cover these types of expenses.

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

3.3.1 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"[11] as "specific provision for unforeseeable elements of cost within the defined project scope; particularly important where previous experience relating estimates and actual costs has shown that unforeseeable events which will increase costs are likely to occur." The cost elements in this estimate are based upon ideal conditions and maximum efficiency; therefore, consistent with industry practice, a contingency factor has been applied. In the AIF/NESP-036 study, the types of unforeseeable events that are likely to occur in decommissioning are discussed and guidelines are provided for percentage contingency in each category. It should be noted that contingency, as used in this estimate, does not account for price escalation and inflation in the cost of decommissioning over the remaining operating life of the unit.

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

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

Disposition of the reactor vessel internals involves the underwater cutting of complex components that are highly radioactive. Costs are based upon optimum segmentation, handling, and packaging scenarios. The schedule is primarily dependent upon the turnaround time for the heavily shielded shipping casks, including preparation, loading, and decontamination of the containers for transport. The number of casks required is a function of the pieces generated in the segmentation activity, a value calculated on optimum performance of the tooling employed in cutting the various subassemblies. The risk and uncertainties associated with this task are that the expected optimization may not be achieved, resulting in delays and additional program costs. For this reason, contingency must be included to mitigate the consequences of the expected inefficiencies inherent in this complex activity, along with related concerns associated with specialty tooling modifications and repairs, field changes, discontinuities in the coordination of plant services, system failure, water clarity, lighting, computer-controlled cutting software corrections, etc. Experience in decommissioning other plants in the past has shown that many of these problem areas have occurred during, and in support of, the segmentation process. Contingency dollars are an integral part of the total cost to complete this task. Exclusion of this component puts at risk a successful completion of the intended tasks and, potentially, subsequent related activities.

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

Incomplete or Changed Conditions:

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

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

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

Adverse Working Conditions:

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

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

Maintenance, Repairs and Modifications

- Facility refurbishment required to support site operations, including those needed to provide new site services, as well as to maintain the integrity of existing structures.
- Damage control, repair, and maintenance from bird nestings and their fouling of equipment and controls.
- Building modification, i.e., re-supporting of floors to enhance loading capacity for heavily shielded casks.
- Roadway upgrades on site to handle heavier and wider loads; roadway rerouting, excavation, and reconstruction.
- Requests for additional safety margins by a vendor.
- Requests to analyze accident scenarios beyond those defined by the removal scenario (requested by the NRC to comply with "total scope of regulation").
- Additional collection of site runoff and processing of such due to disturbance of natural site contours and drainage.
- Concrete coring for removal of embedments and internal conduit, piping, and other potentially contaminated material not originally identified as being contaminated.
- Modifications required to respond to higher than expected worker exposure, water clarity, water disassociation, and hydrogen generation from high temperature cutting operations.
- Additional waste containers needed to accommodate cutting particulates (fines), inefficient waste geometries, and excess material.

Labor

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

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

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

Schedule

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

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

Weather

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

The cost model incorporates considerations for items such as those described above, generating contingency dollars (at varying percentages of total line-item cost) with every activity. The purpose of the contingency is to allow for the costs of high probability program problems occurring in the field where the occurrence, duration, and severity cannot be accurately predicted, and so their associated costs have not been included in the basic estimate. Past decommissioning experience has shown that unforeseeable elements of cost are almost certain to occur in the field and may have a cumulative impact. In 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%
Non-Radioactive Component Removal	15%
Heavy Equipment and Tooling	15%
Supplies	25%
Engineering	15%
Energy	15%
License Termination Survey	30%
Construction	15%
Fees	10%
Insurance	10%
Staffing	15%
Taxes	0%

The overall contingency, when applied to the appropriate components of the estimate on a line item basis, results in an average of approximately 17%.

3.3.2 Financial Risk

Financial risk refers to the possibility and associated probabilities of certain events occurring that could increase or decrease costs for decommissioning.

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, state- 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, state and local hearings, etc.

- 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), or variations in plant inventory, or configuration not indicated by the as-built drawings.

- Regulatory changes, e.g., affecting worker health and safety, site release criteria, waste transportation, and disposal.

- Policy decisions altering federal and state commitments, e.g., in the ability to accommodate certain waste forms for disposition, or in the timetable for such.

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

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

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 Disposition

The last core off-load of used fuel will be allowed to cool in the fuel storage pool for approximately five years after the cessation of plant operations to comply with either dry storage licensing restrictions or the DOE disposal contract requirements. The spent fuel caretaking costs, which include fuel pool maintenance, security, and continuation of emergency planning fees due to fuel being on site, as well as the scheduling delays created by being unable to dismantle certain essential systems and facilities during the storage period, are reflected within the total cost of decommissioning.

The date targeted for startup of the federal Waste Management System was 1998. However, due to a series of delays in the evaluation of the site, DOE has no plans to receive spent fuel before the year 2010.

DOE's generator allocation/receipt schedules are based upon the oldest fuel receiving the highest priority. The information available on the projected rate of transfer and the backlogged national queue indicates that the oldest Crystal River fuel would not be eligible for pickup until 2013. It is therefore reasonable to assume that Florida Power will have developed supplemental fuel storage at the site to support decommissioning operations. When the fuel transfer to the ISFSI is complete, and the pool is emptied, decommissioning operations can be concluded and the operating license terminated. Costs are included within the estimate to construct an independent storage facility and for the continued operation of this facility at the site until the year 2037, when DOE is expected to complete the transfer.

3.4.2 Reactor Vessel and Internal Components

The reactor pressure vessel and reactor internal components are segmented for disposal in shielded transportation casks. Segmentation and packaging of the internals' packages are performed in the refueling canal where a turntable and remote cutter will be 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 Department of Transportation (DOT) regulations dictate segmentation and packaging methodology. All packages must meet the current physical and radiological limitations and regulations. Cask shipments will be made in DOT-approved, currently available, truck casks.

The dismantling of reactor internals will generate radioactive waste generally unsuitable for shallow land disposal (GTCC). Although the material is not classified as high-level waste, the DOE has indicated it will accept title to this waste for disposal at the future high-level waste repository. However, the DOE has not yet established an acceptance criteria or a disposition schedule for this material, and numerous questions remain as to the ultimate disposal cost and waste form requirements. As such, for purposes of this study, the GTCC waste has been packaged and disposed of as high-level waste, at a cost equivalent to that envisioned for the spent fuel.

Intact disposal of the reactor vessel and internal components can provide savings in cost and worker exposure by eliminating the complex segmentation requirements, the isolation of the GTCC material, and the transport/storage of the resulting waste packages. Portland General Electric (PGE) was able to dispose of the Trojan reactor as an intact package. However, the location of the Trojan Nuclear Plant on the Columbia River simplified the transportation analysis since:

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

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

It is not known whether this option will be available when the Crystal River unit ceases operation. Future viability of this option will depend upon the ultimate location of the disposal site, as well as the site licensee's ability to accept highly radioactive packages and effectively isolate them from the environment.

3.4.3 Major Component Removal

The following discussion deals with the one-piece removal and disposition of the steam generators, but the techniques involved are also applicable to other large components, such as the pressurizer. The steam generators' size and weight, as well as their configuration and limited access in the Reactor Building itself, place constraints on the intact removal of these components. Determination of the removal strategy requires several different considerations, including 1) rigging and modifications to the Reactor Building to maneuver and extract the generators from the structure, and 2) the component preparations needed to transport the generators to a disposal site.

The generators will be rigged for removal, disconnected from the surrounding piping and supports, and maneuvered into the open area where they will be lowered onto a dolly. The dolly will allow the lower end of the steam generator to rotate through the equipment hatch opening as it is being lowered. Once the steam generator has been lowered to the horizontal position, nozzles and other openings will be welded closed, and it will be filled with low-density cellular concrete for stabilization of the internal contamination and to satisfy burial ground packaging requirements. When this stage has been completed, the generator will be rigged out of the building and transferred to a multi-wheeled transporter and moved to an on-site steam generator processing area. The final package preparation includes the welding of steel shielding plates to the outside surface to meet DOT transportation regulations, if required. The generators will be loaded onto a barge for transport to the burial facility.

The main turbine would be dismantled using conventional maintenance procedures; the turbine rotors and shafts are removed to a laydown area for packaging and transported for disposal. The lower turbine casings are removed from their anchors by controlled demolition. The main condensers are segmented and transported to the laydown area for off-site disposition along with the upper and lower turbine casings.

3.4.4 Transportation Methods

For the purposes of the cost estimate, it was assumed that the low-level radioactive waste produced in the decontamination and dismantling of the nuclear unit would be moved overland by truck, shielded van, railcar, and/or multi-wheeled transporter. Transportation costs were based upon a one-way distance of approximately 400 miles, (a distance equivalent to the existing disposal site in Barnwell, South Carolina), or approximately 2,400 miles (a distance equivalent to Envirocare of Utah), as appropriate. The steam generators would be transported by barge.

3.4.5 Low-Level Radioactive Waste Disposal

The plant components, equipment, and structural material removed, as well as the debris generated in the decontamination and dismantling of the nuclear unit, will be characterized prior to disposal. For the purposes of this estimate, low-level radioactive material not suitable for recycling is transported to the Envirocare facility in Clive, Utah at a charge of $75 per cubic foot. More highly radioactive material is designated for disposal at a licensed facility located within the present Southeast Compact region. The rate schedule for the currently operating Barnwell facility is used as a proxy for a regional site and is consistent with Florida Power's current cost for waste disposal.

The rate structure at the Barnwell facility is based upon the density of the packaged waste. An average density of 85 pounds per cubic foot for the waste stream generated from the decontamination and dismantling activities was used to produce a volumetric equivalent. At a unit disposal rate of $4.40 per pound,[12] the packaged density equates to a volumetric charge of $374 per cubic foot. This value was used to estimate the cost of controlled disposal at the regional site.

3.4.6 Site Conditions Following Decommissioning

A final radiation survey will be conducted to ensure that all radioactive materials in excess of permissible residual levels have been remediated in accordance with "Radiological Criteria for License Termination." This survey may coincide with final NRC site inspection.

The NRC will terminate the 10 CFR §50 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 typically will end at this point. Local building codes, state environmental regulations, and the Owner's own future plans for the site will dictate the next step in the decommissioning process. TLG assumed the total removal of all plant systems and all non-essential above-grade structures from the site.

These non-radiological costs are included in the total cost of decommissioning.

3.5 ASSUMPTIONS

The following are the major assumptions made in the development of the cost estimates for decommissioning the Crystal River Plant.

3.5.1 Estimating Basis

1. The estimate is performed in accordance with the methodology described in the AIF/NESP-036 study and the assumptions delineated in the previous 1994 study, unless otherwise noted.

2. Decommissioning costs are reported for each year of projected expenditure; however, the values are provided in 1999 dollars for the current estimate. Costs are not inflated or escalated over the period of performance.

3.5.2 Labor Costs

1. Florida Power will continue to provide site operations support, including decommissioning program management. The supervisory staff needed to oversee the labor subcontractors, consultants, and specialty contractors relied upon to perform the work envisioned in the decontamination and dismantling effort will be subcontracted.

2. Florida Power provided the management organization as well as the costs associated with maintaining the organization throughout the decommissioning program.

3. A Decommissioning Operations Contractor (DOC) will be hired to provide contract management of the decommissioning labor force and to subcontract such engineering services as activity specifications, detailed procedures, detailed activation analyses, structural modifications, etc.

4. The craft labor required to decontaminate and dismantle the nuclear unit will be acquired through standard site contracting practices. Representative salary and craft labor rates for site administration, operations, construction, and maintenance personnel were used as a cost basis.

3.5.3 Design Conditions

1. Any fuel cladding failure that occurred during the lifetime of the plant is assumed to have released fission products at sufficiently low levels that the buildup of quantities of long-lived isotopes (e.g., cesium-137, strontium-90, or transuranics) has been prevented from reaching levels exceeding those that permit the major NSSS components to be shipped under current DOT regulations and to be buried within the requirements of 10 CFR §61.

2. The estimated curie contents of the vessel and internal components were derived from those listed in NUREG/CR-3474.[13] Actual estimates were derived from the curie/gram values in NUREG/CR-3474 and adjusted for the different mass of the Crystal River components, expected plant operating life, and periods of decay. Additional short-lived isotopes were derived from NUREG/CR-0130[14] and NUREG/CR-0672 [15] and benchmarked to the long-lived values from NUREG/CR-3474.

3.5.4 Waste Processing and Disposal

1. The disposal costs for the reactor pressure vessel and internals are based on remote in-place segmentation, packaging in casks with shielding, and shipping by truck to the burial ground. The maximum curies per shipment assumed permissible are based upon the license limits of available shielded shipping casks. The number and curie content of vessel segments are selected to meet these limits.

2. This study estimates that there will be some radioactive waste generated that is greater than 10 CFR §61 Class C quantities, resulting from disposal of the highly activated sections of the reactor vessel internals. This waste will most likely be disposed of as high-level waste in the DOE's deep geological repository unless the NRC approves an alternative solution. The cost of disposal, unlike that for the spent fuel, is not covered by the DOE's 1 mill/kWhr surcharge and has been estimated from equivalent disposal costs for spent nuclear fuel.

3. Compactable dry active waste, such as booties, glove liners, respirator filter cartridges, shipping containers, radiological

controls, survey materials, etc. are assumed to be drummed and compacted to 10% of their original volume.

3.5.5 Transportation

1. Contaminated piping, components, and structural material other than the highly activated reactor vessel and internal components will qualify as Low Specific Activity, LSA-I, LSA-II or LSA-III or Surface Contaminated Object, SCO-I or SCO-II, as described in Title 49 of the Code of Federal Regulations.[16] The contaminated materials will be packaged in Industrial Packages, IP-I, IP-II, or IP-III for transport unless demonstrated to qualify as their own shipping containers. The reactor vessel and internal components are expected to be transported as Type B, in accordance with 10 CFR §71. It is conceivable that the reactor, due to its limited specific activity, could qualify as LSA-II or LSA-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.

2. Truck transport assumes a maximum normal road weight limit of 80,000 pounds for all shipments, with the exception of the overweight shielded casks. Rates for shipping radioactive wastes are provided by Tri-State Motor Transit in published tariffs for this cargo.[17]

3. Transport of 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 segments, supplementary shielding, cask tie-downs, and tractor-trailer. The maximum number of curies per shipment assumed permissible is based upon the license limits of available shielded shipping casks. The number and curie content of vessel and internal segments are selected to meet these limits.

3.5.6 Spent Fuel

1. For the basis of this cost study, the DOE is assumed to begin accepting spent fuel from Crystal River beginning in 2013, with the transfer completed by the end of year 2037. The residual spent fuel assemblies remaining in the Auxiliary Building storage pool will be

relocated to an ISFSI for interim storage within approximately five years of final shutdown.

2. The capacity of the ISFSI is based upon a vertical spent fuel storage system, utilizing a Multi-Purpose Canister (MPC) design. The ISFSI is assumed to have the capacity to store the residual inventory present in the spent fuel pool at the cessation of operations. Forty casks are projected to be required for the storage of spent fuel, based upon a loading of 24 assemblies per cask. An additional five casks will be required for the storage of GTCC material generated in the segmentation of the reactor vessel internals. Florida Power provides the spent fuel storage canisters and concrete overpacks for both the spent fuel and GTCC casks. The ISFSI storage pad is sized for a total of 45 casks (40 for spent fuel and 5 for GTCC vessel material).

3. The estimate includes the cost to site, license, and construct the ISFSI and includes engineering, site alterations, pad construction, cask transfer equipment, and cask storage canisters and concrete overpacks. Caretaking costs include staffing, insurance, and fees, as well as costs associated with the final disposition of the facility. The cost to eventually decommission the ISFSI is also included in the estimate.

4. The estimate also includes the cost to isolate the spent fuel pool so that systems can be de-energized and decontamination and dismantling can be conducted in adjacent areas without constraint.

5. GTCC material, generated in the segmentation of the reactor vessel internal components, is assumed to be transferred to the DOE geologic repository.

3.5.7 General

1. The existing plant equipment is considered obsolete and suitable for scrap as deadweight quantities only. Florida Power will make economically reasonable efforts to salvage equipment following final plant shutdown. This estimate does not attempt to quantify the value that Florida Power may realize based upon those efforts.

2. Scrap generated during decommissioning is not included as a salvage credit line item in this study. It is difficult to estimate the

potential salvage value of a decommissioned nuclear power plant for the following reasons:

- The acceptability of nuclear plant equipment to potential salvage equipment buyers is highly speculative, regardless of the ability to free release this material.

- Much of the equipment at a nuclear plant, especially from older units, is too specific to that plant to be of use to potential salvage buyers.

- The cost for removal of equipment to a configuration that is attractive to a salvage dealer is variable. Dismantling techniques assumed for equipment by TLG for this estimate are not consistent with removal techniques required for salvage (resale) of equipment. Yankee Rowe experience 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.

For these reasons, it has generally been considered that the salvage value inherent in free-releasable nuclear plant equipment is sufficient to pay for the cost of removing of this equipment from the site, (i.e., clean equipment that has been removed from its installed location and placed in a laydown area is considered to be removed from the site at no additional charge by salvage dealers). This assumption is an implicit recognition of scrap value in the disposal of clean metallic waste at no cost to the project.

3. Property taxes on the land value remain constant throughout the decommissioning period. Taxes on existing plant structures and equipment are reduced over the phase in which they are removed. Taxes on new construction/capital improvements, e.g., dry storage canisters, are assessed over the storage period.

4. For estimating purposes, non-essential plant systems are assumed to be de-energized. Off-site electrical power will be provided to support decommissioning operations.

5. Current plant staff will remove all items of furniture, tools, mobile equipment (such as forklifts, trucks, bulldozers, and other similar

mobile equipment), and other such items of personal property owned by Florida Power that will be easily removed without the use of special equipment at no cost or credit to the project.

6. Existing warehouses will be cleared of non-essential materials and remain for use by Florida Power and its subcontractors. The warehouses may be dismantled as they become unnecessary to the decommissioning program.

7. Current Florida Power staff perform the following activities at no cost or credit to the project during the first six months post-shutdown:

   - Fuel oil tanks will be emptied; tanks will be cleaned by flushing or steam cleaning as required prior to disposal.

   - Acid and caustic tanks will be emptied.

   - Lubricating and transformer oils will be drained and removed from site by a waste disposal vendor.

8. The decommissioning activities will be performed in accordance with the current regulations assumed to be in place at the time of decommissioning. Changes in current regulations may have a cost impact on decommissioning.

9. Material and equipment costs for conventional demolition and/or construction activities were taken from R.S. Means Construction Cost Data.

10. ALARA planning is considered in the costs for engineering and planning, and in the development of activity specifications and detailed procedures. Changes to 10 CFR §20 worker exposure limits may impact the decommissioning cost and project schedule. The study follows the principles of ALARA through the use of work duration adjustment factors, which incorporate such items as radiological protection instruction, mock-up training, and the use of respiratory protection and personnel protective clothing. These items lengthen a task's duration, which increases the costs and lengthens the overall schedule.

11. Costs for continuing coverage during the decommissioning period are based upon current operating premiums and the status of the spent fuel.

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

13. Identified site structures will be removed while their non-contaminated subgrade foundations remain in place. Holes will be drilled in each of the foundation basemats to allow for natural drainage. Building foundations will be backfilled and the site will be graded such that the site will have a final contour consistent with adjacent surroundings.

14. Piping and electrical manholes, as well as vertical pump structures and sumps, will be backfilled with a suitable earthen material and abandoned. Culverts, head walls and stone riprap will remain in place to allow natural drainage.

15. The existing electrical switchyard and the transmission towers will remain after decommissioning in support of the utility's electrical transmission and distribution system.

16. Non-contaminated underground piping (except the service water and circulating water piping) will be abandoned without special considerations. Accessible circulating and service water piping will be removed/collapsed and backfilled to eliminate the potential for collapse after the site is released for unrestricted access.

3.6 COST ESTIMATE SUMMARY

Summaries of the decommissioning costs and annual expenditures are provided in Tables 3.1 and 3.2. The schedule is based upon the costs reported in Appendix C. The following should be considered when referring to Appendix C:

- "Decon" as used in the headings of these tables, refers to decontamination activities, as opposed to the NRC term DECON, which refers to the prompt removal decommissioning scenario.

- "Total" as used in the headings of these tables, is the sum of Decon, Remove, Pack, Ship, Bury, and Contingency, as well as other miscellaneous items not listed (such as engineering and preparations).

- The subtotal reported for the major cost categories does not include contingency, which is reported in a separate column.

- "Other" includes different types of costs that are not easily categorized. For instance, in systems removal and structures decontamination, the "Other" cost consists of the off-site recycling costs for low-level radioactive waste. In most of the engineering preparatory activities the "Other" cost is strictly engineering labor; however, "Other" also includes taxes, insurance, plant energy budgets, and regulatory fees.

TABLE 3.1

SCHEDULE OF DECOMMISSIONING EXPENDITURES

DECON ALTERNATIVE

Year	Period 1 Planning	Period 2 Decommissioning	Period 3 Site Restoration	Post-Period 3 Dry Fuel Storage	Post-Period 3 ISFSI D & D	Total
2016	6,263,186					6,263,186
2017	88,396,537					88,396,537
2018	38,969,575	31,564,667				70,534,242
2019		55,124,897				55,124,897
2020		54,823,687				54,823,687
2021		54,604,182				54,604,182
2022		52,522,867				52,522,867
2023		11,554,049	11,442,656			22,996,704
2024			21,045,286			21,045,286
2025			3,162,543	2,416,394		5,578,937
2026				2,845,109		2,845,109
2027				2,845,109		2,845,109
2028				2,852,904		2,852,904
2029				2,845,109		2,845,109
2030				2,845,109		2,845,109
2031				2,845,109		2,845,109
2032				2,852,904		2,852,904
2033				2,845,109		2,845,109
2034				2,845,109		2,845,109
2035				2,845,109		2,845,109
2036				2,852,904		2,852,904
2037				26,363,365	29,218	26,392,583
2038					4,337,029	4,337,029
	133,629,299	260,194,348	35,650,485	60,099,339	4,366,247	493,939,718

TABLE 3.2

SCHEDULE OF DECOMMISSIONING EXPENDITURES

SAFSTOR ALTERNATIVE

Year	Period 1 Dormancy Prep	Period 2 Dormancy	Period 3 Preparations	Period 4 Decommissioning	Period 5 Site Restoration	Total
2016	5,445,933					5,445,933
2017	73,620,940					73,620,940
2018	31,465,388	5,084,172				36,549,560
2019		8,879,056				8,879,056
2020		8,903,382				8,903,382
2021		8,879,056				8,879,056
2022		6,346,962				6,346,962
2023		6,086,868				6,086,868
2024		6,103,544				6,103,544
2025		6,086,868				6,086,868
2026		6,086,868				6,086,868
2027		6,086,868				6,086,868
2028		6,103,544				6,103,544
2029		6,086,868				6,086,868
2030		6,086,868				6,086,868
2031		6,086,868				6,086,868
2032		6,103,544				6,103,544
2033		6,086,868				6,086,868
2034		6,086,868				6,086,868
2035		6,086,868				6,086,868
2036		6,103,544				6,103,544
2037		6,082,590				6,082,590
2038		4,525,349				4,525,349
2039		4,525,349				4,525,349
2040		4,537,747				4,537,747
2041		4,525,349				4,525,349
2042		4,525,349				4,525,349
2043		4,525,349				4,525,349
2044		4,537,747				4,537,747
2045		4,525,349				4,525,349

TABLE 3.2

(Continued)

Year	Period 1 Dormancy Prep	Period 2 Dormancy	Period 3 Preparations	Period 4 Decommissioning	Period 5 Site Restoration	Total
2046		4,525,349				4,525,349
2047		4,525,349				4,525,349
2048		4,537,747				4,537,747
2049		4,525,349				4,525,349
2050		4,525,349				4,525,349
2051		4,525,349				4,525,349
2052		4,537,747				4,537,747
2053		4,525,349				4,525,349
2054		4,525,349				4,525,349
2055		4,525,349				4,525,349
2056		4,537,747				4,537,747
2057		4,525,349				4,525,349
2058		4,525,349				4,525,349
2059		4,525,349				4,525,349
2060		4,537,747				4,537,747
2061		4,525,349				4,525,349
2062		4,525,349				4,525,349
2063		4,525,349				4,525,349
2064		4,537,747				4,537,747
2065		4,525,349				4,525,349
2066		4,525,349				4,525,349
2067		4,525,349				4,525,349
2068		4,537,747				4,537,747
2069		4,525,349				4,525,349
2070		4,525,349				4,525,349
2071		161,177	31,116,076			31,277,253
2072			18,929,700	75,298,575		94,228,274
2073				31,565,244		31,565,244
2074				51,854,846		51,854,846
2075				53,270,784		53,270,784
2076				30,899,830	1,249,299	32,149,128
2077					18,239,759	18,239,759
2078					11,343,631	11,343,631
	110,532,261	279,054,935	50,045,776	242,889,279	30,832,689	713,354,939

4. SCHEDULE ESTIMATE

The schedule for the decommissioning scenarios considered in this study follows the sequence presented in the AIF/NESP-036 study, with minor changes to reflect recent experience and site-specific constraints. In addition, the scheduling has been revised to reflect the spent fuel turnover (to the DOE) requirements at shutdown.

Figure 4.1 presents a schedule for the DECON decommissioning alternative; the assumptions supporting this schedule are listed in Section 4.1. The key activities listed in the schedule do not reflect a one-to-one correspondence with those activities in the Appendix C cost table, but reflect dividing some activities for clarity and combining others for convenience. The schedule was prepared using the "Microsoft Project 98" computer software. [18]

4.1 SCHEDULE ESTIMATE ASSUMPTIONS

The schedule estimate 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 durations used in the precedence network reflect the actual man-hour estimates from the cost table in Appendix C, 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.

- All work except vessel and internals removal activities is performed during an 8-hour workday, 5 days per week with no overtime. There are eleven paid holidays per year.
- The fuel area of the Auxiliary Building will continue to serve as the spent fuel storage/transfer facility until such time that all spent fuel has been transferred to the ISFSI. The Auxiliary Building is expected to operate for approximately five years after the cessation of operations.
- 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 Appendix C are based upon the durations developed in the schedule for each decommissioning alternative. 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 was used as the basis for determining the period-dependent costs.

Project timelines for the DECON and SAFSTOR alternatives are shown in this section as Figure 4.2. Milestone dates are based on a 40-year plant operating life from the issuance of the operating license, a five-year wet storage period for the last core discharge, and completion of the transfer of spent fuel to the DOE in 2037.

FIGURE 4.1

DECON ACTIVITY SCHEDULE

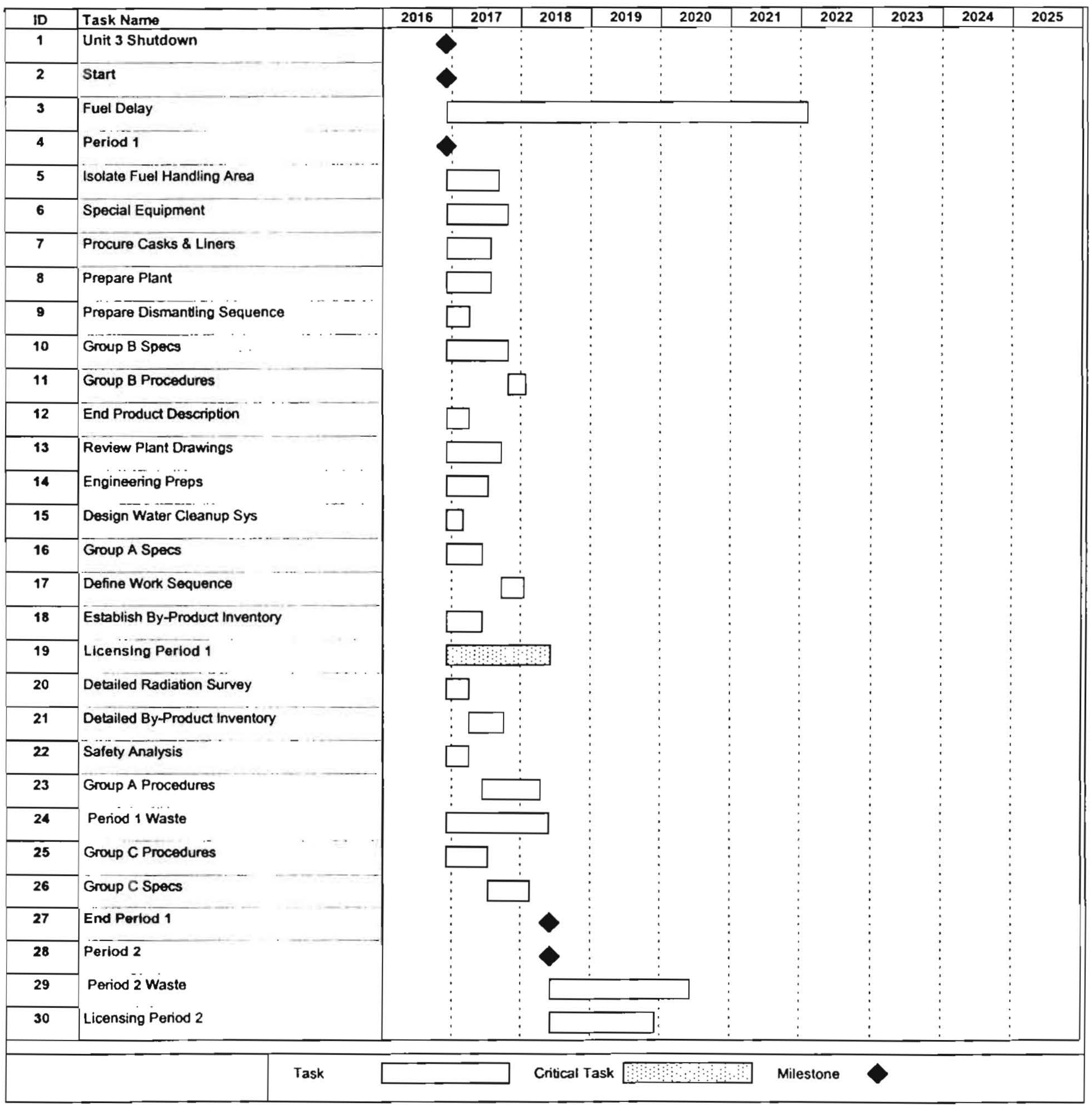


FIGURE 4.1 (continued)

DECON ACTIVITY SCHEDULE

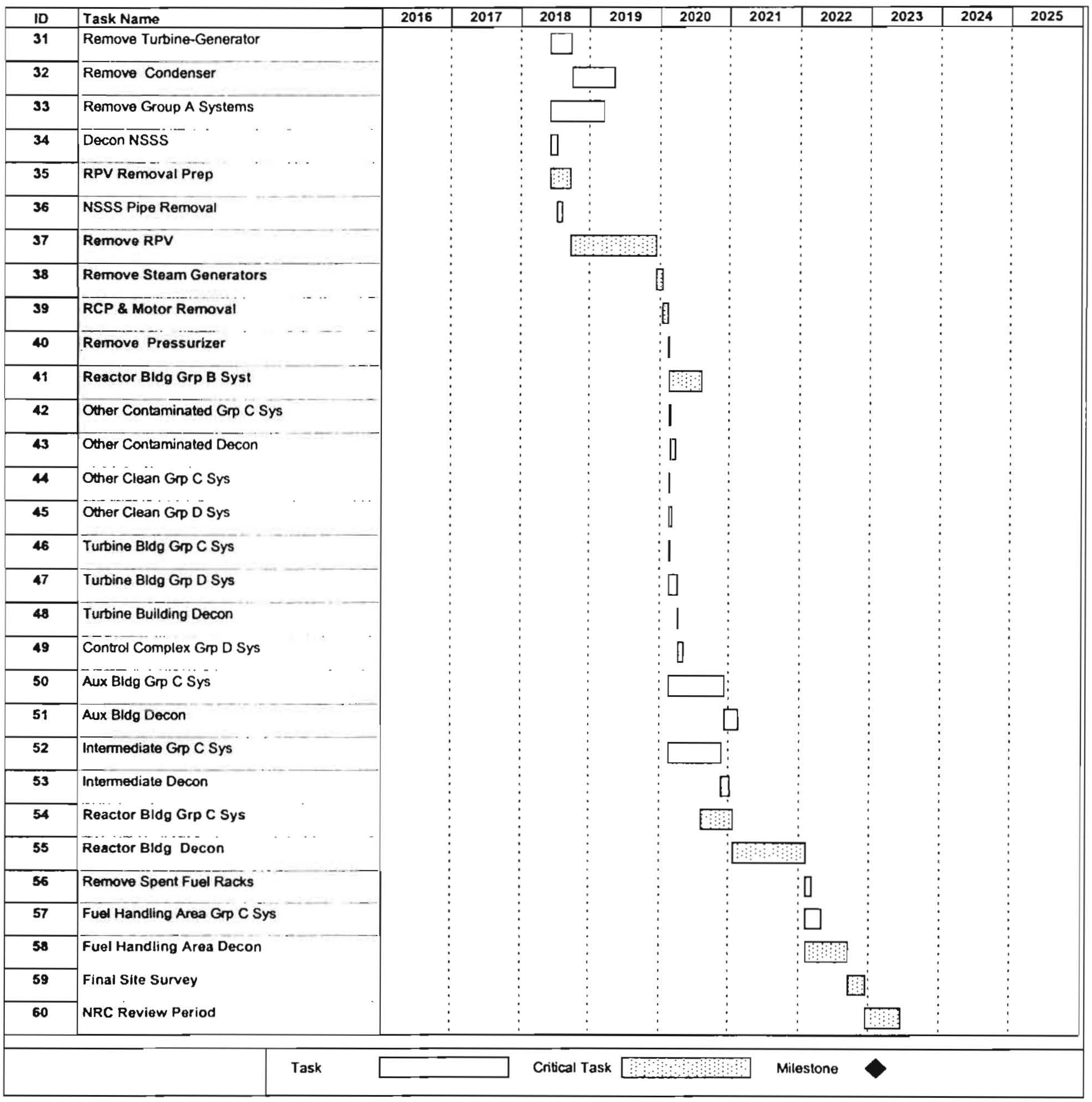


FIGURE 4.1 (continued)

DECON ACTIVITY SCHEDULE

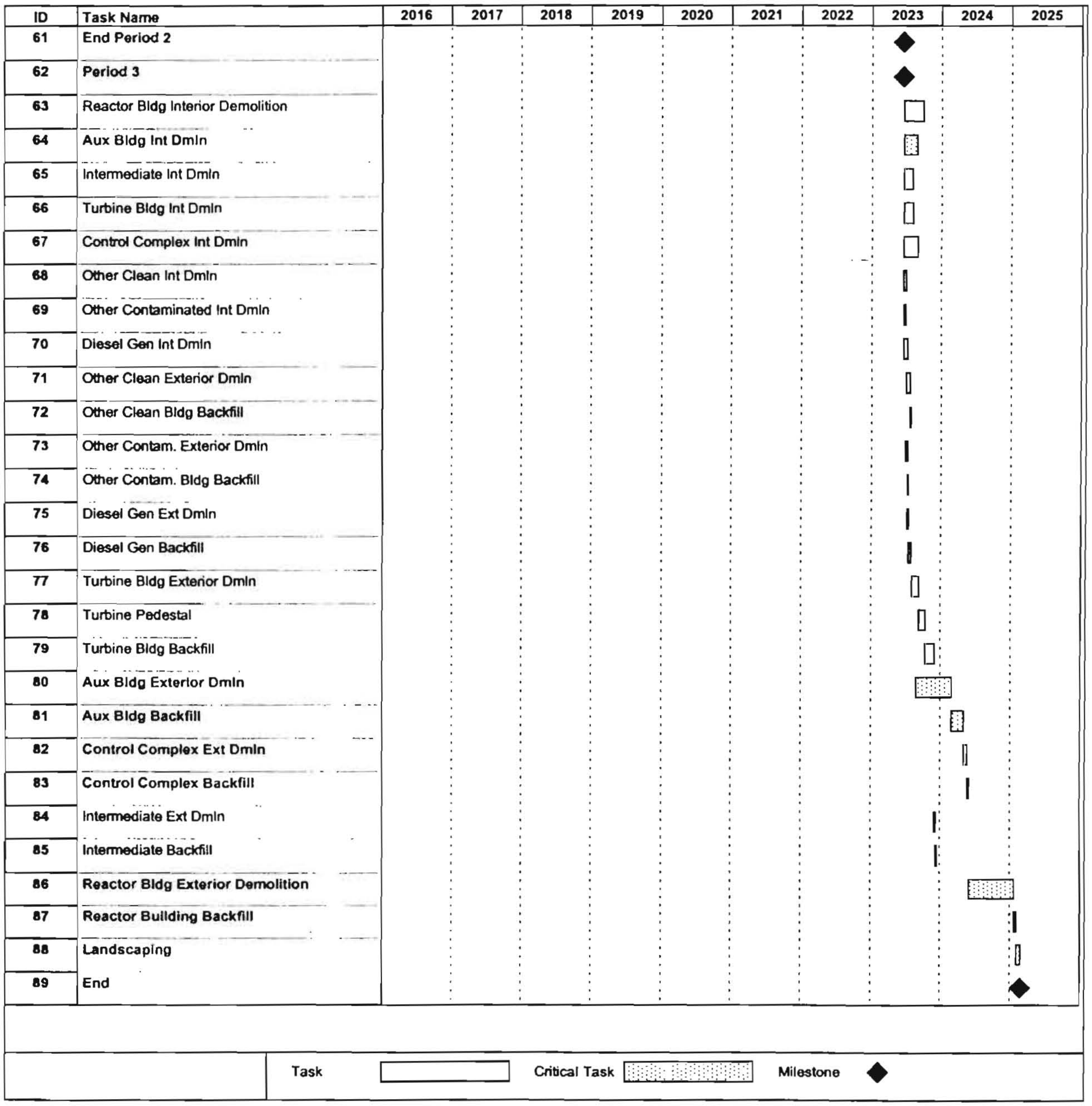
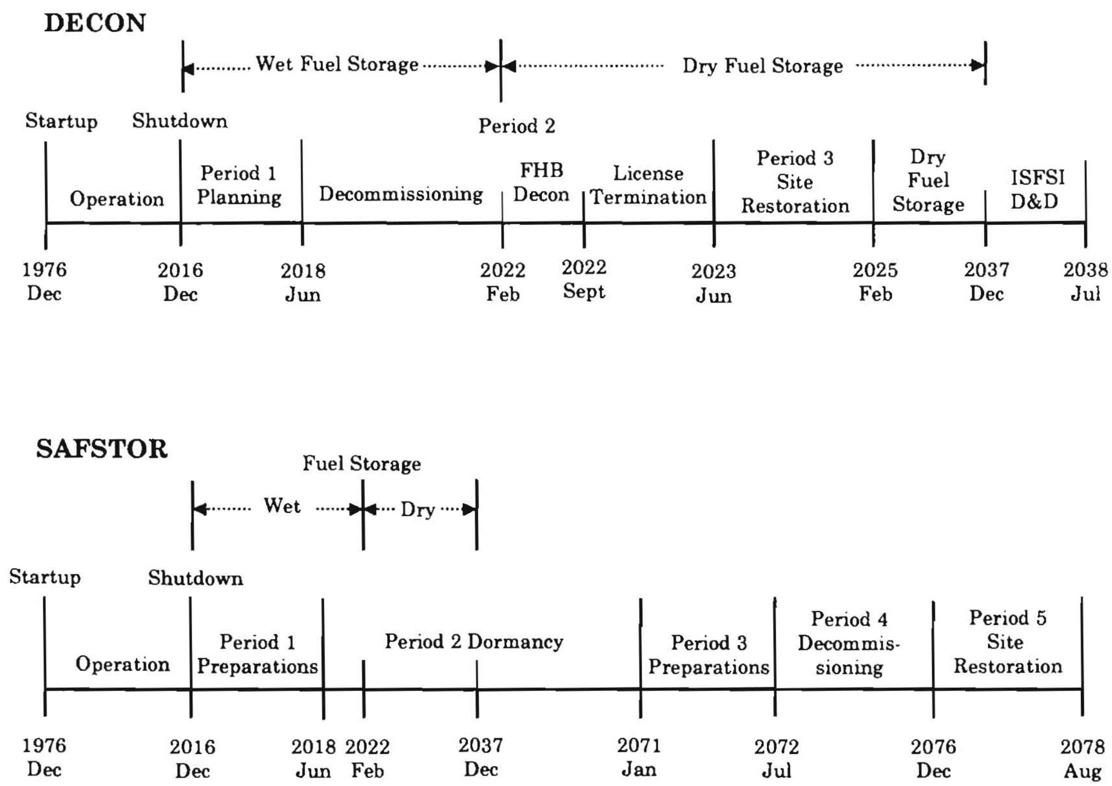


FIGURE 4.2

DECOMMISSIONING TIMELINES



NOT TO SCALE

5. RADIOACTIVE WASTES

The goal of the decommissioning program is the removal of all radioactive material from the site that would restrict its future use, and termination of the NRC license for the site. This currently requires the remediation of all radioactive material at the site in excess of applicable legal limits. Under the Atomic Energy Act,[19] 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, §61 controls the licensing requirements for burial of low-level radioactive material and §71 defines packaging and transportation of radioactive material.

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

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 Table 5.1 are consistent with 10 CFR §61 classifications. The volumes are calculated based on the exterior dimensions for containerized material. The volumes are calculated on the displaced volume of components serving as their own waste containers.

The reactor vessel and internals are categorized as large quantity shipments and, accordingly, will be shipped in reusable, shielded truck casks with disposable liners. In calculating disposal costs, the burial fees are applied against the liner volume, 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 containers.

The waste volume generated in the decontamination and dismantling of the nuclear unit is primarily generated during Period 2 of DECON and Period 4 of SAFSTOR. The majority of the radioactive waste is routed for additional processing off-site, i.e., conditioning and/or recycling. Low-level radioactive material not suitable for recycling is transported to the Envirocare facility in Clive, Utah. More highly radioactive material is designated for disposal at a licensed facility located within the present Southeast Compact region. The rate structure for the currently operating Barnwell facility in South Carolina is used as a proxy.

No significant quantities of chromated water, PCBs, or mercury are expected to be present on site at the time of decommissioning. Transformers and capacitors are certified to have PCB-free oil. Insulation materials used throughout the plant do contain asbestos and Florida Power provided an inventory of waste products that would need to be addressed in remediating the site. The mixed waste volume, which included solvents, oils, and lead shields, is assumed to be sent to a facility in Tennessee for conditioning. Disposal of the hazardous and toxic by-products is assumed to be at a licensed facility.

The burial volumes reported in Table 5.1 reflect the savings from recycling and waste conditioning. Approximately 173,400 cubic feet of non-compactable metallic waste is designated for off-site processing in the DECON alternative, with similar quantities for the other alternatives. The cost of processing this material appears as an "other" cost for the systems and plant structures identified in Appendix C.

TABLE 5.1

DECOMMISSIONING RADIOACTIVE WASTE BURIAL SUMMARY

	Waste Class[1]	Volume (cubic feet)[2]
DECON ALTERNATIVE		
	A	86,701
	B	12,028
	C	517
	>C	724
Total		**99,969**
SAFSTOR ALTERNATIVE		
	A	94,004
	B	5,381
	C	527
	>C	724
Total		**100,637**

1 Waste is classified according to the requirements as delineated in Title 10 of the Code of Federal Regulations, Part 61.55
2 Column may not add due to rounding

6. RESULTS

The projected costs to decommission the Crystal River Plant, presuming the use of the DECON alternative is estimated to be $493.940 million in 1999 dollars. SAFSTOR costs are $713.355 million in 1999 dollars. The costs reflect the site-specific features of the Crystal River Plant, the local cost of labor, the DOE's schedule for spent fuel receipt, and a projected cost for low-level radioactive waste disposal. An analysis of the major activities contributing to the total cost for the DECON and SAFSTOR decommissioning alternatives is provided in Tables 6.1 and 6.2, respectively. Appendix C contains a detailed list of costs by "activity description" for each decommissioning alternative.

Staffing, including management and security, combine with the removal labor to represent the majority of the cost to decommission a nuclear station. This is a direct result of the labor-intensive nature of the decommissioning process, as well as the management controls required to ensure a safe and successful program. Low-level radioactive waste disposal (burial) represents the next largest cost component. Packaging and transportation costs are most sensitive to the waste volume generated in the decontamination and dismantling process, the volume reduction achieved, transport regulations for low-level radioactive waste, as well as the final destination (i.e., distance to the disposal site). Costs related to high level radioactive waste represent another large portion of the total estimate. These costs include expenses such as the construction and capital costs associated with an ISFSI at the Crystal River site to support decommissioning, maintenance of the ISFSI (after the balance of the site has been decommissioned and restored) until the last of the spent fuel has been removed by the DOE, and removal of the ISFSI facility. "Other" costs include off site waste processing expenses, which can also be considered as "decontamination" expenditures, as well as true incidentals such as property taxes, engineering costs, energy, insurance and fees.

This study provides an estimate for decommissioning the site under current requirements, based on present-day costs and available technology. Individual costs associated with decommissioning activities have increased at rates greater than general inflation. For example, there has been significant volatility in the issues and policies surrounding waste disposal, i.e., access and cost of low-level radioactive waste disposal has been unpredictable and has escalated at rates historically greater than inflation (over the past ten years). The government's high-level waste program has experienced a series of delays that have impeded the prompt decommissioning of the commercial reactors retired to date. It is therefore appropriate that this cost estimate be reviewed periodically.

TABLE 6.1

SUMMARY OF DECOMMISSIONING COST CONTRIBUTORS

DECON ALTERNATIVE

Work Category	Cost 99$* (thousand)	Percent of Total Costs
Decontamination	12,546	2.5
Removal	68,079	13.8
Packaging	6,359	1.3
Transportation	5,841	1.2
Low-Level Radioactive Waste Disposal	72,306	14.6
Staffing	153,685	31.1
Taxes	31,232	6.3
Engineering	12,772	2.6
Energy	9,728	2.0
Waste Recycling	22,228	4.5
Insurance	8,087	1.6
ISFSI Capital	57,436	11.6
NRC and EP Fees	7,744	1.6
Site Characterization	1,245	0.3
License Termination Survey	7,624	1.5
Miscellaneous Support Equipment & Supplies	4,480	0.9
Spent Fuel Pool Isolation	7,699	1.6
Other (including hazardous/mixed waste disposal)	4,848	1.0
Total	493,940	100.0

* Column may not add due to rounding

TABLE 6.2

SUMMARY OF DECOMMISSIONING COST CONTRIBUTORS

SAFSTOR ALTERNATIVE

Work Category	Cost 99$* (thousand)	Percent of Total Costs
Decontamination	9,070	1.3
Removal	69,247	9.7
Packaging	5,817	0.8
Transportation	5,000	0.7
Low-Level Radioactive Waste Disposal	68,893	9.7
Staffing	255,990	35.9
Taxes	106,001	14.9
Engineering	16,991	2.4
Energy	22,301	3.1
Waste Recycling	22,228	3.1
Insurance	20,482	2.9
ISFSI Capital	57,436	8.1
NRC and EP Fees	16,930	2.4
Site Characterization	1,979	0.3
License Termination Survey	7,624	1.1
Miscellaneous Support Equipment & Supplies	12,542	1.8
Spent Fuel Pool Isolation	7,699	1.1
Other (including hazardous/mixed waste disposal)	7,126	1.0
Total	713,355	100.0

* Column may not add due to rounding

7. REFERENCES

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

2. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.159, "Assuring the Availability of Funds for Decommissioning Nuclear Reactors," August 1990.

3. 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 (p39278+), July 29, 1996.

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

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

6. U.S. Code of Federal Regulations, Title 10, Part 20, Subpart E, "Radiological Criteria for License Termination", Federal Register, Volume 62, Number 139 (p39058+), July 21, 1997.

7. "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)", NUREG/CR-1575, EPA 402-R-97-016, December 1997.

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 1999," Robert Snow Means Company, Inc., Kingston, Massachusetts.

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

7. REFERENCES
(continued)

12. U.S. Nuclear Regulatory Commission, Division of Regulatory Applications, "Report on Waste Disposal Charges," NUREG-1307, Revision 8, December 1998.

13. 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.

14. 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.

15. 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.

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

17. Tri-State Motor Transit Company, published tariffs, Interstate Commerce Commission (ICC), Docket No. MC-109397 and Supplements, 1999.

18. "Microsoft Project 98", Microsoft Corporation, Redmond, WA, 1997.

19. "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 packing area.

2. CALCULATIONS

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

Duration adjustment(s):

+ Respiratory protection adjustment (50% of critical duration)	128
+ Radiation/ALARA adjustment (33.9% of critical duration)	87
Adjusted work duration	470
+ Protective clothing adjustment (30% of adjusted duration)	141
Productive work duration	611
+ Work break adjustment (8.33 % of productive duration)	51
Total work duration minutes	662

***** Total duration = 11.033 hours *****

APPENDIX A (Continued)

3. LABOR REQUIRED

Crew	Number	Duration (hr)	Rate ($/hr)	Cost
Laborers	3.00	11.033	$18.65	$617.30
Craftsmen	2.00	11.033	$30.72	$677.87
Foreman	1.00	11.033	$31.72	$349.97
General Foreman	0.25	11.033	$32.72	$90.25
Fire Watch	0.05	11.033	$18.65	$10.29
Health Physics Technician	1.00	11.033	$34.14	$376.67
Total labor cost				$2,122.35

4. EQUIPMENT & CONSUMABLES COSTS

Equipment Costs	none
Consumables/Materials Costs	
-Gas torch consumables 1 @ $7.30/hr x 1 hr {1}	$7.30
-Blotting paper 50 @ $0.42 sq ft {2}	$21.00
-Plastic sheets/bags 50 @ $0.10/sq ft {3}	$5.00
Subtotal cost of equipment and materials	$33.30
Overhead & profit on equipment and materials @ 16.00%	$5.33
Total costs, equipment & material	$38.63

TOTAL COST Removal of contaminated heat exchanger <3000 pounds: $2,160.98

Total labor cost:	$2,122.35
Total equipment/material costs:	$38.63
Total adjusted exposure man-hours incurred:	45.472
Total craft labor man-hours required per unit:	80.541

APPENDIX A (Continued)

5. NOTES AND REFERENCES

1. Durations are shown in minutes. The integrated duration accounts for those activities that can be performed in conjunction with other activities, indicated by the alpha designator of the concurrent activity. This results in an overall decrease in the sequenced duration.

2. Work difficulty factors were developed in conjunction with the AIF program to standardize decommissioning cost studies and are delineated in the "Guidelines" study (Vol. 1, Ch. 5).

3. Adjusted for regional material costs for Tampa, Florida.

4. References for equipment & consumables costs:

   1. R.S. Means (1999) Division 016 Section 420-6360 pg 23
   2. McMaster-Carr Ed. 105
   3. R.S. Means (1999) Division 015 Section 602-0200 pg 17

APPENDIX B

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

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Removal of clean instrument and sampling tubing, $/linear foot	0.22
Removal of clean pipe 0.25 to 2 inches diameter, $/linear foot	2.75
Removal of clean pipe >2 to 4 inches diameter, $/linear foot	3.34
Removal of clean pipe >4 to 8 inches diameter, $/linear foot	6.88
Removal of clean pipe >8 to 14 inches diameter, $/linear foot	12.98
Removal of clean pipe >14 to 20 inches diameter, $/linear foot	16.88
Removal of clean pipe >20 to 36 inches diameter, $/linear foot	24.84
Removal of clean pipe >36 inches diameter, $/linear foot	29.50
Removal of clean valves >2 to 4 inches	34.82
Removal of clean valves >4 to 8 inches	68.76
Removal of clean valves >8 to 14 inches	129.77
Removal of clean valves >14 to 20 inches	168.83
Removal of clean valves >20 to 36 inches	248.36
Removal of clean valves >36 inches	295.04
Removal of clean pipe hangers for small bore piping	14.92
Removal of clean pipe hangers for large bore piping	51.63
Removal of clean pumps, <300 pound	114.75
Removal of clean pumps, 300-1000 pound	327.82
Removal of clean pumps, 1000-10,000 pound	1,287.78
Removal of clean pumps, >10,000 pound	2,482.35
Removal of clean pump motors, 300-1000 pound	138.51
Removal of clean pump motors, 1000-10,000 pound	537.32
Removal of clean pump motors, >10,000 pound	1,208.96
Removal of clean turbine-driven pumps < 10,000 pounds	1,487.12
Removal of clean turbine-driven pumps > 10,000 pounds	3,320.76

APPENDIX B (Continued)

Unit Cost Factor	Cost/Unit($)
Removal of clean heat exchanger <3000 pound	694.04
Removal of clean heat exchanger >3000 pound	1,747.89
Removal of clean tanks, <300 gallons	149.41
Removal of clean tanks, 300-3000 gallons	470.76
Removal of clean tanks, >3000 gallons, $/square foot surface area	4.06
Removal of clean electrical equipment, <300 pound	63.07
Removal of clean electrical equipment, 300-1000 pound	225.51
Removal of clean electrical equipment, 1000-10,000 pound	451.02
Removal of clean electrical equipment, >10,000 pound	1,081.39
Removal of clean electrical transformers < 30 tons	751.01
Removal of clean electrical transformers > 30 tons	2,162.78
Removal of clean standby diesel-generator, <100 kW	767.10
Removal of clean standby diesel-generator, 100 kW to 1 MW	1,712.20
Removal of clean standby diesel-generator, >1 MW	3,544.62
Removal of clean electrical cable tray, $/linear foot	5.92
Removal of clean electrical conduit, $/linear foot	2.59
Removal of clean mechanical equipment, <300 pound	63.07
Removal of clean mechanical equipment, 300-1000 pound	225.51
Removal of clean mechanical equipment, 1000-10,000 pound	451.02
Removal of clean mechanical equipment, >10,000 pound	1,081.39
Removal of clean HVAC equipment, <300 pound	63.07
Removal of clean HVAC equipment, 300-1000 pound	225.51
Removal of clean HVAC equipment, 1000-10,000 pound	451.02
Removal of clean HVAC equipment, >10,000 pound	1,081.39
Removal of clean HVAC ductwork, $/pound	0.47

APPENDIX B (Continued)

Unit Cost Factor	Cost/Unit($)
Removal of contaminated instrument and sampling tubing, $/linear foot	0.78
Removal of contaminated pipe 0.25 to 2 inches diameter, $/linear foot	18.31
Removal of contaminated pipe >2 to 4 inches diameter, $/linear foot	33.02
Removal of contaminated pipe >4 to 8 inches diameter, $/linear foot	55.91
Removal of contaminated pipe >8 to 14 inches diameter, $/linear foot	108.19
Removal of contaminated pipe >14 to 20 inches diameter, $/linear foot	130.67
Removal of contaminated pipe >20 to 36 inches diameter, $/linear foot	183.23
Removal of contaminated pipe >36 inches diameter, $/linear foot	217.24
Removal of contaminated valves >2 to 4 inches	157.21
Removal of contaminated valves >4 to 8 inches	274.04
Removal of contaminated valves >8 to 14 inches	540.96
Removal of contaminated valves >14 to 20 inches	686.47
Removal of contaminated valves >20 to 36 inches	916.15
Removal of contaminated valves >36 inches	1,086.18
Removal of contaminated pipe hangers for small bore piping	53.06
Removal of contaminated pipe hangers for large bore piping	167.12
Removal of contaminated pumps, <300 pound	483.48
Removal of contaminated pumps, 300-1000 pound	1,124.10
Removal of contaminated pumps, 1000-10,000 pound	3,541.76
Removal of contaminated pumps, >10,000 pound	8,592.73
Removal of contaminated pump motors, 300-1000 pound	488.24
Removal of contaminated pump motors, 1000-10,000 pound	1,449.02
Removal of contaminated pump motors, >10,000 pound	3,249.98
Removal of contaminated turbine-driven pumps < 10,000 pounds	4,341.81
Removal of contaminated turbine-driven pumps > 10,000 pounds	9,901.84

APPENDIX B (Continued)

Unit Cost Factor	Cost/Unit($)
Removal of contaminated BWR turbine-generator	258,616.11
Removal of contaminated heat exchanger <3000 pound	2,160.98
Removal of contaminated heat exchanger >3000 pound	6,258.03
Removal of contaminated feedwater heater/deaerator	15,247.67
Removal of contaminated moisture separator/reheater	33,011.79
Removal of contaminated BWR main condenser	592,515.88
Removal of contaminated tanks, <300 gallons	808.96
Removal of contaminated tanks, >300 gallons, $/square foot	15.86
Removal of contaminated electrical equipment, <300 pound	373.25
Removal of contaminated electrical equipment, 300-1000 pound	905.65
Removal of contaminated electrical equipment, 1000-10,000 pound	1,737.49
Removal of contaminated electrical equipment, >10,000 pound	3,409.94
Removal of contaminated electrical cable tray, $/linear foot	17.88
Removal of contaminated electrical conduit, $/linear foot	15.90
Removal of contaminated mechanical equipment, <300 pound	414.04
Removal of contaminated mechanical equipment, 300-1000 pound	1,002.41
Removal of contaminated mechanical equipment, 1000-10,000 pound	1,923.33
Removal of contaminated mechanical equipment, >10,000 pound	3,409.94
Removal of contaminated HVAC equipment, <300 pound	414.04
Removal of contaminated HVAC equipment, 300-1000 pound	1,002.41
Removal of contaminated HVAC equipment, 1000-10,000 pound	1,923.33
Removal of contaminated HVAC equipment, >10,000 pound	3,409.94
Removal of contaminated HVAC ductwork, $/pound	1.75
Removal/plasma arc cut of contaminated thin metal components, $/linear in.	1.93
Additional decontamination of surface by washing, $/square foot	3.98

APPENDIX B (Continued)

Unit Cost Factor	Cost/Unit($)
Additional decontamination of surfaces by hydrolasing, $/square foot	18.97
Decontamination rig hook-up and flush	3,508.59
Chemical flush of components/systems, $/gallon	8.65
Removal of standard reinforced concrete, $/cubic yard	98.42
Removal of grade slab concrete, $/cubic yard	131.43
Removal of clean concrete floors, $/cubic yard	176.35
Removal of sections of clean concrete floors, $/cubic yard	559.13
Removal of clean heavily rein concrete w/#9 rebar, $/cubic yard	138.56
Removal of contaminated heavily rein concrete w/#9 rebar, $/cubic yard	1,133.74
Removal of clean heavily rein concrete w/#18 rebar, $/cubic yard	176.43
Removal of contaminated heavily rein concrete w/#18 rebar, $/cubic yard	1,504.19
Removal heavily rein concrete w/#18 rebar & steel embedments, $/cu yd	251.38
Removal of below-grade suspended floors, $/square foot	176.35
Removal of clean monolithic concrete structures, $/cubic yard	479.15
Removal of contaminated monolithic concrete structures, $/cu yd	1,131.56
Removal of clean foundation concrete, $/cubic yard	375.76
Removal of contaminated foundation concrete, $/cubic yard	1,053.76
Explosive demolition of bulk concrete, $/cubic yard	19.57
Removal of clean hollow masonry block wall, $/cubic yard	48.63
Removal of contaminated hollow masonry block wall, $/cubic yard	166.71
Removal of clean solid masonry block wall, $/cubic yard	48.63
Removal of contaminated solid masonry block wall, $/cubic yard	166.71
Backfill of below-grade voids, $/cubic yard	10.01
Removal of subterranean tunnels/voids, $/linear foot	73.91
Placement of concrete for below-grade voids, $/cubic yard	76.31

APPENDIX B (Continued)

Unit Cost Factor	Cost/Unit($)
Excavation of clean material, $/cubic yard	2.28
Excavation of contaminated material, $/cubic yard	25.52
Excavation of submerged concrete rubble, $/cubic yard	7.50
Removal of clean concrete rubble, $/cubic yard *tipping charges included	68.52
Removal of contaminated concrete rubble, $/cubic yard	19.67
Removal of building by volume, $/cubic foot	0.15
Removal of clean building metal siding, $/square foot	0.76
Removal of contaminated building metal siding, $/square foot	2.64
Removal of standard asphalt roofing, $/square foot	1.03
Removal of transite panels, $/square foot	1.27
Scarifying contaminated concrete surfaces (drill & spall)	8.06
Scabbling contaminated concrete floors, $/square foot	4.54
Scabbling contaminated concrete walls, $/square foot	4.99
Scabbling contaminated ceilings, $/square foot	44.89
Scabbling structural steel, $/square foot	3.77
Removal of clean overhead cranes/monorails < 10 ton capacity	325.12
Removal of contaminated overhead cranes/monorails < 10 ton capacity	963.81
Removal of clean overhead cranes/monorails >10-50 ton capacity	780.31
Removal of contaminated overhead cranes/monorails >10-50 ton capacity	2,312.33
Removal of polar cranes > 50 ton capacity, each	3,275.72
Removal of gantry cranes > 50 ton capacity, each	13,517.40
Removal of structural steel, $/pound	0.19
Removal of clean steel floor grating, $/square foot	1.69
Removal of contaminated steel floor grating, $/square foot	5.47
Removal of clean free-standing steel liner, $/square foot	6.09

APPENDIX B (Continued)

Unit Cost Factor	Cost/Unit($)
Removal of contaminated free-standing steel liner, $/square foot	18.31
Removal of clean concrete-anchored steel liner, $/square foot	3.04
Removal of contaminated concrete-anchored steel liner, $/square foot	21.29
Placement of scaffolding in clean areas, $/square foot	3.26
Placement of scaffolding in contaminated areas, $/square foot	7.88
Landscaping w/ topsoil, $/acre	16,363.34
Cost of LSA box & preparation for use	819.22
Cost of LSA drum & preparation for use	73.04
Cost of cask liner for CNSI 14-195 cask	7,533.17
Cost of cask liner for CNSI 8-120A cask (resins)	5,063.53
Cost of cask liner for CNSI 8-120A cask (filters)	5,063.53
Decontamination of surfaces with vacuuming, $/square foot	0.36

APPENDIX C

DETAILED DECOMMISSIONING COST REPORTS:

TABLE C-1: DECON

TABLE C-2: SAFSTOR

TABLE C-1
CRYSTAL RIVER PLANT - UNIT 3
DECON DECOMMISSIONING COST ESTIMATE
(Thousands of 1999 Dollars)

Columns may not add due to rounding

ID Number	Activity Description	Decon	Remove	Pack	Ship	Burial	Other	Contingency	Total	NRC LicTerm	Site Restore	Burial A CF	Burial B CF	Burial C CF	GTCC CF	Craft Labor Hours
PERIOD 1																
1	Prepare preliminary decommissioning cost	-	-	-	-	-	130	20	150	150	-	-	-	-	-	-
2	Notification of Cessation of Operations								Note 1							
3	Remove fuel & source material								Note 2							
4	Notification of Permanent Defueling								Note 1							
5	Deactivate plant systems & process waste								Note 1							
8	Prepare and submit PSDAR	-	-	-	-	-	200	30	230	230	-	-	-	-	-	-
7	Review plant dwgs & specs.	-	-	-	-	-	460	69	529	529	-	-	-	-	-	-
8	Perform detailed rad survey								Note 1							
9	Estimate by-product inventory	-	-	-	-	-	100	15	115	115	-	-	-	-	-	-
10	End product description	-	-	-	-	-	100	15	115	115	-	-	-	-	-	-
11	Detailed by-product inventory	-	-	-	-	-	130	20	150	150	-	-	-	-	-	-
12	Define major work sequence	-	-	-	-	-	750	113	863	863	-	-	-	-	-	-
13	Perform SER and EA	-	-	-	-	-	310	47	357	357	-	-	-	-	-	-
14	Perform Site-Specific Cost Study	-	-	-	-	-	500	75	575	575	-	-	-	-	-	-
15	Prepare/submit License Termination Plan	-	-	-	-	-	410	61	471	471	-	-	-	-	-	-
16	Receive NRC approval of termination plan								Note 1							
Activity Specifications																
17.1	Plant & temporary facilities	-	-	-	-	-	492	74	566	509	57	-	-	-	-	-
17.2	Plant systems	-	-	-	-	-	417	63	479	431	48	-	-	-	-	-
17.3	NSSS Decontamination Flush	-	-	-	-	-	50	8	58	58	-	-	-	-	-	-
17.4	Reactor internals	-	-	-	-	-	710	107	817	817	-	-	-	-	-	-
17.5	Reactor vessel	-	-	-	-	-	650	98	748	748	-	-	-	-	-	-
17.6	Biological shield	-	-	-	-	-	50	8	58	58	-	-	-	-	-	-
17.7	Steam generators	-	-	-	-	-	312	47	359	359	-	-	-	-	-	-
17.8	Reinforced concrete	-	-	-	-	-	160	24	184	92	92	-	-	-	-	-
17.9	Turbine & condenser	-	-	-	-	-	80	12	92	-	92	-	-	-	-	-
17.10	Plant structures & buildings	-	-	-	-	-	312	47	359	179	179	-	-	-	-	-
17.11	Waste management	-	-	-	-	-	460	69	529	529	-	-	-	-	-	-
17.12	Facility & site closeout	-	-	-	-	-	90	14	104	52	52	-	-	-	-	-
17	Total	-	-	-	-	-	3,783	567	4,350	3,830	520	-	-	-	-	-
Planning & Site Preparations																
18	Prepare dismantling sequence	-	-	-	-	-	240	36	276	276	-	-	-	-	-	-
19	Plant prep. & temp. svces	-	-	-	-	-	1,990	299	2,289	2,289	-	-	-	-	-	-
20	Design water clean-up system	-	-	-	-	-	140	21	161	161	-	-	-	-	-	-
21	Rigging/CCEs/tooling/etc.	-	-	-	-	-	1,685	253	1,937	1,937	-	-	-	-	-	-
22	Procure casks/liners & containers	-	-	-	-	-	123	18	141	141	-	-	-	-	-	-
Detailed Work Procedures																
23.1	Plant systems	-	-	-	-	-	473	71	544	490	54	-	-	-	-	-
23.2	NSSS Decontamination Flush	-	-	-	-	-	100	15	115	115	-	-	-	-	-	-
23.3	Vessel head	-	-	-	-	-	250	38	288	288	-	-	-	-	-	-
23.4	Reactor internals	-	-	-	-	-	250	38	288	288	-	-	-	-	-	-
23.5	Remaining buildings	-	-	-	-	-	135	20	155	39	116	-	-	-	-	-
23.6	CRD cooling assembly	-	-	-	-	-	100	15	115	115	-	-	-	-	-	-
23.7	CRD housings & ICI tubes	-	-	-	-	-	100	15	115	115	-	-	-	-	-	-
23.8	Incore Instrumentation	-	-	-	-	-	100	15	115	115	-	-	-	-	-	-
23.9	Reactor vessel	-	-	-	-	-	363	54	417	417	-	-	-	-	-	-

TABLE C-1
CRYSTAL RIVER PLANT - UNIT 3
DECON DECOMMISSIONING COST ESTIMATE
(Thousands of 1999 Dollars)

Columns may not add due to rounding

ID Number	Activity Description	Decon	Remove	Pack	Ship	Burial	Other	Contingency	Total	NRC LicTerm	Site Restore	Burial A CF	Burial B CF	Burial C CF	GTCC CF	Craft Labor Hours
23.10	Facility closeout	-	-	-	-	-	120	18	138	69	69	-	-	-	-	-
23.11	Missile shields	-	-	-	-	-	45	7	52	52	-	-	-	-	-	-
23.12	Biological shield	-	-	-	-	-	120	18	138	138	-	-	-	-	-	-
23.13	Steam generators	-	-	-	-	-	460	69	529	529	-	-	-	-	-	-
23.14	Reinforced concrete	-	-	-	-	-	100	15	115	58	58	-	-	-	-	-
23.15	Turbine & condensers	-	-	-	-	-	312	47	359	-	359	-	-	-	-	-
23.16	Auxiliary building	-	-	-	-	-	273	41	314	283	31	-	-	-	-	-
23.17	Reactor building	-	-	-	-	-	273	41	314	283	31	-	-	-	-	-
23	Total	-	-	-	-	-	3,574	536	4,110	3,391	719	-	-	-	-	-
24	Decon primary loop	544	-	-	-	-	-	272	816	816	-	-	-	-	-	800
25	Asbestos removal program	-	23	6	0	164	-	48	242	222	20	500	-	-	-	955
Period 1 Additional Costs																
26	Site Characterization Survey	-	-	-	-	-	1,083	162	1,245	1,245	-	-	-	-	-	-
27	Fuel Pool Isolation	-	-	-	-	-	6,695	1,004	7,699	7,699	-	-	-	-	-	-
Subtotal Period 1 Activity Costs		544	23	6	0	164	22,402	3,680	26,821	25,562	1,259	500	-	-	-	1,755
Period 1 Undistributed Costs																
1	Decon equipment	572	-	-	-	-	-	86	658	658	-	-	-	-	-	-
2	Decon supplies	34	-	-	-	-	-	9	43	43	-	-	-	-	-	-
3	DOC staff relocation expenses	-	1,088	-	-	-	-	163	1,251	1,251	-	-	-	-	-	-
4	Process liquid waste	74	-	270	297	1,503	-	484	2,628	2,628	-	-	4,019	-	-	183
5	Insurance	-	-	-	-	-	3,096	310	3,405	3,405	-	-	-	-	-	-
6	Property taxes	-	-	-	-	-	5,452	-	5,452	5,452	-	-	-	-	-	-
7	Health physics supplies	-	220	-	-	-	-	55	275	275	-	-	-	-	-	-
8	Heavy equipment rental	-	247	-	-	-	-	37	284	284	-	-	-	-	-	-
9	Small tool allowance	-	1	-	-	-	-	0	1	1	-	-	-	-	-	-
10	Disposal of DAW generated	-	-	201	20	202	-	74	497	497	-	2,699	-	-	-	7,342
11	Plant energy budget	-	-	-	-	-	4,137	621	4,757	4,757	-	-	-	-	-	-
12	ISFSI capital expenditures	-	-	-	-	-	49,945	7,492	57,436	57,436	-	-	-	-	-	-
13	NRC Fees	-	-	-	-	-	383	38	422	422	-	-	-	-	-	-
14	Emergency Planning Fees	-	-	-	-	-	152	15	167	167	-	-	-	-	-	-
15	Site Security Cost	-	-	-	-	-	1,205	181	1,386	1,386	-	-	-	-	-	-
Subtotal Undistributed Costs Period 1		680	1,555	471	317	1,705	64,368	9,563	78,661	78,661	-	2,699	4,019	-	-	7,525
Staff Costs																
	DOC Staff Cost	-	-	-	-	-	5,634	845	6,479	6,479	-	-	-	-	-	-
	Utility Staff Cost	-	-	-	-	-	18,843	2,826	21,669	21,669	-	-	-	-	-	-
TOTAL PERIOD 1 COST		**1,224**	**1,578**	**478**	**318**	**1,870**	**111,247**	**16,915**	**133,629**	**132,371**	**1,259**	**3,199**	**4,019**	**-**	**-**	**9,280**
PERIOD 2																
Nuclear Steam Supply System Removal																
28.1	Reactor Coolant Piping	85	167	7	6	327	-	168	760	760	-	875	-	-	-	8,920
28.2	Pressurizer Relief Tank	10	49	3	2	132	-	51	246	246	-	354	-	-	-	2,073
28.3	Reactor Coolant Pumps & Motors	79	47	32	102	2,299	-	645	3,205	3,205	-	6,148	-	-	-	4,609
28.4	Pressurizer	22	31	4	44	803	-	226	1,129	1,129	-	2,146	-	-	-	1,742

TABLE C-1
CRYSTAL RIVER PLANT - UNIT 3
DECON DECOMMISSIONING COST ESTIMATE
(Thousands of 1999 Dollars)

Columns may not add due to rounding

ID Number	Activity Description	Decon	Remove	Pack	Ship	Burial	Other	Contingency	Total	NRC LicTerm	Site Restore	Burial A CF	Burial B CF	Burial C CF	GTCC CF	Craft Labor Hours
28.5	Steam Generators	114	552	2,021	2,978	4,944	-	2,080	12,688	12,688	-	17,475	-	-	-	8,180
28.6	CRDMs/ICIs/Service Structure Removal	92	61	75	11	1,406	-	422	2,067	2,067	-	3,758	-	-	-	4,907
28.7	Reactor Vessel Internals	49	1,716	703	374	3,642	-	3,402	9,886	9,886	-	876	605	517	-	14,013
28.8	Vessel & Internals GTCC Disposal	-	-	-	-	22,918	-	3,438	26,356	28,356	-	-	-	-	724	-
28.9	Reactor Vessel	150	4,677	956	374	5,428	-	6,630	18,215	18,215	-	5,133	2,003	-	-	34,727
28	Totals	602	7,300	3,802	3,890	41,899	-	17,060	74,552	74,552	-	36,766	2,808	517	724	79,171
29	Remove spent fuel racks	227	23	9	1	984	296	411	1,950	1,950	-	2,630	-	-	-	9,481
	Removal of Major Equipment															
30	Main Turbine/Generator	-	166	-	-	-	3,696	596	4,458	4,458	-	-	-	-	-	5,991
	Disposal of Plant Systems															
31.1	Auxiliary Steam	-	33	-	-	-	-	5	38	-	38	-	-	-	-	1,399
31.2	Auxiliary Steam - RCA	-	29	-	-	-	26	11	66	66	-	-	-	-	-	1,023
31.3	Chemical Addition - Cont	-	51	1	0	38	26	26	142	142	-	102	-	-	-	1,854
31.4	Chemical Addition - Cont - Insulated	-	9	0	0	8	1	5	23	23	-	22	-	-	-	337
31.5	Chemical Addition - Insulated - RCA	-	7	-	-	-	4	2	14	14	-	-	-	-	-	245
31.6	Chemical Addition - RCA	-	40	-	-	-	46	17	102	102	-	-	-	-	-	1,382
31.7	Chemical Cleaning Steam Gen - Cont	-	21	-	-	-	11	7	38	38	-	-	-	-	-	773
31.8	Chemical Cleaning Steam Gen - RCA	-	17	-	-	-	13	8	37	37	-	-	-	-	-	611
31.9	Chemical Feed Secondary Cycle	-	8	-	-	-	-	1	10	-	10	-	-	-	-	351
31.10	Chemical Feed Secondary Cycle - RCA	-	6	-	-	-	4	2	11	11	-	-	-	-	-	201
31.11	Chilled Water	-	37	-	-	-	-	5	42	-	42	-	-	-	-	1,548
31.12	Chilled Water - RCA	-	57	-	-	-	47	21	125	125	-	-	-	-	-	2,021
31.13	Circulating Water	-	55	-	-	-	-	8	63	-	63	-	-	-	-	2,304
31.14	Cond Demin Regeneration	-	26	-	-	-	-	4	30	-	30	-	-	-	-	1,055
31.15	Condensate	-	69	-	-	-	-	10	79	-	79	-	-	-	-	2,932
31.16	Condensate & Demin Water Supply	-	15	-	-	-	-	2	17	-	17	-	-	-	-	618
31.17	Condensate & Demin Water Supply - Cont	-	60	-	-	-	34	20	113	113	-	-	-	-	-	2,203
31.18	Condensate & Demin Water Supply - RCA	-	81	-	-	-	61	29	171	171	-	-	-	-	-	2,856
31.19	Condensate - Cont	-	127	-	-	-	225	65	417	417	-	-	-	-	-	4,812
31.20	Condensate Demineralizer	-	59	-	-	-	-	9	68	-	68	-	-	-	-	2,543
31.21	Condensate Demineralizer - Cont	-	125	2	1	102	73	68	370	370	-	272	-	-	-	4,619
31.22	Condenser Air Removal & Priming	-	56	-	-	-	-	8	64	-	64	-	-	-	-	2,336
31.23	Containment Monitoring	-	52	1	0	41	9	25	127	127	-	109	-	-	-	1,907
31.24	Core Flooding	-	88	1	0	69	69	50	278	278	-	184	-	-	-	3,254
31.25	Cycle Makeup Demin Water	-	37	-	-	-	-	5	42	-	42	-	-	-	-	1,489
31.26	Cycle Makeup Demin Water - RCA	-	51	-	-	-	38	18	104	104	-	-	-	-	-	1,795
31.27	Cycle Startup	-	5	-	-	-	-	1	6	-	6	-	-	-	-	225
31.28	Cycle Startup - RCA	-	19	-	-	-	30	9	58	58	-	-	-	-	-	681
31.29	Decay Heat Closed Cycle Cooling	-	286	9	2	396	449	239	1,380	1,380	-	1,058	-	-	-	10,604
31.30	Decay Heat Removal	298	256	20	6	932	288	492	2,291	2,291	-	2,492	-	-	-	15,686
31.31	Diesel Jacket Coolant	-	15	-	-	-	-	2	18	-	18	-	-	-	-	617
31.32	Diesel-Air Cooler Coolant	-	3	-	-	-	-	0	3	-	3	-	-	-	-	109
	Disposal of Plant Systems (continued)															
31.33	Domestic Water	-	24	-	-	-	-	4	28	-	28	-	-	-	-	1,035
31.34	Domestic Water - RCA	-	54	-	-	-	36	19	110	110	-	-	-	-	-	1,901
31.35	EDG FO & Compressed Air & Exhaust	-	26	-	-	-	-	4	30	-	30	-	-	-	-	1,041
31.36	EDG Lube Oil	-	3	-	-	-	-	0	3	-	3	-	-	-	-	112
31.37	EFP-3 Compressed and Starting Air	-	8	-	-	-	-	1	9	-	9	-	-	-	-	332

TABLE C-1
CRYSTAL RIVER PLANT - UNIT 3
DECON DECOMMISSIONING COST ESTIMATE
(Thousands of 1999 Dollars)

Columns may not add due to rounding

ID Number	Activity Description	Decon	Remove	Pack	Ship	Burial	Other	Contingency	Total	NRC LicTerm	Site Restore	Burial A CF	Burial B CF	Burial C CF	GTCC CF	Craft Labor Hours
31.38	EFP-3 Fuel Oil Transfer	-	11	-	-	-	-	2	13	-	13	-	-	-	-	473
31.39	EFPB Sump Discharge	-	6	-	-	-	-	1	6	-	6	-	-	-	-	255
31.40	Electrical - Clean	-	330	-	-	-	-	50	380	-	380	-	-	-	-	13,208
31.41	Electrical - Contaminated	-	525	1	0	44	290	186	1,046	1,046	-	119	-	-	-	19,108
31.42	Electrical - Decontaminated	-	3,256	-	-	-	2,895	1,248	7,400	7,400	-	-	-	-	-	118,308
31.43	Emergency Feedwater	-	42	-	-	-	-	8	48	-	48	-	-	-	-	1,680
31.44	Emergency Feedwater - RCA	-	117	-	-	-	114	48	277	277	-	-	-	-	-	4,104
31.45	Extraction Steam	-	71	-	-	-	-	11	82	-	82	-	-	-	-	2,977
31.46	FW Heater Relief Vents & Drains	-	29	-	-	-	-	4	33	-	33	-	-	-	-	1,237
31.47	FW Heater Relief Vents & Drains - Cont	-	53	-	-	-	25	17	96	96	-	-	-	-	-	2,006
31.48	Feedwater	-	53	-	-	-	-	8	81	-	61	-	-	-	-	2,115
31.49	Feedwater - Insulated	-	29	-	-	-	-	4	33	-	33	-	-	-	-	1,258
31.50	Feedwater - Insulated - RCA	-	96	-	-	-	159	48	304	304	-	-	-	-	-	3,477
31.51	Feedwater - RCA	-	23	-	-	-	40	12	74	74	-	-	-	-	-	805
31.52	Fire Service Water	-	166	-	-	-	-	25	191	-	191	-	-	-	-	6,782
31.53	Fire Service Water - RCA	-	458	-	-	-	495	189	1,142	1,142	-	-	-	-	-	16,251
31.54	Floor & Equip Drains - Aux & Reac Bldg	157	82	2	1	88	4	122	456	456	-	236	-	-	-	8,842
31.55	HVAC - Auxiliary Bldg	-	200	1	0	68	264	107	640	640	-	181	-	-	-	6,535
31.56	HVAC - Clean Machine Shop	-	6	-	-	-	-	1	7	-	7	-	-	-	-	232
31.57	HVAC - Control Complex	-	25	-	-	-	-	4	28	-	28	-	-	-	-	960
31.58	HVAC - Diesel Gen Bldg	-	5	-	-	-	-	1	5	-	5	-	-	-	-	185
31.59	HVAC - Fire Pump House	-	2	-	-	-	-	0	2	-	2	-	-	-	-	75
31.60	HVAC - Fuel Handling Area	-	200	1	0	27	198	87	512	512	-	73	-	-	-	6,221
31.61	HVAC - Hot Machine Shop	-	31	0	0	5	34	14	83	83	-	12	-	-	-	1,000
31.62	HVAC - Intermediate Bldg	-	63	1	0	46	107	43	260	260	-	123	-	-	-	2,083
31.63	HVAC - Maintenance Support	-	6	-	-	-	-	1	7	-	7	-	-	-	-	243
31.64	HVAC - Office Bldg	-	6	-	-	-	-	1	7	-	7	-	-	-	-	225
31.65	HVAC - Reactor Bldg	-	397	3	1	130	489	205	1,224	1,224	-	346	-	-	-	12,691
31.66	HVAC - Turbine Bldg	-	122	-	-	-	-	18	140	-	140	-	-	-	-	4,682
31.67	HVAC-Misc Outbldgs	-	19	-	-	-	-	3	22	-	22	-	-	-	-	730
31.68	ICI Instrumentation	-	111	2	1	100	13	55	282	282	-	269	-	-	-	4,062
31.69	Industrial Cooler Water	-	20	-	-	-	-	3	23	-	23	-	-	-	-	781
31.70	Industrial Cooler Water - RCA	-	164	-	-	-	161	65	390	390	-	-	-	-	-	5,845
31.71	Instrument & Station Service Air	-	45	-	-	-	-	7	52	-	52	-	-	-	-	1,968
31.72	Instrument & Station Service Air - Cont	-	138	2	1	122	34	71	368	368	-	326	-	-	-	5,139
31.73	Instrument & Station Service Air - RCA	-	233	-	-	-	140	79	453	453	-	-	-	-	-	8,267
31.74	LP & HP Feedwater Drains & Vents	-	119	-	-	-	-	18	137	-	137	-	-	-	-	5,119
31.75	LP & HP Feedwater Drains & Vents - Cont	-	215	-	-	-	163	78	456	456	-	-	-	-	-	8,010
31.76	Leak Rate Test - Cont	-	80	2	0	69	24	41	216	216	-	184	-	-	-	2,946
31.77	Leak Rate Test - RCA	-	65	-	-	-	66	26	157	157	-	-	-	-	-	2,315
31.78	Liquid Sampling - Cont	-	60	1	0	44	5	27	137	137	-	118	-	-	-	2,262
31.79	Liquid Sampling - RCA	-	46	-	-	-	23	15	84	84	-	-	-	-	-	1,635
31.80	Liquid Waste Disposal	993	742	17	5	812	166	912	3,647	3,647	-	2,171	-	-	-	82,462
31.81	Lube Oil	-	6	-	-	-	-	1	7	-	7	-	-	-	-	256
31.82	Main & Reheat Steam	-	53	-	-	-	-	8	61	-	61	-	-	-	-	2,287
31.83	Main & Reheat Steam - Cont	-	507	-	-	-	1,582	364	2,453	2,453	-	-	-	-	-	18,916
31.84	Main & Reheat Steam - RCA	-	14	-	-	-	16	6	35	35	-	-	-	-	-	496
Disposal of Plant Systems (continued)																
31.85	Makeup & Purification	-	524	9	3	453	129	265	1,384	1,384	-	1,212	-	-	-	19,380
31.86	Makeup & Purification - Insulated	-	138	2	1	107	24	65	338	338	-	287	-	-	-	5,211
31.87	Misc Turbine Room Steam Drains	-	33	-	-	-	-	5	38	-	38	-	-	-	-	1,444

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CRYSTAL RIVER PLANT - UNIT 3
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(Thousands of 1999 Dollars)

Columns may not add due to rounding

ID Number	Activity Description	Decon	Remove	Pack	Ship	Burial	Other	Contingency	Total	NRC LicTerm	Site Restore	Burial A CF	Burial B CF	Burial C CF	GTCC CF	Craft Labor Hours
31.88	Misc Turbine Room Steam Drains - Cont	-	196	-	-	-	98	64	358	358	-	-	-	-	-	7,199
31.89	Nitrogen/Hydrogen/Carbon Dioxide	-	18	-	-	-	-	3	21	-	21	-	-	-	-	802
31.90	Nitrogen/Hydrogen/Carbon Dioxide - Cont	-	22	0	0	20	3	11	56	56	-	53	-	-	-	823
31.91	Nitrogen/Hydrogen/Carbon Dioxide - RCA	-	75	-	-	-	45	25	145	145	-	-	-	-	-	2,591
31.92	Noble Gas Effluent Monitoring - Cont	-	18	0	0	15	5	9	48	48	-	39	-	-	-	678
31.93	Noble Gas Effluent Monitoring - RCA	-	14	-	-	-	11	5	29	29	-	-	-	-	-	484
31.94	Nuc Serv & Decay Heat Sea Water	-	29	-	-	-	-	4	33	-	33	-	-	-	-	1,185
31.95	Nuc Serv & Decay Heat Sea Water - Cont	-	64	3	1	128	211	80	487	487	-	342	-	-	-	2,413
31.96	Nuc Serv & Decay Heat Sea Water - RCA	-	69	-	-	-	174	43	287	287	-	-	-	-	-	2,534
31.97	Nuc Serv Closed Cycle Cooling - Cont	-	623	15	4	705	586	422	2,355	2,355	-	1,884	-	-	-	22,899
31.98	Nuc Serv Closed Cycle Cooling - RCA	-	491	-	-	-	1,084	285	1,861	1,861	-	-	-	-	-	17,433
31.99	PASS Containment Monitoring - Cont	-	7	0	0	6	1	3	18	18	-	16	-	-	-	273
31.100	PASS Containment Monitoring - RCA	-	14	-	-	-	9	5	28	28	-	-	-	-	-	499
31.101	Post Accident Sampling - Cont	-	28	0	0	21	6	13	69	69	-	57	-	-	-	1,016
31.102	Post Accident Sampling - RCA	-	23	-	-	-	16	8	47	47	-	-	-	-	-	799
31.103	Post Accident Venting - Cont	-	35	1	0	31	17	19	103	103	-	83	-	-	-	1,290
31.104	Post Accident Venting - RCA	-	12	-	-	-	11	5	28	28	-	-	-	-	-	420
31.105	RB Penetration Cooling - RCA	-	90	-	-	-	67	33	189	189	-	-	-	-	-	3,218
31.106	RC & Misc Waste Evaporator	292	261	8	2	362	327	352	1,603	1,603	-	967	-	-	-	18,980
31.107	RC & Misc Waste Evaporator - Insulated	72	37	1	0	40	2	55	207	207	-	107	-	-	-	4,012
31.108	RCP Lube Oil - Cont	-	4	0	0	3	3	2	12	12	-	7	-	-	-	138
31.109	RCP Lube Oil - RCA	-	3	-	-	-	4	1	8	8	-	-	-	-	-	98
31.110	Radwaste Demineralizer	33	26	1	0	27	10	31	128	128	-	72	-	-	-	2,143
31.111	Reac Bldg Pressure Sensing & Test	-	1	-	-	-	-	0	2	-	2	-	-	-	-	55
31.112	Reac Bldg Pressure Sensing & Test - RCA	-	36	-	-	-	20	12	68	68	-	-	-	-	-	1,242
31.113	Reactor Building Spray	-	188	3	1	146	135	104	578	578	-	392	-	-	-	6,932
31.114	Refueling Equipment	-	87	4	1	161	62	72	387	387	-	431	-	-	-	3,245
31.115	Screen Wash Water	-	24	-	-	-	-	4	28	-	28	-	-	-	-	992
31.116	Seal & Spray Water	-	2	-	-	-	-	0	3	-	3	-	-	-	-	104
31.117	Seal & Spray Water - Cont	-	98	-	-	-	57	33	188	188	-	-	-	-	-	3,578
31.118	Seal & Spray Water - RCA	-	71	-	-	-	54	26	151	151	-	-	-	-	-	2,476
31.119	Secondary Cycle Sampling	-	15	-	-	-	-	2	18	-	18	-	-	-	-	687
31.120	Secondary Cycle Sampling - Cont	-	9	-	-	-	4	3	16	16	-	-	-	-	-	343
31.121	Secondary Cycle Sampling - Cont - Ins	-	3	-	-	-	1	1	5	5	-	-	-	-	-	115
31.122	Secondary Cycle Sampling - Insulated	-	4	-	-	-	-	1	5	-	5	-	-	-	-	202
31.123	Secondary Serv Closed Cycle Cooling	-	120	-	-	-	-	18	138	-	138	-	-	-	-	5,094
31.124	Sewage	-	7	-	-	-	-	1	7	-	7	-	-	-	-	278
31.125	Spent Fuel Cooling	300	310	13	4	565	152	393	1,737	1,737	-	1,512	-	-	-	18,067
31.126	Turb Bldg Sump & Oily Water Separator	-	12	-	-	-	-	2	14	-	14	-	-	-	-	500
31.127	Turbine Generator Seal Oil	-	15	-	-	-	-	2	18	-	18	-	-	-	-	661
31.128	Turbine Gland Steam & Drains	-	9	-	-	-	-	1	11	-	11	-	-	-	-	399
31.129	Turbine Lube Oil	-	27	-	-	-	-	4	31	-	31	-	-	-	-	1,107
31.130	Waste Drumming	32	16	0	0	17	1	24	90	90	-	45	-	-	-	1,769
31.131	Waste Gas Disposal	364	232	5	2	276	123	328	1,330	1,330	-	737	-	-	-	21,433
31.132	Waste Gas Sampling	-	64	1	0	54	10	31	160	160	-	146	-	-	-	2,331
31.133	Wet Layup/N2 Blanketing	-	3	-	-	-	-	0	3	-	3	-	-	-	-	123
31.134	Wet Layup/N2 Blanketing - Cont	-	7	-	-	-	3	2	12	12	-	-	-	-	-	246
31.135	Wet Layup/N2 Blanketing - RCA	-	3	-	-	-	2	1	6	6	-	-	-	-	-	107
31	Totals	2,541	15,177	132	39	6,278	12,455	8,325	44,947	42,686	2,262	16,785	-	-	-	638,172

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ID Number	Activity Description	Decon	Remove	Pack	Ship	Burial	Other	Contingency	Total	NRC LicTerm	Site Restore	Burial A CF	Burial B CF	Burial C CF	GTCC CF	Craft Labor Hours
32	Erect scaffolding for systems removal	-	1,147	1	0	62	151	325	1,887	1,687	-	166	-	-	-	49,801
	Decontamination of Site Buildings															
33.1	Reactor	682	366	85	42	3,243	224	1,292	5,935	5,935	-	9,895	-	-	-	35,555
33.2	Auxiliary Building	293	26	18	28	165	39	206	775	775	-	2,094	-	-	-	10,601
33.3	Fuel Handling Area (Aux Bldg)	546	353	13	19	147	420	465	1,964	1,964	-	1,508	-	-	-	30,559
33.4	Intermediate Bldg	61	5	4	6	36	14	44	171	171	-	454	-	-	-	2,196
33.5	Machine Shop - Hot	46	0	3	5	26	0	31	111	111	-	348	-	-	-	1,529
33.6	Rad Materials Storage & Processing Bldg	29	-	2	3	16	-	19	70	70	-	220	-	-	-	957
33	Totals	1,658	750	125	104	3,634	698	2,057	9,025	9,025	-	14,520	-	-	-	81,397
34	ORISE confirmatory survey	-	-	-	-	-	110	33	142	142	-	-	-	-	-	-
35	Terminate license								Note 1							
	Period 2 Additional Costs															
36	Mixed Waste	-	-	1	47	-	3,288	500	3,836	3,836	-	-	-	-	-	-
37	Hazardous Waste	-	-	0	0	-	2	0	3	3	-	-	-	-	-	-
38	License Termination Survey	-	-	-	-	-	5,756	1,727	7,482	7,482	-	-	-	-	-	101,226
	Subtotal Period 2 Activity Costs	5,027	24,563	4,071	4,081	52,856	26,450	31,034	148,083	145,821	2,262	70,867	2,608	517	724	965,238
	Period 2 Undistributed Costs															
1	Decon equipment	572	-	-	-	-	-	86	658	658	-	-	-	-	-	-
2	Decon supplies	687	-	-	-	-	-	172	858	858	-	-	-	-	-	-
3	DOC staff relocation expenses	-	1,088	-	-	-	-	163	1,251	1,251	-	-	-	-	-	-
4	Process liquid waste	457	-	294	504	2,020	-	839	4,114	4,114	-	-	5,400	-	-	667
5	Insurance	-	-	-	-	-	1,510	151	1,661	1,661	-	-	-	-	-	-
6	Property taxes	-	-	-	-	-	16,769	-	16,769	15,092	1,677	-	-	-	-	-
7	Health physics supplies	-	3,378	-	-	-	-	845	4,223	4,223	-	-	-	-	-	-
8	Heavy equipment rental	-	7,695	-	-	-	-	1,154	8,849	7,964	885	-	-	-	-	-
9	Small tool allowance	-	363	-	-	-	-	54	418	376	42	-	-	-	-	-
10	Pipe cutting equipment	-	787	-	-	-	-	118	905	905	-	-	-	-	-	-
11	Decon rig	1,023	-	-	-	-	-	153	1,176	1,178	-	-	-	-	-	-
12	Disposal of DAW generated	-	-	673	68	678	-	247	1,666	1,666	-	9,046	-	-	-	24,604
13	Decommissioning Equipment Disposition	-	-	5	1	214	410	116	746	746	-	572	-	-	-	778
14	Plant energy budget	-	-	-	-	-	4,196	629	4,825	4,343	483	-	-	-	-	-
15	NRC Fees	-	-	-	-	-	1,567	157	1,724	1,724	-	-	-	-	-	-
16	Emergency Planning Fees	-	-	-	-	-	508	51	558	558	-	-	-	-	-	-
17	Site Security Cost	-	-	-	-	-	6,774	1,016	7,790	7,790	-	-	-	-	-	-
18	LLRW Processing Equipment	-	-	-	-	-	221	33	254	254	-	-	-	-	-	-
	Subtotal Undistributed Costs Period 2	2,739	13,312	972	573	2,912	31,955	5,984	58,446	55,360	3,086	9,618	5,400	-	-	26,049
	Staff Costs															
	DOC Staff Cost	-	-	-	-	-	32,190	4,828	37,018	37,018	-	-	-	-	-	-
	Utility Staff Cost	-	-	-	-	-	37,394	5,609	43,003	43,003	-	-	-	-	-	-
	TOTAL PERIOD 2	**7,766**	**37,875**	**5,042**	**4,654**	**55,768**	**127,988**	**47,456**	**286,550**	**281,202**	**5,348**	**80,484**	**8,009**	**517**	**724**	**991,287**
	PERIOD 3															

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ID Number	Activity Description	Decon	Remove	Pack	Ship	Burial	Other	Contingency	Total	NRC LicTerm	Site Restore	Burial A CF	Burial B CF	Burial C CF	GTCC CF	Craft Labor Hours
	Removal of Major Equipment															
39	Main Condensers	-	195	-	-	-	-	29	224	-	224	-	-	-	-	7,062
	Demolition of Remaining Site Buildings															
40.1	Reactor	-	2,985	-	-	-	-	448	3,432	515	2,918	-	-	-	-	59,237
40.2	Auxiliary Building	-	1,192	-	-	-	-	179	1,371	137	1,234	-	-	-	-	23,740
40.3	Control Complex	-	506	-	-	-	-	76	582	-	582	-	-	-	-	7,768
40.4	Diesel Generator Bldg	-	235	-	-	-	-	35	270	-	270	-	-	-	-	4,132
40.5	EFW Pump Building	-	94	-	-	-	-	14	108	-	108	-	-	-	-	1,226
40.6	Fire Pumphouse	-	12	-	-	-	-	2	14	-	14	-	-	-	-	330
40.7	Fuel Handling Area (Aux Bldg)	-	745	-	-	-	-	112	856	86	771	-	-	-	-	14,669
40.8	Intake & Discharge Structures	-	591	-	-	-	-	89	680	-	680	-	-	-	-	4,499
40.9	Intermediate Bldg	-	500	-	-	-	-	75	575	57	517	-	-	-	-	5,286
40.10	Machine Shop - Cold	-	65	-	-	-	-	10	74	-	74	-	-	-	-	1,690
40.11	Machine Shop - Hot	-	64	-	-	-	-	10	74	4	70	-	-	-	-	1,685
40.12	Maintenance Support Bldg	-	41	-	-	-	-	6	47	-	47	-	-	-	-	1,116
40.13	Misc Yard Structures & Foundations	-	991	-	-	-	-	149	1,140	-	1,140	-	-	-	-	11,415
40.14	Outage Support Bldg	-	16	-	-	-	-	2	18	-	18	-	-	-	-	471
40.15	Rad Materials Storage & Processing Bldg	-	24	-	-	-	-	4	28	1	27	-	-	-	-	378
40.18	Rusty Bldg	-	212	-	-	-	-	32	244	-	244	-	-	-	-	6,295
40.17	Turbine Building	-	1,676	-	-	-	-	251	1,927	-	1,927	-	-	-	-	42,197
40.18	Turbine Pedestal	-	269	-	-	-	-	40	309	-	309	-	-	-	-	4,599
40.19	Warehouse Bldg (Maint) Mezzanine	-	117	-	-	-	-	18	134	-	134	-	-	-	-	3,008
40	Totals	-	10,335	-	-	-	-	1,550	11,886	800	11,086	-	-	-	-	193,741
	Site Closeout Activities															
41	Remove Rubble	-	601	-	-	-	-	90	691	-	691	-	-	-	-	1,201
42	Grade & landscape site	-	98	-	-	-	-	15	113	-	113	-	-	-	-	502
43	Final report to NRC	-	-	-	-	-	156	23	179	179	-	-	-	-	-	-
	Period 3 Additional Costs															
44	Transferal of Spent Fuel to DOE	-	-	-	-	-	733	110	843	843	-	-	-	-	-	-
45	ISFSI License Termination	-	375	34	42	226	1,623	404	2,704	2,704	-	3,017	-	-	-	22,000
46	ISFSI Demolition and Site Restoration	-	270	-	-	-	193	96	559	-	559	-	-	-	-	2,497
	Subtotal Period 3 Activity Costs	-	11,874	34	42	226	2,705	2,318	17,199	4,527	12,672	3,017	-	-	-	227,002
	Period 3 Undistributed Costs															
1	Insurance	-	-	-	-	-	2,747	275	3,021	3,021	-	-	-	-	-	-
2	Property taxes	-	-	-	-	-	9,011	-	9,011	-	9,011	-	-	-	-	-
3	Heavy equipment rental	-	2,673	-	-	-	-	401	3,074	-	3,074	-	-	-	-	-
4	Small tool allowance	-	83	-	-	-	-	13	96	-	96	-	-	-	-	-
5	Plant energy budget	-	-	-	-	-	127	19	146	-	146	-	-	-	-	-
8	NRC ISFSI Fees	-	-	-	-	-	2,961	296	3,257	3,257	-	-	-	-	-	-
7	Emergency Planning Fees	-	-	-	-	-	1,469	147	1,616	1,616	-	-	-	-	-	-
8	Site Security Cost	-	-	-	-	-	10,117	1,518	11,635	10,471	1,163	-	-	-	-	-
	Subtotal Undistributed Costs Penod 3	-	2,756	-	-	-	26,432	2,668	31,856	18,365	13,491	-	-	-	-	-
	Staff Costs															
	DOC Staff Cost	-	-	-	-	-	7,477	1,121	8,598	-	8,598	-	-	-	-	-

TABLE C-1
CRYSTAL RIVER PLANT - UNIT 3
DECON DECOMMISSIONING COST ESTIMATE
(Thousands of 1999 Dollars)

Columns may not add due to rounding

ID Number	Activity Description	Decon	Remove	Pack	Ship	Burial	Other	Contingency	Total	NRC LicTerm	Site Restore	Burial A CF	Burial B CF	Burial C CF	GTCC CF	Craft Labor Hours
	Utility Staff Cost	-	-	-	-	-	14,006	2,101	16,107	14,496	1,611	-	-	-	-	-
	TOTAL PERIOD 3	-	**14,631**	**34**	**42**	**226**	**50,619**	**8,208**	**73,761**	**37,389**	**36,371**	**3,017**	-	-	-	**227,002**
	TOTAL COST TO DECOMMISSION	**8,990**	**54,084**	**5,555**	**5,014**	**57,864**	**289,855**	**72,578**	**493,940**	**450,962**	**42,978**	**86,701**	**12,028**	**517**	**724**	**1,227,570**

Total cost to decommission with	17.22%	contingency:	$ 493,939,718	
Total NRC license termination cost is	91.30%	or	$ 450,961,565	
Non-nuclear demolition cost is	8.70%	or	$ 42,978,148	
Total radwaste volume buried			99,245	cubic feet
Total 10CFR61 greater than class C waste buried			724	cubic feet
Total scrap metal released from Crystal River Unit 3			15,552	tons
Total craft labor requirements			1,227,570	person hours

Note: "0" indicates costs less than $500
Note 1: This activity is performed by the decommissioning staff following plant shutdown; the costs for this are included in this period's staff cost.
Note 2: This activity, while performed after final plant shutdown, is considered part of operations and therefore no decommissioning costs are included for this activity.

TABLE C-2
CRYSTAL RIVER PLANT - UNIT 3
SAFSTOR DECOMMISSIONING COST ESTIMATE
(Thousands of 1999 Dollars)

Columns may not add due to rounding

ID Number	Activity Description	Decon	Remove	Pack	Ship	Burial	Other	Contingency	Total	NRC LicTerm	Site Restore	Burial A CF	Burial B CF	Burial C CF	GTCC CF	Craft Labor Hours
PERIOD 1: Mothballing Activities																
1	SAFSTOR site characterization survey	-	-	-	-	-	279	84	362	362	-	-	-	-	-	-
2	Prepare preliminary decommissioning cost	-	-	-	-	-	130	20	150	150	-	-	-	-	-	-
3	Notification of Cessation of Operations								Note 1							
4	Remove fuel & source material								Note 2							
5	Notification of Permanent Defueling								Note 1							
6	Deactivate plant systems & process waste								Note 1							
7	Prepare and submit PSDAR	-	-	-	-	-	200	30	230	230	-	-	-	-	-	-
8	Review plant dwgs & specs.	-	-	-	-	-	130	20	150	150	-	-	-	-	-	-
9	Perform detailed rad survey								Note 1							
10	Estimate by-product inventory	-	-	-	-	-	100	15	115	115	-	-	-	-	-	-
11	End product description	-	-	-	-	-	100	15	115	115	-	-	-	-	-	-
12	Detailed by-product inventory	-	-	-	-	-	150	23	173	173	-	-	-	-	-	-
13	Define major work sequence	-	-	-	-	-	100	15	115	115	-	-	-	-	-	-
14	Perform SER and EA	-	-	-	-	-	310	47	357	357	-	-	-	-	-	-
15	Perform Site-Specific Cost Study	-	-	-	-	-	500	75	575	575	-	-	-	-	-	-
Activity Specifications																
16.1	Prepare plant and facilities for SAFSTOR	-	-	-	-	-	492	74	566	566	-	-	-	-	-	-
16.2	Plant systems	-	-	-	-	-	417	63	479	479	-	-	-	-	-	-
16.3	Plant structures and buildings	-	-	-	-	-	312	47	359	359	-	-	-	-	-	-
16.4	Waste management	-	-	-	-	-	200	30	230	230	-	-	-	-	-	-
16.5	Facility and site dormancy	-	-	-	-	-	200	30	230	230	-	-	-	-	-	-
16	Total	-	-	-	-	-	1,621	243	1,864	1,864	-	-	-	-	-	-
Detailed Work Procedures																
17.1	Plant systems	-	-	-	-	-	473	71	544	544	-	-	-	-	-	-
17.2	Facility closeout & dormancy	-	-	-	-	-	120	18	138	138	-	-	-	-	-	-
17	Total	-	-	-	-	-	593	89	682	682	-	-	-	-	-	-
18	Procure vacuum drying system	-	-	-	-	-	10	2	12	12	-	-	-	-	-	-
19	Drain/de-energize non-cont. systems								Note 1							
20	Drain & dry NSSS								Note 1							
21	Drain/de-energize contaminated systems								Note 1							
22	Decon/secure contaminated systems								Note 1							
Decontamination of Site Buildings																
23.1	Reactor	593	-	-	-	-	-	297	890	890	-	-	-	-	-	21,352
23.2	Auxiliary Building	200	-	-	-	-	-	100	300	300	-	-	-	-	-	7,428
23.3	Fuel Handling Area (Aux Bldg)	480	-	-	-	-	-	240	720	720	-	-	-	-	-	15,956
23.4	Intermediate Bldg	41	-	-	-	-	-	21	62	62	-	-	-	-	-	1,536
23.5	Machine Shop - Hot	31	-	-	-	-	-	15	46	46	-	-	-	-	-	1,151
23.6	Rad Materials Storage & Processing Bldg	19	-	-	-	-	-	10	29	29	-	-	-	-	-	720
23	Totals	1,365	-	-	-	-	-	682	2,047	2,047	-	-	-	-	-	48,143
24	Prepare support equipment for storage	-	300	-	-	-	-	45	345	345	-	-	-	-	-	3,000
25	Install containment pressure equal. lines	-	22	-	-	-	-	3	25	25	-	-	-	-	-	700
26	Interim survey prior to dormancy	-	-	-	-	-	324	49	372	372	-	-	-	-	-	-
27	Secure building accesses								Note 1							
28	Prepare & submit interim report	-	-	-	-	-	58	9	67	67	-	-	-	-	-	-
Period 1 Additional Costs																

TABLE C-2
CRYSTAL RIVER PLANT - UNIT 3
SAFSTOR DECOMMISSIONING COST ESTIMATE
(Thousands of 1999 Dollars)

Columns may not add due to rounding

ID Number / Activity Description	Decon	Remove	Pack	Ship	Burial	Other	Contingency	Total	NRC LicTerm	Site Restore	Burial A CF	Burial B CF	Burial C CF	GTCC CF	Craft Labor Hours
29 Fuel Pool Isolation	-	-	-	-	-	6,695	1,004	7,699	7,699	-	-	-	-	-	-
30 Mixed Waste	-	-	1	47	-	3,288	500	3,836	3,836	-	-	-	-	-	-
31 Hazardous Waste	-	-	0	0	-	2	0	3	3	-	-	-	-	-	-
Subtotal Period 1 Activity Costs	1,365	322	2	47	-	14,589	2,968	19,293	19,293	-	-	-	-	-	51,843
Period 1 Undistributed Costs															
1 Decon equipment	572	-	-	-	-	-	86	658	658	-	-	-	-	-	-
2 Decon supplies	606	-	-	-	-	-	151	757	757	-	-	-	-	-	-
3 Process liquid waste	217	-	63	165	553	-	278	1,277	1,277	-	-	1,479	-	-	291
4 Insurance	-	-	-	-	-	3,096	310	3,405	3,405	-	-	-	-	-	-
5 Property taxes	-	-	-	-	-	2,709	-	2,709	2,709	-	-	-	-	-	-
6 Health physics supplies	-	358	-	-	-	-	89	447	447	-	-	-	-	-	-
7 Small tool allowance	-	23	-	-	-	-	3	27	27	-	-	-	-	-	-
8 Disposal of DAW generated	-	-	201	20	202	-	74	497	497	-	2,699	-	-	-	7,342
9 Plant energy budget	-	-	-	-	-	1,234	185	1,419	1,419	-	-	-	-	-	-
10 ISFSI capital expenditures	-	-	-	-	-	49,945	7,492	57,436	57,436	-	-	-	-	-	-
11 NRC Fees	-	-	-	-	-	383	38	422	422	-	-	-	-	-	-
12 Emergency Planning Fees	-	-	-	-	-	152	15	167	167	-	-	-	-	-	-
13 Site Security Cost	-	-	-	-	-	1,205	181	1,386	1,386	-	-	-	-	-	-
Subtotal Undistributed Costs Period 1	1,395	381	264	185	756	58,723	8,902	70,606	70,606	-	2,699	1,479	-	-	7,633
Staff Costs															
DOC Staff Cost	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Utility Staff Cost	-	-	-	-	-	17,943	2,691	20,634	20,634	-	-	-	-	-	-
TOTAL COST TO SAFSTOR	**2,760**	**702**	**265**	**232**	**756**	**91,255**	**14,562**	**110,532**	**110,532**	**-**	**2,699**	**1,479**	**-**	**-**	**59,476**

Total cost to SAFSTOR with 15.17% contingency: $ 110,532,261

Total radwaste volume buried 4,178 cubic feet

Total craft labor requirements 59,476 person hours

ID Number / Activity Description	Decon	Remove	Pack	Ship	Burial	Other	Contingency	Total	NRC LicTerm	Site Restore	Burial A CF	Burial B CF	Burial C CF	GTCC CF	Craft Labor Hours
PERIOD 2: Safstor Annual Maintenance Cost															
1 Quarterly Inspection								Note 1							
2 Semi-annual environmental survey								Note 1							
3 Prepare reports								Note 1							
4 Health physics supplies	-	-	-	-	-	48	12	60	60	-	-	-	-	-	-
5 Insurance	-	-	-	-	-	268	27	295	295	-	-	-	-	-	-
6 Property taxes	-	-	-	-	-	1,963	-	1,963	1,963	-	-	-	-	-	-
7 Disposal of contaminated solid waste	-	-	1	0	38	-	10	49	49	-	102	-	-	-	28
8 Bituminous roof replacement	-	-	-	-	-	38	6	43	43	-	-	-	-	-	-
9 Maintenance supplies	-	-	-	-	-	103	26	129	129	-	-	-	-	-	-
10 Plant energy budget	-	-	-	-	-	252	38	290	290	-	-	-	-	-	-
11 NRC Fees	-	-	-	-	-	211	21	233	233	-	-	-	-	-	-
12 Emergency Planning Fees	-	-	-	-	-	38	4	41	41	-	-	-	-	-	-
13 Site Security Cost	-	-	-	-	-	399	60	459	459	-	-	-	-	-	-
Period 2 Additional Costs															
14 Transferal of Spent Fuel to DOE	-	-	-	-	-	14	2	16	16	-	-	-	-	-	-

TABLE C-2
CRYSTAL RIVER PLANT - UNIT 3
SAFSTOR DECOMMISSIONING COST ESTIMATE
(Thousands of 1999 Dollars)

Columns may not add due to rounding

ID Number	Activity Description	Decon	Remove	Pack	Ship	Burial	Other	Contingency	Total	NRC LicTerm	Site Restore	Burial A CF	Burial B CF	Burial C CF	GTCC CF	Craft Labor Hours
15	Site maintenance staff	-	-	-	-	-	1,501	225	1,727	1,727	-	-	-	-	-	-
	PERIOD 2 ANNUAL MAINTENANCE TOTALS	-	-	1	0	38	4,836	430	5,304	5,304	-	102	-	-	-	28

Total cost to SAFSTOR dormancy with 52.60917 years equals $ 279,054,935

Total radwaste volume buried 5,361 cubic feet

ID Number	Activity Description	Decon	Remove	Pack	Ship	Burial	Other	Contingency	Total	NRC LicTerm	Site Restore	Burial A CF	Burial B CF	Burial C CF	GTCC CF	Craft Labor Hours
	PERIOD 3															
1	Review plant dwgs & specs.	-	-	-	-	-	460	69	529	529	-	-	-	-	-	-
2	Perform detailed rad survey								Note 1							
3	End product description	-	-	-	-	-	100	15	115	115	-	-	-	-	-	-
4	Detailed by-product inventory	-	-	-	-	-	130	20	150	150	-	-	-	-	-	-
5	Define major work sequence	-	-	-	-	-	750	113	863	863	-	-	-	-	-	-
6	Perform SER and EA	-	-	-	-	-	310	47	357	357	-	-	-	-	-	-
7	Perform Site-Specific Cost Study	-	-	-	-	-	500	75	575	575	-	-	-	-	-	-
8	Prepare/submit License Termination Plan	-	-	-	-	-	410	61	471	471	-	-	-	-	-	-
9	Receive NRC approval of termination plan								Note 1							
	Activity Specifications															
10.1	Re-activate plant & temporary facilities	-	-	-	-	-	737	111	848	763	85	-	-	-	-	-
10.2	Plant systems	-	-	-	-	-	417	63	479	431	48	-	-	-	-	-
10.3	Reactor internals	-	-	-	-	-	710	107	817	817	-	-	-	-	-	-
10.4	Reactor vessel	-	-	-	-	-	650	98	748	748	-	-	-	-	-	-
10.5	Biological shield	-	-	-	-	-	50	8	58	58	-	-	-	-	-	-
10.6	Steam generators	-	-	-	-	-	312	47	359	359	-	-	-	-	-	-
10.7	Reinforced concrete	-	-	-	-	-	160	24	184	92	92	-	-	-	-	-
10.8	Turbine & condenser	-	-	-	-	-	80	12	92	-	92	-	-	-	-	-
10.9	Plant structures & buildings	-	-	-	-	-	312	47	359	179	179	-	-	-	-	-
10.10	Waste management	-	-	-	-	-	460	69	529	529	-	-	-	-	-	-
10.11	Facility & site closeout	-	-	-	-	-	90	14	104	52	52	-	-	-	-	-
10	Total	-	-	-	-	-	3,978	597	4,574	4,026	548	-	-	-	-	-
	Planning & Site Preparations															
11	Prepare dismantling sequence	-	-	-	-	-	240	36	276	276	-	-	-	-	-	-
12	Plant prep. & temp. svces	-	-	-	-	-	1,990	299	2,289	2,289	-	-	-	-	-	-
13	Design water clean-up system	-	-	-	-	-	140	21	161	161	-	-	-	-	-	-
14	Rigging/CCEs/tooling/etc.	-	-	-	-	-	1,685	253	1,937	1,937	-	-	-	-	-	-
15	Procure casks/liners & containers	-	-	-	-	-	123	18	141	141	-	-	-	-	-	-
	Detailed Work Procedures															
16.1	Plant systems	-	-	-	-	-	473	71	544	490	54	-	-	-	-	-
16.2	Vessel head	-	-	-	-	-	250	38	288	288	-	-	-	-	-	-
16.3	Reactor internals	-	-	-	-	-	250	38	288	288	-	-	-	-	-	-
16.4	Remaining buildings	-	-	-	-	-	135	20	155	39	116	-	-	-	-	-
16.5	CRD cooling assembly	-	-	-	-	-	100	15	115	115	-	-	-	-	-	-
16.6	CRD housings & ICI tubes	-	-	-	-	-	100	15	115	115	-	-	-	-	-	-
16.7	Incore instrumentation	-	-	-	-	-	100	15	115	115	-	-	-	-	-	-
16.8	Reactor vessel	-	-	-	-	-	363	54	417	417	-	-	-	-	-	-
16.9	Facility closeout	-	-	-	-	-	120	18	138	69	69	-	-	-	-	-

TABLE C-2
CRYSTAL RIVER PLANT - UNIT 3
SAFSTOR DECOMMISSIONING COST ESTIMATE
(Thousands of 1999 Dollars)

Columns may not add due to rounding

ID Number	Activity Description	Decon	Remove	Pack	Ship	Burial	Other	Contingency	Total	NRC LicTerm	Site Restore	Burial A CF	Burial B CF	Burial C CF	GTCC CF	Craft Labor Hours
16.10	Missile shields	-	-	-	-	-	45	7	52	52	-	-	-	-	-	-
16.11	Biological shield	-	-	-	-	-	120	18	138	138	-	-	-	-	-	-
16.12	Steam generators	-	-	-	-	-	460	69	529	529	-	-	-	-	-	-
16.13	Reinforced concrete	-	-	-	-	-	100	15	115	58	58	-	-	-	-	-
16.14	Turbine & condensers	-	-	-	-	-	312	47	359	-	359	-	-	-	-	-
16.15	Auxiliary building	-	-	-	-	-	273	41	314	283	31	-	-	-	-	-
16.16	Reactor building	-	-	-	-	-	273	41	314	283	31	-	-	-	-	-
16	Total	-	-	-	-	-	3,474	521	3,995	3,276	719	-	-	-	-	-
17	Asbestos removal program	-	23	8	0	164	-	48	242	222	20	500	-	-	-	955
Period 3 Additional Costs																
18	Site Characterization Survey	-	-	-	-	-	1,083	162	1,245	1,245	-	-	-	-	-	-
Subtotal Period 3 Activity Costs		-	23	8	0	164	15,372	2,353	17,920	16,633	1,287	500	-	-	-	955
Period 3 Undistributed Costs																
1	DOC staff relocation expenses	-	1,088	-	-	-	-	163	1,251	1,251	-	-	-	-	-	-
2	Insurance	-	-	-	-	-	392	39	431	431	-	-	-	-	-	-
3	Property taxes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	Health physics supplies	-	217	-	-	-	-	54	271	271	-	-	-	-	-	-
5	Heavy equipment rental	-	517	-	-	-	-	78	595	595	-	-	-	-	-	-
6	Disposal of DAW generated	-	-	200	20	202	-	73	495	495	-	2,690	-	-	-	7,318
7	Plant energy budget	-	-	-	-	-	1,916	287	2,204	2,204	-	-	-	-	-	-
8	NRC Fees	-	-	-	-	-	382	38	420	420	-	-	-	-	-	-
9	Site Security Cost	-	-	-	-	-	855	128	983	983	-	-	-	-	-	-
Subtotal Undistributed Costs Period 3		-	1,822	200	20	202	3,545	882	6,651	6,651	-	2,690	-	-	-	7,318
Staff Costs																
	DOC Staff Cost	-	-	-	-	-	5,618	843	6,461	6,461	-	-	-	-	-	-
	Utility Staff Cost	-	-	-	-	-	16,534	2,480	19,014	19,014	-	-	-	-	-	-
TOTAL PERIOD 3 COST		-	**1,845**	**208**	**21**	**366**	**41,069**	**6,538**	**50,046**	**48,759**	**1,287**	**3,190**	-	-	-	**8,273**
PERIOD 4																
Nuclear Steam Supply System Removal																
19.1	Reactor Coolant Piping	77	155	7	6	327	-	161	733	733	-	875	-	-	-	8,161
19.2	Pressurizer Relief Tank	9	44	3	2	132	-	49	239	239	-	354	-	-	-	1,879
19.3	Reactor Coolant Pumps & Motors	71	43	32	102	2,299	-	640	3,188	3,188	-	6,148	-	-	-	4,211
19.4	Pressurizer	20	31	4	44	803	-	225	1,126	1,126	-	2,146	-	-	-	1,678
19.5	Steam Generators	103	552	2,021	2,978	4,944	-	2,074	12,673	12,673	-	17,475	-	-	-	8,180
19.6	CRDMs/ICIs/Service Structure Removal	84	60	75	11	1,406	-	417	2,052	2,052	-	3,758	-	-	-	4,604
19.7	Reactor Vessel Internals	42	1,556	600	262	2,694	-	2,751	7,905	7,905	-	1,252	250	527	-	11,009
19.8	Vessel & Internals GTCC Disposal	-	-	-	-	22,918	-	3,438	26,356	26,356	-	-	-	-	724	-
19.9	Reactor Vessel	134	4,498	863	198	4,254	-	5,832	15,777	15,777	-	5,133	1,878	-	-	30,826
19	Totals	541	6,937	3,605	3,602	39,777	-	15,587	70,049	70,049	-	37,141	2,128	527	724	70,549
20	Remove spent fuel racks	208	23	9	1	984	296	401	1,922	1,922	-	2,630	-	-	-	8,683

Removal of Major Equipment

TABLE C-2
CRYSTAL RIVER PLANT - UNIT 3
SAFSTOR DECOMMISSIONING COST ESTIMATE
(Thousands of 1999 Dollars)

Columns may not add due to rounding

ID Number	Activity Description	Decon	Remove	Pack	Ship	Burial	Other	Contingency	Total	NRC LicTerm	Site Restore	Burial A CF	B CF	C CF	GTCC CF	Craft Labor Hours
21	Main Turbine/Generator	-	149	-	-	-	3,696	592	4,436	4,436	-	-	-	-	-	5,374
	Disposal of Plant Systems															
22.1	Auxiliary Steam	-	33	-	-	-	-	5	38	-	38	-	-	-	-	1,399
22.2	Auxiliary Steam - RCA	-	29	-	-	-	26	11	66	66	-	-	-	-	-	1,023
22.3	Chemical Addition - Cont	-	47	1	0	38	26	25	137	137	-	102	-	-	-	1,708
22.4	Chemical Addition - Cont - Insulated	-	9	0	0	8	1	4	23	23	-	22	-	-	-	313
22.5	Chemical Addition - Insulated - RCA	-	7	-	-	-	4	2	14	14	-	-	-	-	-	245
22.6	Chemical Addition - RCA	-	40	-	-	-	46	17	102	102	-	-	-	-	-	1,382
22.7	Chemical Cleaning Steam Gen - Cont	-	19	-	-	-	11	6	36	36	-	-	-	-	-	703
22.8	Chemical Cleaning Steam Gen - RCA	-	17	-	-	-	13	6	37	37	-	-	-	-	-	611
22.9	Chemical Feed Secondary Cycle	-	8	-	-	-	-	1	10	-	10	-	-	-	-	351
22.10	Chemical Feed Secondary Cycle - RCA	-	6	-	-	-	4	2	11	11	-	-	-	-	-	201
22.11	Chilled Water	-	37	-	-	-	-	5	42	-	42	-	-	-	-	1,548
22.12	Chilled Water - RCA	-	57	-	-	-	47	21	125	125	-	-	-	-	-	2,021
22.13	Circulating Water	-	55	-	-	-	-	8	63	-	63	-	-	-	-	2,304
22.14	Cond Demin Regeneration	-	26	-	-	-	-	4	30	-	30	-	-	-	-	1,055
22.15	Condensate	-	69	-	-	-	-	10	79	-	79	-	-	-	-	2,932
22.16	Condensate & Demin Water Supply	-	15	-	-	-	-	2	17	-	17	-	-	-	-	618
22.17	Condensate & Demin Water Supply - Cont	-	55	-	-	-	34	19	107	107	-	-	-	-	-	2,000
22.18	Condensate & Demin Water Supply - RCA	-	81	-	-	-	61	29	171	171	-	-	-	-	-	2,856
22.19	Condensate - Cont	-	116	-	-	-	225	63	403	403	-	-	-	-	-	4,186
22.20	Condensate Demineralizer	-	59	-	-	-	-	9	68	-	68	-	-	-	-	2,543
22.21	Condensate Demineralizer - Cont	-	114	2	1	102	73	65	357	357	-	272	-	-	-	4,195
22.22	Condenser Air Removal & Priming	-	56	-	-	-	-	8	64	-	64	-	-	-	-	2,336
22.23	Containment Monitoring	-	48	1	0	41	9	24	123	123	-	109	-	-	-	1,758
22.24	Core Flooding	-	82	1	0	69	69	48	269	269	-	184	-	-	-	2,981
22.25	Cycle Makeup Demin Water	-	37	-	-	-	-	5	42	-	42	-	-	-	-	1,489
22.26	Cycle Makeup Demin Water - RCA	-	51	-	-	-	36	18	104	104	-	-	-	-	-	1,795
22.27	Cycle Startup	-	5	-	-	-	-	1	6	-	6	-	-	-	-	225
22.28	Cycle Startup - RCA	-	19	-	-	-	30	9	58	58	-	-	-	-	-	681
22.29	Decay Heat Closed Cycle Cooling	-	262	9	2	396	449	233	1,351	1,351	-	1,058	-	-	-	9,633
22.30	Decay Heat Removal	-	234	20	6	932	288	337	1,817	1,817	-	2,492	-	-	-	8,651
22.31	Diesel Jacket Coolant	-	15	-	-	-	-	2	18	-	18	-	-	-	-	617
	Disposal of Plant Systems (continued)															
22.32	Diesel-Air Cooler Coolant	-	3	-	-	-	-	0	3	-	3	-	-	-	-	109
22.33	Domestic Water	-	24	-	-	-	-	4	28	-	28	-	-	-	-	1,035
22.34	Domestic Water - RCA	-	54	-	-	-	36	19	110	110	-	-	-	-	-	1,901
22.35	EDG FO & Compressed Air & Exhaust	-	26	-	-	-	-	4	30	-	30	-	-	-	-	1,041
22.36	EDG Lube Oil	-	3	-	-	-	-	0	3	-	3	-	-	-	-	112
22.37	EFP-3 Compressed and Starting Air	-	8	-	-	-	-	1	9	-	9	-	-	-	-	332
22.38	EFP-3 Fuel Oil Transfer	-	11	-	-	-	-	2	13	-	13	-	-	-	-	473
22.39	EFPB Sump Discharge	-	6	-	-	-	-	1	6	-	6	-	-	-	-	255
22.40	Electrical - Clean	-	330	-	-	-	-	50	380	-	380	-	-	-	-	13,208
22.41	Electrical - Contaminated	-	483	1	0	44	290	175	994	994	-	119	-	-	-	17,496
22.42	Electrical - Decontaminated	-	3,256	-	-	-	2,895	1,248	7,400	7,400	-	-	-	-	-	116,308
22.43	Emergency Feedwater	-	42	-	-	-	-	6	48	-	48	-	-	-	-	1,680
22.44	Emergency Feedwater - RCA	-	117	-	-	-	114	46	277	277	-	-	-	-	-	4,104
22.45	Extraction Steam	-	71	-	-	-	-	11	82	-	82	-	-	-	-	2,977
22.46	FW Heater Relief Vents & Drains	-	29	-	-	-	-	4	33	-	33	-	-	-	-	1,237
22.47	FW Heater Relief Vents & Drains - Cont	-	48	-	-	-	25	16	90	90	-	-	-	-	-	1,810
22.48	Feedwater	-	53	-	-	-	-	8	61	-	61	-	-	-	-	2,115
22.49	Feedwater - Insulated	-	29	-	-	-	-	4	33	-	33	-	-	-	-	1,258
22.50	Feedwater - Insulated - RCA	-	96	-	-	-	159	48	304	304	-	-	-	-	-	3,477

TABLE C-2
CRYSTAL RIVER PLANT - UNIT 3
SAFSTOR DECOMMISSIONING COST ESTIMATE
(Thousands of 1999 Dollars)

Columns may not add due to rounding

ID Number	Activity Description	Decon	Remove	Pack	Ship	Burial	Other	Contingency	Total	NRC LicTerm	Site Restore	Burial A CF	Burial B CF	Burial C CF	GTCC CF	Craft Labor Hours
22.51	Feedwater - RCA	-	23	-	-	-	40	12	74	74	-	-	-	-	-	805
22.52	Fire Service Water	-	166	-	-	-	-	25	191	-	191	-	-	-	-	6,782
22.53	Fire Service Water - RCA	-	458	-	-	-	495	189	1,142	1,142	-	-	-	-	-	16,251
22.54	Floor & Equip Drains - Aux & Reac Bldg	-	77	2	1	88	4	42	214	214	-	236	-	-	-	2,778
22.55	HVAC - Auxiliary Bldg	-	182	1	0	68	264	102	618	618	-	181	-	-	-	5,845
22.56	HVAC - Clean Machine Shop	-	6	-	-	-	-	1	7	-	7	-	-	-	-	232
22.57	HVAC - Control Complex	-	25	-	-	-	-	4	28	-	28	-	-	-	-	960
22.58	HVAC - Diesel Gen Bldg	-	5	-	-	-	-	1	5	-	5	-	-	-	-	185
22.59	HVAC - Fire Pump House	-	2	-	-	-	-	0	2	-	2	-	-	-	-	75
22.60	HVAC - Fuel Handling Area	-	183	1	0	27	198	82	491	491	-	73	-	-	-	5,536
22.61	HVAC - Hot Machine Shop	-	28	0	0	5	34	13	80	80	-	12	-	-	-	893
22.62	HVAC - Intermediate Bldg	-	57	1	0	46	107	42	254	254	-	123	-	-	-	1,866
22.63	HVAC - Maintenance Support	-	6	-	-	-	-	1	7	-	7	-	-	-	-	243
22.64	HVAC - Office Bldg	-	6	-	-	-	-	1	7	-	7	-	-	-	-	225
22.65	HVAC - Reactor Bldg	-	363	3	1	130	489	197	1,181	1,181	-	346	-	-	-	11,324
22.66	HVAC - Turbine Bldg	-	122	-	-	-	-	18	140	-	140	-	-	-	-	4,682
22.67	HVAC-Misc Outbldgs	-	19	-	-	-	-	3	22	-	22	-	-	-	-	730
22.68	ICI Instrumentation	-	104	2	1	100	13	53	274	274	-	269	-	-	-	3,770
22.69	Industrial Cooler Water	-	20	-	-	-	-	3	23	-	23	-	-	-	-	781
22.70	Industrial Cooler Water - RCA	-	164	-	-	-	161	65	390	390	-	-	-	-	-	5,845
22.71	Instrument & Station Service Air	-	45	-	-	-	-	7	52	-	52	-	-	-	-	1,968
22.72	Instrument & Station Service Air - Cont	-	127	2	1	122	34	68	355	355	-	326	-	-	-	4,695
22.73	Instrument & Station Service Air - RCA	-	233	-	-	-	140	79	453	453	-	-	-	-	-	8,267
22.74	LP & HP Feedwater Drains & Vents	-	119	-	-	-	-	18	137	-	137	-	-	-	-	5,119
22.75	LP & HP Feedwater Drains & Vents - Cont	-	197	-	-	-	163	74	433	433	-	-	-	-	-	7,267
22.76	Leak Rate Test - Cont	-	73	2	0	69	24	39	207	207	-	184	-	-	-	2,665
22.77	Leak Rate Test - RCA	-	65	-	-	-	66	26	157	157	-	-	-	-	-	2,315
22.78	Liquid Sampling - Cont	-	56	1	0	44	5	26	131	131	-	118	-	-	-	2,080
22.79	Liquid Sampling - RCA	-	46	-	-	-	23	15	84	84	-	-	-	-	-	1,635
22.80	Liquid Waste Disposal	-	680	17	5	812	166	400	2,081	2,081	-	2,171	-	-	-	24,921
22.81	Lube Oil	-	6	-	-	-	-	1	7	-	7	-	-	-	-	256
22.82	Main & Reheat Steam	-	53	-	-	-	-	8	61	-	61	-	-	-	-	2,287
Disposal of Plant Systems (continued)																
22.83	Main & Reheat Steam - Cont	-	465	-	-	-	1,582	353	2,400	2,400	-	-	-	-	-	17,209
22.84	Main & Reheat Steam - RCA	-	14	-	-	-	16	6	35	35	-	-	-	-	-	496
22.85	Makeup & Purification	-	480	9	3	453	129	254	1,329	1,329	-	1,212	-	-	-	17,577
22.86	Makeup & Purification - Insulated	-	127	2	1	107	24	63	324	324	-	287	-	-	-	4,719
22.87	Misc Turbine Room Steam Drains	-	33	-	-	-	-	5	38	-	38	-	-	-	-	1,444
22.88	Misc Turbine Room Steam Drains - Cont	-	183	-	-	-	98	60	341	341	-	-	-	-	-	6,627
22.89	Nitrogen/Hydrogen/Carbon Dioxide	-	18	-	-	-	-	3	21	-	21	-	-	-	-	802
22.90	Nitrogen/Hydrogen/Carbon Dioxide - Cont	-	21	0	0	20	3	11	54	54	-	53	-	-	-	759
22.91	Nitrogen/Hydrogen/Carbon Dioxide - RCA	-	75	-	-	-	45	25	145	145	-	-	-	-	-	2,591
22.92	Noble Gas Effluent Monitoring - Cont	-	17	0	0	15	5	9	46	46	-	39	-	-	-	625
22.93	Noble Gas Effluent Monitoring - RCA	-	14	-	-	-	11	5	29	29	-	-	-	-	-	484
22.94	Nuc Serv & Decay Heat Sea Water	-	29	-	-	-	-	4	33	-	33	-	-	-	-	1,185
22.95	Nuc Serv & Decay Heat Sea Water - Cont	-	58	3	1	128	211	79	480	480	-	342	-	-	-	2,194
22.96	Nuc Serv & Decay Heat Sea Water - RCA	-	69	-	-	-	174	43	287	287	-	-	-	-	-	2,534
22.97	Nuc Serv Closed Cycle Cooling - Cont	-	572	15	4	705	586	409	2,291	2,291	-	1,884	-	-	-	20,840
22.98	Nuc Serv Closed Cycle Cooling - RCA	-	491	-	-	-	1,084	285	1,861	1,861	-	-	-	-	-	17,433
22.99	PASS Containment Monitoring - Cont	-	7	0	0	6	1	3	17	17	-	16	-	-	-	252
22.100	PASS Containment Monitoring - RCA	-	14	-	-	-	9	5	28	28	-	-	-	-	-	499
22.101	Post Accident Sampling - Cont	-	26	0	0	21	6	13	66	66	-	57	-	-	-	936
22.102	Post Accident Sampling - RCA	-	23	-	-	-	16	8	47	47	-	-	-	-	-	799
22.103	Post Accident Venting - Cont	-	33	1	0	31	17	19	100	100	-	83	-	-	-	1,178

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CRYSTAL RIVER PLANT - UNIT 3
SAFSTOR DECOMMISSIONING COST ESTIMATE
(Thousands of 1999 Dollars)

Columns may not add due to rounding

ID Number	Activity Description	Decon	Remove	Pack	Ship	Burial	Other	Contingency	Total	NRC LicTerm	Site Restore	Burial A CF	Burial B CF	Burial C CF	GTCC CF	Craft Labor Hours
22.104	Post Accident Venting - RCA	-	12	-	-	-	11	5	28	28	-	-	-	-	-	420
22.105	RB Penetration Cooling - RCA	-	90	-	-	-	67	33	189	189	-	-	-	-	-	3,218
22.106	RC & Misc Waste Evaporator	-	238	8	2	362	327	200	1,136	1,136	-	967	-	-	-	8,577
22.107	RC & Misc Waste Evaporator - Insulated	-	35	1	0	40	2	19	97	97	-	107	-	-	-	1,258
22.108	RCP Lube Oil - Cont	-	4	0	0	3	3	2	11	11	-	7	-	-	-	127
22.109	RCP Lube Oil - RCA	-	3	-	-	-	4	1	8	8	-	-	-	-	-	98
22.110	Radwaste Demineralizer	-	24	1	0	27	10	14	76	76	-	72	-	-	-	869
22.111	Reac Bldg Pressure Sensing & Test	-	1	-	-	-	-	0	2	-	2	-	-	-	-	55
22.112	Reac Bldg Pressure Sensing & Test - RCA	-	36	-	-	-	20	12	68	68	-	-	-	-	-	1,242
22.113	Reactor Building Spray	-	172	3	1	146	135	100	558	558	-	392	-	-	-	6,288
22.114	Refueling Equipment	-	79	4	1	161	62	70	377	377	-	431	-	-	-	2,942
22.115	Screen Wash Water	-	24	-	-	-	-	4	28	-	28	-	-	-	-	992
22.116	Seal & Spray Water	-	2	-	-	-	-	0	3	-	3	-	-	-	-	104
22.117	Seal & Spray Water - Cont	-	91	-	-	-	57	31	179	179	-	-	-	-	-	3,285
22.118	Seal & Spray Water - RCA	-	71	-	-	-	54	26	151	151	-	-	-	-	-	2,476
22.119	Secondary Cycle Sampling	-	15	-	-	-	-	2	18	-	18	-	-	-	-	687
22.120	Secondary Cycle Sampling - Cont	-	9	-	-	-	4	3	16	16	-	-	-	-	-	317
22.121	Secondary Cycle Sampling - Cont - Ins	-	3	-	-	-	1	1	5	5	-	-	-	-	-	106
22.122	Secondary Cycle Sampling - Insulated	-	4	-	-	-	-	1	5	-	5	-	-	-	-	202
22.123	Secondary Serv Closed Cycle Cooling	-	120	-	-	-	-	18	138	-	138	-	-	-	-	5,094
22.124	Sewage	-	7	-	-	-	-	1	7	-	7	-	-	-	-	278
22.125	Spent Fuel Cooling	-	282	13	4	565	152	236	1,252	1,252	-	1,512	-	-	-	10,440
22.126	Turb Bldg Sump & Oily Water Separator	-	12	-	-	-	-	2	14	-	14	-	-	-	-	500
22.127	Turbine Generator Seal Oil	-	15	-	-	-	-	2	18	-	18	-	-	-	-	661
22.128	Turbine Gland Steam & Drains	-	9	-	-	-	-	1	11	-	11	-	-	-	-	399
22.129	Turbine Lube Oil	-	27	-	-	-	-	4	31	-	31	-	-	-	-	1,107
22.130	Waste Drumming	-	15	0	0	17	1	8	41	41	-	45	-	-	-	532
22.131	Waste Gas Disposal	-	215	5	2	276	123	142	763	763	-	737	-	-	-	7,782
22.132	Waste Gas Sampling	-	59	1	0	54	10	30	155	155	-	146	-	-	-	2,158
22.133	Wet Layup/N2 Blanketing	-	3	-	-	-	-	0	3	-	3	-	-	-	-	123
Disposal of Plant Systems (continued)																
22.134	Wet Layup/N2 Blanketing - Cont	-	6	-	-	-	3	2	11	11	-	-	-	-	-	228
22.135	Wet Layup/N2 Blanketing - RCA	-	3	-	-	-	2	1	6	6	-	-	-	-	-	107
		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	Totals	-	14,565	132	39	6,278	12,455	6,901	40,370	38,108	2,262	16,785	-	-	-	532,424
23	Erect scaffolding for systems removal	-	1,054	1	0	62	151	302	1,570	1,570	-	166	-	-	-	45,958
Decontamination of Site Buildings																
24.1	Reactor	624	332	85	42	3,243	224	1,254	5,804	5,804	-	9,895	-	-	-	32,236
24.2	Auxiliary Building	268	24	18	28	165	39	193	734	734	-	2,094	-	-	-	9,579
24.3	Fuel Handling Area (Aux Bldg)	497	320	13	19	147	420	432	1,849	1,849	-	1,508	-	-	-	27,711
24.4	Intermediate Bldg	56	4	4	6	36	14	42	163	163	-	454	-	-	-	1,983
24.5	Machine Shop - Hot	42	0	3	5	26	0	29	105	105	-	348	-	-	-	1,376
24.6	Rad Materials Storage & Processing Bldg	27	-	2	3	16	-	18	66	66	-	220	-	-	-	861
24	Totals	1,513	680	125	104	3,634	698	1,968	8,722	8,722	-	14,520	-	-	-	73,746
25	ORISE confirmatory survey	-	-	-	-	-	110	33	142	142	-	-	-	-	-	-
26	Terminate license								Note 1							
Period 4 Additional Costs																
27	License Termination Survey	-	-	-	-	-	5,756	1,727	7,482	7,482	-	-	-	-	-	101,226
28	ISFSI License Termination	-	375	34	42	226	1,623	404	2,704	2,704	-	3,017	-	-	-	22,000

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CRYSTAL RIVER PLANT - UNIT 3
SAFSTOR DECOMMISSIONING COST ESTIMATE
(Thousands of 1999 Dollars)

Columns may not add due to rounding

ID Number	Activity Description	Decon	Remove	Pack	Ship	Burial	Other	Contingency	Total	NRC LicTerm	Site Restore	Burial A CF	Burial B CF	Burial C CF	GTCC CF	Craft Labor Hours
	Subtotal Period 4 Activity Costs	2,261	23,784	3,907	3,789	50,960	24,783	27,914	137,399	135,137	2,262	74,259	2,128	527	724	859,959
	Period 4 Undistributed Costs															
1	Decon equipment	572	-	-	-	-	-	86	658	658	-	-	-	-	-	-
2	Decon supplies	672	-	-	-	-	-	168	841	841	-	-	-	-	-	-
3	DOC staff relocation expenses	-	1,088	-	-	-	-	163	1,251	1,251	-	-	-	-	-	-
4	Process liquid waste	261	-	75	198	663	-	334	1,531	1,531	-	-	1,774	-	-	349
5	Insurance	-	-	-	-	-	925	93	1,018	1,018	-	-	-	-	-	-
6	Property taxes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	Health physics supplies	-	2,999	-	-	-	-	750	3,749	3,749	-	-	-	-	-	-
8	Heavy equipment rental	-	6,814	-	-	-	-	1,022	7,836	7,052	784	-	-	-	-	-
9	Small tool allowance	-	307	-	-	-	-	46	354	318	35	-	-	-	-	-
10	Pipe cutting equipment	-	787	-	-	-	-	118	905	905	-	-	-	-	-	-
11	Disposal of DAW generated	-	-	589	59	594	-	216	1,459	1,459	-	7,923	-	-	-	21,549
12	Decommissioning Equipment Disposition	-	-	5	1	214	410	116	746	746	-	572	-	-	-	778
13	Plant energy budget	-	-	-	-	-	2,866	430	3,296	2,966	330	-	-	-	-	-
14	NRC Fees	-	-	-	-	-	1,373	137	1,510	1,510	-	-	-	-	-	-
15	Site Security Cost	-	-	-	-	-	4,924	739	5,663	5,663	-	-	-	-	-	-
16	LLRW Processing Equipment	-	-	-	-	-	1,314	197	1,511	1,511	-	-	-	-	-	-
	Subtotal Undistributed Costs Period 4	1,505	11,995	669	259	1,472	11,812	4,614	32,326	31,178	1,148	8,494	1,774	-	-	22,676
	Staff Costs															
	DOC Staff Cost	-	-	-	-	-	28,056	4,208	32,265	32,265	-	-	-	-	-	-
	Utility Staff Cost	-	-	-	-	-	35,565	5,335	40,900	40,900	-	-	-	-	-	-
	TOTAL PERIOD 4	**3,766**	**35,780**	**4,576**	**4,048**	**52,432**	**100,217**	**42,071**	**242,889**	**239,479**	**3,410**	**82,754**	**3,902**	**527**	**724**	**882,635**
	PERIOD 5															
	Removal of Major Equipment															
29	Main Condensers	-	195	-	-	-	-	29	224	-	224	-	-	-	-	7,062
	Demolition of Remaining Site Buildings															
30.1	Reactor	-	2,985	-	-	-	-	448	3,432	515	2,918	-	-	-	-	59,237
30.2	Auxiliary Building	-	1,192	-	-	-	-	179	1,371	137	1,234	-	-	-	-	23,740
30.3	Control Complex	-	506	-	-	-	-	76	582	-	582	-	-	-	-	7,768
30.4	Diesel Generator Bldg	-	235	-	-	-	-	35	270	-	270	-	-	-	-	4,132
30.5	EFW Pump Building	-	94	-	-	-	-	14	108	-	108	-	-	-	-	1,226
30.6	Fire Pumphouse	-	12	-	-	-	-	2	14	-	14	-	-	-	-	330
30.7	Fuel Handling Area (Aux Bldg)	-	745	-	-	-	-	112	856	86	771	-	-	-	-	14,669
30.8	Intake & Discharge Structures	-	591	-	-	-	-	89	680	-	680	-	-	-	-	4,499
30.9	Intermediate Bldg	-	500	-	-	-	-	75	575	57	517	-	-	-	-	5,286
30.10	Machine Shop - Cold	-	65	-	-	-	-	10	74	-	74	-	-	-	-	1,690
30.11	Machine Shop - Hot	-	64	-	-	-	-	10	74	4	70	-	-	-	-	1,685
30.12	Maintenance Support Bldg	-	41	-	-	-	-	6	47	-	47	-	-	-	-	1,116
30.13	Misc Yard Structures & Foundations	-	991	-	-	-	-	149	1,140	-	1,140	-	-	-	-	11,415
30.14	Outage Support Bldg	-	16	-	-	-	-	2	18	-	18	-	-	-	-	471
30.15	Rad Materials Storage & Processing Bldg	-	24	-	-	-	-	4	28	1	27	-	-	-	-	378
30.16	Rusty Bldg	-	212	-	-	-	-	32	244	-	244	-	-	-	-	6,295
30.17	Turbine Building	-	1,676	-	-	-	-	251	1,927	-	1,927	-	-	-	-	42,197
30.18	Turbine Pedestal	-	269	-	-	-	-	40	309	-	309	-	-	-	-	4,599
30.19	Warehouse Bldg (Maint) Mezzanine	-	117	-	-	-	-	18	134	-	134	-	-	-	-	3,008

TABLE C-2
CRYSTAL RIVER PLANT - UNIT 3
SAFSTOR DECOMMISSIONING COST ESTIMATE
(Thousands of 1999 Dollars)

Columns may not add due to rounding

ID Number	Activity Description	Decon	Remove	Pack	Ship	Burial	Other	Contingency	Total	NRC LicTerm	Site Restore	Burial A CF	Burial B CF	Burial C CF	GTCC CF	Craft Labor Hours
30	Totals	-	10,335	-	-	-	-	1,550	11,886	800	11,086	-	-	-	-	193,741
	Site Closeout Activities															
31	Remove Rubble	-	601	-	-	-	-	90	691	-	691	-	-	-	-	1,201
32	Grade & landscape site	-	98	-	-	-	-	15	113	-	113	-	-	-	-	502
33	Final report to NRC	-	-	-	-	-	156	23	179	179	-	-	-	-	-	-
	Period 3 Additional Costs															
34	ISFSI Demolition and Site Restoration	-	270	-	-	-	193	96	559	-	559	-	-	-	-	2,497
	Subtotal Period 5 Activity Costs	-	11,499	-	-	-	349	1,804	13,652	980	12,672	-	-	-	-	205,002
	Period 5 Undistributed Costs															
1	Insurance	-	-	-	-	-	118	12	129	129	-	-	-	-	-	-
2	Property taxes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	Heavy equipment rental	-	2,688	-	-	-	-	403	3,092	-	3,092	-	-	-	-	-
4	Small tool allowance	-	83	-	-	-	-	13	96	-	96	-	-	-	-	-
5	Plant energy budget	-	-	-	-	-	126	19	145	-	145	-	-	-	-	-
6	Site Security Cost	-	-	-	-	-	669	100	769	-	769	-	-	-	-	-
	Subtotal Undistributed Costs Period 5	-	2,772		-	-	913	547	4,231	129	4,102	-	-	-	-	-
	Staff Costs															
	DOC Staff Cost	-	-	-	-	-	7,440	1,116	8,556	-	8,556	-	-	-	-	-
	Utility Staff Cost	-	-	-	-	-	3,820	573	4,393	3,954	439	-	-	-	-	-
	TOTAL PERIOD 5	**-**	**14,271**	**-**	**-**	**-**	**12,522**	**4,040**	**30,833**	**5,063**	**25,770**	**-**	**-**	**-**	**-**	**205,002**
	TOTAL COST TO DECOMMISSION	**6,527**	**52,597**	**5,089**	**4,308**	**55,558**	**499,455**	**89,820**	**713,355**	**682,888**	**30,467**	**94,004**	**5,381**	**527**	**724**	**1,156,844**

Total cost to decommission with	14.40%	contingency:	$	713,354,939
Total NRC license termination cost is	95.73%	or	$	682,887,960
Non-nuclear demolition cost is	4.27%	or	$	30,466,978
Total radwaste volume buried				99,913 cubic feet
Total 10CFR61 greater than class C waste buried				724 cubic feet
Total scrap metal released from Crystal River Unit 3				15,552 tons
Total craft labor requirements				1,156,844 person hours

Note: "0" indicates costs less than $500
Note 1: This activity is performed by the decommissioning staff following plant shutdown; the costs for this are included in this period's staff cost.
Note 2: This activity, while performed after final plant shutdown, is considered part of operations and therefore no decommissioning costs are included for this activity.

SECTION H

COMPARATIVE ANALYSIS
OF THE
1994 AND 1999
DECOMMISSIONING COST STUDIES
FOR THE
CRYSTAL RIVER PLANT - UNIT 3

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TABLES

SUMMARY

This document provides comparative discussion on the decommissioning cost estimates prepared for the Crystal River Plant Unit 3 (Crystal River) in 1994 and most recently in 1999, by TLG Services, Inc. (TLG). The 1999 analysis was prepared with the benefit of an experience base expanded from 1994. This experience was gained both from fieldwork in actual decommissioning programs and from plant-related decommissioning activities such as outages, retrofits, and change-out programs. In addition, new NRC regulatory guidance on decommissioning has been issued which better defines the regulatory process of decommissioning.

The current estimate was developed using the basic inventory and design information originally generated for the 1994 decommissioning analysis. This data, along with the 1994 assumptions and site-specific considerations, was reviewed for the 1999 estimate. Modifications and updates were incorporated where new information was available, updated site-specific information was obtained from the client, or experience from ongoing decommissioning programs justified such changes.

Overall, the estimate to decommission Crystal River increased approximately 26% over the five-year period (1994-1999 financial years). As can be seen in Table 1, the increase in the cost is primarily associated with high-level radioactive waste management ($53.8 million) and low-level radioactive waste off-site processing and disposal ($32.8 million). New cost elements, e.g., hazardous and mixed waste disposal and spent fuel pool isolation, also contributed to the increase, as did the recalculation of property tax liabilities.

The 1994 estimate included a cost to operate and maintain an independent spent fuel storage installation (ISFSI) at the site. However, the 1994 estimate assumed that DOE would provide key components of the interim storage system, whereas the 1999 estimate assumes that the utility will be initially responsible for this cost.

Changes in several major cost centers are discussed within the following narrative. This comparative analysis focuses on the permutations in the technical work scope and modifications to assumptions that have affected the cost of decommissioning. Table 1 provides a basis for comparing the major decommissioning cost elements from the two analyses.

COMPARATIVE ANALYSIS

TLG prepared a decommissioning cost analysis for the Crystal River Plant, Unit 3 (Crystal River) in 1994. The analysis provided Florida Power Corporation (Florida Power), owner and operator of the plant, with the projected costs (in 1994 dollars) to completely decontaminate and dismantle its nuclear facility following the normal cessation of plant operations.

In 1999, TLG initiated the current update to the cost estimate for decommissioning Crystal River. This analysis was prepared in 1999 dollars and issued in November of 2000. It uses the basic inventory and design information originally generated for the 1994 decommissioning analysis. This data, along with the 1994 assumptions and site-specific considerations, was reviewed for the 1999 estimate. Modifications and updates were incorporated where new information was available, updated site-specific information was obtained from the client, or experience from ongoing decommissioning programs justified such changes.

Generally, escalation of the various cost components in a decommissioning analysis (with the exception of those costs associated with radioactive waste disposal), follow "standard" cost indices. However, such indices can only be applied successfully to a stable model, i.e., where the bases against which the indices are applied have not undergone significant change. In the period between the analyses (1994-1999 financial years), new cost elements have been added and older cost elements revised. With this in mind, the following discussion encompasses the major areas of difference between the two cost estimates.

A comparison of the cost elements associated with the estimate to decommission Crystal River is shown in Table 1. The costs in this table were extracted from the "Decommissioning Cost Study for the Crystal River Plant – Unit 3," issued in October 1994 as TLG's document F01-25-003 (the 1994 cost study), and in November 2000 as TLG's document F01-1342-002 (the 1999 cost study). The table divides the total costs into the major cost components and shows the change over the five-year period (the 1999 study was prepared in 1999 dollars).

The overall decommissioning scope of the current cost estimate has not dramatically changed from that presented in 1994. While the scope may not have changed, there are some significant differences in the base assumptions between the two studies. The differences are outlined in the discussion of the following cost elements.

1. Interim Spent Fuel Storage

One major difference between the two studies is the costs associated with the interim storage of the spent fuel pending transfer to DOE. Both analyses presume that the fuel will be stored at the site until the DOE can complete the transfer of assemblies to its geologic repository.

The 1994 study assumed that DOE would provide the MultiPurpose Canisters (MPC) for on-site spent fuel storage. The MPCs, under design by DOE at that time, were an integral component to the agency's waste management system. Since it was believed that the DOE would provide the MPCs to the utility, the 1994 study assumed that the only capital costs that the utility needed to pay were for the associated storage overpack.

In April 1995, TRW Environmental Safety Systems awarded the MPC Project to Westinghouse on behalf of the DOE. Westinghouse, as the lead subcontractor, was to perform the design, licensing, testing, and fabrication of a complete storage, transport, and disposal system for handling spent nuclear fuel in a three-phase program. Phase 1 was to include the initial design activity and preparation of the accompanying safety analysis reports. Phase 2 involved the NRC's certification process for the 10 CFR 71 and 10 CFR 72 licensed components of the MPC system, and included associating testing and the fabrication of prototype hardware for system-level demonstration, and ultimate qualification of the MPC system for use by utilities and site operators. Phase 3 involved the fabrication and delivery of the initial complement of approximately 150 multipurpose canisters and automatic welding/drying equipment.

Phase 1 was completed in 1996. Shortly thereafter, the Office of Civilian Radioactive Waste Management (OCRWMS) decided to abandon some of its technology development activities, in part due to funding constraints, and seek services and equipment for these activities from private sector sources. Consistent with this approach, OCRWM chose not to pursue development of the MPC system beyond the initial design stage.

Consequently, the 1999 analysis includes the total cost to site, license, and construct an ISFSI, and includes engineering, site alterations, pad construction, cask transfer equipment, as well as cask storage canisters and concrete overpacks. This change adds approximately $53.8 million to the total estimate, or more than half of the net increase in the cost to decommission Crystal River.

2. Off-Site Waste Processing

In the 1994 study, it was assumed that much of the contaminated metal from the plant's secondary side (main steam related equipment) could be easily and cost effectively decontaminated onsite during the decommissioning process. However, recent industry experiences have shown that even slightly contaminated radioactive waste materials can not be easily or cost effectively decontaminated onsite. In the 1999 study, this contaminated metal is assumed to be sent for off-site waste processing (decontamination and/or recycling), resulting in an increased volume of slightly contaminated metal and a commensurate increased cost of $17.6 million.

3. Low-Level Radioactive Waste Disposal

The cost of low-level waste disposal was estimated using a base rate of $238.60 per cubic foot in 1994. The disposal charge was taken from a schedule of rates published by Chem-Nuclear Systems, Inc. for the Barnwell Low-Level Radioactive Waste Disposal Facility in South Carolina.

The current rate structure at the Barnwell facility is based upon the density of the packaged waste. An assumed average density of 85 pounds per cubic foot for the Crystal River decontamination and dismantling activities waste stream was used to produce a volumetric equivalent. At a unit disposal rate of $4.40 per pound, the packaged density equates to a volumetric charge of $374 per cubic foot. This value was used in the current analysis to estimate the cost of controlled disposal at an assumed regional site, and is approximately 57% higher than the 1994 value.

However, the increase reported for this line item in Table 1 is only 26%. The volume designated for controlled disposal in the 1999 estimate is approximately 9% less than the volume reported in 1994. This is due to more aggressive material recovery assumptions in the 1999 estimating model. Additional cost savings were realized based on the use of a lower cost disposal site (Envirocare) for low-activity waste, e.g., concrete rubble. This results in an increase of $15.1 million.

4. Taxes

Property tax information included within the 1994 estimate reflected a continuing, although annually decreasing, tax obligation over the life of the decommissioning program. The tax model was updated by Florida Power for use in the current estimate, with taxes on existing plant structures and equipment reduced over the phase in which they are removed. Taxes were added on new construction/ capital improvement; for example, dry storage canisters, and were assessed on an annual basis over the storage period. This results in an increase of $14.6 million.

5. Spent Fuel Pool Isolation

The 1999 study incorporates a new cost element called spent fuel pool isolation. This new element is the result of experiences at Maine Yankee and Connecticut Yankee whereby decommissioning activities were being delayed as a result of personal safety and plant equipment concerns. These decommissioning plants found there were electrically powered equipment interconnections supplying both the spent fuel pool and the balance of plant. In order to proceed on schedule, a complete separation between the spent fuel pool and balance of plant was necessary. This activity includes the planning, engineering, licensing, and building modifications necessary to create a spent fuel pool island. This cost, based on experience at sites that have completed a spent fuel modification, is $7.7 million.

6. Energy

The unit cost factor for energy that was used in 1994 was $0.019/KWh. This cost factor was based solely on the fuel cost element of energy production. In 1999, a review of electrical costs concluded that the rates should be based on FPSC's approved General Service Demand (GSD) Rate Schedule. Effective charges under this rate schedule are $0.05124/KWh. This cost was rounded to 5.0 cents per kWh for the decommissioning cost study. The remaining increase can be attributed to modifications in the consumption model and the decommissioning schedule. Overall, the energy cost increased approximately $7.2 million.

7. Site Characterization and License Termination Survey

Based on recent industry and TLG experience, a substantial effort is required to adequately characterize a plant (prior to initiating decommissioning activities and throughout the decontamination process), and to satisfy license termination requirements (after decontamination and removal activities are completed). As a result, TLG has revised its cost estimating methodology to reflect the processes and associated expenditures for survey performance and compliance. In the earlier (1994) study, the personnel required to perform these activities was assumed to be available from within the site management organization. However, due to the effort required to continually monitor the facility and its inventory, sort and characterize material, and maintain control over the decontamination process, the cost for additional personnel and support services to perform these surveys are included within the latest estimate. This results in an increase of $8.5 million.

8. Other (Mixed Waste)

The 1994 study did not include a significant cost element for mixed waste disposal. The primary factor is radioactively contaminated lead shielding. The 1994 study assumed that the lead shielding in use in the plant could be melted and reused within the nuclear industry. However, recent industry decommissioning experience has shown that there is more radioactively contaminated lead than there is a demand for lead. This results in an increase of $4.8 million.

9. Insurance

Costs associated with nuclear and property insurance increased from the 1994 estimated values as a result of the latest proposed NRC guidance on "minimum" insurance coverage during decommissioning. The overall effect of the proposed NRC guidance was to increase the monthly insurance costs during the early phases of decommissioning, and lower them during the latter stages of the project. This cost element has increased by $3.1 million.

10. Transportation

The increase in transportation costs is primarily associated with the disposition of the steam generators, and the cost to prepare them for transport as their own containers. Additional costs have been added to account for package preparation and barge routing, as a result of lessons learned in the disposition of the steam generators at Trojan, Millstone 2, and St. Lucie. This cost element has increased by $1.7 million.

11. Decontamination, Packaging, and Support Equipment

Increases in the cost of materials and equipment generated the modest rise in the Decontamination, Packaging, and Support Equipment and Supplies cost elements. This cost element has increased by $3.5 million.

12. NRC and EP Fees

The 1994 estimate contained line item costs to maintain both the Part 50 and Part 72 licenses. The NRC has since restructured its fee schedule with the result being an overall decrease in the cost reported in the 1999 estimate. This cost element has decreased by $1.4 million.

13. Removal

The labor cost information provided by Florida Power for use in the current estimate resulted in lower fully-burdened costs than the corresponding information provided for craft positions in 1994. Combined with a modification in the removal methodology for non-contaminated structures, this resulted in a decrease in removal costs over the five-year period.

Substantial savings have been realized in the current estimate for the demolition of non-contaminated plant structures. The current cost model incorporates a modified dismantling sequence, which improves the accessibility of the interior portions of the power block structures. This allows more efficient and inexpensive dismantling methods to be used, thereby significantly reducing the effort and expense associated with this activity. This cost element has decreased by $14.0 million.

14. Staffing

The decommissioning organizations (both the utility and the Decommissioning Operations Contractor (DOC)) in the 1994 analysis were developed by TLG with consideration of the decontamination and dismantling processes intended at Crystal River, and were consistent with the guidelines developed in the 1986 program for the Atomic Industrial Forum's (AIF) National Environmental Studies Project (NESP) for standardizing decommissioning cost studies, and then-current experience.

In the most recent analysis, Florida Power provided the staff organization, as well as the costs associated with maintaining the organization throughout the decommissioning program. Fewer positions were included and staff levels reduced. The result is a decrease of $19.9 million.

TABLE 1

DECOMMISSIONING COST COMPARISON
CRYSTAL RIVER PLANT - UNIT 3
1994 vs. 1999

Cost Center	1994[1] ($1000s)	1999[1] ($1000s)	Delta[1] ($1000s)	%Change	Annual Change
Spent Fuel Pool Isolation	0	7,699	7,699		
Site Characterization	0	1,245	1,245		
Engineering	12,198	12,772	574	4.7%	0.92%
Decontamination	11,399	12,546	1,146	10.1%	1.94%
Removal	82,139	68,079	-14,059	-17.1%	-3.69%
Packaging	5,145	6,359	1,214	23.6%	4.33%
Transportation	4,141	5,841	1,700	41.1%	7.12%
Waste Processing	4,590	22,228	17,639	384.3%	37.10%
LLRW Disposal	57,182	72,306	15,124	26.4%	4.81%
Staffing	173,593	153,685	-19,908	-11.5%	-2.41%
Taxes	16,637	31,232	14,595	87.7%	13.42%
Energy	2,494	9,728	7,234	290.1%	31.29%
Insurance	5,029	8,087	3,058	60.8%	9.97%
ISFSI Capital	3,588	57,436	53,848	1500.8%	74.13%
NRC and EP Fees	9,191	7,744	-1,447	-15.7%	-3.37%
License Termination Survey	395	7,624	7,229	1830.1%	80.77%
Misc. Equip & Supplies	3,311	4,480	1,169	35.3%	6.23%
Other[2]	0	4,848	4,848		
Total	$391,034	$493,940	$102,906	26%	4.78%

1 Columns may not add due to rounding
2 Includes hazardous/mixed waste disposal

CONCLUSION

The costs varied between the two estimates, most noticeably in the area of Interim Spent Fuel Storage (+$53.8 million), Waste Recycling (+$17.6 million), Low-Level Radioactive Waste Disposal (+$15.1 million), Property Taxes (+$14.6 million), Removal (-$14.0 million), and Staffing (-$19.9 million). Spent fuel storage costs increased as a result of the DOE's privatization of the storage/transport canister program. The increase in the cost of low-level radioactive waste disposal was mitigated by the more aggressive recycling of material, and through the use of an alternative disposal site. The waste volumes requiring offsite processing were increased resulting in increased Waste Recycling.

COMPARATIVE ANALYSIS
OF THE
1991 AND 1994
DECOMMISSIONING COST STUDIES
FOR THE
CRYSTAL RIVER PLANT - UNIT 3

SUMMARY

This document provides comparative discussion on the decommissioning cost studies prepared for the Crystal River Plant Unit 3 (CR-3) in 1991 and most recently in 1994, by TLG Services, Inc. (TLG). The 1994 study presents new cost analyses, incorporating the most recent estimating methodology. The study was prepared with the benefit of an expanded experience base; experience gained both from field work in actual decommissioning programs and from plant related decommissioning activities such as outages, retrofits and change-out programs.

Overall the estimate to decommission CR-3 increased approximately 33.4% over the three year period. As can be seen in Table 1, the increase in the cost is primarily associated with program management (Staffing), demolition and dismantling (Equipment & Materials), and the disposal of low-level radioactive waste (LLW Burial).

Since the 1991 study, TLG has been involved in the decommissioning planning for the Shoreham Nuclear Plant, Yankee Nuclear Power Station, Rancho Seco Nuclear Generating Station, Trojan Nuclear Plant, San Onofre Nuclear Generating Station and the Big Rock Point Plant. In developing detailed management plans for the intended decommissioning programs, the need for additional technical support was recognized, specifically in the areas of health physics, radiation protection and analytical services. The staffing plan for the 1994 CR-3 estimate reflects the additional manpower requirements in these areas. Another more significant factor, in the staff cost increase, is the longer schedule presented in the 1994 study for decommissioning, spent fuel storage and ultimate site restoration. This increase is most evident in the duration of the phase associated with the spent fuel caretaking. Although dry spent fuel storage was considered in the 1991 study, it was anticipated that the transfer of spent fuel to a Department of Energy (DOE) repository would be completed by the year 2031. Due to continuing delays in siting and construction of the DOE facility, as well as from revisions in the acceptance rates for the repository, projections now indicate that the process could continued until the year 2041. The additional ten year dry fuel storage period, assumed for the 1994 estimate, has a direct effect on all period dependent cost elements, staffing being the most noticeable.

The 1994 study also incorporates new cost projections for low-level radioactive waste (LLRW) disposal. Since base burial costs have quadrupled since the 1991 study was performed, the 1994 decommissioning cost study relies upon additional waste recovery (decontamination, volume reduction, repackaging, etc.). This radioactive waste volume reduction activity serves as a means to reduce the ultimate volume of material requiring controlled disposal and to mitigate the effect of increasing disposal costs. Reduction in the ultimate radioactive waste volume requiring controlled disposal produces corresponding decreases in packaging and transportation costs.

The 1994 decommissioning cost estimate includes a more detailed scheduling analysis than was provided for the 1991 estimate. Although both scheduling analyses provide estimates for individual decommissioning activity durations and consider the sequence of the activities within the decommissioning scenario, the 1994 schedule further analyzes the need for certain systems to remain operable until the spent fuel pool can be decontaminated, e.g., the radwaste and HVAC systems located in the Auxiliary Building. As such, although the project schedule for decontamination of the power block has been extended, it is also believed to have become more indicative of the work sequences which will occur at the time of decommissioning.

Changes in several major cost centers are discussed within the following narrative. One issue not directly addressed, is the effect inflation and escalation have had on the costs of service(s) between 1991 and 1994. Instead, this comparative analysis focuses on the permutations in the technical work scope and modifications to assumptions which have affected the cost of decommissioning. Table 1 provides a basis for comparing the major decommissioning cost elements from the 1991 and 1994 estimates.

TABLE 1
DECOMMISSIONING COST COMPARISON
CRYSTAL RIVER PLANT - UNIT 3
1991 vs. 1994

	1991 study ($1000's)	1994 Study ($1000)'s	% Change	Annual Change
Staffing	130,506	173,593	33.02%	9.97%
Craft Labor	41,497	41,328	-0.41%	-0.14%
Equip & Mat.	37,659	57,355	52.30%	15.04%
LLW Burial	32,594	57,182	75.44%	20.58%
ISFSI	22,741	4,958	-78.20%	-39.78%
Taxes	13	16,727	-	-
Energy	3,602	2,500	-30.59%	-11.45%
Shipping	3,804	4,141	8.86%	2.87%
Insurance	5,917	5,029	-15.01%	-5.27%
Recycling	n/a	4,590	n/a	n/a
NRC & EP Fees	n/a	7,821	n/a	n/a
Remaining Costs	14,803	15,810	6.81%	2.22%
Total	$ 293,136	$ 391,034	33.40%	12.36%

Notes:
1. Staffing includes post decommissioning site restoration staff costs pertaining to the ISFSI operation.
2. ISFSI costs include those costs directly attributable to the construction and operation of the ISFSI.
3. LLW Burial refers to costs pertaining to disposal of low level radioactive waste.

COMPARATIVE ANALYSIS

TLG prepared a decommissioning cost study for CR-3 in 1991. The study provided Florida Power Corporation (FPC), owner and operator of the plant, with the projected costs (in 1991 dollars) to completely decontaminate and dismantle the nuclear facility following normal cessation of plant operations.

In 1994, TLG prepared an update to the site specific decommissioning cost estimate for CR-3. A simple financial update of the earlier estimate was not attempted as it would not have accurately reflected the current state of knowledge and progress in decommissioning cost estimating methodology. As such, the 1994 study did not rely upon assumptions from the earlier study; a new, more complete analysis was prepared with current methodology.

Generally, the components of a decommissioning cost estimate, (with the exception of those costs associated with radioactive waste disposal), escalate with various "standard" cost indices. However, indices can only be applied successfully to a stable model, i.e., where the bases against which the indices are applied are not undergoing continual change. In the past three years, the issues surrounding decommissioning have shown considerable volatility. As such, the following discussion encompasses the major areas of difference between the two cost estimates (1991 and 1994) for decommissioning CR-3.

The estimated cost to decommission the CR-3 is shown in Table 1. Costs were extracted from the 1991 published report and the most recent 1994 study prepared for the nuclear unit. The table includes the major cost components which have shown the greatest rate of change over the past three years.

1. Scope of Estimate

   Upon comparison of the two studies (1994 and 1994) it is apparent the overall scope of the cost estimate has not dramatically changed over the last three years. While the scope may not have changed, there are some significant differences in the base assumptions between the 1994 and 1991 studies.

   One major difference between the two studies is in the treatment of the spent fuel generated during the operation of the CR-3. Although the earlier study (1991) acknowledged the storage of spent fuel on-site during the decommissioning process, schedules for the transfer of the assemblies to a DOE facility have continued to slip due to delays in the siting and construction of a geologic repository.

   Since DOE is not yet capable of receiving spent fuel assemblies, nor will it be able to for some time, many utilities have been forced to consider that they may have to store the fuel on-site for a longer period of time than was anticipated several years ago. As a result, costs which were incorporated within the 1991 study, have been modified to reflect the most recent DOE developments in its fuel management program. For CR-3 the schedule for on-site spent fuel storage, following termination of the 10CFR50 license, has been increased by ten years from the 1991 timetable. This change is reflected in all period dependent costs during this phase including staffing, fees, insurance, taxes, etc.

The 1991 cost study addressed the on-site presence of spent fuel as a constraint on the decommissioning process and schedule. Consequently, spent fuel handling facilities with supporting systems and structures were not available for decontamination and demolition until a minimum of five years after the station has shut down (the five years is based upon a DOE prerequisite condition in the receipt of fuel assemblies for disposition as standard fuel - 10 CFR 961). This is consistent with the assumption for the 1994 estimate. The decommissioning of all non-essential site facilities (non-essential to the storage of the spent fuel) can be initiated soon after a unit ceases operation, however, all fuel storage and radwaste processing support systems are assumed to remain active for the mandatory five year cooling period. Associated with this activity are the costs to provide and maintain the necessary staffing (including security), licensing fees, and energy to operate the systems directly supporting fuel storage as well as ancillary systems, such as service water and radwaste processing. Unlike the 1991 study, the 1994 study includes the Auxiliary Building essential systems as integral to this continuing maintenance activity. This ideology resulted in a lengthening of Period 2, beyond that duration estimated in the 1991 study. Table 2, in this comparison study, identifies the period lengths calculated in both 1991 and 1994 cost estimates.

The 1994 decommissioning study addresses the potential of plant secondary side contamination, not considered in 1991. While designed to be "radiologically clean", the history of PWR steam generator tube failures has produce a detectable inventory of radionuclides throughout the steam, condensate and feedwater systems. The direct effect of secondary side contamination is the additional inventory generated by the decommissioning process requiring treatment and/or controlled disposal. This inventory has increased the 1994 costs associated with decontamination, removal, packaging, transportation, and as required, controlled disposal. The labor requirements associated with these activities has contributed to longer durations and greater period dependent costs.

Another change introduced in the 1994 cost estimate is the recovery of radioactive waste as an alternative to controlled disposal. Recovery is an attractive alternative, the economics of which have become more favorable with the rapid increases in the burial costs for low-level radioactive waste and the unavailability of disposal facilities to a significant number of waste generators. Much of the metallic waste generated by decommissioning can be decontaminated for release as clean scrap and there are vendors who are currently providing utilities with these services. Components suitable for decontamination and recovery are typically components such as large bore pipe, pumps, valves, conduit, cable tray and ductwork.

TABLE 2
PROJECT SCHEDULE

	1991 Study (months)	1994 Study (months)	Total Increase (%)
Period 1	39.49	38.87	-1.57%
Period 2	30.26	40.71	34.53%
Period 3	13.47	14.42	7.05%
Post Period 3	91.63	206.85	125.74%
Total	174.85	300.85	72.06%

2. Staffing

The decommissioning staffs (both utility and Decommissioning Operations Contractor (DOC)) in both the 1991 and 1994 estimates were developed with consideration of the decommissioning processes intended at CR-3 and are consistent with the guidelines developed in the 1986 program for the Atomic Industrial Forum's (AIF) National Environmental Studies Project (NESP) for standardizing decommissioning cost studies. In addition, the staffing organization incorporated within the 1994 study reflects recent information obtained from the current in-house decommissioning projects and is supported by insight gathered subsequent to the AIF program and other relevant activities and projects. As such, there has been a general increase in the level of personnel needed to manage decommissioning programs, particularly in the health physics, radiation protection and analytical support areas.

The peak staffing levels developed for the 1991 and 1994 decommissioning studies are shown in Table 3. Another contributor to the increase in the management cost is the program duration. As mentioned earlier, the overall program length increased for both Period 2 decommissioning activities and Post-Period 3 activities which together represent an overall 72% increase in project duration (as shown in Table 2) from the 1991 estimate to the 1994 estimate.

These two factors, increased staffing levels for the decommissioning activities and project duration, combine to produce a significant increase in the staffing cost component. Table 3 shows the period breakdown of the utility and DOC staffs for both the 1991 and 1994 cost estimates.

TABLE 3
DECOMMISSIONING STAFFING
CRYSTAL RIVER PLANT - UNIT 3

		1991 Study		1994 Study	
		Peak Manloading	Total ($1,000)	Peak Manloading	Total ($1,000)
Period 1:	Utility	159	44,612	135.5	38,717
	DOC	74	6,724	50	6,734
Period 2:	Utility	176	39,979	201.8	59,595
	DOC	122	23,873	57	26,505
Period 3:	Utility	55	5,972	83.3	8,916
	DOC	39	4,462	38	6,457
-Period 3:	Utility	12.9	9,436	20	25,517
	DOC	0	0	0	0
	DOC	0	0	0	0
Total			135,058		172,443

Note: Staffing costs and levels represent those components directly associated with the decommissioning activity and include additional contingent needed to support on-site spent fuel storage activities.

3. Craft Labor

The decrease in craft labor costs from the 1994 study to the 1991 study is attributable to changes in methodology and financial inputs. Since 1991, the unit cost factor approach used by TLG in its decommissioning estimates was revisited and revised to reflect the results of TLG's increased labor productivity assessments.

Another change which contributed to the overall reduction in craft labor costs was the decrease in the hourly craft labor rates and associated overhead. The data supplied by FPC for the 1994 estimate, for labor and overhead, was generally lower than that supplied in 1991.

4. Equipment & Materials

Expenditures associated with the Equipment and Material cost component have increased (over the rate of general inflation), most noticeably in the dismantling and demolition phase of decommissioning. This increase was a direct result of a corresponding increase in the 1994 plant inventory. The addition of the new Administration Building, radiological remediation of the Dry Cask Storage Compound (previously (in 1991) to be considered radiologically clean) and changes to several minor site facilities produced a significant increase in the Period 3 removal requirements, with the equipment and material cost being the prime contributor.

5. Radioactive Waste Disposal

The cost of low-level waste disposal has increased from a base rate of $62.50 per cubic foot in 1991 to a rate of $238.60 per cubic foot used in the 1994 study. Both base disposal charges are based upon the appropriate schedule of rates published by the Barnwell, S.C. facility, operated by Chem-Nuclear Systems, Inc.

TLG has been working to identify areas where the volume generated during decommissioning operations can be reduced so as to offset the rising cost of waste disposal. As a result of this analysis, the waste generated in decommissioning CR-3 has been reduced by 44%. This reduction has helped to lessen the impact of the increase in the cost of waste disposal.

6. Independent Spent Fuel Storage Installation (ISFSI)

The decrease in the capital expenditures associated with the proposed ISFSI resulted from a design modification. While the 1991 study assumed the construction of a conventional horizontal modular system, the 1994 estimate presumes the use of the MultiPurpose Canisters (MPC) for on-site spent fuel storage. The MPC, under design by DOE, is an integral component to the agency's waste management system. Since it is believed that DOE will provide the MPC to the utility, there is an inherent savings in the cost to construct an on-site storage facility. Consequently, the utility would pay for only the associated storage overpack as opposed to the previous system where the utility assumes the total cost.

The lengthening of the Post-Period 3 dry storage phase is not specifically reflected within the 1994 values reported for the ISFSI. The scheduling variation is addressed within the associated period-dependent costs such as staffing. It should also be noted that the decontamination and dismantling cost is not included within the Table 1 ISFSI tabulation. This cost has increased significantly in the 1994 estimate as the assumptions pertaining to the potential activation of the facility have been modified to require substantial remediation.

7. Taxes

Tax information received for the 1991 CR-3 study showed a tax value paid based solely on plant land value alone. No tax implication was considered in the 1991 estimate concerning continuing value of the structures or equipment located on site. FPC was able, in the 1994 study, to provide more comprehensive tax information on the facility. With this information, TLG was able to reflect a continuing obligation (at a decreasing rate) within the cost study.

8. Energy

Differences in the cost for energy usage during the decommissioning program are a function of the data supplied by FPC, i.e., the purchase price for electricity. In the 1991 study, an energy cost of $.032/Kwhr was provided while in 1994 the value was reduced to a level of $.019/Kwhr for purchased power.

9. Transportation

The increase in transportation costs is primarily associated with the disposition of the steam generators and the cost to prepare these components for shipping as their own containers. Additional costs have been added to account for package preparation, e.g., grouting and shielding, as a result of lessons learned in the disposition of the Millstone 2 and Yankee Nuclear Power Station steam generators as well as from the current program to prepare the Trojan steam generators for intact disposal.

10. Insurance

The insurance premiums provided for use in the 1994 were less than the associated costs identified by FPC for use in the 1991 study. No other changes were made to the methods used to calculate the total activity expenditure.

11. LLRW Recovery

Of the changes made to the 1994 cost estimate since 1991, radioactive waste recovery has probably produced the most significant impact. As mentioned earlier in the report, TLG has been working to find methods for reducing the amount of material requiring controlled disposal. For specific types of metallic waste, TLG has found that the total volume from this waste stream can be reduced by up to 80% (20% requiring controlled disposal) through additional decontamination, volume reduction, repackaging, etc. The cost for this activity, which was not reflected within the 1991 estimate, is more than recovered by the avoided waste burial charges.

CONCLUSIONS

As discussed in this comparison, costs varied between the two estimates, most noticeably in the areas of Staffing (+43M), Low-Level Waste Treatment and Disposal (+22M), Equipment & Materials (+19M), ISFSI Capital Expense (-18M) and in Property Taxes (+17M). Staffing increases were driven by a longer decommissioning schedule, which in turn was a result of DOE's revisions to their timetable for taking receipt of CR-3 spent fuel. Staffing costs also increased as positions in health physics and radiation protection were added to the decommissioning organization. Equipment and material costs increased as additional inventory was added and the schedule lengthened. The rise in low-level waste disposal reflected Chem-Nuclear's pricing increases at the Barnwell facility. Property taxes were added consistent with the premise of continuing value for the facility, primarily during the fuel storage phase. ISFSI costs, as described previously, decreased with the assumption of shared construction costs, with DOE providing the internal canister.

In summary, the change in decommissioning costs from 1991 to 1994 was a function of external factors (DOE commitments) and market forces (Chem-Nuclear LLRW disposal fees) combined with staff augmentations in the areas of worker protection and public health and safety. While controllable, so some degree, these factors are expected to have a continuing impact on decommissioning costs in the future.