EO-97-84

Wolf Creek Generating Station Decommissioning Cost Estimate Update for September 1, 1996

Jointly Prepared By
Wolf Creek Nuclear Operating Corporation
and Union Electric Company

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1 Executive Summary

The cost estimate to decommission Wolf Creek Generating Station is $408,887,000 in 1996 dollars. Three decommissioning options were examined: DECON, SAFSTOR and ENTOMB. The least expensive alternative is DECON, which assumes decontaminating and decommissioning (D&D) immediately following the conclusion of power operations in 2025, when the operating license expires. For immediate D&D, work is anticipated to be completed by 2033.

This decommissioning cost estimate is based on a 1993 site specific study performed by TLG Engineering, Inc. (TLG) which estimated a decommissioning cost of $369,790,000 in 1993 dollars. The Kansas Corporation Commission approved the 1993 TLG study on June 9, 1994, in its Order Accepting Stipulation and Agreement in Docket No. 188,904-U. The Missouri Public Service Commission approved the same study on June 14, 1994, in its Order Approving Cost Estimates and Funding Levels for Nuclear Decommissioning Costs in Case No. EO-94-80. A copy of the 1993 TLG study is attached as Appendix E to this report.

This update uses the same assumptions regarding decommissioning requirements, techniques, and cost estimate methodology (except with regard to certain work efficiency assumptions) as the earlier study, but takes into account physical changes made to the plant since 1993 as well as inflation. It also includes a risk assessment of the impact of input variability on total cost.

This cost estimate is based on current requirements and present day technology. Wolf Creek Nuclear Operating Corporation (WCNOC) and Union Electric Company follow technology and cost trends at plants being decommissioned, and believe the technologies assumed by TLG in 1993 remain current, in that there have been no significant advances in decommissioning related technologies during the past three years.

In addition to the removal of radioactive material, this study also assumes demolition of the remaining structures from the power plant site, thereby permitting return of the site for other use. This study is based on current Owner needs and assessment regarding potential future use of the Wolf Creek Generating Station site, and assumes the site will ultimately be released for unrestricted use following decommissioning. Future changes in site cleanup and restoration standards or company needs for use of the site may change this assumption. Future cost updates will re-evaluate the assumption of release of the site for unrestricted use.

2 Regulatory Requirements

2.1 U. S. Nuclear Regulatory Commission

The NRC provides decommissioning guidance in the rule "General Requirements for Decommissioning Nuclear Facilities" (10 CFR Parts 30, 40, 50, 51, 70, and 72). This rule defines three decommissioning alternatives acceptable to NRC: one immediate option (DECON) and two delayed options (SAFSTOR and ENTOMB). These are discussed in Section 4.

2.2 U. S. Department of Energy

This study assumes spent fuel generated over the operating life of the reactor is removed from the site five years following plant shutdown. This requirement to keep fuel on site for at least five years is established by the U. S. Department of Energy (DOE) to allow adequate cooling prior to their acceptance.

The cost for disposal of spent fuel is not included in this estimate, as fuel disposal cost is funded by DOE's 1 mill/kWh surcharge. However, the study does consider the constraints the presence of spent fuel on site may impose on other decommissioning activities.

3 Physical Description

3.1 Site Description

Wolf Creek Generating Station is owned by Kansas Gas and Electric Company, Kansas City Power & Light Company, and Kansas Electric Power Cooperative, Inc. (the Owners), and is located approximately 3.5 miles northeast of Burlington in Coffey County, Kansas, about 75 miles southwest of Kansas City, Kansas. The power plant site is on the east side of a man-made lake formed by impounding Wolf Creek.

3.2 Plant Description

Wolf Creek Generating Station utilizes a pressurized water reactor (PWR) with facilities necessary to support a nominal 1150 MW(e) nuclear power plant. It was designed by Bechtel Power Corporation and constructed by Daniel International Corporation under the SNUPPS (Standardized Nuclear Unit Power Plant System) program along with its sister unit Callaway Plant located in Missouri, and owned by Union Electric Company.

The Westinghouse Nuclear Steam Supply System (NSSS) consists of a PWR with four reactor coolant loops, each with a pump and steam generator. An electrically heated pressurizer and connecting piping completes the NSSS, all of which is housed within a carbon steel lined concrete containment structure.

Heat produced in the reactor is converted to electrical energy by the power conversion system. The turbine-generator is a General Electric 1800 RPM unit, consisting of one high pressure and three low pressure turbine elements driving a directly coupled generator. Heat rejected in the main condensers is removed by the circulating water system. Cooling for the condenser circulating water system is supplied by Wolf Creek Lake, with makeup water drawn from the Neosho River two miles west of the Lake.

4 Decommissioning Activities Description

Although the three options of DECON, SAFSTOR, and ENTOMB differ with respect to process, cost, and schedule, they attain the same result: removal of all radioactive materials from the site allowing its release for unrestricted alternative use.

For all three options addressed in this study, the site is cleared of all above-grade structures and site improvements (excluding the Switchyard, Sewage Treatment Pond, Main Dam, Lake, and facilities west of the Lake — the Learning Center, Make-up Water Screenhouse, Make-Up Water Discharge and Lake Access Facility), and the land returned to a state consistent with adjacent areas. The following sections describe the basic activities necessary for each option.

4.1 DECON Option

DECON consists of removal of fuel assemblies, source material, radioactive fission and corrosion products, and other radioactive materials immediately after cessation of power operations. The advantages of the DECON option are: less cost in current dollars than either of the two delayed options, avoidance of long-term maintenance and security of the site, and the fact that decommissioning can be performed by individuals familiar with the facility.

There are three periods associated with the DECON option:

- Period 1, Decommissioning Preparation: This includes engineering planning, writing specifications and procedures, characterizing the site radioactivity, and assembling a decommissioning management organization. The Owners will file an application for NRC license termination accompanied by a Decommissioning Plan (DP) describing the removal of radioactive components and material from Wolf Creek Generating Station.
- Period 2, Decommissioning Operations and License Termination: Dismantling may begin on receipt of a decommissioning order from NRC. This period consists of decontaminating, removing, packaging, shipping, and burying components, systems, and structures which are radioactively contaminated.
- Period 3, Site Restoration: Following NRC license termination, demolition of the remaining portions of the containment structure and interior portions of the reactor building takes place. The auxiliary, control, diesel generator, turbine and other site structures are demolished, and the site is released for unrestricted use.

4.2 SAFSTOR Option

SAFSTOR places the facility in protective storage once spent fuel and source material are removed, followed by radiation surveys, general decontamination, and removal of any remaining radwaste from power operations. Delayed decontamination and dismantling activities are initiated such that license termination is accomplished within the 60 year time period set by NRC. As with DECON, this study further assumes that the remainder of the plant and facilities are demolished and the site is released for unrestricted use.

The cost of SAFSTOR is increased by the cost of maintaining the facility in protective storage; however, SAFSTOR does have advantages over DECON, including: the dormancy period provides a period of decay for residual radioactive material, lowering occupational radiation exposure during dismantling; and potential savings in the cost of disposal for the waste volume generated during decommissioning operations.

4.3 ENTOMB Option

ENTOMB also consists of placing the facility into protective storage. Initial activities include: removing contaminated components, systems, and structures outside the designated entombment boundary, and sealing the remaining radioactivity within the reactor containment building. After dormancy and radiation planning surveys, dismantlement may begin. It consists of removal of the entombment structure and materials within it, processing and disposing of any remaining solid and liquid radioactive wastes, and release of the site for unrestricted use.

5 1993 Cost Estimate Methodology

Decommissioning technology is well established, and the tools and equipment necessary to dismantle Wolf Creek Generating Station completely are available and have been demonstrated. This decommissioning cost study provides an estimate under current requirements based on present day costs and available technology. As additional dismantling experience on large reactors becomes available, cost estimates will be modified to reflect that experience.

5.1 Unit Cost Factors

The original 1993 study (Appendix E to this report) was performed in accordance with the published study from the Atomic Industrial Forum/National Environmental Studies Project report AIF/NESP-036, "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates". Those guidelines were prepared under review of representatives from utilities, state regulatory commissions, architect/engineering firms, FERC, NRC, and the National Association of Regulatory Utility Commissioners. In this methodology, costs to remove a unit of plant equipment, components, and structures are developed and coupled with the plant specific inventory of equipment, components, and structures.

The 1993 site specific cost estimate was developed using plant drawings and inventory documents to estimate structural and system component quantities, and land area of the site released for unrestricted use. WCNOC developed the plant component inventory as well as salary and craft labor rates for site administration, operations, construction and maintenance personnel for positions anticipated for decommissioning.

5.2 Schedule

The schedule for the decommissioning scenarios considered in the 1993 study follows the sequence presented in AIF/NESP-036. Durations were established between several milestones in each period and used to establish a critical path for the entire project. Period dependent costs presented in Appendices A, B, and C are based on durations identified in the schedule for each of the three options.

This study assumes that spent fuel will be stored in the fuel building for five years following final shutdown in 2025, in accordance with DOE requirements. Decommissioning activities in the fuel building would be limited until the final core load could be transferred to DOE for disposal. Decommissioning activities such as vessel segmentation, steam generator removal, reactor and auxiliary building system removal will be concurrent with spent fuel storage and shipment. The fuel building will be used for spent fuel storage until all spent fuel has been removed from the site.

6 1996 Cost Estimate Methodology

This decommissioning cost estimate update is based on the 1993 study performed by TLG for Wolf Creek Generating Station. This update embraces the methodology and key assumptions used in the earlier study, and makes adjustments to produce a current cost estimate. The 1996 update considers escalation and physical plant changes during the last three years, and also addresses ranges of variables.

Union Electric developed a computer model to mimic the results of the 1993 TLG study, using AIF/NESP-036 for technical guidance. The model was set up to handle changes in plant systems and structures inventory, changes in time dependent variables such as wages and service costs, and changes in other variables as appropriate.

6.1 Inventory

The original plant inventory was developed for the "Response to Missouri PSC Stipulation for Data Relevant to Estimating Decommissioning Costs for Callaway Plant and Wolf Creek Generating Station." In that response WCNOC and UE worked together to develop detailed quantities of components, systems, and structures for WCGS and Callaway Plant. Due to the SNUPPS design there were many common areas, and the same quantities were used for both plants. In other areas there were bona fide differences in inventories, and these were also addressed as part of the stipulation response.

Since that time there have been minor changes made to the plant and the site. These physical changes have been reviewed and the plant inventories updated as necessary. These changes are reflected in this 1996 decommissioning cost update, both as costs to actually remove the new items, and as additional overhead costs due to the slight extension of related work durations. The effect of these changes on the overall cost estimate was minimal.

6.2 Escalation

In some cases escalation since the 1993 study can be accurately quantified. Escalation of these variables is based on reliable in-house data, such as the cost of WCNOC labor. This information is readily available from payroll records, and escalation from year to year is a discrete value which may be calculated with confidence.

In other cases the escalation of variables is uncertain, but the nature of the uncertainty can be described with probability distributions. Appendix D shows the ranges used for several such escalation variables. For example, DOC Staff Labor is estimated to have escalated by anywhere from 9.8% to 10.7% between 1993 and 1996. Since WCNOC does not have actual cost data for this hypothetical DOC, data from the U. S. Bureau of Labor Statistics (BLS) were used. The BLS publication "Monthly Labor Review" provides cost indices for a number of occupation descriptions, but Decommissioning

Operations Contractor is not one of them, not surprisingly. However, two of the occupation descriptions closely approximate the function of the DOC, and were used to establish bounds on the range of probable escalation for DOC Staff Labor between 1993 and 1996.

The 1993 study was based on input data as of mid-year 1993 (except for certain WCNOC wage data from late 1992). This 1996 update is for mid-year 1996, and input data are typically for the end of June.

6.3 Other Changes

This 1996 decommissioning cost update considers ranges of input variables, recognizing that there is a degree of uncertainty regarding the input. In order to minimize excessive conservatism the estimate used for decommissioning funding purposes is based on data in the middle of an expected range. The 1993 study conservatively used the high end of the range for work efficiency factors. This update uses mid-range values as the basis for the funding amount, but analyzes the effect of maximum and minimum input values on the bottom line cost estimate. The range of work efficiency factors used in this study are listed in Appendix D. Use of these improved worker efficiency factors reduces not only actual removal costs, but also overhead costs by shortening the project duration about five months. The decrease in respirator usage under the new 10CFR20 further validates the use of the improved respiratory protection adjustment to worker efficiency.

6.4 Risk Assessment

By using ranges of escalation for some input variables instead of estimated discrete values, WCNOC and Union Electric were able to determine the distribution range of the overall decommissioning cost, including a minimum and maximum value. This approach allows enhanced confidence in the resulting bottom line total cost estimate.

In cases where the values of input variables are uncertain, the nature of their uncertainty can be described with probability distributions which give both the range of values the variable could take and the likelihood of occurrence of each value within the range. The risk assessment calculates a probability distribution of the decommissioning cost estimates, based on the uncertainty of the input variables. Two simple probability distributions used in this analysis:

- A uniform distribution specifies a probability between minimum and maximum values, where every value across the range has an equal likelihood of occurrence. This is used when only a range is known. It is the typical distribution assumed for cases where more than one BLS line item reasonably describes a decommissioning line item, such as DOC Staff Labor.
- A triangular distribution specifies a probability between minimum and maximum values, but there is a skew set by the most likely value. The probability of occurrence of the minimum and maximum values is zero. This is used for rough modeling when actual data are absent, as in the case of Radwaste Burial. In this case

we have reasonable minimum and maximum values based on one source, but other sources indicate a most likely value within that range. In this and other triangular distributions, the most likely value used in this study is the average of the minimum and maximum.

In all cases the output cost shown in Appendices A, B and C is the mean average value of the range. Ranges used for escalation and other variables are listed in Appendix D.

The resulting distribution of the total 1996 decommissioning cost estimate is a typical bell shaped curve, with a minimum, a maximum, and a most likely value. Out of consideration for intergenerational equity, WCNOC has based this cost estimate on the most likely value, since there is an equal probability that the actual cost will be higher or lower. The most likely values are shown in Appendices A, B and C.

7 Description of Appendices Showing Results

Appendix A addresses the decommissioning cost estimate under the DECON option. Appendices B and C address the decommissioning cost estimate under the SAFSTOR and ENTOMB options, respectively. Appendices A, B, and C list costs for specific line items, grouped by Period Total Costs, Activity Costs, Undistributed Costs, and Staff Costs as described below:

- Period Total Costs: Subtotals are provided for each of the periods in DECON, SAFSTOR, and ENTOMB.
- Activity Costs: These costs are associated with the physical labor of dismantling and disposing of the plant, and are dependent upon plant inventory. They typically include the cost to decontaminate, remove, pack, ship, and bury plant components, systems, and structures.
- Undistributed Costs: These are essentially overhead costs, and are dependent on project duration. They consist primarily of insurance, taxes, and energy.
- Staff Costs: These are the balance of overhead costs, and are also dependent on project duration. There are utility staff costs and contractor staff costs. Utility costs are for site security, health physics, quality assurance, and overall site administration during decommissioning and demolition. A Decommissioning Operations Contractor (DOC) will provide sufficient staff to plan and schedule preparatory demolition, and manage the demolition efforts. Demolition is performed by the DOC, or a demolition subcontractor who will provide adequate staff, labor, equipment, materials and overhead to complete the demolition.

The top of the columns indicate the following activities and categories: Decon, Remove, Pack, Ship, Bury, Other, Total, Contingency (2 columns), and Estimate.

- Decon: The NSSS will be chemically decontaminated prior to segmentation, thereby reducing its radioactive contamination by about 90%. Other systems that are decontaminated include Chemical and Volume Control, Liquid Radwaste, Secondary Liquid Waste, Chemical and Detergent Waste, and Containment Spray. Non-system specific items such as electrical conduit and cable trays may also be decontaminated.
- Remove: Radioactive and non-radioactive systems and components will be removed using a variety of methods including: torch cutting, remote plasma arc cutting, scarifying and scabbling, and controlled blasting. Structures will be removed to three feet below local grade and the terrain restored to the local grade level. The existing electrical switchyard will remain after Wolf Creek Generating Station decommissioning in support of the Owners' electrical transmission and distribution systems.

  ALARA ("As Low As Reasonably Achievable") principles impact the removal cost through the use of work duration adjustment factors which include radiological protection instruction, mock-up training, the use of respiratory protection and personnel protective clothing. These items lengthen task duration, increasing cost

and schedule. ALARA planning is considered in the costs for engineering and planning, and in the development of activity specifications and detailed procedures.

- Pack: Cask specifications and U. S. Department of Transportation (DOT) regulations dictate details of segmentation and packaging methodology. Packages meet current physical and radiological limitations and regulations, and shipments are made in DOT approved truck casks. Most of the materials being transported for controlled burial will be categorized as Type A Low Specific Activity (LSA) radwaste. Commercially available steel containers will be used for piping, small components and concrete. Compactible radwaste, such as booties, glove liners, respirator filter cartridges, shipping containers, and HP survey materials are volume reduced and packaged. The steam generators will be removed sequentially and stored on-site in a temporary staging area, where they will be filled with grout prior to loading for shipment.
- Ship: Packaged radwaste will be moved by a combination of overland transporter and rail to a regional burial facility to be located within 700 miles of the plant site.
- Bury: The low level radwaste generated in decommissioning Wolf Creek Generating Station will be shipped to the future Central Interstate Regional Compact burial facility. The cost for disposal in that facility is based on information from currently operating facilities and projections for compact costs. The highly activated sections of the reactor vessel internals will be Greater Than Class C (GTCC), as defined in 10CFR61. This waste most likely will be disposed as high level waste in DOE's repository unless an alternative solution is approved by NRC. The cost of GTCC disposal, unlike that for the spent fuel, is not covered by DOE's 1 mill/kWh surcharge, and is estimated from spent fuel equivalent disposal costs.
- Other: This consists primarily of undistributed and staff costs.
- Total: This is the sum of Decon, Remove, Pack, Ship, Bury, and Other.
- Contingency: There are two columns for contingency: one as a per cent of the line item under Total, and one as the dollar value of contingency for that line item. Contingency is defined as a specific provision for unforeseeable elements of cost within the defined project scope. This is particularly important where previous experiences relating estimates and actual costs have shown that unforeseeable events which will increase costs are likely to occur. The cost elements in this estimate are based on ideal conditions, therefore contingency factors have been applied. Contingency is assigned on a line item basis for this estimate.
- Estimate: This is the sum of Total and Contingency.

8 References

1. T. S. LaGuardia et al., "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates", AIF/NESP-036, May 1986.
2. UE and Kansas City Power & Light Company, "Response to Missouri PSC Stipulation for Data Relevant to Estimating Decommissioning Costs for Callaway Plant and Wolf Creek Generating Station", February 1993 and "Data Unique to Wolf Creek Generating Station", February 1993.

APPENDIX A

DECOMMISSIONING COST ESTIMATE UPDATE — LINE ITEM REPORT

Wolf Creek Generating Station 1996 DECON Option (Immediate)

Cost ($Thousands) Activity:	Decon	Remove	Pack	Ship	Bury	Other	Total	Contingency	Estimate
Period 1: Activity Costs						$2 854	$2 854	15%	$428	$3 282
Prepare prelim decommissioning plan						143	143	15%	21	165
Prepare proposed decommissioning plan						440	440	15%	66	506
Review plant drawings and specs						506	506	15%	76	582
Estimate by-product inventory						110	110	15%	17	127
Submit for license amendment						176	176	15%	26	203
End product description						110	110	15%	17	127
Detailed by-product inventory						143	143	15%	21	165
Define major work sequence						826	826	15%	124	950
Perform safety analysis						341	341	15%	51	393
Submit dismantling plan						57	57	15%	9	66
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 1: Undistributed Costs	$73		$253	$54	$1 058	$8 310	$9 748	15%	$1 461	$11 209
a Decon equipment						206	206	15%	31	237
b Decon supplies						149	149	25%	37	187
c DOC staff relocation expenses						898	898	15%	135	1 033
d Process liquid waste	73		37	47	220		378	21%	80	458
e Insurance						597	597	10%	60	657
f Property taxes						1 616	1 616	10%	162	1 777
g Health physics supplies						1 033	1 033	25%	258	1 291
h Heavy equipment rental						113	113	15%	17	130
i Disposal of DAW generated			216	6	838		1 060	14%	148	1 209
j Plant energy budget						3 264	3 264	15%	490	3 754
k NRC fees						122	122	10%	12	134
l Emergency planning fees						311	311	10%	31	342
Contingencies for a, c, d, h, i, j (standard)	50%	15%	10%	15%	15%	15%				
Contingencies for b, g	50%	15%	10%	15%	15%	25%				
Contingencies for e, f, k, l	50%	15%	10%	15%	15%	10%				
Period 1: Staff Costs						$39 403	$39 403	15%	$5 910	$45 313
DOC staff cost						5 079	5 079	15%	762	5 841
Utility staff cost						34 324	34 324	15%	5 149	39 472
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 1: Total Costs	$73		$253	$54	$1 058	$50 567	$52 005	15%	$7 800	$59 804
Period 2: Activity Specifications						$4 110	$4 110	15%	$617	$4 727
Plant & temporary facilities						542	542	15%	81	623
Plant systems						459	459	15%	69	528
Reactor internals						782	782	15%	117	899
Reactor vessel						716	716	15%	107	823
Biological shield						55	55	15%	8	63
Steam generators						344	344	15%	52	395
Reinforced concrete						176	176	15%	26	203
Turbines & condensers						88	88	15%	13	101
Plant structures & buildings						344	344	15%	52	395
Waste management						506	506	15%	76	582
Facility & site closeout						99	99	15%	15	114
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 2: Planning & Site Preparations						$3 573	$3 573	15%	$536	$4 109
Prepare dismantling sequence						264	264	15%	40	304
Plant preparation & temporary services						1 635	1 635	15%	245	1 880
Design water clean-up system						154	154	15%	23	177
Rigging/CCES/tooling/etc.						1 384	1 384	15%	208	1 592
Procure casks/liners & containers						135	135	15%	20	156
Contingencies (standard)	50%	15%	10%	15%	15%	15%				

DECOMMISSIONING COST ESTIMATE UPDATE — LINE ITEM REPORT

Wolf Creek Generating Station 1996 DECON Option (Immediate)

Cost ($Thousands) Activity:	Decon	Remove	Pack	Ship	Bury	Other	Total	Contingency	Estimate
Period 2: Detailed Work Procedures						$3 825	$3 825	15%	$574	$4 399
Plant systems						521	521	15%	78	599
Vessel head						275	275	15%	41	317
Reactor internals						275	275	15%	41	317
Remaining buildings						149	149	15%	22	171
CRD cooling assembly						110	110	15%	17	127
CRD housings & ICI tubes						110	110	15%	17	127
Incore instrumentation						110	110	15%	17	127
Reactor vessel						400	400	15%	60	460
Facility closeout						132	132	15%	20	152
Missile shields						50	50	15%	7	57
Biological shield						132	132	15%	20	152
Steam generators						506	506	15%	76	582
Reinforced concrete						110	110	15%	17	127
Turbines & condensers						344	344	15%	52	395
Auxiliary building						301	301	15%	45	346
Reactor building						301	301	15%	45	346
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 2: Decon NSSS/Rack Removal	$735	$35	$87	$23	$1 039	$1 260	$3 179	23%	$733	$3 913
Decon primary loop	504						504	50%	252	757
Remove spent fuel racks	231	35	87	23	1 039	1 260	2 675	18%	481	3 156
Contingencies	50%	25%	10%	15%	15%	15%				
Period 2: NSSS Removal	$519	$6 405	$865	$4 280	$38 945		$51 013	21%	$10 523	$61 536
Reactor vessel	113	2 824	290	263	3 310		6 799	41%	2 809	9 608
Reactor vessel internals	49	1 070	294	316	7 515		9 245	23%	2 107	11 352
Steam generators	151	2 246	145	3 613	19 725		25 880	16%	4 152	30 032
Reactor coolant piping	73	115	68	19	2 273		2 548	16%	416	2 963
Reactor coolant pumps & motors	28	35	36	41	3 840		3 980	15%	609	4 589
Pressurizer	27	24	4	10	1 408		1 473	16%	233	1 706
Pressurizer relief tank	13	55	6	4	217		295	18%	54	349
CRDMs/ICIs/service structure removal	65	36	22	15	656		793	18%	144	938
Contingencies for Reactor Vessel and Internals	50%	75%	25%	25%	15%	15%				
Contingencies for Others	50%	25%	10%	15%	15%	15%				
Period 2: Disposal of Plant Systems	$1 351	$11 632	$2 507	$557	$20 233	$13 847	$50 128	17%	$8 485	$58 613
CP/WCGS Contam Components (System Specific)	$1 196	$5 510	$2 181	$459	$17 877	$11 068	$38 291	17%	$6 604	$44 895
BB - Reactor Coolant (partial)		107	70	16	810	348	1 352	16%	210	1 562
BG - Chemical & Volume Control	386	471	189	48	2 362	966	4 423	19%	836	5 259
BL - Reactor Makeup Water		140	34	9	244	238	665	17%	112	777
BM - Steam Generator Blowdown		316	113	30	1 107	740	2 306	16%	372	2 678
BN - Borated Refueling Water Storage		149	61	9	391	459	1 069	16%	172	1 241
EC - Fuel Pool Cooling & Cleanup		229	78	18	714	518	1 558	16%	253	1 810
EJ - Residual Heat Removal		204	84	18	881	489	1 676	16%	268	1 944
EM - High Pressure Coolant Injection		161	62	17	570	413	1 224	16%	197	1 420
EP - Accumulator Safety Injection		82	30	6	209	208	535	16%	87	622
GG - Fuel Building HVAC		148	49	11	570	213	990	16%	161	1 151
GH - Radwaste Building HVAC		103	30	7	322	151	613	16%	101	714
GL - Auxiliary Building HVAC		268	50	12	319	367	1 017	17%	177	1 193
GN - Containment Cooling		311	114	23	1 230	540	2 217	16%	358	2 575
GR - Containment Atmospheric Control		6	25	4	414	33	482	15%	72	554
GS - Containment Hydrogen Control		26	21	5	163	147	362	15%	56	418
GT - Containment Purge HVAC		69	35	5	356	190	656	16%	103	759
HA - Gaseous Radwaste		152	77	15	563	273	1 080	16%	173	1 253
HB - Liquid Radwaste	419	410	142	28	905	679	2 583	22%	568	3 151
HC - Solid Radwaste		241	226	28	1 004	499	1 998	16%	312	2 310
HD - Decontamination		40	51	6	147	151	396	15%	61	457
HE - Boron Recycle		253	78	19	481	474	1 305	17%	217	1 523
HF - Secondary Liquid Waste	358	456	209	37	1 034	884	2 978	20%	607	3 585
KE - Fuel Handling & Storage, RPV Service		6	9	5	292		312	15%	47	359
LD - Chemical & Detergent Waste	34	69	21	5	137	147	412	19%	80	492
LF - Floor & Equipment Drains		1 007	228	57	1 477	1 675	4 443	17%	756	5 198
RM - Process Sampling & Analysis		56	45	13	709	215	1 038	15%	159	1 197
SJ - Nuclear Sampling		31	50	6	466	50	603	15%	91	694
Contingencies for Contaminated Systems	50%	25%	10%	15%	15%	15%				

DECOMMISSIONING COST ESTIMATE UPDATE — LINE ITEM REPORT

Wolf Creek Generating Station 1996 DECON Option (Immediate)

Cost ($Thousands) Activity:	Decon	Remove	Pack	Ship	Bury	Other	Total	Contingency		Estimate
CP/WCGS Contam Comp (Non-Syst Specific)		$672	$327	$99	$2 355	$2 779	$6 232	16%	$986	$7 218
Auxiliary Building		237	112	35	844	995	2 223	16%	352	2 574
Control Building		216	115	35	835	985	2 187	16%	344	2 531
Fuel Building		34	16	5	130	153	339	16%	53	392
Radwaste Building		102	50	15	341	403	910	16%	144	1 054
Reactor Building		83	33	10	205	243	574	16%	93	667
Contingencies for Contaminated Systems	50%	25%	10%	15%	15%	15%				
CP/WCGS Decon-able Comp (Non-Syst Spec)	$103	$383					$486	22%	$109	$595
Auxiliary Building	37	141					178	22%	40	217
Control Building	37	129					166	23%	38	204
Fuel Building	4	17					21	22%	5	26
Radwaste Building	13	48					61	23%	14	75
Reactor Building	12	48					60	22%	13	73
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
CP/WCGS Clean Comp (Non-Syst Specific)		$1 189					$1 189	15%	$178	$1 367
Auxiliary Building		427					427	15%	64	491
Control Building		400					400	15%	60	460
Fuel Building		55					55	15%	8	63
Radwaste Building		163					163	15%	24	188
Reactor Building		144					144	15%	22	165
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
CP/WCGS Non-Contam Comp (Syst Specific)	$52	$1 766					$1 818	16%	$291	$2 109
AB - Main Steam		148					148	15%	22	171
AC - Main Turbine		137					137	15%	21	157
AD - Condensate		139					139	15%	21	160
AE - Feedwater		94					94	15%	14	109
AF - Feedwater Htr Extraction, Drains, Vents		142					142	15%	21	163
AK - Condensate Demineralizer		49					49	15%	7	56
AL - Auxiliary Feedwater		21					21	15%	3	24
AP - Condensate Storage & Transfer		41					41	15%	6	47
AQ - Condensate & Feedwater Chem Addition		13					13	15%	2	15
CA - Steam Seal		13					13	15%	2	15
CB - Main Turbine Lube Oil		28					28	15%	4	33
CC - Generator Hydrogen & CO2		5					5	15%	1	6
CD - Generator Seal Oil		7					7	15%	1	8
CE - Stator Cooling Water		6					6	15%	1	7
CF - Lube Oil Storage, Transfer, Purification		22					22	15%	3	25
CG - Condenser Air Removal		16					16	15%	2	19
CH - Main Turbine Control Oil		30					30	15%	5	35
EB - Closed Cooling Water		34					34	15%	5	39
EG - Component Cooling Water		141					141	15%	21	162
EN - Containment Spray	52	42					93	34%	32	126
FA - Auxiliary Steam Generator		16					16	15%	2	18
FB - Auxiliary Steam		68					68	15%	10	78
FC - Auxiliary Turbines		33					33	15%	5	38
FE - Auxiliary Steam Chemical Addition		3					3	15%	0	3
GA - Plant Heating		73					73	15%	11	84
GB - Central Chilled Water		54					54	15%	8	62
GK - Control Building HVAC		160					160	15%	24	184
GM - Diesel Generator Building HVAC		29					29	15%	4	33
GP - Containment Integrated Leak Rate Test		7					7	15%	1	8
JE - Emergency Fuel Oil		32					32	15%	5	37
KJ - Standby Diesel Engine		106					106	15%	16	122
LB - Roof Drains		58					58	15%	9	67
Contingencies (standard)	50%	15%	10%	15%	15%	15%				

DECOMMISSIONING COST ESTIMATE UPDATE — LINE ITEM REPORT

Wolf Creek Generating Station 1996 DECON Option (Immediate)

Cost ($Thousands) Activity:	Decon	Remove	Pack	Ship	Bury	Other	Total	Contingency		Estimate
WCGS Non-Contam Comp (System Specific)		$2 112					$2 112	15%	$317	$2 429
AN - Demineralized Water Storage & Transfe		43					43	15%	6	50
AX - Acid Feed		22					22	15%	3	25
CL - Chlorination		14					14	15%	2	17
CO - Carbon Dioxide		4					4	15%	1	5
CW - Circulating Water		199					199	15%	30	229
CZ - Caustic Acid		3					3	15%	0	4
DA - Circulating Water		205					205	15%	31	236
DM - Equipment Drains		63					63	15%	9	72
DO - Diesel Oil		1					1	15%	0	1
EA - Service Water		66					66	15%	10	76
EF - Essential Service Water		80					80	15%	12	93
FO - Fuel Oil		15					15	15%	2	17
FP - Fire Protection		159					159	15%	24	182
GD - Essntl Svce Water Pmphse Bldg HVAC		9					9	15%	1	11
GE - Turbine Building HVAC		111					111	15%	17	128
GF - Miscellaneous Building HVAC		36					36	15%	5	41
HY- Hydrogen		7					7	15%	1	8
KA - Compressed Air & Instrument		169					169	15%	25	195
KB - Breathing Air		28					28	15%	4	32
KC - Fire Protection		290					290	15%	44	334
KD - Domestic Water		48					48	15%	7	56
KH - Service Gas		19					19	15%	3	22
LA - Sanitary Drains		14					14	15%	2	16
LC - Yard Drains		2					2	15%	0	3
LE - Oily Waste		103					103	15%	15	119
NT - Nitrogen		4					4	15%	1	5
OX - Oxygen		4					4	15%	1	5
ST - Sewage Treatment		25					25	15%	4	29
SW - Screen Wash		16					16	15%	2	18
SZ - Service Air		49					49	15%	7	57
VA - I&C Shop HVAC		3					3	15%	1	4
VB - I&C Shop Computer Room HVAC		2					2	15%	0	3
VC - Health Physics Computer Room HVAC		5					5	15%	1	6
VH - Circ Water & Makeup Water Scrnhse Ve		6					6	15%	1	7
VJ - Shop Bldg Machine Shop Area Ventilatio		1					1	15%	0	1
VL - Shop Building HVAC		2					2	15%	0	3
VS - Administration Building HVAC		6					6	15%	1	7
VT - Technical Support Building HVAC		2					2	15%	0	2
VV - Miscellaneous Building HVAC		3					3	15%	0	4
VW - Waste Water Treatment Ventilation		1					1	15%	0	1
WD - Domestic Water		28					28	15%	4	33
WG - Gland Water & Motor Cooling Water		18					18	15%	3	21
WL - Cooling Lake Makeup & Blowdown		17					17	15%	3	20
WM - Makeup Demineralizer		97					97	15%	15	112
WS - Plant Service Water		85					85	15%	13	98
WT - Waste Water Treatment		18					18	15%	3	21
WZ - Radioactive Liquid Waste		6					6	15%	1	6
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 2: Erect Scaffolding for Syst Removal		$917					$917	15%	$138	$1 055
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 2: Decontamination of Site Bldgs	$2 004	$619	$291	$80	$7 771	$1 041	$11 805	21%	$2 519	$14 325
Auxiliary Building	463	25	63	17	1 925	144	2 636	21%	557	3 193
· Aux Bldg — Hot Machine Shop	18		1	1	48		68	24%	16	84
· Aux Bldg — Balance	446	25	62	17	1 876	144	2 569	21%	541	3 109
Control Building	9	0	1	1	40	1	53	21%	11	64
Fuel Building	412	262	45	14	730	300	1 762	25%	432	2 195
Radwaste Building	264	12	34	9	1 100	71	1 491	21%	316	1 807
· Radw Bldg — Rad & Personnel Tunnel	12		1	1	26		39	25%	10	49
· Radw Bldg — Radwaste Drum Storage	26	1	3	1	110	6	147	21%	31	179
· Radw Bldg — Balance	226	11	30	7	963	66	1 304	21%	274	1 579
Reactor Building	855	320	149	40	3 976	524	5 863	21%	1 203	7 066
Contingencies for Contaminated Structures	50%	25%	10%	15%	15%	15%				

DECOMMISSIONING COST ESTIMATE UPDATE — LINE ITEM REPORT

Wolf Creek Generating Station 1996 DECON Option (Immediate)

Cost ($Thousands) Activity:	Decon	Remove	Pack	Ship	Bury	Other	Total	Contingency		Estimate
Period 2: License Termination Survey						$329	$329	15%	$49	$379
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 2: Activity Costs Subtotal	$4 609	$19 608	$3 750	$4 940	$67 988	$27 985	$128 880	19%	$24 174	$153 054
Period 2: Undistributed Costs	$375		$1 470	$697	$8 612	$22 619	$33 774	16%	$5 371	$39 145
a Decon equipment						206	206	15%	31	237
b Decon supplies						546	546	25%	137	683
c DOC staff relocation exp						898	898	15%	135	1 033
d Process liquid radwaste	375		681	671	5 069		6 796	16%	1 117	7 913
e Insurance						1 023	1 023	10%	102	1 126
f Property taxes						1 917	1 917	10%	192	2 109
g Health physics supplies						3 777	3 777	25%	944	4 722
h Heavy equipment rental						7 936	7 936	15%	1 190	9 126
i Small tool allowance						374	374	15%	56	430
j Pipe cutting equipment						640	640	15%	96	736
k Decon rig						832	832	15%	125	957
l Disposal of DAW generated			790	26	3 543		4 359	14%	614	4 973
m Plant energy budget						3 699	3 699	15%	555	4 254
n NRC fees						338	338	10%	34	371
o Emergency planning fees						432	432	10%	43	475
Contingencies for a, c, d, h, i, j, k, l, m	50%	15%	10%	15%	15%	15%				
Contingencies for Undistributed items b, g	50%	15%	10%	15%	15%	25%				
Contingencies for Undist items e, f, n, o	50%	15%	10%	15%	15%	10%				
Period 2: Staff Costs						$74 307	$74 307	15%	$11 146	$85 453
DOC staff costs						17 420	17 420	15%	2 613	20 033
Utility staff costs						56 887	56 887	15%	8 533	65 420
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 2: Total Costs	$4 984	$19 608	$5 220	$5 637	$76 600	$124 911	$236 961	17%	$40 691	$277 651
Period 3: Removal of Major Equipment		$305					$305	15%	$46	$351
Main turbine/generator		76					76	15%	11	87
Main condensers		229					229	15%	34	264
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 3: Demolition of Remaining Site Bldgs		$35 066					$35 066	15%	$5 260	$40 326
CP/WCGS Demolition Quantities		$29 185					$29 185	15%	$4 378	$33 562
Auxiliary Building		8 467					8 467	15%	1 270	9 737
· Aux Bldg — Hot Machine Shop		24					24	15%	4	28
· Aux Bldg — Balance		8 442					8 442	15%	1 266	9 709
Control Building		2 833					2 833	15%	425	3 258
· Ctrl Bldg — Communications Corridor		368					368	15%	55	423
· Ctrl Bldg — Balance		2 465					2 465	15%	370	2 835
Diesel Generator Building		429					429	15%	64	493
Fuel Building		2 747					2 747	15%	412	3 159
Radwaste Building		3 375					3 375	15%	506	3 881
· Radw Bldg — Rad & Personnel Tunnel		20					20	15%	3	22
· Radw Bldg — Radwaste Drum Storage		455					455	15%	68	523
· Radw Bldg — Balance		2 901					2 901	15%	435	3 336
Reactor Building		5 148					5 148	15%	772	5 921
Turbine Building		6 186					6 186	15%	928	7 114
· Turb Bldg — Auxiliary Boiler		25					25	15%	4	29
· Turb Bldg — Balance		6 160					6 160	15%	924	7 084
Contingencies (standard)	50%	15%	10%	15%	15%	15%				

DECOMMISSIONING COST ESTIMATE UPDATE — LINE ITEM REPORT

Wolf Creek Generating Station 1996 DECON Option (Immediate)

Cost ($Thousands) Activity:	Decon	Remove	Pack	Ship	Bury	Other	Total	Contingency	Estimate
Wolf Creek G S Demolition Quantities		$5 881					$5 881	15%	$882	$6 764
Access Vaults		40					40	15%	6	46
Administration		228					228	15%	34	262
Chlorine Storage		19					19	15%	3	21
Circulating Water Discharge Structure		383					383	15%	57	441
Circulating Water Intake & Screenhouse		893					893	15%	134	1 027
Covered Walkways		13					13	15%	2	14
Essential Service Water System Pumphouse		845					845	15%	127	971
Essential Service Water System Valve House		13					13	15%	2	15
MMO Building		163					163	15%	24	187
Miscellaneous Site Foundations		408					408	15%	61	469
Miscellaneous Site Structures (32 structures)		2 509					2 509	15%	376	2 885
Oil Separator and Waste Tank		2					2	15%	0	3
Security Building/Guardhouse		345					345	15%	52	396
Site Security Diesel Generator		3					3	15%	0	3
Waste Water Treatment		19					19	15%	3	22
Contingencies (standard)	50%	15%	10%	15%	15%	15%			
Period 3: Site Closeout Activities		$5 670				$172	$5 841	15%	$876	$6 718
Remove rubble		4 150					4 150	15%	623	4 773
Grade & landscape site		1 519					1 519	15%	228	1 747
Final report to NRC						172	172	15%	26	198
Contingencies (standard)	50%	15%	10%	15%	15%	15%			
Period 3: Activity Costs Subtotal		$41 041				$172	$41 213	15%	$6 182	$47 394
Period 3: Undistributed Costs						$3 915	$3 915	14%	$531	$4 446
a Insurance						180	180	10%	18	198
b Property taxes						943	943	10%	94	1 037
c Heavy equipment rental						2 354	2 354	15%	353	2 708
d Small tool allowance						312	312	15%	47	359
e Plant energy budget						126	126	15%	19	145
Contingencies for a, b	50%	15%	10%	15%	15%	10%			
Contingencies for c, d, e (standard)	50%	15%	10%	15%	15%	15%			
Period 3: Staff Costs						$17 039	$17 039	15%	$2 556	$19 595
DOC staff costs						7 541	7 541	15%	1 131	8 672
Utility staff costs						9 498	9 498	15%	1 425	10 923
Contingencies (standard)	50%	15%	10%	15%	15%	15%			
Period 3: Total Costs		$41 041				$21 126	$62 167	15%	$9 269	$71 436
Total Cost to Decommission	$5 057	$60 648	$5 473	$5 691	$77 657	$196 602	$351 128	16%	$57 759	$408 887

Input Variables Summary

Indirect Personnel Overhead [%]	1996	1993
Utility O&B (All Labor)	71.0%	64.6%
DOC O&B (Administrative)	90.0%	90.0%
DOC O&B (General Labor)	40.0%	40.0%
Subcontractor Overhead and Profit [%]		
On Decommissioning Labor	21.0%	21.0%
On Demolition Labor	13.0%	13.0%
On Equipment and Materials	14.2%	14.2%
Work Efficiencies [%]		
Height Adjustment, 12' - 20'	15.0%	20.0%
Respiratory Protection Adjustment	37.5%	50.0%
Radiation/ALARA Adjustment	25.0%	32.0%
Protective Clothing Adjustment	22.5%	30.0%
Work Break Adjustment	8.3%	8.3%

Cost Component Chg from '93:	1996	Avg Annl
WCNOC Staff — Management Labor	11.3%	3.6%
WCNOC Staff — Contract Labor	12.3%	3.9%
DOC Staff Labor	10.3%	3.3%
Security Guards Labor	12.3%	3.9%
Craft Labor	9.1%	2.9%
Specialty Consultant Labor	10.1%	3.3%
Transportation Costs	3.1%	1.0%
Material and Equipment	9.0%	2.9%
NRC Fees	4.8%	1.6%
Emergency Planning Fees	17.9%	5.6%
Other	6.3%	2.1%
Radwaste Burial	10.0%	3.2%
Radwaste Off-Site Processing	72.4%	19.9%
Primary Liability Insurance	12.1%	3.9%
Excess Property Insurance (NEIL II)	-36.6%	-14.1%
Property Taxes (initial rate)	44.0%	12.9%
Electrical Energy	-14.2%	-5.0%
Oil	14.8%	4.7%
Total Cost Estimate	10.6%	3.4%

APPENDIX B

DECOMMISSIONING COST ESTIMATE UPDATE — LINE ITEM REPORT

Wolf Creek Generating Station 1996 SAFSTOR Option (Delayed)

Cost ($Thousands) Activity:	Decon	Remove	Pack	Ship	Bury	Other	Total	Contingency	Estimate
Period 1: Mothballing Activities						$1 775	$1 775	15%	$266	$2 041
Prepare prelim decommissioning plan						132	132	15%	20	152
Prepare proposed decommissioning plan						344	344	15%	52	395
Review plant drawings and specs						143	143	15%	21	165
Estimate by-product inventory						110	110	15%	17	127
Submit for possession-only license						110	110	15%	17	127
End product description						110	110	15%	17	127
Detailed by-product inventory						165	165	15%	25	190
Define major work sequence						110	110	15%	17	127
Perform safety analysis of operation						220	220	15%	33	253
Perform safety analysis of end product						220	220	15%	33	253
Submit dismantling plan						110	110	15%	17	127
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 1: Activity Specifications						$1 785	$1 785	15%	$268	$2 052
Prepare plant & facilities for mothball ops						542	542	15%	81	623
Plant systems						459	459	15%	69	528
Plant structures & buildings						344	344	15%	52	395
Waste management						220	220	15%	33	253
Facility & site dormancy						220	220	15%	33	253
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 1: Detailed Work Procedures						$653	$653	15%	$98	$751
Plant systems						521	521	15%	78	599
Facility closeout & dormancy						132	132	15%	20	152
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 1: Miscellaneous						$11	$11	15%	$2	$13
Procure vacuum drying system						11	11	15%	2	13
Period 1: Decontamination of Site Bldgs	$1 700						$1 700	50%	$850	$2 550
Auxiliary Building	360						360	50%	180	541
· Aux Bldg — Hot Machine Shop	10						10	50%	5	15
· Aux Bldg — Balance	350						350	50%	175	525
Control Building	8						8	50%	4	12
Fuel Building	363						363	50%	181	544
Radwaste Building	208						208	50%	104	312
· Radw Bldg — Rad & Personnel Tunnel	3						3	50%	2	5
· Radw Bldg — Radwaste Drum Storage	21						21	50%	11	32
· Radw Bldg — Balance	184						184	50%	92	275
Reactor	761						761	50%	381	1 142
Contingencies for Contaminated Structures	50%	25%	10%	15%	15%	15%				
Period 1: Miscellaneous		$280				$393	$673	15%	$101	$774
Prepare support equipment for storage		259					259	15%	39	298
Install containment pressure equalization line		21					21	15%	3	24
Interim survey prior to dormancy						329	329	15%	49	379
Prepare and submit interim report						64	64	15%	10	73
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Subtotal Period 1 Activity Costs	$1 700	$280				$4 616	$6 596	24%	$1 585	$8 181
Period 1: Undistributed Costs	$288		$371	$204	$1 716	$3 766	$6 345	18%	$1 112	$7 457
a Decon equipment						213	213	15%	32	245
b Decon supplies						154	154	25%	39	193
c Process liquid waste	288		148	197	857		1 490	21%	317	1 808
d Insurance						250	250	10%	25	275
e Property taxes						474	474	10%	47	522
f Health physics supplies						1 067	1 067	25%	267	1 334
g Small tool allowance						25	25	15%	4	29
h Disposal of DAW generated			223	7	858		1 088	14%	152	1 240
i Plant energy budget						1 421	1 421	15%	213	1 634
j NRC fees						50	50	10%	5	55
k Emergency planning fees						113	113	10%	11	124
Contingencies for a, c, g, h, i (standard)	50%	15%	10%	15%	15%	15%				
Contingencies for b, f	50%	15%	10%	15%	15%	25%				
Contingencies for d, e, j, k	50%	15%	10%	15%	15%	10%				

DECOMMISSIONING COST ESTIMATE UPDATE — LINE ITEM REPORT

Wolf Creek Generating Station 1996 SAFSTOR Option (Delayed)

Cost ($Thousands) Activity:	Decon	Remove	Pack	Ship	Bury	Other	Total	Contingency	Estimate
Period 1: Staff Costs						$12 913	$12 913	15%	$1 937	$14 850
Utility staff cost						12 913	12 913	15%	1 937	14 850
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 1: Total Cost to Mothball	$1 989	$280	$371	$204	$1 716	$21 296	$25 854	18%	$4 633	$30 487
Period 2: Mothballed Annual Maintenance Cost			$1	$1	$44	$5 084	$5 131	15%	$755	$5 887
a Health physics supplies						41	41	25%	10	51
b Insurance						60	60	10%	6	66
c Property taxes						480	480	10%	48	528
d Disposal of contaminated solid waste			1	1	44		47	15%	7	54
e Bituminous roof replacement						41	41	15%	6	47
f Maintenance supplies						88	88	25%	22	110
g Plant energy budget						194	194	15%	29	223
h NRC Fees						11	11	15%	2	13
i Emergency planning fees						8	8	15%	1	9
j Site maintenance staff						4 161	4 161	15%	624	4 785
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Contingencies for a, f	50%	15%	10%	15%	15%	25%				
Contingencies for b, c	50%	15%	10%	15%	15%	10%				
Period 2: Maintenance Cost (55.1 yr dormancy)			$63	$63	$2 449	$280 145	$282 720	15%	$41 626	$324 346
Period 3: Activity Costs						$1 984	$1 984	15%	$298	$2 282
Review plant drawings and specifications						506	506	15%	76	582
End product description						110	110	15%	17	127
Detailed by-product inventory						143	143	15%	21	165
Define major work sequence						826	826	15%	124	950
Perform safety analysis						341	341	15%	51	393
Submit dismantling plan						57	57	15%	9	66
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 3: Undistributed Costs			$221	$7	$858	$5 591	$6 677	16%	$1 039	$7 716
a DOC staff relocation expenses						952	952	15%	143	1 095
b Insurance						375	375	10%	38	413
c Property taxes						712	712	10%	71	783
d Health physics supplies						1 067	1 067	25%	267	1 334
e Heavy equipment rental						262	262	15%	39	302
f Disposal of DAW generated			221	7	858		1 086	14%	152	1 238
g Plant energy budget						2 148	2 148	15%	322	2 471
h NRC fees						74	74	10%	7	82
Contingencies for a, e, f, g (standard)	50%	15%	10%	15%	15%	15%				
Contingencies for item d	50%	15%	10%	15%	15%	25%				
Contingencies for items b, c, h	50%	15%	10%	15%	15%	10%				
Period 3: Staff Costs						$18 821	$18 821	15%	$2 823	$21 644
DOC staff costs						4 802	4 802	15%	720	5 523
Utility staff costs						14 019	14 019	15%	2 103	16 122
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 3: Total Costs			$221	$7	$858	$26 396	$27 482	15%	$4 160	$31 642
Period 4: Activity Specifications						$4 380	$4 380	15%	$657	$5 037
Re-activate plant and temporary facilities						811	811	15%	122	933
Plant systems						459	459	15%	69	528
Reactor internals						782	782	15%	117	899
Reactor vessel						716	716	15%	107	823
Biological shield						55	55	15%	8	63
Steam generators						344	344	15%	52	395
Reinforced concrete						176	176	15%	26	203
Turbine and condenser						88	88	15%	13	101
Plant structures & buildings						344	344	15%	52	395
Waste management						506	506	15%	76	582
Facility & site closeout						99	99	15%	15	114
Contingencies (standard)	50%	15%	10%	15%	15%	15%				

DECOMMISSIONING COST ESTIMATE UPDATE — LINE ITEM REPORT

Wolf Creek Generating Station 1996 SAFSTOR Option (Delayed)

Cost ($Thousands) Activity:	Decon	Remove	Pack	Ship	Bury	Other	Total	Contingency	Estimate
Period 4: Planning and Site Preparations						$3 573	$3 573	15%	$536	$4 109
Prepare dismantling sequence						264	264	15%	40	304
Plant prep. and temp. services						1 635	1 635	15%	245	1 880
Design water clean-up system						154	154	15%	23	177
Rigging/CCES/tooling/etc.						1 384	1 384	15%	208	1 592
Procure casks/liners and containers						135	135	15%	20	156
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 4: Detailed Work Procedures						$3 825	$3 825	15%	$574	$4 399
Plant systems						521	521	15%	78	599
Vessel head						275	275	15%	41	317
Reactor internals						275	275	15%	41	317
Remaining buildings						149	149	15%	22	171
CRD cooling assembly						110	110	15%	17	127
CRD housings and ICI tubes						110	110	15%	17	127
Incore instrumentation						110	110	15%	17	127
Reactor vessel						400	400	15%	60	460
Facility closeout						132	132	15%	20	152
Missile shields						50	50	15%	7	57
Biological shield						132	132	15%	20	152
Steam generators						506	506	15%	76	582
Reinforced concrete						110	110	15%	17	127
Turbine and condensers						344	344	15%	52	395
Auxiliary building						301	301	15%	45	346
Reactor building						301	301	15%	45	346
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 4: Rack Removal	$253	$44	$100	$28	$1 195	$924	$2 544	18%	$469	$3 013
Remove spent fuel racks	253	44	100	28	1 195	924	2 544	18%	469	3 013
Contingencies	50%	25%	10%	15%	15%	15%				
Period 4: NSSS Removal	$460	$6 879	$831	$4 365	$36 867		$49 402	21%	$10 308	$59 710
a Reactor coolant piping	66	127	67	19	2 221		2 499	16%	407	2 907
b Pressurizer relief tank	12	60	5	4	211		292	18%	54	346
c Reactor coolant pumps & motors	25	38	35	43	3 753		3 894	15%	595	4 488
d Pressurizer	24	29	4	11	1 376		1 444	16%	228	1 671
e Steam generators	134	2 674	143	3 765	19 238		25 953	16%	4 200	30 154
f CRDMS/ICIS/service structure removal	58	39	22	15	641		774	18%	139	913
g Reactor vessel internals	41	1 058	270	237	6 666		8 271	23%	1 940	10 212
h Reactor vessel	101	2 855	285	271	2 762		6 274	44%	2 745	9 019
Contingencies for reactor vessel & internals	50%	75%	25%	25%	15%	15%				
Contingencies for others	50%	25%	10%	15%	15%	25%				
Period 4: Disposal of Plant Systems	$1 322	$12 718	$2 729	$654	$22 027	$9 684	$49 134	17%	$8 422	$57 557
CP/WCGS Contam Comp (System Specific)	$1 183	$6 470	$2 350	$531	$19 283	$7 618	$37 436	18%	$6 559	$43 995
BB - Reactor Coolant		125	76	19	873	240	1 333	16%	209	1 541
BG - Chemical & Volume Control	387	553	203	56	2 548	665	4 411	19%	842	5 254
BL - Reactor Makeup Water		165	37	11	263	164	640	17%	111	750
BM - Steam Generator Blowdown		371	122	34	1 194	509	2 231	16%	366	2 597
BN - Borated Refueling Water Storage		177	66	11	421	316	991	16%	163	1 154
EC - Fuel Pool Cooling & Cleanup		271	83	21	770	357	1 503	17%	248	1 751
EJ - Residual Heat Removal		241	90	21	951	337	1 640	16%	266	1 906
EM - High Pressure Coolant Injection		189	68	20	615	285	1 176	16%	192	1 368
EP - Accumulator Safety Injection		96	31	7	225	144	503	17%	84	587
GG - Fuel Building HVAC		170	53	12	615	146	996	16%	164	1 159
GH - Radwaste Building HVAC		119	33	8	348	104	612	17%	102	714
GL - Auxiliary Building HVAC		309	55	14	344	253	974	18%	174	1 149
GN - Containment Cooling		362	122	26	1 328	371	2 210	16%	362	2 571
GR - Containment Atmospheric Control		7	26	5	447	23	508	15%	76	584
GS - Containment Hydrogen Control		31	23	6	176	101	336	16%	52	388
GT - Containment Purge HVAC		78	38	6	382	131	635	16%	101	736
HA - Gaseous Radwaste		178	83	18	608	189	1 075	16%	175	1 250
HB - Liquid Radwaste	412	484	153	32	977	468	2 526	22%	564	3 089
HC - Solid Radwaste		281	243	32	1 081	343	1 981	16%	313	2 294

DECOMMISSIONING COST ESTIMATE UPDATE — LINE ITEM REPORT

Wolf Creek Generating Station 1996 SAFSTOR Option (Delayed)

Cost ($Thousands) Activity:	Decon	Remove	Pack	Ship	Bury	Other	Total	Contingency		Estimate
HD - Decontamination		46	55	7	159	104	371	16%	58	429
HE - Boron Recycle		299	83	21	520	326	1 250	17%	213	1 463
HF - Secondary Liquid Waste	352	538	225	43	1 116	609	2 883	21%	598	3 481
KE - Fuel Handling & Storage, RPV Service		7	9	6	316		338	15%	51	389
LD - Chemical & Detergent Waste	32	82	21	6	147	101	389	20%	77	466
LF - Floor & Equipment Drains		1 193	246	65	1 593	1 152	4 249	18%	744	4 993
RM - Process Sampling & Analysis		64	50	15	764	147	1 041	15%	160	1 201
SJ - Nuclear Sampling		36	55	7	502	34	634	15%	96	730
Contingencies for Contaminated Systems	50%	25%	10%	15%	15%	15%				
CP/WCGS Contam Comp (Non-System Specific)		$788	$379	$123	$2 744	$2 066	$6 101	16%	$975	$7 076
Auxiliary Building		278	131	44	983	740	2 175	16%	348	2 522
Control Building		255	135	44	973	732	2 138	16%	339	2 477
Fuel Building		40	19	6	151	114	331	16%	53	383
Radwaste Building		119	58	18	397	300	892	16%	143	1 035
Reactor Building		96	37	12	240	181	565	16%	93	658
Contingencies for Contaminated Systems	50%	25%	10%	15%	15%	15%				
CP/WCGS Non-Contam Comp (Syst Specific)	$47	$1 772					$1 818	16%	$289	$2 108
AB - Main Steam		148					148	15%	22	170
AC - Main Turbine		139					139	15%	21	160
AD - Condensate		141					141	15%	21	162
AE - Feedwater		96					96	15%	14	110
AF - Feedwater Htr Extraction, Drains, Vents		143					143	15%	22	165
AK - Condensate Demineralizer		49					49	15%	7	56
AL - Auxiliary Feedwater		21					21	15%	3	24
AP - Condensate Storage & Transfer		41					41	15%	6	48
AQ - Condensate & Feedwater Chem Addition		13					13	15%	2	15
CA - Steam Seal		13					13	15%	2	15
CB - Main Turbine Lube Oil		29					29	15%	4	33
CC - Generator Hydrogen & CO2		5					5	15%	1	6
CD - Generator Seal Oil		7					7	15%	1	9
CE - Stator Cooling Water		6					6	15%	1	7
CF - Lube Oil Storage, Transfer, & Purificatio		22					22	15%	3	26
CG - Condenser Air Removal		17					17	15%	3	20
CH - Main Turbine Control Oil		31					31	15%	5	35
EB - Closed Cooling Water		34					34	15%	5	39
EG - Component Cooling Water		142					142	15%	21	164
EN - Containment Spray	47	42					89	33%	30	119
FA - Auxiliary Steam Generator		7					7	15%	1	9
FB - Auxiliary Steam		69					69	15%	10	79
FC - Auxiliary Turbines		33					33	15%	5	38
FE - Auxiliary Steam Chemical Addition		3					3	15%	0	4
GA - Plant Heating		74					74	15%	11	86
GB - Central Chilled Water		54					54	15%	8	62
GK - Control Building HVAC		156					156	15%	23	180
GM - Diesel Generator Building HVAC		29					29	15%	4	33
GP - Containment Integrated Leak Rate Test		6					6	15%	1	7
JE - Emergency Fuel Oil		33					33	15%	5	38
KJ - Standby Diesel Engine		107					107	15%	16	123
LB - Roof Drains		58					58	15%	9	67
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
WCGS Non-Contam Comp (System Specific)		$2 111					$2 111	15%	$317	$2 427
AN - Demineralized Water Storage & Transfe		43					43	15%	6	50
AX - Acid Feed		20					20	15%	3	23
CL - Chlorination		15					15	15%	2	17
CO - Carbon Dioxide		4					4	15%	1	5
CW - Circulating Water		200					200	15%	30	230
CZ - Caustic Acid		3					3	15%	0	4
DA - Circulating Water		207					207	15%	31	238
DM - Equipment Drains		63					63	15%	9	73
DO - Diesel Oil		1					1	15%	0	1
EA - Service Water		66					66	15%	10	76
EF - Essential Service Water		81					81	15%	12	93
FO - Fuel Oil		15					15	15%	2	17

DECOMMISSIONING COST ESTIMATE UPDATE — LINE ITEM REPORT

Wolf Creek Generating Station 1996 SAFSTOR Option (Delayed)

Cost ($Thousands) Activity:	Decon	Remove	Pack	Ship	Bury	Other	Total	Contingency		Estimate
FP - Fire Protection		160					160	15%	24	184
GD - Essntl Svce Water Pmphse Bldg HVAC		9					9	15%	1	11
GE - Turbine Building HVAC		108					108	15%	16	124
GF - Miscellaneous Building HVAC		35					35	15%	5	40
HY- Hydrogen		6					6	15%	1	7
KA - Compressed Air & Instrument		169					169	15%	25	194
KB - Breathing Air		27					27	15%	4	32
KC - Fire Protection		292					292	15%	44	336
KD - Domestic Water		48					48	15%	7	56
KH - Service Gas		19					19	15%	3	22
LA - Sanitary Drains		14					14	15%	2	16
LC - Yard Drains		2					2	15%	0	2
LE - Oily Waste		103					103	15%	15	119
NT - Nitrogen		4					4	15%	1	5
OX - Oxygen		4					4	15%	1	5
ST - Sewage Treatment		24					24	15%	4	28
SW - Screen Wash		16					16	15%	2	18
SZ - Service Air		50					50	15%	7	57
VA - I&C Shop HVAC		3					3	15%	0	4
VB - I&C Shop Computer Room HVAC		2					2	15%	0	2
VC - Health Physics Computer Room HVAC		5					5	15%	1	6
VH - Circ Water & Makeup Water Scrnhse Ve		6					6	15%	1	7
VJ - Shop Bldg Machine Shop Area Ventilatio		1					1	15%	0	1
VL - Shop Building HVAC		2					2	15%	0	2
VS - Administration Building HVAC		5					5	15%	1	6
VT - Technical Support Building HVAC		2					2	15%	0	2
VV - Miscellaneous Building HVAC		3					3	15%	0	4
VW - Waste Water Treatment Ventilation		1					1	15%	0	1
WD - Domestic Water		26					26	15%	4	30
WG - Gland Water & Motor Cooling Water		18					18	15%	3	21
WL - Cooling Lake Makeup & Blowdown		18					18	15%	3	21
WM - Makeup Demineralizer		97					97	15%	15	112
WS - Plant Service Water		86					86	15%	13	99
WT - Waste Water Treatment		18					18	15%	3	21
WZ - Radioactive Liquid Waste		5					5	15%	1	6
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
CP/WCGS Decontaminable Comp (Non-SystSpec	$92	$388					$480	22%	$104	$584
Auxiliary Building	33	143					176	22%	38	213
Control Building	34	131					165	22%	37	202
Fuel Building	3	17					20	21%	4	24
Radwaste Building	12	49					60	22%	13	73
Reactor Building	11	49					59	21%	13	72
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
CP/WCGS Clean Comp (Non-Syst Specific)		$1 189					$1 189	15%	$178	$1 367
Auxiliary Building		428					428	15%	64	492
Control Building		400					400	15%	60	460
Fuel Building		55					55	15%	8	63
Radwaste Building		162					162	15%	24	186
Reactor Building		144					144	15%	22	166
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 4: Erect Scaffolding for Syst Removal		$917					$917	15%	$138	$1 055
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 4: Decontamination of Site Bldgs	$1 922	$688	$295	$88	$7 907	$675	$11 575	21%	$2 463	$14 039
Auxiliary Building	445	27	63	19	1 959	93	2 606	21%	546	3 152
· Aux Bldg — Hot Machine Shop	17		1	1	49		68	24%	16	84
· Aux Bldg — Balance	429	27	62	18	1 909	93	2 537	21%	530	3 068
Control Building	9	1	1	1	40	1	54	21%	11	65
Fuel Building	391	295	46	15	743	195	1 685	25%	417	2 101
Radwaste Building	254	13	35	10	1 119	46	1 477	21%	310	1 788
· Radw Bldg — Rad & Personnel Tunnel	10		1	1	24		36	25%	9	45
· Radw Bldg — Radwaste Drum Storage	26	1	3	1	112	3	147	21%	31	178
· Radw Bldg — Balance	218	12	30	8	984	43	1 295	21%	270	1 565
Reactor Building	823	351	151	44	4 045	340	5 754	20%	1 179	6 933
Contingencies for Contaminated Structures	50%	25%	10%	15%	15%	15%				

DECOMMISSIONING COST ESTIMATE UPDATE — LINE ITEM REPORT

Wolf Creek Generating Station 1996 SAFSTOR Option (Delayed)

Cost ($Thousands) Activity:	Decon	Remove	Pack	Ship	Bury	Other	Total	Contingency		Estimate
Period 4: License Termination Survey						$329	$329	15%	$49	$379
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Subtotal Period 4 Activity Costs	$3 957	$21 247	$3 956	$5 134	$67 995	$23 390	$125 679	19%	$23 617	$149 296
Period 4: Undistributed Costs	$335		$810	$384	$4 549	$13 303	$19 381	16%	$3 158	$22 538
a Decon equipment						199	199	15%	30	229
b Decon supplies						345	345	25%	86	431
c DOC staff relocation expenses						891	891	15%	134	1 025
d Process liquid radwaste	335		316	365	2 173		3 190	18%	580	3 770
e Insurance						734	734	10%	73	807
f Property taxes						1 031	1 031	10%	103	1 134
g Health physics supplies						2 384	2 384	25%	596	2 980
h Heavy equipment rental						4 058	4 058	15%	609	4 666
i Small tool allowance						342	342	15%	51	393
j Pipe cutting equipment						619	619	15%	93	712
k Disposal of DAW generated			494	19	2 376		2 888	14%	409	3 297
l Plant energy budget						2 478	2 478	15%	372	2 850
m NRC fees						221	221	10%	22	244
Contingencies for a, c, d, h, i, j, l, m	50%	15%	10%	15%	15%	15%				
Contingencies for items b, g	50%	15%	10%	15%	15%	25%				
Contingencies for items e, f, n	50%	15%	10%	15%	15%	10%				
Period 4: Staff Costs						$43 648	$43 648	15%	$6 547	$50 196
DOC staff costs						11 973	11 973	15%	1 796	13 769
Utility staff costs						31 676	31 676	15%	4 751	36 427
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 4: Total Costs	$4 292	$21 247	$4 765	$5 518	$72 545	$80 341	$188 708	18%	$33 321	$222 029
Period 5: Removal of Major Equipment		$306					$306	15%	$46	$352
Main turbine/generator		74					74	15%	11	85
Main condensers		232					232	15%	35	267
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 5: Demolition of Remaining Site Bldgs		$35 065					$35 065	15%	$5 260	$40 325
CP/WCGS Demolition Quantities		$29 184					$29 184	15%	$4 378	$33 562
Auxiliary Building		8 441					8 441	15%	1 266	9 708
· Aux Bldg — Hot Machine Shop		24					24	15%	4	27
· Aux Bldg — Balance		8 418					8 418	15%	1 263	9 680
Control Building		2 835					2 835	15%	425	3 260
· Ctrl Bldg — Communications Corridor		372					372	15%	56	428
· Ctrl Bldg — Balance		2 463					2 463	15%	369	2 832
Diesel Generator Building		428					428	15%	64	492
Fuel Building		2 766					2 766	15%	415	3 181
Radwaste Building		3 370					3 370	15%	505	3 875
· Radw Bldg — Rad & Personnel Tunnel		18					18	15%	3	21
· Radw Bldg — Radwaste Drum Storage		453					453	15%	68	521
· Radw Bldg — Balance		2 898					2 898	15%	435	3 333
Reactor Building		5 182					5 182	15%	777	5 960
Turbine Building		6 162					6 162	15%	924	7 087
· Turb Bldg — Auxiliary Boiler		25					25	15%	4	28
· Turb Bldg — Balance		6 138					6 138	15%	921	7 058
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Wolf Creek G S Demolition Quantities		$5 881					$5 881	15%	$882	$6 763
Access Vaults		53					53	15%	8	61
Administration		298					298	15%	45	343
Chlorine Storage		24					24	15%	4	28
Circulating Water Discharge Structure		500					500	15%	75	575
Circulating Water Intake & Screenhouse		1 180					1 180	15%	177	1 357
Covered Walkways		11					11	15%	2	13
Essential Service Water System Pumphouse		1 113					1 113	15%	167	1 280
Essential Service Water System Valve House		17					17	15%	3	20

DECOMMISSIONING COST ESTIMATE UPDATE — LINE ITEM REPORT

Wolf Creek Generating Station 1996 SAFSTOR Option (Delayed)

Cost ($Thousands) Activity:	Decon	Remove	Pack	Ship	Bury	Other	Total	Contingency		Estimate
MMO Building		245					245	15%	37	282
Miscellaneous Site Foundations		533					533	15%	80	613
Miscellaneous Site Structures (32 structures)		1 424					1 424	15%	214	1 637
Oil Separator and Waste Tank		3					3	15%	0	3
Security Building/Guardhouse		452					452	15%	68	519
Site Security Diesel Generator		4					4	15%	1	5
Waste Water Treatment		24					24	15%	4	28
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 5: Site Closeout Activities		$5 671				$170	$5 841	15%	$876	$6 718
Remove rubble		4 151					4 151	15%	623	4 774
Grade & landscape site		1 520					1 520	15%	228	1 748
Final report to NRC						170	170	15%	26	196
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 5: Activity Costs		$41 042				$170	$41 213	15%	$6 182	$47 394
Period 5: Undistributed Costs						$3 946	$3 946	14%	$551	$4 497
a Insurance						207	207	10%	21	227
b Property taxes						620	620	10%	62	682
c Heavy equipment rental						2 633	2 633	15%	395	3 027
d Small tool allowance						343	343	15%	52	395
e Plant energy budget						144	144	15%	22	166
Contingencies for a, b	50%	15%	10%	15%	15%	10%				
Contingencies for c, d, e (standard)	50%	15%	10%	15%	15%	15%				
Period 5: Staff Costs						$17 109	$17 109	15%	$2 566	$19 675
DOC staff costs						7 715	7 715	15%	1 157	8 873
Utility staff costs						9 394	9 394	15%	1 409	10 803
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 5: Total Costs		$41 042				$21 226	$62 268	15%	$9 299	$71 567
Total Cost to Decommission	$6 281	$62 575	$5 420	$5 792	$77 575	$429 444	$587 088	16%	$93 048	$680 136

Input Variables Summary

Indirect Personnel Overhead [%]	1996	1993
Utility O&B (All Labor)	71.0%	64.6%
DOC O&B (Administrative)	90.0%	90.0%
DOC O&B (General Labor)	40.0%	40.0%
Subcontractor Overhead and Profit [%]		
On Decommissioning Labor	21.0%	21.0%
On Demolition Labor	13.0%	13.0%
On Equipment and Materials	14.2%	14.2%
Work Efficiencies [%]		
Height Adjustment, 12' - 20'	15.0%	20.0%
Respiratory Protection Adjustment	37.5%	50.0%
Radiation/ALARA Adjustment	25.0%	32.0%
Protective Clothing Adjustment	22.5%	30.0%
Work Break Adjustment	8.3%	8.3%

Cost Component Chg from '93:	1996	Avg Annl
WCNOC Staff — Management Labor	11.3%	3.6%
WCNOC Staff — Contract Labor	12.3%	3.9%
DOC Staff Labor	10.3%	3.3%
Security Guards Labor	12.3%	3.9%
Craft Labor	9.1%	2.9%
Specialty Consultant Labor	10.1%	3.3%
Transportation Costs	3.1%	1.0%
Material and Equipment	9.0%	2.9%
NRC Fees	4.8%	1.6%
Emergency Planning Fees	17.9%	5.6%
Other	6.3%	2.1%
Radwaste Burial	10.0%	3.2%
Radwaste Off-Site Processing	72.4%	19.9%
Primary Liability Insurance	12.1%	3.9%
Excess Property Insurance (NEIL II)	-36.6%	-14.1%
Property Taxes (initial rate)	44.0%	12.9%
Electrical Energy	-14.2%	-5.0%
Oil	14.8%	4.7%
Total Cost Estimate	12.3%	3.9%

APPENDIX C

DECOMMISSIONING COST ESTIMATE UPDATE — LINE ITEM REPORT

Wolf Creek Generating Station 1996 ENTOMB Option (Delayed)

Cost ($Thousands) Activity:	Decon	Remove	Pack	Ship	Bury	Other	Total	Contingency	Estimate
Period 1: Activity Costs						$2 347	$2 347	15%	$352	$2 699
Prepare prelim decommissioning plan						143	143	15%	21	165
Review plant drawings and specs						506	506	15%	76	582
End product description						110	110	15%	17	127
Detailed by-product inventory						143	143	15%	21	165
Define major work sequence						826	826	15%	124	950
Perform safety analysis of operation						220	220	15%	33	253
Perform safety analysis						341	341	15%	51	393
Submit dismantling plan						57	57	15%	9	66
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 1: Undistributed Costs	$115		$282	$86	$1 200	$12 618	$14 300	15%	$2 097	$16 398
a Decon equipment						213	213	15%	32	245
b Decon supplies						154	154	25%	39	193
c DOC staff relocation expenses						952	952	15%	143	1 095
d Process liquid waste	115		59	79	341		594	21%	126	720
e Insurance						1 104	1 104	10%	110	1 214
f Property taxes						2 097	2 097	10%	210	2 306
g Health physics supplies						1 067	1 067	25%	267	1 334
i Disposal of DAW generated			223	7	858		1 088	14%	152	1 240
j Plant energy budget						6 315	6 315	15%	947	7 263
k NRC fees						219	219	10%	22	240
l Emergency planning fees						498	498	10%	50	548
Contingencies for a, c, d, i, j (standard)	50%	15%	10%	15%	15%	15%				
Contingencies for b, g	50%	15%	10%	15%	15%	25%				
Contingencies for e, k, l	50%	15%	10%	15%	15%	10%				
Period 1: Staff Costs						$62 294	$62 294	15%	$9 344	$71 638
DOC staff cost						5 251	5 251	15%	788	6 038
Utility staff cost						57 043	57 043	15%	8 556	65 600
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 1: Total Costs	$115		$282	$86	$1 200	$77 260	$78 942	15%	$11 794	$90 735
Period 2: Activity Specifications						$2 126	$2 126	15%	$319	$2 445
Prepare plant & facilities for entombment						542	542	15%	81	623
Plant systems						459	459	15%	69	528
Reinforced concrete						176	176	15%	26	203
Plant structures & buildings						344	344	15%	52	395
Waste management						506	506	15%	76	582
Facility & site closeout						99	99	15%	15	114
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 2: Detailed Work Procedures						$1 053	$1 053	15%	$158	$1 210
Plant systems						521	521	15%	78	599
Entombment structures						99	99	15%	15	114
Facility closeout & dormancy						132	132	15%	20	152
Auxiliary building						301	301	15%	45	346
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 2: Additional Work Procedures						$66	$66	15%	$10	$76
Prepare dismantling sequence						55	55	15%	8	63
Procure vacuum drying system						11	11	15%	2	13
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 2: Rack Removal	$268	$44	$101	$28	$1 195	$924	$2 560	19%	$477	$3 037
Remove spent fuel racks	268	44	101	28	1 195	924	2 560	19%	477	3 037
Contingencies	50%	25%	10%	15%	15%	15%				

DECOMMISSIONING COST ESTIMATE UPDATE — LINE ITEM REPORT

Wolf Creek Generating Station 1996 ENTOMB Option (Delayed)

Cost ($Thousands) Activity:	Decon	Remove	Pack	Ship	Bury	Other	Total	Contingency	Estimate
Period 2: Disposal of Plant Systems External to Entombment Barrier									
CP/WCGS Contam Components (System Specific)	$1 302	$6 894	$2 295	$512	$18 410	$7 378	$36 791	18%	$6 549	$43 340
BG - Chemical & Volume Control	420	602	205	56	2 548	665	4 496	19%	871	5 367
BL - Reactor Makeup Water		180	37	11	263	164	655	17%	114	770
BM - Steam Generator Blowdown		405	123	34	1 194	509	2 266	17%	374	2 640
BN - Borated Refueling Water Storage		193	66	11	421	316	1 008	17%	167	1 175
EC - Fuel Pool Cooling & Cleanup		294	84	21	770	357	1 527	17%	254	1 782
EJ - Residual Heat Removal		262	91	21	951	337	1 663	16%	271	1 934
EM - High Pressure Coolant Injection		205	68	20	615	285	1 193	16%	196	1 389
EP - Accumulator Safety Injection		104	32	7	225	144	513	17%	86	598
GG - Fuel Building HVAC		183	53	12	615	146	1 009	17%	167	1 176
GH - Radwaste Building HVAC		128	33	8	348	104	622	17%	104	726
GL - Auxiliary Building HVAC		332	55	14	344	253	998	18%	180	1 178
GN - Containment Cooling		392	123	26	1 328	371	2 241	16%	369	2 610
GR - Containment Atmospheric Control		7	27	5	447	23	509	15%	76	585
GS - Containment Hydrogen Control		33	23	6	176	101	338	16%	53	391
GT - Containment Purge HVAC		85	38	6	382	131	642	16%	103	745
HA - Gaseous Radwaste		192	84	18	608	189	1 091	16%	179	1 269
HB - Liquid Radwaste	456	525	154	32	977	468	2 611	23%	596	3 207
HC - Solid Radwaste		306	246	32	1 081	343	2 008	16%	320	2 328
HD - Decontamination		51	56	7	159	104	377	16%	59	436
HE - Boron Recycle		324	84	21	520	326	1 276	17%	220	1 495
HF - Secondary Liquid Waste	389	585	227	43	1 116	609	2 968	21%	629	3 597
KE - Fuel Handling & Storage, RPV Service		7	9	6	316		338	15%	51	389
LD - Chemical & Detergent Waste	37	89	23	6	147	101	402	20%	81	483
LF - Floor & Equipment Drains		1 297	248	65	1 593	1 152	4 356	18%	771	5 126
RM - Process Sampling & Analysis		71	50	15	764	147	1 048	15%	162	1 210
SJ - Nuclear Sampling		39	55	7	502	34	637	15%	97	734
Contingencies for Contaminated Systems	50%	25%	10%	15%	15%	15%				
CP/WCGS Contam Comp (Non-System Specific)		$898	$384	$123	$2 744	$2 066	$6 216	16%	$1 003	$7 219
Auxiliary Building		317	132	44	983	740	2 215	16%	357	2 572
Control Building		290	136	44	973	732	2 174	16%	348	2 522
Fuel Building		46	19	6	151	114	337	16%	54	391
Radwaste Building		136	59	18	397	300	910	16%	147	1 057
Reactor Building		110	38	12	240	181	581	17%	96	677
Contingencies for Contaminated Systems	50%	25%	10%	15%	15%	15%				
Period 2: Erect Scaffolding for Syst Removal		$855					$855	15%	$128	$984
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 2: Decon of Site Bldgs Ext Entomb Barrier	$1 180	$369	$147	$45	$3 861	$335	$5 937	22%	$1 333	$7 270
Auxiliary Building	476	30	64	19	1 959	93	2 640	21%	562	3 203
· Aux Bldg — Hot Machine Shop	18		1	1	49		69	24%	17	86
· Aux Bldg — Balance	458	30	63	18	1 909	93	2 571	21%	546	3 117
Control Building	10	1	1	1	40	1	55	22%	12	67
Fuel Building	423	323	46	15	743	195	1 745	25%	440	2 185
Radwaste Building	271	15	36	10	1 119	46	1 496	21%	319	1 815
· Radw Bldg — Rad & Personnel Tunnel	10		1	1	24		36	25%	9	45
· Radw Bldg — Radwaste Drum Storage	27	1	3	1	112	3	148	21%	32	179
· Radw Bldg — Balance	234	13	31	8	984	43	1 313	21%	279	1 591
Contingencies for Contaminated Structures	50%	25%	10%	15%	15%	15%				
Period 2: Entombment Operations		$620				$443	$1 063	15%	$159	$1 223
Prepare support equipment for storage		125					125	15%	19	144
Isolate systems & components at entombment		56					56	15%	8	64
Construct entombment barriers		419					419	15%	63	482
Install containment pressure equalizer line		20					20	15%	3	23
Interim survey prior to dormancy						316	316	15%	47	364
Prepare and submit interim report						127	127	15%	19	146
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 2: Activity Costs Subtotal	$2 750	$9 681	$2 928	$707	$26 210	$14 391	$56 667	18%	$10 137	$66 803

DECOMMISSIONING COST ESTIMATE UPDATE — LINE ITEM REPORT

Wolf Creek Generating Station 1996 ENTOMB Option (Delayed)

Cost ($Thousands) Activity:	Decon	Remove	Pack	Ship	Bury	Other	Total	Contingency	Estimate
Period 2: Undistributed Costs	$243		$689	$314	$3 504	$9 304	$14 053	16%	$2 314	$16 367
a Decon equipment						199	199	15%	30	229
b Decon supplies						289	289	25%	72	361
c DOC staff relocation expenses						891	891	15%	134	1 025
d Process liquid radwaste	243		271	302	1 897		2 712	18%	478	3 190
e Insurance						468	468	10%	47	515
f Property taxes						888	888	10%	89	977
g Health physics supplies						1 997	1 997	25%	499	2 497
h Heavy equipment rental						1 130	1 130	15%	170	1 300
i Small tool allowance						167	167	15%	25	192
j Pipe cutting equipment						619	619	15%	93	712
l Disposal of DAW generated			418	13	1 607		2 037	14%	285	2 322
m Plant energy budget						2 548	2 548	15%	382	2 930
n NRC fees						46	46	10%	5	51
o Emergency planning fees						61	61	10%	6	67
Contingencies for a, c, d, h, i, j, k, l, m	50%	15%	10%	15%	15%	15%				
Contingencies for Undistributed items b, g	50%	15%	10%	15%	15%	25%				
Contingencies for Undist items e, f, n, o	50%	15%	10%	15%	15%	10%				
Period 2: Staff Costs						$38 664	$38 664	15%	$5 800	$44 463
DOC staff costs						9 381	9 381	15%	1 407	10 789
Utility staff costs						29 282	29 282	15%	4 392	33 675
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 2: Total Costs	$2 992	$9 681	$3 616	$1 021	$29 714	$62 359	$109 384	17%	$18 250	$127 634
Period 3: Entombed Annual Maintenance Cost						$2 412	$2 412	15%	$362	$2 773
Health physics supplies						7	7	15%	1	8
Insurance						51	51	15%	8	58
Property taxes						444	444	15%	67	511
Maintenance supplies						55	55	15%	8	63
Plant energy budget						89	89	15%	13	102
NRC Fees						9	9	15%	1	11
Site maintenance staff						1 757	1 757	15%	264	2 020
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 3: Entombed Maintenance Cost — 49.6 yr						$119 617	$119 617	15%	$17 943	$137 560
Period 4: Entombment Dismantling Activity Costs						$1 114	$1 114	15%	$167	$1 281
Review plant drawings and specifications						143	143	15%	21	165
Submit for possession-only license						110	110	15%	17	127
End product description						35	35	15%	5	41
Detailed by-product inventory						165	165	15%	25	190
Define major work sequence						110	110	15%	17	127
Perform safety analysis of operation						220	220	15%	33	253
Perform safety analysis of end product						220	220	15%	33	253
Submit dismantling plan						110	110	15%	17	127
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 4: Undistributed Costs						$4 196	$4 196	16%	$675	$4 871
a DOC staff relocation expenses						891	891	15%	134	1 025
b Insurance						351	351	10%	35	386
c Property taxes						666	666	10%	67	733
d Health physics supplies						999	999	25%	250	1 248
e Heavy equipment rental						246	246	15%	37	283
f Plant energy budget						973	973	15%	146	1 119
g NRC fees						70	70	10%	7	77
Contingencies (standard) for items a, e, f	50%	15%	10%	15%	15%	15%				
Contingencies for Undistributed items d	50%	15%	10%	15%	15%	25%				
Contingencies for Undistributed items b, c, g	50%	15%	10%	15%	15%	10%				
Period 4: Staff Costs						$18 821	$18 821	15%	$2 823	$21 644
DOC staff costs						4 802	4 802	15%	720	5 523
Utility staff costs						14 019	14 019	15%	2 103	16 122
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 4: Total Costs						$24 131	$24 131	15%	$3 665	$27 796

DECOMMISSIONING COST ESTIMATE UPDATE — LINE ITEM REPORT

Wolf Creek Generating Station 1996 ENTOMB Option (Delayed)

Cost ($Thousands) Activity:	Decon	Remove	Pack	Ship	Bury	Other	Total	Contingency	Estimate
Period 5: Activity Specifications						$4 380	$4 380	15%	$657	$5 037
Re-activate plant and temporary facilities						811	811	15%	122	933
Plant systems						459	459	15%	69	528
Reactor internals						782	782	15%	117	899
Reactor vessel						716	716	15%	107	823
Biological shield						55	55	15%	8	63
Steam generators						344	344	15%	52	395
Reinforced concrete						176	176	15%	26	203
Turbine & condenser						88	88	15%	13	101
Plant structures & buildings						344	344	15%	52	395
Waste management						506	506	15%	76	582
Facility & site closeout						99	99	15%	15	114
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 5: Planning & Site Preparations						$3 573	$3 573	15%	$536	$4 109
Prepare dismantling sequence						264	264	15%	40	304
Plant preparation & temporary services						1 635	1 635	15%	245	1 880
Design water clean-up system						154	154	15%	23	177
Rigging/CCES/tooling/etc.						1 384	1 384	15%	208	1 592
Procure casks/liners & containers						135	135	15%	20	156
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 5: Detailed Work Procedures						$3 524	$3 524	15%	$529	$4 053
Plant systems						521	521	15%	78	599
Vessel head						275	275	15%	41	317
Reactor internals						275	275	15%	41	317
Remaining buildings						149	149	15%	22	171
CRD cooling assembly						110	110	15%	17	127
CRD housings & ICI tubes						110	110	15%	17	127
Incore instrumentation						110	110	15%	17	127
Reactor vessel						400	400	15%	60	460
Facility closeout						132	132	15%	20	152
Missile shields						50	50	15%	7	57
Biological shield						132	132	15%	20	152
Steam generators						506	506	15%	76	582
Reinforced concrete						110	110	15%	17	127
Turbine & condensers						344	344	15%	52	395
Reactor building						301	301	15%	45	346
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 5: Nuclear Steam Supply System Removal	$460	$6 879	$831	$4 365	$36 867		$49 402	21%	$10 308	$59 710
a Reactor coolant piping	66	127	67	19	2 221		2 499	16%	407	2 907
b Pressurizer relief tank	12	60	5	4	211		292	18%	54	346
c Reactor coolant pumps & motors	25	38	35	43	3 753		3 894	15%	595	4 488
d Pressurizer	24	29	4	11	1 376		1 444	16%	228	1 671
e Steam generators	134	2 674	143	3 765	19 238		25 953	16%	4 200	30 154
f CRDMS/ICIS/service structure removal	58	39	22	15	641		774	18%	139	913
g Reactor vessel internals	41	1 058	270	237	6 666		8 271	23%	1 940	10 212
h Reactor vessel	101	2 855	285	271	2 762		6 274	44%	2 745	9 019
Contingencies for reactor vessel & internals	50%	75%	25%	25%	15%	15%				
Contingencies for others	50%	25%	10%	15%	15%	25%				
Period 5: Disposal of Plant Systems	$191	$5 632	$76	$19	$873	$240	$7 031	16%	$1 130	$8 161
CP/WCGS Contam Comp (Syst Specific)	$52	$172	$76	$19	$873	$240	$1 432	17%	$242	$1 674
BB - Reactor Coolant		125	76	19	873	240	1 333	16%	209	1 541
EN - Containment Spray	52	47					100	33%	33	133
Contingencies	50%	25%	10%	15%	15%	15%				

DECOMMISSIONING COST ESTIMATE UPDATE — LINE ITEM REPORT

Wolf Creek Generating Station 1996 ENTOMB Option (Delayed)

Cost ($Thousands) Activity:	Decon	Remove	Pack	Ship	Bury	Other	Total	Contingency		Estimate
CP/WCGS Non-Contam Comp (Syst Specific)	$47	$1 772					$1 818	16%	$289	$2 108
AB - Main Steam		148					148	15%	22	170
AC - Main Turbine		139					139	15%	21	160
AD - Condensate		141					141	15%	21	162
AE - Feedwater		96					96	15%	14	110
AF - Feedwater Htr Extraction, Drains, Vents		143					143	15%	22	165
AK - Condensate Demineralizer		49					49	15%	7	56
AL - Auxiliary Feedwater		21					21	15%	3	24
AP - Condensate Storage & Transfer		41					41	15%	6	48
AQ - Condensate & Feedwater Chem Addition		13					13	15%	2	15
CA - Steam Seal		13					13	15%	2	15
CB - Main Turbine Lube Oil		29					29	15%	4	33
CC - Generator Hydrogen & CO2		5					5	15%	1	6
CD - Generator Seal Oil		7					7	15%	1	9
CE - Stator Cooling Water		6					6	15%	1	7
CF - Lube Oil Storage, Transfer, Purification		22					22	15%	3	26
CG - Condenser Air Removal		17					17	15%	3	20
CH - Main Turbine Control Oil		31					31	15%	5	35
EB - Closed Cooling Water		34					34	15%	5	39
EG - Component Cooling Water		142					142	15%	21	164
EN - Containment Spray	47	42					89	33%	30	119
FA - Auxiliary Steam Generator		7					7	15%	1	9
FB - Auxiliary Steam		69					69	15%	10	79
FC - Auxiliary Turbines		33					33	15%	5	38
FE - Auxiliary Steam Chemical Addition		3					3	15%	0	4
GA - Plant Heating		74					74	15%	11	86
GB - Central Chilled Water		54					54	15%	8	62
GK - Control Building HVAC		156					156	15%	23	180
GM - Diesel Generator Building HVAC		29					29	15%	4	33
GP - Containment Integrated Leak Rate Test		6					6	15%	1	7
JE - Emergency Fuel Oil		33					33	15%	5	38
KJ - Standby Diesel Engine		107					107	15%	16	123
LB - Roof Drains		58					58	15%	9	67
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
WCGS Non-Contam Comp (System Specific)		$2 111					$2 111	15%	$317	$2 427
AN - Demineralized Water Storage & Transfe		43					43	15%	6	50
AX - Acid Feed		20					20	15%	3	23
CL - Chlorination		15					15	15%	2	17
CO - Carbon Dioxide		4					4	15%	1	5
CW - Circulating Water		200					200	15%	30	230
CZ - Caustic Acid		3					3	15%	0	4
DA - Circulating Water		207					207	15%	31	238
DM - Equipment Drains		63					63	15%	9	73
DO - Diesel Oil		1					1	15%	0	1
EA - Service Water		66					66	15%	10	76
EF - Essential Service Water		81					81	15%	12	93
FO - Fuel Oil		15					15	15%	2	17
FP - Fire Protection		160					160	15%	24	184
GD - Essntl Svce Water Pmphse Bldg HVAC		9					9	15%	1	11
GE - Turbine Building HVAC		108					108	15%	16	124
GF - Miscellaneous Building HVAC		35					35	15%	5	40
HY- Hydrogen		6					6	15%	1	7
KA - Compressed Air & Instrument		169					169	15%	25	194
KB - Breathing Air		27					27	15%	4	32
KC - Fire Protection		292					292	15%	44	336
KD - Domestic Water		48					48	15%	7	56
KH - Service Gas		19					19	15%	3	22
LA - Sanitary Drains		14					14	15%	2	16
LC - Yard Drains		2					2	15%	0	2
LE - Oily Waste		103					103	15%	15	119
NT - Nitrogen		4					4	15%	1	5
OX - Oxygen		4					4	15%	1	5
ST - Sewage Treatment		24					24	15%	4	28
SW - Screen Wash		16					16	15%	2	18
SZ - Service Air		50					50	15%	7	57

DECOMMISSIONING COST ESTIMATE UPDATE — LINE ITEM REPORT

Wolf Creek Generating Station 1996 ENTOMB Option (Delayed)

Cost ($Thousands) Activity:	Decon	Remove	Pack	Ship	Bury	Other	Total	Contingency		Estimate
VA - I&C Shop HVAC		3					3	15%	0	4
VB - I&C Shop Computer Room HVAC		2					2	15%	0	2
VC - Health Physics Computer Room HVAC		5					5	15%	1	6
VH - Circ Water & Makeup Water Scrnhse Ve		6					6	15%	1	7
VJ - Shop Bldg Machine Shop Area Ventilatio		1					1	15%	0	1
VL - Shop Building HVAC		2					2	15%	0	2
VS - Administration Building HVAC		5					5	15%	1	6
VT - Technical Support Building HVAC		2					2	15%	0	2
VV - Miscellaneous Building HVAC		3					3	15%	0	4
VW - Waste Water Treatment Ventilation		1					1	15%	0	1
WD - Domestic Water		26					26	15%	4	30
WG - Gland Water & Motor Cooling Water		18					18	15%	3	21
WL - Cooling Lake Makeup & Blowdown		18					18	15%	3	21
WM - Makeup Demineralizer		97					97	15%	15	112
WS - Plant Service Water		86					86	15%	13	99
WT - Waste Water Treatment		18					18	15%	3	21
WZ - Radioactive Liquid Waste		5					5	15%	1	6
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
CP/WCGS Decon-able Comp (Non-Syst Spec)	$92	$388					$480	22%	$104	$584
Auxiliary Building	33	143					176	22%	38	213
Control Building	34	131					165	22%	37	202
Fuel Building	3	17					20	21%	4	24
Radwaste Building	12	49					60	22%	13	73
Reactor Building	11	49					59	21%	13	72
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
CP/WCGS Clean Comp (Non-Syst Specific)		$1 189					$1 189	15%	$178	$1 367
Auxiliary Building		428					428	15%	64	492
Control Building		400					400	15%	60	460
Fuel Building		55					55	15%	8	63
Radwaste Building		162					162	15%	24	186
Reactor Building		144					144	15%	22	166
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 5: Erect Scaffolding for Syst Removal		$62					$62	15%	$9	$71
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 5: Decontamination of Site Buildings	$823	$351	$151	$44	$4 045	$340	$5 754	20%	$1 179	$6 933
Reactor Building	823	351	151	44	4 045	340	5 754	20%	1 144	6 898
Contingencies	50%	25%	10%	15%	15%	15%				
Period 5: License Termination Survey						$329	$329	15%	$49	$379
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 5: Total Activity Costs	$1 474	$12 924	$1 058	$4 427	$41 786	$12 386	$74 055	19%	$14 397	$88 452
Period 5: Undistributed Costs	$233		$703	$180	$3 483	$14 087	$18 686	16%	$3 055	$21 741
a Decon equipment						227	227	15%	34	261
b Decon supplies						408	408	25%	102	510
c DOC staff relocation expenses						1 015	1 015	15%	152	1 167
d Process liquid waste	233		118	159	689		1 199	21%	255	1 454
e Insurance						870	870	10%	87	956
f Property taxes						1 221	1 221	10%	122	1 344
g Health physics supplies						2 825	2 825	25%	706	3 531
h Heavy equipment rental						4 807	4 807	15%	721	5 529
i Small tool allowance						221	221	15%	33	254
j Pipe cutting equipment						705	705	15%	106	811
k Disposal of DAW generated			585	22	2 793		3 400	14%	481	3 881
l Plant energy budget						1 525	1 525	15%	229	1 754
m NRC fees						263	263	10%	26	289
Contingencies (standard) for a c d e h i j k l	50%	15%	10%	15%	15%	15%				
Contingencies for b, g	50%	15%	10%	15%	15%	25%				
Contingencies for e, f, m	50%	15%	10%	15%	15%	10%				

DECOMMISSIONING COST ESTIMATE UPDATE — LINE ITEM REPORT

Wolf Creek Generating Station 1996 ENTOMB Option (Delayed)

Cost ($Thousands) Activity:	Decon	Remove	Pack	Ship	Bury	Other	Total	Contingency	Estimate
Period 5: Staff Costs						$48 399	$48 399	15%	$7 260	$55 659
DOC staff costs						14 977	14 977	15%	2 247	17 224
Utility staff costs						33 422	33 422	15%	5 013	38 435
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 5: Total Cost	$1 707	$12 924	$1 761	$4 607	$45 268	$74 872	$141 140	18%	$24 712	$165 851
Period 6: Removal of Major Equipment		$306					$306	15%	$46	$352
Main turbine/generator		74					74	15%	11	85
Main condensers		232					232	15%	35	267
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 6: Demolition of Remaining Site Bldgs		$35 065					$35 065	15%	$5 260	$40 325
CP/WCGS Demolition Quantities		$29 184					$29 184	15%	$4 378	$33 562
Auxiliary Building		8 441					8 441	15%	1 266	9 708
· Aux Bldg — Hot Machine Shop		24					24	15%	4	27
· Aux Bldg — Balance		8 418					8 418	15%	1 263	9 680
Control Building		2 835					2 835	15%	425	3 260
· Ctrl Bldg — Communications Corridor		372					372	15%	56	428
· Ctrl Bldg — Balance		2 463					2 463	15%	369	2 832
Diesel Generator Building		428					428	15%	64	492
Fuel Building		2 766					2 766	15%	415	3 181
Radwaste Building		3 370					3 370	15%	505	3 875
· Radw Bldg — Rad & Personnel Tunnel		18					18	15%	3	21
· Radw Bldg — Radwaste Drum Storage		453					453	15%	68	521
· Radw Bldg — Balance		2 898					2 898	15%	435	3 333
Reactor Building		5 182					5 182	15%	777	5 960
Turbine Building		6 162					6 162	15%	924	7 087
· Turb Bldg — Auxiliary Boiler		25					25	15%	4	28
· Turb Bldg — Balance		6 138					6 138	15%	921	7 058
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Wolf Creek G S Demolition Quantities		$5 881					$5 881	15%	$882	$6 763
Access Vaults		53					53	15%	8	61
Administration		298					298	15%	45	343
Chlorine Storage		24					24	15%	4	28
Circulating Water Discharge Structure		500					500	15%	75	575
Circulating Water Intake & Screenhouse		1 180					1 180	15%	177	1 357
Covered Walkways		11					11	15%	2	13
Essential Service Water System Pumphouse		1 113					1 113	15%	167	1 280
Essential Service Water System Valve House		17					17	15%	3	20
MMO Building		245					245	15%	37	282
Miscellaneous Site Foundations		533					533	15%	80	613
Miscellaneous Site Structures (32 structures)		1 424					1 424	15%	214	1 637
Oil Separator and Waste Tank		3					3	15%	0	3
Security Building/Guardhouse		452					452	15%	68	519
Site Security Diesel Generator		4					4	15%	1	5
Waste Water Treatment		24					24	15%	4	28
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 6: Site Closeout Activities		$5 671				$170	$4 321	15%	$648	$4 970
Remove rubble		4 151					4 151	15%	623	4 774
Grade & landscape site		1 520								
Final report to NRC						170	170	15%	26	196
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 6: Activity Costs Subtotal		$41 042				$170	$39 692	15%	$5 954	$45 646

DECOMMISSIONING COST ESTIMATE UPDATE — LINE ITEM REPORT

Wolf Creek Generating Station 1996 ENTOMB Option (Delayed)

Cost ($Thousands) Activity:	Decon	Remove	Pack	Ship	Bury	Other	Total	Contingency	Estimate
Period 6: Undistributed Costs						$3 938	$1 305	12%	$155	$1 460
a Insurance						207	207	10%	21	227
b Property taxes						620	620	10%	62	682
c Heavy equipment rental						2 633				
d Small tool allowance						343	343	15%	52	395
e Plant energy budget						136	136	15%	20	156
Contingencies for a, b	50%	15%	10%	15%	15%	10%				
Contingencies for c, d, e (standard)	50%	15%	10%	15%	15%	15%				
Period 6: Staff Costs						$17 109	$17 109	15%	$2 566	$19 675
DOC staff costs						7 715	7 715	15%	1 157	8 873
Utility staff costs						9 394	9 394	15%	1 409	10 803
Contingencies (standard)	50%	15%	10%	15%	15%	15%				
Period 6: Total Costs		$41 042				$21 217	$58 107	15%	$8 675	$66 782
Total Cost to Decommission	$4 841	$64 007	$5 690	$5 747	$76 612	$381 595	$534 315	16%	$85 517	$619 833

Input Variables Summary

Indirect Personnel Overhead [%]	1996	1993
Utility O&B (All Labor)	71.0%	64.6%
DOC O&B (Administrative)	90.0%	90.0%
DOC O&B (General Labor)	40.0%	40.0%
Subcontractor Overhead and Profit [%]		
On Decommissioning Labor	21.0%	21.0%
On Demolition Labor	13.0%	13.0%
On Equipment and Materials	14.2%	14.2%
Work Efficiencies [%]		
Height Adjustment, 12' - 20'	15.0%	20.0%
Respiratory Protection Adjustment	37.5%	50.0%
Radiation/ALARA Adjustment	25.0%	32.0%
Protective Clothing Adjustment	22.5%	30.0%
Work Break Adjustment	8.3%	8.3%

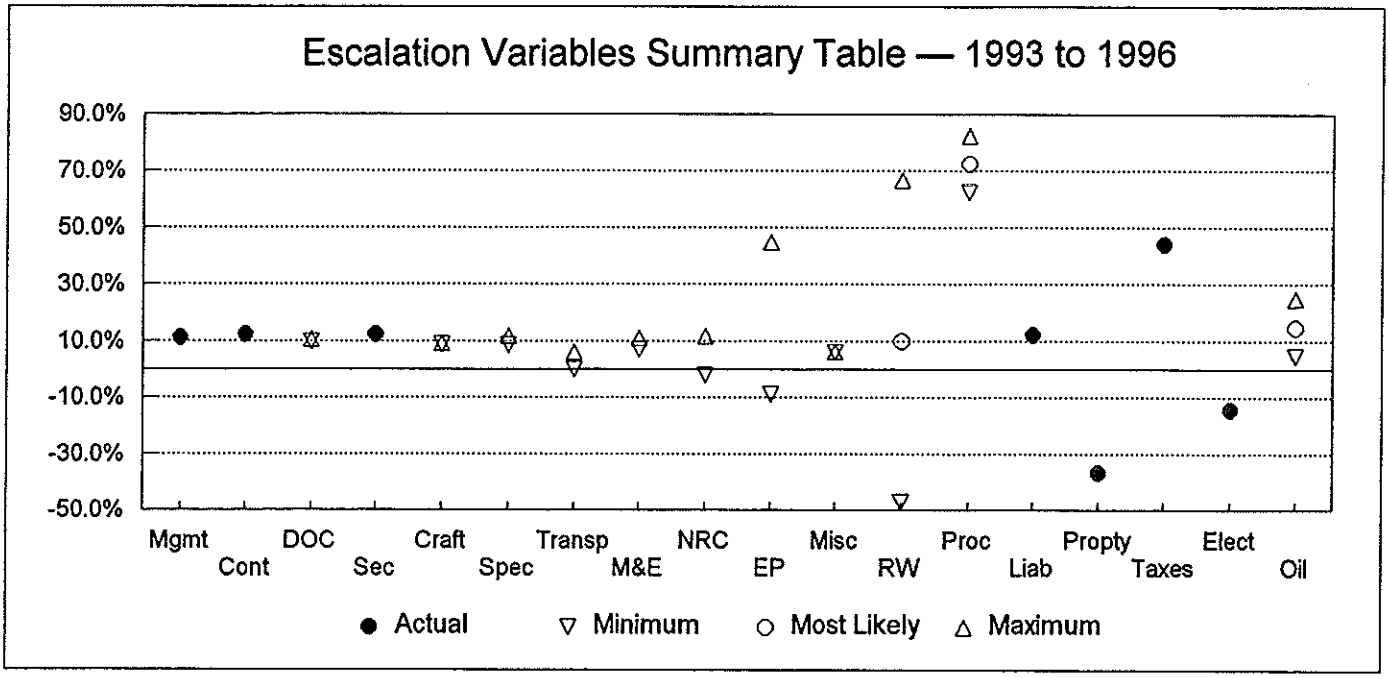
Cost Component	Chg from '93:	1996	Avg Annl
WCNOC Staff — Management Labor		11.3%	3.6%
WCNOC Staff — Contract Labor		12.3%	3.9%
DOC Staff Labor		10.3%	3.3%
Security Guards Labor		12.3%	3.9%
Craft Labor		9.1%	2.9%
Specialty Consultant Labor		10.1%	3.3%
Transportation Costs		3.1%	1.0%
Material and Equipment		9.0%	2.9%
NRC Fees		4.8%	1.6%
Emergency Planning Fees		17.9%	5.6%
Other		6.3%	2.1%
Radwaste Burial		10.0%	3.2%
Radwaste Off-Site Processing		72.4%	19.9%
Primary Liability Insurance		12.1%	3.9%
Excess Property Insurance (NEIL II)		-36.6%	-14.1%
Property Taxes (initial rate)		44.0%	12.9%
Electrical Energy		-14.2%	-5.0%
Oil		14.8%	4.7%
Total Cost Estimate		11.3%	3.6%

APPENDIX D

Wolf Creek GS Decommissioning Cost Estimate September 1996
Input Variables and Ranges

	Escalation Variables (Change From 1993 To 1996)			
Escalation Variables	**Actual**	**Minimum**	**MostLikely**	**Maximum**
Utility Management Labor	11.3%			
Utility Contract Labor	12.3%			
DOC Staff Labor		9.8%		10.7%
Security Guard Labor	12.3%			
Craft Labor		8.9%		9.3%
Specialty Consultant Labor		8.5%		11.7%
Transportation		0.090%		6.2%
Material and Equipment		7.0%		11.1%
NRC Fees		-2.1%		11.8%
Emergency Planning Fees		-8.9%		44.7%
Miscellaneous		6.2%		6.4%
Radwaste Burial		-47.0%	10.0%	66.7%
Radwaste Processing		62.4%	72.4%	82.4%
Primary Liability Insurance	12.1%			
Excess Property Insurance	-36.6%			
Property Taxes (initial rate)	44.0%			
Electrical Energy	-14.2%			
Fuel Oil		4.8%	14.8%	24.8%

	Other Variables (Cost Adders)		
Indirect Personnel Overhead	**Minimum**	**MostLikely**	**Maximum**
Utility O&B (All Labor)	61.0%	71.0%	81.0%
DOC O&B (Administrative)	80.0%	90.0%	100.0%
DOC O&B (General Labor)	30.0%	40.0%	50.0%
Subcontractor Overhead and Profit			
On Decommissioning Labor	11.0%	21.0%	31.0%
On Demolition Labor	3.0%	13.0%	23.0%
On Equipment and Materials	4.2%	14.2%	24.2%
Work Efficiencies			
Height Adjustment, 12' - 20'	10.0%		20.0%
Respiratory Protection Adjustment	25.0%		50.0%
Radiation/ALARA Adjustment	10.0%		40.0%
Protective Clothing Adjustment	15.0%		30.0%
Work Break Adjustment	0.0%	8.3%	16.7%



Wolf Creek GS Decommissioning Cost Estimate September 1996
Input Variables and Ranges

Escalation Variable	Source of Data or Basis of Change from 1993 to 1996 Cost Estimate
Utility Management Labor	
Actual	in-house historical wages data
Minimum	-
Most Likely	-
Maximum	-
Utility Contract Labor	
Actual	in-house historical wages data
Minimum	-
Most Likely	-
Maximum	-
DOC Staff Labor	
Actual	-
Minimum	Ref 1: Private industry workers, Professional specialty and technical occupations
Most Likely	-
Maximum	Ref 1: Private industry workers, Executive, administrative, and managerial occupations
Security Guard Labor	
Actual	in-house historical contract data
Minimum	-
Most Likely	-
Maximum	-
Craft Labor	
Actual	-
Minimum	Ref 2: Midwest (formerly North Central)
Most Likely	-
Maximum	Ref 1: Private industry workers, Blue collar workers - Handlers, equipment cleaners, helpers, and laborers
Specialty Consultant Labor	
Actual	-
Minimum	lower limit of UE confidential in-house policy for consultants, based on Ref 3
Most Likely	-
Maximum	upper limit of UE confidential in-house policy for consultants, based on Ref 3
Transportation	
Actual	-
Minimum	Ref 4: Railroads, line haul operations (code 4011)
Most Likely	-
Maximum	Ref 4: Trucking and courier services, except air (code 421)
Material and Equipment	
Actual	-
Minimum	Ref 5: All commodities
Most Likely	-
Maximum	Ref 5: Chemical and allied products (code 06)
NRC Fees	
Actual	-
Minimum	anticipated fees based on extrapolation of actual historical charges
Most Likely	-
Maximum	actual hourly rate charged for resident NRC inspector

Wolf Creek GS Decommissioning Cost Estimate — September 1996
Input Variables and Ranges

Escalation Variable	Source of Data or Basis of Change from 1993 to 1996 Cost Estimate
Emergency Planning Fees	
Actual	-
Minimum	anticipated fees based on extrapolation of actual historical charges
Most Likely	-
Maximum	anticipated fees based on extrapolation of actual historical charges
Miscellaneous	
Actual	-
Minimum	Ref 6: All commodities except farm products
Most Likely	-
Maximum	Ref 7: Total manufacturing
Radwaste Burial	
Actual	-
Minimum	Ref 8: current low estimate for LLW compacts ($160/ft³)
Most Likely	current base fees for CNSI at Barnwell, South Carolina ($330/ft³)
Maximum	Ref 8: current high estimate for LLW compacts ($500/ft³)
Radwaste Processing	
Actual	-
Minimum	most likely less 10%
Most Likely	Ref 8: current average for recycling ($100/ft³)
Maximum	most likely plus 10%
Primary Liability Insurance	
Actual	current actual insurance premiums
Minimum	-
Most Likely	-
Maximum	-
Excess Property Insurance	
Actual	current actual insurance premiums
Minimum	-
Most Likely	-
Maximum	-
Property Taxes	
Actual	Owners' Tax Departments' estimate for decommissioning period
Minimum	-
Most Likely	-
Maximum	
Electrical Energy	
Actual	estimated current marginal replacement power costs with Wolf Creek offline
Minimum	-
Most Likely	-
Maximum	-
Fuel Oil	
Actual	-
Minimum	most likely less 10%
Most Likely	based on 1996 actual cost
Maximum	most likely plus 10%

Wolf Creek GS Decommissioning Cost Estimate — September 1996
Input Variables and Ranges

Indirect Personnel Overhead	Source of Data or Basis of Change from 1993 to 1996 Cost Estimate
Utility O&B (All Labor)	
Actual	-
Minimum	most likely less 10%
Most Likely	based on Wolf Creek actuals
Maximum	most likely plus 10%
DOC O&B (Administrative)	
Actual	-
Minimum	most likely less 10%
Most Likely	estimated in 1993 by TLG - no change
Maximum	most likely plus 10%
DOC O&B (General Labor)	
Actual	-
Minimum	most likely less 10%
Most Likely	estimated in 1993 by TLG - no change
Maximum	most likely plus 10%
Subcontractor Overhead and Profit	
On Decommissioning Labor	
Actual	-
Minimum	most likely less 10%
Most Likely	estimated in 1993 by TLG - no change
Maximum	most likely plus 10%
On Demolition Labor	
Actual	-
Minimum	most likely less 10%
Most Likely	estimated in 1993 by TLG - no change
Maximum	most likely plus 10%
On Equipment and Materials	
Actual	-
Minimum	most likely less 10%
Most Likely	estimated in 1993 by TLG - no change
Maximum	most likely plus 10%

Wolf Creek GS Decommissioning Cost Estimate — September 1996
Input Variables and Ranges

Work Efficiencies	Source of Data or Basis of Change from 1993 to 1996 Cost Estimate
Height Adjustment, 12' - 20'	
Actual	-
Minimum	AIF/NESP-036 lower limit
Most Likely	-
Maximum	AIF/NESP-036 upper limit
Respiratory Protection Adjustment	
Actual	-
Minimum	AIF/NESP-036 lower limit
Most Likely	-
Maximum	AIF/NESP-036 upper limit
Radiation/ALARA Adjustment	
Actual	-
Minimum	AIF/NESP-036 lower limit
Most Likely	-
Maximum	AIF/NESP-036 upper limit
Protective Clothing Adjustment	
Actual	-
Minimum	AIF/NESP-036 lower limit
Most Likely	-
Maximum	AIF/NESP-036 upper limit
Work Break Adjustment	
Actual	-
Minimum	most likely less 10% (or zero, whichever is higher)
Most Likely	AIF/NESP-036 figure
Maximum	most likely plus 10% (or double, whichever is lower)

NOTE: TLG used the upper limit for these work efficiency adjustments in their 1993 study.

References

Ref 1 Monthly Labor Review, Table 21 - Employment Cost Index, Compensation, by occupation and industry group

Ref 2 Monthly Labor Review, Table 24 - Employment Cost Index, Compensation, Workers, By Region

Ref 3 Consumer Price Index, Table 6 - CPI for Urban Wage Earners and Clerical Workers (CPI-W): U. S. city average, by expenditure category and commodity and service group, All items.

Ref 4 Producer Price Indexes, Table 5

Ref 5 Producer Price Indexes, Table 6

Ref 6 Producer Price Indexes, Table 8

Ref 7 Producer Price Indexes, Table 4

Ref 8 "Trends in Decommissioning Costs — A Five-Year Retrospective", a paper delivered by John Carlson, TLG Services, Inc. Tuesday afternoon, April 16, 1996 ANS Topical Meeting on D&D, Chicago, Illinois

NOTE: June 1993 and June 1996 data are used for references 1 through 7.

APPENDIX E

DECOMMISSIONING COST STUDY

for the

WOLF CREEK GENERATING STATION

Prepared for the

WOLF CREEK NUCLEAR OPERATING CORPORATION

August 1993

prepared by

TLG Engineering, Inc.
for
TLG Services, Inc.

Bridgewater, Connecticut

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APPENDICES

TABLES & FIGURES

REVISION LOG

Rev.	Date	Description	Approval
0	8-24-93	Original Issue	WAC

EXECUTIVE SUMMARY

A site-specific cost estimate was performed for the decommissioning of the Wolf Creek Generating Station (WCGS) by TLG Services, Inc., of Bridgewater, Connecticut (TLG). This study addressed the decommissioning options to DECON, SAFSTOR or ENTOMB. Using the DECON alternative, work is anticipated to be completed by 2033, and the total costs for decommissioning WCGS is anticipated to be $369,789,856 in 1993 dollars. For the deferred alternatives, work is anticipated to be completed in 2087, with total expenditures of $605,733,632 and $556,846,208 for the SAFSTOR and ENTOMB scenarios, respectively.

This study provides cost estimates for decommissioning WCGS under current requirements and based upon present-day technology. Using drawings and inventory documents, TLG and Wolf Creek Nuclear Operating Corporation (WCNOC) estimated quantities and volumes of the equipment and material removed during decommissioning. A unit cost factor was then applied to the volumes and quantities to estimate the removal of "activity dependent" costs. The period dependent costs were then determined from a detailed critical path schedule based on the removal activities.

The estimates considered that the final core discharge of spent fuel would be stored in the Fuel Building for approximately five years, following final shutdown in 2025, in accordance with the U.S. Department of Energy's (DOEs) minimum cooling requirements for acceptance. Decommissioning activities within the Fuel Building would be limited until the final core load, as well as the remainder of the spent fuel generated during plant operations, could be transferred to DOE's Waste Management System for deep geologic disposal. This is assumed, for this study, to be accomplished approximately five years following the cessation of plant operations.

This study includes the following additional considerations:

Burial of low-level radioactive wastes at a Central Interstate regional facility within 700 miles of the plant site. Base rates were provided by WCNOC along with information from currently operating facilities on disposal fee schedules.

Low-level waste classified as "greater than class C" packaged for disposal with the high-level spent nuclear fuel at a cost comparable to that envisioned for spent fuel.

Contingency was included in the estimate to address the many uncertainties that exist in a project of this nature. The analysis, prepared on a line item basis, used a range of contingencies selected to reflect conditions and uncertainties likely to be present at the time of decommissioning.

In addition to estimated costs, the report includes program schedules, scrap projections and estimates of occupational radiation exposures and low-level radioactive waste volumes inherent in the proposed decommissioning scenarios.

1. SUMMARY

The Wolf Creek Generating Station (WCGS) is located approximately 3.5 miles northeast of the town of Burlington, in Coffey County, Kansas, approximately 75 miles southwest of Kansas City, Kansas. The station is comprised of a single pressurized water reactor with supporting facilities. WCGS was designed and constructed under the standardization program SNUPPS (Standardized Nuclear Unit Power Plant System). WCGS is owned by Kansas Gas and Electric Company, Kansas City Power & Light Company and Kansas Electric Power Cooperative, Inc. (Owners). The Owners formed a wholly-owned subsidiary corporation, Wolf Creek Nuclear Operating Corporation (WCNOC), to act as their agent in performing all functions related to the operation, maintenance, repair, decommissioning and decontamination of WCGS.

This study provides estimates associated with the decommissioning of the nuclear unit at WCGS, following the conclusion of its operation: cost; schedule; waste generation/disposition; and radiation exposure. The study considers the decommissioning methods of DECON, SAFSTOR and ENTOMB .

DECON of a power reactor consists of the removal of all fuel assemblies and source material, radioactive fission and corrosion products, and all other radioactive materials having activities above Regulatory Guide 1.86, NUREG 5512 and other applicable release limits shortly after the cessation of plant operations. The facility operator may then have unrestricted use of the site with no requirement for a Nuclear Regulatory Commission (NRC) license. DECON is described in the rule on decommissioning issued by the NRC, "General Requirements for Decommissioning Nuclear Facilities." In this study, the site is cleared of all above-grade structures and site improvements, and the land returned to a state consistent with adjacent areas.

There are advantages to the DECON alternative. The alternative is less costly, in 1993 dollars, than the scenarios involving extended delays in the station dismantling. (The ultimate cost for any alternative will depend upon future economic factors such as inflation and policy factors such as future NRC regulations and waste policy decisions and actions.) DECON eliminates a potential long-term safety hazard, and those individuals familiar with the nuclear facility will still be available to support the dismantling effort. DECON also relieves the utility of long term obligations and liability for continuing maintenance of the property.

SAFSTOR places and maintains the facility in protective storage once spent fuel and source material are removed. Concurrently, the plant staff conducts general plant decontamination activities, radiation surveys, and the processing and removal of any

radioactive waste materials remaining from operations. In addition, a possession-only license is obtained and the security, surveillance and maintenance plans for the delay period implemented. Delayed dismantling (decontamination) activities are initiated such that license termination is accomplished within the 60 year time period set by the NRC. As with the DECON alternative, this study further assumes that the remainder of the reactor facility is dismantled and site restoration is performed.

The cost of the SAFSTOR alternative is increased by the cost incurred in maintaining the station in protective storage. However, SAFSTOR does have other advantages over the DECON alternative. Primarily, the dormancy period provides a period of decay for the residual radioactive material, resulting in lower personnel radiation exposures during dismantling, than are incurred in the DECON alternative, and potential savings in the cost of disposal for the waste volume generated during decommissioning operations.

ENTOMB also consists of placing the facility into protective storage. Initial activities consist of removing from the site all contaminated components, systems and structures outside the designated entombment boundary and sealing the remaining radioactivity within an entombment structure (usually the massive, concrete central portion of the containment or reactor building). This structure provides for isolation of the entire radioactive inventory on the site during the delay period. Additional activities involve the securing of a possession-only license, and the implementation of security and surveillance plans for the delay period. Dismantling activities are initiated after the delay or dormancy period and consist of radiation surveys, removal of the entombment structure and materials within it, processing and disposing of any remaining solid and liquid radioactive wastes followed by the restoration and release of the site as described in the DECON alternative.

While the disposal cost of spent fuel assemblies generated during plant operation is not considered a decommissioning expense, the presence of those assemblies on-site does have a bearing on the cost to decommission. This study recognizes that the current wet spent fuel storage facilities at WCGS will be active approximately five years after operations cease. This duration is based upon the Department of Energy's (DOE) minimum criteria for fuel turnover and transfer to a federal repository.

This study provides cost estimates for decommissioning WCGS under current requirements based upon present-day costs and available technology. Cost and schedule estimates presented herein are based upon the complete removal of all components and structures within the property lines, as the station is presently configured, except as noted within the body of this report. The total cost associated with decommissioning WCGS is shown in Table 1.1. The costs shown in Table 1.1 are summaries taken from the detailed cost tables in Appendix C and the scheduling analysis described in Section 5.

TABLE 1.1

WCGS
COST AND SCHEDULE ESTIMATE SUMMARY

	Cost, 93$ (thousands)	Schedule (months)
DECON		
Total	369,790	99.2
SAFSTOR		
Preparations	27,038	12.0
55 year maintenance cost	284,644	661.4
Delayed dismantling	294,052	70.3
Total	605,734	743.6
ENTOMB		
Preparations	194,612	77.0
50 year maintenance cost	129,568	595.2
Delayed dismantling	232,666	71.4
Total	556,846	743.6

2. INTRODUCTION

This analysis is designed to provide WCNOC with the information needed to prepare financial planning documents required by the NRC as well as state and local regulators. It is not a detailed engineering document, but a cost estimate prepared in advance of the detailed engineering preparations which will be necessary to carry out the decommissioning of WCGS. The costs estimated in this study should be considered in light of this qualification.

2.1 OBJECTIVE OF STUDY

The objective of this study is to estimate cost, schedule, occupational exposure and waste volume generated to decommission WCGS including all supporting facilities.

This study considers the license expiration date as March 11, 2025, 40 years from the date of issuance of the facility's low power operating license.

2.2 SITE DESCRIPTION

WCGS is located approximately 3.5 miles northeast of the town of Burlington, in Coffey County, Kansas, approximately 75 miles southwest of Kansas City, Kansas. The site is on the east side of a man-made lake formed by impounding Wolf Creek. The station is an 1150 MWe (nominal) pressurized water reactor plant with supporting facilities. The WCGS was designed and constructed under the standardization program SNUPPS.

The Nuclear Steam Supply Steam System (NSSS) was designed by Westinghouse Electric Corporation. The NSSS consists of a pressurized water reactor with four independent primary coolant loops, each of which contains a reactor coolant pump and a steam generator. An electrically heated pressurizer and connecting piping complete the system. The NSSS is rated at a thermal power level of 3425 MWt (3411 MWt reactor core plus, 14 MWt for reactor coolant pumps) with a corresponding turbine-generator gross output of 1186 MWe. The system is housed within a containment structure, a pre-stressed, post-tensioned concrete structure with cylindrical wall, a hemispherical dome, and a flat foundation slab. The wall and dome form a pre-stressed post-tensioned system. The inside surface of the structure is covered with a carbon steel liner, providing a leaktight membrane.

Heat produced in the reactor is converted to electrical energy by the Power Conversion System. This system converts the thermal energy of the steam into mechanical shaft power and then into electrical energy. The turbine-generator at WCGS is a tandem-compound, six-flow, four element, 1800 rpm unit. The unit consists of one high pressure and three low pressure turbine elements driving a directly coupled generator. The turbine is operated in a closed feedwater cycle which condenses the steam; the feedwater is returned to the steam generators. Heat rejected in the main condensers is removed by the Circulating Water system.

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

2.3 REGULATORY GUIDANCE

The NRC provides decommissioning guidance in the rule "General Requirements for Decommissioning Nuclear Facilities" (Ref. 1) in addition to that previously set forth in Regulatory Guide 1.86 (Ref. 2). This new rule defines three decommissioning alternatives acceptable to the NRC, i.e., DECON, SAFSTOR, and ENTOMB.

DECON is defined by the NRC 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."

SAFSTOR is defined as "the alternative in which the nuclear facility is placed and maintained in a condition that allows the nuclear facility to be safely stored and subsequently decontaminated (deferred decontamination) to levels that permit release for unrestricted use."

ENTOMB is defined as "the alternative in which radioactive contaminants are encased in a structurally long-lived material, such as concrete; the entombed structure is appropriately maintained and continued surveillance is carried out until the radioactive material decays to a level permitting unrestricted release of the property." However, this process (as with SAFSTOR) is restricted in overall duration to 60 years and therefore limited in application unless it can be shown that a longer duration is necessary to protect health and safety.

3. DECOMMISSIONING ALTERNATIVE DESCRIPTIONS

Three specific decommissioning alternatives were examined for the WCGS study: DECON, SAFSTOR and ENTOMB.

The dormancy durations selected for use in the SAFSTOR and ENTOMB alternatives was based upon the maximum allowable interval (60 years) between cessation of operations and termination of the site license(s). Although the alternatives differ with respect to technique, process, cost, and schedule, the three alternatives attain the same result: removal of all radioactive materials from the site and ultimate release of the site for unrestricted and/or alternative use.

The following sections describe the basic activities necessary for each alternative. Although detailed procedures for each activity required are not provided, and actual sequences of work may vary, these activity descriptions may provide a basis for detailed engineering planning and scheduling at the time of decommissioning.

3.1 DECON

This alternative deals with the immediate removal of all radioactive materials from the site after the cessation of operations. This study does not address the cost of the removal of spent fuel from the site because such costs are assumed to be covered through WCNOC's contract with DOE. However, the study does consider the constraints that the presence of spent fuel on site may impose on other decommissioning activities. In addition to the removal of radioactive material, this study also assumes the dismantling of the remaining structures from the site, thereby permitting return of WCGS for other use.

3.1.1 Period 1 - Preparations

Prior to the commencement of decommissioning operations, detailed preparations are undertaken to provide a smooth transition from plant operations to site decommissioning activities. These preparations include engineering planning, surveys of plant areas to determine contamination levels, activation analyses of the vessel and vessel internals, as well as the assembly of a decommissioning management organization. Final planning for activities and writing of activity specifications and detailed procedures also begin at this time. Period 1 ends upon receipt of a decommissioning order from the NRC.

3.1.1.1 Engineering and Planning

Prior to the commencement of decommissioning operations, WCNOC will file an application for license termination accompanied by a Decommissioning Plan (DP) with the NRC describing how it will remove all radioactive components and essentially all radioactive material from WCGS. This request for dismantling of the reactor and termination of the facility's license should include a detailed plan describing the organization and program that will be used during the decommissioning of the facility. The plan will accomplish the required tasks within the As-Low-As-Reasonably-Achievable (ALARA as defined in 10 CFR 20) guidelines for protection of personnel from exposure to radioactive and non-radioactive contaminants. It will also clearly describe how WCNOC will continue to protect the health and safety of the public and the environment during the dismantling activity.

Prior to the start of decommissioning operations, work begins on the documentation and planning necessary for both licensing change applications and for accomplishing the work required. The development of a decommissioning organization within the utility is essential to this planning. This development includes identifying the staff requirements and commitment of key personnel.

In preparation for a change in license, regulatory criteria applicable to decommissioning are reviewed. The existing technical specifications are reviewed and modified to reflect decommissioning requirements and to delete non-applicable operating specifications. A DP is prepared during this time.

In addition, a supplemental environmental report will be required by the NRC and all applicable records (i.e., as-built or revised drawings and specifications, operating records, and site-specific background data) will be needed.

Much of the work in the development of the DP is also relevant to the development of the detailed engineering plans and procedures. This work includes:

* Site preparation plans for decommissioning activities;

* Detailed procedures and sequences for removal of systems and components;

* Procedures for sectioning and disposing of the reactor vessel and its internals;

* Plans for decontamination of structures and systems;

* Design/procurement and testing of tooling and equipment;

* Identification/selection of specialty contractors;

* Procedures for removal and disposal of radioactive materials; and

* Sequential planning of activities to minimize conflicts with simultaneous activities.

3.1.1.2 Site Preparations

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

* Prepare site support and storage facilities as required.

* This study assumes that the spent fuel and source material generated over the operating life of the reactor will be removed from the site within a five year period following plant shutdown. This duration is based upon the minimum turnover requirements as established by DOE for spent fuel acceptance. While the fuel remains on site, the existing spent fuel handling facilities will remain operational. This activity may be carried out by existing plant personnel in accordance with standard operating technical specifications. Decommissioning operations are assumed to proceed around the Fuel Building, in essence to divorce the spent fuel issue from the balance of the decommissioning program. Following the spent fuel storage and shipment period, the remaining Fuel Building and its associated systems will be decontaminated and removed in like fashion as the balance of the WCGS site.

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

    * Conduct radiation surveys of work area contamination and general dose levels; major component, piping, and structure

dose levels (including the reactor vessel and its internals); internal piping contamination levels; and activation profiles from primary shield core samples.

* Calculate residual by-product material inventory for plant components, structures and systems, and normalize neutron flux profiles from operational survey data for development of packaging and shipping requirements and decommissioning safety requirements.

* Determine shipping container requirements for activated materials and fabricate such containers.

* Develop procedures for occupational exposure control, control and release of liquid and gaseous effluents, control of solid radwaste, site security and emergency programs, and industrial safety.

3.1.2 Period 2 - Decommissioning Operations and License Termination

The dismantling procedures may begin upon receipt of the dismantling order from the NRC. For the DECON alternative the decommissioning operations involve the following:

* Construct temporary facilities and arrange existing storage facilities to support the dismantling activities. These may include: changing rooms and contaminated laundry facilities for increased work force, protected and open laydown areas to facilitate equipment removal and shipping operations and additional roads to facilitate hauling and transportation.

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

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

* Procure required shipping casks, liners, and Low Specific Activity (LSA) containers from suppliers.

* 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.

* Remove and section control rod drive housings and instrumentation tubes from reactor vessel head.

* Reassemble reactor vessel head and flange (following flange separation from vessel) for shipment and burial as its own container.

* Segment upper and lower core support structures and in-core instrumentation and package in shielded casks. These operations are performed underwater by remote cutting equipment within a contamination control envelope. Ship and bury packaged items which meet 10 CFR 61 Class "C" requirements or less.

* Provide additional spent fuel casks to accommodate 10 CFR 61 "Greater Than Class C" (GTCC) reactor vessel internals materials and components.

* Remove the reactor coolant piping and pumps and package the piping in standard LSA containers. The reactor coolant pumps are sealed with steel plate so as to serve as their own containers. Ship and bury piping and pumps.

* Segment/section the reactor vessel and package into shielded containers. The operation is performed remotely in air using a contamination control envelope. Sections are placed in containers under water, e.g., in the refueling cavity. Ship and bury packaged items.

* 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, electrical systems, HVAC systems, water systems).

* Remove activated portions of the concrete biological shield and all 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.

* Remove steam generators and pressurizer for shipment and burial. Decontaminate exterior surfaces, as required, and seal-weld all openings in steam generators and pressurizer. These components can serve as their own burial containers provided that all penetrations are properly sealed.

* Pump low-density concrete grout into the primary side of the steam generator to control movement of loose contamination during transport. Pump concrete grout into the secondary side of the steam generator at the lower shells to provide additional shielding for transport.

* Decontaminate all remaining containment structure areas including steam generator and pressurizer cubicles.

* Decontaminate the Auxiliary Building as well as all contaminated outlying structures and facilities. This activity may necessitate the dismantling and disposition of most of the systems and components (both clean and contaminated) located within these buildings so as to facilitate surface decontamination and subsequent verification surveys required prior to obtaining release for demolition.

* Decontaminate Fuel Building with the conclusion of spent fuel transfer operations. Conduct final radiation survey to ensure that all radioactive materials have been removed from the Fuel Building. This survey may coincide with final NRC site inspection.

* Following notification by WCNOC of completion of the decontamination and disposal of components and materials from the facility, the NRC regional staff conducts an on-site survey to verify that the acceptable residual activity and contamination levels are satisfied. When the requirements are satisfied, the NRC can terminate the license for the station.

3.1.3 Period 3 - Site Restoration

Following completion of the decommissioning operations, site restoration activities may begin. Building foundations and portions of structures three feet below grade and lower are abandoned in place. The clean fill from above-grade structures demolition can be used to backfill voids created by the demolition process. Excess fill is removed from the site. Site areas affected by the dismantling activities are cleaned up and the plant area graded and landscaped as required. These activities include:

* Perform 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 is 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.

* Remaining buildings are then removed using conventional demolition techniques for above ground structures, including the Turbine Building, Auxiliary Building, Control Building, Diesel Generator Building, and other site structures.

* Prepare the final dismantling program report.

3.2 SAFSTOR

The SAFSTOR decommissioning alternative provides a condition that ensures public health and safety from radioactive material remaining at the site without the need for extensive modifications to the facility. During the SAFSTOR period the facility is left intact and all structures are maintained in a sound condition. Systems not required to be operational for support of the spent fuel pool and surveillance purposes during the dormancy period are drained, de-energized, and secured. Minimal cleaning/removal of loose contamination and/or fixation and sealing of remaining contamination are performed. Access to contaminated areas is secured to provide controlled access for inspection and maintenance.

The engineering and planning requirements are similar to those for the DECON alternative, although a shorter time period is expected for these activities. Site preparations are also similar to those for the DECON

alternative. However, with the exception of required radiation surveys, the mobilization and preparation of site facilities is less extensive.

3.2.1 Period 1 - SAFSTOR Operations

Prior to commencement of decommissioning operations, WCNOC will file a Decommissioning Plan (DP) with the NRC describing how it will remove all radioactive components and essentially all radioactivity from the WCGS site. This request for eventual dismantling of the reactor and termination of the facility's license includes a detailed plan describing the organization and program that will be used during the decommissioning of the facility. The plan will accomplish the required tasks within the ALARA guidelines for protection of personnel from exposure to radioactive and non-radioactive contaminants. It will also clearly describe how WCNOC will continue to protect the health and safety of the public and the environment during the dismantling activities.

Following approval of the DP by the NRC, the NRC issues an order authorizing implementation. The DP may then be implemented by WCNOC. The DP includes spent fuel disposition, partial decontamination, followed by a delay period before the remaining radioactive components are removed. The NRC may amend the operating license to permit "Possession Only" after final plant shutdown. This amended license would remain in effect until final decontamination of the site and its release is complete.

The "Possession Only" license permits ownership and possession of fuel, by-product material and reactor components, but does not permit operation of the reactor. This license status, though permitting significant relief from the technical specifications, still requires adequate surveillance, monitoring and reporting.

After plant shutdown, modified technical specifications are implemented. Spent fuel and in-core source materials are isolated in the spent fuel storage facilities awaiting ultimate disposal or until they can be transferred to another facility. These steps may be carried out by plant personnel in accordance with standard operating procedures. The residual inventories of liquid and solid wastes are processed and removed and plant radiation surveys initiated.

The decommissioning activities for the SAFSTOR alternative are as follows:

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

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

* Drain reactor vessel; internals will remain in place.

* Drain/de-energize/secure all contaminated systems. Decontaminate as required.

* 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.

* Install containment building pressure equalization line. This line should be provided with an absolute filter.

* Clean loose surface contamination from building access pathways.

* Perform final radiation survey of plant; post warning signs as appropriate.

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

* Spent fuel shipments to the DOE will continue throughout Period 1 and the first few years of the "dormancy" period.

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

* Nonradioactive structures, located outside the secured area, may be demolished. However, this study assumes that demolition would be delayed until after license termination.

* Sections of the site outside the controlled area may be graded and landscaped as required. Part of this site area may be released for unrestricted use or for restricted use, depending on the terms of the possession-only license.

* Prepare final decommissioning program report for submittal to NRC.

3.2.2 Period 2 - SAFSTOR Dormancy

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 buildings, maintenance of structural integrity, and an environmental and radiation monitoring program.

Maintenance and equipment inspection activities are provided by a utility maintenance staff. Their duty is to maintain the structures in a safe condition, provide adequate lighting, ventilation, and heating, and perform periodic preventative maintenance on essential equipment.

An environmental surveillance program is carried out during the dormancy period to ensure that releases of radioactive material to the environment are controlled. Such releases are identified and quantified. Appropriate emergency procedures are established and initiated for releases that exceed prescribed limits. The environmental surveillance program will be a abbreviated version of that carried out during normal plant operations.

Primary physical security is provided by the security fence which must be maintained in good condition for the duration of this period. Fire and radiation alarms will be monitored.

3.2.3 Periods 3 - 5 Deferred Decommissioning

Deferred decommissioning involves decontamination and dismantling processes similar to those described in the DECON alternative. SAFSTOR Period 3 activities would correspond to the DECON Period 1 Planning Phase, Period 4 to the Period 2 Decommissioning Operations Phase, and Period 5 to the Period 3 Site Restoration Phase. Section 3.1

of this report delineates the activities associated with each phase of the decommissioning process.

Although the initial radiation levels due to Co60 will decrease significantly during the dormancy period, the internal components of the reactor vessel will still have sufficiently high radiation dose rates to require remote sectioning under water due to the presence of long-lived radionuclides such as Nb94 and Ni59. Therefore, the dismantling procedures described for the DECON alternative would be employed. Portions of the concrete shield will still be radioactive because of the presence of activated trace elements with long half-lives (Eu152 and Eu154) and will require controlled removal, packaging, and burial procedures. 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 are surveyed as they are removed with disposition dependent upon the existing release criteria. No system in this study designated as contaminated in the DECON alternative is assumed to be releasable after the dormancy; they are removed and disposed of as contaminated material.

Because this alternative provides a period of decay of the residual radioactivity, lower personnel radiation exposures are incurred than with the DECON alternative. Many of the dismantling activities may employ manual techniques rather than remote procedures. Thus, dismantling operations can be simplified.

Following the completion of the decontamination and removal of radioactive components and materials from the facility, the NRC regional staff conducts an on-site survey to verify that the acceptable activity and contamination level requirements are satisfied. When the requirements are satisfied, NRC can terminate the license and any further NRC jurisdiction over the facility.

Site restoration activities may now be performed, similar to those for DECON, for structures still remaining on site. The site is graded and landscaped as required. A final decommissioning program completion report is then prepared.

3.3 ENTOMB

This alternative deals with creation of an entombment structure within the Reactor Building. An entombment structure is constructed within the containment structure to serve as an additional barrier in preventing contact with the reactor vessel and internals, steam generators, reactor coolant pumps and piping, and pressurizer, and the refueling pool area. This structure uses the existing biological shield concrete where possible; new concrete is added as necessary to provide a sealed reinforced concrete barrier around the primary system, preventing personnel access. Feedwater and steam piping to and from the steam generators is isolated. All radioactive material exterior to this structure is either moved within the entombment structure, or removed and packaged for off-site disposal. The decontaminated structures and systems and all other site structures and systems remain as is until after the dormancy period. At this time all remaining radioactive material within the entombment structure is removed.

In addition to removal of radioactivity, this study also assumes the removal of all remaining structures from the site; thereby ending WCNOC's liability and permitting release of the WCGS site for alternative use.

3.3.1 Period 1: Preparations

Prior to the start of the decommissioning process detailed preparations are undertaken to provide a smooth transition from operations to decommissioning. These preparations include engineering planning, surveys of plant areas to determine contamination levels, activation analyses of the vessel and vessel internals, as well as the assembly of a decommissioning management organization. Upon final shutdown, more detailed surveys and benchmarking of calculated estimates are performed to validate results. Final planning for activities and writing of activity specifications and detailed procedures also begin at this time.

3.3.1.1 Engineering and Planning

WCNOC will file a DP with the NRC describing how it will remove all radioactive components and essentially all radioactivity from the WCGS site. This request for eventual dismantling of the reactor and termination of the facility operating license should include a detailed plan describing the organization and program that will be used during the decommissioning of the facility. The plan should address how the major activities will be accomplished with the least possible personnel

exposure to radioactive and non-radioactive contaminants. It should also clearly describe how WCNOC will continue to protect the health and safety of the public and the environment during the dismantling activity.

The DP will address spent fuel disposition, partial decontamination and a delay period (assumed to be approximately 60 years for this study) before the remaining radioactive components are removed. The NRC may amend the operating license to permit "Possession Only" after final shutdown. This would pertain until final decontamination of the site and its release.

The "Possession Only" license permits ownership and possession of spent fuel, by-product material and reactor components, but does not permit operation of the reactor. This license status, though permitting significant relief from the technical specifications, still requires adequate surveillance, monitoring and reporting.

The goal in this method of decommissioning is to confine the highly radioactive or contaminated components (e.g., the reactor vessel and its internals) within concrete structures integral with the primary containment and other designated portions of the reactor building. This alternative includes the removal and disposal of all fuel assemblies, solid and liquid wastes, and any remaining radioactive materials, components, and structural materials exterior to the entombment structure(s). The engineering and planning requirements for this alternative are similar to those described for the DECON alternative. However, the DP should include descriptions for monitoring the structures/facility and the environment, with associated reports, security requirements, and any other activities necessary during the dormancy period.

3.3.1.2 Site Preparations

Site preparations for ENTOMB include most of the activities previously described for the DECON alternative. However, because ENTOMB is not as extensive as DECON, plant support and storage facility requirements may be less.

After final plant shutdown, modified technical specifications are implemented. Spent fuel and in-core source materials are isolated in the spent fuel storage facilities awaiting ultimate disposal or until they

can be transferred to another facility. These steps may be carried out by plant personnel in accordance with standard operating procedures.

An entombment structure is constructed within the containment structure to serve as an additional barrier in preventing contact with the reactor vessel and internals, steam generators, reactor coolant pumps and piping, pressurizer, and the refueling pool area. This structure uses the existing concrete where possible; new concrete is added as necessary to provide a sealed reinforced concrete barrier around the NSSS, preventing access. Except for draining and drying the reactor coolant system, only minimal work is performed on any component(s) within the entombment boundary prior to the dormancy period, thereby significantly reducing the occupational radiation exposure. Upon beginning the delayed dismantling portion of decommissioning, occupational exposure is reduced due to radioactive decay of the radionuclides during the dormancy period.

Liquid and solid wastes are processed and removed and plant radiation surveys conducted. The actual entombment program begins upon receipt of the Dismantling (ENTOMB) Order from the NRC.

Following approval of the DP by the NRC, the NRC will issue an order authorizing implementation. The DP may then be implemented by WCNOC.

3.3.2 Period 2: Entombment Operations

The activities necessary to accomplish the entombment requirements are as follows:

* Drain/de-energize/secure non-contaminated systems not required to support decommissioning operations.

* Convert the existing spent fuel storage facilities into a self contained wet fuel storage facility and isolate the Fuel Building from the power block such that decommissioning operations can commence. This activity may be carried out by existing plant personnel in accordance with standard operating technical specifications. Decommissioning operations are assumed to be scheduled around the Fuel Building to the greatest extent possible such that the overall project schedule is optimized.

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

* Drain reactor vessel, steam generators and pressurizer. Cut, cap, and seal weld all piping at the entombment boundary interface.

* Drain/de-energize/secure contaminated systems. Decontaminate, as required, and remove portions of these systems located outside entombment boundary. Package, ship, and bury removed systems; isolate remaining systems, if required, at the entombment boundary. Certain components can be moved or stored within the entombment structure.

* Prepare lighting and security alarm systems required for continued use. De-energize and/or secure sections of the fire protection, electric power, and HVAC systems not required for continued use.

* Remove all large contaminated components external to the entombment boundary(s). Where feasible, these components are decontaminated (in situ if possible, and therefore not removed) and released; otherwise the components are boxed/packaged and shipped for disposal as low specific activity (LSA) waste.

* Complete the entombment barrier(s) by capping and filling all openings and penetrations with concrete.

* Structural surfaces exterior to the entombment barrier should be cleaned/decontaminated to unrestricted levels. Equipment and normal personnel access hatches located outside the entombment barrier boundary remain operational with controlled access.

* An entombment structure pressure equalization line equipped with an absolute filter should be installed.

* Decommission all other radioactive structures and remove all radioactive materials for shipping and burial. Alternatively, selected contaminated material and non-combustible wastes may be transferred to storage within the entombment structure. Decontaminated structures other than the Reactor Building may remain intact with accesses properly secured against unauthorized entry.

* Drain and decontaminate spent fuel pool once all assemblies have been removed from the site or to another storage facility on-site. Decontaminate Fuel Building and secure access.

* Install security and surveillance monitoring equipment and relocate security fence around structures containing radioactive material as required.

* Perform final radiation survey of plant and post warning signs as appropriate.

* Prepare interim decommissioning program report for submittal to NRC.

Sections of the site outside the controlled area may be graded and landscaped as required and released for unrestricted use. All other site structures may remain intact.

3.3.3 Period 3: Dormancy

Activities required during the planned dormancy period, for the ENTOMB alternative, include routine inspection, preventive and corrective maintenance on safety systems, maintenance of structural integrity, and an environmental and radiation monitoring program. Maintenance and equipment inspection activities may also be distributed over a quarterly period in such a manner that all portions of the plant are inspected and maintained within that period.

An environmental surveillance program is carried out during the dormancy period to ensure that releases of radioactivity to the environment are controlled. Such releases should be identified and quantified. Appropriate emergency procedures should be established and initiated for releases that exceed prescribed limits. The environmental surveillance program is generally a modified/abbreviated version of that carried on during normal plant operations.

Security during the dormancy period is primarily conducted to prevent unauthorized entry and to protect the public from the consequences of their own actions. Security detection and notification systems used during plant operations are augmented by the installation of audible alarms. Additionally, silent alarms may be installed to alert off-site security personnel to trespass and fire. It is assumed for purposes of

this study that employment of full time on-site security personnel is required once fuel has been removed from the site. These personnel can provide periodic site checks and prompt response to alarms. Liaison with local law enforcement agencies is maintained and their assistance requested as necessary.

Primary physical security by the security fence must be maintained in good condition for the duration of this period. The facility is secured; exterior doors will be locked and alarmed for intrusion. Fire and radiation alarms are monitored continuously by security personnel.

The utility will designate a representative who will be responsible for controlling authorized entry into, and movement within, the facility. Interior access doors are also under his control. In addition, he is responsible for plant maintenance, surveillance programs and for providing notification and administrative reports for security breaches and taking appropriate actions.

3.3.4 Periods 4-6: Deferred Decommissioning

At the end of the dormancy period for the ENTOMB alternative, remaining structures will be completely dismantled. Basically, the same dismantling operations as those described for the DECON alternative are performed. Because this alternative provides a period of decay for the residual radioactivity, lower personnel radiation exposures are incurred than in the DECON alternative. Many of the dismantling activities may employ manual techniques rather than remote procedures, thus dismantling operations can be simplified.

Although the initial contact dose levels due to Co60 would decay significantly during the dormancy period, the internal components of the reactor vessel will still have sufficiently high radiation dose rates to require remote sectioning under water due to the presence of long-lived radionuclides such as Nb94, Ni59, and Ni63. In addition, the reactor vessel is segmented remotely for ALARA reasons. Therefore, the procedures described for the DECON alternative are employed. Portions of the concrete biological shield will still be radioactive because of the presence of activated trace elements with long half-lives and will require controlled removal, packaging, and burial procedures. It is unlikely that radioactive corrosion products on inner surfaces of piping and components will have decayed to levels that will permit unrestricted release or allow conventional removal. These systems and components

will have to be removed under controlled conditions and their interiors surveyed to determine their disposition as either radioactive waste or releasable as unrestricted scrap material.

Following notification by WCNOC of completion of the decontamination and disposal of components and materials from the facility, the NRC regional staff will conduct an on-site survey to verify that the acceptable activity and contamination levels are satisfied. When the requirements are satisfied, NRC can terminate the license and any further NRC jurisdiction over the facility.

Site restoration activities may now be performed, as are those for DECON, for those structures still remaining on site. The site is then graded and landscaped. A final decommissioning program completion report is prepared and the site released for unrestricted use.

4. COST ESTIMATE

A site-specific cost estimate was prepared for WCGS to account for the unique features of the NSSS, electric power generation systems, site buildings and structures. The basis for the estimate (including the source of information), methodology, site specific considerations, assumptions and total costs, are described in this section.

4.1 BASIS OF ESTIMATE

A site-specific cost estimate was developed using WCGS drawings and the inventory documents provided by WCNOC. These drawings and documents were used to develop the general arrangement of the facility and to determine estimates of building concrete volumes, steel quantities, and land area of the site restored. WCNOC developed the plant component inventory in conjunction with a similar effort by the Union Electric Company for the Callaway Plant nuclear unit.

This cost estimate is based on averages, such that the cost shown for the project is a reasonable approximation of what is expected to occur. Individual cost elements will vary and as such, this estimate, while a useful tool for cost control, may not provide sufficient detail for actual management of the decommissioning project and is not intended to replace detailed engineering or cost-benefit analyses.

Listed below are the major factors considered as the basis of the cost estimates:

1. WCGS drawings, including architectural and civil, were provided by WCNOC. The inventory of structural material, developed from these drawings, is essentially the same as that previously reported in WCNOC's response to the Missouri PSC stipulation (Ref. 3) for data relevant to estimating decommissioning costs. As mentioned, WCNOC developed the plant component data base which was also provided in response to the Missouri PSC stipulation. This inventory was used by TLG, with minor modification, to generate the cost estimates presented within this study.

2. Employee salary and craft labor rates for site administration, operations, construction and maintenance personnel were provided by WCNOC for positions identified by TLG Engineering.

3. Engineering services for such items as writing activity specifications, detailed procedures, detailed activation analyses, structural modifications, etc. are assumed to be provided by a Decommissioning Operations Contractor (DOC).

4. Material and equipment costs for conventional demolition and/or construction activities are taken from R.S. Means Construction Cost Data (Ref. 4).

5. Rates for shipping radioactive wastes were provided by Tri-State Motor Transit in published tariffs for this cargo (Ref. 5).

6. Disposition of radioactive wastes is a major contributor to the cost to decommissioning. The availability of burial sites is of national concern, with regional compacts being formed to provide adequate burial space for operating and planned reactors. In this study, a Central Interstate Compact burial facility is assumed (for cost estimating) to be located within 700 miles of the plant site. The cost for disposal in this, as yet undeveloped, site is based upon information from currently operating facilities along with the fee and surcharge structure used to generate total disposal costs (Ref. 6).

7. Costs in this estimate are in 1993 dollars. This estimate excludes interest and escalation. No present-value economic analysis is included.

8. Site property taxes were provided by WCNOC for inclusion in the total decommissioning cost.

9. This study does not address the removal or disposal of spent fuel from the site. The costs for such activities are assumed to be covered by WCNOC's contract with DOE and funded by DOE's 1 mill/kwhr surcharge. However, this study does consider the constraints that the presence of spent fuel on site may impose on other decommissioning activities due to the inability to ship spent fuel cooled less than five years to the DOE repository. Consequently, the Fuel Building at WCGS will not be available for decommissioning until approximately five years after the final shutdown.

10. This study presumes that any and all dry cask spent fuel storage canisters used to supplement plant storage capacity during operations will have been removed from the site prior to shutdown of the station.

11. The WCNOC staffing requirements during decommissioning vary with the level of effort associated with the various phases of the on-site storage of spent fuel.

12. In Period 1 of SAFSTOR/Delayed Dismantling, it was assumed that the level of effort required to accomplish the activities called for additional labor from off-site personnel. It is these personnel that are costed and accounted for in Period 1. The utility personnel perform the remaining activities as indicated in the detailed cost table (Table C-2) by the designation "a".

13. This 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, the use of respiratory protection and personnel protective clothing. These items lengthen a task's duration, which increases the costs and lengthens the schedule. ALARA planning is considered in the costs for engineering and planning, and in the development of activity specifications and detailed procedures.

14. This study is performed in accordance with the published study from the Atomic Industrial Forum/National Environmental Studies Project report AIF/NESP-036, "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates" (Ref. 7). The contents of those guidelines were prepared under the review of a task force consisting of representatives from utilities, state regulatory commissions, architect/engineering firms, the Federal Energy Regulatory Commission, the NRC, and the National Association of Regulatory Utility Commissioners.

4.2 METHODOLOGY

The methodology used to develop the cost estimates follows the basic approach presented in the AIF/NESP-036 study report and the US DOE "Decommissioning Handbook" (Ref. 8). These references utilize a unit cost factor method for estimating decommissioning activity costs to simplify the estimating calculations. Unit cost factors for concrete removal ($/cubic yard) steel removal ($/ton) and cutting costs ($/in) were developed from the labor and material cost information provided by WCNOC. With the item quantity (cubic yards, tons, inches, etc.) developed from plant drawings and inventory documents, the activity-dependent costs are estimated.

The unit cost factors used in this study reflect the latest available information about worker productivity in decommissioning, including the Shippingport Station Decommissioning Project, completed in 1989.

The 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. WCNOC provided typical salary and hourly rates for personnel associated with period-dependent costs. The costs for conventional demolition of nonradioactive structures, materials, backfill, landscaping and equipment rental were obtained from the "Building Construction Cost Data" published by R. S. Means (Ref. 4). Examples of unit cost factor development are presented in the AIF "Guidelines" study (Ref. 7), one of which is reproduced in Appendix A. Appendix B lists specific factors developed for the WCGS analyses.

The unit cost factor method provides a demonstrable basis for establishing reliable cost estimates. The detail of activities for labor costs (by craft) and equipment, and consumables costs provide 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.

"Contingencies" are defined in the American Association of Cost Engineers' Cost Engineers' Notebook (Ref. 9) 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, therefore a contingency factor has been applied. As with any major project, examples of items which could occur that have not been accounted for in this estimate are changes, the effects of craft labor strikes, bad weather halting or slowing down waste shipments to the burial grounds, equipment/tool breakage, changes in the anticipated plant shutdown conditions, etc. In the AIF/NESP-036 study, (Ref. 7), the types of unforeseeable events that are likely to occur in decommissioning are discussed and guidelines are provided for percentage contingency in each category. Application of contingency is assigned on a line item basis for this estimate.

In the past, most cost studies were similar in the weight or contribution of the individual cost components as compared to the total cost. As such, average contingencies were consistently calculated in the 23-27% range for a standard estimate, with 25% used as a typical value for decommissioning cost estimates by TLG as well as Battelle Pacific Northwest Laboratories, FERC and other regulating agencies. However, more recent cost estimates have deviated in composition from one utility, and in some instances from one nuclear unit, to the next. With extremes in the cost implications from issues such as the post-operational storage of spent fuel, and projections for low-level radioactive waste disposal, the distribution of cost components has shifted within current

estimates. As such, the same contingency analysis that calculated an average 25% value five years ago, can now yield a significantly different result.

4.3 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 these considerations identified below is included in this cost study.

4.3.1 Spent Fuel Disposition

The spent fuel bundles stored in the spent fuel pool will be transferred to the Department of Energy as per the existing contract between WCNOC and DOE. This is currently assumed to be completed by 2030, approximately five years following final plant shutdown. The decommissioning scenario has been constructed to permit freedom of the project from the restraints imposed by continued spent fuel storage and shipment. Once the spent fuel assemblies from the final core discharge have been transferred/shipped to DOE, the spent fuel storage and handling facilities are released for decommissioning.

4.3.2 Major Component Removal

The reactor pressure vessel and reactor internal components are segmented for disposal and shipped in shielded casks. Segmentation and packaging of the reactor vessel internals is performed in the refueling cavity 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 canal. Shipping cask specifications and United States Department of Transportation (US DOT) regulations will dictate segmentation and packaging methodology; all packages designated meet current physical and radiological limitations and regulations. All cask shipments are made in US DOT-approved, currently available, truck casks. The closure head is disposed of intact and is modified for shipment as its own container and shipped to the burial site with the steam generators, reactor coolant pumps and pressurizer.

Reactor coolant piping is cut from the reactor vessel once the water level in the vessel (used for personnel shielding during dismantling and cutting operations in and around the vessel) is dropped below the nozzle

zone. The piping is boxed and shipped by shielded van to the disposal site.

The steam generators are assumed to be removed as follows: an auxiliary trolley placed on the Reactor Building polar crane rail is used in conjunction with an elevated runway with a trolley outside the equipment hatch to extract the generators. The equipment hatch may be enlarged, or a secondary opening created, to accommodate removal of the generators. Once outside the containment structure, the generators are moved to a temporary staging area on-site. Concrete grout is pumped into the steam generators to control movement of radioactive contamination during transport, and for radiation shielding. Additional carbon steel shields will be welded onto the outer surface of the steam generator as required to meet transportation requirements. Impact limiters will be placed on the generator package to provide protection against possible accidents during rail transport. The generators and other large components will then be transferred to high-capacity railcars. These railcars transport the generators (and other NSSS components) to the regional burial site. This study assumes that the burial site has reasonable rail access for handling these high-capacity railcars.

The main turbine is dismantled using conventional maintenance procedures. The turbine rotors and shafts are removed to a clean laydown area 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 disposal as scrap along with the lower turbine casings.

4.3.3 Transportation Methods

TLG assumed that the NSSS components are moved by a combination of overland transporter and rail to the regional burial facility. These payloads include the reactor vessel closure head package, reactor coolant pumps, the steam generators and the pressurizer unit. In this study it is assumed that the steam generator units are removed sequentially and stored on-site in a temporary staging area. The generators are then rigged for loading onto the transports.

4.3.4 Site Conditions at Facility Closeout

It is assumed that the site is restored by regrading to conform to the adjacent landscape. Sufficient topsoil is to be placed to permit new growth of native vegetation.

4.4 ASSUMPTIONS

The following are the major assumptions made in the development of the cost estimates for WCGS.

1. WCNOC will hire a Decommissioning Operations Contractor (DOC). The DOC will provide sufficient staff to perform the preparatory demolition planning and scheduling, and manage the demolition efforts. Site security, health physics, quality assurance and overall site administration during decommissioning and demolition is provided by WCNOC. The demolition work is performed by the DOC, or a demolition subcontractor who will provide adequate staff, labor, equipment, materials and overhead to complete the demolition.

2. Only existing site structures and those presently in the construction stage are considered in the dismantling cost. Tentative designs and future site improvements are not considered.

3. A regional burial facility was assumed to exist within 700 miles of the WCGS site. This location was taken as the final destination for all low-level radioactive waste shipments from WCGS. The cost of burial at this yet-to-be-developed site was based upon information supplied by WCNOC, and from existing low-level radioactive waste disposal sites' published rate schedules.

4. No plant process system identified as being contaminated upon final shutdown will become releasable due to the decay period, i.e., there is no significant reduction in waste volume in delaying decommissioning.

5. The decommissioning activities will be performed in accordance with the current regulations which are assumed to be in place at the time of dismantling.

6. Nuclear liability insurance provides coverage for damage or injuries due to radiation exposure from equipment, material, etc. used during decom-

missioning. Nuclear liability insurance is phased out upon final decontamination of the site. WCNOC provided nuclear liability as well as property insurance premiums.

7. The NSSS (reactor vessel and reactor coolant systems) are chemically decontaminated using one chemical flush and two water rinses prior to segmentation. Typically, a decontamination factor (DF) of 10 is expected (Ref. 10). The NSSS flush will only be performed for the DECON mode.

8. Reactor vessel and internals packages conditions:

   Any fuel cladding failure that has occurred or may occur during the lifetime of the plant is assumed:

   a) 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 which permit the major NSSS components to be shipped as LSA waste and burial within the requirements of 10 CFR 61 or the regional burial ground; or

   b) to have necessitated systematic decontamination during the operating life of the plant and therefore the radionuclide levels are acceptable for transport as LSA waste and burial within the requirements of 10 CFR 61.

   The Control Element Assemblies (CEA) are integral to a number of the spent fuel assemblies. Separate disposal of the CEAs is therefore not required, and not considered a decommissioning expense.

   The curie contents of the vessel and internals at final shutdown are derived from those listed in NUREG/CR-3474 (Ref. 11). Actual estimates are derived from the Ci/gram values in NUREG/CR-3474 and adjusted for the different mass of WCGS components, projected operating life, as well as for different periods of decay. Additional short-lived isotopes were derived from NUREG/CR-0130 (Ref. 10) and NUREG/CR-0672 (Ref. 12) and benchmarked to the long-lived values from NUREG/CR-3474.

9. The reactor vessel and internals disposal costs are based on remote segmentation in-place, packaging in casks with shielding, and shipping by truck to the burial ground. A maximum normal road weight limit of

80,000 pounds is assumed for all truck shipments including cask shipments. This includes vessel segment(s), supplementary shielding, cask tie-downs and tractor trailer. 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.

10. Overland transport costs for the steam generators are based upon information provided by Reliance Trucking of Phoenix, Arizona. This company has handled the overland transport and installation of NSSS components for several plants.

11. Whenever possible, steam generators are removed sequentially and stored on site until ready to be moved. This scenario will consolidate shipping and reduce mobilization costs for the heavy haul vehicles.

12. WCNOC provides for the electrical power to be brought on-site required to demolish the plant.

13. Scrap generated during decommissioning is not included as a salvage credit line item in this study for two reasons: (1) the scrap value merely offsets the associated site removal and scrap reprocessing costs, and (2) a relatively low value of scrap exists in the market. Scrap processing and site removal costs are not included in the estimate.

    Decommissioning will take place sufficiently far in the future that all equipment will be worn, obsolete and suitable for scrap as deadweight quantities only. No equipment is salvageable as used equipment.

14. WCNOC removes all items of furniture, tools, mobile equipment such as forklifts, trucks, bulldozers, other similar mobile equipment and other such items of personal property owned by WCNOC that is easily removed without the use of special equipment. The costs for these activities are presumed to be covered by the WCNOC transition staff.

15. Existing warehouses will remain for use by the demolition contractor and its subcontractors, as well as WCNOC. The warehouses will be dismantled as they are no longer needed to support the decommissioning program.

16. All contaminated piping, components and structures other than the reactor vessel and internals are assumed to meet US DOT limits for LSA material.

17. The WCNOC staff will perform the following:

    * Fuel oil tanks will be emptied. Tanks are cleaned by flushing or steam cleaning as required prior to disposal.

    * Acid and caustic tanks are emptied through normal usage.

    * Excess acid or caustic removed to support disposal at the storage container is returned to the vendor at no credit or cost to the project.

    * Lubricating and transformer oils are drained and removed from site by a waste disposal vendor.

18. All structures and site improvements will be removed to three foot below local grade and the local terrain restored to the local grade level. The intake and discharge conduits will be sealed.

19. The perimeter fence is moved as appropriate to conform with the Site Security Plan in force at the various stages in the project.

20. All road and parking area base material is removed. Road and parking areas with asphalt surfacing or concrete are broken up and the asphalt and concrete used for backfill on site if needed. All gravel road and parking areas remain in place and the area covered with fill.

21. This study estimates that there will be some radioactive waste generated which 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 an alternative solution is approved by the NRC. The cost of disposal, unlike that for the spent fuel, is not covered by DOE's 1 mill/kWhr surcharge, and has been estimated from spent fuel equivalent disposal costs.

22. The existing electrical switchyard will remain after WCGS decommissioning in support of the WCNOC electrical transmission and distribution system.

23. WCGS is assumed to have no significant amount of asbestos or inventories of hazardous and toxic materials at the time of final shutdown.

24. To the greatest extent practical, non-compactible LLW is recovered through decontamination to reduce the total volume of radioactive material buried. The components and materials deemed suitable for recovery include mid-size and large piping, pumps, mid-size and large valves, plate and structural steel, and other metallic components that are easily surveyed and decontaminated. The recovery fractions assigned for these components range from 70% to 90%. Materials and components that are unlikely to be recovered include concrete, small bore piping, heat exchangers, and dry active waste (DAW). Recovery is not attempted for these components or materials due to the difficulty of surveying the material, or the unlikelihood of success in decontamination.

    The recovered waste that meets radioactive material release limits is released as clean scrap, requiring no further cost consideration. Material that does not meet release limits will be shipped as LLRW to the regional site for controlled burial.

    Compactible DAW, such as booties, glove liners, respirator filter cartridges, shipping containers, HP survey materials, etc. are assumed to be drummed and compacted to 10% of their original volume.

25. The number of cask shipments out of the containments is expected to average three over a two week period. Non-cask shipments are limited to three shipments per week.

4.5 COST ESTIMATE SUMMARY

Summaries of the decommissioning alternative costs with annual expenditures are provided in Tables 4.1a, b and c. These costs were taken from the detailed cost tables in Appendix C.

The detailed cost tables (Appendix C) show the detailed listing and costs of major activities for each decommissioning scenario. Note that "Decon" as used in the headings of these tables, refers to decontamination. It should be noted that "Total" as used in the heading of tables, is the sum of Decon, Remove, Pack, Ship and Bury as well as other miscellaneous items not listed (such as engineering and preparations). Staff relocation expenses are those costs

associated with moving DOC/WCNOC personnel to the site; either for per diem allowance or for moving expenses.

4.6 DECOMMISSIONING vs. SITE RESTORATION

The total projected station cost of decommissioning WCGS, for the DECON mode is $369,789,856. Of these total costs, the majority is directly attributable to the engineering and planning and the actual disposition of the residual radioactive material at WCGS. It should be noted, however, that a direct accounting of only these costs is not entirely accurate in portraying the actual cost of "decommissioning" as defined by the NRC and consideration must also be given to the methods of executing the decontamination processes.

Nuclear power plants are designed to contain the radioactive material generated during the normal operation of the facility. Accordingly, radioactive and potentially radioactive systems are located in shielded labyrinths, tunnels and pipe chases. This inaccessibility, while essential during operation, serves to impede decommissioning activities. Consequently, disposition of these components requires that, in many situations, additional access (and working space) be developed. This access is achieved by dismantling structures and components along the intended path of egress and in the immediate working area. In most instances, this material is non-radioactive and therefore not normally perceived as a necessary constituent in facility decontamination. However, failure to establish adequate working room will increase the residence times for decontamination and dismantling activities resulting in increases in the incurred occupational exposure.

The cost associated with the removal of non-contaminated and other releasable materials in support of the decommissioning process are commonly referred to as cascading costs. Cascading costs are identified in evaluating the dismantling processes involved in decommissioning WCGS and included with the license termination costs delineated in Appendix C. Consequently, for the utility to meet the intent of the NRC's definition of decommissioning, ("...release of the property for unrestricted use and termination of license") a cost of $307,315,744 would be required to terminate the facility's license(s), or approximately 83.11% of the total cost. This percentage of the total station projected costs for license termination at WCGS meets the NRC's minimum requirements for decommissioning as delineated in title 10 of the Code of Federal Regulations, Part 50.75. The remaining costs would be required for site restoration as described in Section 3.

TABLE 4.1a
SUMMARY OF DECON DECOMMISSIONING COSTS
(Thousands of 1993 Dollars)

Year	Period 1	Period 2	Period 3	Totals
2025	$10,623,119	$0		$10,623,119
2026	$16,102,992	$0		$16,102,992
2027	$25,963,805	$11,757,513		$37,721,318
2028	$0	$71,720,829		$71,720,829
2029	$0	$69,058,013		$69,058,013
2030	$0	$68,796,377		$68,796,377
2031	$0	$33,926,980	$15,978,271	$49,905,251
2032	$0	$0	$31,611,066	$31,611,066
2033	$0	$0	$14,250,891	$14,250,891
	$52,689,916	$255,259,712	$61,840,228	$369,789,856

TABLE 4.1b
SUMMARY OF SAFSTOR DECOMMISSIONING COSTS
(Thousands of 1993 Dollars)

Year	Period 1	Period 2	Period 3	Period 4	Period 5	Totals
2025	$21,866,696					$21,866,696
2026	$5,171,178	$7,167,411				$12,338,589
2027		$8,838,193				$8,838,193
2028		$8,838,193				$8,838,193
2029		$8,838,193				$8,838,193
2030		$5,647,590				$5,647,590
2031		$4,873,976				$4,873,976
2032 through 2070		$238,985,058				$238,985,058
2081		$1,455,516	$12,613,065			$14,068,581
2082			$17,072,305	$17,195,806		$34,268,112
2083				$85,916,926		$85,916,926
2084				$83,712,154		$83,712,154
2085				$15,595,689	$25,552,595	$41,148,284
2086					$31,489,056	$31,489,056
2087					$4,904,033	$4,904,033
	$27,037,874	$284,644,128	$29,685,370	$202,420,576	$61,945,684	$605,733,632

TABLE 4.1c
SUMMARY OF ENTOMB DECOMMISSIONING COSTS
(Thousands of 1993 Dollars)

Year	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Totals
2025	$10,456,451						$10,456,451
2026	$13,571,138						$13,571,138
2027	$13,534,059						$13,534,059
2028	$21,650,171						$21,650,171
2029	$20,650,573	$22,573,791					$43,224,364
2030		$57,375,052					$57,375,052
2031		$34,801,261	$1,022,868				$35,824,129
2032 through 2080			$128,015,880				$128,015,880
2081			$529,316	$12,988,483			$13,517,799
2082				$13,557,709	$17,515,936		$31,073,645
2083					$59,135,123		$59,135,123
2084					$56,925,121		$56,925,121
2085					$10,605,228	$25,549,445	$36,154,673
2086						$31,485,174	$31,485,174
2087						$4,903,429	$4,903,429
	$79,862,392	$114,750,104	$129,568,064	$26,546,192	$144,181,408	$61,938,048	$556,846,208

5. SCHEDULE ESTIMATE

The schedule for the decommissioning scenarios considered in this study follow the sequence presented in the AIF/NESP-036 study (Ref. 7) with minor changes to reflect recent experience and revised estimates. In addition, the scheduling has been revised to reflect spent fuel turnover (to DOE) requirements at shutdown.

TLG has prepared a schedule for decommissioning WCGS. The assumptions supporting this schedule are listed in Section 5.1. Figure 5.1 presents the schedule of key activities for the DECON alternative. Note that the activities listed in the schedules do not reflect a one to one correspondence with the activities in the cost tables in Appendix C, but reflect dividing some activities for clarity and combining others for convenience. A legend defining the schedule nomenclature and depictions is also included. The schedule was prepared using the "Microsoft Project" computer software (Ref. 13).

5.1 SCHEDULE ESTIMATE ASSUMPTIONS

The schedule estimate reflects the results of a precedence network developed for WCGS decommissioning activities, i.e., a PERT (Programmed Evaluation and Review Technique). The durations used in the precedence network reflect the actual manhour estimates from the cost tables in Appendix C. The schedule output is then adjusted by stretching certain activities over their slack range; other activities were pushed to the end of their slack period. The following assumptions were made in the development of the schedule for WCGS.

1. 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.

2. The Fuel Building will continue to serve as spent fuel storage until such time that all spent fuel has been removed from the site.

3. Vessel 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.

4. 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.

5. 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.

5.2 PROJECT SCHEDULE

The period-dependent costs presented in the cost tables in Appendix C are based upon the durations developed in the schedule for the three decommissioning alternatives. 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 total costs for these items.

Project timelines for the DECON, SAFSTOR and ENTOMB alternatives are included in this section as Figure 5.2. Milestone dates are based on a 40 year plant operating life.

5.3 SPENT FUEL SCHEDULE IMPACT

The decommissioning scenarios allows for approximately five years of wet fuel storage in the spent fuel pool. Other decommissioning activities such as vessel segmentation, steam generator removals, reactor and auxiliary building system removals, etc. are performed in parallel with the spent fuel storage and shipment.

FIGURE 5.1
DECON ACTIVITY SCHEDULE

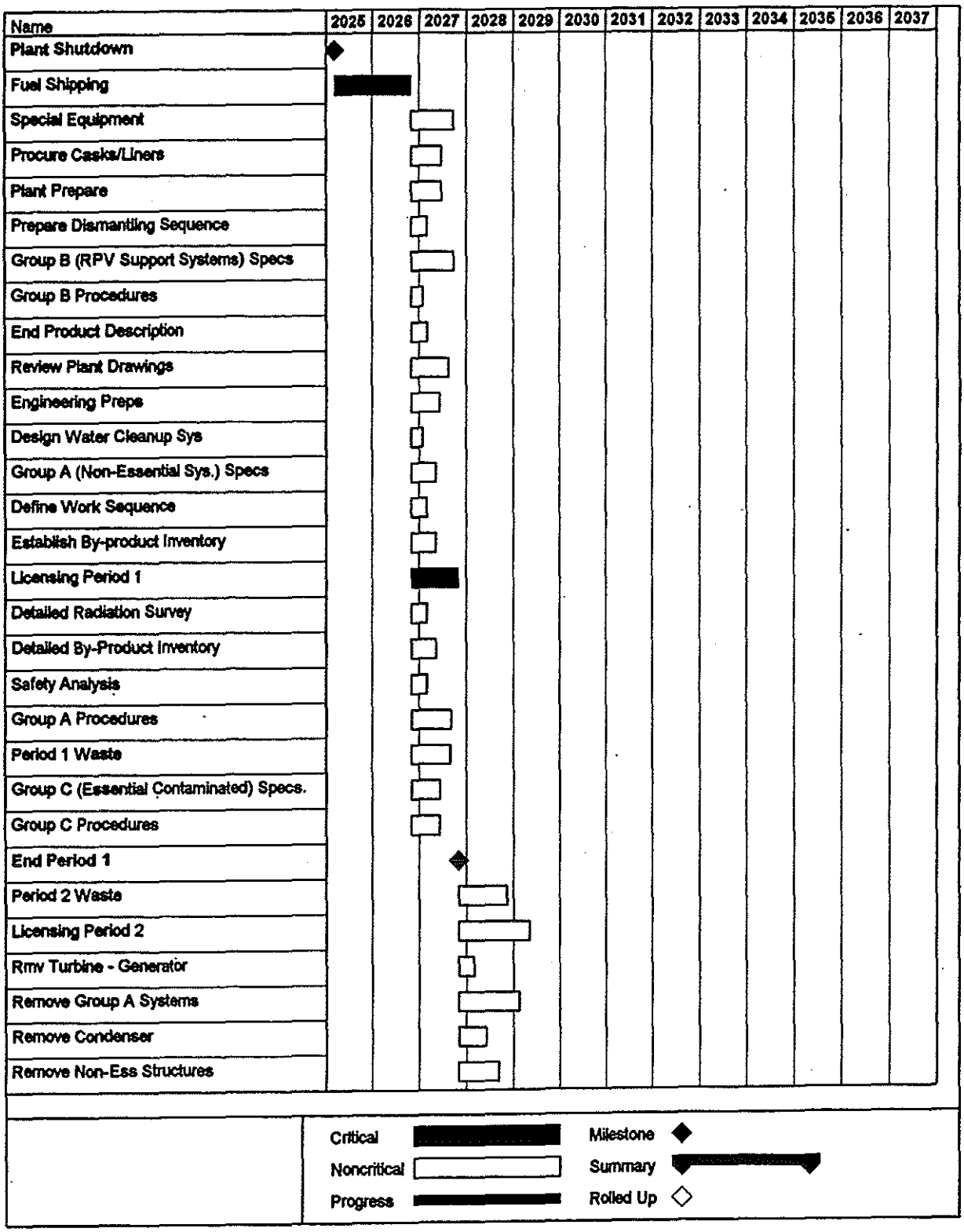


FIGURE 5.1
DECON ACTIVITY SCHEDULE
(continued)

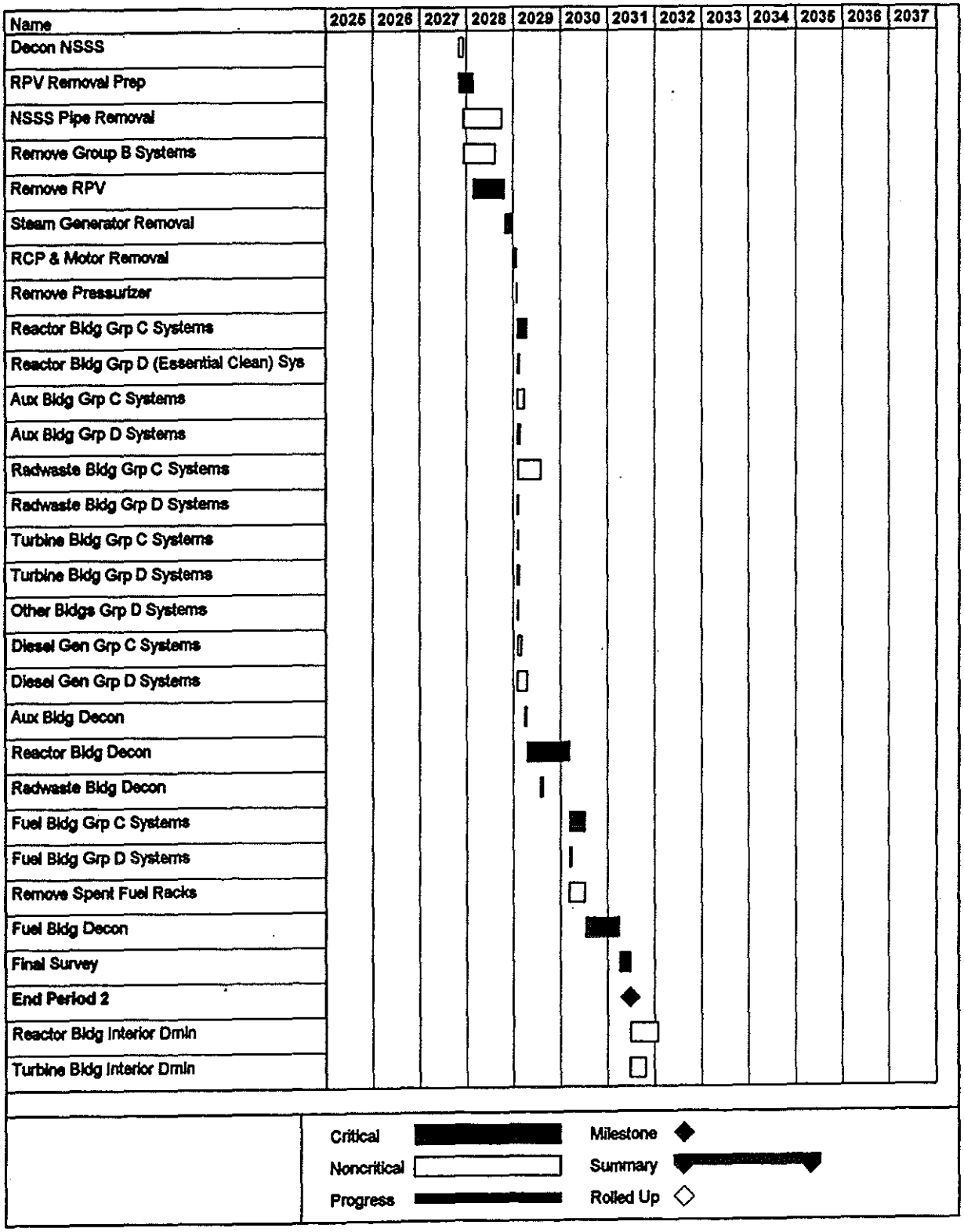


FIGURE 5.1
DECON ACTIVITY SCHEDULE
(continued)

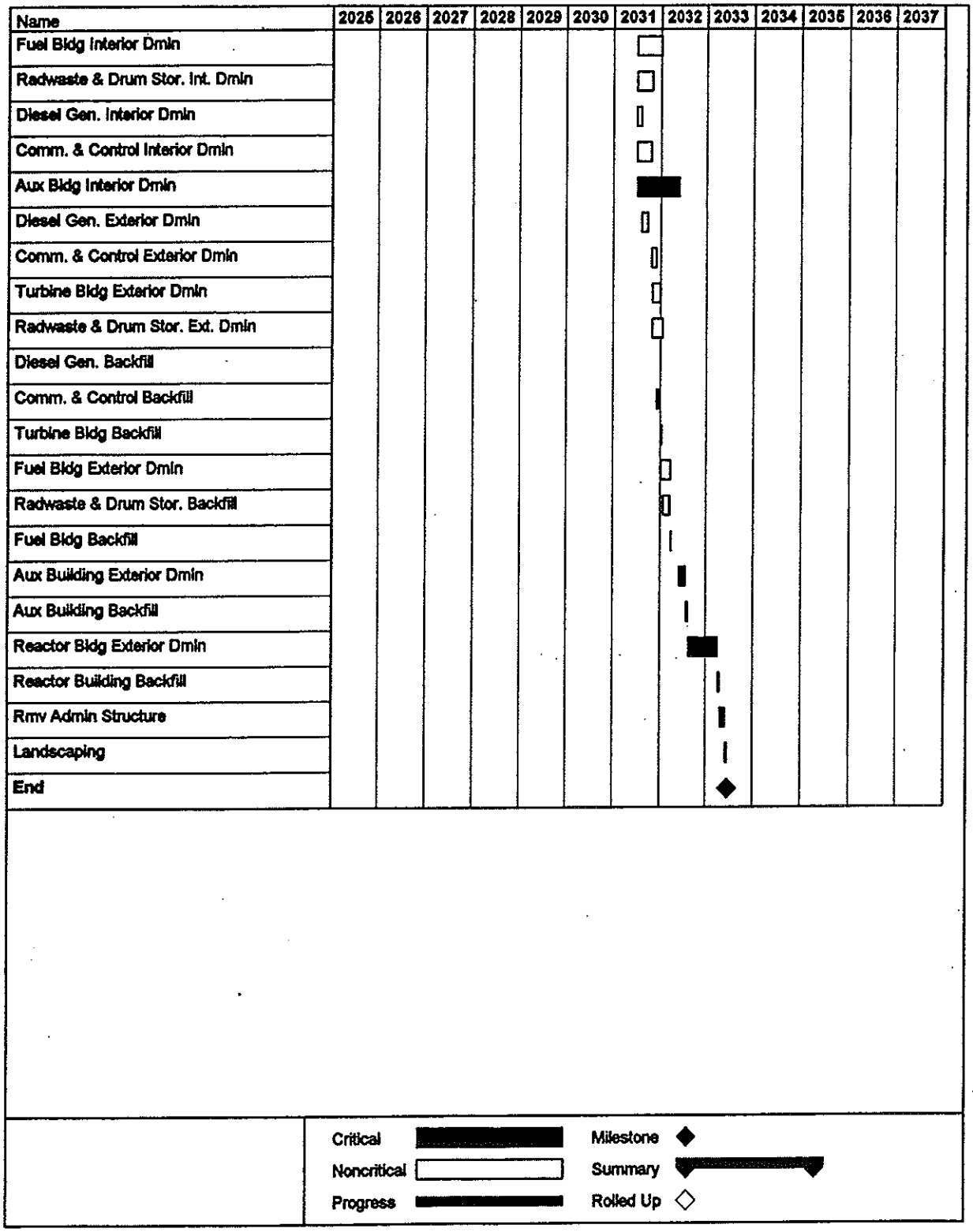
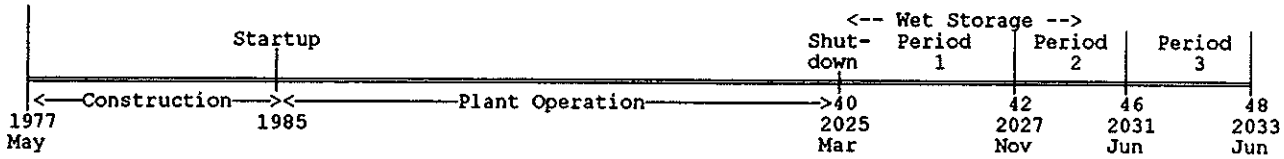
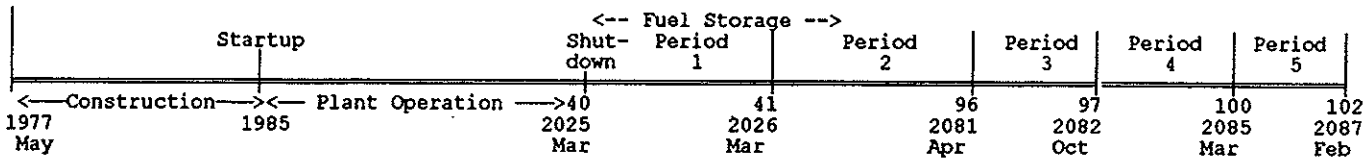


FIGURE 5.2
DECOMMISSIONING TIME LINE
(not to scale)

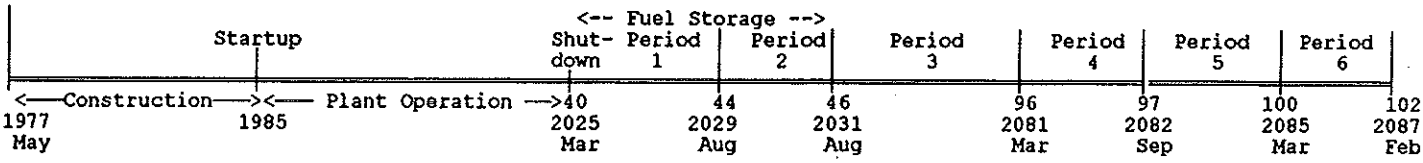
DECON:



SAFSTOR:



ENTOMB:



6. RADIOACTIVE WASTES

The ultimate goal of the decommissioning program is the removal all material from the site which would restrict its future use. This requires the removal of all material from the site which is in excess of applicable legal limits for radioactive contamination.

Under the Atomic Energy Act, the NRC is responsible for protecting the public from sources of ionizing radiation. Title 10 of the Code of Federal Regulations delineates the production, utilization and disposal of radioactive materials and processes. In particular, 10 CFR, Part 61 of controls the burial of radioactive material; Part 72 defines radioactive material

The radioactive waste volume generated during the various decommissioning programs at WCGS are shown by line activity in the cost tables in Appendix C. Waste volumes shown in Table 6.1 are quantified consistent with 10 CFR 61 classifications. The waste volumes shown are calculated based on the gross container volume to be shipped and buried in the controlled burial ground.

Most of the materials being transported for controlled burial are categorized as LSA material containing Type A quantities as defined in 49 CFR 173-178 (Ref. 14). The containers must be strong tight packages. For this study, commercially available steel containers are presumed to be used for piping, small components and concrete.

The reactor vessel and internals are categorized as large quantity shipments and, accordingly, must be shipped in reusable shielded casks with disposable liners. In this case, the liner volume is taken as the waste volume. Radioactive Waste classified as 10 CFR 61 Greater than Class C (GTCC) is assumed to be disposed of in the same manner as the spent fuel, i.e., at DOE's ultimate repository.

The waste volume attributed to site decontamination is primarily generated during Period 2 of DECON, Period 4 of SAFSTOR and Period 5 of ENTOMB. The low-level radioactive waste generated as a result of the decommissioning of WCGS is destined for disposal at the future Central Interstates regional burial facility. For cost estimating purposes, this study uses a projection provided by WCNOC and from an existing burial facility's published rate schedule.

Table 6.1 displays waste volumes associated with the decommissioning. No process system containing or handling radioactive substances at shutdown is presumed releasable as non-contaminated scrap metal because of the presence of long-lived radionuclides.

TABLE 6.1

RADIOACTIVE WASTE BURIAL VOLUMES FOR DECOMMISSIONING

	Waste Class[1]	Volume (Cubic feet)
DECON	A	188,591
	B	12,935
	C	476
	>C	221
Total		**202,223**
SAFSTOR		
	A	195,371
	B	8,649
	C	476
	>C	221
Total		**204,717**
ENTOMB		
	A	191,026
	B	8,315
	C	476
	>C	221
Total		**200,038**

[1] Waste is classified according to the requirements as delineated in Title 10 of the Code of Federal Regulations, Part 61.55

7. OCCUPATIONAL EXPOSURE

Estimates of occupational radiation exposure were developed by TLG. These estimates are scoping in nature and are performed to provide an upper bound to the exposure estimates. This bounding calculation is a check to see if NRC dose limitations are not exceeded in the cost study. It should be noted that the radiation exposure rates used to calculate the exposures shown in Appendix C are based on optimum conditions; factors such as plant age, maintenance and operating history could cause the expected exposure rates at the time of decommissioning to vary significantly.

Radiation doses to decommissioning workers are calculated as the product of the estimated radiation zone work force requirements and the radiation exposure rates estimated for each decommissioning task. The decommissioning occupational exposure estimates are based on the following assumptions:

1. Occupational exposure estimates include only the craft labor necessary for decontamination, removal and packaging activities as well as all required health physics personnel exposures in support of these activities. Casual exposures to the plant staff are not included in this estimate.

2. Personnel exposure to radiation is minimized by utilizing shielding and remote handling techniques and avoiding higher radiation fields when personnel presence is not necessary.

3. Local exposure rates near items such as tanks and pipes are reduced by chemical decontamination prior to work in that area.

4. Careful prompt accounting of accumulated radiation exposure is maintained to rapidly identify tasks causing excessive dose accumulation by workers so that corrective action can be taken.

5. Cobalt-60 is the primary contributor to radiation exposure. The reduction in personnel exposure from area and components during the activities performed after the SAFSTOR/ENTOMB dormancy period is assumed to be that of the reduction in Cobalt-60.

6. Exposures as the result of spent fuel storage activities are expected to be minimal and therefore are not included.

Implementation of the DECON alternative yields the higher occupational radiation exposure because the work is performed sooner after shutdown, without the benefit of any extended decay time for the radionuclides on site. The SAFSTOR alternative yields a lower cumulative dose, primarily due to the decay during dormancy and because almost all of the dismantling operations are performed after the dormancy period. However, additional dose is incurred in the ENTOMB alternative from the activities associated with removing contaminated material outside the entombment boundary, yielding a total cumulative dose higher than the SAFSTOR alternative yet still lower than DECON.

Typical field experience relative to recent cost studies performed by TLG indicate that actual field exposures are significantly less than TLG projections. This may be due to ignoring the dose reduction impact of the ALARA factors costed into the study.

8. RESULTS

Decommissioning technology is well established and the tools and equipment necessary to dismantle WCGS completely are available and have been demonstrated. The projected costs to decommission the plant, presuming the use of the DECON alternative, including the five year operation of the spent fuel pool, is **$369,789,856.** This projected cost includes shipment of wastes and dismantled materials to a regional disposal site and demolition of the remaining site structures. The estimate reflects the site-specific features of WCGS and the projected cost of radioactive waste shipping and burial costs. An analysis of the major activities contributing to the total cost is shown in Table 8.1.

The decommissioning and utility staffs along with the removal activity combine to represent the majority of the cost to decommission WCGS. This is a direct result of the labor-intensive nature of the decommissioning process. Burial is the next largest cost component reflecting the costs associated with the development of new regional waste disposal facilities. Transportation costs are most sensitive to increases in fuel costs and distances to existing or new burial facilities. Removal costs are dependent on the degree of remotely operated equipment available in the future and the associated higher cost of that equipment versus the savings in labor costs.

This study for WCGS provides an estimate for decommissioning the site under current requirements based on present day costs and available technology. As additional dismantling experience on large reactors becomes available, cost estimates must be modified to reflect this experience. In addition, there are costs associated with decommissioning activities that historically increase at rates significantly greater than inflationary trends. For example, the cost of radioactive waste burial has increased rapidly in the last few years. It is therefore appropriate that this cost estimate be reviewed periodically, and updated/revised as required.

TABLE 8.1

SUMMARY OF DECOMMISSIONING COSTS

Work Category	Costs 93$ (thousands)	Percent of Total Costs
DECON		
Decontamination	6,957	1.88
Removal	68,487	18.52
Packaging	5,599	1.51
Shipping	6,392	1.73
Burial (off-site)	81,180	21.95
Decommissioning Staffs	137,406	37.16
Other *	63,769	17.24
Subtotal	**369,790**	**100.00**
SAFSTOR		
Decontamination	8,353	1.38
Removal	67,782	11.19
Packaging	5,295	0.87
Shipping	6,106	1.01
Burial (off-site)	79,884	13.19
Decommissioning Staffs	329,107	54.33
Other *	109,207	18.03
Subtotal	**605,734**	**100.00**
ENTOMB		
Decontamination	6,276	1.13
Removal	68,886	12.37
Packaging	5,471	0.98
Shipping	6,055	1.09
Burial (off-site)	78,177	14.04
Decommissioning Staffs	281,676	50.58
Other *	110,306	19.81
Subtotal	**556,846**	**100.00**

* Other includes: engineering & preparations, property lease payments, insurance, off-site LLW recycling costs and plant energy budget.

9. 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 1.86, "Termination of Operating Licenses for Nuclear Reactors", June, 1974.

3. "Response to Missouri PSC Stipulation for Data Relevant to Estimating Decommissioning Costs for WCNGS and Wolf Creek Generating Station", February 1993.

4. "Building Construction Cost Data 1990", Robert Snow Means Company, Inc., Kingston, Massachusetts.

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

6. Chem-Nuclear Services, Inc., Low-Level Radioactive Waste Management Facility, Barnwell, SC.

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

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

9. Cost Engineers Notebook: American Association of Cost Engineers, AA-4.000, pg 3 of 22, Rev. 2 (January 1978) (Updated periodically).

10. 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.

11. 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.

12. 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.

13. "Microsoft Project for Windows," Version 3.0, Microsoft Corporation, Redmond, WA 1993.

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

APPENDIX A

UNIT COST FACTOR DEVELOPMENT

APPENDIX A
UNIT COST FACTOR DEVELOPMENT

Example: Unit Factor for Removal of Contaminated Heat Exchanger < 3000 lbs.

1. SCOPE

Heat exchangers weighing < 3,000 lb 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	60
b	Mount pipe cutters	45	45
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)	340	300
Duration adjustment(s):			
+ Respiratory protection adjustment (50% of critical duration)			150
+ Radiation/ALARA adjustment (32% of critical duration)			96
	Adjusted work duration		546
+ Protective clothing adjustment (30% of adjusted duration)			164
Productive work duration			710
+ Work break adjustment (8.33 % of productive duration)			59
Total work duration (mins)			769

***** Total duration = 12.82 hr *****

3. LABOR REQUIRED

Crew	Number	Duration (hr)	Rate ($/hr)	Cost
Laborers	3.00	12.82	$14.06	$540.62
Craftsmen	2.00	12.82	$22.10	$566.51
Foreman	1.00	12.82	$24.35	$312.09
General Foreman	0.25	12.82	$33.23	$106.48
Subtotal labor cost				$1,525.70
Overhead & Profit on labor @ 21%				$320.40
Total labor cost				$1,846.10

4. EQUIPMENT & CONSUMABLES COSTS

Equipment Costs	none
Consumables/Materials Costs	
-Blotting paper 50 @ $0.48 sq ft {2}	$24.00
-Plastic sheets/bags 50 @ $0.06/sq ft {3}	$3.00
-Gas torch consumables 1 @ $7.39/hr x 1 hr {1}	$7.39
Subtotal cost of equipment and materials	$34.39
Overhead & profit on equipment and materials @ 14.25%	$4.90
Total costs, equipment & material	$39.29
TOTAL COST Removal of contaminated heat exchanger <3000 pound:	**$1,885.39**
Total labor cost:	$1,846.10
Total equipment/material costs:	$39.29
Total adjusted exposure manhours incurred:	52.83
Total craft labor manhours required per unit:	80.11

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 (Ref. 7, p. 64).

3. Adjusted for regional material costs for Wichita, Kansas:

4. References:

1. R.S. Means (1992) Division 016 Section 420-6360 pg 19
2. McMaster-Carr Ed. 94 pg 735
3. R.S. Means (1992) Division 015 Section 602-0200 pg 12

APPENDIX B

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

APPENDIX B

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

Unit Cost Factor	Cost/Unit($)
Removal of clean instrument and sampling tubing, $/linear foot	$0.21
Removal of clean pipe 0.25 to 2 inches diameter $/linear foot	$3.79
Removal of clean pipe >2 to 4 inches diameter $/linear foot	$4.61
Removal of clean pipe >4 to 8 inches diameter $/linear foot	$6.23
Removal of clean pipe >8 to 14 inches diameter $/linear foot	$11.77
Removal of clean pipe >14 to 20 inches diameter $/linear foot	$15.33
Removal of clean pipe >20 to 36 inches diameter $/linear foot	$22.55
Removal of clean pipe >36 inches diameter $/linear foot	$26.78
Removal of clean valves >2 to 4 inches	$46.07
Removal of clean valves >4 to 8 inches	$62.34
Removal of clean valves >8 to 14 inches	$106.33
Removal of clean valves >14 to 20 inches	$153.29
Removal of clean valves >20 to 36 inches	$225.49
Removal of clean valves >36 inches	$267.82
Removal of clean pipe hangers for small bore piping	$13.76
Removal of clean pipe hangers for large bore piping	$47.37
Removal of clean pumps, <300 pound	$105.55
Removal of clean pumps, 300-1000 pound	$266.61
Removal of clean pumps, 1000-10,000 pound	$1,107.01
Removal of clean pumps, >10,000 pound	$2,263.21
Removal of clean turbine-driven pumps < 10,000 pounds	$1,345.84
Removal of clean turbine-driven pumps > 10,000 pounds	$2,622.82
Removal of clean PWR turbine-generator	$73,648.02
Removal of clean heat exchanger <3000 pound	$555.77
Removal of clean heat exchanger >3000 pound	$1,594.11
Removal of clean feedwater heater/deaerator	$3,973.55

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only for DECON)
(continued)

Unit Cost Factor	Cost/Unit($)
Removal of clean moisture separator/reheater	$9131.48
Removal of clean PWR main condenser	$205,661.95
Removal of clean tanks, <300 gallons	$135.71
Removal of clean tanks, 300-3000 gallons	$427.16
Removal of clean tanks, >3000 gallons, $/square foot surface area	$3.65
Removal of clean electrical equipment, <300 pound	$57.74
Removal of clean electrical equipment, 300-1000 pound	$203.80
Removal of clean electrical equipment, 1000-10,000 pound	$407.61
Removal of clean electrical equipment, >10,000 pound	$990.78
Removal of clean electrical transformers < 30 tons	$688.08
Removal of clean electrical transformers > 30 tons	$1,981.56
Removal of clean standby diesel-generator, <100 kW	$702.83
Removal of clean standby diesel-generator, 100 kW to 1 MW	$1,568.73
Removal of clean standby diesel-generator, >1 MW	$3,247.59
Removal of clean electrical cable tray, $/linear foot	$5.38
Removal of clean electrical conduit, $/linear foot	$2.35
Removal of clean mechanical equipment, <300 pound	$57.74
Removal of clean mechanical equipment, 300-1000 pound	$203.80
Removal of clean mechanical equipment, 1000-10,000 pound	$407.61
Removal of clean mechanical equipment, >10,000 pound	$990.78
Removal of clean HVAC equipment, <300 pound	$57.74
Removal of clean HVAC equipment, 300-1000 pound	$203.80
Removal of clean HVAC equipment, 1000-10,000 pound	$407.61
Removal of clean HVAC equipment, >10,000 pound	$990.78
Removal of clean HVAC ductwork, $/pound	$0.43
Removal/manual flame cut of clean thin metal components, $/inch-cut	$2.36
Asbestos clean removal (pipe/components)	$3.88

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only for DECON)
(continued)

Unit Cost Factor	Cost/Unit($)
Removal of contaminated instrument and sampling tubing, $/linear foot	$0.34
Removal of contaminated pipe 0.25 to 2 inches diameter $/linear foot	$13.39
Removal of contaminated pipe >2 to 4 inches diameter $/linear foot	$34.85
Removal of contaminated pipe >4 to 8 inches diameter $/linear foot	$43.10
Removal of contaminated pipe >8 to 14 inches diameter $/linear foot	$76.20
Removal of contaminated pipe >14 to 20 inches diameter $/linear foot	$91.45
Removal of contaminated pipe >20 to 36 inches diameter $/linear foot	$127.34
Removal of contaminated pipe >36 inches diameter $/linear foot	$150.44
Removal of contaminated valves >2 to 4 inches	$166.19
Removal of contaminated valves >4 to 8 inches	$206.60
Removal of contaminated valves >8 to 14 inches	$381.00
Removal of contaminated valves >14 to 20 inches	$512.54
Removal of contaminated valves >20 to 36 inches	$682.28
Removal of contaminated valves >36 inches	$752.21
Removal of contaminated pipe hangers for small bore piping	$30.91
Removal of contaminated pipe hangers for large bore piping	$111.40
Removal of contaminated pumps, <300 pound	$325.63
Removal of contaminated pumps, 300-1000 pound	$800.26
Removal of contaminated pumps, 1000-10,000 pound	$3,541.04
Removal of contaminated pumps, >10,000 pound	$7,556.83
Removal of contaminated turbine-driven pumps < 10,000 pound	$3,520.15
Removal of contaminated turbine-driven pumps > 10,000 pound	$7,425.00
Removal of contaminated heat exchanger <3000 pound	$1,885.39
Removal of contaminated heat exchanger >3000 pound	$4,872.75
Removal of contaminated tanks, <300 gallons	$582.64
Removal of contaminated tanks, >300 gallons, $/square foot	$11.92
Removal of contaminated electrical equipment, <300 pound	$203.02

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only for DECON)
(continued)

Unit Cost Factor	Cost/Unit($)
Removal of contaminated electrical equipment, 300-1000 pound	$523.55
Removal of contaminated electrical equipment, 1000-10,000 pound	$979.10
Removal of contaminated electrical equipment, >10,000 pound	$2,142.85
Removal of contaminated electrical cable tray, $/linear foot	$19.29
Removal of contaminated electrical conduit, $/linear foot	$16.86
Removal of contaminated mechanical equipment, <300 pound	$203.02
Removal of contaminated mechanical equipment, 300-1000 pound	$523.55
Removal of contaminated mechanical equipment, 1000-10,000 pound	$979.10
Removal of contaminated mechanical equipment, >10,000 pound	$2,142.85
Removal of contaminated HVAC equipment, <300 pound	$203.02
Removal of contaminated HVAC equipment, 300-1000 pound	$523.55
Removal of contaminated HVAC equipment, 1000-10,000 pound	$979.10
Removal of contaminated HVAC equipment, >10,000 pound	$2,142.85
Removal of contaminated HVAC ductwork, $/pound	$1.34
Removal/plasma arc cut of contaminated thin metal components, $/linear inch	$1.44
Surface dectonamination of equipment, $/square foot	$3.88
Surface decontamination of large components, $/square foot	$13.94
Decontamination rig hook-up and flush	$1,497.75
Chemical flush of components/systems, $/gallon	$5.18
Removal of standard reinforced concrete, $/cubic yard	$258.66
Removal of grade slab concrete, $/cubic yard	$128.18
Removal of clean concrete floors, $/cubic yard	$157.00
Removal of sections of clean concrete floors, $/cubic yard	$477.97
Removal of clean heavily rein concrete w/#9 rebar, $/cubic yard	$126.82
Removal of contaminated heavily rein concrete w/#9 rebar, $/cubic yard	$962.88
Removal of clean heavily rein concrete w/#18 rebar, $/cubic yard	$161.77

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only for DECON)
(continued)

Unit Cost Factor	Cost/Unit($)
Removal of contaminated heavily rein concrete w/#18 rebar, $/cubic yard	$1,275.93
Removal heavily rein concrete w/#18 rebar & steel embedments, $/cubic yard	$226.68
Removal of below grade suspended floors, $/square foot	$157.00
Removal of clean monolithic concrete structures, $/cubic yard	$428.07
Removal of contaminated monolithic concrete structures, $/cubic yard	$959.51
Removal of clean foundation concrete, $/cubic yard	$336.25
Removal of contaminated foundation concrete, $/cubic yard	$893.15
Explosive demolition of bulk concrete, $/cubic yard	$16.91
Removal of clean hollow masonry block wall, $/cubic yard	$41.36
Removal of contaminated hollow masonry block wall, $/cubic yard	$101.18
Removal of clean solid masonry block wall, $/cubic yard	$41.36
Removal of contaminated solid masonry block wall, $/cubic yard	$101.18
Placement of concrete for below grade voids, $/cubic yard	$72.04
Placement of entombment concrete, $/cubic yard	$235.36
Removal of subterranean tunnels/voids, $/linear foot	$62.56
Backfill of below grade voids, $/cubic yard	$13.50
Excavation of clean material, $/cubic yard	$2.42
Excavation of contaminated material, $/cubic yard	$5.82
Excavation of submerged concrete rubble, $/cubic yard	$7.26
Removal of clean concrete rubble, $/cubic yard	$42.29
Removal of contaminated concrete rubble, $/cubic yard	$16.86
Removal of building by volume, $/cubic foot	$0.15
Removal of clean building metal siding, $/square foot	$0.67
Removal of contaminated building metal siding, $/square foot	$1.67
Removal of standard asphalt roofing, $/square foot	$0.90
Removal of transite panels, $/square foot	$0.89
Scarifying contaminated concrete surfaces (drill & spall)	$6.18

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only for DECON)
(continued)

Unit Cost Factor	Cost/Unit($)
Scabbling contaminated concrete floors $/square foot	$4.18
Scabbling contaminated concrete walls $/square foot	$12.50
Scabbling contaminated ceilings $/square foot	$41.66
Scabbling structural steel $/square foot	$2.95
Removal of clean overhead cranes/monorails < 10 ton capacity	$273.93
Removal of contaminated overhead cranes/monorails < 10 ton capacity	$642.33
Removal of clean overhead cranes/monorails >10 - 50 ton capacity	$657.43
Removal of contaminated overhead cranes/monorails >10 - 50 ton capacity	$1,540.33
Removal of polar cranes > 50 ton capacity, each	$2,804.71
Removal of gantry cranes > 50 ton capacity, each	$10,332.19
Removal of structural steel, $/pound	$0.17
Removal of clean steel floor grating, $/square foot	$1.45
Removal of contaminated steel floor grating, $/square foot	$3.66
Removal of clean free-standing steel liner, $/square foot	$5.12
Removal of contaminated free-standing steel liner, $/square foot	$12.67
Removal of clean concrete anchored steel liner, $/square foot	$2.56
Removal of contaminated concrete anchored steel liner, $/square foot	$14.83
Placement of scaffolding in clean areas, $/square foot	$2.39
Placement of scaffolding in contaminated areas, $/square foot	$3.84
Landscaping with topsoil, $/acre	$14,512.75
Landscaping w/o topsoil, $/acre	$1,747.55
Cost of LSA box & preparation for use	$1,024.65
Cost of LSA drum & preparation for use	$96.91
Cost of cask liner for CNSI 14-195 cask	$6,638.16
Cost of cask liner for CNSI 8-120A cask (resins)	$8,930.12
Cost of cask liner for CNSI 8-120A cask (filters)	$8,923.15
Decontamination of surfaces with vacuuming, $/square foot	$0.62

APPENDIX C

DETAILED COST ANALYSIS

TABLE C-1
DECON COST ESTIMATE FOR WOLF CREEK GENERATING STATION
(THOUSANDS OF 1993 DOLLARS)

	Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
PERIOD 1																
1.	Prepare preliminary decommissioning plan						130	20	150	150						
2.	Prepare proposed decommissioning plan						400	60	460	460						
3.	Remove fuel & source material								n/a							
4.	Decon plant & process waste								a							
5.	Review plant dwgs & specs.						460	69	529	529						
6.	Perform detailed rad survey								a							
7.	Estimate by-product inventory						100	15	115	115						
8.	Submit for license amendment						160	24	184	184						
9.	End product description						100	15	115	115						
10.	Detailed by-product inventory						130	20	150	150						
11.	Define major work sequence						750	113	863	863						
12.	Perform safety analysis						310	47	357	357						
13.	Submit dismantling plan						52	8	60	60						
14.	Receive license amendment								a							
15.	Receive dismantling order								a							
Subtotal Period 1 Activity Costs							2592	389	2981	2981						
Period 1 Undistributed Costs																
1.	Decon equipment						189	28	217	217						
2.	Decon supplies						137	34	171	171						
3.	DOC staff relocation expenses						845	127	972	972						
4.	Process liquid waste	67		34	46	200		74	422	422		458			119	3
5.	Insurance						587	59	645	645						
6.	Property taxes						693	69	762	762						
7.	Health physics supplies						947	237	1184	1184						
8.	Heavy equipment rental						104	16	120	120						
9.	Disposal of DAW generated			198	6	762		135	1101	1101	2473				6725	17

NOTES- "n/a" indicates that fuel handling, packaging, shipping, and disposal are charged to plant operations, not decommissioning

- "a" indicates that costs are included in the utility staff costs.
- Columns may not total due to rounding errors.

TABLE C-1 (continued)
DECON COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean	A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
Period 1 Undistributed Costs (continued)																
10. Plant energy budget						3425	514	3939	3939							
11. NRC Fees						116	12	128	128							
12. Emergency Planning Fees						264	26	291	291							
Subtotal Undistributed Costs Period 1	67		232	52	962	7308	1331	9952	9952		2473	458			6844	20
Staff Costs																
DOC Staff Cost						4607	691	5298	5298							
Utility Staff Cost						29965	4495	34459	34459							
TOTAL PERIOD 1 COST	67		232	52	962	44471	6905	52690	52690		2473	458			6844	20
PERIOD 2																
Activity Specifications																
16.1 Plant & temporary facilities						492	74	566	509	57						
16.2 Plant systems						417	63	479	431	48						
16.3 Reactor internals						710	107	817	817							
16.4 Reactor vessel						650	98	748	748							
16.5 Biological shield						50	8	58	58							
16.6 Steam generators						312	47	359	359							
16.7 Reinforced concrete						160	24	184	92	92						
16.8 Turbine & condenser						80	12	92		92						
16.9 Plant structures & buildings						312	47	359	179	179						
16.10 Waste management						460	69	529	529							
16.11 Facility & site closeout						90	14	104	52	52						
16. Total						3733	560	4293	3773	520						
Planning & Site Preparations																
17. Prepare dismantling sequence						240	36	276	276							
18. Plant prep. & temp. svcs						1485	223	1708	1708							
19. Design water clean-up system						140	21	161	161							
20. Rigging/CCES/tooling/etc.						1257	189	1446	1446							
21. Procure casks/liners & containers						123	18	141	141							

TABLE C-1 (continued)
DECON COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean	A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
Detailed Work Procedures																
22.1 Plant systems						473	71	544	490	54						
22.2 Vessel head						250	38	288	288							
22.3 Reactor internals						250	38	288	288							
22.4 Remaining buildings						135	20	155	39	116						
22.5 CRD cooling assembly						100	15	115	115							
22.6 CRD housings & ICI tubes						100	15	115	115							
22.7 Incore instrumentation						100	15	115	115							
22.8 Reactor vessel						363	54	417	417							
22.9 Facility closeout						120	18	138	69	69						
22.10 Missile shields						45	7	52	52							
22.11 Biological shield						120	18	138	138							
22.12 Steam generators						460	69	529	529							
22.13 Reinforced concrete						100	15	115	58	58						
22.14 Turbine & condensers						312	47	359		359						
22.15 Auxiliary building						273	41	314	283	31						
22.16 Reactor building						273	41	314	283	31						
22. Total						3474	521	3995	3276	719						
Decon NSSS/Rack Removal																
23. Decon primary loop	463						231	694	694						800	8
24.. Remove spent fuel racks	212	35	80	22	945	731	378	2402	2402		3150				8531	46
Nuclear Steam Supply System Removal																
25.1 Reactor Coolant Piping	67	127	62	16	2066		384	2725	2725		6485				7987	176
25.2 Pressurizer Relief Tank	12	61	5	4	197		52	330	330		621				3007	74
25.3 Reactor Coolant Pumps & Motors	26	38	33	40	3491		555	4183	4183		11312				2862	65
25.4 Pressurizer	25	27	4	10	1280		213	1558	1558		4147				1933	38
25.5 Steam Generators	138	2487	133	3502	17932		3919	28112	28112		58484				99082	1258
25.6 CRDMs/ ICIs/Service Structure Removal	60	37	20	14	596		133	861	861		1843				3546	85
25.7 Reactor Vessel Internals	45	1066	269	302	6832		1989	10503	10503		1441	801	476	221	13273	40
25.8 Reactor Vessel	103	2689	265	252	3009		2649	8967	8967		5540	2096			15731	43
25. Totals	475	6532	792	4141	35403		9894	57238	57238		89873	2897	476	221	147420	1778

TABLE C-1 (continued)
DECON COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean	A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
Disposal of Plant Systems																
26.1 AX - Acid Feed		19					3	22		22					833	
26.2 Accumulator Safety Injection		88	27	6	190	121	72	504	504		617				3844	31
26.3 Auxiliary Bldg Non-System Specific Clean		404					61	465		465					17709	
26.4 Auxiliary Bldg Non-System Specific Cont		247	103	34	767	577	279	2007	2007		2488				11246	14
26.5 Auxiliary Bldg Non-System Specific Decon	34	135					37	206	51	155					7291	
26.6 Auxiliary Building HVAC		280	46	12	290	213	152	992	992		940				9618	13
26.7 Auxiliary Feedwater		20					3	23		23					912	
26.8 Auxiliary Steam		65					10	75		75					2948	
26.9 Auxiliary Steam Chemical Addition		3					<1	3		3					121	
26.10 Auxiliary Steam Generator		7					1	8		8					321	
26.11 Auxiliary Turbines		31					5	36		36					1358	
26.12 Borated Refueling Water Storage		163	56	9	355	266	141	990	990		1152				7142	23
26.13 Boron Recycle		273	71	18	438	275	185	1260	1260		1422				11754	126
26.14 CL - Chlorination		14					2	16		16					607	
26.15 CW - Circulating Water		190					29	219		219					8903	
26.16 CZ - Caustic Acid		3					<1	3		3					134	
26.17 Central Chilled Water		51					8	59		59					2304	
26.18 Chemical & Detergent Waste	31	75	19	5	124	85	68	406	406		401				4502	25
26.19 Chemical & Volume Control	354	507	173	47	2147	560	734	4523	4523		6968				32065	177
26.20 Closed Cooling Water		32					5	37		37					1443	
26.21 CO - Carbon Dioxide		4					<1	5		5					177	
26.22 Component Cooling Water		134					20	154		154					6177	
26.23 Condensate		133					20	153		153					5956	
26.24 Condensate & Feedwater Chemical Addition		12					2	14		14					526	
26.25 Condensate Demineralizer		46					7	53		53					2068	
26.26 Condensate Storage & Transfer		39					6	45		45					1656	
26.27 Condenser Air Removal		16					2	18		18					699	
26.28 Containment Atmospheric Control		6	23	4	377	19	64	492	492		1222				343	<1
26.29 Containment Cooling		330	104	22	1119	313	311	2198	2198		3631				12706	16
26.30 Containment Hydrogen Control		28	19	5	148	85	45	330	330		481				1285	<1
26.31 Containment Integrated Leak Rate Test		6					<1	7		7					287	
26.32 Containment Purge HVAC		72	32	5	322	110	87	629	629		1046				2724	3
26.33 Containment Spray	47	40					29	116	70	46					3339	
26.34 Control Bldg Non-System Specific Clean		378					57	435		435					16569	
26.35 Control Bldg Non-System Specific Cont		226	106	34	759	571	272	1968	1968		2462				10332	12
26.36 Control Bldg Non-System Specific Decon	34	124					36	194	52	142					6802	

TABLE C-1 (continued)
DECON COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean	A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
Disposal of Plant Systems (continued)																
26.37 Control Building HVAC		147					22	169		169					6162	
26.38 DA - Circulating Water System		196					29	226		226					9126	
26.39 DM - Equipment Drains		60					9	69		69					2710	
26.40 DO - Diesel Oil		1					<1	1		1					47	
26.41 Decontamination		43	47	6	134	88	49	366	366		435				1945	5
26.42 Demineralized Water Storage & Transfer		41					6	47		47					1819	
26.43 Diesel Generator Building HVAC		27					4	31		31					1115	
26.44 EA - Service Water		63					10	73		73					2928	
26.45 EF - Essential Service Water		77					12	89		89					3541	
26.46 Emergency Fuel Oil		31					5	36		36					1329	
26.47 FO - Fuel Oil		14					2	16		16					625	
26.48 FP - Fire Protection		152					23	175		175					7096	
26.49 Feedwater		90					14	104		104					4105	
26.50 Feedwater Heater Extraction		135					20	155		155					6164	
26.51 Floor & Equipment Drains		1093	209	55	1342	971	649	4320	4320		4357				46675	126
26.52 Fuel Bldg Non-System Specific Clean		52					8	60		60					2293	
26.53 Fuel Bldg Non-System Specific Cont		36	15	5	118	89	42	306	306		383				1638	2
26.54 Fuel Bldg Non-System Specific Decon	4	16					4	24	6	18					852	
26.55 Fuel Building HVAC		154	45	10	518	123	141	991	991		1682				5374	7
26.56 Fuel Handling & Storage Reactor Vessel		6	8	5	266		43	329	329		864				292	<1
26.57 Fuel Pool Cooling & Cleanup		248	71	18	649	301	214	1501	1501		2106				10872	29
26.58 GD - Esstl. Srvc. Wtr Pumphs. Bldg HVAC		9					1	10		10					365	
26.59 GE - Turbine Bldg HVAC		102					15	118		118					4319	
26.60 GF - Miscellaneous Building HVAC		33					5	38		38					1387	
26.61 Gaseous Radwaste		162	71	15	512	159	150	1069	1069		1662				7023	17
26.62 Generator Hydrogen Seal & CO2		5					<1	6		6					210	
26.63 Generator Seal Oil		7					1	8		8					296	
26.64 HY - Hydrogen		6					<1	7		7					277	
26.65 High Pressure Coolant Injection		173	57	17	518	240	165	1170	1170		1682				7576	37
26.66 KA - Compressed Air and Instrument		160					24	185		185					7081	
26.67 KB - Breathing Air		26					4	30		30					1182	
26.68 KC - Fire Protection		277					42	319		319					12879	
26.69 KD - Domestic Water		46					7	52		52					2023	
26.70 KH - Service Gas		18					3	21		21					780	
26.71 LA - Sanitary Drains		13					2	15		15					582	
26.72 LC - Yard Drains		2					<1	3		3					95	

TABLE C-1 (continued)
DECON COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean	A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
Disposal of Plant Systems (continued)																
26.73 LE - Oily Waste		98					15	112		112					4433	
26.74 Liquid Radwaste	384	442	130	27	823	394	502	2702	2702		2670				32913	384
26.75 Lube Oil Storage,Transfer,& Purification		21					3	24		24					925	
26.76 Main Steam		139					21	160		160					6475	
26.77 Main Turbine		131					20	151		151					5932	
26.78 Main Turbine Control Oil		29					4	33		33					1211	
26.79 Main Turbine Lube Oil		27					4	31		31					1164	
26.80 NT - Nitrogen		4					<1	5		5					186	
26.81 Nuclear Sampling		33	46	6	423	29	81	618	618		1373				1564	3
26.82 OX - Oxygen		4					<1	5		5					177	
26.83 Plant Heating		70					11	81		81					3155	
26.84 Process Sampling & Analysis		60	42	13	644	124	136	1020	1020		2090				2650	4
26.85 Radwaste Bldg Non-System Specific Clean		153					23	176		176					6704	
26.86 Radwaste Bldg Non-System Specific Cont		106	46	14	310	234	115	825	825		1007				4848	6
26.87 Radwaste Bldg Non-System Specific Decon	12	46					13	70	18	53					2487	
26.88 Radwaste Building HVAC		108	28	7	293	88	88	611	611		951				3781	5
26.89 Reactor Bldg Non-System Specific Clean		136					20	157		157					5982	
26.90 Reactor Bldg Non-System Specific Cont		86	30	9	187	141	75	527	527		607				3884	5
26.91 Reactor Bldg Non-System Specific Decon	11	46					12	70	17	53					2474	
26.92 Reactor Coolant System		115	65	16	736	202	178	1313	1313		2390				5295	75
26.93 Reactor Makeup Water		152	31	9	222	138	96	647	647		720				6469	7
26.94 Residual Heat Removal		221	77	18	601	284	228	1628	1628		2599				9890	82
26.95 Roof Drains		55					8	63		63					2529	
26.96 ST - Sewage Treatment		23					3	26		26					1000	
26.97 SW - Screen Wash		15					2	17		17					640	
26.98 SZ - Service Air		47					7	54		54					2101	
26.99 Secondary Liquid Waste	328	493	191	36	940	513	530	3030	3030		3050				33315	195
26.100Solid Radwaste		258	207	27	911	289	269	1961	1961		2955				11609	58
26.101Standby Diesel Engine		101					15	117		117					4394	
26.102Stator Cooling Water		6					<1	7		7					249	
26.103Steam Generator Blowdown		341	104	29	1006	429	315	2225	2225		3264				14867	117
26.104Steam Seal		12					2	14		14					539	
26.105VA - I&C Shop HVAC		3					<1	4		4					141	
26.106VB - I&C Shop Computer Room HVAC		2					<1	3		3					95	
26.107VC - Health Physics Computer Room HVAC		5					<1	5		5					200	
26.108VH - Circ Water & Makeup Water Scrnhs Vt		6					<1	6		6					245	

TABLE C-1 (continued)
DECON COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean	A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
Disposal of Plant Systems (continued)																
26.109VJ - Shop Bldg Machine Shop Area Vent		1					<1	1		1					51	
26.110VL - Shop Building HVAC		2					<1	2		2					92	
26.111VS - Admin. Bldg HVAC		5					<1	6		6					238	
26.112VT - Tech Support Building HVAC		2					<1	2		2					79	
26.113VV - Misc. Bldg. HVAC		3					<1	3		3					123	
26.114VW - Waste Water Treatment Ventilation		1					<1	1		1					48	
26.115WD - Domestic Water		25					4	28		28					1089	
26.116WG - Gland Water & Motor Cooling Water		17					3	20		20					781	
26.117WL- Cooling Lake Makeup & Blowdown		17					3	19		19					754	
26.118WM - Makeup Demineralizer		92					14	105		105					4108	
26.119WS - Plant Services Water		82					12	94		94					3791	
26.120WT - Waste Water Treatment		17					3	19		19					767	
26.121WZ - Radioactive Liquid Waste		5					<1	6		6					237	
26. Totals	1238	11785	2298	542	18389	8031	7323	49606	43671	5936	59679				556167	1605
27. Erect scaffolding for systems removal		918					138	1056	1056						29008	
Decontamination of Site Buildings																
28.1 Reactor	784	344	136	39	3614	304	1085	6306	6306		11728				36369	136
28.2 Auxiliary	409	27	56	16	1706	83	487	2784	2784		5536				14327	54
28.3 Communication Corridor - Contaminated	9	<1	1	<1	36	<1	10	58	58		118				315	<1
28.4 Fuel Building	378	289	41	13	664	174	393	1953	1953		2156				25593	56
28.5 Hot Machine Shop	16		1	<1	44		15	76	76		142				546	1
28.6 Radwaste	218	12	29	8	900	38	257	1462	1462		2921				7625	57
28.7 Radwaste Drum Storage	24	1	3	<1	100	3	28	161	161		324				857	2
28. Totals	1838	674	267	77	7064	604	2276	12800	12800		22926				85633	306
29. License termination survey						299	45	344	344							
30. Terminate license								a								
Subtotal Period 2 Activity Costs	4226	19944	3437	4782	61801	20117	21853	136160	128986	7174	175628	2897	476	221	827559	3744

TABLE C-1 (continued)
DECON COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean	A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
Period 2 Undistributed Costs																
1. Decon equipment						189	28	217	217							
2. Decon supplies						501	125	626	626							
3. DOC staff relocation expenses						845	127	972	972							
4. Process liquid waste	344		624	651	4608		1023	7250	7250			9580			835	19
5. Insurance						1067	107	1173	1173							
6. Property taxes						1498	150	1648	1483	165						
7. Health physics supplies						3464	866	4330	4330							
8. Heavy equipment rental						7277	1092	8369	7532	837						
9. Small tool allowance						343	51	394	355	39						
10. Pipe cutting equipment						587	88	675	675							
11. Decon rig						763	114	878	878							
12. Disposal of DAW generated			724	25	3221		559	4529	4529		10490				24597	61
13. Plant energy budget						4611	692	5303	4773	530						
14. NRC Fees						322	32	354	354							
15. Emergency Planning Fees						366	37	402	402							
Subtotal Undistributed Costs Period 2	344		1348	676	7829	21832	5091	37120	35549	1571	10490	9580			25433	81
Staff Costs																
DOC Staff Cost						17260	2589	19849	19849							
Utility Staff Cost						54026	8104	62130	62130							
TOTAL PERIOD 2	4570	19944	4785	5458	69630	113235	37637	255260	246514	8746	186118	12477	476	221	852991	3825
PERIOD 3																
Removal of Major Equipment																
31. Main Turbine/Generator		70					10	80		80					3082	
32. Main Condensers		219					33	252		252					9282	

TABLE C-1 (continued)
DECON COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
Demolition of Remaining Site Buildings														
33.1 -Reactor	4823					723	5546		5546				118164	
33.2 Access Vaults	37					6	43		43				436	
33.3 Administration	209					31	241		241				4753	
33.4 Auxiliary	7834					1175	9009		9009				162497	
33.5 Auxiliary Boiler	23					3	26		26				672	
33.6 Chlorine Storage	17					3	19		19				376	
33.7 Circ. Water Discharge Structure	351					53	403		403				4140	
33.8 Circulating Water Intake & Screenhouse	828					124	952		952				5369	
33.9 Communication Corridor - Contaminated	346					52	398		398				8911	
33.10 Communication Corridor-Clean	2292					344	2635		2635				53284	
33.11 Covered Walkways	8					1	10		10				322	
33.12 Diesel Generator	398					60	458		458				7888	
33.13 E.S.W.S. Pumphouse	781					117	898		898				5070	
33.14 ESWS Valve House	12					2	14		14				243	
33.15 Fuel Building	2574					386	2960		2960				63283	
33.16 Hot Machine Shop	22					3	25		25				639	
33.17 M.M.O. Building	172					26	198		198				3483	
33.18 Misc. Site Foundations	374					56	431		431				7394	
33.19 Misc. Site Structures	999					150	1149		1149				20240	
33.20 Oil Separator and Waste Tank	2					<1	3		3				48	
33.21 Radwaste	2714					407	3121		3121				58493	
33.22 Radwaste Drum Storage	422					63	485		485				12006	
33.23 Security/Guardhouse	317					47	364		364				4682	
33.24 Site Diesel Generator	3					<1	3		3				60	
33.25 Turbine Building	5712					857	6569		6569				166045	
33.26 Waste Water Treatment	17					3	20		20				432	
33. Totals	31285					4693	35978		35978				708928	

TABLE C-1 (continued)
DECON COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Class A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
Site Closeout Activities															
34. Remove Rubble		3804					571	4374		4374				12323	
35. Grade & landscape site		1393					209	1602		1602				8028	
36. Final report to NRC						156	23	179	179						
Subtotal Period 3 Activity Costs		36771				156	5539	42466	179	42287				741643	
Period 3 Undistributed Costs															
1. Insurance						172	17	189	189						
2. Property taxes						514	51	565		565					
3. Heavy equipment rental						2159	324	2483		2483					
4. Small tool allowance						286	43	329		329					
5. Plant energy budget						119	18	137		137					
Subtotal Undistributed Costs Period 3						3250	453	3704	189	3515					
Staff Costs															
DOC Staff Cost						6145	922	7067		7067					
Utility Staff Cost						7481	1122	8604	7743	860					
TOTAL PERIOD 3		36771				17033	8036	61840	8112	53728				741643	

TABLE C-1 (continued)
DECON COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
TOTAL COST TO DECOMMISSION	4638	56716	5017	5510	70592	174739	52578	369790	307316	62474	188591	12935	476	221	1601479	3844

TOTAL COST TO DECOMMISSION WITH 16.58% CONTINGENCY:	$369,789,856	
TOTAL NRC LICENSE TERMINATION COST IS 83.11% OR	$307,315,744	
NON-NUCLEAR DEMOLITION COST IS 16.89% OR:	$ 62,474,080	
TOTAL RADWASTE VOLUME BURIED:	202,223	cubic feet
TOTAL SCRAP METAL REMOVED:	41,775.9	tons
TOTAL CRAFT LABOR REQUIREMENTS:	1,601,478.5	man-hours
TOTAL PERSONNEL RADIATION EXPOSURE:	3,844.5	man-rem
TOTAL CRAFT LABOR COST WITH 22.51% CONTINGENCY:	$ 43,652,808	

TABLE C-2
SAFSTOR COST ESTIMATE FOR WOLF CREEK GENERATING STATION
(THOUSANDS OF 1993 DOLLARS)

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
PERIOD 1: Mothballing Activities															
1. Prepare preliminary decommissioning plan						120	18	138	138						
2. Prepare proposed decommissioning plan						312	47	359	359						
3. Remove fuel & source material								n/a							
4. Decon plant & process waste								a							
5. Review plant dwgs & specs.						130	20	150	150						
6. Perform detailed rad survey								a							
7. Estimate by-product inventory						100	15	115	115						
8. Submit for possession-only license						100	15	115	115						
9. End product description						100	15	115	115						
10. Detailed by-product inventory						150	23	173	173						
11. Define major work sequence						100	15	115	115						
12. Perform safety analysis of operation						200	30	230	230						
13. Perform safety analysis of end product						200	30	230	230						
14. Submit dismantling plan						100	15	115	115						
15. Receive possession-only license								a							
Activity Specifications															
16.1 Prepare plant and facilities for mothbal						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						1621	243	1864	1864						
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						

NOTES- "n/a" indicates that fuel handling, packaging, shipping, and disposal are charged to plant operations, not decommissioning
- "a" indicates that costs are included in the utility staff costs.
- Columns may not total due to rounding errors.

TABLE C-2 (continued)
SAFSTOR COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Class A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
Detailed Work Procedures (continued)															
18. Procure vacuum drying system						10	2	12	12						
19. Drain/de-energize non-cont. systems								a							
20. Drain & dry NSSS								a							
21. Drain/de-energize contaminated systems								a							
22. Decon/secure contaminated systems								a							
Decontamination of Site Buildings															
23.1 -Reactor	680						340	1019	1019					22048	
23.2 Auxiliary	313						156	469	469					9872	
23.3 Communication corridor - contaminated	7						3	10	10					218	
23.4 Fuel Building	324						162	486	486					11308	
23.5 Hot Machine Shop	9						4	13	13					271	
23.6 Radwaste	167						83	250	250					5257	
23.7 Radwaste Drum Storage	19						9	28	28					591	
23. Totals	1517						758	2275	2275					49565	
24. Prepare support equipment for storage		235					35	271	271					3000	3
25. Install containment pressure equal. fins		19					3	22	22					700	2
26. Interim survey prior to dormancy						299	45	344	344						
27. Secure building accesses								a							
28. Prepare & submit interim report						58	9	67	67						
Subtotal Period 1 Activity Costs	1517	254				4193	1426	7390	7390					53265	5
Period 1 Undistributed Costs															
1. Decon equipment						189	28	217	217						
2. Decon supplies						137	34	171	171						
3. Process liquid waste	256		131	175	761		282	1605	1605		1744			452	11
4. Insurance						222	22	244	244						
5. Property taxes						421	42	463	463						
6. Health physics supplies						947	237	1184	1184						
7. Small tool allowance						22	3	25	25						
8. Disposal of DAW generated			198	6	762		135	1101	1101	2473				6725	17

TABLE C-2 (continued)
SAFSTOR COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Licterm	Clean A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
Period 1 Undistributed Costs (continued)															
9. Plant energy budget						1261	189	1451	1451						
10. NRC fees						44	4	48	48						
11. Emergency Planning Fees						100	10	110	110						
Subtotal Undistributed Costs Period 1	256		329	181	1523	3342	987	6619	6619	2473	1744			7178	27
Staff Costs															
DOC Staff Cost															
Utility Staff Cost						11330	1699	13029	13029						
TOTAL COST TO MOTHBALL	1773	254	329	181	1523	18865	4112	27038	27038	2473	1744			60443	32

TOTAL COST TO MOTHBALL WITH 17.94% CONTINGENCY: $27,037,874

TOTAL MOTHBALLING RADWASTE VOLUME BURIED: 4,216 cubic feet

TOTAL SCRAP REMOVED: 0.0 tons

TOTAL CRAFT LABOR REQUIREMENTS: 60,442.6 man-hours

TOTAL PERSONNEL RADIATION EXPOSURE: 32.1 man-rem

TOTAL CRAFT LABOR COST WITH 17.94% CONTINGENCY: $1,243,463

TABLE C-2 (continued)
SAFSTOR COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
PERIOD 2: Mothballed Annual Maintenance Cost															
1. Quarterly inspection								$							
2. Semi-annual environmental survey								$							
3. Prepare reports								$							
4. Health physics supplies						36	9	45	45						
5. Insurance						53	5	58	58						
6. Property taxes						421	42	463	463						
7. Disposal of contaminated solid waste			1	<1	39		6	47	47	128				35	<1
8. Bituminous roof replacement						36	5	41	41						
9. Maintenance supplies						77	19	97	97						
10. Plant energy budget						170	26	196	196						
11. NRC Fees						10	<1	11	11						
12. Emergency Planning Fees						7	<1	8	8						
13. Site maintenance staff						3651	548	4199	4199						
PERIOD 2 ANNUAL MAINTENANCE TOTALS			1	<1	39	4462	662	5165	5165	128				35	<1
MAINTENANCE COST FOR 55.1125 YEARS DORMANCY:							$284,644,128								
PERIOD 3															
1. Review plant dwgs & specs.						460	69	529	529						
2. Perform detailed rad survey								n/a							
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 safety analysis						310	47	357	357						
7. Submit dismantling plan						52	8	60	60						
8. Receive dismantling order								a							
Subtotal Period 3 Activity Costs						1802	270	2072	2072						

TABLE C-2 (continued)
SAFSTOR COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Class A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
Period 3 Undistributed Costs														
1. DOC staff relocation expenses					845	127	972	972						
2. Insurance					333	33	366	366						
3. Property taxes					632	63	695	695						
4. Health physics supplies					947	237	1184	1184						
5. Heavy equipment rental					233	35	267	267						
6. Disposal of DAW generated		196	6	762		135	1099	1099	2473				6725	17
7. Plant energy budget					1907	286	2193	2193						
8. NRC fees					66	7	73	73						
Subtotal Undistributed Costs Period 3		196	6	762	4962	922	6849	6849	2473				6725	17
Staff Costs														
DOC Staff Cost					4607	691	5298	5298						
Utility Staff Cost					13449	2017	15466	15466						
TOTAL PERIOD 3 COST		196	6	762	24820	3901	29685	29685	2473				6725	17
PERIOD 4														
Activity Specifications														
9.1 Re-activate plant & temporary facilities					737	111	848	763	85					
9.2 Plant systems					417	63	479	431	48					
9.3 Reactor internals					710	107	817	817						
9.4 Reactor vessel					650	98	748	748						
9.5 Biological shield					50	8	58	58						
9.6 Steam generators					312	47	359	359						
9.7 Reinforced concrete					160	24	184	92	92					
9.8 Turbine & condenser					80	12	92		92					
9.9 Plant structures & buildings					312	47	359	179	179					
9.10 Waste management					460	69	529	529						
9.11 Facility & site closeout					90	14	104	52	52					
9. Total					3978	597	4574	4026	548					

TABLE C-2 (continued)
SAFSTOR COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean	A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
Planning & Site Preparations																
10. Prepare dismantling sequence						240	36	276	276							
11. Plant prep. & temp. svcs						1485	223	1708	1708							
12. Design water clean-up system						140	21	161	161							
13. Rigging/CCEs/tooling/etc.						1257	189	1446	1446							
14. Procure casks/liners & containers						123	18	141	141							
Detailed Work Procedures																
15.1 Plant systems						473	71	544	490	54						
15.2 Vessel head						250	38	288	288							
15.3 Reactor internals						250	38	288	288							
15.4 Remaining buildings						135	20	155	39	116						
15.5 CRD cooling assembly						100	15	115	115							
15.6 CRD housings & ICI tubes						100	15	115	115							
15.7 Incore instrumentation						100	15	115	115							
15.8 Reactor vessel						363	54	417	417							
15.9 Facility closeout						120	18	138	69	69						
15.10 Missile shields						45	7	52	52							
15.11 Biological shield						120	18	138	138							
15.12 Steam generators						460	69	529	529							
15.13 Reinforced concrete						100	15	115	58	58						
15.14 Turbine & condensers						312	47	359		359						
15.15 Auxiliary building						273	41	314	283	31						
15.16 Reactor building						273	41	314	283	31						
15. Total						3474	521	3995	3276	719						
16. Remove spent fuel racks	200	35	79	22	945	731	371	2383	2383		3150				7874	42

TABLE C-2 (continued)
SAFSTOR COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Licterm	Clean A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
Nuclear Steam Supply System Removal															
17.1 Reactor Coolant Piping	61	118	62	18	2066		379	2703	2703	6485				7280	26
17.2 Pressurizer Relief Tank	11	56	5	4	196		50	321	321	621				2731	2
17.3 Reactor Coolant Pumps & Motors	23	35	33	40	3491		553	4175	4175	11312				2633	2
17.4 Pressurizer	22	27	4	10	1280		212	1554	1554	4147				1852	1
17.5 Steam Generators	125	2487	133	3502	17895		3907	28050	28050	58484				98627	50
17.6 CRDMs/ ICIs/Service Structure Removal	54	36	20	14	596		130	851	851	1843				3308	2
17.7 Reactor Vessel Internals	38	984	251	220	6201		1805	9499	9499	1834	393	476	221	11270	3
17.8 Reactor Vessel	94	2656	265	252	2569		2553	8389	8389	5540	2096			15026	4
17. Totals	429	6398	773	4059	34294		9589	55542	55542	90266	2489	476	221	142727	90
Disposal of Plant Systems															
18.1 AX - Acid Feed		19					3	22		22				833	
18.2 Accumulator Safety Injection		81	26	6	190	121	70	495	495	617				3503	28
18.3 Auxiliary Bldg Non-System Specific Clean		404					61	465	465					17709	
18.4 Auxiliary Bldg Non-System Specific Cont		217	102	34	767	577	271	1968	1968	2488				9846	12
18.5 Auxiliary Bldg Non-System Specific Decon	31	135					36	202	47	155				7182	
18.6 Auxiliary Building HVAC		260	46	12	290	213	147	967	967	940				8707	12
18.7 Auxiliary Feedwater		20					3	23		23				912	
18.8 Auxiliary Steam		65					10	75		75				2948	
18.9 Auxiliary Steam Chemical Addition		3					<1	3		3				121	
18.10 Auxiliary Steam Generator		7					1	8		8				321	
18.11 Auxiliary Turbines		31					5	36		36				1358	
18.12 Borated Refueling Water Storage		149	56	9	355	266	137	972	972	1152				6477	21
18.13 Boron Recycle		252	70	18	438	275	180	1232	1232	1422				10710	115
18.14 CL - Chlorination		14					2	16		16				607	
18.15 CW - Circulating Water		190					29	219		219				8903	
18.16 CZ - Caustic Acid		3					<1	3		3				134	
18.17 Central Chilled Water		51					8	59		59				2304	
18.18 Chemical & Detergent Waste	27	69	18	5	124	85	65	393	393	401				4051	23
18.19 Chemical & Volume Control	326	466	171	47	2147	560	710	4429	4429	6968				28855	160
18.20 Closed Cooling Water		32					5	37		37				1443	
18.21 CO - Carbon Dioxide		4					<1	5		5				177	
18.22 Component Cooling Water		134					20	154		154				6177	
18.23 Condensate		133					20	153		153				5956	
18.24 Condensate & Feedwater Chemical Addition		12					2	14		14				526	
18.25 Condensate Demineralizer		46					7	53		53				2068	

TABLE C-2 (continued)
SAFSTOR COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean	A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
18.26 Condensate Storage & Transfer		39					6	45		45					1656	
18.27 Condenser Air Removal		16					2	18		18					699	
18.28 Containment Atmospheric Control		6	22	4	377	19	64	491	491		1222				302	<1
18.29 Containment Cooling		305	103	22	1119	313	305	2166	2166		3631				11519	14
18.30 Containment Hydrogen Control		26	19	5	148	85	44	327	327		481				1153	<1
18.31 Containment Integrated Leak Rate Test		6					<1	7		7					287	
18.32 Containment Purge HVAC		66	32	5	322	110	85	622	622		1046				2469	3
18.33 Containment Spray	44	40					28	112	67	46					3219	
18.34 Control Bldg Non-System Specific Clean		378					57	435		435					16569	
18.35 Control Bldg Non-System Specific Cont		199	105	34	759	571	265	1933	1933		2462				9079	11
18.36 Control Bldg Non-System Specific Decon	32	124					34	189	47	142					6691	
18.37 Control Building HVAC		147					22	169		169					6162	
18.38 DA - Circulating Water System		196					29	226		226					9126	
18.39 DM - Equipment Drains		60					9	69		69					2710	
18.40 DO - Diesel Oil		1					<1	1		1					47	
18.41 Decontamination		39	46	6	134	88	49	361	361		435				1762	5
18.42 Demineralized Water Storage & Transfer		41					6	47		47					1819	
18.43 Diesel Generator Building HVAC		27					4	31		31					1115	
18.44 EA - Service Water		63					10	73		73					2928	
18.45 EF - Essential Service Water		77					12	89		89					3541	
18.46 Emergency Fuel Oil		31					5	36		36					1329	
18.47 FO - Fuel Oil		14					2	16		16					625	
18.48 FP - Fire Protection		152					23	175		175					7096	
18.49 Feedwater		90					14	104		104					4105	
18.50 Feedwater Heater Extraction		135					20	155		155					6164	
18.51 Floor & Equipment Drains		1005	207	55	1342	971	627	4208	4208		4357				42514	116
18.52 Fuel Bldg Non-System Specific Clean		52					8	60		60					2293	
18.53 Fuel Bldg Non-System Specific Cont		31	15	5	118	89	41	300	300		383				1429	2
18.54 Fuel Bldg Non-System Specific Decon	3	16					4	24	5	18					840	
18.55 Fuel Building HVAC		143	45	10	518	123	138	977	977		1682				4864	7
18.56 Fuel Handling & Storage Reactor Vessel		6	8	5	266		43	328	328		864				259	<1
18.57 Fuel Pool Cooling & Cleanup		228	70	18	649	301	209	1475	1475		2106				9874	27
18.58 GD - Esstl. Srvc. Wtr Pumphs. Bldg HVAC		9					1	10		10					365	
18.59 GE - Turbine Bldg HVAC		102					15	118		118					4319	
18.60 GF - Miscellaneous Building HVAC		33					5	38		38					1387	
18.61 Gaseous Radwaste		150	70	15	512	159	147	1053	1053		1662				6409	15
18.62 Generator Hydrogen Seal & CO2		5					<1	6		6					210	

TABLE C-2 (continued)
SAFSTOR COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean	A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
Disposal of Plant Systems (continued)																
18.63 Generator Seal Oil		7					1	8		8					296	
18.64 HY - Hydrogen		6					<1	7		7					277	
18.65 High Pressure Coolant Injection		159	57	17	518	240	162	1152	1152		1682				6875	33
18.66 KA - Compressed Air and Instrument		160					24	185		185					7081	
18.67 KB - Breathing Air		26					4	30		30					1182	
18.68 KC - Fire Protection		277					42	319		319					12879	
18.69 KD - Domestic Water		46					7	52		52					2023	
18.70 KH - Service Gas		18					3	21		21					780	
18.71 LA - Sanitary Drains		13					2	15		15					582	
18.72 LC - Yard Drains		2					<1	3		3					95	
18.73 LE - Oily Waste		98					15	112		112					4433	
18.74 Liquid Radwaste	347	408	129	27	823	394	475	2603	2603		2670				29740	347
18.75 Lube Oil Storage,Transfer,& Purification		21					3	24		24					925	
18.76 Main Steam		139					21	160		160					6475	
18.77 Main Turbine		131					20	151		151					5932	
18.78 Main Turbine Control Oil		29					4	33		33					1211	
18.79 Main Turbine Lube Oil		27					4	31		31					1164	
18.80 NT - Nitrogen		4					<1	5		5					186	
18.81 Nuclear Sampling		30	46	6	423	29	81	613	613		1373				1407	2
18.82 OX - Oxygen		4					<1	5		5					177	
18.83 Plant Heating		70					11	81		81					3155	
18.84 Process Sampling & Analysis		54	42	13	644	124	135	1013	1013		2090				2399	4
18.85 Radwaste Bldg Non-System Specific Clean		153					23	176		176					6704	
18.86 Radwaste Bldg Non-System Specific Cont		93	45	14	310	234	112	808	808		1007				4237	5
18.87 Radwaste Bldg Non-System Specific Decon	11	46					12	69	16	53					2449	
18.88 Radwaste Building HVAC		100	28	7	293	88	86	601	601		951				3414	5
18.89 Reactor Bldg Non-System Specific Clean		136					20	157		157					5982	
18.90 Reactor Bldg Non-System Specific Cont		75	29	9	187	141	72	513	513		607				3392	4
18.91 Reactor Bldg Non-System Specific Decon	10	46					12	68	15	53					2438	
18.92 Reactor Coolant System		105	64	16	736	202	176	1299	1299		2390				4772	68
18.93 Reactor Makeup Water		139	31	9	222	138	93	631	631		720				5868	7
18.94 Residual Heat Removal		203	76	18	801	284	224	1604	1604		2599				8987	75
18.95 Roof Drains		55					8	63		63					2529	
18.96 ST - Sewage Treatment		23					3	26		26					1000	
18.97 SW - Screen Wash		15					2	17		17					640	
18.98 SZ - Service Air		47					7	54		54					2101	

TABLE C-2 (continued)
SAFSTOR COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
Disposal of Plant Systems (continued)															
18.99 Secondary Liquid Waste	297	453	190	36	940	513	504	2932	2932	3050				30121	177
18.100Solid Radwaste		237	205	27	911	289	264	1933	1933	2955				10526	53
18.101Standby Diesel Engine		101					15	117	117					4394	
18.102Stator Cooling Water		6					<1	7	7					249	
18.103Steam Generator Blowdown		313	103	29	1006	429	308	2189	2189	3264				13504	107
18.104Steam Seal		12					2	14	14					539	
18.105VA - I&C Shop HVAC		3					<1	4	4					141	
18.106VB - I&C Shop Computer Room HVAC		2					<1	3	3					95	
18.107VC - Health Physics Computer Room HVAC		5					<1	5	5					200	
18.108VH - Circ Water & Makeup Water Scrnhs Vt		6					<1	6	6					245	
18.109VJ - Shop Bldg Machine Shop Area Vent		1					<1	1	1					51	
18.110VL - Shop Building HVAC		2					<1	2	2					92	
18.111VS - Admin. Bldg HVAC		5					<1	6	6					238	
18.112VT - Tech Support Building HVAC		2					<1	2	2					79	
18.113VV - Misc. Bldg. HVAC		3					<1	3	3					123	
18.114VW - Waste Water Treatment Ventilation		1					<1	1	1					48	
18.115WD - Domestic Water		25					4	28	28					1089	
18.116WG - Gland Water & Motor Cooling Water		17					3	20	20					781	
18.117WL- Cooling Lake Makeup & Blowdown		17					3	19	19					754	
18.118WM - Makeup Demineralizer		92					14	105	105					4108	
18.119WS - Plant Services Water		82					12	94	94					3791	
18.120WT - Waste Water Treatment		17					3	19	19					767	
18.121WZ - Radioactive Liquid Waste		5					<1	6	6					237	
18. Totals	1129	11226	2277	542	18389	8031	7127	48721	42785	5936 59679				524723	1455
19. Erect scaffolding for systems removal		918					138	1056	1056					29008	
Decontamination of Site Buildings															
20.1 -Reactor	735	314	135	39	3614	304	1053	6194	6194	11728				33325	124
20.2 Auxiliary	383	24	55	16	1706	83	474	2742	2742	5536				13102	49
20.3 Communication Corridor - Contaminated	8	<1	1	<1	36	<1	10	57	57	118				288	<1
20.4 Fuel Building	349	264	41	13	664	174	372	1878	1878	2156				23412	52
20.5 Hot Machine Shop	15		1	<1	44		14	74	74	142				500	1
20.6 Radwaste	204	11	28	8	900	38	250	1440	1440	2921				6973	52
20.7 Radwaste Drum Storage	23	<1	3	<1	100	3	28	159	159	324				784	2
20. Totals	1719	615	264	77	7064	604	2201	12544	12544	22926				78385	280

TABLE C-2 (continued)
SAFSTOR COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean	A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
21. License termination survey						299	45	344	344							
22. Terminate license								a								
Subtotal Period 4 Activity Costs	3477	19192	3393	4700	60692	20362	21076	132892	125689	7202	176021	2489	476	221	782717	1867
Period 4 Undistributed Costs																
1. Decon equipment						189	28	217	217							
2. Decon supplies						327	82	408	408							
3. DOC staff relocation expenses						845	127	972	972							
4. Process liquid waste	318		300	346	2061		550	3576	3576			4416			551	13
5. Insurance						696	70	766	766							
6. Property taxes						978	98	1075	968	108						
7. Health physics supplies						2261	565	2826	2826							
8. Heavy equipment rental						3848	577	4425	3983	443						
9. Small tool allowance						324	49	373	335	37						
10. Pipe cutting equipment						587	88	675	675							
11. Disposal of DAW generated			468	18	2253		387	3126	3126		7350				16056	40
12. Plant energy budget						2350	353	2703	2433	270						
13. NRC Fees						210	21	231	231							
Subtotal Undistributed Costs Period 4	318		768	364	4314	12616	2995	21375	20517	858	7350	4416			16608	53
Staff Costs																
DOC Staff Cost						11486	1723	13208	13208							
Utility Staff Cost						30388	4558	34946	34946							
TOTAL PERIOD 4	3795	19192	4162	5064	65006	74851	30351	202421	194360	8060	183371	6905	476	221	799325	1920
PERIOD 5																
Removal of Major Equipment																
23. Main Turbine/Generator		70					10	80		80					3082	
24. Main Condensers		219					33	252		252					9282	

TABLE C-2 (continued)
SAFSTOR COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon Remove	Pack	Ship	Bury	other	cntgcy	Total	LicTerm	Clean A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
Demolition of Remaining Site Buildings														
25.1 •Reactor	4823					723	5546		5546				118164	
25.2 Access Vaults	37					6	43		43				436	
25.3 Administration	209					31	241		241				4753	
25.4 Auxiliary	7834					1175	9009		9009				162497	
25.5 Auxiliary Boiler	23					3	26		26				672	
25.6 Chlorine Storage	17					3	19		19				376	
25.7 Circ. Water Discharge Structure	351					53	403		403				4140	
25.8 Circulating Water Intake & Screenhouse	828					124	952		952				5369	
25.9 Communication Corridor - Contaminated	346					52	398		398				8911	
25.10 Communication Corridor-Clean	2292					344	2635		2635				53284	
25.11 Covered Walkways	8					1	10		10				322	
25.12 Diesel Generator	398					60	458		458				7888	
25.13 E.S.W.S. Pumphouse	781					117	898		898				5070	
25.14 ESWS Valve House	12					2	14		14				243	
25.15 Fuel Building	2574					386	2960		2960				63283	
25.16 Hot Machine Shop	22					3	25		25				639	
25.17 M.M.O. Building	172					26	198		198				3483	
25.18 Misc. Site Foundations	374					56	431		431				7394	
25.19 Misc. Site Structures	999					150	1149		1149				20240	
25.20 Oil Separator and Waste Tank	2					<1	3		3				48	
25.21 Radwaste	2714					407	3121		3121				58493	
25.22 Radwaste Drum Storage	422					63	485		485				12006	
25.23 Security/Guardhouse	317					47	364		364				4682	
25.24 Site Diesel Generator	3					<1	3		3				60	
25.25 Turbine Building	5712					857	6569		6569				166045	
25.26 Waste Water Treatment	17					3	20		20				432	
25. Totals	31285					4693	35978		35978				708928	
Site Closeout Activities														
26. Remove Rubble	3804					571	4374		4374				12323	
27. Grade & landscape site	1393					209	1602		1602				8028	
28. Final report to NRC					156	23	179	179						
Subtotal Period 5 Activity Costs	36771				156	5539	42466	179	42287				741643	

TABLE C-2 (continued)
SAFSTOR COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean	A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
Period 5 Undistributed Costs																
1. Insurance						172	17	190	190							
2. Property taxes						516	52	567		567						
3. Heavy equipment rental						2192	329	2521		2521						
4. Small tool allowance						286	43	329		329						
5. Plant energy budget						120	18	138		138						
Subtotal Undistributed Costs Period 5						3287	459	3745	190	3556						
Staff Costs																
DOC Staff Cost						6170	925	7095		7095						
Utility Staff Cost						7512	1127	8639	7775	864						
TOTAL PERIOD 5		36771				17125	8050	61946	8144	53802					741643	
TOTAL COST TO DECOMMISSION	5568	56218	4743	5268	69465	381568	82904	605734	543872	61862	195371	8649	476	221	1610054	1973

TOTAL COST TO DECOMMISSION WITH 15.86% CONTINGENCY: $605,733,632

TOTAL NRC LICENSE TERMINATION COST IS 89.79% OR $543,871,872

NON-NUCLEAR DEMOLITION COST IS 10.21% OR: $ 61,861,820

TOTAL RADWASTE VOLUME BURIED: 204,717 cubic feet

TOTAL SCRAP METAL REMOVED: 41,775.9 tons

TOTAL CRAFT LABOR REQUIREMENTS: 1,610,054.4 man-hours

TOTAL PERSONNEL RADIATION EXPOSURE: 1,973.5 man-rem

TOTAL CRAFT LABOR COST WITH 22.93% CONTINGENCY: $ 43,984,232

TABLE C-3
ENTOMB COST ESTIMATE FOR WOLF CREEK GENERATING STATION
(THOUSANDS OF 1993 DOLLARS)

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
PERIOD 1															
1. Prepare preliminary decommissioning plan						130	20	150	150						
2. Revise decommissioning plan								a							
3. Review plant dwgs & specs.						460	69	529	529						
4. Perform detailed rad survey								a							
5. End product description						100	15	115	115						
6. Detailed by-product inventory						130	20	150	150						
7. Define major work sequence						750	113	863	863						
8. Perform safety analysis of operation						200	30	230	230						
9. Perform safety analysis						310	47	357	357						
10. Submit dismantling plan						52	8	60	60						
11. Submit dismantling plan								a							
Subtotal Period 1 Activity Costs						2132	320	2452	2452						
Period 1 Undistributed Costs															
1. Decon equipment						189	28	217	217						
2. Decon supplies						137	34	171	171						
3. DOC staff relocation expenses						845	127	972	972						
4. Process liquid waste	102		52	70	303		112	639	639		695			180	4
5. Insurance						980	98	1078	1078						
6. Property taxes						1861	186	2047	2047						
7. Health physics supplies						947	237	1184	1184						
8. Disposal of DAW generated			198	6	762		135	1101	1101	2473				6725	17
9. Plant energy budget						5606	841	6447	6447						
10. NRC fees						194	19	214	214						
11. Emergency planning fees						442	44	486	486						
Subtotal Undistributed Costs Period 1	102		250	76	1065	11200	1862	14555	14555	2473	695			6905	21

NOTES- "n/a" indicates that fuel handling, packaging, shipping, and disposal are charged to plant operations, not decommissioning

- "a" indicates that costs are included in the utility staff costs.
- Columns may not total due to rounding errors.

TABLE C-3 (continued)
ENTOMB COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
Staff Costs															
DOC Staff Cost						4607	691	5298	5298						
Utility Staff Cost						50050	7508	57558	57558						
TOTAL PERIOD 1 COST	102		250	76	1065	67989	10380	79862	79862	2473	695			6905	21
PERIOD 2															
Activity Specifications															
12.1 Prepare plant and facilities for entombm						492	74	566	566						
12.2 Plant systems						417	63	479	479						
12.3 Reinforced concrete						160	24	184	184						
12.4 Plant structures and buildings						312	47	359	359						
12.5 Waste management						460	69	529	529						
12.6 Facility and site dormancy						90	14	104	104						
12. Total						1931	290	2220	2220						
Detailed Work Procedures															
13.1 Plant systems						473	71	544	544						
13.2 Entombment structures						90	14	104	104						
13.3 Facility closeout & dormancy						120	18	138	138						
13.4 Auxiliary Building						273	41	314	314						
13. Total						956	143	1100	1100						
14. Prepare dismantling sequence						50	8	58	58						
15. Procure vacuum drying system						10	2	12	12						
16. Drain/de-energize non-cont. systems								a							
17. Drain & dry NSSS								a							
18. Drain/de-energize contaminated systems								a							
Rack Removal															
19. Remove spent fuel racks	212	35	80	22	945	731	378	2402	2402	3150				8531	46

TABLE C-3 (continued)
ENTOMB COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
Disposal of Plant Systems															
External to Entombment Barrier															
20.1 Accumulator Safety Injection		88	27	6	190	121	72	504	504	617				3844	31
20.2 Auxiliary Bldg Non-System Specific Cont		247	103	34	767	577	279	2007	2007	2488				11246	14
20.3 Auxiliary Building HVAC		280	46	12	290	213	152	992	992	940				9618	13
20.4 Borated Refueling Water Storage		163	56	9	355	266	141	990	990	1152				7142	23
20.5 Boron Recycle		273	71	18	438	275	185	1260	1260	1422				11754	126
20.6 Chemical & Detergent Waste	31	75	19	5	124	85	68	406	406	401				4502	25
20.7 Chemical & Volume Control	354	507	173	47	2147	560	734	4523	4523	6968				32065	177
20.8 Containment Atmospheric Control		6	23	4	377	19	64	492	492	1222				343	<1
20.9 Containment Cooling		330	104	22	1119	313	311	2198	2198	3631				12706	16
20.10 Containment Hydrogen Control		28	19	5	148	85	45	330	330	481				1285	<1
20.11 Containment Purge HVAC		72	32	5	322	110	87	629	629	1046				2724	3
20.12 Control Bldg Non-System Specific Cont		226	106	34	759	571	272	1968	1968	2462				10332	12
20.13 Decontamination		43	47	6	134	88	49	366	366	435				1945	5
20.14 Floor & Equipment Drains		1093	209	55	1342	971	649	4320	4320	4357				46675	126
20.15 Fuel Bldg Non-System Specific Cont		36	15	5	118	89	42	306	306	383				1638	2
20.16 Fuel Building HVAC		154	45	10	518	123	141	991	991	1682				5374	7
20.17 Fuel Handling & Storage Reactor Vessel		6	8	5	266		43	329	329	864				292	<1
20.18 Fuel Pool Cooling & Cleanup		248	71	18	649	301	214	1501	1501	2106				10872	29
20.19 Gaseous Radwaste		162	71	15	512	159	150	1069	1069	1662				7023	17
20.20 High Pressure Coolant Injection		173	57	17	518	240	165	1170	1170	1682				7576	37
20.21 Liquid Radwaste	384	442	130	27	823	394	502	2702	2702	2670				32913	384
20.22 Nuclear Sampling		33	46	6	423	29	81	618	618	1373				1564	3
20.23 Process Sampling & Analysis		60	42	13	644	124	136	1020	1020	2090				2650	4
20.24 Radwaste Bldg Non-System Specific Cont		106	46	14	310	234	115	825	825	1007				4848	6
20.25 Radwaste Building HVAC		108	28	7	293	88	88	611	611	951				3781	5
20.26 Reactor Bldg Non-System Specific Cont		86	30	9	187	141	75	527	527	607				3884	5
20.27 Reactor Makeup Water		152	31	9	222	138	96	647	647	720				6469	7
20.28 Residual Heat Removal		221	77	18	801	284	228	1628	1628	2599				9890	82
20.29 Secondary Liquid Waste	328	493	191	36	940	513	530	3030	3030	3050				33315	195
20.30 Solid Radwaste		258	207	27	911	289	269	1961	1961	2955				11609	58
20.31 Steam Generator Blowdown		341	104	29	1006	429	315	2225	2225	3264				14867	117
20. Totals	1096	6509	2233	526	17652	7829	6300	42145	42145	57289				314747	1530
21. Erect scaffolding for systems removal		856					128	985	985					27060	

TABLE C-3 (continued)
ENTOMB COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
Decontamination of Site Buildings															
External to Entombment Barrier															
22.1 Auxiliary	409	27	56	16	1706	83	487	2784	2784	5536				14327	54
22.2 Communication Corridor - Contaminated	9	<1	1	<1	36	<1	10	58	58	118				315	<1
22.3 Fuel Building	378	289	41	13	664	174	393	1953	1953	2156				25593	56
22.4 Hot Machine Shop	16		1	<1	44		15	76	76	142				546	1
22.5 Radwaste	218	12	29	8	900	38	257	1462	1462	2921				7625	57
22.6 Radwaste Drum Storage	24	1	3	<1	100	3	28	161	161	324				857	2
22. Totals	1054	330	131	38	3450	299	1191	6494	6494	11197				49263	171
23. Prepare support equipment for storage		118					18	135	135					1500	2
24. Isolate sys & comp. at entombment bndry		53					8	62	62					2000	5
25. Construct entombment barriers		396					59	456	456					7549	
26. Install containment pressure equal. line		19					3	22	22					700	2
27. Interim survey prior to dormancy						299	45	344	344						
28. Secure building accesses								a							
29. Prepare and submit interim report						120	18	138	138						
Subtotal Period 2 Activity Costs	2362	8316	2444	586	22048	12226	8589	56571	56571	71637				411349	1756
Period 2 Undistributed Costs															
1. Decon equipment						189	28	217	217						
2. Decon supplies						274	68	342	342						
3. DOC staff relocation expenses						845	127	972	972						
4. Process liquid waste	230		257	266	1799		454	3026	3026		3818			477	11
5. Insurance						444	44	488	488						
6. Property taxes						842	84	927	927						
7. Health physics supplies						1894	474	2368	2368						
8. Heavy equipment rental						1072	161	1233	1233						
9. Small tool allowance						158	24	182	182						
10. Pipe cutting equipment						587	88	675	675						
11. Disposal of DAW generated			396	12	1524		270	2202	2202	4945				13450	34
12. Plant energy budget						2416	362	2778	2778						
13. NRC Fees						44	4	48	48						
14. Emergency Planning Fees						58	6	64	64						
Subtotal Undistributed Costs Period 2	230		653	299	3323	8823	2195	15522	15522	4945	3818			13928	45

TABLE C-3 (continued)
ENTOMB COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
Staff Costs															
DOC Staff Cost						9000	1350	10350	10350						
Utility Staff Cost						28092	4214	32306	32306						
TOTAL PERIOD 2 COST	2593	8316	3097	885	25371	58142	16348	114750	114750	76582	3818			425277	1800
TOTAL COST TO ENTOMB	2593	8316	3097	885	25371	58142	16348	114750	114750	76582	3818			425277	1800

TOTAL COST TO ENTOMB WITH 15.92% CONTINGENCY	$194,612,496	
TOTAL ENTOMBMENT RADWASTE VOLUME BURIED	83,566	cubic feet
TOTAL SCRAP REMOVED	0.0	tons
TOTAL CRAFT LABOR REQUIREMENTS	432,182.3	man-hours
TOTAL PERSONNEL RADIATION EXPOSURE	1,821.3	man-rem
TOTAL CRAFT LABOR COST WITH 15.92% CONTINGENCY	$8,987,725	

TABLE C-3 (continued)
ENTOMB COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
ENTOMBMENT DORMANCY															
PERIOD 3: Entombed Annual Maintenance Cost															
1. Quarterly inspection								$							
2. Semi-annual environmental survey								$							
3. Prepare reports								$							
4. Health physics supplies							7	2	9	9					
5. Insurance							48	5	53	53					
6. Property taxes							421	42	463	463					
7. Maintenance supplies							52	13	65	65					
8. Plant energy budget							84	13	97	97					
9. NRC fees							9	<1	10	10					
10. Site maintenance staff							1666	250	1915	1915					
PERIOD 3 ANNUAL MAINTENANCE TOTALS							2287	325	2612	2612					
MAINTENANCE COST FOR 49.59917 YEARS DORMANCY:								29,568,064							
ENTOMBMENT DISMANTLING															
PERIOD 4															
1. Review plant dwgs & specs.							130	20	150	150					
2. Perform detailed rad survey									n/a						
3. Submit for possession-only license							100	15	115	115					
4. End product description							32	5	37	37					
5. Detailed by-product inventory							150	23	173	173					
6. Define major work sequence							100	15	115	115					
7. Perform safety analysis of operation							200	30	230	230					
8. Perform safety analysis of end product							200	30	230	230					
9. Submit dismantling plan							100	15	115	115					
10. Receive dismantling order									a						
Subtotal Period 4 Activity Costs							1012	152	1164	1164					

TABLE C-3 (continued)
ENTOMB COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
Period 4 Undistributed Costs															
1. DOC staff relocation expenses						845	127	972	972						
2. Insurance						333	33	366	366						
3. Property taxes						632	63	695	695						
4. Health physics supplies						947	237	1184	1184						
5. Heavy equipment rental						233	35	267	267						
6. Plant energy budget						923	138	1061	1061						
7. NRC Fees						66	7	73	73						
Subtotal Undistributed Costs Period 4						3978	640	4618	4618						
Staff Costs															
DOC Staff Cost						4607	691	5298	5298						
Utility Staff Cost						13449	2017	15466	15466						
TOTAL PERIOD 4 COST						23046	3500	26546	26546						
PERIOD 5															
Activity Specifications															
11.1 Re-activate plant & temporary facilities						737	111	848	763	85					
11.2 Plant systems						417	63	479	431	48					
11.3 Reactor internals						710	107	817	817						
11.4 Reactor vessel						650	98	748	748						
11.5 Biological shield						50	8	58	58						
11.6 Steam generators						312	47	359	359						
11.7 Reinforced concrete						160	24	184	92	92					
11.8 Turbine & condenser						80	12	92		92					
11.9 Plant structures & buildings						312	47	359	179	179					
11.10 Waste management						460	69	529	529						
11.11 Facility & site closeout						90	14	104	52	52					
11. Total						3978	597	4574	4026	548					

TABLE C-3 (continued)
ENTOMB COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
Planning & Site Preparations															
12. Prepare dismantling sequence						240	36	276	276						
13. Plant prep. & temp. svces						1485	223	1708	1708						
14. Design water clean-up system						140	21	161	161						
15. Rigging/CCES/tooling/etc.						1257	189	1446	1446						
16. Procure casks/liners & containers						123	18	141	141						
Detailed Work Procedures															
17.1 Plant systems						473	71	544	490	54					
17.2 Vessel head						250	38	288	288						
17.3 Reactor internals						250	38	288	288						
17.4 Remaining buildings						135	20	155	39	116					
17.5 CRD cooling assembly						100	15	115	115						
17.6 CRD housings & ICI tubes						100	15	115	115						
17.7 Incore instrumentation						100	15	115	115						
17.8 Reactor vessel						363	54	417	417						
17.9 Facility closeout						120	18	138	69	69					
17.10 Missile shields						45	7	52	52						
17.11 Biological shield						120	18	138	138						
17.12 Steam generators						460	69	529	529						
17.13 Reinforced concrete						100	15	115	58	58					
17.14 Turbine & condensers						312	47	359		359					
17.15 Reactor building						273	41	314	283	31					
17. Total						3201	480	3681	2994	688					
Nuclear Steam Supply System Removal															
18.1 Reactor Coolant Piping	61	118	62	18	2066		379	2703	2703	6485				7280	26
18.2 Pressurizer Relief Tank	11	56	5	4	196		50	321	321	621				2731	2
18.3 Reactor Coolant Pumps & Motors	23	35	33	40	3491		553	4175	4175	11312				2633	2
18.4 Pressurizer	22	27	4	10	1280		212	1554	1554	4147				1852	1
18.5 Steam Generators	125	2487	133	3502	17895		3907	28050	28050	58484				98627	50
18.6 CRDMs/ ICIs/Service Structure Removal	54	36	20	14	596		130	851	851	1843				3308	2
18.7 Reactor Vessel Internals	38	984	251	220	6201		1805	9499	9499	1834	393	476	221	11270	3
18.8 Reactor Vessel	94	2656	265	252	2569		2553	8389	8389	5540	2096			15026	4
18. Totals	429	6398	773	4059	34294		9589	55542	55542	90266	2489	476	221	142727	90

TABLE C-3 (continued)
ENTOMB COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean	A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
Disposal of Plant Systems																
19.1 AX - Acid Feed		19					3	22		22					833	
19.2 Auxiliary Bldg Non-System Specific Clean		404					61	465		465					17709	
19.3 Auxiliary Bldg Non-System Specific Decon	31	135					36	202	47	155					7182	
19.4 Auxiliary Feedwater		20					3	23		23					912	
19.5 Auxiliary Steam		65					10	75		75					2948	
19.6 Auxiliary Steam Chemical Addition		3					<1	3		3					121	
19.7 Auxiliary Steam Generator		7					1	8		8					321	
19.8 Auxiliary Turbines		31					5	36		36					1358	
19.9 CL - Chlorination		14					2	16		16					607	
19.10 CW - Circulating Water		190					29	219		219					8903	
19.11 CZ - Caustic Acid		3					<1	3		3					134	
19.12 Central Chilled Water		51					8	59		59					2304	
19.13 Closed Cooling Water		32					5	37		37					1443	
19.14 CO - Carbon Dioxide		4					<1	5		5					177	
19.15 Component Cooling Water		134					20	154		154					6177	
19.16 Condensate		133					20	153		153					5956	
19.17 Condensate & Feedwater Chemical Addition		12					2	14		14					526	
19.18 Condensate Demineralizer		46					7	53		53					2068	
19.19 Condensate Storage & Transfer		39					6	45		45					1656	
19.20 Condenser Air Removal		16					2	18		18					699	
19.21 Containment Integrated Leak Rate Test		6					<1	7		7					287	
19.22 Containment Spray	44	40					28	112	67	46					3219	
19.23 Control Bldg Non-System Specific Clean		378					57	435		435					16569	
19.24 Control Bldg Non-System Specific Decon	32	124					34	189	47	142					6691	
19.25 Control Building HVAC		147					22	169		169					6162	
19.26 DA - Circulating Water System		196					29	226		226					9126	
19.27 DM - Equipment Drains		60					9	69		69					2710	
19.28 DO - Diesel Oil		1					<1	1		1					47	
19.29 Demineralized Water Storage & Transfer		41					6	47		47					1819	
19.30 Diesel Generator Building HVAC		27					4	31		31					1115	
19.31 EA - Service Water		63					10	73		73					2928	
19.32 EF - Essential Service Water		77					12	89		89					3541	
19.33 Emergency Fuel Oil		31					5	36		36					1329	
19.34 FO - Fuel Oil		14					2	16		16					625	
19.35 FP - Fire Protection		152					23	175		175					7096	

TABLE C-3 (continued)
ENTOMB COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
Disposal of Plant Systems (continued)															
19.36 Feedwater		90					14	104		104				4105	
19.37 Feedwater Heater Extraction		135					20	155		155				6164	
19.38 Fuel Bldg Non-System Specific Clean		52					8	60		60				2293	
19.39 Fuel Bldg Non-System Specific Decon	3	16					4	24	5	18				840	
19.40 GD - Esstl. Srvc. Wtr Pumphs. Bldg HVAC		9					1	10		10				365	
19.41 GE - Turbine Bldg HVAC		102					15	118		118				4319	
19.42 GF - Miscellaneous Building HVAC		33					5	38		38				1387	
19.43 Generator Hydrogen Seal & CO2		5					<1	6		6				210	
19.44 Generator Seal Oil		7					1	8		8				296	
19.45 HY - Hydrogen		6					<1	7		7				277	
19.46 KA - Compressed Air and Instrument		160					24	185		185				7081	
19.47 KB - Breathing Air		26					4	30		30				1182	
19.48 KC - Fire Protection		277					42	319		319				12879	
19.49 KD - Domestic Water		46					7	52		52				2023	
19.50 KH - Service Gas		18					3	21		21				780	
19.51 LA - Sanitary Drains		13					2	15		15				582	
19.52 LC - Yard Drains		2					<1	3		3				95	
19.53 LE - Oily Waste		98					15	112		112				4433	
19.54 Lube Oil Storage,Transfer,& Purification		21					3	24		24				925	
19.55 Main Steam		139					21	160		160				6475	
19.56 Main Turbine		131					20	151		151				5932	
19.57 Main Turbine Control Oil		29					4	33		33				1211	
19.58 Main Turbine Lube Oil		27					4	31		31				1164	
19.59 NT - Nitrogen		4					<1	5		5				186	
19.60 OX - Oxygen		4					<1	5		5				177	
19.61 Plant Heating		70					11	81		81				3155	
19.62 Radwaste Bldg Non-System Specific Clean		153					23	176		176				6704	
19.63 Radwaste Bldg Non-System Specific Decon	11	46					12	69	16	53				2449	
19.64 Reactor Bldg Non-System Specific Clean		136					20	157		157				5982	
19.65 Reactor Bldg Non-System Specific Decon	10	46					12	68	15	53				2438	
19.66 Reactor Coolant System		105	64	16	736	202	176	1299	1299		2390			4772	68
19.67 Roof Drains		55					8	63		63				2529	
19.68 ST - Sewage Treatment		23					3	26		26				1000	
19.69 SW - Screen Wash		15					2	17		17				640	
19.70 SZ - Service Air		47					7	54		54				2101	
19.71 Standby Diesel Engine		101					15	117		117				4394	

TABLE C-3 (continued)
ENTOMB COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean	A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
Disposal of Plant Systems (continued)																
19.72 Stator cooling water		6					<1	7		7					249	
19.73 Steam Seal		12					2	14		14					539	
19.74 VA - I&C Shop HVAC		3					<1	4		4					141	
19.75 VB - I&C Shop Computer Room HVAC		2					<1	3		3					95	
19.76 VC - Health Physics Computer Room HVAC		5					<1	5		5					200	
19.77 VH - Circ Water & Makeup Water Scrnhs Vt		6					<1	6		6					245	
19.78 VJ - Shop Bldg Machine Shop Area Vent		1					<1	1		1					51	
19.79 VL - Shop Building HVAC		2					<1	2		2					92	
19.80 VS - Admin. Bldg HVAC		5					<1	6		6					238	
19.81 VT - Tech Support Building HVAC		2					<1	2		2					79	
19.82 VV - Misc. Bldg. HVAC		3					<1	3		3					123	
19.83 VW - Waste Water Treatment Ventilation		1					<1	1		1					48	
19.84 WD - Domestic Water		25					4	28		28					1089	
19.85 WG - Gland Water & Motor Cooling Water		17					3	20		20					781	
19.86 WL- Cooling Lake Makeup & Blowdown		17					3	19		19					754	
19.87 WM - Makeup Demineralizer		92					14	105		105					4108	
19.88 WS - Plant Services Water		82					12	94		94					3791	
19.89 WT - Waste Water Treatment		17					3	19		19					767	
19.90 WZ - Radioactive Liquid Waste		5					<1	6		6					237	
19. Totals	131	5266	64	16	736	202	1016	7432	1496	5936	2390				240471	68
20. Erect scaffolding for systems removal		62					9	71	71						1948	
Decontamination of Site Buildings																
21.1 -Reactor	735	314	135	39	3614	304	1053	6194	6194		11728				33325	124
21. Totals	735	314	135	39	3614	304	1053	6194	6194		11728				33325	124
22. License termination survey						299	45	344	344							
23. Terminate license								a								
Subtotal Period 5 Activity Costs	1296	12040	972	4114	38644	11229	13276	81571	74400	7171	104384	2489	476	221	418470	282

TABLE C-3 (continued)
ENTOMB COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean	A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
Period 5 Undistributed Costs																
1. Decon equipment						189	28	217	217							
2. Decon supplies						340	85	425	425							
3. DOC staff relocation expenses						845	127	972	972							
4. Process liquid waste	193		98	132	574		212	1209	1209			1314			297	7
5. Insurance						724	72	797	797							
6. Property taxes						1017	102	1119	1007	112						
7. Health physics supplies						2352	588	2940	2940							
8. Heavy equipment rental						4003	600	4603	4143	460						
9. Small tool allowance						184	28	212	191	21						
10. Pipe cutting equipment						587	88	675	675							
11. Disposal of DAW generated			487	18	2326		400	3231	3231		7587				16701	42
12. Plant energy budget						1270	190	1460	1314	146						
13. NRC Fees						219	22	240	240							
Subtotal Undistributed Costs Period 5	193		585	150	2900	11729	2543	18100	17361	739	7587	1314			16998	49
Staff Costs																
DOC Staff Cost						11977	1797	13774	13774							
Utility Staff Cost						26727	4009	30736	30736							
TOTAL PERIOD 5	1489	12040	1556	4264	41544	61663	21624	144181	136271	7910	111972	3803	476	221	435468	330
PERIOD 6																
Removal of Major Equipment																
24. Main Turbine/Generator		70					10	80		80					3082	
25. Main Condensers		219					33	252		252					9282	

TABLE C-3 (continued)
ENTOMB COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
Demolition of Remaining Site Buildings															
26.1 *Reactor		4823					723	5546		5546				118164	
26.2 Access Vaults		37					6	43		43				436	
26.3 Administration		209					31	241		241				4753	
26.4 Auxiliary		7834					1175	9009		9009				162497	
26.5 Auxiliary Boiler		23					3	26		26				672	
26.6 Chlorine Storage		17					3	19		19				376	
26.7 Circ. Water Discharge Structure		351					53	403		403				4140	
26.8 Circulating Water Intake & Screenhouse		828					124	952		952				5369	
26.9 Communication Corridor - Contaminated		346					52	398		398				8911	
26.10 Communication Corridor-Clean		2292					344	2635		2635				53284	
26.11 Covered Walkways		8					1	10		10				322	
26.12 Diesel Generator		398					60	458		458				7888	
26.13 E.S.W.S. Pumphouse		781					117	898		898				5070	
26.14 ESWS Valve House		12					2	14		14				243	
26.15 Fuel Building		2574					386	2960		2960				63283	
26.16 Hot Machine Shop		22					3	25		25				639	
26.17 M.M.O. Building		172					26	198		198				3483	
26.18 Misc. Site Foundations		374					56	431		431				7394	
26.19 Misc. Site Structures		999					150	1149		1149				20240	
26.20 Oil Separator and Waste Tank		2					<1	3		3				48	
26.21 Radwaste		2714					407	3121		3121				58493	
26.22 Radwaste Drum Storage		422					63	485		485				12006	
26.23 Security/Guardhouse		317					47	364		364				4682	
26.24 Site Diesel Generator		3					<1	3		3				60	
26.25 Turbine Building		5712					857	6569		6569				166045	
26.26 Waste Water Treatment		17					3	20		20				432	
26. Totals		31285					4693	35978		35978				708928	
Site Closeout Activities															
27. Remove Rubble		3804					571	4374		4374				12323	
28. Grade & landscape site		1393					209	1602		1602				6028	
29. Final report to NRC						156	23	179	179						
Subtotal Period 6 Activity Costs		36771				156	5539	42466	179	42287				741643	

TABLE C-3 (continued)
ENTOMB COST ESTIMATE FOR WOLF CREEK GENERATING STATION

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
Period 6 Undistributed Costs															
1. Insurance						172	17	190	190						
2. Property taxes						516	52	567		567					
3. Heavy equipment rental						2192	329	2521		2521					
4. Small tool allowance						286	43	329		329					
5. Plant energy budget						113	17	130		130					
Subtotal Undistributed Costs Period 6						3280	458	3738	190	3548					
Staff Costs															
DOC Staff Cost						6170	925	7095		7095					
Utility Staff Cost						7512	1127	8639	7775	864					
TOTAL PERIOD 6		36771				17118	8049	61938	8144	53794				741643	
TOTAL COST TO DECOMMISSION	4184	57127	4904	5224	67980	341401	76026	556846	495142	61705	191026	8315	476	221 1609294	2152

TOTAL COST TO DECOMMISSION WITH 15.81% CONTINGENCY: $556,846,208

TOTAL NRC LICENSE TERMINATION COST IS 88.92% OR $495,141,664

NON-NUCLEAR DEMOLITION COST IS 11.08% OR: $ 61,704,532

TOTAL RADWASTE VOLUME BURIED: 200,038 cubic feet

TOTAL SCRAP METAL REMOVED: 41,775.9 tons

TOTAL CRAFT LABOR REQUIREMENTS: 1,609,293.5 man-hours

TOTAL PERSONNEL RADIATION EXPOSURE: 2,151.5 man-rem

TOTAL CRAFT LABOR COST WITH 22.19% CONTINGENCY: $ 43,516,888