PENNSYLVANIA POWER & LIGHT COMPANY

Exhibit TSL 1-2
Dismantling Cost Study and
Decommissioning Cost Study

Witness: Thomas S. LaGuardia
Docket No. R-00943271

DISMANTLING COST STUDY

for the

HOLTWOOD, SUNBURY, MARTINS CREEK,

BRUNNER ISLAND and MONTOUR

STEAM ELECTRIC STATIONS

prepared for

PENNSYLVANIA POWER & LIGHT COMPANY

Allentown, PA

prepared by

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Bridgewater, Connecticut

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EXECUTIVE SUMMARY

This report presents a summary of the estimated costs for the total dismantling of the following fossil generating stations:

Holtwood (Units 15 through 17 only)
Sunbury (Units 1 through 4)
Martins Creek (Units 1 through 4)
Brunner Island (Units 1 through 3)
Montour (Units 1 and 2)

These plants are owned and operated by the Pennsylvania Power & Light Company (PP&L).

The costs for dismantling the boiler and the boiler structure are estimated using a unit cost factor method. The costs for dismantling the turbine generator, air quality control system, restoration of the plant area and removal of remaining plant equipment are estimated in a similar fashion. At the conclusion of the dismantling process, the plant site will be in a state such that the land will be available for alternative use.

This study provides the costs to dismantle each station under current regulatory requirements and using available technology. The study assumes that all units at an individual site are retired at the same time and dismantling is initiated immediately after final station shutdown.

Complete dismantling of all existing site structures is assumed. Partial dismantling of selected structures is not considered in this study. Complete dismantling relieves the owner of the liabilities associated with leaving behind partially dismantled, potentially unsafe structures. Leaving unsafe structures in place would also be in direct violation of the Uniform Building Code.

The cost estimates for dismantling, presented in 1994 dollars and including appropriate contingency, are summarized in Table 1.1. Detailed line item cost estimates are provided in Appendices C through G.

1. INTRODUCTION

1.1 OBJECTIVE OF STUDY

The objective of this study is to present an estimate of the manpower, schedule, constant dollar costs and scrap credit for the total dismantling of the Holtwood, Sunbury, Martins Creek, Brunner Island and Montour Steam Electric Stations at the end of their useful lives. Costs related to dismantling combustion turbines or hydroelectric units located at these stations are not included in this study. This approach will allow PP&L to verify the adequacy of current funding levels and, if necessary, adjust contributions to reflect current cost projections.

1.2 SITE DESCRIPTIONS

Different station designs are reflective of the era in which they were constructed. Older units, such as Holtwood 17 and Sunbury 1 & 2 burn combinations of anthracite and bituminous coals. Their boilers are top-supported, non-membrane waterwall type. The thermal cycle is non-reheat. The retired units, Holtwood 15 & 16, are bottom-supported, straight tube boilers.

The newer units, such as Sunbury 3 & 4, Martins Creek 1 & 2, Brunner Island and Montour burn bituminous coals. Sunbury 3 & 4, Martins Creek 1 & 2 and Brunner Island 1 have non-membrane boiler waterwalls; Martins Creek 3 & 4, Brunner Island 2 & 3 and Montour have membrane-type boiler waterwalls. Sunbury 3 & 4 and Martins Creek 1 & 2 have non-reheat thermal cycles; Martins Creek 3 & 4, Brunner Island and Montour have reheat thermal cycles. Brunner Island 3 and Montour operate at supercritical pressure.

All units are direct river water cooled, except for Martins Creek 3 & 4, and Montour, which are cooled by natural draft cooling towers.

The station name, unit(s) designator and megawatt (electric) rating for each of the steam electric generating stations addressed by this study are identified in Table 1.1.

1.3 GENERAL APPROACH

Cost estimates were prepared on an item-by-item basis using unit cost factors developed for each cost item. The basis for determining these unit cost factors is derived from prior dismantling experience or similar related experience. The costs for project management staffing, equipment rental and consumables, and other collateral costs were estimated on a period-dependent basis (i.e., the magnitude of the expense is related to the duration of the project). Credit for scrap was included to offset the costs of dismantling. Contingency was included to account for unpredictable project events.

The study recognizes that individual units at each site are retired at different times. However, it is assumed that dismantling of a given site will not occur until the last unit at that site is retired. The transition costs for security and maintenance on the units retired prior to final dismantling are not included in the study. Such costs are assumed to be a station operating expense rather than a dismantling expense.

The estimates include the cost to dismantle and remove all systems and structures on the site to a level of three feet below local grade. The cost estimates developed reflect demolition by controlled/engineered dismantling rather than a "wrecking ball" approach. While the "cut and drop" approach may have been the accepted practice for older, bottom-supported boilers, it is not acceptable for top-supported boilers 200 feet or more in height. Concerns for worker safety reinforces the need for controlled dismantling. Accordingly, all large components and major steel structures were assumed to be lowered to grade.

The boilers are generally dismantled from the bottom upward, and the boiler steel support structures dismantled from the top downward. The turbine generators, condensate and feedwater systems and the concrete structures will be removed by disassembly and segmentation where necessary.

Limited landscaping includes site grading and seeding for drainage and erosion control. At the end of dismantling activities the plant site will be in a condition such that the land will be available for alternative use.

1.4 REGULATORY GUIDELINES AND CRITERIA

The Susquehanna and Delaware Rivers supply cooling water for the five generating stations. The U.S. Army Corps of Engineers (ACE) regulations

apply to the intake, discharge and coal handling structures at the river. To comply with ACE requirements, the concrete structures must be completely removed, and the river shoreline returned to its natural contour.

Ash disposal sites will be closed by PP&L in accordance with closure plans approved by the State agencies.

These regulations are a summary of those currently required. During the actual dismantling process, the plant would have to meet all applicable State and Federal requirements that will exist at that time.

TABLE 1.1

PP&L FOSSIL-FIRED STEAM ELECTRIC GENERATING STATIONS

Station	Unit	MWe
Holtwood SES (Lancaster County, PA)	15&16	(retired)
	17	72
Sunbury SES (Snyder County, PA)	1&2	85
	3	110
	4	145
Martins Creek SES (Northampton County, PA)	1&2	150
	3&4	820
Brunner Island SES (York County, PA)	1&2	344
	3	754
Montour SES (Montour County, PA)	1&2	750

TABLE 1.2
STATION DISMANTLING
COST AND SCHEDULE SUMMARY
(Thousands of 1994 Dollars)*

Cost Category	Holtwood	Sunbury	Martins Creek	Brunner Island	Montour
Dismantling Activity	$31,978	$99,092	$114,771	$132,281	$115,357
Period-Dependent	$13,562	$46,673	$47,473	$48,048	$28,155
Cost Subtotal	**$45,540**	**$145,765**	**$162,244**	**$180,329**	**$143,512**
Scrap Credit	($1,926)	($9,353)	($15,711)	($12,247)	($9,623)
Total Project Cost	**$43,614**	**$136,412**	**$146,533**	**$168,082**	**$133,889**
Duration (months)	20.18	28.95	29.28	34.97	24.22

*Notes: -Columns may not total due to rounding

DISMANTLING OPERATIONS

The costs described in this report are based on the complete dismantling of each station. The following sections describe the project organization, basic activities and special equipment necessary for accomplishing the dismantling operations.

2.1 PROJECT ORGANIZATION

For the purposes of this study the project was assumed to be managed by a PP&L Project Director (shown as the Plant General Manager) who will have primary authority for dismantling the stations and will direct the project as required. A Demolition Operations Contractor (DOC) who is experienced in dismantling similar facilities will be the prime contractor for the dismantling. The DOC Project Manager will report to the PP&L Project Director and will supervise the day-to-day dismantling of the station to ensure it is completed in an expeditious and safe manner. The DOC staff will be under the supervision of the DOC Project Manager but may interface with its utility counterpart. Figure 2.1 outlines a typical Utility project organization; Figure 2.2 outlines the DOC organization.

2.2 PRELIMINARY PLANNING/PREPARATION

The preliminary planning phase of the program begins once PP&L has determined that a station has reached the end of its useful life and should be dismantled. During this time, PP&L assemblies the dismantling management organization and accomplishes those site preparation activities necessary to provide a smooth transition from plant operation to site dismantling.

Costs incurred during this preliminary planning phase of the program are assumed to be plant operation expenses and are not included in the dismantling costs presented in this study.

PP&L prepares stations for dismantling by performing the following activities for each station:

1. Removing buildings and personal property outside the scope of dismantling;

2. Incinerating (within boiler) any coal in active or inactive storage areas;

3. Installing environmental monitoring equipment;

4. Obtaining appropriate permits for disposal of hazardous and toxic materials;

5. Selecting a Demolition Operations Contractor (DOC).

6. Emptying coal silos;

7. Dewatering ash ponds;

8. Draining acid, caustic, oil and water tanks;

9. Burning any residual fuel oil in storage tanks;

10. Cleaning all electrostatic precipitators and fabric filters of fly ash;

11. Returning all nitrogen, bulk chemical supplies and other gas storage cylinders to suppliers; and

12. Dewatering all water retention lagoons and tanks, removing and properly disposing of sediment.

2.3 DISMANTLING PROGRAM

A dismantling program is characterized by three distinct Periods: Period 1 - Engineering and Planning; Period 2 - Dismantling Operations; and Period 3 - Site Restoration. This section summarizes the activities accomplished under each period of the program.

Although detailed procedures for each activity required are not provided, and actual sequences of work may differ from that presented herein, these activity descriptions provide a basis for the detailed engineering, planning and scheduling at the time of dismantling.

2.3.1 Period 1 - Engineering and Planning

Period 1 activities begin once PP&L has selected a DOC to manage and direct the dismantling program. Period 1 includes preparation of activity specifications which identify the major work activities to be accomplished. Detailed work procedures which provide the step-by-step instructions for the work crews are also prepared at this time.

The DOC proceeds with dismantling engineering and planning by performing the following activities:

1. Reviewing plant drawings and specifications;

2. Performing detailed plant system material inventory;

3. Preparing description of final site configuration;

4. Identifying major work sequence;

5. Preparing dismantling activity specifications and work orders/forms;

6. Preparing detailed dismantling procedures;

7. Performing safety analysis of dismantling activities;

8. Performing safety analysis on fluids in plant systems;

9. Preparing and submitting a dismantling plan to the utility for review and approval;

10. Submitting an application for plant demolition permit from appropriate authorities;

11. Receiving dismantling authorization from PP&L; and

12. Mobilizing the DOC staff which will provide temporary services/facilities to support dismantling operations; select subcontractors, rent/procure equipment, rigging, special equipment and tools; and mobilize the labor force.

2.3.2 Period 2 - Dismantling Operations

The DOC initiates dismantling operations and performs the following activities:

1. Excavate and collapse circulating water lines and back fill voids;

2. Remove coal yard equipment as applicable, rail car unloading structures, conveyors, transfer towers, breaker house;

3. Remove systems and/or components that are non-essential to the station dismantling effort (these systems are referred to as "A Systems") including steam piping, generator auxiliary equipment, feed water heaters and pumps, various water systems, main condenser, condensate;

4. Remove intake and discharge structures;

5. Remove non-essential "B Systems" (identified in Appendix A) equipment that must be removed prior to start of boiler structure removal, including fly-ash handling, air and flue gas ducts, coal handling, burner fuel supply, etc.;

6. Remove electrostatic precipitator by cutting collection electrodes and casing;

7. Remove top of boiler enclosure to allow access to platens;

8. Disassemble boiler:

   a) Removing boiler waterwall from the bottom of the furnace to the top. (A hoist attached to the building structure will be used to lower water wall sections to grade for removal.)

   b) Placing a steel beam across top of boiler steel structure and attach hoist to beam, rig platens to hoist and lower them to grade for additional segmentation.

   c) Removing headers by rigging them to steel beam across top of boiler steel structure and lowering them to grade for additional segmentation prior to removal.

9. Remove steam drum and deaerator by cutting shell in-place and lowering pieces to grade for removal.

10. Disassemble turbine/generator for delivery to a scrap yard;

11. Remove all essential "C Systems" (identified in Appendix A) such as fire protection, compressed air, electrical;

12. Remove boiler structural steel from top to bottom (in conjunction with removal of essential systems), placing small pieces in a transfer container. Large pieces are lowered to grade for removal;

13. Remove the turbine building structure shell and floors;

14. Remove remaining site buildings;

15. Blast, and remove (to grade level), the turbine-generator pedestal monolithic concrete;

16. Remove the electrostatic precipitator foundations;

17. Control blast the chimney stacks to grade (after all site buildings have been removed) and remove the concrete and steel liners;

18. Control blasts the cooling towers (Martins Creek 3 & 4 and Montour only) to grade, breaking large pieces into rubble. Rubble can be used to backfill the tower basin;

19. Control blast the stack, turbine and boiler foundations (sufficient to allow for ground water penetration.)

2.3.3 Period 3 - Site Restoration

Following completion of the dismantling operations, site restoration activities are initiated. The de-watered ash ponds and coal storage areas are covered with clay and topsoil. No attempt shall be made to restore the original contour of the land. Landscaping will be limited to grading and seeding necessary for site drainage and erosion control. A final dismantling report is issued upon completion of the program. Personnel and equipment are demobilized from site.

2.4 SPECIAL EQUIPMENT

A track-mounted cutting torch will be used to segment the boiler, drums and waterwall headers. The track is magnetically attached to the item to be cut, and the cutting torch is advanced along the track to make the cut. This technique allows greater output than manual cutting for extremely thick sections.

A front-end loader with a demolition bucket is also used during the dismantling operations. The bucket has two movable jaws which allow it to pick up scrap and place it on a truck for removal. Other equipment used in the dismantling process, including forklifts, cutting torches, wheeled backhoes and

mobile cranes, are assumed to be readily available from rental equipment yards.

FIGURE 2.1
UTILITY DISMANTLING PROJECT ORGANIZATION

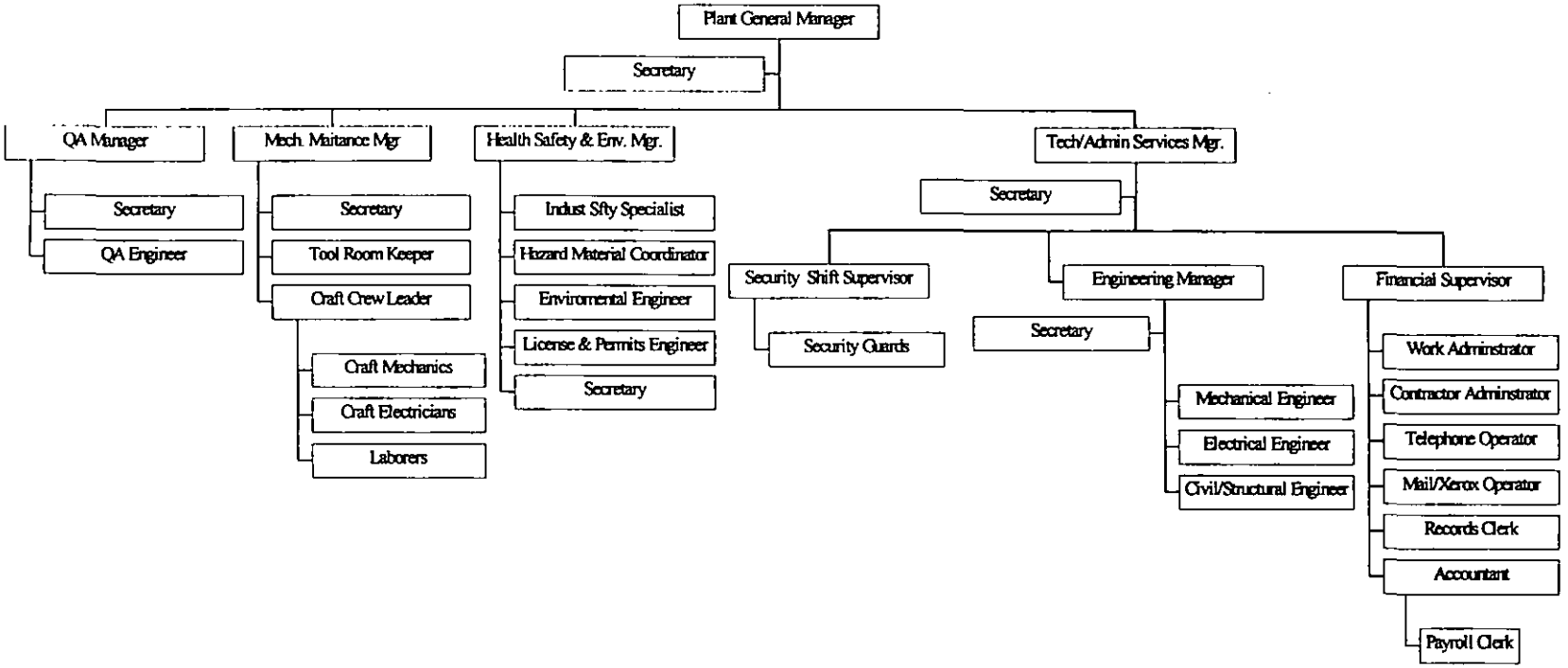
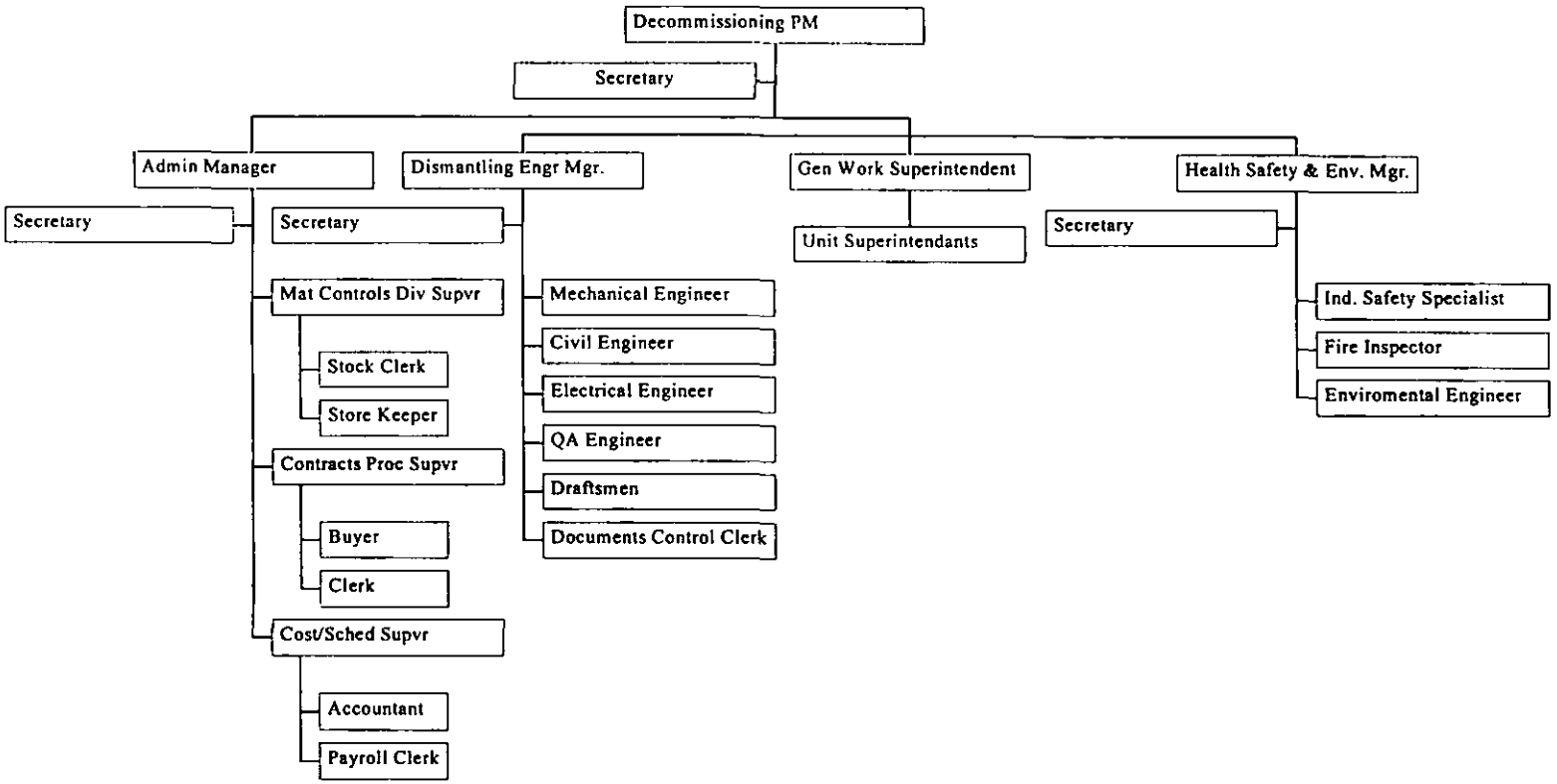


FIGURE 2.2
DOC DISMANTLING PROJECT ORGANIZATION



3. COST ESTIMATE

Site-specific cost estimates were prepared for the dismantling of the Holtwood, Sunbury, Martins Creek, Brunner Island and Montour Steam Electric Stations. The basis, methodology, assumptions and total estimated costs are described in the following sections.

3.1 BASIS OF ESTIMATE

Site-specific cost estimates were developed using drawings and the inventory documents provided by PP&L and from site inspections. Drawings and other documents were used to determine the general arrangement of the facility and to develop estimates of building concrete volumes, steel quantities and component inventories for the various stations.

The cost estimates are based on averages, such that the total costs shown for the projects are a reasonable approximation of what is expected to occur. However, individual cost elements will likely vary from the estimated values. Accordingly, this estimate is not a substitute for the detailed engineering and planning that will be performed in preparation for dismantling the units.

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

1. Component and structural inventories were developed from information provided by PP&L.

2. Employee salary information for site administration, operations, construction and maintenance personnel were provided by PP&L for positions identified by TLG. Craft labor costs were taken from R.S. Means "Building Construction Cost Data 1994", (Ref. 1).

3. Engineering services for such items as activity specifications, detailed work procedures, structural analysis and modifications, etc. will be provided by the DOC.

4. Material and equipment costs for conventional demolition and/or construction activities are taken from R.S. Means "Building Construction Cost Data 1994", (Ref. 1).

5. Costs in this estimate are in 1994 dollars. This estimate of the station excludes interest and escalation over the remaining operating life. A present-value economic analysis is not included.

6. Insurance costs were provided by PP&L and adjusted by TLG over the dismantling schedule to reflect changing site inventory.

7. Site property taxes were not provided by PP&L and as such, no allowance has been included within the estimates for any continual obligation.

8. Only the fossil-fuel facilities at these stations were considered in this study; combustion turbines and hydroelectric units are not addressed.

3.2 METHODOLOGY

The methodology used to develop the cost estimates follows the basic approach presented in the AIF/NESP-036, "Guidelines for Preparing Decommissioning Cost Estimates", (Ref. 2) and the US DOE "Decommissioning Handbook" (Ref. 3). 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 cost information from R.S. Means. 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 concerning worker productivity in dismantling programs.

An activity duration critical path was used to determine the total dismantling 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. PP&L provided typical salary and hourly rates for personnel associated with period-dependent costs. The costs for conventional demolition of structures, materials, back fill, landscaping and equipment rental were obtained from R.S. Means publication. Examples of unit cost factor development are presented in the AIF/NESP-036 publication.

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

not been omitted. These detailed unit cost factors coupled with the site-specific inventory of piping, components and structures provide a high degree of confidence in the cost estimates.

The activity- and period-dependent costs are combined to develop the total decommissioning costs. A contingency is then applied. "Contingencies" are defined in the American Association of Cost Engineers' Cost Engineers' Notebook (Ref. 4) 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. Examples of items which could occur that have not otherwise been accounted for in this estimate include: the effects of craft labor strikes; bad weather halting or slowing down operations; equipment/tool breakage; and changes in the anticipated plant shutdown conditions, etc. In the AIF/NESP-036 study the types of unforeseeable events that are likely to occur 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.

3.3 ASSUMPTIONS

The following are the major assumptions for developing the dismantling estimates.

1. Estimates are presented in 1994 dollars; inflation or escalation over the remaining operating lives of the units is not reflected within the estimates.

2. The dismantling process shall be an engineered process rather than by wrecking ball demolition.

3. The demolition will be performed by a DOC who will provide adequate staff and equipment to complete the dismantling.

4. Security will be provided by the owner.

5. The inventory estimates are based on drawings provided to TLG by PP&L.

6. Only buildings and property listed in the study are included in the dismantling costs.

7. Environmental regulations effective in 1994 will be assumed in force during the dismantling effort.

8. All systems will be evaluated by engineering prior to dismantling to determine if cleaning or flushing is required prior to removal.

9. Office trailers will be used by PP&L and DOC personnel.

10. All transformers have PCB-free oil. Lubricating and transformer oils are drained and removed from site by a waste disposal vendor prior to the start of dismantling.

11. Acid, caustic and demineralizer tanks will be empty prior to the start of dismantling.

12. Hazardous and/or toxic materials and residues shall be removed and disposed of according to current regulations.

13. All non-hazardous waterwall refractory and pipe/duct insulation will be removed for disposal at a local sanitary landfill.

14. Nuclear detectors (and other sources) will be removed prior to dismantling and the disposition of such is not considered in the estimates.

15. Nitrogen storage cylinders and other gas storage containers shall be removed from the site prior to dismantling.

16. Remaining inventories of fuel (both coal and oil) will be transferred to another site prior to dismantling. However, remediation and disposal costs of fuel residues are estimated.

17. Coal silos and fuel oil tanks will be empty prior to the start of dismantling.

18. Estimates will be prepared on a unit-by-unit basis. However, it is assumed that dismantling shall not take place until the last unit at a site is retired with the entire station complete plant being demolished at the same time.

19. Estimates do not address the value of the land. Ownership of all land will remain with PP&L.

20. Warehoused inventory, spare parts, chemical supplies, and furniture will be removed prior to the dismantling and therefore the disposition of such is not addressed in the estimates.

21. Material designated for scrap will be processed for transport. The cost of preparation will not exceed the value of reclaimed material.

22. Structural steel, piping, electrical cable, etc. shall be designated for scrap and a credit developed for such.

23. In general, equipment shall be assumed to have no salvage value other than the scrap value of the materials. Items that can be reused, such as rotary car dumpers and stacker/reclaimers, could be transferred to another operating facility. However, this study assumes that all material from the sites is scrapped.

24. Equipment and material, removed from the station in the dismantling process, will be placed in the laydown area for removal by a scrap dealer.

25. The turbine and boiler building foundations will be control blasted to break concrete in place to provide ground water drainage. Cover soil with a minimum of 4" will be placed over the foundations.

26. Structures, foundations, etc. shall be removed to three (3) feet below grade.

27. Underground piping shall be excavated, collapsed and back filled if top of the pipe is within three (3) feet of grade. It will be capped and abandoned if the top is located greater than three feet below grade.

28. The chimney stacks will be control blasted to the ground and broken into rubble, the steel liners cut and removed, and the foundations control blasted to break the concrete in place so that groundwater drainage is provided.

29. The cooling towers will be control blasted to the ground and the large pieces broken into rubble to fill the basin void.

30. Fly ash disposal areas will have been shutdown by PP&L and made ready for closing prior to start of dismantling activities.

31. The boiler platens and waterwalls will be cut from their boiler supports, lowered to the ground and sectioned into 8' x 8' pieces at a cutting area.

32. Conveyors will be rigged to cranes, cut, lowered to the ground and cut into 10' sections.

33. Water drainage holes will be drilled in the bottom of all structures abandoned below grade.

34. Roads and parking lots will be removed. On-site railroad spurs will be maintained until the end of the project to expedite the removal of scrap after which time the spurs will be dismantled.

35. Solid, non-combustible, non-hazardous, non-toxic materials not suitable for scrap will be used as on-site fill, where possible. Otherwise the material will be hauled to the nearest landfill. Soil required for fill is assumed to be available on site.

36. Intake and discharge channels shall be filled in, and structures removed unless otherwise noted by PP&L. (Montour intake will remain in service to maintain the level in Lake Chillisaqua)

37. Electrical power will be provided by the utility through the existing switchyard.

38. The estimates will address the dismantling of the electrical transmission equipment out to the dead-end towers. The dead-end towers, lines to the switchyard and the switchyard itself are left intact.

39. Underground tanks shall be removed and disposed of according to current regulations.

40. Plant turbine room cranes, miscellaneous hoists and trolleys shall be left in service as long as possible to assist in dismantling.

41. Plant lighting, heating and power systems shall be left in service as long as possible to support dismantling activities.

42. Essential systems listed under Appendix B will remain in service until the latest possible time.

43. Fire protection systems shall be left intact and operational until the systems they protect are removed. Chemical fire extinguishers and/or other temporary fire protection shall be utilized as needed after existing systems are removed from service.

44. Fire hose racks will be removed with piping.

45. Contractor-owned structures, equipment and components are assumed removed by the contractors at their cost.

46. Valves 2" and smaller will be removed with the small bore piping. Valves 2-1/2" and larger will be cut and removed separately.

47. Existing ash ponds are to be closed by 1998 and thus not included in the study unless otherwise directed by PP&L. Those ponds existing at the time of shutdown (Ash Basin #4 at Martins Creek, landfill at Montour) as well as residual waste impoundments will be clean closed at that time; the cost for remediation has been included in the cost estimate. Monitoring costs provided by PP&L will be included in the study.

48. Precipitators and ash silos will be empty of fly ash prior to the start of dismantling.

49. Boundary fencing around switchyards and general access roads shall remain in place after dismantling.

3.4 COST ESTIMATE SUMMARY

Tables 3.1 through 3.5 provide a summary of the expenditures for dismantling the five stations. Costs are reported in constant 1994 dollars. Detailed cost tables listing costs for the major dismantling activities for each station may be found in Appendices C through G.

TABLE 3.1

SUMMARY OF HOLTWOOD STEAM ELECTRIC STATION DISMANTLING COSTS*

Activity	Costs	Percent
Asbestos Abatement	$5,084	11.16%
Systems Removal	$1,942	4.26%
Structures Demolition	$7,047	15.47%
Site Restoration	$1,048	2.30%
Utility Staffing	$4,600	10.10%
DOC Staffing	$3,101	6.81%
Liability Insurance	$124	0.27%
Engineering	$16,304	35.80%
Energy	$160	0.35%
Tools and Equipment	$6,130	13.46%
Total Dismantling Costs	**$45,540**	**100.00%**
Scrap Credit	($1,926)	
Total Project Cost	**$43,614**	

* Notes:
- Parenthesis indicate a credit
- Columns may not total due to rounding
- Thousands of 1994 dollars

TABLE 3.2

SUMMARY OF SUNBURY STEAM ELECTRIC STATION DISMANTLING COSTS*

Activity	Costs	Percent
Asbestos Abatement	$30,128	20.67%
Systems Removal	$14,393	9.87%
Structures Demolition	$24,053	16.50%
Site Restoration	$1,318	0.90%
Utility Staffing	$18,552	12.73%
DOC Staffing	$9,708	6.66%
Liability Insurance	$564	0.39%
Engineering	$27,200	18.66%
Energy	$570	0.39%
Tools and Equipment	$19,279	13.23%
Total Dismantling Costs	**$145,765**	**100.00%**
Scrap Credit	($9,353)	
Total Cost	**$136,412**	

* Notes:
- Parenthesis indicate a credit
- Columns may not total due to rounding
- Thousands of 1994 dollars

TABLE 3.3

SUMMARY OF MARTINS CREEK STEAM ELECTRIC STATION DISMANTLING COSTS*

Activity	Costs	Percent
Asbestos Abatement	$21,888	13.49%
Systems Removal	$23,654	14.58%
Structures Demolition	$35,149	21.66%
Site Restoration	$4,402	2.71%
Utility Staffing	$18,756	11.56%
DOC Staffing	$9,872	6.08%
Liability Insurance	$570	0.35%
Engineering	$27,200	16.76%
Energy	$559	0.34%
Tools and Equipment	$20,194	12.45%
Total Dismantling Costs	**$162,244**	**100.00%**
Scrap Credit	($15,711)	
Total Cost	**$146,533**	

* Notes:
- Parenthesis indicate a credit
- Columns may not total due to rounding
- Thousands of 1994 dollars

TABLE 3.4

SUMMARY OF BRUNNER ISLAND STEAM ELECTRIC STATION DISMANTLING COSTS*

Activity	Costs	Percent
Asbestos Abatement	$61,236	33.96%
Systems Removal	$19,241	10.67%
Structures Demolition	$25,188	13.97%
Site Restoration	$2,786	1.54%
Utility Staffing	$18,452	10.23%
DOC Staffing	$11,578	6.42%
Liability Insurance	$509	0.28%
Engineering	$22,320	12.38%
Energy	$420	0.23%
Tools and Equipment	$18,599	10.31%
Total Dismantling Costs	**$180,329**	**100.00%**
Scrap Credit	($12,247)	
Total Cost	**$168,082**	

* Notes:
- Parenthesis indicate a credit
- Columns may not total due to rounding
- Thousands of 1994 dollars

TABLE 3.5

SUMMARY OF MONTOUR STEAM ELECTRIC STATION DISMANTLING COSTS*

Activity	Costs	Percent
Asbestos Abatement	$38,700	26.97%
Systems Removal	$12,829	8.94%
Structures Demolition	$42,090	29.33%
Site Restoration	$4,511	3.14%
Utility Staffing	$10,502	7.32%
DOC Staffing	$6,126	4.27%
Liability Insurance	$325	0.23%
Engineering	$14,960	10.42%
Energy	$396	0.28%
Tools and Equipment	$13,073	9.11%
Total Dismantling Costs	**$143,512**	**100.00%**
Scrap Credit	($9,623)	
Total Cost	**$133,889**	

* Notes:
- Parenthesis indicate a credit
- Columns may not total due to rounding
- Thousands of 1994 dollars

4. SCHEDULE ESTIMATE

Using information presented in AIF/NESP-036 publication and recent industry experience, dismantling project schedules have been developed for the Holtwood, Sunbury, Martins Creek, Brunner Island and Montour Steam Electric Stations. The assumptions supporting the schedules are discussed in Section 4.1. Figure 4.1 presents the project sequence for key activities in the dismantling of the five stations. Activities listed in the schedules do not reflect a one-to-one correspondence with the activities listed in the cost tables in Appendices C through G. Some activities have been divided for clarity, while others have been combined for convenience. The schedules were prepared using the "Microsoft Project" computer software (Ref. 5).

4.1 SCHEDULE ESTIMATE ASSUMPTIONS

Figure 4.1 reflects the results of a precedence network developed for the dismantling activities, i.e., a PERT (Programmed Evaluation and Review Technique). The durations used in the precedence network reflect the actual manhour estimates from the detailed cost tables in Appendices C through G. The schedule outputs were adjusted by stretching certain activities over their slack range and by "pushing" other activities to the end of their slack period. Both the project schedules and the manpower estimates account for the limitations of personnel workspace and maximum worker safety and protection. Such considerations contribute to differences in project schedules among the five stations.

The following limitations and assumptions are reflected in the development of the dismantling schedules.

1. Work is performed during an 8-hour workday, 5 days per week with no overtime. There are eleven paid holidays per year.

2. 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.

3. It is assumed that only six crews, working inside and outside of the boiler, can safely work on waterwall removal at one time. Since the work is in a confined and hazardous area, additional crews would increase the probability of accidents, i.e. tools, waterwall panels or materials dropping from above.

4. The boiler steel structures are adjacent to and at a higher elevation than the turbine building. To expedite the schedule it would be desirable to proceed with dismantling of both the boiler steel structures and the turbine building at the same time. To further expedite the process, the past practice in dismantling structural steel and/or large components was to simply torch-cut and drop sections to lower elevations for removal and handling. However, in the interest of safety, demolition of these structures is scheduled in series rather than in parallel, using a controlled "rig, cut and lower" technique.

5. Demolition of the Chimney Stack/Cooling Tower structures is performed by controlled blasting. Blast fragments have the potential to cause injury to personnel and ground vibrations could collapse other structures or trailers. In order to limit risk of injury or damage, demolition of these structures has been delayed until the number of on-site personnel and structures has been reduced.

6. Scheduling was performed without restraints on the availability of labor, equipment and materials, or regulatory inspection schedules.

4.2 PROJECT SCHEDULE

The period-dependent costs presented in the cost tables in Appendices C through G are based upon the durations developed in the schedules for the respective stations dismantling. Durations were established between several milestones in each project period; these durations were used to establish a critical path for the entire project. In turn, the critical path durations for each period were used as the basis for determining the total period-dependent costs. for these items.

FIGURE 4.1
DISMANTLING ACTIVITY SCHEDULE

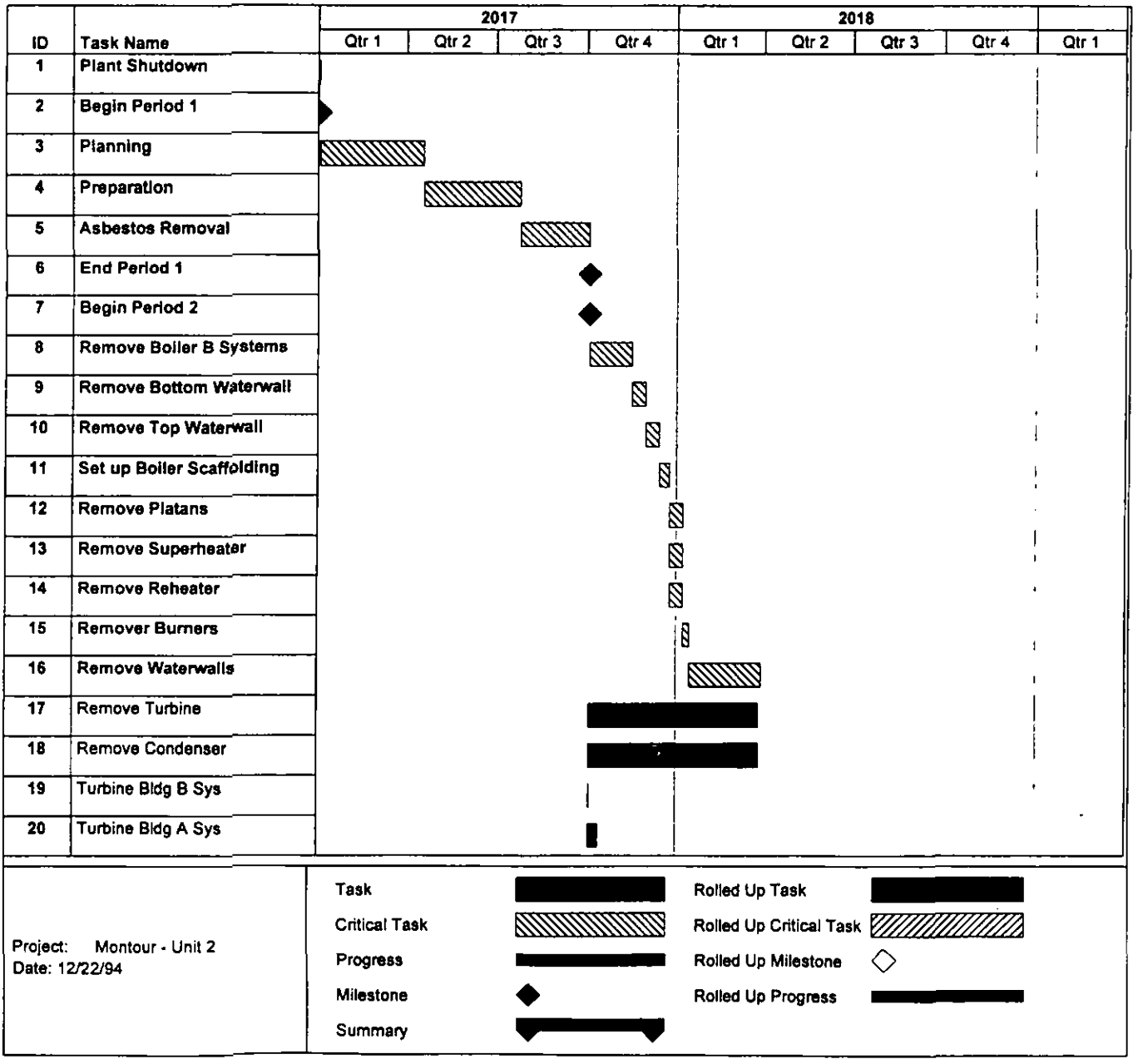


FIGURE 4.1
DISMANTLING ACTIVITY SCHEDULE
(Continued)

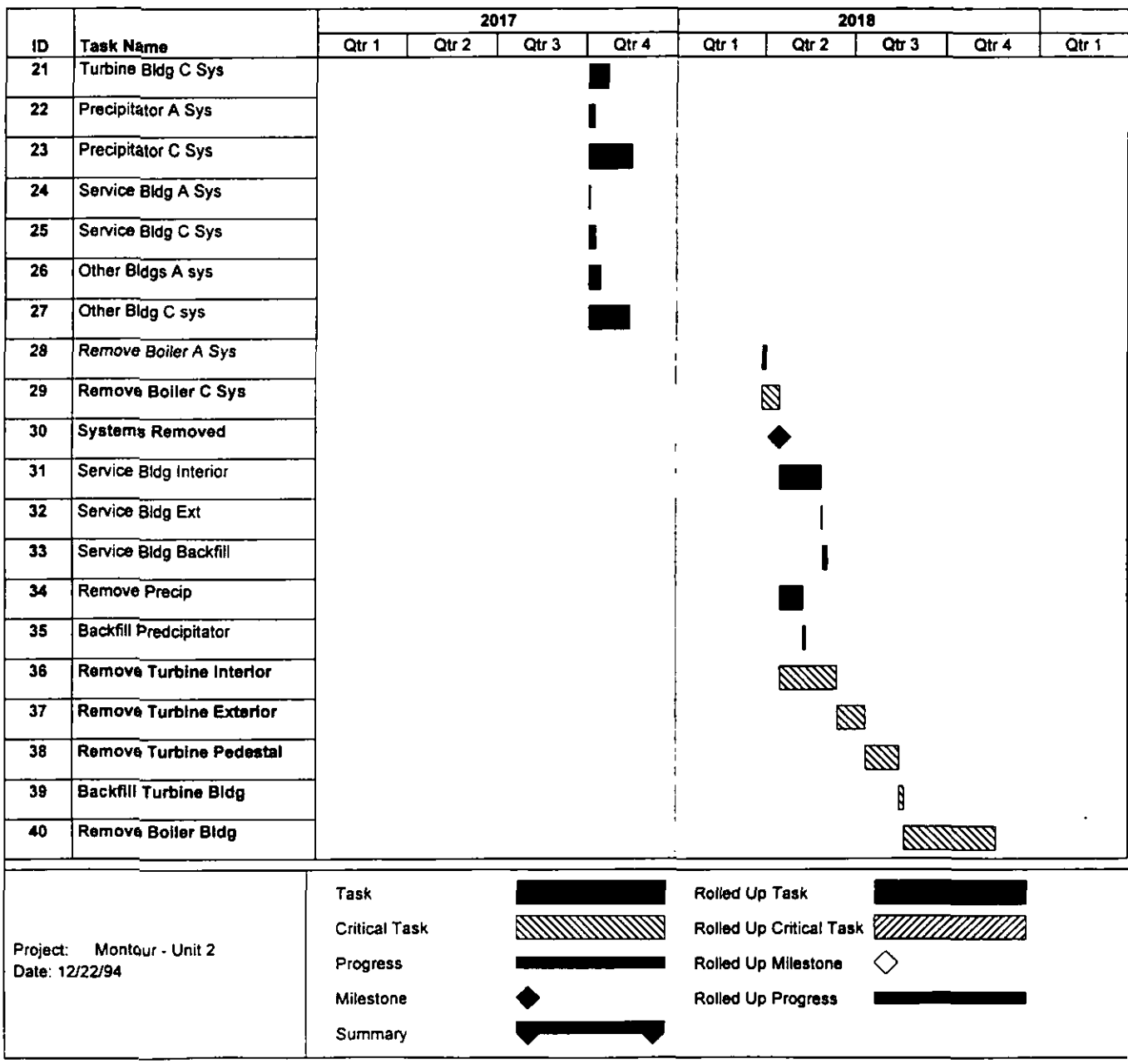
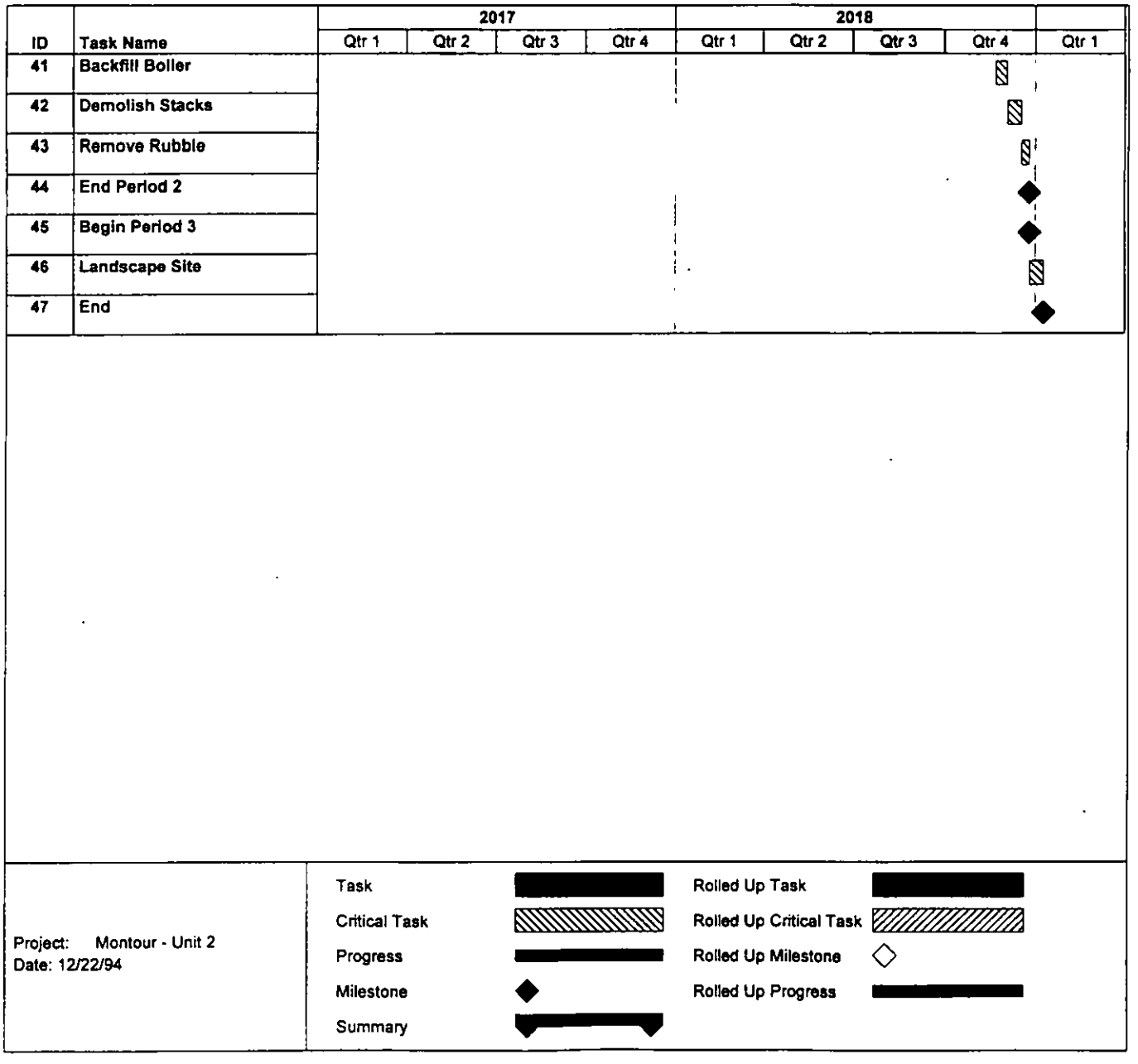


FIGURE 4.1
DISMANTLING ACTIVITY SCHEDULE
(Continued)



5. WASTE MANAGEMENT

There are several types of hazardous and non-hazardous wastes located on the plant sites. These include asbestos insulation, calcium silicate insulation, fuel oil and non-PCB equipment oil.

If additional hazardous wastes are discovered during dismantling operations or if environmental regulations change, then appropriate measures will be taken by PP&L and the DOC. Fuel oil in the fuel system of the plant should be burned in the boiler. Any residual fuel oil and any oil obtained from equipment draining will be collected and removed by a certified waste handler for disposal.

The non-hazardous and non-residual wastes will be disposed of in a safe and reasonable manner. Asbestos-bearing insulation and building materials will be removed by qualified waste disposal contractors and disposed of in a licensed landfill.

6. SCRAP

The value of scrap was estimated from current market value published information. In general, scrap materials were assumed removed from their installed location and placed on a loading dock or laydown area on-site for a scrap dealer to remove. The value of the scrap was estimated using a value of $100 per ton of carbon steel, $1,100 per ton of copper and $240 per ton of stainless steel. The estimated scrap amounts for each station are summarized in the table below:

TABLE 6.1

ESTIMATED SCRAP QUANTITIES

Station	Carbon Steel (tons)	Copper (tons)	Stainless Steel (tons)
Holtwood 15,16 & 17	14,554	397	138
Sunbury 1,2,3 & 4	71,489	1,886	543
Martins Creek 1,2,3 & 4	125,356	2,585	1,382
Brunner Island 1,2&3	93,230	2,384	1,257
Montour 1,2	71,843	2,017	918

7. RESULTS

Dismantling technology is well established. The techniques, tools and equipment necessary to dismantle the Holtwood, Sunbury, Martins Creek, Brunner Island and Montour Steam Electric Stations are available and have been demonstrated. The estimated costs considered necessary to safely dismantle the stations are summarized in Table 7.1.

The dismantling and utility staffs along with the removal activity combine to represent the majority of the cost to dismantle the stations. This is a direct result of the labor-intensive nature of the dismantling process.

This study provides an estimate for dismantling under current requirements based on present-day costs and available technology. As additional dismantling experience becomes available, cost estimates should be modified to reflect this experience.

TABLE 7.1

SUMMARY OF DISMANTLING COSTS

UNIT	MW(e)	Total Cost (1000's $)	Asbestos Cost	All Other Costs	Scrap Credit	Cost per kW(e)
Holtwood 15 & 16	n/a	20,117	2,542	17,575	(754)	n/a
Holtwood 17	72	25,423	2,542	22,881	(1,172)	$ 302
Holtwood Station Total		**45,540**	**5,084**	40,456	**(1,926)**	
Sunbury 1	85	33,985	7,532	26,453	(2,195)	$ 285
Sunbury 2	85	33,250	7,532	25,718	(2,099)	$ 278
Sunbury 3	110	34,612	7,532	27,080	(2,353)	$ 225
Sunbury 4	145	43,918	7,532	36,386	(2,706)	$ 232
Sunbury Station Total		**145,765**	**30,128**	115,637	**(9,353)**	
Martins Creek 1	150	35,799	10,944	24,855	(2,404)	$ 150
Martins Creek 2	150	40,807	10,944	29,863	(2,335)	$ 184
Martins Creek 3	820	46,239	0	46,239	(5,548)	$ 50
Martins Creek 4	820	39,399	0	39,399	(5,424)	$ 41
Martins Creek Station Total		**162,244**	**21,888**	140,356	**(15,711)**	
Brunner Island 1	344	57,775	20,412	37,363	(3,372)	$ 99
Brunner Island 2	344	56,025	20,412	35,613	(3,759)	$ 93
Brunner Island 3	754	66,528	20,412	46,116	(5,116)	$ 54
Brunner Island Station Total		**180,329**	**61,236**	119,093	**(12,247)**	
Montour 1	750	58,540	19,350	39,190	(4,667)	$ 46
Montour 2	750	84,972	19,350	65,622	(4,956)	$ 81
Montour Station Total		**143,512**	**38,700**	104,812	**(9,623)**	
Total for All Stations		**677,389**	**157,036**	**520,353**	**(48,860)**	

8. REFERENCES

1. "Building Construction Cost Data, 1994," Robert Snow Means Company, Inc., Duxbury, MA.

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

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

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

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

APPENDIX A

SYSTEM DESIGNATIONS

APPENDIX A

SYSTEM DESIGNATIONS

In general, those systems classified as "B Systems" are those which are involved in the generation of steam at the plants, or which are connected to the boiler and would limit accessibility to it at the time of removal. Examples of such systems include:

Air Removal
Ash Disposal-Wet
Boiler
Boiler Feed Suction
Flyash Disposal
Main or Power Steam
Main\Reheat & Extraction Steam Drains
Combustion Air & Flue Gas

Those systems classified as "C Systems" are those which are essential in the dismantling effort prior to demolition of the buildings. These systems are the last to be removed from the plant.

Building Services (Elevators)
Building Steam
Electrical
Heating & Ventilating (HVAC)
Instrument Air
Potable Water
Station Air
Yard Fire Hydrants (Fire Service)

Those systems which are not included in the above listings are generally classified as "A Systems". These systems are not essential to the overall dismantling effort and can be removed at any time in the dismantling period.

APPENDIX B

UNIT COST FACTOR DEVELOPMENT

APPENDIX B
UNIT COST FACTOR DEVELOPMENT

Example: *Unit Factor for Removal of Heat Exchanger < 3,000 pounds*

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 laydown area. (Based on labor rates obtained for Martins Creek SES.)

2. CALCULATIONS

Act ID	Activity Description	Activity Duration	Critical Duration
a	Remove insulation and mount pipe cutters	60	60
b	Disconnect inlet and outlet lines	60	60
c	Rig for removal	30	30
d	Unbolt from mounts	30	(c)
e	Remove, send to packing area	60	60
	Totals (Activity/Critical)	240	210
Duration adjustment(s):			
+ *Respiratory protection adjustment (50% of critical duration)*			none
+ Radiation/ALARA adjustment (32% of critical duration)			none
	Adjusted work duration		210
+ Protective clothing adjustment (30% of adjusted duration)			none
Productive work duration			210
+ Work break adjustment (8.33 % of productive duration)			18
Total work duration (minutes)			228

***** Total duration = 3.800 hr *****

3. LABOR REQUIRED

Crew	Number	Duration (hr)	Rate ($/hr)	Cost
Laborers	3.0	3.800	$19.61	$223.55
Craftsmen	2.0	3.800	$29.06	$220.86
Foreman	1.0	3.800	$30.59	$116.24
General Foreman	0.25	3.800	$31.38	$29.81
Fire Watch	0.05	3.800	$19.61	$3.73
Subtotal labor cost				$594.19
Overhead & Profit on labor @ 45.741%				$271.79
Total labor cost				$865.98

4. EQUIPMENT & CONSUMABLES COSTS

Equipment Costs	none
Consumables/Materials Costs	
-Gas torch consumables 1 @ $7.77/hr x 1 hr {1}	$7.77
Subtotal cost of equipment and materials	$7.77
Overhead & profit on equipment and materials @ 16.0%	$1.24
Total costs, equipment & material	$9.01
TOTAL COST Removal of heat exchanger <3000 pound:	**$874.99**
Total labor cost:	$865.98
Total equipment/material costs:	$9.01
Total craft labor manhours required per unit:	23.94

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. 6, Vol. 1, Ch. 5).

3. Adjusted regional material costs for Allentown, PA

4. References:

1. R.S. Means (1994) Division 016 Section 420-6360 pg 19
2. McMaster-Carr Ed. 94 pg 735
3. R.S. Means (1994) Division 015 Section 602-0200 pg 13

APPENDIX C

HOLTWOOD STEAM ELECTRIC STATION

TABLE C-1
DISMANTLING COST ESTIMATE FOR HOLTWOOD STEAM ELECTRIC STATION - UNITS 15 and 16
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
PERIOD 1											
Engineering Preparation											
1 Review plant dwgs & specs.					311	47	357				
2 Submit for license amendment					108	16	124				
3 End product description					68	10	78				
4 Define major work sequence					506	76	582				
5 Perform safety analysis					209	31	241				
6 Submit dismantling plan					35	5	40				
Total					**1237**	**186**	**1422**				
Activity Specifications											
7 Plant & temporary facilities					332	50	382				
8 Plant systems					281	42	323				
9 Boiler Removal					439	66	505				
10 Reinforced concrete					108	16	124				
11 Turbine & condenser					54	8	62				
12 Plant structures & buildings					211	32	242				
13 Waste management					311	47	357				
14 Facility & site closeout					61	9	70				
Total					**1796**	**269**	**2066**				
Planning & Site Preparations											
15 Prepare dismantling sequence					162	24	186				
16 Plant prep. & temp. svces					1559	234	1793				
17 Rigging/CCEs/tooling/etc.					1320	198	1518				
Total					**3041**	**456**	**3498**				
Detailed Work Procedures											
18 Plant systems					320	48	367				
19 Remaining buildings					91	14	105				
20 Boiler					245	37	282				
21 Facility closeout					81	12	93				
22 Reinforced concrete					68	10	78				
23 Turbine & condensers					211	32	242				
Total					**1015**	**152**	**1167**				

TABLE C-1
DISMANTLING COST ESTIMATE FOR HOLTWOOD STEAM ELECTRIC STATION - UNITS 15 and 16
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
24 Asbestos Removal Program	1532	440		115		456	2542				48583
Subtotal Period 1 Activity Costs	**1532**	**440**		**115**	**7089**	**1519**	**10695**				**48583**
Period 1 Undistributed Costs											
1 DOC staff relocation expenses											
2 Insurance					2	0	2				
3 Property taxes											
4 Heavy equipment rental	35					5	40				
5 Plant energy budget					10	1	11				
Subtotal Undistributed Costs Period 1	35				12	7	53				
Staff Costs											
DOC Staff Cost					176	26	202				
Utility Staff Cost					296	44	340				
TOTAL PERIOD 1 COST	**1566**	**440**		**115**	**7573**	**1597**	**11290**				**48583**
PERIOD 2											
Disposal of Plant Systems											
25.1 Boiler	188					28	216	1348	40	1	5675
25.2 Boiler Feed	5					1	6	10	0	1	149
25.3 Boiler Gas Flow	16					2	18	27		1	506
25.4 Circulating Water	19					3	22	151		10	612
25.5 Coal Preparation	50					8	58	614	1	28	1576
25.6 Condensate	17					2	19	20	0	1	534
25.7 Electrical	150					22	172	268		174	4568
25.8 Filtered Water	43					7	50	34	0	1	1401
25.9 Flyash Disposal	225					34	259	229	17		6699
25.10 Fuel Oil	12					2	14	6		0	382
25.11 HVAC	34					5	39	254		1	995
25.12 Heating Steam	2					0	2	2	0	0	60

TABLE C-1
DISMANTLING COST ESTIMATE FOR HOLTWOOD STEAM ELECTRIC STATION - UNITS 15 and 16
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
25.13 Lube Oil	7					1	8	3	1		227
25.14 Main & Power Steam	38					6	44	50	8	0	1249
25.15 Potable Water	5					1	6	3			172
25.16 Priming	6					1	7	3	0	0	204
25.17 Process Ductwork	13					2	15	1			396
25.18 Raw Water	0					0	0	10			12
25.19 River Water	60					9	69	125	22	3	1900
25.20 Service Water	2					0	2	2	0		59
25.21 Station Air	43					6	50	50	1		1374
25 Totals	**936**					**140**	**1076**	**3211**	**90**	**221**	**28747**
26 Erect scaffolding for systems removal	151					23	174				3647
Removal of Major Equipment											
27 Main Turbine/Generator	17					3	20	472			732
28 Main Condensers	28					4	32	178			1086
Demolition of Remaining Site Buildings											
29.1 Boiler Building	897					135	1031	409			14157
29.2 Turbine Building	942					141	1083	623			12691
29 Totals	**1839**					**276**	**2115**	**1032**			**26848**
Subtotal Period 2 Activity Costs	2970					446	3416	4892	90	221	61060
Period 2 Undistributed Costs											
1 DOC staff relocation expenses											
2 Insurance					37	4	40				
3 Property taxes											
4 Heavy equipment rental	1488					223	1711				
5 Small tool allowance	64					10	74				
6 Pipe cutting equipment	617					92	709				
7 Plant energy budget					30	5	35				
Subtotal Undistributed Costs Period 2	**2168**				**67**	**333**	**2569**				

TABLE C-1
DISMANTLING COST ESTIMATE FOR HOLTWOOD STEAM ELECTRIC STATION - UNITS 15 and 16
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
Staff Costs											
DOC Staff Cost					931	140	1071				
Utility Staff Cost					1149	172	1322				
TOTAL PERIOD 2	**5139**				**2147**	**1091**	**8377**	**4892**	**90**	**221**	**61060**
PERIOD 3											
Site Closeout Activities											
30 BackFill Site	349					52	402				906
31 Grade & landscape site											
Subtotal Period 3 Activity Costs	**349**					**52**	**402**				**906**
Period 3 Undistributed Costs											
1 Insurance					0	0	0				
2 Property taxes											
Subtotal Undistributed Costs Period 3					**0**	**0**	**0**				
Staff Costs											
DOC Staff Cost					20	3	23				
Utility Staff Cost					22	3	25				
TOTAL PERIOD 3	349				42	59	450				906
TOTAL COST TO DECOMMISSION	**7054**	**440**		**115**	**9761**	**2746**	**20117**	**4892**	**90**	**221**	**110550**

TABLE C-1

DISMANTLING COST ESTIMATE FOR HOLTWOOD STEAM ELECTRIC STATION - UNITS 15 and 16

(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
TOTAL COST TO DISMANTLE WITH 15.81% CONTINGENCY:							$20,116,827				
TOTAL SCRAP METAL REMOVED:					Carbon		4,892				
					St. Steel		90				
					Copper		221				
					Total		5,203	TONS			
SCRAP CREDIT					Carbon (at $100/ton)		$489,232				
					St. Steel (at $240/ton		$21,620				
					Copper (at $1100/ton		$242,936				
					Total		$753,788				
TOTAL COST LESS SCRAP CREDIT							$19,363,039				
TOTAL CRAFT LABOR REQUIREMENTS:								110,550	MAN-HOURS		
TOTAL CRAFT LABOR COST WITH 19.25% CONTINGENCY:							$4,045,005				

TABLE C-2
DISMANTLING COST ESTIMATE FOR HOLTWOOD STEAM ELECTRIC STATION - UNIT 17
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
PERIOD 1											
Engineering Preparation											
1 Review plant dwgs & specs.					311	47	357				
2 Submit for license amendment					108	16	124				
3 End product description					68	10	78				
4 Define major work sequence					506	76	582				
5 Perform safety analysis					209	31	241				
6 Submit dismantling plan					35	5	40				
Total					**1237**	**186**	**1422**				
Activity Specifications											
7 Plant & temporary facilities					332	50	382				
8 Plant systems					281	42	323				
9 Boiler Removal					439	66	505				
10 Reinforced concrete					108	16	124				
11 Turbine & condenser					54	8	62				
12 Plant structures & buildings					211	32	242				
13 Waste management					311	47	357				
14 Facility & site closeout					61	9	70				
Total					**1796**	**269**	**2066**				
Planning & Site Preparations											
15 Prepare dismantling sequence					162	24	186				
16 Plant prep. & temp. svces					1559	234	1793				
17 Rigging/CCEs/tooling/etc.					1320	198	1518				
Total					**3041**	**456**	**3498**				
Detailed Work Procedures											
18 Plant systems					320	48	367				
19 Remaining buildings					91	14	105				
20 Boiler					245	37	282				
21 Facility closeout					81	12	93				
22 Reinforced concrete					68	10	78				
23 Turbine & condensers					211	32	242				
Total					**1015**	**152**	**1167**				

TABLE C-2
DISMANTLING COST ESTIMATE FOR HOLTWOOD STEAM ELECTRIC STATION - UNIT 17
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
24 Asbestos Removal Program	1532	440		115		456	2542				48583
Subtotal Period 1 Activity Costs	**1532**	**440**		**115**	**7089**	**1519**	**10695**				**48583**
Period 1 Undistributed Costs											
1 DOC staff relocation expenses											
2 Insurance					28	3	31				
3 Property taxes											
4 Heavy equipment rental	129					19	149				
5 Plant energy budget					50	7	57				
Subtotal Undistributed Costs Period 1	129				78	30	237				
Staff Costs											
DOC Staff Cost					411	62	473				
Utility Staff Cost					1106	166	1272				
TOTAL PERIOD 1 COST	**1661**	**440**		**115**	**8685**	**1776**	**12677**				**48583**
PERIOD 2											
Disposal of Plant Systems											
25.1 Air Removal	3					0	4	5	0	1	98
25.2 Boiler	399					60	459	3846	35	3	12189
25.3 Boiler Gas Flow	8					1	9	33		0	239
25.4 Building Services	0					0	0	0			9
25.5 CW Chlorinator	0					0	0	0	0		11
25.6 Circulating Water	7					1	8	103		5	223
25.7 Coal Handling	9					1	10	80	0	5	269
25.8 Community Center Service	0					0	0	0		0	5
25.9 Condensate	25					4	29	68	5	6	781
25.10 Drips & Drains	0					0	0	0	0	0	11
25.11 Electrical	119					18	137	628		149	3604
25.12 Filtered Water	2					0	2	4	0		66

TABLE C-2
DISMANTLING COST ESTIMATE FOR HOLTWOOD STEAM ELECTRIC STATION - UNIT 17
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
25.13 Fly Ash Disposal	15					2	17	55	0	1	464
25.14 Fuel Oil	8					1	9	8	1	0	231
25.15 HVAC	1					0	1	3		0	29
25.16 Lube Oil	5					1	6	8	0	0	150
25.17 Main & Power Steam	2					0	3	11	0	0	71
25.18 Priming	3					0	3	7	0	1	92
25.19 Process Ductwork	1					0	2	0			40
25.20 Reuse Water & Incidental Waste	8					1	9	57	0	6	243
25.21 River Cooling Water	6					1	7	43	0	1	192
25.22 Service Water	2					0	2	19	0	0	61
25.23 Station Air	7					1	7	30	1		197
25.24 Vapor & Vents	7					1	8	13	4		224
25 Totals	**638**					**96**	**734**	**5025**	**48**	**176**	**19499**
26 Erect scaffolding for systems removal	330					50	380				7949
Removal of Major Equipment											
27 Main Turbine/Generator	18					3	21	498			773
28 Main Condensers	51					8	59	328			2004
Demolition of Remaining Site Buildings											
29.1 Baghouse	12					2	14	11			368
29.2 Boiler Area	365					55	420	520			9032
29.3 Coal Handling Structures	104					16	120	28			2114
29.4 Coal Preparation Plant	1096					164	1261	1387			18593
29.5 Construction Warehouse	55					8	63	20			1036
29.6 Filtration Plant	137					21	157	57			1925
29.7 Intake Structure	80					12	92	98			1610
29.8 Mill Room	496					74	570	368			10392
29.9 Miscellaneous Structures	78					12	90	39			1304
29.10 Miscellaneous Yard Fixtures	472					71	543	269			7004

TABLE C-2
DISMANTLING COST ESTIMATE FOR HOLTWOOD STEAM ELECTRIC STATION - UNIT 17
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
29.11 Precipitator & Economizer	271					41	312	114			5506
29.12 Stack	129					19	148				1551
29.13 Stoker House	28					4	32				481
29.14 Storage Annex Building	26					4	29	7			319
29.15 Stores & Shops Building	422					63	486	205			6918
29.16 Turbine Building	386					58	443	689			7783
29.17 Turbine Pedestal	132					20	152				2207
29 Totals	**4289**					**643**	**4932**	**3811**			**78141**
Subtotal Period 2 Activity Costs	5325					799	6124	9662	48	176	108367
Period 2 Undistributed Costs											
1 DOC staff relocation expenses											
2 Insurance					45	4	49				
3 Property taxes											
4 Heavy equipment rental	1809					271	2080				
5 Small tool allowance	92					14	106				
6 Pipe cutting equipment	617					92	709				
7 Plant energy budget					50	8	58				
Subtotal Undistributed Costs Period 2	**2518**				**95**	**390**	**3002**				
Staff Costs											
DOC Staff Cost					1137	170	1307				
Utility Staff Cost					1403	210	1614				
TOTAL PERIOD 2	**7843**				**2634**	**1569**	**12047**	**9662**	**48**	**176**	**108367**

TABLE C-2
DISMANTLING COST ESTIMATE FOR HOLTWOOD STEAM ELECTRIC STATION - UNIT 17
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
PERIOD 3											
Site Closeout Activities											
30 BackFill Site	246					37	283				639
31 Grade & landscape site	317					47	364				1606
Subtotal Period 3 Activity Costs	563					84	647				2244
Period 3 Undistributed Costs											
1 Insurance					0	0	0				
2 Property taxes											
Subtotal Undistributed Costs Period 3					0	0	0				
Staff Costs											
DOC Staff Cost					22	3	25				
Utility Staff Cost					23	3	27				
TOTAL PERIOD 3	563				45	91	699				2244
TOTAL COST TO DECOMMISSION	**10067**	**440**		**115**	**11364**	**3437**	**25423**	**9662**	**48**	**176**	**159194**

TABLE C-2
DISMANTLING COST ESTIMATE FOR HOLTWOOD STEAM ELECTRIC STATION - UNIT 17
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
TOTAL COST TO DISMANTLE WITH 15.63% CONTINGENCY:							$25,422,761				
TOTAL SCRAP METAL REMOVED:						Carbon	9,662				
						St. Steel	48				
						Copper	176				
						Total	9,887 TONS				
SCRAP CREDIT						Carbon (at $100/ton)	$966,222				
						St. Steel (at $240/ton	$11,563				
						Copper (at $1100/ton	$193,988				
						Total	$1,171,772				
TOTAL COST LESS SCRAP CREDIT							$24,250,989				
TOTAL CRAFT LABOR REQUIREMENTS:							159,195 MAN-HOURS				
TOTAL CRAFT LABOR COST WITH 17.96% CONTINGENCY:							$5,740,211				

APPENDIX D

SUNBURY STEAM ELECTRIC STATION

TABLE D-1
DISMANTLING COST ESTIMATE FOR SUNBURY STEAM ELECTRIC STATION - UNIT 1
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
PERIOD 1											
Engineering Preparation											
1 Review plant dwgs & specs.					224	34	257				
2 Submit for license amendment					78	12	90				
3 End product description					49	7	56				
4 Define major work sequence					365	55	420				
5 Perform safety analysis					151	23	173				
6 Submit dismantling plan					25	4	29				
Total					**891**	**134**	**1025**				
Activity Specifications											
7 Plant & temporary facilities					239	36	275				
8 Plant systems					203	30	233				
9 Boiler Removal					316	47	364				
10 Reinforced concrete					78	12	90				
11 Turbine & condenser					39	6	45				
12 Plant structures & buildings					152	23	175				
13 Waste management					224	34	257				
14 Facility & site closeout					44	7	50				
Total					**1294**	**194**	**1489**				
Planning & Site Preparations											
15 Prepare dismantling sequence					117	18	134				
16 Plant prep. & temp. svces					1559	234	1793				
17 Rigging/CCEs/tooling/etc.					1320	198	1518				
Total					**2996**	**449**	**3446**				
Detailed Work Procedures											
18 Plant systems					230	35	265				
19 Remaining buildings					66	10	76				
20 Boiler					177	26	203				
21 Facility closeout					58	9	67				
22 Reinforced concrete					49	7	56				
23 Turbine & condensers					152	23	175				
Total					**731**	**110**	**841**				

TABLE D-1
DISMANTLING COST ESTIMATE FOR SUNBURY STEAM ELECTRIC STATION - UNIT 1
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
24 Asbestos Removal Program	4521	1317		346		1348	7532				145855
Subtotal Period 1 Activity Costs	**4521**	**1317**		**346**	**5913**	**2235**	**14332**				**145855**
Period 1 Undistributed Costs											
1 DOC staff relocation expenses											
2 Insurance					28	3	31				
3 Property taxes											
4 Heavy equipment rental	129					19	149				
5 Plant energy budget					39	6	45				
Subtotal Undistributed Costs Period 1	129				67	28	225				
Staff Costs											
DOC Staff Cost					308	46	354				
Utility Staff Cost					1106	166	1272				
TOTAL PERIOD 1 COST	**4650**	**1317**		**346**	**7395**	**2476**	**16183**				**145855**
PERIOD 2											
Disposal of Plant Systems											
25.1 Air Removal	3					0	3	6			92
25.2 Ash Disposal-Wet	41					6	47	51			1366
25.3 Blowdown	1					0	2	4	0		47
25.4 Boiler	812					122	933	7688	88	5	25853
25.5 Boiler Feed Suction	3					0	3	7			84
25.6 Building Services	1					0	1	6			35
25.7 Chemical Cleaning	4					1	5	4			130
25.8 Chemical Feed	28					4	33	15	0	0	924
25.9 Chlorine	10					1	11	6	0		314
25.10 Circulating Water	20					3	23	186			667
25.11 Coal Handling	127					19	146	1301		5	4332
25.12 Condensate	74					11	85	213	14	16	2389

TABLE D-1
DISMANTLING COST ESTIMATE FOR SUNBURY STEAM ELECTRIC STATION - UNIT 1
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
25.13 Drainage: Venting & Priming	10					1	11	13	0	0	307
25.14 Drip & Air Removal	17					3	20	22			571
25.15 Electrical	471					71	542	1082		383	14526
25.16 Extraction Steam	17					3	19	33	4		553
25.17 Feedwater	37					6	43	67	8	2	1231
25.18 Filtered Water	86					13	99	134	1	0	2806
25.19 Fluidizing Air	26					4	30	12			862
25.20 Flyash Disposal	772					116	888	1129	24	6	23364
25.21 Fuel Oil	35					5	41	25	1		1122
25.22 HVAC	82					12	94	578	0	0	2435
25.23 Hydrogen	4					.1	5	2			138
25.24 Hydrovactor	1					0	1	1			36
25.25 Instrument Air	13					2	15	13	1		431
25.26 Lube Oil	20					3	23	18	1	0	617
25.27 Main Steam	52					8	60	48	5	0	1705
25.28 Main\Reheat & Extraction Steam Drains	14					2	16	17			457
25.29 Potable Water	13					2	14	13	0	0	410
25.30 Process Ductwork	21					3	24	1			669
25.31 Raw Water	78					12	90	536		42	2490
25.32 River Cooling Water	104					16	120	408	14	13	3360
25.33 Station Air	77					12	88	43	0		2519
25.34 Steam Ash Reducer	25					4	28	26			799
25.35 Turbine Room	1					0	1	1			39
25.36 Yard Fire Hydrants	6					1	7	6			199
25 Totals	**3107**					**466**	**3573**	**13716**	**162**	**471**	**97878**
26 Erect scaffolding for systems removal	483					72	555				11801
Removal of Major Equipment											
27 Main Turbine/Generator	18					3	21	513			797
28 Main Condensers	34					5	39	222			1355

TABLE D-1
DISMANTLING COST ESTIMATE FOR SUNBURY STEAM ELECTRIC STATION - UNIT 1
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
Demolition of Remaining Site Buildings											
29.1 Boiler Building	2283					342	2626	1170			51799
29.2 Precipitator Enclosure	380					57	437	233			9151
29.3 Steel Stack	11					2	13	2			232
29.4 Turbine Pedestal	80					12	92				2399
29.5 Turbine Room & Auxiliary Bay	757					113	870	522			14264
29 Totals	**3511**					**527**	**4037**	**1927**			**77845**
Subtotal Period 2 Activity Costs	7152					1073	8225	16377	162	471	189676
Period 2 Undistributed Costs											
1 DOC staff relocation expenses											
2 Insurance					66	7	73				
3 Property taxes											
4 Heavy equipment rental	2645					397	3042				
5 Small tool allowance	192					29	221				
6 Pipe cutting equipment	617					92	709				
7 Plant energy budget					58	9	67				
Subtotal Undistributed Costs Period 2	**3454**				**124**	**533**	**4111**				
Staff Costs											
DOC Staff Cost					1681	252	1933				
Utility Staff Cost					2075	311	2386				
TOTAL PERIOD 2	**10606**				**3879**	**2170**	**16655**	**16377**	**162**	**471**	**189676**

TABLE D-1

DISMANTLING COST ESTIMATE FOR SUNBURY STEAM ELECTRIC STATION - UNIT 1

(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
PERIOD 3											
Site Closeout Activities											
30 BackFill Site	103					15	118				268
31 Grade & landscape site	118					18	135				1051
32 30 year Monitoring Program							a				
Note: An "a" Indicates those cost associated with activity have been accounted for with the undistributed costs.											
Subtotal Period 3 Activity Costs	**221**					**33**	**254**				**1319**
Period 3 Undistributed Costs											
1 Insurance					30	3	33				
2 Property taxes											
Subtotal Undistributed Costs Period 3					**30**	**3**	**33**				
Staff Costs											
DOC Staff Cost					20	3	23				
Utility Staff Cost					727	109	836				
TOTAL PERIOD 3	221				778	148	1147				1319
TOTAL COST TO DECOMMISSION	**15477**	**1317**		**346**	**12052**	**4793**	**33985**	**16377**	**162**	**471**	**336850**

TABLE D-1
DISMANTLING COST ESTIMATE FOR SUNBURY STEAM ELECTRIC STATION - UNIT 1
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
TOTAL COST TO DISMANTLE WITH 16.42% CONTINGENCY:							$33,985,186				
TOTAL SCRAP METAL REMOVED:					Carbon		16,377				
					St. Steel		162				
					Copper		471				
					Total		17,010 TONS				
SCRAP CREDIT					Carbon (at $100/ton)		$1,637,734				
					St. Steel (at $240/ton		$38,831				
					Copper (at $1100/ton		$518,266				
					Total		$2,194,831				
TOTAL COST LESS SCRAP CREDIT							$31,790,355				
TOTAL CRAFT LABOR REQUIREMENTS:							336,850 MAN-HOURS				
TOTAL CRAFT LABOR COST WITH 19.18% CONTINGENCY:							$12,107,006				

TABLE D-2
DISMANTLING COST ESTIMATE FOR SUNBURY STEAM ELECTRIC STATION - UNIT 2
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
PERIOD 1											
Engineering Preparation											
1 Review plant dwgs & specs.					224	34	257				
2 Submit for license amendment					78	12	90				
3 End product description					49	7	56				
4 Define major work sequence					365	55	420				
5 Perform safety analysis					151	23	173				
6 Submit dismantling plan					25	4	29				
Total					**891**	**134**	**1025**				
Activity Specifications											
7 Plant & temporary facilities					239	36	275				
8 Plant systems					203	30	233				
9 Boiler Removal					316	47	364				
10 Reinforced concrete					78	12	90				
11 Turbine & condenser					39	6	45				
12 Plant structures & buildings					152	23	175				
13 Waste management					224	34	257				
14 Facility & site closeout					44	7	50				
Total					**1294**	**194**	**1489**				
Planning & Site Preparations											
15 Prepare dismantling sequence					117	18	134				
16 Plant prep. & temp. svces					1559	234	1793				
17 Rigging/CCEs/tooling/etc.					1320	198	1518				
Total					**2996**	**449**	**3446**				
Detailed Work Procedures											
18 Plant systems					230	35	265				
19 Remaining buildings					66	10	76				
20 Boiler					177	26	203				
21 Facility closeout					58	9	67				
22 Reinforced concrete					49	7	56				
23 Turbine & condensers					152	23	175				
Total					**731**	**110**	**841**				

TABLE D-2
DISMANTLING COST ESTIMATE FOR SUNBURY STEAM ELECTRIC STATION - UNIT 2
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
24 Asbestos Removal Program	4521	1317		346		1348	7532				145855
Subtotal Period 1 Activity Costs	**4521**	**1317**		**346**	**5913**	**2235**	**14332**				**145855**
Period 1 Undistributed Costs											
1 DOC staff relocation expenses											
2 Insurance					28	3	31				
3 Property taxes											
4 Heavy equipment rental	129					19	149				
5 Plant energy budget					39	6	45				
Subtotal Undistributed Costs Period 1	129				67	28	225				
Staff Costs											
DOC Staff Cost					308	46	354				
Utility Staff Cost					1106	166	1272				
TOTAL PERIOD 1 COST	**4650**	**1317**		**346**	**7395**	**2476**	**16183**				**145855**
PERIOD 2											
Disposal of Plant Systems											
25.1 Air Removal	3					0	3	6			92
25.2 Ash Disposal-Wet	41					6	47	51			1366
25.3 Blowdown	1					0	2	4	0		47
25.4 Boiler	833					125	958	7688	88	5	26371
25.5 Boiler Feed Suction	3					0	3	7			84
25.6 Chemical Cleaning	4					1	5	4			130
25.7 Chemical Feed	27					4	31	12		0	866
25.8 Chlorine	9					1	10	4			279
25.9 Circulating Water	20					3	23	186			667
25.10 Coal Handling	30					4	34	1041		3	964
25.11 Condensate	73					11	84	212	14	16	2373
25.12 Drainage: Venting & Priming	9					1	11	13	0	0	305

TABLE D-2
DISMANTLING COST ESTIMATE FOR SUNBURY STEAM ELECTRIC STATION - UNIT 2
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
25.13 Drip & Air Removal	17					3	20	22			571
25.14 Electrical	471					71	542	1082		383	14526
25.15 Extraction Steam	17					3	19	33	4		553
25.16 Feedwater	37					6	43	67	8	2	1231
25.17 Filtered Water	80					12	92	128		0	2624
25.18 Fluidizing Air	26					4	30	12			862
25.19 Flyash Disposal	764					115	878	1113	24	5	23100
25.20 Fuel Oil	35					5	40	24	1	0	1109
25.21 HVAC	80					12	91	571	0	0	2362
25.22 Hydrogen	4					1	5	2			138
25.23 Hydrovactor	1					0	1	1			36
25.24 Instrument Air	12					2	14	10	0		389
25.25 Lube Oil	20					3	23	18	1	0	617
25.26 Main Steam	52					8	59	48	5	0	1680
25.27 Main\Reheat & Extraction Steam Drains	14					2	16	17			457
25.28 Potable Water	12					2	14	12	0		386
25.29 Process Ductwork	21					3	24	1			669
25.30 Raw Water	45					7	52	203		21	1461
25.31 River Cooling Water	97					15	111	350	9	8	3112
25.32 Station Air	77					12	88	43	0		2519
25.33 Steam Ash Reducer	25					4	28	26			799
25.34 Turbine Room	1					0	1	1			39
25.35 Yard Fire Hydrants	5					1	6	5			173
25 Totals	**2965**					**445**	**3410**	**13018**	**155**	**442**	**92957**
26 Erect scaffolding for systems removal	483					72	556				11818
Removal of Major Equipment											
27 Main Turbine/Generator	18					3	21	513			797
28 Main Condensers	34					5	39	222			1355

TABLE D-2
DISMANTLING COST ESTIMATE FOR SUNBURY STEAM ELECTRIC STATION - UNIT 2
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
Demolition of Remaining Site Buildings											
29.1 Boiler Building	2295					344	2639	1171			52044
29.2 Precipitator Enclosure	380					57	437	233			9151
29.3 Pumphouse	24					4	27	3			412
29.4 Steel Stack	29					4	34	78			689
29.5 Turbine Pedestal	87					13	100				2520
29.6 Turbine Room & Auxiliary Bay	757					113	870	522			14264
29 Totals	**3571**					**536**	**4106**	**2007**			**79080**
Subtotal Period 2 Activity Costs	7072					1061	8132	15761	155	442	186007
Period 2 Undistributed Costs											
1 DOC staff relocation expenses											
2 Insurance					60	6	66				
3 Property taxes											
4 Heavy equipment rental	2415					362	2778				
5 Small tool allowance	190					29	219				
6 Pipe cutting equipment	617					92	709				
7 Plant energy budget					53	8	61				
Subtotal Undistributed Costs Period 2	**3222**				**113**	**497**	**3832**				
Staff Costs											
DOC Staff Cost					1527	229	1756				
Utility Staff Cost					1885	283	2168				
TOTAL PERIOD 2	**10294**				**3525**	**2070**	**15889**	**15761**	**155**	**442**	**186007**

TABLE D-2
DISMANTLING COST ESTIMATE FOR SUNBURY STEAM ELECTRIC STATION - UNIT 2
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
PERIOD 3											
Site Closeout Activities											
30 BackFill Site	124					19	142				322
31 Grade & landscape site	118					18	135				1051
32 30 year Monitoring Program							a				
Note: An "a" Indicates those cost associated with activity have been accounted for with the undistributed costs.											
Subtotal Period 3 Activity Costs	**242**					**36**	**278**				**1372**
Period 3 Undistributed Costs											
1 Insurance					30	3	33				
2 Property taxes											
Subtotal Undistributed Costs Period 3					**30**	**3**	**33**				
Staff Costs											
DOC Staff Cost					23	3	27				
Utility Staff Cost					730	110	840				
TOTAL PERIOD 3	242				784	152	1177				1372
TOTAL COST TO DECOMMISSION	15185	1317		346	11704	4698	33250	15761	155	442	333235

TABLE D-2
DISMANTLING COST ESTIMATE FOR SUNBURY STEAM ELECTRIC STATION - UNIT 2
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
TOTAL COST TO DISMANTLE WITH 16.45% CONTINGENCY:							$33,249,623				
TOTAL SCRAP METAL REMOVED:					Carbon		15,761				
					St. Steel		155				
					Copper		442				
					Total		16,357 TONS				
SCRAP CREDIT					Carbon (at $100/ton)		$1,576,058				
					St. Steel (at $240/ton		$37,202.				
					Copper (at $1100/ton		$485,868				
					Total		$2,099,129				
TOTAL COST LESS SCRAP CREDIT							$31,150,494				
TOTAL CRAFT LABOR REQUIREMENTS:							333,235 MAN-HOURS				
TOTAL CRAFT LABOR COST WITH 19.23% CONTINGENCY:							$11,984,047				

TABLE D-3
DISMANTLING COST ESTIMATE FOR SUNBURY STEAM ELECTRIC STATION - UNIT 3
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
PERIOD 1											
Engineering Preparation											
1 Review plant dwgs & specs.					224	34	257				
2 Submit for license amendment					78	12	90				
3 End product description					49	7	56				
4 Define major work sequence					365	55	420				
5 Perform safety analysis					151	23	173				
6 Submit dismantling plan					25	4	29				
Total					**891**	**134**	**1025**				
Activity Specifications											
7 Plant & temporary facilities					239	36	275				
8 Plant systems					203	30	233				
9 Boiler Removal					316	47	364				
10 Reinforced concrete					78	12	90				
11 Turbine & condenser					39	6	45				
12 Plant structures & buildings					152	23	175				
13 Waste management					224	34	257				
14 Facility & site closeout					44	7	50				
Total					**1294**	**194**	**1489**				
Planning & Site Preparations											
15 Prepare dismantling sequence					117	18	134				
16 Plant prep. & temp. svces					1559	234	1793				
17 Rigging/CCEs/tooling/etc.					1320	198	1518				
Total					**2996**	**449**	**3446**				
Detailed Work Procedures											
18 Plant systems					230	35	265				
19 Remaining buildings					66	10	76				
20 Boiler					177	26	203				
21 Facility closeout					58	9	67				
22 Reinforced concrete					49	7	56				
23 Turbine & condensers					152	23	175				
Total					**731**	**110**	**841**				

TABLE D-3
DISMANTLING COST ESTIMATE FOR SUNBURY STEAM ELECTRIC STATION - UNIT 3
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
24 Asbestos Removal Program	4521	1317		346		1348	7532				145855
Subtotal Period 1 Activity Costs	**4521**	**1317**		**346**	**5913**	**2235**	**14332**				**145855**
Period 1 Undistributed Costs											
1 DOC staff relocation expenses											
2 Insurance					28	3	31				
3 Property taxes											
4 Heavy equipment rental	129					19	149				
5 Plant energy budget					38	6	44				
Subtotal Undistributed Costs Period 1	129				66	28	223				
Staff Costs											
DOC Staff Cost					308	46	354				
Utility Staff Cost					1106	166	1272				
TOTAL PERIOD 1 COST	**4650**	**1317**		**346**	**7394**	**2475**	**16182**				**145855**
PERIOD 2											
Disposal of Plant Systems											
25.1 Air Preheater	5					1	5	2			155
25.2 Air Removal	9					1	10	12			301
25.3 Ash Disposal-Wet	41					6	47	54			1350
25.4 Aux Boiler Feedwater	0					0	0	5			14
25.5 Blowdown	21					3	24	13	0		682
25.6 Boiler	748					112	860	9481	46	1	24047
25.7 Boiler Feed Suction	8					1	9	12			268
25.8 Building Services	1					0	1	3			18
25.9 Building Steam	13					2	15	12			439
25.10 Chemical Cleaning	17					3	20	12			558
25.11 Chemical Feed	11					2	12	7	0	0	352
25.12 Circulating Water	29					4	33	126			968

TABLE D-3
DISMANTLING COST ESTIMATE FOR SUNBURY STEAM ELECTRIC STATION - UNIT 3
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
25.13 Coal Handling	37					6	42	850	2	2	1159
25.14 Condensate	113					17	130	269	13	16	3751
25.15 Cooling Water	95					14	109	278	14	11	3065
25.16 Drainage: Venting & Priming	21					3	24	17	0	0	681
25.17 Drip & Air Removal	22					3	26	21			737
25.18 Electrical	617					93	710	1121		430	19053
25.19 Extraction Steam	58					9	67	73	4		1923
25.20 Feedwater	99					15	114	114	8	2	3274
25.21 Filtered Water	88					13	101	91	1	0	2893
25.22 Fluidizing Air Flow	1					0	1	1			18
25.23 Flyash Disposal	678					102	779	893	20	4	20433
25.24 Fuel Oil	30					4	34	20	1	0	951
25.25 Heating & Ventilating	76					11	87	565		0	2244
25.26 Hydrogen	3					0	3	1			87
25.27 Instrument Air	43					7	50	24	1		1414
25.28 Lube Oil	22					3	26	23	1	0	694
25.29 Main Steam	68					10	79	105	5	0	2225
25.30 Main\Reheat & Extraction Steam Drains	8					1	9	10			269
25.31 Potable Water	9					1	11	8	0		307
25.32 Process Ductwork	21					3	24	1			669
25.33 Raw Water	50					8	58	240		26	1637
25.34 River Cooling Water	9					1	11	10			306
25.35 Station Air	25					4	28	19	1		801
25.36 Steam Ash Reducer	3					0	3	3			95
25.37 Yard Fire Hydrants	4					1	5	3			146
25 Totals	**3103**					**466**	**3569**	**14502**	**116**	**492**	**97985**
26 Erect scaffolding for systems removal	380					57	437				9297
Removal of Major Equipment											
27 Main Turbine/Generator	19					3	22	543			843
28 Main Condensers	45					7	52	291			1778

TABLE D-3
DISMANTLING COST ESTIMATE FOR SUNBURY STEAM ELECTRIC STATION - UNIT 3
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
Demolition of Remaining Site Buildings											
29.1 Boiler	1649					247	1897	1146			37881
29.2 Precipitator Enclosure	193					29	222	284			4748
29.3 Steel Stack	28					4	32	78			659
29.4 Turbine Pedestal	115					17	133	2			3061
29.5 Turbine Room & Auxiliary Bay	666					100	766	999			14106
29 Totals	**2652**					**398**	**3049**	**2509**			**60454**
Subtotal Period 2 Activity Costs	6199					930	7129	17845	116	492	170358
Period 2 Undistributed Costs											
1 DOC staff relocation expenses											
2 Insurance					81	8	89				
3 Property taxes											
4 Heavy equipment rental	3245					487	3732				
5 Small tool allowance	181					27	208				
6 Pipe cutting equipment	617					92	709				
7 Plant energy budget					69	10	79				
Subtotal Undistributed Costs Period 2	**4042**				**150**	**625**	**4817**				
Staff Costs											
DOC Staff Cost					2068	310	2378				
Utility Staff Cost					2552	383	2935				
TOTAL PERIOD 2	**10242**				**4770**	**2248**	**17259**	**17845**	**116**	**492**	**170358**

TABLE D-3
DISMANTLING COST ESTIMATE FOR SUNBURY STEAM ELECTRIC STATION - UNIT 3
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
PERIOD 3											
Site Closeout Activities											
30 BackFill Site	121					18	139				611
31 Grade & landscape site	118					18	135				1051
32 30 year Monitoring Program							a				
Note: An "a" Indicates those cost associated with activity have been accounted for with the undistributed costs.											
Subtotal Period 3 Activity Costs	**239**					**36**	**275**				**1662**
Period 3 Undistributed Costs											
1 Insurance					30	3	33				
2 Property taxes											
Subtotal Undistributed Costs Period 3					**30**	**3**	**33**				
Staff Costs											
DOC Staff Cost					22	3	25				
Utility Staff Cost					729	109	838				
TOTAL PERIOD 3	239				781	151	1171				1662
TOTAL COST TO DECOMMISSION	**15130**	**1317**		**346**	**12944**	**4875**	**34612**	**17845**	**116**	**492**	**317875**

TABLE D-3
DISMANTLING COST ESTIMATE FOR SUNBURY STEAM ELECTRIC STATION - UNIT 3
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
TOTAL COST TO DISMANTLE WITH 16.39% CONTINGENCY:							$34,612,443				
TOTAL SCRAP METAL REMOVED:					Carbon		17,845				
					St. Steel		116				
					Copper		492				
					Total		18,452	TONS			
SCRAP CREDIT					Carbon (at $100/ton)		$1,784,518				
					St. Steel (at $240/ton		$27,768				
					Copper (at $1100/ton		$540,698				
					Total		$2,352,985				
TOTAL COST LESS SCRAP CREDIT							$32,259,458				
TOTAL CRAFT LABOR REQUIREMENTS:							317,875	MAN-HOURS			
TOTAL CRAFT LABOR COST WITH 19.44% CONTINGENCY:							$11,418,700				

TABLE D-4
DISMANTLING COST ESTIMATE FOR SUNBURY STEAM ELECTRIC STATION - UNIT 4
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
PERIOD 1											
Engineering Preparation											
1 Review plant dwgs & specs.					224	34	257				
2 Submit for license amendment					78	12	90				
3 End product description					49	7	56				
4 Define major work sequence					365	55	420				
5 Perform safety analysis					151	23	173				
6 Submit dismantling plan					25	4	29				
Total					**891**	**134**	**1025**				
Activity Specifications											
7 Plant & temporary facilities					239	36	275				
8 Plant systems					203	30	233				
9 Boiler Removal					316	47	364				
10 Reinforced concrete					78	12	90				
11 Turbine & condenser					39	6	45				
12 Plant structures & buildings					152	23	175				
13 Waste management					224	34	257				
14 Facility & site closeout					44	7	50				
Total					**1294**	**194**	**1489**				
Planning & Site Preparations											
15 Prepare dismantling sequence					117	18	134				
16 Plant prep. & temp. svces					1559	234	1793				
17 Rigging/CCEs/tooling/etc.					1320	198	1518				
Total					**2996**	**449**	**3446**				
Detailed Work Procedures											
18 Plant systems					230	35	265				
19 Remaining buildings					66	10	76				
20 Boiler					177	26	203				
21 Facility closeout					58	9	67				
22 Reinforced concrete					49	7	56				
23 Turbine & condensers					152	23	175				
Total					**731**	**110**	**841**				

TABLE D-4
DISMANTLING COST ESTIMATE FOR SUNBURY STEAM ELECTRIC STATION - UNIT 4
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
24 Asbestos Removal Program	4521	1317		346		1348	7532				145855
Subtotal Period 1 Activity Costs	**4521**	**1317**		**346**	**5913**	**2235**	**14332**				**145855**
Period 1 Undistributed Costs											
1 DOC staff relocation expenses											
2 Insurance					28	3	31				
3 Property taxes											
4 Heavy equipment rental	129					19	149				
5 Plant energy budget					74	11	85				
Subtotal Undistributed Costs Period 1	129				102	33	265				
Staff Costs											
DOC Staff Cost					308	46	354				
Utility Staff Cost					1106	166	1272				
TOTAL PERIOD 1 COST	**4650**	**1317**		**346**	**7430**	**2481**	**16224**				**145855**
PERIOD 2											
Disposal of Plant Systems											
25.1 Air Preheater	5					1	5	2			155
25.2 Air Removal	9					1	10	12			301
25.3 Ash Disposal-Wet	41					6	47	54			1350
25.4 Aux Boiler Feedwater	0					0	0	5			14
25.5 Blowdown	21					3	24	13	0		682
25.6 Boiler	748					112	860	9508	46	1	24060
25.7 Boiler Feed Suction	8					1	9	12			268
25.8 Building Services	1					0	1	3			18
25.9 Building Steam	13					2	15	12			439
25.10 Chemical Cleaning	17					3	20	12			558
25.11 Chemical Feed	10					1	11	5	0	0	310
25.12 Circulating Water	29					4	33	126			968

TABLE D-4
DISMANTLING COST ESTIMATE FOR SUNBURY STEAM ELECTRIC STATION - UNIT 4
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
25.13 Coal Handling	35					5	40	865	2	2	1106
25.14 Condensate	113					17	130	268	13	16	3731
25.15 Cooling Water	95					14	109	237	9	6	3061
25.16 Drainage: Venting & Priming	21					3	24	17	0	0	681
25.17 Drip & Air Removal	22					3	26	21			737
25.18 Electrical	617					93	710	1121		430	19053
25.19 Extraction Steam	58					9	67	73	4		1923
25.20 Feedwater	99					15	114	114	8	2	3274
25.21 Filtered Water	81					12	94	85		0	2692
25.22 Fluidizing Air Flow	1					0	1	1			18
25.23 Flyash Disposal	693					104	796	887	20	3	20888
25.24 Fuel Oil	30					4	34	20	1	0	951
25.25 Heating & Ventilating	76					11	87	565		0	2238
25.26 Hydrogen	3					0	3	1			87
25.27 Instrument Air	42					6	48	21	0		1372
25.28 Lube Oil	22					3	26	23	1	0	694
25.29 Main Steam	68					10	79	105	5	0	2225
25.30 Main\Reheat & Extraction Steam Drains	8					1	9	10			269
25.31 Potable Water	9					1	11	8	0		307
25.32 Process Ductwork	21					3	24	1			669
25.33 Raw Water	46					7	53	200		21	1497
25.34 River Cooling Water	9					1	10	8			300
25.35 Station Air	25					4	28	19	1		801
25.36 Steam Ash Reducer	3					0	3	3			95
25.37 Yard Fire Hydrants	4					1	5	3			146
25 Totals	**3102**					**465**	**3567**	**14441**	**110**	**481**	**97939**
26 Erect scaffolding for systems removal	388					58	446				9496
Removal of Major Equipment											
27 Main Turbine/Generator	21					3	24	585			908
28 Main Condensers	49					7	56	315			1926

TABLE D-4
DISMANTLING COST ESTIMATE FOR SUNBURY STEAM ELECTRIC STATION - UNIT 4
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
Demolition of Remaining Site Buildings											
29.1 Boiler Building	1980					297	2277	1348			45418
29.2 Conveyor Tunnel	464					70	533	6			8052
29.3 Intake Structure	733					110	843	8			12861
29.4 Miscellaneous Yard Structures	4707					706	5413	2231			80425
29.5 Office & Service Building	209					31	240	158			3379
29.6 Precipator Enclosure	571					86	657	276			13598
29.7 Pumphouse	24					4	27	3			412
29.8 Reclaim Hopper "B"	47					7	54	1			804
29.9 Reclaiming Hopper "A"	47					7	54	1			804
29.10 Rotary Car Dumper	70					10	80	44			1627
29.11 Steel Stack	29					4	34	78			689
29.12 Sub Station Control House	49					7	57	12			648
29.13 Turbine Pedestal	96					14	110				2687
29.14 Turbine Room & Auxiliary Bay	703					105	808	1011			14776
29.15 Warehouses	395					59	454	198			6444
29.16 Yard Fixtures	1062					159	1221	789			12546
29 Totals	**11184**					**1678**	**12861**	**6165**			**205169**
Subtotal Period 2 Activity Costs	14743					2211	16955	21506	110	481	315437
Period 2 Undistributed Costs											
1 DOC staff relocation expenses											
2 Insurance					73	7	80				
3 Property taxes											
4 Heavy equipment rental	2906					436	3342				
5 Small tool allowance	266					40	306				
6 Pipe cutting equipment	617					92	709				
7 Plant energy budget					126	19	145				
Subtotal Undistributed Costs Period 2	**3789**				**198**	**594**	**4582**				
Staff Costs											
DOC Staff Cost					1848	277	2125				
Utility Staff Cost					2281	342	2623				
TOTAL PERIOD 2	**18532**				**4327**	**3425**	**26285**	**21506**	**110**	**481**	**315437**

TABLE D-4
DISMANTLING COST ESTIMATE FOR SUNBURY STEAM ELECTRIC STATION - UNIT 4
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
PERIOD 3											
Site Closeout Activities											
30 BackFill Site	329					49	378				1660
31 Grade & landscape site	118					18	135				1051
32 30 year Monitoring Program							a				
Note: An "a" indicates those cost associated with activity have been accounted for with the undistributed costs.											
Subtotal Period 3 Activity Costs	**447**					**67**	**513**				**2711**
Period 3 Undistributed Costs											
1 Insurance					30	3	33				
2 Property taxes											
Subtotal Undistributed Costs Period 3					30	3	33				
Staff Costs											
DOC Staff Cost					22	3	25				
Utility Staff Cost					729	109	838				
TOTAL PERIOD 3	447				781	183	1410				2711
TOTAL COST TO DECOMMISSION	**23628**	**1317**		**346**	**12538**	**6089**	**43918**	**21506**	**110**	**481**	**464003**

TABLE D-4
DISMANTLING COST ESTIMATE FOR SUNBURY STEAM ELECTRIC STATION - UNIT 4
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
TOTAL COST TO DISMANTLE WITH 16.1% CONTINGENCY:							$43,917,703				
TOTAL SCRAP METAL REMOVED:					Carbon		21,506				
					St. Steel		110				
					Copper		481				
					Total		22,096 TONS				
SCRAP CREDIT					Carbon (at $100/ton)		$2,150,553				
					St. Steel (at $240/ton		$26,301				
					Copper (at $1100/ton		$528,989				
					Total		$2,705,843				
TOTAL COST LESS SCRAP CREDIT							$41,211,859				
TOTAL CRAFT LABOR REQUIREMENTS:							464,003 MAN-HOURS				
TOTAL CRAFT LABOR COST WITH 18.02% CONTINGENCY:							$16,611,577				

APPENDIX E

MARTINS CREEK STEAM ELECTRIC STATION

TABLE E-1
DISMANTLING COST ESTIMATE FOR MARTINS CREEK STEAM ELECTRIC STATION - UNIT 1
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
PERIOD 1											
Engineering Preparation											
1 Review plant dwgs & specs.					224	34	257				
2 Submit for license amendment					78	12	90				
3 End product description					49	7	56				
4 Define major work sequence					365	55	420				
5 Perform safety analysis					151	23	173				
6 Submit dismantling plan					25	4	29				
Total					**891**	**134**	**1025**				
Activity Specifications											
7 Plant & temporary facilities					239	36	275				
8 Plant systems					203	30	233				
9 Boiler Removal					316	47	364				
10 Reinforced concrete					78	12	90				
11 Turbine & condenser					39	6	45				
12 Plant structures & buildings					152	23	175				
13 Waste management					224	34	257				
14 Facility & site closeout					44	7	50				
Total					**1294**	**194**	**1489**				
Planning & Site Preparations											
15 Prepare dismantling sequence					117	18	134				
16 Plant prep. & temp. svces					1559	234	1793				
17 Rigging/CCEs/tooling/etc.					1320	198	1518				
Total					**2996**	**449**	**3446**				
Detailed Work Procedures											
18 Plant systems					230	35	265				
19 Remaining buildings					66	10	76				
20 Boiler					177	26	203				
21 Facility closeout					58	9	67				
22 Reinforced concrete					49	7	56				
23 Turbine & condensers					152	23	175				
Total					**731**	**110**	**841**				

TABLE E-1
DISMANTLING COST ESTIMATE FOR MARTINS CREEK STEAM ELECTRIC STATION - UNIT 1
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
24 Asbestos Removal Program	6734	1773		461		1976	10944				194474
Subtotal Period 1 Activity Costs	**6734**	**1773**		**461**	**5913**	**2863**	**17744**				**194474**
Period 1 Undistributed Costs											
1 DOC staff relocation expenses											
2 Insurance					28	3	31				
3 Property taxes											
4 Heavy equipment rental	129					19	149				
5 Plant energy budget					37	5	42				
Subtotal Undistributed Costs Period 1	129				65	28	221				
Staff Costs											
DOC Staff Cost					378	57	434				
Utility Staff Cost					1106	166	1272				
TOTAL PERIOD 1 COST	**6863**	**1773**		**461**	**7462**	**3113**	**19673**				**194474**
PERIOD 2											
Disposal of Plant Systems											
25.1 Air Preheater	5					1	6	2			155
25.2 Air Removal	10					2	12	12			301
25.3 Ash Disposal-Wet	45					7	52	54			1350
25.4 Aux Boiler Feedwater	0					0	1	5			14
25.5 Blowdown	23					3	27	13	0		682
25.6 Boiler	834					125	959	9481	46	1	24047
25.7 Boiler Feed Suction	9					1	10	12			268
25.8 Building Services	1					0	1	3			18
25.9 Building Steam	15					2	17	12			439
25.10 Chemical Cleaning	19					3	22	12			558
25.11 Chemical Feed	12					2	14	7	0	0	352
25.12 Circulating Water	32					5	37	126			968

TABLE E-1
DISMANTLING COST ESTIMATE FOR MARTINS CREEK STEAM ELECTRIC STATION - UNIT 1
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
25.13 Coal Handling	41					6	47	850	2	2	1159
25.14 Condensate	126					19	145	269	13	16	3751
25.15 Cooling Water	106					16	122	278	14	11	3065
25.16 Drainage: Venting & Priming	23					4	27	17	0	0	681
25.17 Drip & Air Removal	25					4	29	21			737
25.18 Electrical	686					103	789	1121		430	19053
25.19 Extraction Steam	65					10	74	73	4		1923
25.20 Feedwater	111					17	127	114	8	2	3274
25.21 Filtered Water	98					15	113	91	1	0	2893
25.22 Fluidizing Air Flow	1					0	1	1			18
25.23 Flyash Disposal	753					113	866	893	20	4	20433
25.24 Fuel Oil	33					5	38	20	1	0	951
25.25 Heating & Ventilating	84					13	97	565		0	2244
25.26 Hydrogen	3					0	3	1			87
25.27 Instrument Air	48					7	56	24	1		1414
25.28 Lube Oil	25					4	28	23	1	0	694
25.29 Main Steam	76					11	88	105	5	0	2225
25.30 Main\Reheat & Extraction Steam Drains	9					1	10	10			269
25.31 Potable Water	10					2	12	8	0		307
25.32 Process Ductwork	25					4	28	1			669
25.33 Raw Water	56					8	64	240		26	1637
25.34 River Cooling Water	10					2	12	10			306
25.35 Station Air	27					4	32	19	1		801
25.36 Steam Ash Reducer	3					0	4	3			95
25.37 Yard Fire Hydrants	5					1	6	3			146
25 Totals	**3457**					**519**	**3975**	**14502**	**116**	**492**	**97985**
26 Erect scaffolding for systems removal	244					37	281				5519
Removal of Major Equipment											
27 Main Turbine/Generator	23					4	27	591			917
28 Main Condensers	56					8	64	328			2006

TABLE E-1
DISMANTLING COST ESTIMATE FOR MARTINS CREEK STEAM ELECTRIC STATION - UNIT 1
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
Demolition of Remaining Site Buildings											
29.1 Boiler Building	962					144	1107	913			18205
29.2 Boiler Room Stack	116					17	134	215			2494
29.3 Electrical Equipment Building	77					11	88	78			1575
29.4 Miscellaneous Steel	219					33	252	438			5256
29.5 Precipitator	297					45	341	300			6940
29.6 Turbine Building	517					78	595	992			11290
29.7 Turbine Pedestal	150					23	173				2258
29 Totals	**2339**					**351**	**2690**	**2936**			**48018**
Subtotal Period 2 Activity Costs	6119					918	7037	18357	116	492	154445
Period 2 Undistributed Costs											
1 DOC staff relocation expenses											
2 Insurance					59	6	65				
3 Property taxes											
4 Heavy equipment rental	2401					360	2761				
5 Small tool allowance	225					34	258				
6 Pipe cutting equipment	617					92	709				
7 Plant energy budget					48	7	56				
Subtotal Undistributed Costs Period 2	**3243**				**108**	**500**	**3850**				
Staff Costs											
DOC Staff Cost					1513	227	1740				
Utility Staff Cost					1868	280	2148				
TOTAL PERIOD 2	**9362**				**3489**	**1925**	**14776**	**18357**	**116**	**492**	**154445**

TABLE E-1
DISMANTLING COST ESTIMATE FOR MARTINS CREEK STEAM ELECTRIC STATION - UNIT 1
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
PERIOD 3											
Site Closeout Activities											
30 BackFill Site	261					39	301				673
31 Grade & landscape site	125					19	144				1544
32 30 year Monitoring Program							a				
Note: An "a" indicates those cost associated with activity have been accounted for with the undistributed costs.											
Subtotal Period 3 Activity Costs	**386**					**58**	**444**				**2217**
Period 3 Undistributed Costs											
1 Insurance					30	3	33				
2 Property taxes											
Subtotal Undistributed Costs Period 3					**30**	**3**	**33**				
Staff Costs											
DOC Staff Cost					26	4	30				
Utility Staff Cost					734	110	844				
TOTAL PERIOD 3	386				789	175	1351				2217
TOTAL COST TO DECOMMISSION	**16612**	**1773**		**461**	**11740**	**5213**	**35799**	**18357**	**116**	**492**	**351136**

TABLE E-1
DISMANTLING COST ESTIMATE FOR MARTINS CREEK STEAM ELECTRIC STATION - UNIT 1
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
TOTAL COST TO DISMANTLE WITH 17% CONTINGENCY:							$35,799,245				
TOTAL SCRAP METAL REMOVED:					Carbon		18,357				
					St. Steel		116				
					Copper		492				
					Total		18,964 TONS				
SCRAP CREDIT					Carbon (at $100/ton)		$1,835,692				
					St. Steel (at $240/ton		$27,768				
					Copper (at $1100/ton		$540,698				
					Total		$2,404,158				
TOTAL COST LESS SCRAP CREDIT							$33,395,087				
TOTAL CRAFT LABOR REQUIREMENTS:							351,136 MAN-HOURS				
TOTAL CRAFT LABOR COST WITH 20.35% CONTINGENCY:							$14,298,841				

TABLE E-2
DISMANTLING COST ESTIMATE FOR MARTINS CREEK STEAM ELECTRIC STATION - UNIT 2
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
PERIOD 1											
Engineering Preparation											
1 Review plant dwgs & specs.					224	34	257				
2 Submit for license amendment					78	12	90				
3 End product description					49	7	56				
4 Define major work sequence					365	55	420				
5 Perform safety analysis					151	23	173				
6 Submit dismantling plan					25	4	29				
Total					**891**	**134**	**1025**				
Activity Specifications											
7 Plant & temporary facilities					239	36	275				
8 Plant systems					203	30	233				
9 Boiler Removal					316	47	364				
10 Reinforced concrete					78	12	90				
11 Turbine & condenser					39	6	45				
12 Plant structures & buildings					152	23	175				
13 Waste management					224	34	257				
14 Facility & site closeout					44	7	50				
Total					**1294**	**194**	**1489**				
Planning & Site Preparations											
15 Prepare dismantling sequence					117	18	134				
16 Plant prep. & temp. svces					1559	234	1793				
17 Rigging/CCEs/tooling/etc.					1320	198	1518				
Total					**2996**	**449**	**3446**				
Detailed Work Procedures											
18 Plant systems					230	35	265				
19 Remaining buildings					66	10	76				
20 Boiler					177	26	203				
21 Facility closeout					58	9	67				
22 Reinforced concrete					49	7	56				
23 Turbine & condensers					152	23	175				
Total					**731**	**110**	**841**				

TABLE E-2
DISMANTLING COST ESTIMATE FOR MARTINS CREEK STEAM ELECTRIC STATION - UNIT 2
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
24 Asbestos Removal Program	6734	1773		461		1976	10944				194474
Subtotal Period 1 Activity Costs	**6734**	**1773**		**461**	**5913**	**2863**	**17744**				**194474**
Period 1 Undistributed Costs											
1 DOC staff relocation expenses											
2 Insurance					28	3	31				
3 Property taxes											
4 Heavy equipment rental	129					19	149				
5 Plant energy budget					36	5	42				
Subtotal Undistributed Costs Period 1	129				64	28	221				
Staff Costs											
DOC Staff Cost					378	57	434				
Utility Staff Cost					1106	166	1272				
TOTAL PERIOD 1 COST	**6863**	**1773**		**461**	**7462**	**3113**	**19673**				**194474**
PERIOD 2											
Disposal of Plant Systems											
25.1 Air Preheater	5					1	6	2			155
25.2 Air Removal	10					2	12	12			301
25.3 Ash Disposal-Wet	45					7	52	54			1350
25.4 Aux Boiler Feedwater	0					0	1	5			14
25.5 Blowdown	23					3	27	13	0		682
25.6 Boiler	834					125	959	9508	46	1	24060
25.7 Boiler Feed Suction	9					1	10	12			268
25.8 Building Services	1					0	1	3			18
25.9 Building Steam	15					2	17	12			439
25.10 Chemical Cleaning	19					3	22	12			558
25.11 Chemical Feed	11					2	12	5	0	0	310
25.12 Circulating Water	32					5	37	126			968

TABLE E-2
DISMANTLING COST ESTIMATE FOR MARTINS CREEK STEAM ELECTRIC STATION - UNIT 2
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
25.13 Coal Handling	39					6	45	865	2	2	1106
25.14 Condensate	126					19	145	268	13	16	3731
25.15 Cooling Water	106					16	121	237	9	6	3061
25.16 Drainage: Venting & Priming	23					4	27	17	0	0	681
25.17 Drip & Air Removal	25					4	29	21			737
25.18 Electrical	686					103	789	1121		430	19053
25.19 Extraction Steam	65					10	74	73	4		1923
25.20 Feedwater	111					17	127	114	8	2	3274
25.21 Filtered Water	91					14	104	85		0	2692
25.22 Fluidizing Air Flow	1					0	1	1			18
25.23 Flyash Disposal	769					115	884	887	20	3	20888
25.24 Fuel Oil	33					5	38	20	1	0	951
25.25 Heating & Ventilating	84					13	97	565		0	2238
25.26 Hydrogen	3					0	3	1			87
25.27 Instrument Air	47					7	54	21	0		1372
25.28 Lube Oil	25					4	28	23	1	0	694
25.29 Main Steam	76					11	88	105	5	0	2225
25.30 Main\Reheat & Extraction Steam Drains	9					1	10	10			269
25.31 Potable Water	10					2	12	8	0		307
25.32 Process Ductwork	25					4	28	1			669
25.33 Raw Water	51					8	59	200		21	1497
25.34 River Cooling Water	10					2	12	8			300
25.35 Station Air	27					4	32	19	1		801
25.36 Steam Ash Reducer	3					0	4	3			95
25.37 Yard Fire Hydrants	5					1	6	3			146
25 Totals	**3454**					**518**	**3972**	**14441**	**110**	**481**	**97939**
26 Erect scaffolding for systems removal	261					39	300				5895
Removal of Major Equipment											
27 Main Turbine/Generator	23					4	27	591			917
28 Main Condensers	56					8	64	328			2006

TABLE E-2
DISMANTLING COST ESTIMATE FOR MARTINS CREEK STEAM ELECTRIC STATION - UNIT 2
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
Demolition of Remaining Site Buildings											
29.1 Ash Basin #4	3518					528	4046				
29.2 Boiler Building	962					144	1107	913			18205
29.3 Boiler Room Stack (abandoned)	63					9	72	5			1237
29.4 Miscellaneous Yard Structures	852					128	980	591			18277
29.5 Precipitator Area	299					45	344	300			6948
29.6 Turbine Building	500					75	575	632			10832
29.7 Turbine Building Pedestal	150					23	173				2258
29 Totals	**6345**					**952**	**7296**	**2440**			**57758**
Subtotal Period 2 Activity Costs	10140					1521	11661	17800	110	481	164516
Period 2 Undistributed Costs											
1 DOC staff relocation expenses											
2 Insurance					64	6	71				
3 Property taxes											
4 Heavy equipment rental	2575					386	2961				
5 Small tool allowance	231					35	265				
6 Pipe cutting equipment	617					92	709				
7 Plant energy budget					52	8	59				
Subtotal Undistributed Costs Period 2	**3422**				**116**	**527**	**4065**				
Staff Costs											
DOC Staff Cost					1635	245	1880				
Utility Staff Cost					2019	303	2321				
TOTAL PERIOD 2	**13562**				**3770**	**2596**	**19928**	**17800**	**110**	**481**	**164516**

TABLE E-2
DISMANTLING COST ESTIMATE FOR MARTINS CREEK STEAM ELECTRIC STATION - UNIT 2
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
PERIOD 3											
Site Closeout Activities											
30 BackFill Site	148					22	171				736
31 Grade & landscape site	125					19	144				1544
32 30 year Monitoring Program							a				
Note: An "a" indicates those cost associated with activity have been accounted for with the undistributed costs.											
Subtotal Period 3 Activity Costs	**273**					**41**	**314**				**2280**
Period 3 Undistributed Costs											
1 Insurance					30	3	33				
2 Property taxes											
Subtotal Undistributed Costs Period 3					**30**	**3**	**33**				
Staff Costs											
DOC Staff Cost					20	3	23				
Utility Staff Cost					727	109	836				
TOTAL PERIOD 3	273				778	156	1207				2280
TOTAL COST TO DECOMMISSION	**20698**	**1773**		**461**	**12009**	**5866**	**40807**	**17800**	**110**	**481**	**361269**

TABLE E-2
DISMANTLING COST ESTIMATE FOR MARTINS CREEK STEAM ELECTRIC STATION - UNIT 2
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
TOTAL COST TO DISMANTLE WITH 16.79% CONTINGENCY:							$40,807,472				
TOTAL SCRAP METAL REMOVED:					Carbon		17,800				
					St. Steel		110				
					Copper		481				
					Total		18,391 TONS				
SCRAP CREDIT					Carbon (at $100/ton)		$1,780,006				
					St. Steel (at $240/ton		$26,301				
					Copper (at $1100/ton		$528,989				
					Total		$2,335,296				
TOTAL COST LESS SCRAP CREDIT							$38,472,175				
TOTAL CRAFT LABOR REQUIREMENTS:							361,269 MAN-HOURS				
TOTAL CRAFT LABOR COST WITH 20.22% CONTINGENCY:							$14,662,866				

TABLE E-3
DISMANTLING COST ESTIMATE FOR MARTINS CREEK STEAM ELECTRIC STATION - UNIT 3
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
PERIOD 1											
Engineering Preparation											
1 Review plant dwgs & specs.					224	34	257				
2 Submit for license amendment					78	12	90				
3 End product description					49	7	56				
4 Define major work sequence					365	55	420				
5 Perform safety analysis					151	23	173				
6 Submit dismantling plan					25	4	29				
Total					**891**	**134**	**1025**				
Activity Specifications											
7 Plant & temporary facilities					239	36	275				
8 Plant systems					203	30	233				
9 Boiler Removal					316	47	364				
10 Reinforced concrete					78	12	90				
11 Turbine & condenser					39	6	45				
12 Plant structures & buildings					152	23	175				
13 Waste management					224	34	257				
14 Facility & site closeout					44	7	50				
Total					**1294**	**194**	**1489**				
Planning & Site Preparations											
15 Prepare dismantling sequence					117	18	134				
16 Plant prep. & temp. svces					1559	234	1793				
17 Rigging/CCEs/tooling/etc.					1320	198	1518				
Total					**2996**	**449**	**3446**				
Detailed Work Procedures											
18 Plant systems					230	35	265				
19 Remaining buildings					66	10	76				
20 Boiler					177	26	203				
21 Facility closeout					58	9	67				
22 Reinforced concrete					49	7	56				
23 Turbine & condensers					152	23	175				
Total					**731**	**110**	**841**				

TABLE E-3
DISMANTLING COST ESTIMATE FOR MARTINS CREEK STEAM ELECTRIC STATION - UNIT 3
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
24 Asbestos Removal Program											
Subtotal Period 1 Activity Costs					5913	887	6800				
Period 1 Undistributed Costs											
1 DOC staff relocation expenses											
2 Insurance					28	3	31				
3 Property taxes											
4 Heavy equipment rental	129					19	149				
5 Plant energy budget					68	10	78				
Subtotal Undistributed Costs Period 1	129				96	32	258				
Staff Costs											
DOC Staff Cost					236	35	271				
Utility Staff Cost					1106	166	1272				
TOTAL PERIOD 1 COST	**129**				**7351**	**1121**	**8601**				
PERIOD 2											
Disposal of Plant Systems											
25.1 Ash Disposal-Wet	167					25	193	157		2	4979
25.2 Aux Boiler Feedwater	20					3	23	29		1	589
25.3 Auxiliary Steam	37					6	42	60			1080
25.4 Blowdown	6					1	7	6			182
25.5 Boiler	2595					389	2985	21898	415	2	75738
25.6 Boiler Drains & Vents	29					4	33	316	0	24	836
25.7 Boiler Feed	31					5	36	202	20	20	904
25.8 Building Services	1					0	1	3			18
25.9 Chemical Addition	10					2	12	7			302
25.10 Chemical Cleaning	20					3	23	108		10	580
25.11 Chilled Water	32					5	37	36		0	935
25.12 Chimney Wash	2					0	3	5		1	65

TABLE E-3
DISMANTLING COST ESTIMATE FOR MARTINS CREEK STEAM ELECTRIC STATION - UNIT 3
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
25.13 Circulating Water	109					16	125	907	10	25	3207
25.14 Circulating Water Chlorination	10					2	12	11	0	0	289
25.15 Closed Cycle Cooling Water	70					10	80	103	12	3	2016
25.16 Combustion Air & Flue Gas	127					19	146	193	2	2	3613
25.17 Condensate	136					20	156	497	19	16	3884
25.18 Condenser Air Removal	13					2	15	22	1	0	365
25.19 Demineralized Water	186					28	214	210	13	2	5097
25.20 Electrical	1403					210	1613	1510		636	39036
25.21 Extraction Steam	132					20	152	378	30		3965
25.22 Feedwater	108					16	125	324			3212
25.23 Filtered Water	21					3	24	33			600
25.24 Fire Service	31					5	35	173	0	5	885
25.25 Forced Draft Fan Air Preheating	34					5	39	201	5	10	961
25.26 Fuel Additives	22					3	25	15	1	0	639
25.27 Fuel Oil	582					87	670	696	49	4	15636
25.28 Fuel Oil Heating	43					6	49	48	6	0	1256
25.29 Fuel Unloading	5					1	6	37			153
25.30 Gland Sealing Steam	61					9	70	69			1798
25.31 Gland Sealing Water	9					1	11	6			271
25.32 HVAC	227					34	261	1511		1	6041
25.33 Heater Drains & Vents	61					9	70	138	0	5	1783
25.34 Hydrogen\Nitrogen\Carbon Dioxide	13					2	15	16	1		391
25.35 Injection Water	9					1	11	7	0	1	275
25.36 Lube Oil	104					16	120	111	5	2	2988
25.37 Main & Reheat Steam	115					17	132	210			3429
25.38 Main\Reheat & Extraction Steam Drains	2					0	3	3	0		65
25.39 Miscellaneous Drains & Vents	129					19	148	118			3814
25.40 Potable Water	1					0	1	2			30
25.41 Process Ductwork	20					3	23	1			557
25.42 Raw Water	85					13	97	733	12	35	2434
25.43 Seal Oil	3					1	4	2			102
25.44 Soot Blowing	0					0	0	0			2
25.45 Station & Instrument Air	92					14	106	80			2742
25.46 Steam Generator	6					1	7	62	0	0	177
25.47 Sump Pumps Discharge	17					2	19	29		3	460
25.48 Tank Car Heating	15					2	18	37	1	1	414

TABLE E-3

DISMANTLING COST ESTIMATE FOR MARTINS CREEK STEAM ELECTRIC STATION - UNIT 3

(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
25.49 Turbine Bypass	22					3	25	30	0		649
25.50 Water & Steam Sampling	27					4	31	9	6	0	762
25 Totals	**6999**					**1050**	**8049**	**31359**	**609**	**809**	**200201**
26 Erect scaffolding for systems removal	791					119	910				17865
Removal of Major Equipment											
27 Main Turbine/Generator	74					11	85	1773			2874
28 Main Condensers	57					9	66	337			2057
Demolition of Remaining Site Buildings											
29.1 Auxiliary Boiler Building	106					16	122	151			2412
29.2 Boiler Building	4355					653	5008	5239			99404
29.3 Control Complex	253					38	291	154			4335
29.4 Cooling Tower	2976					446	3423	5			59405
29.5 Diesel Generator Building	59					9	68	103			1392
29.6 Main Station Sump "C"	9					1	10	4			192
29.7 Makeup Demineralizer Area	89					13	102	18			1630
29.8 Miscellaneous Yard Structures	434					65	500	577			9441
29.9 Office & Service Building	990					149	1139	963			19442
29.10 Precipitator Area	686					103	789	1253			16512
29.11 Turbine Building	1930					290	2220	3176			43467
29.12 Turbine Pedestal	441					66	507				6282
29 Totals	**12329**					**1849**	**14179**	**11643**			**263912**
Subtotal Period 2 Activity Costs	20251					3038	23289	45112	609	809	486909

TABLE E-3
DISMANTLING COST ESTIMATE FOR MARTINS CREEK STEAM ELECTRIC STATION - UNIT 3
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
Period 2 Undistributed Costs											
1 DOC staff relocation expenses											
2 Insurance					83	8	91				
3 Property taxes											
4 Heavy equipment rental	3295					494	3789				
5 Small tool allowance	316					47	363				
6 Pipe cutting equipment	617					92	709				
7 Plant energy budget					129	19	149				
Subtotal Undistributed Costs Period 2	**4227**				**212**	**662**	**5101**				
Staff Costs											
DOC Staff Cost					2102	315	2418				
Utility Staff Cost					2595	389	2985				
TOTAL PERIOD 2	**24479**				**4910**	**4404**	**33793**	**45112**	**609**	**809**	**486909**
PERIOD 3											
Site Closeout Activities											
30 BackFill Site	2451					368	2818				6309
31 Grade & landscape site	116					17	133				976
32 30 year Monitoring Program							a				
Note: An "a" Indicates those cost associated with activity have been accounted for with the undistributed costs.											
Subtotal Period 3 Activity Costs	**2567**					**385**	**2952**				**7284**
Period 3 Undistributed Costs											
1 Insurance					30	3	33				
2 Property taxes											
Subtotal Undistributed Costs Period 3					**30**	**3**	**33**				

TABLE E-3
DISMANTLING COST ESTIMATE FOR MARTINS CREEK STEAM ELECTRIC STATION - UNIT 3
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
Staff Costs											
DOC Staff Cost					20	3	23				
Utility Staff Cost					727	109	836				
TOTAL PERIOD 3	2567				778	500	3844				7284
TOTAL COST TO DECOMMISSION	**27175**				**13039**	**6025**	**46238**	**45112**	**609**	**809**	**494193**

TOTAL COST TO DISMANTLE WITH 14.98% CONTINGENCY:		$46,238,301	
TOTAL SCRAP METAL REMOVED:	Carbon	45,112	
	St. Steel	609	
	Copper	809	
	Total	46,531	TONS
SCRAP CREDIT	Carbon (at $100/ton)	$4,511,205	
	St. Steel (at $240/ton	$146,239	
	Copper (at $1100/ton	$890,155	
	Total	$5,547,599	
TOTAL COST LESS SCRAP CREDIT		$40,690,702	
TOTAL CRAFT LABOR REQUIREMENTS:		494,193	MAN-HOURS
TOTAL CRAFT LABOR COST WITH 15% CONTINGENCY:		$19,194,126	

TABLE E-4
DISMANTLING COST ESTIMATE FOR MARTINS CREEK STEAM ELECTRIC STATION - UNIT 4
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
PERIOD 1											
Engineering Preparation											
1 Review plant dwgs & specs.					224	34	257				
2 Submit for license amendment					78	12	90				
3 End product description					49	7	56				
4 Define major work sequence					365	55	420				
5 Perform safety analysis					151	23	173				
6 Submit dismantling plan					25	4	29				
Total					**891**	**134**	**1025**				
Activity Specifications											
7 Plant & temporary facilities					239	36	275				
8 Plant systems					203	30	233				
9 Boiler Removal					316	47	364				
10 Reinforced concrete					78	12	90				
11 Turbine & condenser					39	6	45				
12 Plant structures & buildings					152	23	175				
13 Waste management					224	34	257				
14 Facility & site closeout					44	7	50				
Total					**1294**	**194**	**1489**				
Planning & Site Preparations											
15 Prepare dismantling sequence					117	18	134				
16 Plant prep. & temp. svces					1559	234	1793				
17 Rigging/CCEs/tooling/etc.					1320	198	1518				
Total					**2996**	**449**	**3446**				
Detailed Work Procedures											
18 Plant systems					230	35	265				
19 Remaining buildings					66	10	76				
20 Boiler					177	26	203				
21 Facility closeout					58	9	67				
22 Reinforced concrete					49	7	56				
23 Turbine & condensers					152	23	175				
Total					**731**	**110**	**841**				

TABLE E-4
DISMANTLING COST ESTIMATE FOR MARTINS CREEK STEAM ELECTRIC STATION - UNIT 4
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
24 Asbestos Removal Program											
Subtotal Period 1 Activity Costs					**5913**	**887**	**6800**				
Period 1 Undistributed Costs											
1 DOC staff relocation expenses											
2 Insurance					28	3	31				
3 Property taxes											
4 Heavy equipment rental	129					19	149				
5 Plant energy budget					42	6	48				
Subtotal Undistributed Costs Period 1	129				70	28	228				
Staff Costs											
DOC Staff Cost					236	35	271				
Utility Staff Cost					1106	166	1272				
TOTAL PERIOD 1 COST	**129**				**7325**	**1117**	**8571**				
PERIOD 2											
Disposal of Plant Systems											
25.1 Ash Disposal-Wet	167					25	193	157		2	4979
25.2 Aux Boiler Feedwater	16					2	18	12			460
25.3 Auxiliary Steam	37					6	42	60			1080
25.4 Blowdown	6					1	7	6			182
25.5 Boiler	2595					389	2984	21898	415	2	75719
25.6 Boiler Drains & Vents	29					4	33	316	0	24	836
25.7 Boiler Feed	31					5	36	202	20	20	904
25.8 Building Services	1					0	1	3			18
25.9 Chemical Addition	10					2	12	7			302
25.10 Chemical Cleaning	20					3	23	108		10	580
25.11 Chilled Water	33					5	38	39		0	957
25.12 Chimney Wash	5					1	5	10		1	131

TABLE E-4
DISMANTLING COST ESTIMATE FOR MARTINS CREEK STEAM ELECTRIC STATION - UNIT 4
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
25.13 Circulating Water	109					16	125	907	10	25	3207
25.14 Circulating Water Chlorination	7					1	8	8		0	207
25.15 Closed Cycle Cooling Water	70					10	80	103	12	3	2016
25.16 Combustion Air & Flue Gas	109					16	125	176	0	2	3115
25.17 Condensate	137					21	157	496	19	16	3912
25.18 Condenser Air Removal	13					2	15	22	1	0	365
25.19 Demineralized Water	35					5	40	71		0	1026
25.20 Electrical	1403					210	1613	1510		636	39036
25.21 Emerg Rail Unloading Fire Service	1					0	1	3	0		29
25.22 Emerg Rail Unloading Fuel Oil	27					4	31	218		25	776
25.23 Emerg Rail Unloading Instr Control Air	1					0	1	1	0		32
25.24 Emerg Rail Unloading Package Steam Blr	8					1	9	30	1	0	217
25.25 Extraction Steam	132					20	152	378	30		3965
25.26 Feedwater	108					16	125	324			3212
25.27 Filtered Water	21					3	24	33			600
25.28 Fire Service	22					3	25	128	0	0	631
25.29 Forced Draft Fan Air Preheating	34					5	39	201	5	10	961
25.30 Fuel Additives	19					3	22	11	0	0	560
25.31 Fuel Oil	112					17	129	289	5	3	3137
25.32 Fuel Oil Heating	43					6	49	48	6	0	1256
25.33 Fuel Unloading	5					1	6	37			153
25.34 Gland Sealing Steam	61					9	70	69			1798
25.35 Gland Sealing Water	9					1	11	6			271
25.36 HVAC	141					21	162	878		1	3763
25.37 Heater Drains & Vents	61					9	70	138	0	5	1783
25.38 Hydrogen\Nitrogen\Carbon Dioxide	7					1	8	4			209
25.39 Injection Water	9					1	11	7	0	1	275
25.40 Lube Oil	97					15	111	104	4	2	2789
25.41 Main & Reheat Steam	115					17	132	210			3429
25.42 Main\Reheat & Extraction Steam Drains	2					0	3	3	0		65
25.43 Miscellaneous Drains & Vents	133					20	152	126	0	0	3928
25.44 Potable Water	1					0	1	2			30
25.45 Process Ductwork	20					3	23	1			557
25.46 Raw Water	60					9	69	533	12	10	1733
25.47 Seal Oil	3					1	4	2			102
25.48 Soot Blowing	0					0	0	0			2

TABLE E-4
DISMANTLING COST ESTIMATE FOR MARTINS CREEK STEAM ELECTRIC STATION - UNIT 4
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
25.49 Station & Instrument Air	92					14	106	80			2742
25.50 Steam Generator	2					0	3	54			72
25.51 Sump Pumps Discharge	13					2	15	55		7	356
25.52 Turbine Bypass	22					3	25	30	0		649
25.53 Water & Steam Sampling	27					4	31	9	6	0	762
25 Totals	**6238**					**936**	**7174**	**30125**	**547**	**803**	**179872**
26 Erect scaffolding for systems removal	857					129	986				19349
Removal of Major Equipment											
27 Main Turbine/Generator	74					11	85	1773			2874
28 Main Condensers	57					9	66	337			2057
Demolition of Remaining Site Buildings											
29.1 Auxiliary Boiler Building	116					17	134	151			2612
29.2 Boiler Building	4355					653	5008	5239			99404
29.3 Diesel Generator Building	60					9	69	102			1410
29.4 Miscellaneous Yard Structures	1767					265	2033	1711			34806
29.5 Precipitator	755					113	868	1253			17915
29.6 Turbine Building	2057					309	2366	3397			46212
29.7 Turbine Pedestal	441					66	507				6282
29 Totals	**9551**					**1433**	**10984**	**11852**			**208641**
Subtotal Period 2 Activity Costs	16777					2517	19294	44087	547	803	412793
Period 2 Undistributed Costs											
1 DOC staff relocation expenses											
2 Insurance					79	8	87				
3 Property taxes											
4 Heavy equipment rental	3145					472	3616				
5 Small tool allowance	261					39	301				
6 Pipe cutting equipment	617					92	709				
7 Plant energy budget					75	11	86				
Subtotal Undistributed Costs Period 2	**4023**				**153**	**622**	**4799**				

TABLE E-4
DISMANTLING COST ESTIMATE FOR MARTINS CREEK STEAM ELECTRIC STATION - UNIT 4
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
Staff Costs											
DOC Staff Cost					2005	301	2305				
Utility Staff Cost					2475	371	2846				
TOTAL PERIOD 2	**20800**				**4633**	**3811**	**29244**	**44087**	**547**	**803**	**412793**
PERIOD 3											
Site Closeout Activities											
30 BackFill Site	601					90	691				1547
31 Grade & landscape site											
32 30 year Monitoring Program							a				
Note: An "a" Indicates those cost associated with activity have been accounted for with the undistributed costs.											
Subtotal Period 3 Activity Costs	**601**					**90**	**691**				**1547**
Period 3 Undistributed Costs											
1 Insurance					30	3	33				
2 Property taxes											
Subtotal Undistributed Costs Period 3					**30**	**3**	**33**				
Staff Costs											
DOC Staff Cost					20	3	23				
Utility Staff Cost					727	109	836				
TOTAL PERIOD 3	601				778	205	1584				1547
TOTAL COST TO DECOMMISSION	**21530**				**12736**	**5133**	**39399**	**44087**	**547**	**803**	**414339**

TABLE E-4
DISMANTLING COST ESTIMATE FOR MARTINS CREEK STEAM ELECTRIC STATION - UNIT 4
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
TOTAL COST TO DISMANTLE WITH 14.98% CONTINGENCY:							$39,398,881				
TOTAL SCRAP METAL REMOVED:					Carbon		44,087				
					St. Steel		547				
					Copper		803				
					Total		45,437 TONS				
SCRAP CREDIT					Carbon (at $100/ton)		$4,408,682				
					St. Steel (at $240/ton		$131,293				
					Copper (at $1100/ton		$883,723				
					Total		$5,423,699				
TOTAL COST LESS SCRAP CREDIT							$33,975,183				
TOTAL CRAFT LABOR REQUIREMENTS:							414,339 MAN-HOURS				
TOTAL CRAFT LABOR COST WITH 15% CONTINGENCY:							$15,892,578				

APPENDIX F

BRUNNER ISLAND STEAM ELECTRIC STATION

TABLE F-1
DISMANTLING COST ESTIMATE FOR BRUNNER ISLAND STEAM ELECTRIC STATION - UNIT 1
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
PERIOD 1											
Engineering Preparation											
1 Review plant dwgs & specs.					265	40	305				
2 Submit for license amendment					92	14	106				
3 End product description					58	9	66				
4 Define major work sequence					432	65	497				
5 Perform safety analysis					178	27	205				
6 Submit dismantling plan					30	4	34				
Total					**1055**	**158**	**1213**				
Activity Specifications											
7 Plant & temporary facilities					283	42	326				
8 Plant systems					240	36	276				
9 Boiler Removal					374	56	430				
10 Reinforced concrete					92	14	106				
11 Turbine & condenser					46	7	53				
12 Plant structures & buildings					180	27	207				
13 Waste management					265	40	305				
14 Facility & site closeout					52	8	60				
Total					**1532**	**230**	**1762**				
Planning & Site Preparations											
15 Prepare dismantling sequence					138	21	159				
16 Plant prep. & temp. svces					1559	234	1793				
17 Rigging/CCEs/tooling/etc.					1320	198	1518				
Total					**3018**	**453**	**3470**				
Detailed Work Procedures											
18 Plant systems					272	41	313				
19 Remaining buildings					78	12	89				
20 Boiler					209	31	240				
21 Facility closeout					69	10	79				
22 Reinforced concrete					58	9	66				
23 Turbine & condensers					180	27	207				
Total					**865**	**130**	**995**				

TABLE F-1
DISMANTLING COST ESTIMATE FOR BRUNNER ISLAND STEAM ELECTRIC STATION - UNIT 1
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
24 Asbestos Removal Program	12310	3520		922		3660	20412				388947
Subtotal Period 1 Activity Costs	**12310**	**3520**		**922**	**6469**	**4630**	**27852**				**388947**
Period 1 Undistributed Costs											
1 DOC staff relocation expenses											
2 Insurance					28	3	31				
3 Property taxes											
4 Heavy equipment rental	129					19	149				
5 Plant energy budget					38	6	44				
Subtotal Undistributed Costs Period 1	129				66	28	223				
Staff Costs											
DOC Staff Cost					455	68	523				
Utility Staff Cost					1106	166	1272				
TOTAL PERIOD 1 COST	**12439**	**3520**		**922**	**8097**	**4892**	**29870**				**388947**
PERIOD 2											
Disposal of Plant Systems											
25.1 Ash Disposal-Wet	105					16	121	129	0	0	3421
25.2 Boiler	1125					169	1293	11699	224	2	35957
25.3 Boiler Feed Suction	11					2	13	13			370
25.4 Building Services	1					0	1	3			18
25.5 Building Steam	25					4	28	16			804
25.6 Chemical Cleaning	25					4	29	21	0		809
25.7 Chemical Feed	14					2	16	8	0	0	436
25.8 Circulating Water	57					9	66	295			1891
25.9 Coal Handling	56					8	64	1576	0	2	1730
25.10 Cold Reheat	5					1	6	11			153
25.11 Combustion Air	17					2	19	20			541
25.12 Condensate	220					33	253	440	15	27	7022

TABLE F-1
DISMANTLING COST ESTIMATE FOR BRUNNER ISLAND STEAM ELECTRIC STATION - UNIT 1
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
25.13 Cooling Water	70					11	81	44			2244
25.14 Drainage: Vent & Priming	55					8	64	43			1782
25.15 Drip & Air Removal	120					18	138	155	1	1	3891
25.16 Dust Suppression	1					0	1	1	0	0	26
25.17 Electrical	1201					180	1381	1490		611	36707
25.18 Extraction Steam	82					12	94	80			2644
25.19 Feeder Air Supply	2					0	3	1			71
25.20 Feedwater	155					23	178	344	16	15	5018
25.21 Fluidizing Air	13					2	15	29		1	433
25.22 Flyash Disposal	741					111	853	859	17		22407
25.23 Fuel Oil	52					8	60	39	2	0	1650
25.24 Gland Steam Sealing	12					2	14	32	6	1	371
25.25 HVAC	70					11	81	517		0	2051
25.26 Hydrogen	3					0	4	2		0	96
25.27 Instrument Air	76					11	87	44	1		2420
25.28 Lube Oil	27					4	31	58	12	1	853
25.29 Main Steam	57					9	66	41	0	0	1863
25.30 PH Stabilization	57					9	65	32			1823
25.31 Potable Water	32					5	37	26	0		1019
25.32 Primary Water Treatment	127					19	146	135		1	4101
25.33 Process Ductwork	25					4	29	2			761
25.34 Raw Water	85					13	98	458	1	19	2708
25.35 Reheat Steam	29					4	34	69			951
25.36 River Cooling Water	108					16	124	182	10	3	3441
25.37 Service Water	327					49	376	387	9	2	10447
25.38 Soot Blowing	5					1	6	119	0	3	169
25.39 Station Air	62					9	71	44	1		1989
25.40 Steam Drains	21					3	25	32			699
25.41 Yard Fire Hydrants	13					2	15	9			435
25 Totals	**5290**					**793**	**6083**	**19503**	**318**	**689**	**166221**
26 Erect scaffolding for systems removal	460					69	529				11044
Removal of Major Equipment											
27 Main Turbine/Generator	30					4	34	822			1276
28 Main Condensers	79					12	91	512			3129

TABLE F-1
DISMANTLING COST ESTIMATE FOR BRUNNER ISLAND STEAM ELECTRIC STATION - UNIT 1
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
Domolition of Remaining Site Buildings											
29.1 Baghouse	146					22	168	129			4122
29.2 Boiler Building	1161					174	1335	2124			30069
29.3 Circ Water Intake	253					38	291				4646
29.4 Mill Room	1413					212	1625	684			22383
29.5 Miscellaneous Warehouses	295					44	339	209			4830
29.6 Precipitator	238					36	273	262			5886
29.7 Turbine	725					109	833	1116			16850
29.8 Turbine Pedestal	339					51	389				5730
29.9 Water Treatment Bldg	88					13	101	19			1823
29 Totals	**4657**					**698**	**5355**	**4542**			**96339**
Subtotal Period 2 Activity Costs	10515					1577	12093	25379	318	689	278009
Period 2 Undistributed Costs											
1 DOC staff relocation expenses											
2 Insurance					116	12	128				
3 Property taxes											
4 Heavy equipment rental	4625					694	5318				
5 Small tool allowance	389					58	447				
6 Pipe cutting equipment	617					92	709				
7 Plant energy budget					98	15	113				
Subtotal Undistributed Costs Period 2	**5630**				**215**	**871**	**6715**				
Staff Costs											
DOC Staff Cost					2964	445	3408				
Utility Staff Cost					3659	549	4207				
TOTAL PERIOD 2	**16145**				**6837**	**3441**	**26423**	**25379**	**318**	**689**	**278009**

TABLE F-1

DISMANTLING COST ESTIMATE FOR BRUNNER ISLAND STEAM ELECTRIC STATION - UNIT 1

(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
PERIOD 3											
Site Closeout Activities											
30 BackFill Site	252					38	290				654
31 Grade & landscape site	260					39	299				2040
32 30 year Monitoring Program							a				
Note: An "a" Indicates those cost associated with activity have been accounted for with the undistributed costs.											
Subtotal Period 3 Activity Costs	**512**					**77**	**589**				**2694**
Period 3 Undistributed Costs											
1 Insurance					30	3	33				
2 Property taxes											
Subtotal Undistributed Costs Period 3					**30**	**3**	**33**				
Staff Costs											
DOC Staff Cost					20	3	23				
Utility Staff Cost					727	109	836				
TOTAL PERIOD 3	512				778	192	1481				2694
TOTAL COST TO DECOMMISSION	**29096**	**3520**		**922**	**15711**	**8526**	**57775**	**25379**	**318**	**689**	**669650**

TABLE F-1
DISMANTLING COST ESTIMATE FOR BRUNNER ISLAND STEAM ELECTRIC STATION - UNIT 1
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
TOTAL COST TO DISMANTLE WITH 17.31% CONTINGENCY:							$57,774,888				
TOTAL SCRAP METAL REMOVED:					Carbon		25,379				
					St. Steel		318				
					Copper		689				
					Total		26,386 TONS				
SCRAP CREDIT					Carbon (at $100/ton)		$2,537,934				
					St. Steel (at $240/ton		$76,316				
					Copper (at $1100/ton		$757,938				
					Total		$3,372,188				
TOTAL COST LESS SCRAP CREDIT							$54,402,699				
TOTAL CRAFT LABOR REQUIREMENTS:							669,650 MAN-HOURS				
TOTAL CRAFT LABOR COST WITH 20.64% CONTINGENCY:							$24,780,464				

TABLE F-2
DISMANTLING COST ESTIMATE FOR BRUNNER ISLAND STEAM ELECTRIC STATION - UNIT 2
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
PERIOD 1											
Engineering Preparation											
1 Review plant dwgs & specs.					265	40	305				
2 Submit for license amendment					92	14	106				
3 End product description					58	9	66				
4 Define major work sequence					432	65	497				
5 Perform safety analysis					178	27	205				
6 Submit dismantling plan					30	4	34				
Total					**1055**	**158**	**1213**				
Activity Specifications											
7 Plant & temporary facilities					283	42	326				
8 Plant systems					240	36	276				
9 Boiler Removal					374	56	430				
10 Reinforced concrete					92	14	106				
11 Turbine & condenser					46	7	53				
12 Plant structures & buildings					180	27	207				
13 Waste management					265	40	305				
14 Facility & site closeout					52	8	60				
Total					**1532**	**230**	**1762**				
Planning & Site Preparations											
15 Prepare dismantling sequence					138	21	159				
16 Plant prep. & temp. svces					1559	234	1793				
17 Rigging/CCEs/tooling/etc.					1320	198	1518				
Total					**3018**	**453**	**3470**				
Detailed Work Procedures											
18 Plant systems					272	41	313				
19 Remaining buildings					78	12	89				
20 Boiler					209	31	240				
21 Facility closeout					69	10	79				
22 Reinforced concrete					58	9	66				
23 Turbine & condensers					180	27	207				
Total					**865**	**130**	**995**				

TABLE F-2
DISMANTLING COST ESTIMATE FOR BRUNNER ISLAND STEAM ELECTRIC STATION - UNIT 2
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
24 Asbestos Removal Program	12310	3520		922		3660	20412				388947
Subtotal Period 1 Activity Costs	**12310**	**3520**		**922**	**6469**	**4630**	**27852**				**388947**
Period 1 Undistributed Costs											
1 DOC staff relocation expenses											
2 Insurance					28	3	31				
3 Property taxes											
4 Heavy equipment rental	129					19	149				
5 Plant energy budget					38	6	43				
Subtotal Undistributed Costs Period 1	129				66	28	223				
Staff Costs											
DOC Staff Cost					556	83	639				
Utility Staff Cost					1106	166	1272				
TOTAL PERIOD 1 COST	**12439**	**3520**		**922**	**8197**	**4908**	**29986**				**388947**
PERIOD 2											
Disposal of Plant Systems											
25.1 Ash Disposal-Wet	108					16	124	131	0	0	3496
25.2 Boiler	1260					189	1449	16148	401	4	40240
25.3 Boiler Feed Suction	11					2	13	13			370
25.4 Building Services	1					0	1	3			18
25.5 Building Steam	25					4	28	16			804
25.6 Chemical Cleaning	25					4	29	21	. 0		809
25.7 Chemical Feed	13					2	15	8	0	0	408
25.8 Circulating Water	57					9	66	295			1891
25.9 Coal Handling	7					1	8	164		1	229
25.10 Cold Reheat	5					1	6	11			153
25.11 Combustion Air	17					2	19	20			541
25.12 Condensate	179					27	206	369	11	22	5820

TABLE F-2
DISMANTLING COST ESTIMATE FOR BRUNNER ISLAND STEAM ELECTRIC STATION - UNIT 2
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
25.13 Cooling Water	70					11	81	44			2244
25.14 Demineralizing Water	14					2	16	16	2	0	420
25.15 Drainage: Vent & Priming	55					8	64	43			1782
25.16 Drip & Air Removal	120					18	138	155	1	1	3891
25.17 Electrical	1201					180	1381	1490		611	36707
25.18 Extraction Steam	82					12	94	80			2644
25.19 Feeder Air Supply	2					0	3	1			71
25.20 Feedwater	155					23	178	344	16	15	5018
25.21 Fluidizing Air	14					2	16	29		1	470
25.22 Flyash Disposal	741					111	853	859	17		22407
25.23 Fuel Oil	41					6	47	28	1	0	1323
25.24 Gland Steam Sealing	12					2	14	32	6	1	371
25.25 HVAC	70					11	81	517		0	2046
25.26 Hydrogen	3					0	4	2		0	96
25.27 Instrument Air	75					11	87	43	1		2412
25.28 Lube Oil	24					4	27	54	12	1	744
25.29 Main Steam	57					9	66	41	0	0	1863
25.30 PH Stabilization	57					9	65	32			1823
25.31 Potable Water	31					5	35	23	0		982
25.32 Primary Water Treatment	121					18	139	123		0	3928
25.33 Process Ductwork	25					4	29	2			761
25.34 Raw Water	79					12	91	442	1	17	2523
25.35 Reheat Steam	29					4	34	69			951
25.36 River Cooling Water	105					16	121	177	10	3	3372
25.37 Service Water	286					43	329	384	5	6	9259
25.38 Soot Blowing	5					1	5	119	0	3	155
25.39 Station Air	62					9	71	44	1		1989
25.40 Steam Drains	21					3	25	32			697
25.41 Yard Fire Hydrants	13					2	15	9			436
25 Totals	**5280**					**792**	**6072**	**22433**	**486**	**687**	**166160**
26 Erect scaffolding for systems removal	340					51	391				8155
Removal of Major Equipment											
27 Main Turbine/Generator	30					4	34	822			1276
28 Main Condensers	93					14	107	597			3648

TABLE F-2
DISMANTLING COST ESTIMATE FOR BRUNNER ISLAND STEAM ELECTRIC STATION - UNIT 2
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
Demolition of Remaining Site Buildings											
29.1 Boiler	1228					184	1413	2317			31594
29.2 Coal Handling System	15					2	17	45			385
29.3 Mill Room	1428					214	1642	730			22692
29.4 Precipitator	266					40	306	310			6676
29.5 Turbine	779					117	896	1613			18723
29.6 Turbine Pedestal	338					51	389				5727
29 Totals	**4055**					**608**	**4663**	**5015**			**85796**
Subtotal Period 2 Activity Costs	9797					1470	11266	28866	486	687	265035
Period 2 Undistributed Costs											
1 DOC staff relocation expenses											
2 Insurance					107	11	118				
3 Property taxes											
4 Heavy equipment rental	4269					640	4910				
5 Small tool allowance	381					57	438				
6 Pipe cutting equipment	617					92	709				
7 Plant energy budget					89	13	103				
Subtotal Undistributed Costs Period 2	**5267**				**197**	**814**	**6278**				
Staff Costs											
DOC Staff Cost					2733	410	3144				
Utility Staff Cost					3374	506	3881				
TOTAL PERIOD 2	**15063**				**6305**	**3200**	**24568**	**28866**	**486**	**687**	**265035**

TABLE F-2

DISMANTLING COST ESTIMATE FOR BRUNNER ISLAND STEAM ELECTRIC STATION - UNIT 2

(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
PERIOD 3											
Site Closeout Activities											
30 BackFill Site	243					37	280				631
31 Grade & landscape site	260					39	299				2040
32 30 year Monitoring Program							a				
Note: An "a" Indicates those cost associated with activity have been accounted for with the undistributed costs.											
Subtotal Period 3 Activity Costs	503					75	579				2671
Period 3 Undistributed Costs											
1 Insurance					30	3	33				
2 Property taxes											
Subtotal Undistributed Costs Period 3					30	3	33				
Staff Costs											
DOC Staff Cost					20	3	23				
Utility Staff Cost					727	109	836				
TOTAL PERIOD 3	503				778	191	1472				2671
TOTAL COST TO DECOMMISSION	28006	3520		922	15280	8298	56025	28866	486	687	656654

TABLE F-2
DISMANTLING COST ESTIMATE FOR BRUNNER ISLAND STEAM ELECTRIC STATION - UNIT 2
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
TOTAL COST TO DISMANTLE WITH 17.39% CONTINGENCY:							$56,025,354				
TOTAL SCRAP METAL REMOVED:					Carbon		28,866				
					St. Steel		486				
					Copper		687				
					Total		30,039 TONS				
SCRAP CREDIT					Carbon (at $100/ton)		$2,886,618				
					St. Steel (at $240/ton		$116,709				
					Copper (at $1100/ton		$755,227				
					Total		$3,758,554				
TOTAL COST LESS SCRAP CREDIT							$52,266,800				
TOTAL CRAFT LABOR REQUIREMENTS:							656,654 MAN-HOURS				
TOTAL CRAFT LABOR COST WITH 20.75% CONTINGENCY:							$24,310,296				

TABLE F-3
DISMANTLING COST ESTIMATE FOR BRUNNER ISLAND STEAM ELECTRIC STATION - UNIT 3
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
PERIOD 1											
Engineering Preparation											
1 Review plant dwgs & specs.					265	40	305				
2 Submit for license amendment					92	14	106				
3 End product description					58	9	66				
4 Define major work sequence					432	65	497				
5 Perform safety analysis					178	27	205				
6 Submit dismantling plan					30	4	34				
Total					**1055**	**158**	**1213**				
Activity Specifications											
7 Plant & temporary facilities					283	42	326				
8 Plant systems					240	36	276				
9 Boiler Removal					374	56	430				
10 Reinforced concrete					92	14	106				
11 Turbine & condenser					46	7	53				
12 Plant structures & buildings					180	27	207				
13 Waste management					265	40	305				
14 Facility & site closeout					52	8	60				
Total					**1532**	**230**	**1762**				
Planning & Site Preparations											
15 Prepare dismantling sequence					138	21	159				
16 Plant prep. & temp. svces					1559	234	1793				
17 Rigging/CCEs/tooling/etc.					1320	198	1518				
Total					**3018**	**453**	**3470**				
Detailed Work Procedures											
18 Plant systems					272	41	313				
19 Remaining buildings					78	12	89				
20 Boiler					209	31	240				
21 Facility closeout					69	10	79				
22 Reinforced concrete					58	9	66				
23 Turbine & condensers					180	27	207				
Total					**865**	**130**	**995**				

TABLE F-3
DISMANTLING COST ESTIMATE FOR BRUNNER ISLAND STEAM ELECTRIC STATION - UNIT 3
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
24 Asbestos Removal Program	12310	3520		922		3660	20412				388947
Subtotal Period 1 Activity Costs	**12310**	**3520**		**922**	**6469**	**4630**	**27852**				**388947**
Period 1 Undistributed Costs											
1 DOC staff relocation expenses					28	3	31				
2 Insurance											
3 Property taxes	129					19	149				
4 Heavy equipment rental					42	6	49				
5 Plant energy budget											
Subtotal Undistributed Costs Period 1	129				70	29	228				
Staff Costs											
DOC Staff Cost					455	68	523				
Utility Staff Cost					1106	166	1272				
TOTAL PERIOD 1 COST	**12439**	**3520**		**922**	**8101**	**4893**	**29875**				**388947**
PERIOD 2											
Disposal of Plant Systems											
25.1 Air Preheat	48					7	55	112	6	1	1529
25.2 Ash Disposal-Wet	781					117	898	936	18	0	23697
25.3 Aux Boiler Feed	2					0	2	7			47
25.4 Auxiliary Steam	16					2	18	54	5	1	503
25.5 Auxiliary Systems Drains & Condensate	1					0	2	4			44
25.6 Boiler	1013					152	1165	12669	258	3	32539
25.7 Boiler Feed	134					20	154	303	34	10	4323
25.8 Building Services	1					0	1	3			18
25.9 Chemical Cleaning	2					0	3	5	0	0	75
25.10 Chemical Feed	17					2	19	13	1	0	498
25.11 Chlorine	2					0	3	1			74
25.12 Circulating & Cooling Water	252					38	290	1013	3	53	8151

TABLE F-3
DISMANTLING COST ESTIMATE FOR BRUNNER ISLAND STEAM ELECTRIC STATION - UNIT 3
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
25.13 Circulating Water Chemical Treatment	44					7	50	64	4	1	1296
25.14 Coal Handling	145					22	166	2334	0	2	4789
25.15 Coal Yard Spray Oil	1					0	1	1			17
25.16 Condensate	195					29	225	391	9	13	6088
25.17 Drainage-Venting & Priming	6					1	7	32	0	0	195
25.18 Electrical	2058					309	2367	1708		890	62989
25.19 Extraction Steam	80					12	92	264			2608
25.20 Fire Protection	61					9	70	54	5		1828
25.21 Fuel Additives	1					0	1	2			18
25.22 Fuel Oil	127					19	147	135	16	1	3782
25.23 Gas Sampling	0					0	0	0			5
25.24 HVAC	85					13	98	169		0	2734
25.25 Hydrogen-Nitrogen-Carbon Dioxide	15					2	17	7	2		460
25.26 Instrument Air	50					8	58	24	2	2	1528
25.27 Leachite Run-off	11					2	13	84			354
25.28 Lube Oil	38					6	43	76	16	2	1156
25.29 Main Steam	115					17	133	358	59	10	3851
25.30 Main\Reheat\Extraction Steam Drains	73					11	84	57			2371
25.31 River Cooling Water	134					20	154	405	4	1	4192
25.32 Service Water	105					16	121	244	7	14	3179
25.33 Soot Blowing	27					4	31	108		4	908
25.34 Start-up Steam	34					5	39	44			1109
25.35 Station Air	37					6	43	54	1		1181
25.36 Sulfur Feed-Flyash Cond	36					5	41	187	1	0	1068
25.37 Vacuum Cleaning	42					6	48	28	0	0	1374
25.38 Waste Oil	0					0	0	1			9
25 Totals	**5789**					**868**	**6657**	**21949**	**453**	**1008**	**180585**
26 Erect scaffolding for systems removal	510					77	587				12249
Removal of Major Equipment											
27 Main Turbine/Generator	63					9	72	1673			2711
28 Main Condensers	82					12	95	531			3246

TABLE F-3
DISMANTLING COST ESTIMATE FOR BRUNNER ISLAND STEAM ELECTRIC STATION - UNIT 3
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
Demolition of Remaining Site Buildings											
29.1 Boiler	2293					344	2637	4275			56627
29.2 Chimney	1020					153	1173	1			13350
29.3 Coal Handling & Hydrogen Bottle Shelter	4					1	4	2			70
29.4 Coal Sample Storage Building	3					0	4	1			77
29.5 Coal Silos	73					11	84	258			1852
29.6 Crusher House	769					115	885	1540			19488
29.7 Intake Structure	224					34	258	3			3210
29.8 Mill Room	1340					201	1541	1471			26854
29.9 Miscellaneous Warehouses	203					30	233	124			3350
29.10 Miscellaneous Yard Fixtures	3053					458	3511	2750			35974
29.11 Miscellaneous Yard Structures	391					59	449	253			6435
29.12 Precipitator	997					150	1147	1767			26755
29.13 Railroad Car Dumper	23					3	26	30			972
29.14 Reclaim Hopper & Tunnel	67					10	77	2			1132
29.15 Thaw Shed	101					15	116	40			2090
29.16 Transfer & Emergency Towers	78					12	90	70			1952
29.17 Turbine	1701					255	1957	2227			35010
29.18 Turbine Pedestal	761					114	875				11458
29.19 Water Treatment	88					13	101	19			1823
29 Totals	**13191**					**1979**	**15170**	**14832**			**248480**
Subtotal Period 2 Activity Costs	19635					2945	22581	38985	453	1008	447272
Period 2 Undistributed Costs											
1 DOC staff relocation expenses											
2 Insurance					61	6	68				
3 Property taxes											
4 Heavy equipment rental	2471					371	2842				
5 Small tool allowance	488					73	562				
6 Pipe cutting equipment	617					92	709				
7 Plant energy budget					59	9	68				
Subtotal Undistributed Costs Period 2	**3576**				**121**	**551**	**4248**				

TABLE F-3
DISMANTLING COST ESTIMATE FOR BRUNNER ISLAND STEAM ELECTRIC STATION - UNIT 3
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
Staff Costs											
DOC Staff Cost					2845	427	3272				
Utility Staff Cost					3512	527	4039				
TOTAL PERIOD 2	**23212**				**6478**	**4450**	**34140**	**38985**	**453**	**1008**	**447272**
PERIOD 3											
Site Closeout Activities											
30 BackFill Site	1147					172	1319				2976
31 Grade & landscape site	260					39	299				2040
32 30 year Monitoring Program							a				
Note: An "a" Indicates those cost associated with activity have been accounted for with the undistributed costs.											
Subtotal Period 3 Activity Costs	**1407**					**211**	**1618**				**5016**
Period 3 Undistributed Costs											
1 Insurance					33	3	36				
2 Property taxes											
Subtotal Undistributed Costs Period 3					**33**	**3**	**36**				
Staff Costs											
DOC Staff Cost					20	3	23				
Utility Staff Cost					727	109	836				
TOTAL PERIOD 3	1407				780	326	2514				5016
TOTAL COST TO DECOMMISSION	**37058**	**3520**		**922**	**15359**	**9670**	**66528**	**38985**	**453**	**1008**	**841235**

TABLE G-2
DISMANTLING COST ESTIMATE FOR MONTOUR STEAM ELECTRIC STATION - UNIT 2
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
25.13 Circulating Water Chemical Treatment	42					6	48	64	4	1	1296
25.14 Coal Handling	6					1	7	119		1	213
25.15 Coal Yard Spray Oil	1					0	1	1			17
25.16 Condensate	185					28	212	391	9	13	6088
25.17 Drainage-Venting & Priming	6					1	7	32	0	0	195
25.18 Electrical	1952					293	2245	1708		890	62989
25.19 Extraction Steam	74					11	85	264			2608
25.20 Fire Protection	58					9	67	55	5		1836
25.21 Fuel Additives	1					0	1	2			18
25.22 Fuel Oil	122					18	141	135	16	1	3782
25.23 Gas Sampling	0					0	0	0			5
25.24 HVAC	80					12	92	169		0	2734
25.25 Hydrogen-Nitrogen-Carbon Dioxide	14					2	16	7	2		460
25.26 Instrument Air	47					7	54	24	2	2	1528
25.27 Lube Oil	36					5	41	76	16	2	1156
25.28 Main Steam	109					16	126	358	59	10	3851
25.29 Main\Reheat\Extraction Steam Drains	68					10	78	57			2371
25.30 River Cooling Water	70					10	80	146			2447
25.31 Seal Oil	1					0	1	0		0	19
25.32 Service Water	101					15	116	244	7	14	3179
25.33 Soot Blowing	26					4	29	108		4	908
25.34 Start-up Steam	32					5	36	44			1109
25.35 Station Air	34					5	40	54	1		1181
25.36 Sulfur Feed-Flyash Cond	34					5	39	187	1	0	1068
25.37 Vacuum Cleaning	39					6	45	28	0	0	1374
25.38 Waste Oil	0					0	0	1			9
25 Totals	**5240**					**786**	**6026**	**19021**	**448**	**1007**	**173296**
26 Erect scaffolding for systems removal	1106					166	1272				28467
Removal of Major Equipment											
27 Main Turbine/Generator	61					9	70	1667			2701
28 Main Condensers	98					15	113	655			4001

TABLE G-2
DISMANTLING COST ESTIMATE FOR MONTOUR STEAM ELECTRIC STATION - UNIT 2
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
Demolition of Remaining Site Buildings											
29.1 Ash Landfill	12408					1861	14269				
29.2 Auxiliary Equip & Switchgear Bldg	74					11	85	30			1651
29.3 Boiler Building	2972					446	3418	4998			77120
29.4 Car Indexer-Coal Handling	386					58	444	54			8614
29.5 Control Building-Coal Handling	18					3	20	5			238
29.6 Cooling Tower	1909					286	2195	838			31159
29.7 Crusher House-Coal Handling	165					25	189	39			3489
29.8 Miscellaneous Site Structures	5278					792	6070	5429			110681
29.9 Precipitator Area	571					86	657	1112			15631
29.10 Service Building	621					93	714	619			15016
29.11 Service Water Pumphouse	25					4	29	5			524
29.12 Turbine Building	1878					282	2160	2806			45597
29.13 Turbine Parts Cleaning Building	29					4	33	15			552
29.14 Turbine Pedestal	859					129	988				13034
29.15 Waste Oil Storage Facility	15					2	17				185
29.16 Water Treatment	89					13	103	29			1734
29.17 Yard Service & Maintenance Bldg	57					9	66	31			982
29.18 Yard Service Building-Coal Handling	86					13	99	57			1710
29 Totals	**27439**					**4116**	**31555**	**16069**			**327915**
Subtotal Period 2 Activity Costs	33944					5092	39036	37411	448	1007	536380
Period 2 Undistributed Costs											
1 DOC staff relocation expenses											
2 Insurance					112	11	123				
3 Property taxes											
4 Heavy equipment rental	4446					667	5113				
5 Small tool allowance	514					77	591				
6 Pipe cutting equipment	617					92	709				
7 Plant energy budget					173	26	199				
Subtotal Undistributed Costs Period 2	**5576**				**285**	**874**	**6735**				

TABLE G-2
DISMANTLING COST ESTIMATE FOR MONTOUR STEAM ELECTRIC STATION - UNIT 2
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
Staff Costs											
DOC Staff Cost					2845	427	3272				
Utility Staff Cost					3512	527	4039				
TOTAL PERIOD 2	**39521**				**6642**	**6919**	**53082**	**37411**	**448**	**1007**	**536380**
PERIOD 3											
Site Closeout Activities											
30 BackFill Site	32					5	36				161
31 Grade & landscape site	1805					271	2076				17795
32 30 year Monitoring Program							a				
Note: An "a" Indicates those cost associated with activity have been accounted for with the undistributed costs.											
Subtotal Period 3 Activity Costs	**1837**					**275**	**2112**				**17956**
Period 3 Undistributed Costs											
1 Insurance					33	3	36				
2 Property taxes											
Subtotal Undistributed Costs Period 3					**33**	**3**	**36**				
Staff Costs											
DOC Staff Cost					20	3	23				
Utility Staff Cost					727	109	836				
TOTAL PERIOD 3	1837				780	391	3008				17956
TOTAL COST TO DECOMMISSION	**52968**	**3495**		**922**	**15584**	**12002**	**84972**	**37411**	**448**	**1007**	**943283**

TABLE G-2
DISMANTLING COST ESTIMATE FOR MONTOUR STEAM ELECTRIC STATION - UNIT 2
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
TOTAL COST TO DISMANTLE WITH 16.45% CONTINGENCY:							$84,971,956				
TOTAL SCRAP METAL REMOVED:											
Carbon							37,411				
St. Steel							448				
Copper							1,007				
Total							38,866 TONS				
SCRAP CREDIT											
Carbon (at $100/ton)							$3,741,140				
St. Steel (at $240/ton							$107,596				
Copper (at $1100/ton							$1,107,377				
Total							$4,956,113				
TOTAL COST LESS SCRAP CREDIT							$80,015,843				
TOTAL CRAFT LABOR REQUIREMENTS:							943,283 MAN-HOURS				
TOTAL CRAFT LABOR COST WITH 18.96% CONTINGENCY:							$32,325,472				

TABLE F-3
DISMANTLING COST ESTIMATE FOR BRUNNER ISLAND STEAM ELECTRIC STATION - UNIT 3
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
TOTAL COST TO DISMANTLE WITH 17.01% CONTINGENCY:							$66,528,415				
TOTAL SCRAP METAL REMOVED:											
					Carbon		38,985				
					St. Steel		453				
					Copper		1,008				
					Total		40,445 TONS				
SCRAP CREDIT											
					Carbon (at $100/ton)		$3,898,482				
					St. Steel (at $240/ton		$108,648				
					Copper (at $1100/ton		$1,108,741				
					Total		$5,115,871				
TOTAL COST LESS SCRAP CREDIT							$61,412,544				
TOTAL CRAFT LABOR REQUIREMENTS:							841,235 MAN-HOURS				
TOTAL CRAFT LABOR COST WITH 19.48% CONTINGENCY:							$30,857,222				

APPENDIX G

MONTOUR STEAM ELECTRIC STATION

TABLE G-1
DISMANTLING COST ESTIMATE FOR MONTOUR STEAM ELECTRIC STATION - UNIT 1
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
PERIOD 1											
Engineering Preparation											
1 Review plant dwgs & specs.					267	40	308				
2 Submit for license amendment					93	14	107				
3 End product description					58	9	67				
4 Define major work sequence					436	65	501				
5 Perform safety analysis					180	27	207				
6 Submit dismantling plan					30	5	35				
Total					**1065**	**160**	**1225**				
Activity Specifications											
7 Plant & temporary facilities					286	43	329				
8 Plant systems					242	36	279				
9 Boiler Removal					378	57	435				
10 Reinforced concrete					93	14	107				
11 Turbine & condenser					47	7	53				
12 Plant structures & buildings					181	27	209				
13 Waste management					267	40	308				
14 Facility & site closeout					52	8	60				
Total					**1547**	**232**	**1779**				
Planning & Site Preparations											
15 Prepare dismantling sequence					140	21	160				
16 Plant prep. & temp. svces					1559	234	1793				
17 Rigging/CCEs/tooling/etc.					1320	198	1518				
Total					**3019**	**453**	**3472**				
Detailed Work Procedures											
18 Plant systems					275	41	316				
19 Remaining buildings					78	12	90				
20 Boiler					211	32	243				
21 Facility closeout					70	10	80				
22 Reinforced concrete					58	9	67				
23 Turbine & condensers					181	27	209				
Total					**874**	**131**	**1005**				

TABLE G-1
DISMANTLING COST ESTIMATE FOR MONTOUR STEAM ELECTRIC STATION - UNIT 1
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
24 Asbestos Removal Program	11482	3495		922		3451	19350				388947
Subtotal Period 1 Activity Costs	**11482**	**3495**		**922**	**6505**	**4426**	**26831**				**388947**
Period 1 Undistributed Costs											
1 DOC staff relocation expenses											
2 Insurance					28	3	31				
3 Property taxes											
4 Heavy equipment rental	129					19	149				
5 Plant energy budget					43	6	50				
Subtotal Undistributed Costs Period 1	129				71	29	229				
Staff Costs											
DOC Staff Cost					404	61	465				
Utility Staff Cost					1106	166	1272				
TOTAL PERIOD 1 COST	**11611**	**3495**		**922**	**8087**	**4682**	**28797**				**388947**
PERIOD 2											
Disposal of Plant Systems											
25.1 Air Preheat	45					7	51	112	6	1	1529
25.2 Ash Disposal-Wet	746					112	858	936	18	0	23697
25.3 Aux Boiler Feed	1					0	2	7			47
25.4 Auxiliary Steam	15					2	17	54	5	1	503
25.5 Auxiliary Systems Drains & Condensate	1					0	2	4			44
25.6 Boiler	913					137	1050	12298	258	3	31897
25.7 Boiler Feed	126					19	144	303	34	10	4323
25.8 Building Services	1					0	1	3			18
25.9 Chemical Cleaning	2					0	3	5	0	0	75
25.10 Chemical Feed	16					2	18	13	1	0	498
25.11 Chlorine	2					0	2	1			74
25.12 Circulating & Cooling Water	235					35	271	1013	3	53	8151

TABLE G-1
DISMANTLING COST ESTIMATE FOR MONTOUR STEAM ELECTRIC STATION - UNIT 1
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
25.13 Circulating Water Chemical Treatment	42					6	48	64	4	1	1296
25.14 Coal Handling	298					45	343	2863	17	4	9860
25.15 Coal Yard Spray Oil	1					0	1	1			17
25.16 Condensate	185					28	212	391	9	13	6088
25.17 Drainage-Venting & Priming	6					1	7	32	0	0	195
25.18 Electrical	1952					293	2245	1708		890	62989
25.19 Extraction Steam	74					11	85	264			2608
25.20 Fire Protection	58					9	67	54	5		1828
25.21 Fuel Additives	1					0	1	2			18
25.22 Fuel Oil	122					18	141	135	16	1	3782
25.23 Gas Sampling	0					0	0	0			5
25.24 HVAC	80					12	92	169		0	2734
25.25 Hydrogen-Nitrogen-Carbon Dioxide	14					2	16	7	2		460
25.26 Instrument Air	47					7	54	24	2	2	1528
25.27 Leachite Run-off	10					2	12	84			354
25.28 Lube Oil	36					5	41	76	16	2	1156
25.29 Main Steam	109					16	126	358	59	10	3851
25.30 Main\Reheat\Extraction Steam Drains	68					10	78	57			2371
25.31 River Cooling Water	126					19	145	405	4	1	4192
25.32 Service Water	101					15	116	244	7	14	3179
25.33 Soot Blowing	26					4	29	108		4	908
25.34 Start-up Steam	32					5	36	44			1109
25.35 Station Air	34					5	40	54	1		1181
25.36 Sulfur Feed-Flyash Cond	34					5	39	187	1	0	1068
25.37 Vacuum Cleaning	39					6	45	28	0	0	1374
25.38 Waste Oil	0					0	0	1			9
25 Totals	**5597**					**840**	**6437**	**22107**	**470**	**1010**	**185015**
26 Erect scaffolding for systems removal	864					130	994				22245
Removal of Major Equipment											
27 Main Turbine/Generator	61					9	70	1667			2701
28 Main Condensers	98					15	113	655			4001

TABLE G-1
DISMANTLING COST ESTIMATE FOR MONTOUR STEAM ELECTRIC STATION - UNIT 1
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
Demolition of Remaining Site Buildings											
29.1 Boiler Building	2972					446	3418	4998			77120
29.2 Chimney	994					149	1143	1			13350
29.3 Coal Silos	70					11	81	258			1852
29.4 Cooling Tower	1912					287	2199	843			31284
29.5 Precipitator Area	571					86	657	1112			15631
29.6 Turbine Building	1848					277	2126	2791			44906
29.7 Turbine Pedestal	793					119	912				12012
29 Totals	**9161**					**1374**	**10535**	**10003**			**196156**
Subtotal Period 2 Activity Costs	15781					2367	18149	34432	470	1010	410118
Period 2 Undistributed Costs											
1 DOC staff relocation expenses											
2 Insurance					62	6	68				
3 Property taxes											
4 Heavy equipment rental	2499					375	2874				
5 Small tool allowance	444					67	510				
6 Pipe cutting equipment	617					92	709				
7 Plant energy budget					62	9	71				
Subtotal Undistributed Costs Period 2	**3559**				**124**	**549**	**4232**				
Staff Costs											
DOC Staff Cost					1583	237	1820				
Utility Staff Cost					1954	293	2247				
TOTAL PERIOD 2	**19341**				**3661**	**3447**	**26449**	**34432**	**470**	**1010**	**410118**

TABLE G-1
DISMANTLING COST ESTIMATE FOR MONTOUR STEAM ELECTRIC STATION - UNIT 1
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
PERIOD 3											
Site Closeout Activities											
30 BackFill Site	281					42	323				733
31 Grade & landscape site	1805					271	2076				17795
32 30 year Monitoring Program							a				
Note: An "a" Indicates those cost associated with activity have been accounted for with the undistributed costs.											
Subtotal Period 3 Activity Costs	**2086**					**313**	**2399**				**18528**
Period 3 Undistributed Costs											
1 Insurance					33	3	36				
2 Property taxes											
Subtotal Undistributed Costs Period 3					**33**	**3**	**36**				
Staff Costs											
DOC Staff Cost					20	3	23				
Utility Staff Cost					727	109	836				
TOTAL PERIOD 3	2086				780	428	3294				18528
TOTAL COST TO DECOMMISSION	**33038**	**3495**		**922**	**12528**	**8557**	**58540**	**34432**	**470**	**1010**	**817593**

TABLE G-1
DISMANTLING COST ESTIMATE FOR MONTOUR STEAM ELECTRIC STATION - UNIT 1
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
TOTAL COST TO DISMANTLE WITH 17.12% CONTINGENCY:							$58,540,159				
TOTAL SCRAP METAL REMOVED:											
					Carbon		34,432				
					St. Steel		470				
					Copper		1,010				
					Total		35,911 TONS				
SCRAP CREDIT											
					Carbon (at $100/ton)		$3,443,185				
					St. Steel (at $240/ton		$112,773				
					Copper (at $1100/ton		$1,110,666				
					Total		$4,666,624				
TOTAL COST LESS SCRAP CREDIT							$53,873,536				
TOTAL CRAFT LABOR REQUIREMENTS:							817,593 MAN-HOURS				
TOTAL CRAFT LABOR COST WITH 19.59% CONTINGENCY:							$28,050,688				

TABLE G-2
DISMANTLING COST ESTIMATE FOR MONTOUR STEAM ELECTRIC STATION - UNIT 2
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
PERIOD 1											
Engineering Preparation											
1 Review plant dwgs & specs.					267	40	308				
2 Submit for license amendment					93	14	107				
3 End product description					58	9	67				
4 Define major work sequence					436	65	501				
5 Perform safety analysis					180	27	207				
6 Submit dismantling plan					30	5	35				
Total					**1065**	**160**	**1225**				
Activity Specifications											
7 Plant & temporary facilities					286	43	329				
8 Plant systems					242	36	279				
9 Boiler Removal					378	57	435				
10 Reinforced concrete					93	14	107				
11 Turbine & condenser					47	7	53				
12 Plant structures & buildings					181	27	209				
13 Waste management					267	40	308				
14 Facility & site closeout					52	8	60				
Total					**1547**	**232**	**1779**				
Planning & Site Preparations											
15 Prepare dismantling sequence					140	21	160				
16 Plant prep. & temp. svces					1559	234	1793				
17 Rigging/CCEs/tooling/etc.					1320	198	1518				
Total					**3019**	**453**	**3472**				
Detailed Work Procedures											
18 Plant systems					275	41	316				
19 Remaining buildings					78	12	90				
20 Boiler					211	32	243				
21 Facility closeout					70	10	80				
22 Reinforced concrete					58	9	67				
23 Turbine & condensers					181	27	209				
Total					**874**	**131**	**1005**				

TABLE G-2
DISMANTLING COST ESTIMATE FOR MONTOUR STEAM ELECTRIC STATION - UNIT 2
(Thousands of 1994 Dollars)

Activity	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	Carbon Ton	St. Steel Ton	Copper Ton	M-Hrs
24 Asbestos Removal Program	11482	3495		922		3451	19350				388947
Subtotal Period 1 Activity Costs	**11482**	**3495**		**922**	**6505**	**4426**	**26831**				**388947**
Period 1 Undistributed Costs											
1 DOC staff relocation expenses											
2 Insurance					28	3	31				
3 Property taxes											
4 Heavy equipment rental	129					19	149				
5 Plant energy budget					67	10	77				
Subtotal Undistributed Costs Period 1	129				95	32	257				
Staff Costs											
DOC Staff Cost					455	68	523				
Utility Staff Cost					1106	166	1272				
TOTAL PERIOD 1 COST	**11611**	**3495**		**922**	**8161**	**4693**	**28883**				**388947**
PERIOD 2											
Disposal of Plant Systems											
25.1 Air Preheat	45					7	51	112	6	1	1529
25.2 Ash Disposal-Wet	746					112	858	936	18	0	23697
25.3 Aux Boiler Feed	1					0	2	7			47
25.4 Auxiliary Steam	15					2	17	54	5	1	503
25.5 Auxiliary Systems Drains & Condensate	1					0	2	4			44
25.6 Boiler	913					137	1050	12298	258	3	31897
25.7 Boiler Feed	126					19	144	303	34	10	4323
25.8 Building Services	1					0	1	3			18
25.9 Chemical Cleaning	2					0	3	5	0	0	75
25.10 Chemical Feed	16					2	18	13	1	0	498
25.11 Chlorine	2					0	2	1			74
25.12 Circulating & Cooling Water	235					35	271	1013	3	53	8151

DECOMMISSIONING COST STUDY

for the

SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1&2

Prepared for the

PENNSYLVANIA POWER & LIGHT COMPANY

December 1993

prepared by

TLG Engineering, Inc.
for
TLG Services, Inc.

Bridgewater, Connecticut

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APPENDICES

REVISION LOG

Rev.	Date	Description	Approval
0	12-23-93	Original Issue	WAC

EXECUTIVE SUMMARY

Site-specific cost estimates were performed for decommissioning the Susquehanna Steam Electric Station (Susquehanna SES) by TLG Engineering, Inc., of Bridgewater, Connecticut (TLG). This study, prepared for Pennsylvania Power & Light Company (PP&L), considered the DECON and SAFSTOR decommissioning options. Total DECON costs for decommissioning Susquehanna SES are anticipated to be $350,524,416 and $453,735,072 for Unit 1 and Unit 2, respectively (in 1993 dollars). For the SAFSTOR alternative, with deferred decommissioning to be completed within 60 years, the costs are projected at $408,560,640 and $632,395,840 for Unit 1 and Unit 2, respectively.

This study provides costs estimates for decommissioning Susquehanna SES under current requirements and are based upon present-day technology. Using plant drawings and inventory documents, TLG estimated quantities and volumes of the equipment and material to be removed during decommissioning. Unit cost factors are then applied to the volumes and quantities to estimate the "activity dependent" costs. The period dependent costs are then determined from a detailed critical path schedule which is based on the removal activity durations.

This study includes the following considerations:

This study assumes that, with the exception of the last fuel cycle, the spent fuel generated over the operating life of the two nuclear units will have been transferred off-site to a Department of Energy (DOE) facility before shutdown. The final core discharges would need to be stored on-site for approximately five years for cooling prior to DOE taking receipt (based upon DOE's current transportation criteria). With the older fuel having been removed from the pools, this study assumes that the Unit 1 fuel can be discharged to the Unit 2 pool, enabling decommissioning activities to proceed in the Unit 1 Reactor Building immediately after defueling. Deferred decommissioning, in the SAFSTOR scenario, is assumed to commence such that the termination of the site licenses is accomplished within 60 years of final shutdown.

Burial of low-level radioactive wastes is assumed to be at a regional site within the Appalachian Compact. Disposal costs are based on rates seen at the currently operating low-level radioactive waste disposal site at Barnwell, S.C. Volume reduction and recycling of low-level radioactive waste are performed to reduce burial costs. 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 is 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, uses 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 Susquehanna Steam Electric Station (Susquehanna SES) is located in Salem Township, Luzerne County, Pennsylvania approximately 20 miles southwest of Wilkes-Barre. The twin nuclear units are located on the west side of the Main Branch of the Susquehanna River. The Susquehanna facility is jointly owned by Pennsylvania Power & Light Co. (90%), and Allegheny Electric Cooperative (10%). For purposes of this study, however, only the undivided decommissioning costs (100%) are presented, since the division of ownership has no effect on the total estimated costs.

This study provides estimates associated with decommissioning the two nuclear units at Susquehanna SES, following the conclusion of their operation: cost; schedule; waste generation/disposition; and radiation exposure. The study considers the decommissioning methods of DECON and SAFSTOR .

DECON of a power reactor consists of 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 and NUREG 5512 and other applicable release limits shortly after the cessation of plant operations. A possession-only license is obtained following final shutdown of Unit 2 and removal of all fuel from the reactor. The facility operator may then have unrestricted use of the site with no requirement for an NRC license. DECON is described in the rule on decommissioning issued by the Nuclear Regulatory Commission (NRC), "General Requirements for Decommissioning Nuclear Facilities." In this study, the site is further 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.) 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 obligation and liability for continuing maintenance of the property.

SAFSTOR consists of placing and maintaining the facility in protective storage once the 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 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 a potential savings in the cost for disposal of the waste volume generated during decommissioning operations.

While the disposal cost of spent fuel assemblies generated during plant operations 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, as a minimum, the Unit 2 spent fuel storage pool will be active for approximately five and one-half years following final plant shutdown. This duration coincides with the minimum cooling requirements identified by the Department of Energy (DOE) for transfer of the spent fuel assemblies to a federal facility. The final core discharge from Unit 1 is assumed to be transferred to the Unit 2 pool, allowing decommissioning activities to proceed at the first unit shortly after the cessation of operations.

This study provides cost estimates for decommissioning Susquehanna SES 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 Susquehanna SES 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

SUSQUEHANNA STEAM ELECTRIC STATION
COST AND SCHEDULE ESTIMATE SUMMARY

	Cost, 93$ (thousands)	**Schedule** (months)
DECON		
Unit 1	350,524	126.79
Unit 2	453,735	103.0
Total	804,259	127.6
SAFSTOR		
Unit 1		
Preparations	20,412	12.0
55 year maintenance cost	64,727	652.6
Delayed dismantling	323,422	121.4
Subtotal Unit 1	408,561	786.0
Unit 2		
Preparations	29,041	12.0
55 year maintenance cost	212,819	653.0
Delayed dismantling	390,536	75.4
Subtotal Unit 2	632,396	740.4
TOTAL	**1,040,957**	**761.1**

2. INTRODUCTION

This analysis is designed to provide PP&L with the information needed to prepare financial planning documents required by the U.S. Nuclear Regulatory Commission. 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 Susquehanna SES. 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 Susquehanna SES including all supporting facilities.

2.2 SCOPE OF STUDY

The scope of this study encompasses the entire Susquehanna SES including all structures, equipment and components.

Joint Ownership of Facility

The Susquehanna SES is jointly owned by Pennsylvania Power & Light Co. (90% share) and Allegheny Electric Cooperative (10% share). However, for purposes of this study, only the undivided (100%) plant decommissioning costs are presented, since the division of ownership has no effect on the estimate.

2.3 FINAL SHUTDOWN DATES

The construction permits for the two Susquehanna SES nuclear units were issued in 1973.

The Unit 1 operating license was issued on July 17, 1982, and expires at the end of 40 years on July 16, 2022.

The Unit 2 operating license was issued on March 23, 1984, and expires at the end of 40 years on March 22, 2024. For purposes of this study, final shutdown of each of the two units is assumed to occur on the expiration date of each unit's operating license.

2.4 SITE DESCRIPTION

The Susquehanna SES site is in the Salem Township, Luzerne County, Pennsylvania approximately 20 miles southwest of Wilkes-Barre. The plant is located on the west side of the Main Branch of the Susquehanna River.

The station is comprised of two units which have a common control room, diesel generators and refueling floor, turbine operating deck, radwaste system, and other auxiliary systems. The Nuclear Steam Supply System (NSSS) for each unit consists of a single cycle General Electric boiling water reactor, producing steam for direct use in the steam turbine. The supporting facilities were engineered and constructed by Bechtel Power Corporation.

The reactor vessel and the recirculation piping system are contained within the drywell of a primary containment structure housed within the Reactor Building. The pressure suppression system consists of a drywell, a pressure suppression chamber storing a large volume of water, and a connecting vent system between the drywell and water pool, isolation valves, containment cooling systems, and other service equipment. The Reactor Building encloses the primary containment system thereby providing a secondary containment.

The reactor operates at a rated power level of 3293 Megawatts thermal (MWt). Gross electrical power output of the turbine-generator is 1085 Megawatts electric (MWe). A planned power uprate will increase the electrical output of each unit by approximately 50 MWe. Heat produced in the reactor is converted to electrical energy by the Power Conversion System. A turbine-generator system converts the thermal energy of steam produced by the reactor into mechanical shaft power and then into electrical energy. The turbine consists of a double flow high pressure cylinder and three double flow low pressure cylinders all aligned in tandem. The generator is a direct driven 1800 rpm hydrogen-cooled, synchronous generator. The turbine is operated in a closed feedwater cycle which condenses the steam; the heated feedwater is returned to the reactor. Heat rejected in the main condensers is removed by the Circulating Water System (CWS), and discharged to the atmosphere through natural draft cooling towers.

2.5 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 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 is restricted in overall duration to 60 years and therefore impractical for use at a Part 50 licensee which generates significant amounts of long-lived radioactive material due to neutron activation. ENTOMB as such cannot demonstrate that such items as the vessel and internals will decay to unrestricted release levels within this time frame.

3. DECOMMISSIONING ALTERNATIVE DESCRIPTIONS

Two specific decommissioning alternatives were examined for the Susquehanna SES study: DECON and SAFSTOR. Decommissioning activities for the two units were coordinated to the maximum possible extent and the schedules presented in Section 5 reflect an integrated program of decontamination and dismantling.

Although the DECON and SAFSTOR alternatives differ with respect to technique, process, cost, and schedule, both alternatives attain the same result: removal of all radioactive material from the site and ultimate release of the site for unrestricted and/or alternative use. The dormancy durations selected for use in the SAFSTOR alternative were based on the constraint that decommissioning be completed within 60 years from final plant shutdown.

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 material from the site after the cessation of operations. This study does not address the cost for the removal of spent fuel from the site because such costs are assumed to be covered through PP&L'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. Although not required for license termination, this study further assumes the removal of the remaining structures from the site, thereby ending PP&L's liability and permitting return of the Susquehanna SES site 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, PP&L 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 Susquehanna SES. 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 contaminants. It will also clearly describe how PP&L 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, with the exception of the last fuel cycle, the spent fuel generated over the operating life of the two nuclear units will have been transferred off-site to a DOE facility. The final core discharges would need to be stored on-site for approximately five years for cooling prior to DOE taking receipt (based upon DOE's current transportation criteria). With the older fuel having been removed from the pools, this study assumes that the Unit 1 fuel can be discharged to the Unit 2 pool, enabling decommissioning activities to proceed in the Unit 1 Reactor Building.

* 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 reactor well, spent fuel, steam separator and dryer storage pools 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.

* Segment core support structures and the steam separator and dryer assemblies and package in shielded casks. These operations are performed underwater by remotely operated equipment within contamination control barrier(s). Ship and bury packaged items.

* Disassemble, segment and package remaining reactor internals including the top fuel guide, feedwater and core spray spargers, in-core instrument tubes, fuel support pieces, control rod guide tubes, jet pumps and core support assembly in shielded shipping casks. The operations are conducted under water using remotely operated tooling and a contamination control envelope or other contamination barrier(s). Ship and bury packaged items which meet 10 CFR 61 Class "C" requirements or less.

* Provide spent fuel containers to accommodate 10 CFR 61 "Greater Than Class C" (GTCC) components.

* Remove control rod drives and instrumentation tubes from reactor vessel lower head. Section drives and tubes for disposal.

* Section the reactor vessel and package in shielded containers. This operation is accomplished in air using remotely operated equipment within a contamination control envelope. Sections are placed in containers under water (for example, in the fuel storage pool) or in air with the crane operator protected by a shielded envelope. Ship and bury packaged items.

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

* Remove sacrificial shield including activated concrete by controlled demolition. Package, ship and bury radioactive portions.

* Remove steel liner from drywell, disposing of the activated and contaminated sections as radioactive waste. Remove steel vent pipes connecting the drywell to the suppression chamber, again disposing of steel as non-releasable waste. Dispose of any activated/contaminated drywell concrete; package, ship, and bury using LSA containers.

* Decontaminate, dismantle/section the suppression chamber steel structure, packaging contaminated material for controlled disposition.

* Remove steel liners from the steam separator and dryer pool, reactor well, and spent fuel pool. Package contaminated material in LSA containers, including contaminated pool concrete, for shipping and burial.

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

* Decontaminate the remaining reactor building areas.

* Perform radiation survey to assure that the remaining portions of the containment structure are free of surface contamination and that containment integrity is no longer required.

* Remove contaminated equipment and material from the Turbine Generator, Radwaste Buildings and any other contaminated areas. Utilize radiation and contamination control techniques until radiation surveys indicate that the structures can be released for unrestricted access and conventional demolition. This activity may necessitate the dismantling and disposition of most of the systems and components (both clean and contaminated) located within these buildings so as to facilitate surface decontamination and subsequent verification surveys required prior to obtaining release for demolition.

* Ship and bury all remaining radioactive materials.

* Conduct final radiation survey of all structures and facilities to ensure that all radioactive materials have been removed. This survey may coincide with the confirmatory NRC site inspection.

* The NRC will conduct a survey to verify that the acceptable activity and contamination levels are satisfied. The NRC will review the termination package prepared by PP&L and typically perform a 10% validation survey. This is expected to require approximately three months. When the requirements are deemed satisfactory, the NRC can release the areas of the site for unrestricted use and conventional disposition.

3.1.3 Period 3 - Site Restoration

Although not required for license termination, upon completion of the primary decommissioning operations, site restoration activities may begin.

With the ability to transfer Unit 1 fuel to the Unit 2 spent fuel storage pool, Unit 1 structures, i.e., the Reactor and Turbine Buildings, will be available for dismantling much earlier than the Unit 2 facilities. This study assumes that once the termination surveys are completed for the Unit 1 structures, these buildings will be sealed and remain so until the Unit 2 facilities are decontaminated to permit release. At that time, an integrated conventional demolition program will commence.

Building foundations and portions of structures that are three feet below grade and lower are abandoned in place. The clean fill from above-grade structure 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 are used on-site to backfill voids. Suitable materials can be used on site for fill; otherwise the rubble is trucked off-site for disposal as construction debris.

* Remaining buildings are then removed using conventional demolition techniques for above ground structures, including the Turbine Generator Building, Radwaste, Cooling Towers, 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. All 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. All 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, PP&L will file a Decommissioning Plan (DP) with the NRC describing how it will remove all radioactive components and essentially all radioactivity from the Susquehanna SES 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 contaminants. It will also clearly describe how PP&L 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

PP&L. 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 will be transferred from Unit 1 to Unit 2 as soon as practical. 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 are 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 contaminated systems. Decontaminate these systems 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 a containment 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, i.e., inspection and maintenance.

* 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 of 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.

Spent fuel shipments to the DOE repository will continue throughout the first four to five years of Period 2.

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, heating, and ventilation, and perform periodic preventative maintenance on essential equipment.

An environmental surveillance program is carried out during the dormancy period to ensure that release of radioactive material to the environment is 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 an 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. At the end of the dormancy period for the SAFSTOR alternative, the remaining systems and structures are completely dismantled.

Although the initial radiation levels due to Co60 will decrease significantly (75% reduction from shutdown values) 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

3.2.3 Period 3 - Preparations

Prior to the commencement of decommissioning operations, detailed preparations are undertaken to provide a smooth transition from dormancy 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 3 ends upon receipt of a decommissioning order from the NRC.

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

Much of the work in revising 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.

3.2.4 Period 4 - Decommissioning Operations and License Termination

For the SAFSTOR 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, additional roads to facilitate hauling and transportation, and an access hatch to facilitate entrance into the reactor building for large/heavy equipment.

* 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 program.

* Segment core support structures and the steam separator and dryer assemblies and package in shielded casks. These operations are performed underwater by remotely operated equipment within contamination control barrier(s). Ship and bury packaged items.

* Disassemble, segment and package remaining reactor internals including the top fuel guide, feedwater and core spray spargers, in-core instrument tubes, fuel support pieces, control rod guide tubes, jet pumps and core support assembly in shielded shipping casks. The operations are conducted under water using remotely operated tooling and a contamination control envelope or other contamination barrier(s). Ship and bury packaged items which meet 10 CFR 61 Class "C" requirements or less.

* Provide spent fuel containers to accommodate 10 CFR 61 "Greater Than Class C" (GTCC) components.

* Remove control rod drives and instrumentation tubes from reactor vessel lower head. Section drives and tubes for disposal.

* Section the reactor vessel and package the sections in shielded containers. This operation is accomplished in air using remotely operated equipment within a contamination control envelope. Sections are placed in containers under water (for example, in the

fuel storage pool) or in air with the crane operator protected by a shielded envelope. Ship and bury packaged items.

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

* Remove concrete sacrificial shield including activated concrete by controlled demolition. Package, ship and bury radioactive portions.

* Remove steel liner from drywell, disposing of the activated and contaminated sections as radioactive waste. Remove steel vent pipes connecting the drywell to the suppression chamber, again disposing of steel as non-releasable waste. Remove any activated/contaminated drywell concrete; package inventory in LSA containers for disposal at the controlled burial facility.

* Decontaminate, dismantle/section the suppression chamber steel structure, packaging contaminated material for controlled disposition.

* Remove steel liners from the dryer/separator pool, reactor well, and spent fuel pool. Package contaminated material in LSA containers, including contaminated pool concrete, for shipping and burial.

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

* Decontaminate the remaining Reactor Building areas.

* Perform radiation survey to assure that the remaining portions of the containment structure are free of surface contamination and that containment integrity is no longer required.

* Remove contaminated equipment and material from the Turbine Generator, Radwaste Buildings and any other contaminated

areas. Utilize radiation and contamination control techniques until radiation surveys indicate that the structures can be released for unrestricted access and conventional demolition. This activity may necessitate the dismantling and disposition of most of the systems and components (both clean and contaminated) located within these buildings so as to facilitate surface decontamination and subsequent verification surveys required prior to obtaining release for demolition.

* Ship and bury all remaining radioactive materials.

* Conduct final radiation survey to ensure that all radioactive materials have been removed.

* The NRC will conduct a survey to verify that the acceptable activity and contamination levels are satisfied. The NRC will review the termination package prepared by PP&L and typically perform a 10% validation survey. This is expected to require approximately three months. When the requirements are deemed satisfactory, the NRC can terminate the license for the site.

3.2.5 Period 5 - Site Restoration

Although not required for license termination, upon completion of the primary decommissioning operations, site restoration activities may begin. All building foundations and structures that are three feet below grade and lower are abandoned in place. The clean fill from structure 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 is 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 removed using conventional demolition techniques for above ground structures.

* Prepare the final dismantling program report.

4. COST ESTIMATE

A site-specific cost estimate was prepared for Susquehanna SES 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 Susquehanna SES drawings and the inventory documents provided by PP&L. These drawings and documents were used to develop the general arrangement of the facility and to determine estimates of building concrete volumes, steel quantities, numbers and sizes of components, and land area of the site to be restored.

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 cost estimating tool, may not provide sufficient detail for actual management of the decommissioning project and is not intended to replace detailed engineering or cost-benefit analyses.

Disposition of radioactive wastes is a major contributor to the cost to decommissioning. Since access costs are not available on the future Appalachian regional disposal site, TLG used rates and schedules from the currently operating LLRW facility in Barnwell, South Carolina.

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

4.1.1 Susquehanna SES drawings, equipment and structural specifications, including construction details, were provided by PP&L.

4.1.2 Employee salary and craft labor rates for site administration, operations, construction and maintenance personnel were provided by PP&L for positions identified by TLG and PP&L.

4.1.3 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).

4.1.4 Material and equipment costs for conventional demolition and/or construction activities were taken from R.S. Means Construction Cost Data (Ref. 3).

4.1.5 Rates for shipping radioactive wastes were provided by Tri-State Motor Transit in published tariffs for this cargo (Ref. 4).

4.1.6 Burial costs for the regional radioactive waste disposal facility were based upon information provided by PP&L for the current disposition of LLRW at the Barnwell Low-Level Radioactive Waste Management Facility operated by Chem-Nuclear Systems, Inc. (Ref 5).

4.1.7 All costs in this estimate are calculated using 1993 dollars. The estimate excludes escalation. No present-value economic analysis is included.

4.1.8 This study assumes that, with the exception of the last fuel cycle, the spent fuel generated over the operating life of the two nuclear units will have been transferred off site to a Department of Energy (DOE) facility. The final core discharges would need to be stored on-site for approximately five years for cooling prior to DOE taking receipt (based upon DOE's current transportation criteria). With the older fuel having been removed from the pools, this study assumes that the Unit 1 fuel can be discharged to the Unit 2 pool, enabling decommissioning activities to proceed in the Unit 1 Reactor Building immediately after defueling.

4.1.9 The PP&L staffing requirements during decommissioning vary with the level of effort associated with the various phases of the project. The transitions of unit operating staff organizations from full operation to unit shutdowns are excluded from the scope of this study since these transitions are plant operations activities.

4.1.10 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.

4.1.11 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. 6). 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.

4.1.12 Unit 2 will continue operation for an additional two years following Unit 1 final shutdown.

4.2 METHODOLOGY

The methodology used to develop the cost estimates follows the basic approach originally presented in the AIF/NESP-036 study report and the US DOE "Decommissioning Handbook" (Ref. 7). 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 PP&L. 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. PP&L 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. 3). Examples of unit cost factor development are presented in the AIF "Guidelines" study (Ref. 6), one of which is reproduced in Appendix

A. Appendix B lists specific factors developed for the Susquehanna SES 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.

The activity and period-dependent costs are combined to develop the total decommissioning costs. A contingency is then applied. "Contingencies" are defined in the American Association of Cost Engineers' Cost Engineers' Notebook (Ref. 8) 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, in the anticipated plant shutdown conditions, etc. In the AIF/NESP-036 study (Ref. 6), 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.

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 herein is included in this cost study.

4.3.1 Plant Condition

On July 20, 1993, TLG visited the Susquehanna SES for a visual inspection and general evaluation of the facility's condition. The objective was to identify any design characteristics or operating conditions at the site that may impact the proposed decommissioning program, as well as gather site specific information for the decommissioning cost study.

The inspection of the power block structures included a walk through of the Unit 2 Turbine Building, the top operating floor and several lower floors of Unit 2 Reactor Building, and a brief tour of the main systems in the Radwaste Building. It was pointed out that Unit 1 was a mirror image of Unit 2 with a shared control structure and Radwaste Building. These structures were viewed from the exterior as well.

The Diesel Generator and 5th Diesel Generator Buildings were also inspected as were several of the miscellaneous site buildings including the Security buildings, the Service and Administration Building and various Warehouse structures. It was noted that no new buildings or major site modifications were planned. A complete walk down of the owner controlled area was conducted including the area around the spray pond and cooling towers. Photographs were taken to document the site layout and inventory miscellaneous structures. Only an external view of the Low Level Radwaste Holding Facility was permitted. The inspection concluded with a visit to the intake/discharge building. It was noted that this building, pursuant to local regulations, should be totally removed and the grade restored.

The site tour revealed several specific details that needed to be addressed in the study. These are as follows:

The Unit 1 and Unit 2 Reactor Buildings, and Control Structure are monolithically constructed and structurally integrated. With Unit 2 operating, only limited decommissioning work can be performed in Unit 1, although a barrier could be placed to segregate the operating floor as was done during construction of the second unit. Common equipment and facilities will need to be available as long as Unit 2 is operating, including the diesel generators, radwaste facilities, refueling floor functions and spray pond. Several of these services may also be needed to support decommissioning operations

The mirror design of the Reactor Buildings allows for transfer of the spent fuel generated at one unit to be transferred to the second unit for storage (this capability was utilized to accelerate the decontamination and removal of the reactor vessel at Unit 1).

Demolition activities (with the exception of low impact decontamination processes) need to be minimized in the structures adjacent to the Unit 2 spent fuel storage due to seismic and dynamic

loading restrictions until such time the fuel has been removed from the facility.

The site is very compact with equipment efficiently spaced throughout the power block structures. This limits the number of crews that can work in any given area and may lengthen the time to remove certain systems.

An epoxy coating covers most of the concrete floor surfaces. This should prevent contamination in certain areas of buildings otherwise assumed to be contaminated, and save time and money during the decommissioning process by reducing the amount of decontamination and surface removal.

The plant had an overall clean and orderly appearance. Insulation containing asbestos was not in use and the site is expected to be free of any hazardous or toxic materials following the cessation of plant operations.

4.3.2 Spent Fuel Disposition

The spent fuel bundles stored in the spent fuel pools will be transferred to the Department of Energy as per the existing contract between PP&L and DOE. With the exception of the last fuel cycle, the spent fuel pools at shutdown will be essentially empty, the fuel having been transferred off-site previously. The final core discharges will require a minimum of five years of cooling prior to transport. This study assumes that the Unit 1 fuel can be discharged to the Unit 2 pool, enabling decommissioning activities to proceed in the Unit 1 Reactor Building. Decontamination of the Unit 2 Reactor Building will be delayed five and one-half years by the presence of the spent fuel. Decommissioning would proceed on the surrounding facilities and non-essential systems during the storage and transfer period.

The SAFSTOR scenario was developed such that deferred decommissioning would be completed within the 60 year period allowed by the NRC.

4.3.3 Major Component Removal

The reactor pressure vessel and internals packages are segmented for disposal and shipped in shielded shipping casks. Segmentation and

packaging of the internals packages is performed in the separator and dryer storage pool where a turntable and remote cutter will be installed. The vessel is segmented in place using a mast mounted cutter supported off the lower head and directed from a shielded work platform installed overhead in the reactor well. Shipping cask specifications and U.S. Department of Transportation (DOT) regulations will dictate segmentation and packaging methodology; all packages designated meet current physical and radiological limitations and regulations. Cask shipments will be made in DOT approved, currently available, truck casks.

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

The main turbine is dismantled using conventional maintenance procedures; the turbine rotors and shafts are removed to a laydown area for packaging and transported for disposal. The lower turbine casings are removed from their anchors by controlled demolition. The main condensers are segmented and transported to the laydown area for packaging and disposition as low-level radioactive waste along with the upper and lower turbine casings.

4.3.4 Transportation Methods

For the purposes of cost estimation, it was assumed that the NSSS components are moved overland by a combination of either truck or multi-wheeled transporters to the burial facility. Large payloads could be moved by rail.

4.3.5 Site Conditions at Facility Closeout

Although not required for license termination, it is assumed that the site is restored by regrading the site to conform to the adjacent landscape. Soil matching that of the adjacent landscape is brought on-site and placed to allow growth of native vegetation and provide adequate drainage.

4.4 ASSUMPTIONS

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

4.4.1 PP&L 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, radiological controls, quality assurance and overall site administration during decommissioning and demolition are provided by PP&L. 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.

4.4.2 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.

4.4.3 An Appalachian Compact regional burial facility was assumed to exist within 500 miles of the plant site. This location was taken as the final destination for all radioactive waste shipments from Susquehanna SES. The cost of burial at this yet-to-be-developed site was based upon information from the operating low-level radioactive waste disposal site at Barnwell, South Carolina.

4.4.4 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.

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

4.4.6 Nuclear liability insurance provides coverage for damage or injuries due to radiation exposure from equipment, material, etc. used during decommissioning. Nuclear liability insurance is phased out upon final decontamination of the site. PP&L provided nuclear liability as well as property insurance premiums.

4.4.7 The NSSS (reactor vessel and reactor recirculation system) are chemically decontaminated using one chemical flush and two water rinses prior to segmentation. Typically, a decontamination factor (DF)

of 10 is expected (Ref. 9). The NSSS flush will only be performed for the DECON mode.

4.4.8 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.

Control blades are removed and disposed of along with the reactor vessel internal components.

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 Susquehanna SES components, projected operating life, as well as for different periods of decay. Additional short-lived isotopes were derived from NUREG/CR-0130 (Ref. 9) and NUREG/CR-0672 (Ref. 11) and benchmarked to the long-lived values from NUREG/CR-3474.

The results of the planned power uprate project are reflected in the activation profile for the reactor vessel and internals. The radionuclide inventory has been adjusted to reflect the increased power level over the remaining operating lives of the two units. As such, the impact of the power uprate project on the decommissioning cost is seen in the additional cost to dispose of the reactor vessel and internal components. The impact of the uprate modifications on plant decommissioning are expected to be limited to the nuclear boiler and are not expected to have an appreciable effect on dismantling the balance of plant.

4.4.9 The reactor vessel and internals disposal costs are based on remote in-place segmentation, 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 with the exception of several overweight cask shipments. Cask shipments may exceed 95,000 pounds, including 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.

4.4.10 PP&L provides for the electrical power to be brought on-site required to demolish the plant.

4.4.11 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.

4.4.12 PP&L 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 PP&L that are easily removed without the use of special equipment. The costs for these activities are presumed to be covered by the PP&L transition staff.

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

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

4.4.15 The PP&L 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.

4.4.16 All structures and site improvements will be removed to three feet below local grade and the terrain restored to the local grade level. The station grounds will be regraded such that the site will have a final contour consistent with adjacent surroundings.

4.4.17 The perimeter fence and in-plant security barriers are moved as appropriate to conform with the Site Security Plan in force at the various stages in the project.

4.4.18 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 is covered with fill.

4.4.19 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 equivalent disposal costs for spent nuclear fuel.

4.4.20 The existing electrical switchyard will remain after Susquehanna SES decommissioning in support of the electrical transmission and distribution system.

4.4.21 Susquehanna SES is assumed to have no significant amount of hazardous or toxic materials.

4.4.22 To the greatest extent practical, non-compactible LLW is recycled to reduce the total volume of radioactive material buried. The components and materials deemed suitable for recycling 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 recycle fractions assigned for these components range from 70% to 90%. Materials and components that are unlikely to be recycled include concrete, small bore piping, heat exchangers, and dry active waste (DAW). Recycling is not attempted for these components or materials due to the difficulty of surveying the material, or the unlikelihood of success in decontamination.

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

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

4.4.23 The number of cask shipments out of the Reactor Building is expected to average two per week. Non-cask shipments are limited to three shipments per week.

4.5 DECOMMISSIONING vs. SITE RESTORATION

The total projected cost of dismantling the Susquehanna SES, for the DECON alternative, is **$804,259,488**. Of the total cost, approximately **$676,873,728** is attributable to the engineering and planning for and the actual disposition of the residual radioactivity at the facility. It should be noted, however, that this accounting of costs includes not only those costs directly attributable to "decommissioning" as defined by the NRC, but those clean "cascading" costs necessary to be expended in order to execute the decontamination processes.

Nuclear power plants are designed to contain the radioactivity inherent in 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 that 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; material which in some cases is non-radioactive and therefore not normally perceived as a necessary constituent in facility decontamination. Failure to establish adequate working room will increase the residence times for decontamination and dismantling activities resulting in increases in the incurred occupational exposure. Therefore, the clean "cascading" costs necessary to perform decontamination activities are reported as decommissioning costs.

The cost associated with the removal of non-contaminated and releasable material to result in restoration and release of the site for unrestricted use is **$127,385,716**.

4.6 COST ESTIMATE SUMMARY

A summary of the decommissioning alternative costs with annual expenditures is provided in Tables 4.1 and 4.2. "Nuclear" or license termination expenditures are provided for the DECON scenario as are schedules for the "non-nuclear" or site restoration expense. Integrated schedules are provided for the SAFSTOR alternative. Costs were taken from the detailed cost tables in Appendix C.

Since the common plant systems and services will be needed to support Unit 2 operations (with several needed to support post shutdown fuel storage and decommissioning activities), the cost to decontaminate, dismantle and dispose of these common systems is included within the decommissioning cost for Unit 2.

The detailed cost tables (Appendix C) list the costs of major activities for each unit's 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 personnel to the site; either for per diem allowance or for moving expenses.

TABLE 4.1a
SUMMARY OF TOTAL DECON DECOMMISSIONING COSTS
Susquehanna Steam Electric Station Unit 1
(in 1993 Dollars)

Year	Period 1	Period 2	Period 3 Demolition Delay	Period 3	Totals
2022	$3,606,568				$3,606,568
2023	$19,971,205				$19,971,205
2024	$957,777	$79,466,527			$80,424,304
2025		$83,109,691			$83,109,691
2026		$74,451,440			$74,451,440
2027		$44,540,324	$235,616		$44,775,940
2028			$598,858		$598,858
2029			$597,222		$597,222
2030			$597,222		$597,222
2031			$255,251	$14,366,352	$14,621,603
2032				$25,158,300	$25,158,300
2033				$2,612,064	$2,612,064
	$24,535,550	$281,567,982	$2,284,168	$42,136,716	$350,524,416

TABLE 4.1b
SUMMARY OF TOTAL DECON DECOMMISSIONING COSTS
Susquehanna Steam Electric Station Unit 2
(in 1993 Dollars)

Year	Period 1	Period 2	Period 3	Totals
2024	$5,026,609			$5,026,609
2025	$6,437,586			$6,437,586
2026	$6,985,673			$6,985,673
2027	$25,718,280	$2,598,327		$28,316,607
2028		$95,098,760		$95,098,760
2029		$95,013,116		$95,013,116
2030		$95,698,102		$95,698,102
2031		$40,901,107	$26,332,527	$67,233,634
2032			$46,113,421	$46,113,421
2033			$7,811,563	$7,811,563
	$44,168,148	$329,309,412	$80,257,512	$453,735,072

TABLE 4.1c
SUMMARY OF NUCLEAR DECON DECOMMISSIONING COSTS
Susquehanna Steam Electric Station Unit 1
(in 1993 Dollars)

Year	Period 1	Period 2	Period 3 Demolition Delay	Period 3	Totals
2022	$3,606,568				$3,606,568
2023	$19,971,205				$19,971,205
2024	$957,777	$79,133,219			$80,090,996
2025		$82,761,103			$82,761,103
2026		$74,102,852			$74,102,852
2027		$44,329,261			$44,329,261
2028					
2029					
2030					
2031					
2032					
2033					
	$24,535,550	$280,326,434			$304,861,984

TABLE 4.1d
SUMMARY OF NUCLEAR TOTAL DECON DECOMMISSIONING COSTS
Susquehanna Steam Electric Station Unit 2
(in 1993 Dollars)

Year	Period 1	Period 2	Period 3	Totals
2024	$5,026,609			$5,026,609
2025	$6,437,586			$6,437,586
2026	$6,985,673			$6,985,673
2027	$25,718,280	$2,586,712		$28,304,992
2028		$94,673,650		$94,673,650
2029		$94,589,168		$94,589,168
2030		$95,274,154		$95,274,154
2031		$40,719,912		$40,719,912
2032				
2033				
	$44,168,148	$327,843,596		$372,011,744

TABLE 4.1e
SUMMARY OF NON-NUCLEAR DECON DECOMMISSIONING COSTS
Susquehanna Steam Electric Station Unit 1
(in 1993 Dollars)

Year	Period 1	Period 2	Period 3 Demolition Delay	Period 3	Totals
2022					
2023					
2024		$333,308			$333,308
2025		$348,588			$348,588
2026		$348,588			$348,588
2027		$211,063	$235,616		$446,679
2028			$598,858		$598,858
2029			$597,222		$597,222
2030			$597,222		$597,222
2031			$255,251	$14,366,352	$14,621,603
2032				$25,158,300	$25,158,300
2033				$2,612,064	$2,612,064
		$1,241,547	$2,284,169	$42,136,716	$45,662,432

TABLE 4.1f
SUMMARY OF NON-NUCLEAR DECON DECOMMISSIONING COSTS
Susquehanna Steam Electric Station Unit 2
(in 1993 Dollars)

Year	Period 1	Period 2	Period 3	Totals
2024				
2025				
2026				
2027		$11,615		$11,615
2028		$425,110		$425,110
2029		$423,948		$423,948
2030		$423,948		$423,948
2031		$181,195	$26,332,527	$26,513,722
2032			$46,113,421	$46,113,421
2033			$7,811,563	$7,811,563
		$1,465,816	$80,257,511	$81,723,327

TABLE 4.2a
SUMMARY OF SAFSTOR DECOMMISSIONING COSTS
Susquehanna Steam Electric Station Unit 1
(in 1993 Dollars)

Year	Period 1	Period 2	Period 3	Period 4	Period 5	Totals
2022	$9,395,082					$9,395,082
2023	$11,016,852	$1,018,883				$12,035,735
2024		$2,213,645				$2,213,645
2025		$2,213,645				$2,213,645
2026		$2,219,710				$2,219,710
2027		$2,213,645				$2,213,645
2028		$1,139,946				$1,139,946
2029		$1,097,121				$1,097,121
2030		$1,100,126				$1,100,126
2031		$1,097,121				$1,097,121
2032		$1,097,121				$1,097,121
2033		$1,097,121				$1,097,121
2034		$1,100,126				$1,100,126
2035		$1,097,121				$1,097,121
2036		$1,097,121				$1,097,121
2037		$1,097,121				$1,097,121
2038		$1,100,126				$1,100,126
2039		$1,097,121				$1,097,121
2040		$1,097,121				$1,097,121
2041		$1,097,121				$1,097,121
2042		$1,100,126				$1,100,126
2043		$1,097,121				$1,097,121
2044		$1,097,121				$1,097,121
2045		$1,097,121				$1,097,121
2046		$1,100,126				$1,100,126
2047		$1,097,121				$1,097,121
2048		$1,097,121				$1,097,121
2049		$1,097,121				$1,097,121
2050		$1,100,126				$1,100,126
2051		$1,097,121				$1,097,121
2052		$1,097,121				$1,097,121
2053		$1,097,121				$1,097,121
2054		$1,100,126				$1,100,126
2055		$1,097,121				$1,097,121
2056		$1,097,121				$1,097,121
2057		$1,097,121				$1,097,121
2058		$1,100,126				$1,100,126
2059		$1,097,121				$1,097,121
2060		$1,097,121				$1,097,121
2061		$1,097,121				$1,097,121
2062		$1,100,126				$1,100,126
2063		$1,097,121				$1,097,121
2064		$1,097,121				$1,097,121
2065		$1,097,121				$1,097,121
2067		$1,097,121				$1,097,121
2068		$1,097,121				$1,097,121
2069		$1,097,121				$1,097,121
2070		$1,100,126				$1,100,126
2071		$1,097,121				$1,097,121
2072		$1,097,121				$1,097,121
2073		$1,097,121				$1,097,121
2074		$1,100,126				$1,100,126
2075		$1,097,121				$1,097,121
2076		$1,097,121				$1,097,121
2077		$1,009,952	$1,692,253			$2,702,205
2078			$21,427,544			$21,427,544
2079			$9,037,642	$35,851,332		$44,888,974
2080				$62,017,707		$62,017,707
2081				$47,614,610		$47,614,610
2082				$45,452,592		$45,452,592
2083				$45,328,404		$45,328,404
2084				$10,555,930	$20,501,076	$31,057,006
2085					$23,942,328	$23,942,328
	$20,411,934	$64,727,288	$32,157,439	$246,820,575	$44,443,404	$408,560,640

TABLE 4.2b
SUMMARY OF SAFSTOR DECOMMISSIONING COSTS
Susquehanna Steam Electric Station Unit 2
(in 1993 Dollars)

Year	Period 1	Period 2	Period 3	Period 4	Period 5	Totals
2024	$22,676,557					$22,676,557
2025	$6,365,349	$6,204,195				$12,569,544
2026		$7,967,492				$7,967,492
2027		$7,945,723				$7,945,723
2028		$7,945,723				$7,945,723
2029		$6,703,637				$6,703,637
2030		$3,553,866				$3,553,866
2031		$3,544,156				$3,544,156
2032		$3,544,156				$3,544,156
2033		$3,544,156				$3,544,156
2034		$3,553,866				$3,553,866
2035		$3,544,156				$3,544,156
2036		$3,544,156				$3,544,156
2037		$3,544,156				$3,544,156
2038		$3,553,866				$3,553,866
2039		$3,544,156				$3,544,156
2040		$3,544,156				$3,544,156
2041		$3,544,156				$3,544,156
2042		$3,553,866				$3,553,866
2043		$3,544,156				$3,544,156
2044		$3,544,156				$3,544,156
2045		$3,544,156				$3,544,156
2046		$3,553,866				$3,553,866
2047		$3,544,156				$3,544,156
2048		$3,544,156				$3,544,156
2049		$3,544,156				$3,544,156
2050		$3,553,866				$3,553,866
2051		$3,544,156				$3,544,156
2052		$3,544,156				$3,544,156
2053		$3,544,156				$3,544,156
2054		$3,553,866				$3,553,866
2055		$3,544,156				$3,544,156
2056		$3,544,156				$3,544,156
2057		$3,544,156				$3,544,156
2058		$3,553,866				$3,553,866
2059		$3,544,156				$3,544,156
2060		$3,544,156				$3,544,156
2061		$3,544,156				$3,544,156
2062		$3,553,866				$3,553,866
2063		$3,544,156				$3,544,156
2064		$3,544,156				$3,544,156
2065		$3,544,156				$3,544,156
2066		$3,553,866				$3,553,866
2067		$3,544,156				$3,544,156
2069		$3,544,156				$3,544,156
2070		$3,553,866				$3,553,866
2071		$3,544,156				$3,544,156
2072		$3,544,156				$3,544,156
2073		$3,544,156				$3,544,156
2074		$3,553,866				$3,553,866
2075		$3,544,156				$3,544,156
2076		$3,544,156				$3,544,156
2077		$3,544,156				$3,544,156
2078		$3,553,866				$3,553,866
2079		$2,262,434	$4,005,359			$6,267,792
2080			$11,102,018			$11,102,018
2081			$1,521,416	$82,176,992		$83,698,408
2082				$95,515,455		$95,515,455
2083				$95,320,716		$95,320,716
2084				$20,631,059	$36,035,939	$56,666,998
2085					$44,225,925	$44,225,925
	$29,041,906	$212,819,056	$16,628,793	$293,644,221	$80,261,864	$632,395,840

5. SCHEDULE ESTIMATE

The schedule for the decommissioning scenarios considered in this study follow the sequence presented in the AIF/NESP-036 study (Ref. 6) with minor changes to reflect recent experience and revised estimates. In addition, the scheduling has been revised to reflect the transportation constraint for the spent fuel from the last core discharge, i.e., five years of cooling.

TLG has prepared a schedule for decommissioning Susquehanna SES. 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. The schedule was prepared using the "Microsoft Project" computer software (Ref. 12).

5.1 SCHEDULE ESTIMATE ASSUMPTIONS

The schedule estimate reflects the results of a precedence network developed for Susquehanna SES 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 Susquehanna SES.

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 Reactor Building will continue to serve as the spent fuel storage building until such time that all spent fuel can be transfer to an off-site facility, assumed in this study to be accomplished approximately 5.5 years after the cessation of operations at Unit 2.

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 DECON and SAFSTOR 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 period-dependent costs.

Project timelines for the DECON and SAFSTOR alternatives are included in this section as Figure 5.2. Milestone dates are based on the plant operating life from the date of commercial operation. Deferred decommissioning, in the SAFSTOR scenario, is assumed to commence such that the termination of the site licenses is accomplished within 60 years of final shutdown.

5.3 SPENT FUEL SCHEDULE

This study assumes that, with the exception of the last fuel cycle, the spent fuel generated over the operating life of the two nuclear units will have been transferred off-site to a Department of Energy (DOE) facility. The final core discharges would need to be stored on-site for approximately five years for cooling prior to DOE taking receipt (based upon DOE's current transportation criteria). With the older fuel having been removed from the pools, this study assumes that the Unit 1 fuel can be discharged to the Unit 2 pool, enabling decommissioning activities to proceed in the Unit 1 Reactor Building, immediately after defueling.

FIGURE 5.1
DECON ACTIVITY SCHEDULE

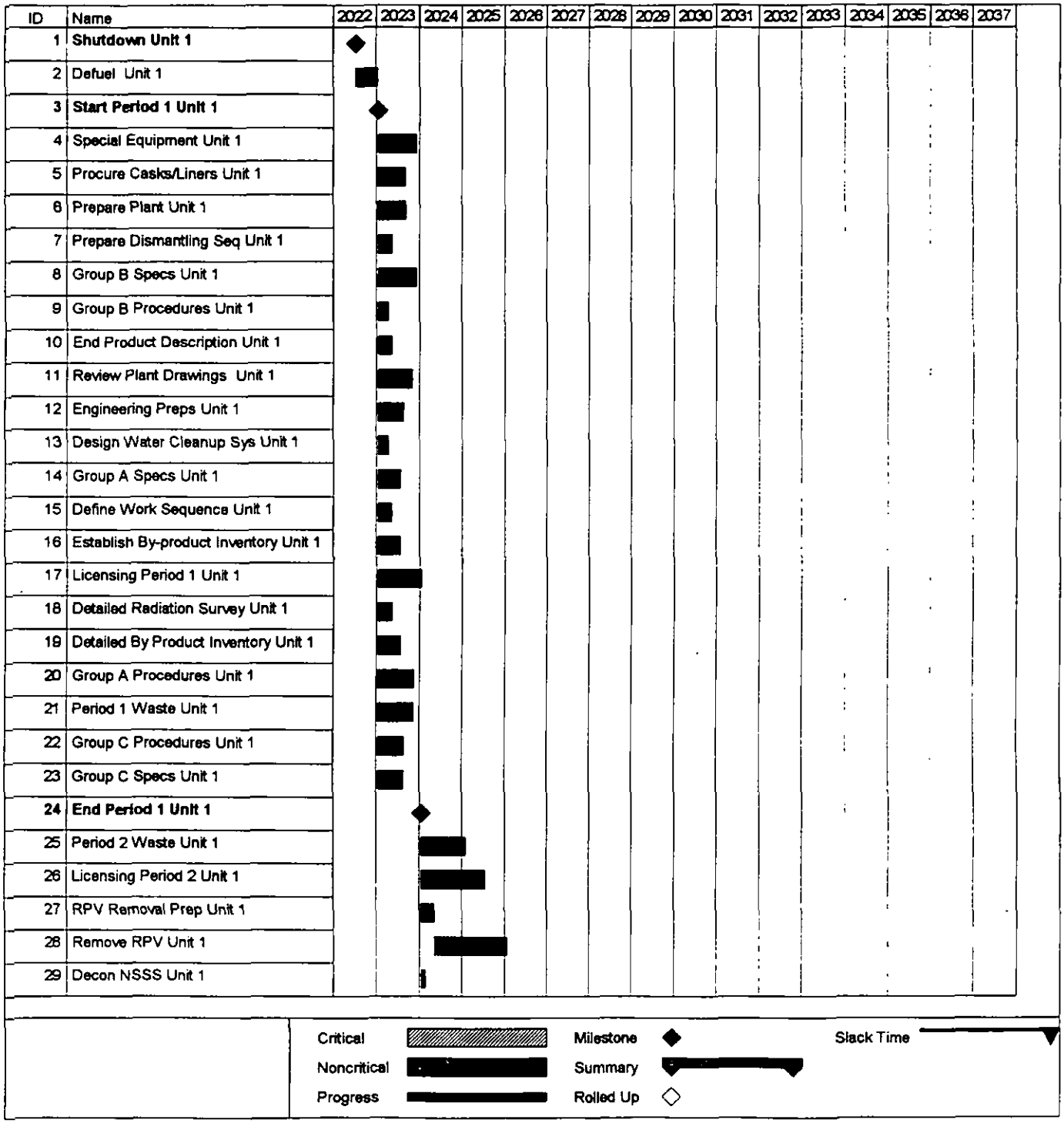


FIGURE 5.1
DECON ACTIVITY SCHEDULE
(continued)

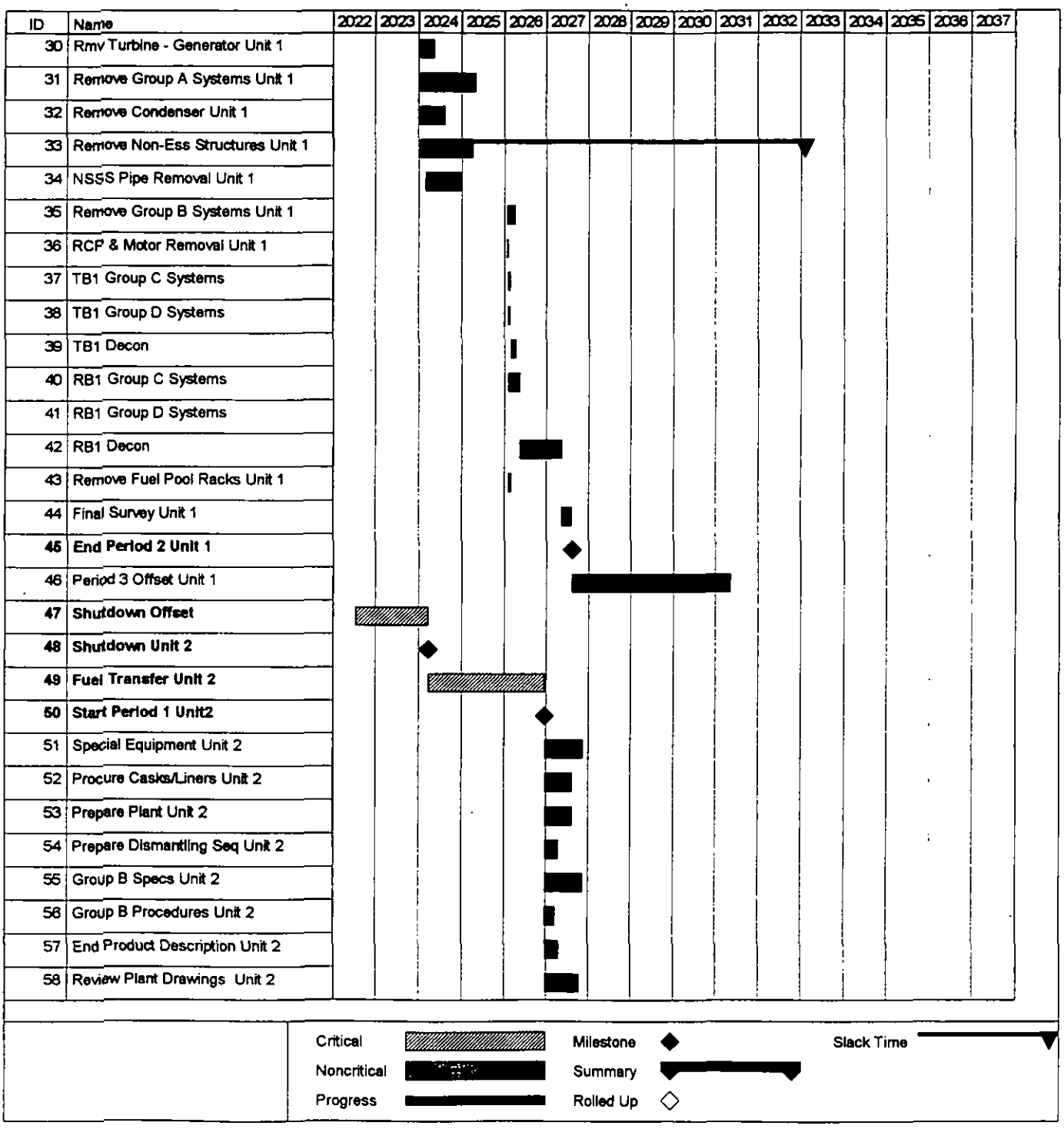


FIGURE 5.1
DECON ACTIVITY SCHEDULE
(continued)

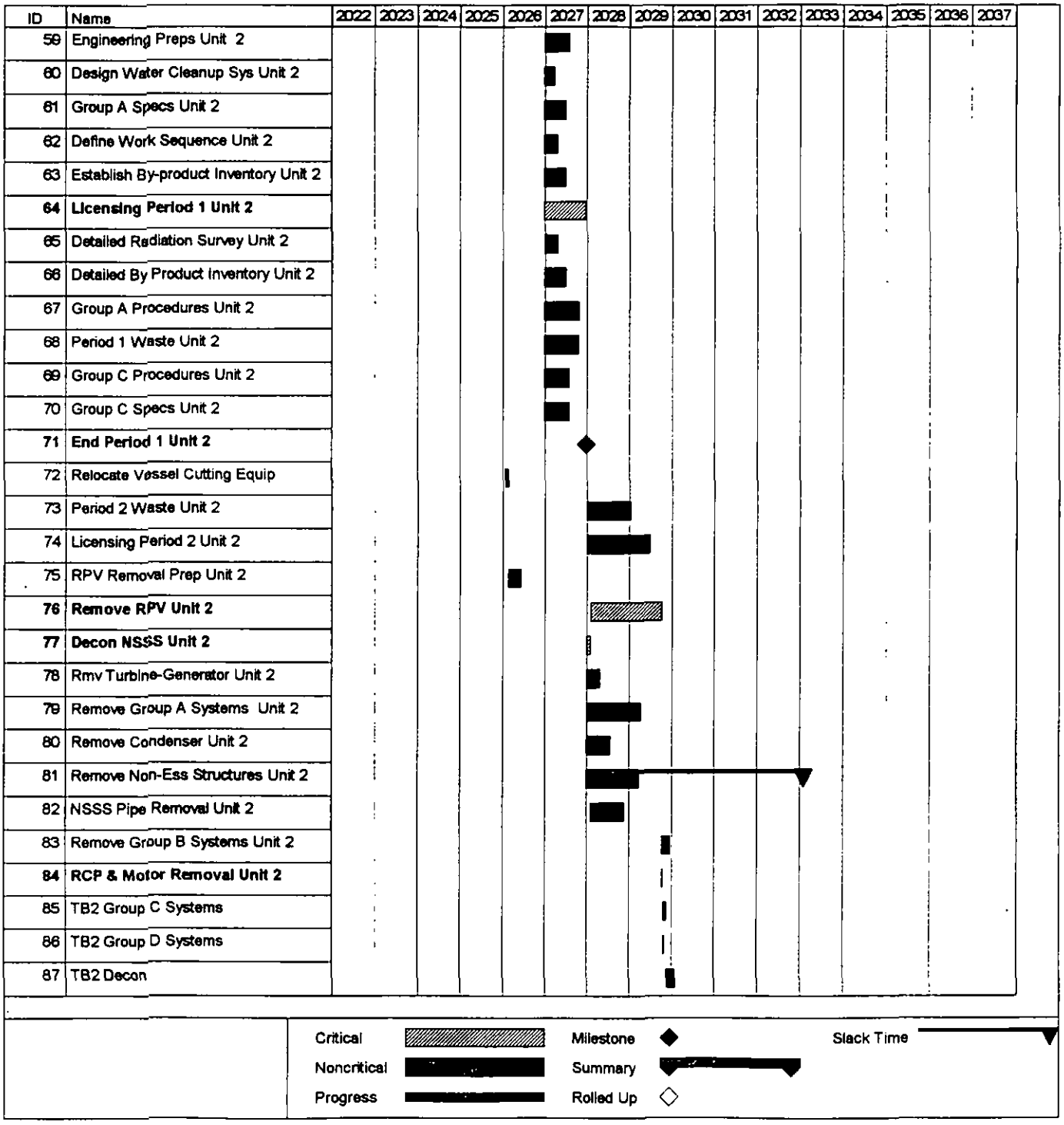


FIGURE 5.1
DECON ACTIVITY SCHEDULE
(continued)

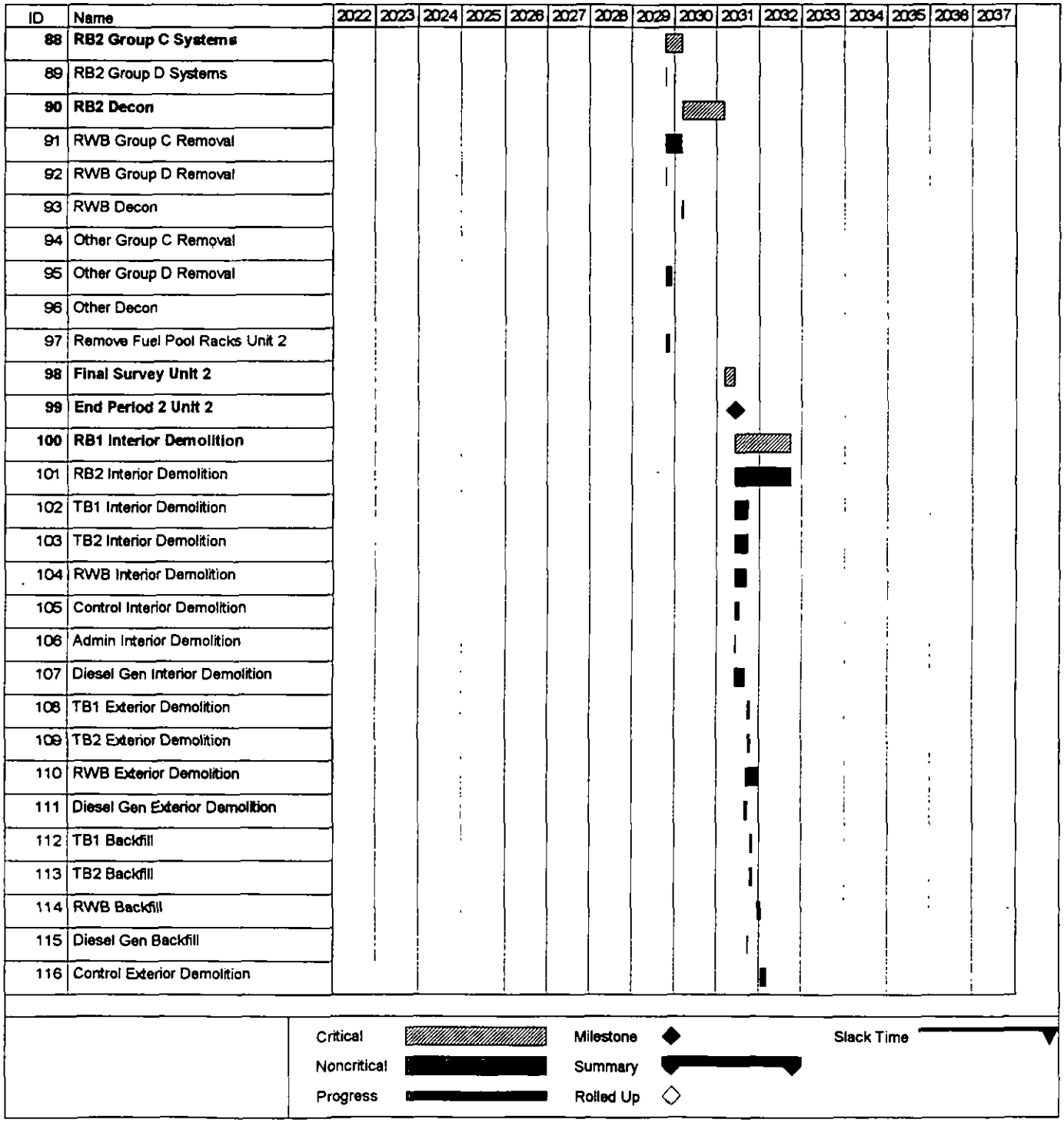


FIGURE 5.1
DECON ACTIVITY SCHEDULE
(continued)

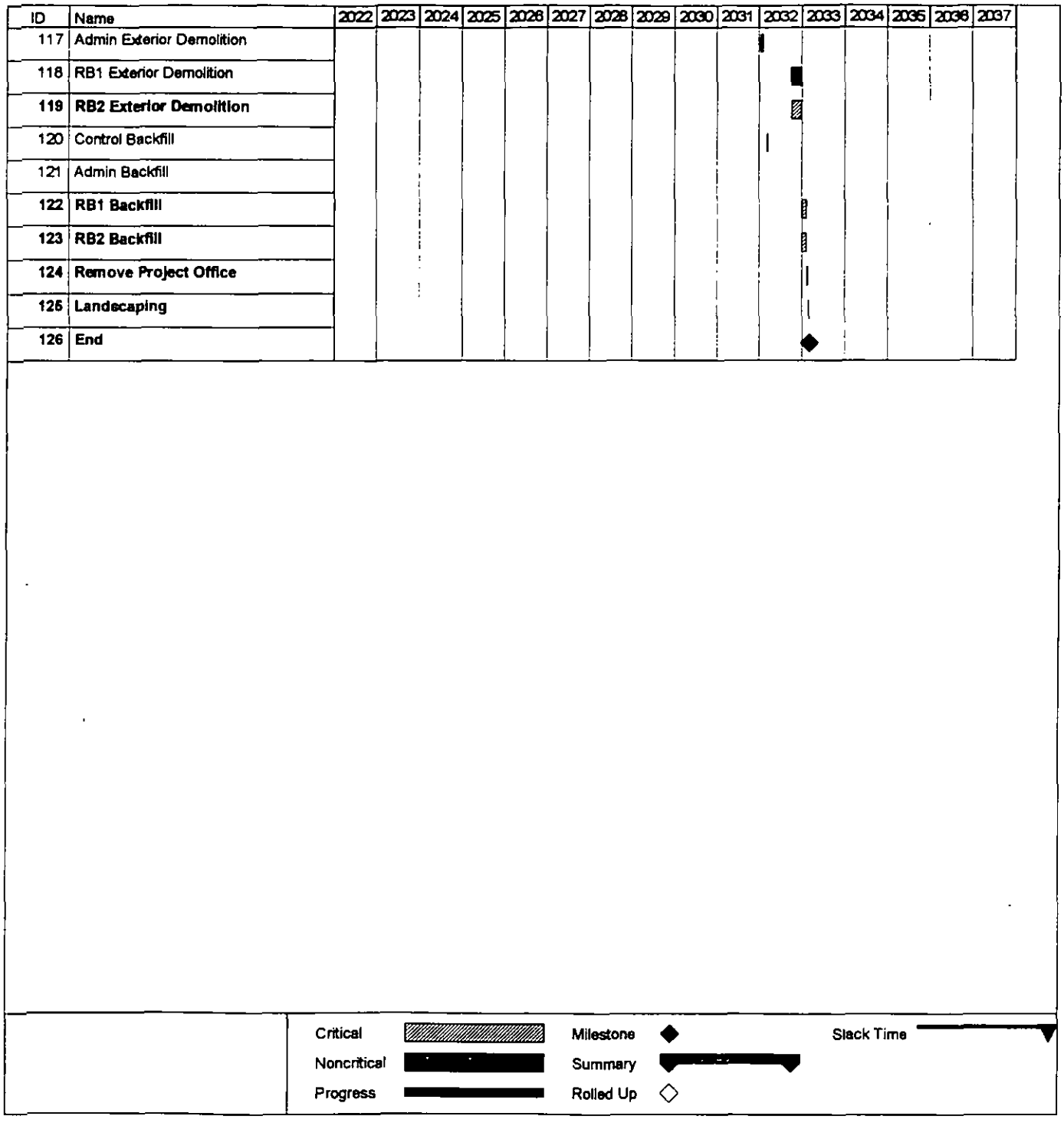
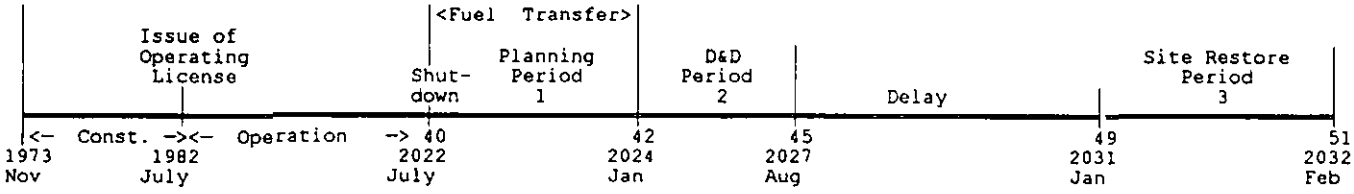


FIGURE 5.2a
DECON DECOMMISSIONING TIME LINE
(not to scale)

Unit 1:



Unit 2:

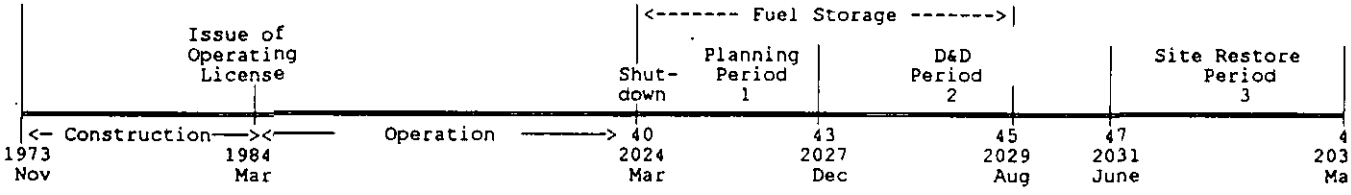
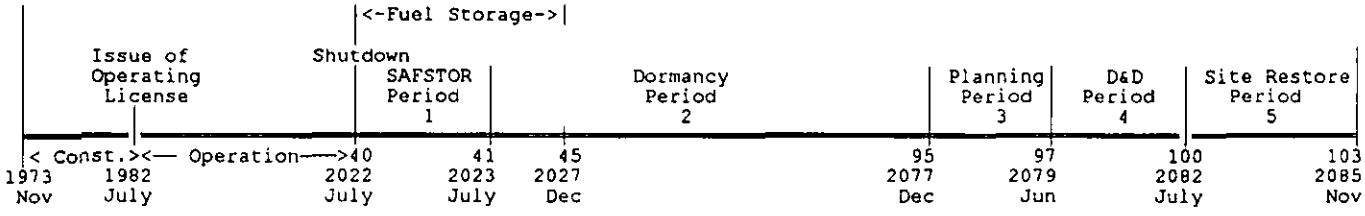
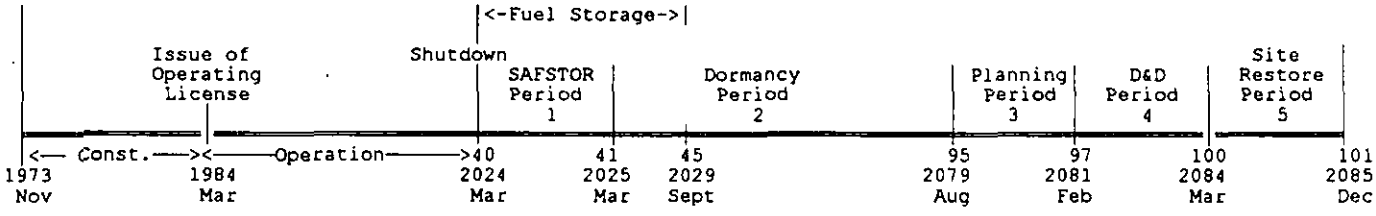


FIGURE 5.2b
SAFSTOR DECOMMISSIONING TIME LINE
(not to scale)

Unit 1:



Unit 2:



6. RADIOACTIVE WASTES

The ultimate goal of the decommissioning program is the removal of all material from the site which would restrict its future use. This requires the disposal of all licensed radioactive material from the site.

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 controls the burial of radioactive material; Part 72 defines radioactive material.

The radioactive waste volume generated during the various decommissioning programs at Susquehanna SES 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. 13). 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 spent fuel.

The waste volume attributed to site decontamination is primarily generated during Period 2 of DECON and Period 4 of SAFSTOR. The low-level radioactive waste generated as a result of the decommissioning of Susquehanna SES is destined for disposal at the future Appalachian Compact burial facility. For cost estimating purposes, this study uses information from an existing burial facility in Barnwell, South Carolina, reflecting the current cost of low-level radioactive waste disposal for PP&L.

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. An average unit disposal cost is provided for each waste classification.

The differential in the unit prices for A, B and C waste is attributable to the surcharges and handling fees imposed by the disposal facility for such waste characteristics as form, curie content and isotopic makeup. Although the levels of radioactivity decrease during the SAFSTOR phase, the volume of material requiring controlled disposal after the delay period is relatively unaffected. As such, the differences in the unit prices for the SAFSTOR volumes are primarily a result of the shift in the classification of the material resulting from the delayed decommissioning activity.

The disposal cost for the waste volumes identified in Table 6.1 was derived as if the material would be placed in the Barnwell facility, i.e., a current Chem-Nuclear Systems rate schedule was used for the estimate. The pricing structure for the future Appalachian Compact burial facility is not as yet available and the facility may not be designed to accommodate a full spectrum of waste, e.g., Class C. The disposal costs reported within this study do reflect the current cost for disposing low-level radioactive waste from Susquehanna SES, however, as the Appalachian Compact becomes operational, the pricing assumptions need to be re-evaluated.

TABLE 6.1

RADIOACTIVE WASTE BURIAL VOLUMES FOR DECOMMISSIONING

	Waste Class[1]	Volume (cubic feet)	Average $/cubic foot Disposal Cost
DECON			
Unit 1	A	201,341	$364.89
	B	25,937	622.83
	C	748	2,213.46
	>C	226	26,136.15
Total		**228,252**	
Unit 2	A	232,093	$364.34
	B	26,961	602.80
	C	612	2,142.38
	>C	226	26,136.15
Total		**259,892**	
SAFSTOR			
Unit 1	A	212,107	$364.64
	B	15,092	548.75
	C	408	1,167.50
	>C	226	26,136.15
Total		**227,833**	
Unit 2	A	243,148	$364.11
	B	16,170	548.74
	C	408	1,167.50
	>C	226	26,136.15
Total		**259,952**	

[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 guidelines are met 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 radiological controls 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 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 radioactive decay during dormancy and because almost all of the dismantling operations are performed after the dormancy period.

Typical field experience relative to recent cost studies performed by TLG indicate that actual field exposures are significantly less than those projected in this cost estimate.

8. RESULTS

Decommissioning technology is well established and the tools and equipment necessary to completely dismantle Susquehanna SES are available and have been demonstrated. The projected costs to decommission the plant, presuming the use of the DECON alternative is **$350,524,416** and **$453,735,072** for Unit 1 and Unit 2, respectively. The projected costs includes shipment and disposal of wastes and dismantled materials to a regional burial site and demolition of the remaining site structures. The estimate reflects the site-specific features of Susquehanna SES 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 Susquehanna SES. 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 increases in 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 Susquehanna SES provides an estimate for decommissioning the site under current requirements based on present day cost 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 8.1a

SUMMARY OF DECON DECOMMISSIONING COSTS

Work Category	Costs (thousands)	Percent of Total Costs
UNIT 1		
Decontamination	12,824	3.66
Removal (nuclear)	33,159	9.46
Removal (non-nuclear)	36,900	10.53
Packaging	10,761	3.07
Shipping	4,604	1.31
Burial (off-site)	91,284	26.04
Decommissioning Staffs (nuclear)	97,574	27.84
Decommissioning Staffs (non-nuclear)	3,809	1.09
Other * (nuclear)	54,656	15.59
Other * (non-nuclear)	4,953	1.41
Subtotal	**350,524**	**100.00**
UNIT 2		
Decontamination	13,930	3.07
Removal (nuclear)	41,596	9.17
Removal (non-nuclear)	66,687	14.70
Packaging	12,132	2.67
Shipping	4,602	1.01
Burial (off-site)	101,179	22.30
Decommissioning Staffs (nuclear)	134,124	29.56
Decommissioning Staffs (non-nuclear)	10,071	2.22
Other * (nuclear)	64,448	14.20
Other * (non-nuclear)	4,966	1.09
Subtotal	**453,735**	**100.00**

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

TABLE 8.1b

SUMMARY OF SAFSTOR DECOMMISSIONING COSTS

Work Category	Costs (thousands)	Percent of Total Costs
UNIT 1		
Decontamination	15,156	3.71
Removal (nuclear)	29,475	7.21
Removal (non-nuclear)	38,267	9.37
Packaging	10,118	2.48
Shipping	3,508	0.86
Burial (off-site)	86,142	21.08
Decommissioning Staffs (nuclear)	136,151	33.32
Decommissioning Staffs (non-nuclear)	3,809	0.93
Other * (nuclear)	81,324	19.91
Other * (non-nuclear)	4,610	1.13
Subtotal	**408,560**	**100.00**
UNIT 2		
Decontamination	16,867	2.67
Removal (nuclear)	37,522	5.93
Removal (non-nuclear)	68,231	10.79
Packaging	11,546	1.83
Shipping	3,592	0.57
Burial (off-site)	97,003	15.34
Decommissioning Staffs (nuclear)	287,442	45.45
Decommissioning Staffs (non-nuclear)	10,071	1.59
Other * (nuclear)	95,472	15.10
Other * (non-nuclear)	4,650	0.74
Subtotal	**632,396**	**100.00**

* Other includes: engineering & preparations, property tax payments, insurance premiums, off-site LLRW 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. "Building Construction Cost Data 1990", Robert Snow Means Company, Inc., Kingston, Massachusetts.

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

5. Chem-Nuclear Systems, Inc., Barnwell Low-Level Radioactive Waste Management Facility, Rate Schedule.

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

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

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

9. 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.

10. 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.

11. 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.

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

13. 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 (34% of critical duration)			102
	Adjusted work duration		552
+ Protective clothing adjustment (30% of adjusted duration)			166
Productive work duration			718
+ Work break adjustment (8.33 % of productive duration)			60
Total work duration min			778

***** Total duration = 12.967 hr *****

3. LABOR REQUIRED

Crew	Number	Duration (hr)	Rate ($/hr)	Cost
Laborers	3.0	12.967	$18.97	$737.95
Craftsmen	2.0	12.967	$23.85	$618.53
Foreman	1.0	12.967	$24.99	$324.05
General Foreman	.25	12.967	$25.52	$82.73
Subtotal labor cost				$1,763.26
Overhead & Profit on labor @ 44.390				$782.71
Total labor cost				$2,545.97

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 @ $7.50/hr x 1 hr {1}	$7.50
Subtotal cost of equipment and materials	$34.50
Overhead & profit on equipment and materials @ 16%	$5.52
Total costs, equipment & material	$40.02
TOTAL COST Removal of contaminated heat exchanger <3000 pound:	**$2,585.99**
Total labor cost:	$2,545.97
Total equipment/material costs:	$40.02
Total adjusted exposure manhours incurred:	53.406
Total craft labor manhours required per unit:	81.044

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 Scranton, Pennsylvania:

4. References:

1. R.S. Means (1993) Division 016 Section 420-6360 pg 19
2. McMaster-Carr Ed. 94 pg 735
3. R.S. Means (1993) 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	$0.30
Removal of clean pipe 0.25 to 2 inches diameter $/linear foot	$5.25
Removal of clean pipe >2 to 4 inches diameter $/linear foot	$6.39
Removal of clean pipe >4 to 8 inches diameter $/linear foot	$8.64
Removal of clean pipe >8 to 14 inches diameter $/linear foot	$16.78
Removal of clean pipe >14 to 20 inches diameter $/linear foot	$21.80
Removal of clean pipe >20 to 36 inches diameter $/linear foot	$32.08
Removal of clean pipe >36 inches diameter $/linear foot	$38.13
Removal of clean valves >2 to 4 inches	$63.86
Removal of clean valves >4 to 8 inches	$86.38
Removal of clean valves >8 to 14 inches	$151.52
Removal of clean valves >14 to 20 inches	$218.03
Removal of clean valves >20 to 36 inches	$320.83
Removal of clean valves >36 inches	$381.26
Removal of pipe fittings > 2 to 4 inches	$63.86
Removal of pipe fittings > 4 to 8 inches	$110.55
Removal of pipe fittings > 8 to 14 inches	$167.82
Removal of pipe fittings > 14 to 20 inches	$218.03
Removal of pipe fittings > 20 to 36 inches	$320.83
Removal of pipe fittings > 36 inches	$381.26
Removal of clean pipe hangers for small bore piping	$18.94
Removal of clean pipe hangers for large bore piping	$69.34
Removal of clean pumps, <300 pound	$145.36
Removal of clean pumps, 300-1000 pound	$361.75
Removal of clean pumps, 1000-10,000 pound	$1,518.99

APPENDIX B

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

Unit Cost Factor	Cost/Unit($)
Removal of clean pumps, >10,000 pound	$3,102.70
Removal of pump motors 300-1000 pounds	$131.68
Removal of pump motors 1000-10,000 pounds	$671.24
Removal of pump motors > 10,000 pounds	$1,510.29
Removal of clean turbine-driven pumps < 10,000 pounds	$1,848.04
Removal of clean turbine-driven pumps > 10,000 pounds	$3,596.13
Removal of clean heat exchanger <3000 pound	$754.79
Removal of clean heat exchanger >3000 pound	$2,161.77
Removal of clean feedwater heater/deaerator	$5,439.51
Removal of clean moisture separator	$12,584.29
Removal of clean tanks, <300 gallons	$187.03
Removal of clean tanks, 300-3000 gallons	$590.40
Removal of clean tanks, >3000 gallons, $/square foot surface area	$4.94
Removal of clean electrical equipment, <300 pound	$80.21
Removal of clean electrical equipment, 300-1000 pound	$227.98
Removal of clean electrical equipment, 1000-10,000 pound	$555.94
Removal of clean electrical equipment, >10,000 pound	$1,317.80
Removal of clean electrical transformers < 30 tons	$915.20
Removal of clean electrical transformers > 30 tons	$2,635.62
Removal of clean standby diesel-generator, <100 kW	$934.80
Removal of clean standby diesel-generator, 100 kW to 1 MW	$2,086.55
Removal of clean standby diesel-generator, >1 MW	$4,319.57
Removal of clean electrical cable tray, $/linear foot	$7.42
Removal of clean electrical conduit, $/linear foot	$3.24
Removal of clean mechanical equipment, <300 pound	$80.21

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

Unit Cost Factor	Cost/Unit($)
Removal of clean mechanical equipment, 300-1000 pound	$277.98
Removal of clean mechanical equipment, 1000-10,000 pound	$555.94
Removal of clean mechanical equipment, >10,000 pound	$1,317.80
Removal of clean HVAC equipment, <300 pound	$80.21
Removal of clean HVAC equipment, 300-1000 pound	$277.98
Removal of clean HVAC equipment, 1000-10,000 pound	$555.94
Removal of clean HVAC equipment, >10,000 pound	$1,317.80
Removal of clean HVAC ductwork, $/pound	$0.59
Removal/manual flame cut of clean thin metal components, $/inch-cut	$3.21
Asbestos clean removal (pipe/components)	$5.08
Removal of contaminated instrument and sampling tubing, $/linear foot	$0.49
Removal of contaminated pipe 0.25 to 2 inches diameter $/linear foot	$19.06
Removal of contaminated pipe >2 to 4 inches diameter $/linear foot	$47.97
Removal of contaminated pipe >4 to 8 inches diameter $/linear foot	$59.36
Removal of contaminated pipe >8 to 14 inches diameter $/linear foot	$107.15
Removal of contaminated pipe >14 to 20 inches diameter $/linear foot	$128.77
Removal of contaminated pipe >20 to 36 inches diameter $/linear foot	$180.44
Removal of contaminated pipe >36 inches diameter $/linear foot	$213.86
Removal of contaminated valves >2 to 4 inches	$226.75
Removal of contaminated valves >4 to 8 inches	$284.73
Removal of contaminated valves >8 to 14 inches	$535.73
Removal of contaminated valves >14 to 20 inches	$722.82
Removal of contaminated valves >20 to 36 inches	$969.61
Removal of contaminated valves >36 inches	$1,069.32
Removal of contaminated pipe fittings > 2 to 4 inches	$226.75

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

Unit Cost Factor	Cost/Unit($)
Removal of contaminated pipe fittings > 4 to 8 inches	$284.73
Removal of contaminated pipe fittings > 8 to 14 inches	$535.73
Removal of contaminated pipe fittings > 14 to 20 inches	$676.45
Removal of contaminated pipe fittings > 20 to 36 inches	$902.21
Removal of contaminated pipe fittings > 36 inches	$1,069.32
Removal of contaminated pipe hangers for small bore piping	$43.76
Removal of contaminated pipe hangers for large bore piping	$164.49
Removal of contaminated pumps, <300 pound	$445.18
Removal of contaminated pumps, 300-1000 pound	$1,077.94
Removal of contaminated pumps, 1000-10,000 pound	$4,894.73
Removal of contaminated pumps, >10,000 pound	$10,424.90
Removal of contaminated pump motors 300-1000 pounds	$472.29
Removal of contaminated pump motors 1000-10,000 pounds	$1,671.81
Removal of contaminated pump motors > 10,000 pounds	$3,479.86
Removal of contaminated turbine-driven pumps < 10,000 pound	$4,862.59
Removal of contaminated turbine-driven pumps > 10,000 pound	$10,259.97
Removal of contaminated BWR turbine generator	$271,861.69
Removal of contaminated heat exchanger <3000 pound	$2,585.99
Removal of contaminated heat exchanger >3000 pound	$6,639.53
Removal of contaminated feedwater heater	$16,271.80
Removal of contaminated moisture separator	$36,253.20
Removal of contaminated BWR main condensor	$667,308.63
Removal of contaminated tanks, <300 gallons	$792.23
Removal of contaminated tanks, >300 gallons, $/square foot	$16.33
Removal of contaminated electrical equipment, <300 pound	$283.30

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	$721.36
Removal of contaminated electrical equipment, 1000-10,000 pound	$1,350.11
Removal of contaminated electrical equipment, >10,000 pound	$2,876.05
Removal of contaminated electrical cable tray, $/linear foot	$26.95
Removal of contaminated electrical conduit, $/linear foot	$23.61
Removal of contaminated mechanical equipment, <300 pound	$283.30
Removal of contaminated mechanical equipment, 300-1000 pound	$721.36
Removal of contaminated mechanical equipment, 1000-10,000 pound	$1,350.11
Removal of contaminated mechanical equipment, >10,000 pound	$2,876.05
Removal of contaminated HVAC equipment, <300 pound	$283.30
Removal of contaminated HVAC equipment, 300-1000 pound	$721.36
Removal of contaminated HVAC equipment, 1000-10,000 pound	$1,350.11
Removal of contaminated HVAC equipment, >10,000 pound	$2,876.05
Removal of contaminated HVAC ductwork, $/pound	$1.73
Removal/plasma arc cut of contaminated thin metal components, $/linear in	$1.95
Additional decontamination of equipment,$/square foot	$5.08
Additional decontamination of large components, $/square foot	$17.63
Decontamination rig hook-up and flush	$2,110.58
Chemical flush of components/systems, $/gallon	$5.34
Removal of standard reinforced concrete, $/cubic yard	$295.62
Removal of grade slab concrete, $/cubic yard	$156.91
Removal of clean concrete floors, $/cubic yard	$196.49
Removal of sections of clean concrete floors, $/cubic yard	$614.19
Removal of clean heavily rein concrete w/#9 rebar, $/cubic yard	$150.96
Removal of contaminated heavily rein concrete w/#9 rebar, $/cubic yard	$1,186.98

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

Unit Cost Factor	Cost/Unit($)
Removal of clean heavily rein concrete w/#18 rebar, $/cubic yard	$192.46
Removal of contaminated heavily rein concrete w/#18 rebar, $/cy	$1,575.35
Removal heavily rein concrete w/#18 rebar & steel embedments, $/cy	$281.66
Removal of below grade suspended floors, $/square foot	$196.49
Removal of clean monolithic concrete structures, $/cubic yard	$546.06
Removal of contaminated monolithic concrete structures, $/cubic yard	$1,183.75
Removal of clean foundation concrete, $/cubic yard	$427.79
Removal of contaminated foundation concrete, $/cubic yard	$1,102.41
Explosive demolition of bulk concrete, $/cubic yard	$20.54
Removal of wooden structures $/cubic foot	$0.50
Removal of hyperbolic natural draft cooling tower $/cubic foot	$12.33
Removal of mechanical draft cooling tower $/cubic foot	$1.94
Removal of clean hollow masonry block wall, $/cubic yard	$56.23
Removal of contaminated hollow masonry block wall, $/cubic yard	$134.47
Removal of clean solid masonry block wall, $/cubic yard	$56.23
Removal of contaminated solid masonry block wall, $/cubic yard	$134.47
Placement of concrete for below grade voids, $/cubic yard	$76.32
Placement of entombment concrete, $/cubic yard	$287.63
Removal of subterranean tunnels/voids, $/linear foot	$92.22
Backfill of below grade voids, $/cubic yard	$14.64
Excavation of clean material, $/cubic yard	$2.70
Excavation of contaminated material, $/cubic yard	$6.46
Excavation of submerged concrete rubble, $/cubic yard	$8.97
Removal of clean concrete rubble, $/cubic yard	$44.92
Removal of contaminated concrete rubble, $/cubic yard	$20.23

APPENDIX B

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

Unit Cost Factor	Cost/Unit($)
Removal of building by volume, $/cubic foot	$0.19
Removal of clean building metal siding, $/square foot	$0.94
Removal of contaminated building metal siding, $/square foot	$2.27
Asbestos removal (roofing), $/ square foot	$3.71
Removal of standard asphalt roofing, $/square foot	$1.39
Removal of transite panels, $/square foot	$1.24
Scarifying contaminated concrete surfaces (drill & spall)	$7.42
Scabbling contaminated concrete floors $/square foot	$5.56
Scabbling contaminated concrete walls $/square foot	$16.58
Scabbling contaminated ceilings $/square foot	$55.26
Scabbling structural steel $/square foot	$3.68
Removal of clean overhead cranes/monorails < 10 ton capacity	$386.47
Removal of contaminated overhead cranes/monorails < 10 ton capacity	$854.14
Removal of clean overhead cranes/monorails >10 - 50 ton capacity	$927.52
Removal of contaminated overhead cranes/monorails >10 - 50 ton cap	$2,049.21
Removal of polar cranes > 50 ton capacity, each	$3,864.58
Removal of gantry cranes > 50 ton capacity, each	$14,715.61
Removal of structural steel, $/pound	$0.23
Removal of contaminated structural steel $/pound	$0.56
Removal of clean steel floor grating, $/square foot	$2.10
Removal of contaminated steel floor grating, $/square foot	$5.01
Removal of clean free-standing steel liner, $/square foot	$7.41
Removal of contaminated free-standing steel liner, $/square foot	$17.41
Removal of clean concrete anchored steel liner, $/square foot	$3.71
Removal of contaminated concrete anchored steel liner, $/square foot	$20.35

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

Unit Cost Factor	Cost/Unit($)
Placement of scaffolding in clean areas, $/square foot	$3.27
Placement of scaffolding in contaminated areas, $/square foot	$5.37
Landscaping with topsoil, $/acre	$15,766.65
Landscaping w/o topsoil, $/acre	$2,223.96
Cost of LSA box & preparation for use	$1,091.40
Cost of LSA drum & preparation for use	$115.33
Cost of cask liner for CNSI 14-195 cask	$6,774.00
Cost of cask liner for CNSI 8-120A cask (resins)	$9,367.52
Cost of cask liner for CNSI 8-120A cask (filters)	$9,360.45
Decontamination of surfaces with vacuuming, $/square foot	$0.85

APPENDIX C

DETAILED COST ANALYSES

TABLE C-1
DECON COST ESTIMATE FOR SUSQUEHANNA STEAM ELECTRIC STATION UNIT 1
(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						85	13	98	98						
2. Prepare proposed decommissioning plan						263	39	302	302						
3. Remove fuel & source material								n/a							
4. Decon plant & process waste								a							
5. Review plant dwgs & specs.						302	45	348	348						
6. Perform detailed rad survey								a							
7. Estimate by-product inventory						66	10	76	76						
8. Submit for license amendment						105	16	121	121						
9. End product description						66	10	76	76						
10. Detailed by-product inventory						85	13	98	98						
11. Define major work sequence						493	74	567	567						
12. Perform safety analysis						204	31	234	234						
13. Submit dismantling plan						34	5	39	39						
14. Receive license amendment								a							
15. Receive dismantling order								a							
Subtotal Period 1 Activity Costs						1703	255	1959	1959						
Period 1 Undistributed Costs															
1. Decon equipment						189	28	217	217						
2. Decon supplies						132	33	165	165						
3. DOC staff relocation expenses						737	110	847	847						
4. Process liquid waste	77		41	51	218		83	471	471		525			138	3
5. Insurance						370	37	407	407						
6. Property taxes						15	2	17	17						
7. Health physics supplies						914	229	1143	1143						
8. Heavy equipment rental						108	16	124	124						
9. Disposal of DAW generated			234	4	793		143	1175	1175	2749				7476	19

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

TABLE C-1 (continued)
DECON COST ESTIMATE FOR SUSQUEHANNA STEAM ELECTRIC STATION UNIT 1

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						1520	228	1747	1747							
11. NRC Fees						74	7	81	81							
12. Emergency Planning Fees						151	15	166	166							
Subtotal Undistributed Costs Period 1	77		276	55	1011	4208	931	6559	6559		2749	525			7615	22
Staff Costs																
DOC Staff Cost						5704	856	6559	6559							
Utility Staff Cost						8225	1234	9459	9459							
TOTAL PERIOD 1 COST	77		276	55	1011	19840	3276	24536	24536		2749	525			7615	22
PERIOD 2																
Activity Specifications																
16.1 Plant & temporary facilities						323	48	372	335	37						
16.2 Plant systems						274	41	315	283	31						
16.3 Reactor internals						467	70	537	537							
16.4 Reactor vessel						427	64	491	491							
16.5 Sacrificial shield						33	5	38	38							
16.6 Moisture separators/reheaters						66	10	76	76							
16.7 Reinforced concrete						105	16	121	60	60						
16.8 Turbine & condenser						274	41	315	315							
16.9 Pressure suppression structure						131	20	151	151							
16.10 Primary containment						105	16	121	121							
16.11 Plant structures & buildings						205	31	236	118	118						
16.12 Waste management						302	45	348	348							
16.13 Facility & site closeout						59	9	68	34	34						
16. Total						2771	416	3187	2906	281						
Planning & Site Preparations																
17. Prepare dismantling sequence						158	24	181	181							
18. Plant prep. & temp. svces						1485	223	1708	1708							
19. Design water clean-up system						92	14	106	106							

TABLE C-1 (continued)
DECON COST ESTIMATE FOR SUSQUEHANNA STEAM ELECTRIC STATION UNIT 1

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean	A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
20. Rigging/CCES/tooling/etc.						1257	189	1446	1446							
21. Procure casks/liners & containers						81	12	93	93							
Detailed Work Procedures																
22.1 Plant systems						311	47	358	322	36						
22.2 Vessel head						16	2	18	18							
22.3 Reactor internals						263	39	302	302							
22.4 Remaining buildings						89	13	102	26	77						
22.5 CRD housings & ICI tubes						66	10	76	76							
22.6 Incore instrumentation						66	10	76	76							
22.7 Removal primary containment						131	20	151	151							
22.8 Reactor vessel						239	36	274	274							
22.9 Facility closeout						79	12	91	45	45						
22.10 Sacrificial shield						79	12	91	91							
22.11 Reinforced concrete						66	10	76	38	38						
22.12 Turbine & condensers						274	41	315	315							
22.13 Moisture separators & reheaters						131	20	151	151							
22.14 Radwaste building						179	27	206	186	21						
22.15 Reactor building						179	27	206	186	21						
22. Total						2167	325	2492	2256	237						
Decon NSSS/Rack Removal																
23. Decon NSSS	923						462	1385	1385						800	8
24. Remove spent fuel racks	404	90	158	26	1630	1192	525	4025	4025		5842				13349	70
Nuclear Steam Supply System Removal																
25.1 Recirculation System Piping & Valves	94	167	92	36	2270		444	3101	3101		7450				8177	312
25.2 Recirculation Pumps & Motors	26	26	12	4	700		126	895	895		2358				1677	27
25.3 CRDMs & ICIs Removal	106	74	51	30	1081		243	1584	1584		3451				5337	100
25.4 Reactor vessel internals	98	2295	574	797	9010		4365	17140	17140		917	2380	748	226	40066	234
25.5 Reactor vessel	233	4496	646	770	4394		4941	15480	15480		10218	2489			26619	164
25. Totals	556	7057	1375	1637	17456		10119	38201	38201		24395	4869	748	226	81876	838
Removal of Major Equipment																
26. Main Turbine/Generator		267	1508	255	3522	1864	1064	8479	8479		12183				8190	12
27. Main Condensers	1742	668	503	96	2552	2557	1869	9988	9988		8849				20855	149

TABLE C-1 (continued)
DECON COST ESTIMATE FOR SUSQUEHANNA STEAM ELECTRIC STATION UNIT 1

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																
28.1 Acid Injector for Circulating Water		13					2	15		15					425	
28.2 Air Removal and Sealing Steam		591	176	19	1751	362	485	3384	3384		6071				18779	49
28.3 Building Vent Stack Monitoring		2	1	<1	8	5	3	20	20		27				68	<1
28.4 Chemical Addition System		1					<1	2	<1	1					45	
28.5 Chlorination		5					<1	6		6					160	
28.6 Circ Pumphouse HVAC		30					4	34		34					911	
28.7 Circulating Water		181					27	208	42	166					5869	
28.8 Clean Up Filter Demineralizer		131	19	3	130	69	65	417	417		450				4032	20
28.9 Compressed Air		128					19	147	22	125					4106	
28.10 Condensate		1242	290	38	2648	690	846	5754	5754		9181				38972	106
28.11 Containment Atmosphere Control		121	55	7	306	189	111	789	789		1061				4027	6
28.12 Containment Instrument Gas		75	24	4	206	78	64	451	451		713				2387	4
28.13 Control Rod Drive		108	19	3	129	69	59	387	387		447				3350	3
28.14 Control Structure HVAC		24					4	27		27					720	
28.15 Core Sprav		264	127	16	1593	173	346	2519	2519		5523				8623	23
28.16 Demineralized Water Distribution		<1					<1	1	<1	<1					31	
28.17 Diesel Gen Bldgs & Pump House HVAC		24					4	28		28					746	
28.18 Drywell Air Flow		8	3	<1	18	13	7	50	50		62				286	<1
28.19 Electrical (clean)		949					142	1092		1092					30065	
28.20 Electrical (contaminated)		2617	438	80	2687	1901	1398	9121	9121		9316				84679	108
28.21 Electrical (decontaminated)	15	66					17	99	15	84					2551	
28.22 Emergency Service Water		59					9	68	17	51					1883	
28.23 Extraction Steam		661	298	35	4660	699	1004	7357	7357		16159				21567	61
28.24 Feed Pump Turbine Steam		37					6	43	4	38					1205	
28.25 Feedwater		576	132	20	718	452	336	2235	2235		2488				18274	48
28.26 Feedwater Drainage		705	153	20	775	457	379	2489	2489		2688				22089	56
28.27 Fire Protection		116					17	133	40	93					3738	
28.28 Fuel Pool Cooling and Clean-up	144	319	65	11	449	236	263	1486	1486		1557				13454	75
28.29 Fuel Pool Filter Demineralizer	35	73	13	2	76	49	56	304	304		265				3168	35
28.30 Gaseous Radwaste Recombiner CCW		39	23	3	350	14	67	497	497		1215				1292	2
28.31 Generator H2 Cooling Makeup		4					<1	5	<1	4					130	
28.32 Generator Stator Cooling Water		22					3	25	3	23					710	
28.33 High Pressure Coolant Injection		104	25	4	137	86	63	419	419		476				3311	9
28.34 HPCI Turbine Pump		102	66	7	907	57	178	1317	1317		3146				3387	4

TABLE C-1 (continued)
DECON COST ESTIMATE FOR SUSQUEHANNA STEAM ELECTRIC STATION UNIT 1

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)																
28.35 Instrument Air		39					6	45	23	23					1272	
28.36 Liquid Radwaste		286	42	8	277	154	141	907	907		959				8813	46
28.37 Lube Oil		48					7	55	5	49					1525	
28.38 Main Steam		405	241	37	4488	379	861	6410	6410		15561				13641	38
28.39 Main Turbine EHC Air Flow		13					2	15	2	14					431	
28.40 Main Turbine Lube Oil		49					7	56	6	51					1570	
28.41 Miscellaneous Buildings HVAC		24					4	27		27					720	
28.42 Miscellaneous Drainage		54	9	2	55	32	27	178	178		191				1653	4
28.43 MSIV - Leakage Control		44	6	1	57	17	23	147	147		196				1381	2
28.44 Nuclear Boiler		24	15	2	64	46	24	176	176		223				835	7
28.45 Off Gas		153	109	7	259	150	111	789	789		897				5098	8
28.46 Process Sampling		48	24	3	138	43	42	298	298		478				1695	4
28.47 Radwaste Building HVAC		69	7	1	40	28	28	173	173		137				1786	4
28.48 RCIC Turbine Pump		65	29	3	291	70	74	530	530		1008				2101	2
28.49 Reactor Building Closed Cooling Water		53					8	61	61						1694	
28.50 Reactor Building HVAC		891	236	35	1912	709	645	4427	4427		6629				27102	46
28.51 Reactor Core Isolation Cooling		92	18	3	105	66	51	334	334		365				2877	7
28.52 Reactor Recirc Motor-Generator Set		119	45	5	197	134	85	584	584		683				3828	6
28.53 Reactor Recirculation		46	6	1	41	20	21	135	135		140				1421	1
28.54 Reactor Water Clean-up	64	140	30	5	305	92	130	766	766		1057				6228	35
28.55 Residual Heat Removal	376	652	303	39	2481	780	877	5508	5508		8603				27067	150
28.56 RFPT/RFP Oil Reservoir		44					7	51	5	46					1419	
28.57 RHR Service Water		49					7	56	14	42					1581	
28.58 Service and Admin Building HVAC		24					4	27		27					720	
28.59 Service Water		189					28	217	43	174					6112	
28.60 Solid Radwaste Collection		58	7	1	47	25	26	165	165		163				1795	10
28.61 Standby Liquid Control		15					2	17	17						465	
28.62 Turbine Bldg Closed Cooling Water		45					7	51	8	44					1431	
28.63 Turbine Building HVAC		213					32	244	61	183					6723	
28. Totals	634	13348	3056	424	28301	8345	9274	63381	60913	2468	98136				438022	980
29. Erect Scaffolding for Systems Removal		881					132	1013	1013						21275	

TABLE C-1 (continued)
DECON COST ESTIMATE FOR SUSQUEHANNA STEAM ELECTRIC STATION UNIT 1

Activity	Decon	Remove	Pack	Ship	Burv	Other	Cntgcy	Total	LicTerm	Clean	A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
Decontamination of Site Buildings																
30.1 Reactor	2681	2337	390	72	7858	940	3294	17572	17572		27250				141676	519
30.2 Turbine	1176	185	164	27	3454	368	1228	6602	6602		11978				28596	48
30. Totals	3857	2522	553	99	11313	1308	4522	24174	24174		39229				170272	567
31. License termination survey						339	51	390	390							
32. Terminate license								a								
Subtotal Period 2 Activity Costs	8117	24833	7153	2538	64773	23616	29219	160249	157263	2986	188634	4869	748	226	754639	2624
Period 2 Undistributed Costs																
1. Decon equipment						189	28	217	217							
2. Decon supplies						470	118	588	588							
3. DOC staff relocation expenses						737	110	847	847							
4. Process liquid waste	449		1347	1257	9556		1981	14591	14591			20542			1392	32
5. Insurance						1112	111	1223	1223							
6. Property taxes						36	4	39	35	4						
7. Health physics supplies						3256	814	4070	4070							
8. Heavy equipment rental						7302	1095	8397	7557	840						
9. Small tool allowance						445	67	512	461	51						
10. Pipe cutting equipment						587	88	675	675							
11. Decon rig						763	114	878	878							
12. Disposal of DAW generated			835	16	2871		517	4239	4239		9959				26632	67
13. Plant energy budget						3529	529	4058	3652	406						
14. NRC Fees						350	35	385	385							
Subtotal Undistributed Costs Period 2	449		2181	1273	12428	18775	5612	40719	39418	1301	9959	20542			28024	99
Staff Costs																
DOC Staff Cost						19640	2946	22586	22586							
Utility Staff Cost						50447	7567	58014	58014							
TOTAL PERIOD 2	8566	24833	9334	3812	77201	112478	45344	281568	277282	4286	198592	25411	748	226	782663	2722

TABLE C-1 (continued)
DECON COST ESTIMATE FOR SUSQUEHANNA STEAM ELECTRIC STATION UNIT 1

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean	A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
PERIOD 3																
Demolition of Remaining Site Buildings																
33.1 Reactor		16064					2410	18473	924	17550					341322	
33.2 Cooling Tower		2639					396	3035		3035					56276	
33.3 Transformer Foundation Unit 1		54					8	62		62					1109	
33.4 Turbine		10627					1594	12221	611	11610					223708	
33. Totals		29383					4408	33791	1535	32256					622416	
Site Closeout Activities																
34. Grade & landscape site		1892					284	2176		2176					10035	
35. Final report to NRC						103	15	118	118							
Subtotal Period 3 Activity Costs		31275				103	4707	36085	1653	34432					632450	
Period 3 Undistributed Costs																
1. Insurance						397	40	437	437							
2. Property taxes						55	6	61		61						
3. Heavy equipment rental						1906	286	2192		2192						
4. Small tool allowance						369	55	425		425						
5. Plant energy budget						398	60	457		457						
Subtotal Undistributed Costs Period 3						3125	446	3571	437	3134						
Staff Costs																
DOC Staff Cost						3220	483	3703		3703						
Utility Staff Cost						923	138	1061	955	106						
TOTAL PERIOD 3		31275				7371	5774	44421	3045	41376					632450	
TOTAL COST TO DECOMMISSION	8643	56108	9610	3867	78212	139689	54395	350524	304862	45662	201341	25937	748	226	1422728	2744

TABLE C-1 (continued)
DECON COST ESTIMATE FOR SUSQUEHANNA STEAM ELECTRIC STATION UNIT 1

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 WITH 18.37% CONTINGENCY: $350,524,416

Total NRC license termination cost is 86.97% of $304,861,984

Non-nuclear demolition cost is 13.03% of: $ 45,662,428

Total radwaste volume buried:	228,251	cubic feet
Total scrap metal removed:	11,408.8	tons
Total craft labor requirements:	1,422,727.8	man-hours
Total personnel radiation exposure:	2,744.4	man-Rem
Total craft labor cost with 24.52% contingency:	$ 55,734,372	

TABLE C-2
DECON COST ESTIMATE FOR SUSQUEHANNA STEAM ELECTRIC STATION UNIT 2
(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						85	13	98	98						
2. Prepare proposed decommissioning plan						263	39	302	302						
3. Remove fuel & source material								n/a							
4. Decon plant & process waste								a							
5. Review plant dwgs & specs.						302	45	348	348						
6. Perform detailed rad survey								a							
7. Estimate by-product inventory						66	10	76	76						
8. Submit for license amendment						105	16	121	121						
9. End product description						66	10	76	76						
10. Detailed by-product inventory						85	13	98	98						
11. Define major work sequence						493	74	567	567						
12. Perform safety analysis						204	31	234	234						
13. Submit dismantling plan						34	5	39	39						
14. Receive license amendment								a							
15. Receive dismantling order								a							
Subtotal Period 1 Activity Costs						1703	255	1959	1959						
Period 1 Undistributed Costs															
1. Decon equipment						189	28	217	217						
2. Decon supplies						132	33	165	165						
3. DOC staff relocation expenses						737	110	847	847						
4. Process liquid waste	77		41	51	218		83	471	471		525			134	3
5. Insurance						923	92	1015	1015						
6. Property taxes						38	4	41	41						
7. Health physics supplies						915	229	1143	1143						
8. Heavy equipment rental						108	16	124	124						
9. Disposal of DAW generated			234	4	793		143	1175	1175	2751				7483	19

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

TABLE C-2 (continued)
DECON COST ESTIMATE FOR SUSQUEHANNA STEAM ELECTRIC STATION UNIT 2

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						4810	721	5531	5531							
11. NRC Fees						185	18	203	203							
12. Emergency Planning Fees						375	38	413	413							
Subtotal Undistributed Costs Period 1	77		275	55	1012	8410	1516	11345	11345		2751	525			7617	22
Staff Costs																
DOC Staff Cost						3866	580	4446	4446							
Utility Staff Cost						22972	3446	26418	26418							
TOTAL PERIOD 1 COST	77		275	55	1012	36952	5798	44168	44168		2751	525			7617	22
PERIOD 2																
Activity Specifications																
16.1 Plant & temporary facilities						323	48	372	335	37						
16.2 Plant systems						274	41	315	283	31						
16.3 Reactor internals						467	70	537	537							
16.4 Reactor vessel						427	64	491	491							
16.5 Sacrificial shield						33	5	38	38							
16.6 Moisture separators/reheaters						66	10	76	76							
16.7 Reinforced concrete						105	16	121	60	60						
16.8 Turbine & condenser						274	41	315	315							
16.9 Pressure suppression structure						131	20	151	151							
16.10 Primary containment						105	16	121	121							
16.11 Plant structures & buildings						205	31	236	118	118						
16.12 Waste management						302	45	348	348							
16.13 Facility & site closeout						59	9	68	34	34						
16. Total						2771	416	3187	2906	281						
Planning & Site Preparations																
17. Prepare dismantling sequence						158	24	181	181							
18. Plant prep. & temp. svces						1485	223	1708	1708							
19. Design water clean-up system						92	14	106	106							

TABLE C-2 (continued)
DECON COST ESTIMATE FOR SUSQUEHANNA STEAM ELECTRIC STATION UNIT 2

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
20. Rigging/CCEs/tooling/etc.						1257	189	1446	1446						
21. Procure casks/liners & containers						81	12	93	93						
Detailed work Procedures															
22.1 Plant systems						311	47	358	322	36					
22.2 Vessel head						16	2	18	18						
22.3 Reactor internals						263	39	302	302						
22.4 Remaining buildings						89	13	102	26	77					
22.5 CRD housings & ICI tubes						66	10	76	76						
22.6 Incore instrumentation						66	10	76	76						
22.7 Removal primary containment						131	20	151	151						
22.8 Reactor vessel						239	36	274	274						
22.9 Facility closeout						79	12	91	45	45					
22.10 Sacrificial shield						79	12	91	91						
22.11 Reinforced concrete						66	10	76	38	38					
22.12 Turbine & condensers						274	41	315	315						
22.13 Moisture separators & reheaters						131	20	151	151						
22.14 Radwaste building						179	27	206	186	21					
22.15 Reactor building						179	27	206	186	21					
22. Total						2167	325	2492	2256	237					
Decon NSSS/Rack Removal															
23. Decon NSSS	923						462	1385	1385					800	8
24. Remove spent fuel racks	399	90	157	26	1630	1192	524	4019	4019	5842				13172	68
Nuclear Steam Supply System Removal															
25.1 Recirculation System Piping & Valves	91	164	91	36	2270		442	3094	3094	7450				8010	307
25.2 Recirculation Pumps & Motors	25	26	12	4	700		126	893	893	2358				1641	27
25.3 CRDMS & ICIS Removal	103	74	50	30	1081		242	1580	1580	3451				5256	99
25.4 Reactor Vessel Internals	92	2270	562	699	8369		4156	16148	16148	917	2380	612	226	39403	231
25.5 Reactor Vessel	227	4491	646	645	4360		4895	15266	15266	10218	2489			26542	163
25. Totals	539	7026	1362	1414	16780		9861	36982	36982	24395	4869	612	226	80852	827
Removal of Major Equipment															
26. Main Turbine/Generator		261	1503	255	3522	1864	1062	8467	8467	12183				8012	12
27. Main Condensers	1742	655	501	96	2552	2557	1866	9970	9970	8849				20446	146

TABLE C-2 (continued)
DECON COST ESTIMATE FOR SUSQUEHANNA STEAM ELECTRIC STATION UNIT 2

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																
28.1 A - D Diesel Auxiliaries		134					20	154		154					4305	
28.2 Acid Injector for Circulating Water		21					3	24		24					667	
28.3 Air Removal and Sealing Steam		666	188	20	1761	375	509	3519	3519		6107				21070	56
28.4 Auxiliary Steam		364	145	8	796	174	252	1740	1740		2761				11571	18
28.5 Building Vent Stack Monitoring		3	2	<1	9	6	3	23	23		31				94	<1
28.6 Chemical Addition System		11					2	13	1	11					351	
28.7 Chlorination		12					2	14		14					390	
28.8 Circ Pumphouse HVAC		38					6	44		44					1171	
28.9 Circulating Water		190					29	219	44	175					6174	
28.10 Clean Up Filter Demineralizer		137	17	3	116	63	63	400	400		403				4210	21
28.11 Compressed Air		161					24	185	28	157					5186	
28.12 Condensate		1984	496	69	3787	1493	1348	9176	9176		13131				62794	170
28.13 Containment Atmosphere Control		138	63	7	357	220	128	914	914		1239				4574	7
28.14 Containment Instrument Gas		79	23	4	208	76	65	456	456		722				2504	4
28.15 Control Rod Drive		116	18	3	127	64	60	388	388		439				3587	4
28.16 Control Structure HVAC		162					24	186		186					5175	
28.17 Core Spray		274	122	15	1563	155	340	2468	2468		5418				8847	24
28.18 Demineralized Water Distribution		6					<1	7	4	4					208	
28.19 Diesel Aux Jacket Water Storage		25					4	29		29					796	
28.20 Diesel Gen Bldgs & Pump House HVAC		43					6	49		49					1325	
28.21 Diesel Oil Storage and Transfer		86					13	99		99					2691	
28.22 Domestic Water Distribution		152					23	174		174					4815	
28.23 Drywell Air Flow		8	3	<1	18	13	7	49	49		62				276	<1
28.24 E Diesel Auxiliaries		43					6	49		49					1362	
28.25 Electrical (clean)		4952					743	5695		5695					156835	
28.26 Electrical (contaminated)		4244	757	140	4739	3352	2371	15603	15603		16432				137397	174
28.27 Electrical (decontaminated)	26	114					30	170	26	144					4399	
28.28 Emergency Service Water		158					24	181	45	136					5066	
28.29 Extraction Steam		710	313	35	4751	767	1042	7618	7618		16475				23092	66
28.30 Feed Pump Turbine Steam		40					6	46	5	41					1293	
28.31 Feedwater		631	135	19	733	471	355	2344	2344		2542				19915	53
28.32 Feedwater Drainage		776	149	18	741	444	389	2518	2518		2569				24193	63
28.33 Fire Protection		335					50	385	116	270					10839	
28.34 Fuel Pool Cooling and Clean-up	166	360	66	11	453	241	285	1582	1582		1571				15110	85

TABLE C-2 (continued)
DECON COST ESTIMATE FOR SUSQUEHANNA STEAM ELECTRIC STATION UNIT 2

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)																
28.35 Fuel Pool Filter Demineralizer	82	171	25	4	153	97	125	658	658		530				7458	84
28.36 Gaseous Radwaste Recombiner CCW	28	47	24	3	353	17	84	555	555		1225				2174	4
28.37 Gatehouses & Security Center HVAC		61					9	71		71					1896	
28.38 Generator H2 Cooling Makeup		4					<1	5	<1	4					128	
28.39 Generator Stator Cooling Water		23					3	26	3	23					729	
28.40 High Pressure Coolant Injection		116	27	4	149	96	69	461	461		516				3658	10
28.41 HPCI Turbine Pump		104	65	6	902	55	177	1310	1310		3129				3428	4
28.42 Instrument Air		75					11	87	43	43					2441	
28.43 Liquid Radwaste		1719	239	39	1410	810	792	5009	5009		4888				53024	291
28.44 Lube Oil		47					7	54	5	49					1515	
28.45 Main Steam		450	267	38	4854	450	940	6999	6999		16831				15116	42
28.46 Main Turbine EHC Air Flow		13					2	15	2	14					425	
28.47 Main Turbine Lube Oil		49					7	57	6	51					1580	
28.48 Makeup Demineralizer		104					16	120		120					3338	
28.49 Makeup Water Supply		71					11	82		82					2295	
28.50 Miscellaneous Buildings HVAC		36					5	41		41					1101	
28.51 Miscellaneous Drainage		308	51	9	317	189	159	1033	1033		1099				9448	26
28.52 MSIV - Leakage Control		48	5	<1	60	15	24	153	153		208				1489	2
28.53 Nuclear Boiler		26	10	2	55	39	22	154	154		192				868	8
28.54 Off Gas		165	108	6	259	148	114	800	800		898				5450	8
28.55 Primary Coolant Degasifier		71	22	3	123	86	52	356	356		426				2252	13
28.56 Process Sampling		52	24	3	148	45	45	317	317		513				1771	4
28.57 Radwaste Building HVAC		485	105	17	846	323	310	2086	2086		2934				14676	24
28.58 Radwaste Solidification	40	82	24	2	78	47	62	335	335		270				3769	22
28.59 Raw Water Treatment		206					31	237		237					6490	
28.60 RCIC Turbine Pump		66	29	3	288	68	73	526	526		998				2128	2
28.61 Reactor Building Closed Cooling Water		55					8	63	63						1759	
28.62 Reactor Building HVAC		957	251	37	1990	773	685	4694	4694		6901				29087	49
28.63 Reactor Core Isolation Cooling		101	17	3	101	65	52	339	339		352				3145	8
28.64 Reactor Recirc Motor-Generator Set		128	44	5	196	134	87	594	594		679				4099	7
28.65 Reactor Recirculation		48	5	<1	36	18	21	129	129		124				1478	2
28.66 Reactor Water Clean-Up	65	146	29	5	294	87	130	755	755		1019				6404	36
28.67 Residual Heat Removal	428	728	332	39	2648	905	968	6047	6047		9181				29763	166
28.68 RFPT/RFP Oil Reservoir		43					7	50	5	45					1394	

TABLE C-2 (continued)
DECON COST ESTIMATE FOR SUSQUEHANNA STEAM ELECTRIC STATION UNIT 2

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)																
28.69 RHR Service Water		122					18	140	35	105					3943	
28.70 Security Diesel Generator		1					<1	2		2					42	
28.71 Service and Admin Building HVAC		42					6	48		48					1289	
28.72 Service Water		207					31	238	48	190					6689	
28.73 Sewage Treatment		87					13	100		100					2729	
28.74 Solid Rawaste Collection		311	34	6	228	121	134	834	834		791				9550	52
28.75 Standby Liquid Control		14					2	17	17						459	
28.76 Turbine Bldg Closed Cooling Water		45					7	52	8	44					1438	
28.77 Turbine Building HVAC		231					35	266	66	199					7325	
28. Totals	835	25038	4236	589	35645	12500	13589	92433	83510	8923	123606				811520	1609
29. Erect scaffolding for systems removal		1529					229	1758	1758						36940	
Decontamination of Site Buildings																
30.1 Reactor	2637	2285	388	72	7858	940	3259	17440	17440		27250				138793	509
30.2 Low Level Radwaste Facility	45		3	<1	116		40	205	205		403				1062	2
30.3 Miscellaneous Structures	41		5	1	179		48	274	274		621				1009	
30.4 Radwaste Building	494	8	40	8	1274	16	448	2288	2288		4417				11873	84
30.5 Turbine	1160	181	163	27	3454	368	1219	6572	6572		11978				28096	47
30. Totals	4377	2474	600	109	12882	1324	5014	26779	26779		44669				180832	642
31. License termination survey						339	51	390	390							
32. Terminate license								a								
Subtotal Period 2 Activity Costs	8816	37073	8360	2489	73012	27787	33859	191396	181955	9441	219543	4869	612	226	1152575	3313
Period 2 Undistributed Costs																
1. Decon equipment						189	28	217	217							
2. Decon supplies						457	114	571	571							
3. DOC staff relocation expenses						737	110	847	847							
4. Process liquid waste	487		1414	1324	10027		2087	15339	15339			21566			1441	34
5. Insurance						1079	108	1187	1187							
6. Property taxes						35	3	38	34	4						
7. Health physics supplies						3161	790	3951	3951							

TABLE C-2 (continued)
DECON COST ESTIMATE FOR SUSQUEHANNA STEAM ELECTRIC STATION UNIT 2

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 (continued)																
8. Heavy equipment rental						7088	1063	8151	7336	815						
9. Small tool allowance						665	100	765	689	77						
10. Pipe cutting equipment						587	88	675	675							
11. Decon rig						763	114	878	878							
12. Disposal of DAW generated			808	16	2825		507	4155	4155		9799				25853	65
13. Plant energy budget						4165	625	4790	4311	479						
14. NRC fees						340	34	374	374							
Subtotal Undistributed Costs Period 2	487		2222	1340	12852	19265	5773	41939	40564	1374	9799	21566			27294	98
Staff Costs																
DOC Staff Cost						23791	3569	27359	27359							
Utility Staff Cost						59666	8950	68615	68615							
TOTAL PERIOD 2	9303	37073	10582	3829	85863	130509	52151	329309	318494	10815	229342	26435	612	226	1179869	3411
PERIOD 3																
Demolition of Remaining Site Buildings																
33.1 Reactor		16064					2410	18473	924	17550					341322	
33.2 Administration		173					26	199		199					2902	
33.3 Circ Water Pumphouse & Water Treat		560					84	644		644					10099	
33.4 Control		2763					414	3177		3177					43975	
33.5 Cooling Tower		2638					396	3034		3034					56262	
33.6 Diesel Generator		1247					187	1434		1434					17572	
33.7 Diesel Generator "E"		514					77	591		591					8156	
33.8 Domestic Fire Pumphouse		5					<1	6		6					114	
33.9 Engineered Safeguard & Spray Pond		4225					634	4859		4859					72168	
33.10 Hazardous Waste Storage Facility		12					2	14		14					264	
33.11 Low Level Radwaste Facility		1318					198	1516	76	1440					21308	
33.12 Miscellaneous Structures		1424					214	1638		1638					28840	
33.13 Miscellaneous Yard Struct & Foundations		204					31	235		235					2879	
33.14 North and South Gatehouses		501					75	576		576					7701	

TABLE C-2 (continued)
DECON COST ESTIMATE FOR SUSQUEHANNA STEAM ELECTRIC STATION UNIT 2

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 (continued)															
33.15 Project Office		298					45	342		342				4965	
33.16 Radwaste Building		2987					448	3435	172	3263				53629	
33.17 River Intake Structure		257					39	296		296				4410	
33.18 Security Control Center		63					9	72		72				916	
33.19 Service & Administration		454					68	522		522				8717	
33.20 Sewage Treatment Plant		26					4	30		30				539	
33.21 Turbine		10627					1594	12221	611	11610				223708	
33. Totals		46360					6954	53314	1782	51532				910447	
Site Closeout Activities															
34. Remove Rubble		3527					529	4056		4056				10757	
35. Grade & landscape site		1892					284	2176		2176				10035	
36. Final report to NRC						103	15	118	118						
Subtotal Period 3 Activity Costs		51779				103	7782	59664	1900	57764				931238	
Period 3 Undistributed Costs															
1. Insurance						149	15	163	163						
2. Property taxes						17	2	19		19					
3. Heavy equipment rental						1981	297	2278		2278					
4. Small tool allowance						539	81	620		620					
5. Plant energy budget						137	20	157		157					
Subtotal Undistributed Costs Period 3						2823	415	3238	163	3074					
Staff Costs															
DOC Staff Cost						8053	1208	9261		9261					
Utility Staff Cost						7039	1056	8095	7286	810					
TOTAL PERIOD 3		51779				18017	10461	80258	9349	70908				931238	
TOTAL COST TO DECOMMISSION	9380	88852	10857	3885	86875	185478	68409	453735	372012	81723	232093	26961	612	226	2118724	3433

TABLE C-2 (continued)
DECON COST ESTIMATE FOR SUSQUEHANNA STEAM ELECTRIC STATION UNIT 2

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 WITH 17.75% CONTINGENCY: $453,735,072

Total NRC license termination cost is 81.99% of $372,011,744

Non-nuclear demolition cost is 18.01% of: $ 81,723,288

Total radwaste volume buried:	259,891	cubic feet
Total scrap metal removed:	35,712.1	tons
Total craft labor requirements:	2,118,724.0	man-hours
Total personnel radiation exposure:	3,432.6	man-Rem
Total craft labor cost with 22.43% contingency:	$ 80,990,936	

TABLE C-3

SAFSTOR COST ESTIMATE FOR SUSQUEHANNA STEAM ELECTRIC STATION UNIT 1

(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						79	12	91	91						
2. Prepare proposed decommissioning plan						205	31	236	236						
3. Remove fuel & source material								n/a							
4. Decon plant & process waste								a							
5. Review plant dwgs & specs.						85	13	98	98						
6. Perform detailed rad survey								a							
7. Estimate by-product inventory						66	10	76	76						
8. Submit for possession-only license						66	10	76	76						
9. End product description						66	10	76	76						
10. Detailed by-product inventory						99	15	113	113						
11. Define major work sequence						66	10	76	76						
12. Perform safety analysis of operation						131	20	151	151						
13. Perform safety analysis of end product						131	20	151	151						
14. Submit dismantling plan						66	10	76	76						
15. Receive possession-only license								a							
Activity Specifications															
16.1 Prepare plant and facilities for SAFSTOR						323	48	372	372						
16.2 Plant systems						274	41	315	315						
16.3 Plant structures and buildings						205	31	236	236						
16.4 Waste management						131	20	151	151						
16.5 Facility and site dormancy						131	20	151	151						
16. Total						1065	160	1225	1225						
Detailed Work Procedures															
17.1 Plant systems						311	47	358	358						
17.2 Facility closeout & dormancy						79	12	91	91						
17. Total						390	58	448	448						

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

TABLE C-3 (continued)
SAFSTOR COST ESTIMATE FOR SUSQUEHANNA STEAM ELECTRIC STATION UNIT 1

Activity	Decon	Remove	Pack	Ship	Bury	other	Cntgcy	Total	LicTerm	Clean	A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
18. Procure vacuum drying system						7	<1	8	8							
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	1991						996	2987	1991	996					54686	
23.2 Turbine	744						372	1115	744	372					17611	
23. Totals	2735						1367	4102	2735	1367					72296	
24. Prepare support equipment for storage		258					39	297	297						3000	3
25. Install containment pressure equal. line		24					4	28	28						700	2
26. Interim survey prior to dormancy						339	51	390	390							
27. Secure building accesses								a								
28. Prepare & submit interim report						38	6	44	44							
Subtotal Period 1 Activity Costs	2735	283				2898	1845	7760	6393	1367					75996	5
Period 1 Undistributed Costs																
1. Decon equipment						189	28	217	217							
2. Decon supplies						132	33	165	165							
3. Process liquid waste	335		177	220	947		360	2040	2040			2279			515	12
4. Insurance						246	25	271	271							
5. Property taxes						10	1	11	11							
6. Health physics supplies						915	229	1143	1143							
7. Small tool allowance						45	7	52	52							
8. Disposal of DAW generated			231	4	793		143	1172	1172		2751				7483	19
9. Plant energy budget						967	145	1112	1112							
10. NRC Fees						49	5	54	54							
11. Emergency Planning Fees						100	10	110	110							
Subtotal Undistributed Costs Period 1	335		408	225	1741	2653	986	6347	6347		2751	2279			7998	31
Staff Costs																
Utility Staff Cost						5482	822	6304	6304							

TABLE C-3 (continued)
SAFSTOR COST ESTIMATE FOR SUSQUEHANNA STEAM ELECTRIC STATION UNIT 1

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 SAFSTOR	3070	283	408	225	1741	11033	3652	20412	19044	1367	2751	2279			83994	35

TOTAL COST TO SAFSTOR WITH 21.79% CONTINGENCY: $20,411,934

Total SAFSTOR radwaste volume buried:	5,030	cubic feet
Total scrap removed:	0.0	tons
Total craft labor requirements:	83,994.5	man-hours
Total personnel radiation exposure:	35.4	man-Rem
Total craft labor cost with 21.79% contingency:	$2,526,761	

TABLE C-3 (continued)
SAFSTOR COST ESTIMATE FOR SUSQUEHANNA STEAM ELECTRIC STATION UNIT 1

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
SAFSTOR DORMANCY															
PERIOD 2: Safstor Annual Maintenance Cost															
1. Quarterly inspection								$							
2. Semi-annual environmental survey								$							
3. Prepare reports								$							
4. Health physics supplies						36	9	45	45						
5. Insurance						86	9	95	95						
6. Property taxes						10	1	11	11						
7. Disposal of contaminated solid waste			1	<1	37		6	44	44	128				35	<1
8. Bituminous roof replacement						25	4	29	29						
9. Maintenance supplies						77	19	97	97						
10. Plant energy budget						163	24	187	187						
11. NRC Fees						11	1	12	12						
12. Emergency Planning Fees						8	<1	9	9						
13. Site maintenance staff						576	86	662	662						
PERIOD 2 ANNUAL MAINTENANCE TOTALS			1	<1	37	992	160	1190	1190	128				35	<1

MAINTENANCE COST FOR 54.4 YEARS DORMANCY: $ 64,727,288

TABLE C-3 (continued)
SAFSTOR COST ESTIMATE FOR SUSQUEHANNA STEAM ELECTRIC STATION UNIT 1

Activity	Decon	Remove	Pack	Ship	Bury	Other	Cntgcy	Total	LicTerm	Clean A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
PERIOD 3															
1. Review plant dwgs & specs.						302	45	348	348						
2. Perform detailed rad survey								n/a							
3. End product description						66	10	76	76						
4. Detailed by-product inventory						85	13	98	98						
5. Define major work sequence						493	74	567	567						
6. Perform safety analysis						204	31	234	234						
7. Submit dismantling plan						34	5	39	39						
8. Receive dismantling order								a							
Subtotal Period 3 Activity Costs						1184	178	1362	1362						
Period 3 Undistributed Costs															
1. DOC staff relocation expenses						737	110	847	847						
2. Insurance						369	37	406	406						
3. Property taxes						15	2	17	17						
4. Health physics supplies						915	229	1143	1143						
5. Heavy equipment rental						240	36	276	276						
6. Disposal of DAW generated			235	4	793		143	1176	1176	2751				7483	19
7. Plant energy budget						1480	222	1702	1702						
8. NRC fees						74	7	81	81						
Subtotal Undistributed Costs Period 3			235	4	793	3829	786	5647	5647	2751				7483	19
Staff Costs															
DOC Staff Cost						8561	1284	9845	9845						
Utility Staff Cost						13307	1996	15303	15303						
TOTAL PERIOD 3 COST			235	4	793	26881	4244	32157	32157	2751				7483	19

TABLE C-3 (continued)
SAFSTOR COST ESTIMATE FOR SUSQUEHANNA STEAM ELECTRIC STATION UNIT 1

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																
Activity Specifications																
9.1 Re-activate plant & temporary facilities						484	73	557	501	56						
9.2 Plant systems						274	41	315	283	31						
9.3 Reactor internals						467	70	537	537							
9.4 Reactor vessel						427	64	491	491							
9.5 Sacrificial shield						33	5	38	38							
9.6 Moisture separators/reheaters						66	10	76	76							
9.7 Reinforced concrete						105	16	121	60	60						
9.8 Turbine & condenser						274	41	315	315							
9.9 Pressure suppression structure						131	20	151	151							
9.10 Primary containment						105	16	121	121							
9.11 Plant structures & buildings						205	31	236	118	118						
9.12 Waste management						302	45	348	348							
9.13 Facility & site closeout						59	9	68	34	34						
9. Total						2932	440	3372	3073	300						
Planning & Site Preparations																
10. Prepare dismantling sequence						158	24	181	181							
11. Plant prep. & temp. svces						1485	223	1708	1708							
12. Design water clean-up system						92	14	106	106							
13. Rigging/CCES/tooling/etc.						1257	189	1446	1446							
14. Procure casks/liners & containers						81	12	93	93							
Detailed Work Procedures																
15.1 Plant systems						311	47	358	322	36						
15.2 Vessel head						16	2	18	18							
15.3 Reactor internals						263	39	302	302							
15.4 Remaining buildings						89	13	102	26	77						
15.5 CRD housings & ICI tubes						66	10	76	76							
15.6 Incore instrumentation						66	10	76	76							
15.7 Removal primary containment						131	20	151	151							
15.8 Reactor vessel						239	36	274	274							
15.9 Facility closeout						79	12	91	45	45						

TABLE C-3 (continued)
SAFSTOR COST ESTIMATE FOR SUSQUEHANNA STEAM ELECTRIC STATION UNIT 1

Activity	Decon	Remove	Pack	Ship	Burv	Other	Cntgcy	Total	LicTerm	Clean	A CF	B CF	C CF	>C CF	M-Hrs	M-Rem
Detailed Work Procedures (continued)																
15.10 Sacrificial shield						79	12	91	91							
15.11 Reinforced concrete						66	10	76	38	38						
15.12 Turbine & condensers						274	41	315	315							
15.13 Moisture separators & reheaters						131	20	151	151							
15.14 Radwaste building						179	27	206	186	21						
15.15 Reactor building						179	27	206	186	21						
15. Total						2167	325	2492	2256	237						
16. Remove spent fuel racks	377	90	155	26	1630	1192	521	3991	3991		5842				12396	64
Nuclear Steam Supply System Removal																
17.1 Recirculation system piping & valves	85	152	90	36	2270		435	3067	3067		7450				7370	188
17.2 Recirculation pumps & motors	23	24	12	4	700		124	888	888		2358				1524	<1
17.3 CRDMs & ICIS Removal	96	74	50	30	1081		238	1568	1568		3451				5016	4
17.4 Reactor vessel internals	66	1957	450	382	6534		3343	12733	12733		917	2431	408	226	30884	7
17.5 Reactor vessel	210	4373	646	666	4305		4789	14989	14989		12707				23776	6
17. Totals	480	6579	1249	1117	14891		8929	33246	33246		26884	2431	408	226	68571	206
Removal of Major Equipment																
18. Main Turbine/Generator		240	1486	255	3522	1864	1055	8421	8421		12183				7344	11
19. Main Condensers	1742	606	496	96	2552	2557	1853	9903	9903		8849				18912	135
Disposal of Plant Systems																
20.1 Acid injector for circulating water		13					2	15		15					425	
20.2 Air Removal and Sealing Steam		536	174	19	1751	362	471	3312	3312		6071				16861	44
20.3 Building vent stack monitoring		2	1	<1	8	5	3	19	19		27				61	<1
20.4 Chemical addition system		1					<1	2	<1	1					45	
20.5 Chlorination		5					<1	6		6					160	
20.6 Circ Pumphouse HVAC		30					4	34		34					911	
20.7 Circulating water		181					27	208	42	166					5869	
20.8 Clean up filter demineralizer		119	19	3	130	69	62	401	401		450				3618	18
20.9 Compressed air		128					19	147	22	125					4106	
20.10 Condensate		1131	286	38	2648	690	818	5610	5610		9181				35163	96
20.11 Containment Atmosphere Control		109	54	7	306	189	108	773	773		1061				3590	6

TABLE C-3 (continued)
SAFSTOR COST ESTIMATE FOR SUSQUEHANNA STEAM ELECTRIC STATION UNIT 1

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)																
20.12 Containment Instrument Gas		67	23	4	206	78	62	442	442		713				2117	3
20.13 Control Rod Drive		98	19	3	129	69	57	374	374		447				3000	3
20.14 Control Structure HVAC		24					4	27		27					720	
20.15 Core Spray		240	125	16	1593	173	340	2486	2486		5523				7748	21
20.16 Demineralized Water Distribution		<1					<1	1	<1	<1					31	
20.17 Diesel Gen Bldgs & Pump House HVAC		24					4	28		28					746	
20.18 Drywell Air Flow		7	3	<1	18	13	7	48	48		62				246	<1
20.19 Electrical (clean)		949					142	1092		1092					30065	
20.20 Electrical (contaminated)		2261	432	80	2687	1901	1309	8669	8669		9316				72922	94
20.21 Electrical (decontaminated)	14	66					17	97	14	83					2515	
20.22 Emergency Service Water		59					9	68	17	51					1883	
20.23 Extraction Steam		600	294	35	4660	699	989	7277	7277		16159				19448	55
20.24 Feed Pump Turbine Steam		37					6	43	4	38					1205	
20.25 Feedwater		524	130	20	718	452	323	2167	2167		2488				16453	43
20.26 Feedwater Drainage		639	151	20	775	457	363	2404	2404		2688				19828	51
20.27 Fire Protection		116					17	133	40	93					3738	
20.28 Fuel Pool Cooling and Clean-up	129	289	64	11	449	236	247	1425	1425		1557				11945	66
20.29 Fuel Pool Filter Demineralizer	31	66	13	2	76	49	52	289	289		265				2808	31
20.30 Gaseous Radwaste Recombiner CCW		35	23	3	350	14	66	492	492		1215				1163	2
20.31 Generator H2 Cooling Makeup		4					<1	5	<1	4					130	
20.32 Generator Stator Cooling Water		22					3	25	3	23					710	
20.33 High Pressure Coolant Injection		95	25	4	137	86	60	407	407		476				2978	8
20.34 HPCI Turbine Pump		93	65	7	907	57	175	1304	1304		3146				3046	3
20.35 Instrument Air		39					6	45	23	23					1272	
20.36 Liquid Radwaste		259	42	8	277	154	135	873	873		959				7918	42
20.37 Lube Oil		48					7	55	5	49					1525	
20.38 Main Steam		368	238	37	4488	379	851	6360	6360		15561				12302	34
20.39 Main Turbine EHC Air Flow		13					2	15	2	14					431	
20.40 Main Turbine Lube Oil		49					7	56	6	51					1570	
20.41 Miscellaneous Buildings HVAC		24					4	27		27					720	
20.42 Miscellaneous Drainage		49	8	2	55	32	26	171	171		191				1482	4
20.43 MSIV - Leakage Control		40	6	1	57	17	22	141	141		196				1220	2
20.44 Nuclear Boiler		21	15	2	64	46	24	172	172		223				734	7
20.45 Off Gas		138	107	7	259	150	108	768	768		897				4528	7

TABLE C-3 (continued)
SAFSTOR COST ESTIMATE FOR SUSQUEHANNA STEAM ELECTRIC STATION UNIT 1

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)																
20.46 Process Sampling		42	24	3	138	43	40	290	290		478				1431	3
20.47 Radwaste Building HVAC		64	7	1	40	28	27	166	166		137				1623	3
20.48 RCIC Turbine Pump		59	29	3	291	70	72	522	522		1008				1888	2
20.49 Reactor Building Closed Cooling Water		53					8	61	61						1694	
20.50 Reactor Building HVAC		809	233	35	1912	709	624	4321	4321		6629				24342	41
20.51 Reactor Core Isolation Cooling		83	17	3	105	66	49	323	323		365				2581	7
20.52 Reactor Recirc Motor-Generator Set		107	44	5	197	134	82	569	569		683				3432	6
20.53 Reactor Recirculation		42	6	1	41	20	20	130	130		140				1273	1
20.54 Reactor Water Clean-up	56	127	30	5	305	92	123	737	737		1057				5519	31
20.55 Residual Heat Removal	352	593	298	39	2481	780	849	5391	5391		8603				24135	134
20.56 RFPT/RFP Oil Reservoir		44					7	51	5	46					1419	
20.57 RHR Service Water		49					7	56	14	42					1581	
20.58 Service and Again Building HVAC		24					4	27		27					720	
20.59 Service Water		189					28	217	43	174					6112	
20.60 Solid Rawaste Collection		53	7	1	47	25	25	158	158		163				1615	9
20.61 Standby Liquid Control		15					2	17	17						465	
20.62 Turbine Bldg Closed Cooling Water		45					7	51	8	44					1431	
20.63 Turbine Building HVAC		213					32	244	61	183					6723	
20. Totals	581	12227	3012	424	28301	8345	8962	61852	59384	2468	98136				397939	877
21. Erect Scaffolding for Systems Removal		881					132	1013	1013						21275	
Decontamination of Site Buildings																
22.1 Reactor	2446	2114	384	72	7858	940	3120	16935	16935		27250				128278	470
22.2 Turbine	1088	166	161	27	3454	368	1179	6443	6443		11978				25898	43
22. Totals	3534	2280	545	99	11313	1308	4299	23378	23378		39229				154176	513
23. License Termination Survey						339	51	390	390							
24. Terminate License								a								
Subtotal Period 4 Activity Costs	6714	22903	6943	2018	62208	23777	27028	151591	148588	3004	191123	2431	408	226	680613	1806