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The Northeast Utilities System

July 17, 2000
B18129

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Subject: Millstone Nuclear Power Station Unit No. 1, Docket No 50-245
Irradiated Fuel Management Plan and Site-Specific Decommissioning Cost Estimate

References:
(1) NU letter to NRC, B17388, "Certification of Permanent Cessation of Power Operations and that Fuel Has Been Permanently Removed from the Reactor," dated July 21, 1998.
(2) NU Letter to NRC, B18062, "Decommissioning Funding Status Report," dated March 30, 2000.

10 CFR 50.54(bb) requires an irradiated fuel management plan be submitted within two years following the permanent cessation of operations and 10 CFR 50.82(a)(8)(iii) requires that a site-specific decommissioning cost estimate also be submitted within two years. The permanent cessation of operations at Millstone Unit 1 (MP1) occurred on July 17, 1998, as documented in Reference 1.

Attachment 1 provides the MP1 irradiated fuel management plan. This plan is being submitted to the Commission for its review and preliminary approval in accordance with 10 CFR 50.54(bb).

Attachment 2 provides the complete site-specific cost estimate prepared by TLG Services, Inc. in 1999. The early shutdown decommissioning cost was estimated at $700.6 million in mid-year 1999 dollars, including costs to store spent fuel and to restore the site to green-field condition.

The TLG estimate includes $34.1 million for site restoration which is not considered an expense associated with License Termination. Therefore, the adjusted cost estimate to achieve NRC License Termination is $666.4 million.

Funding for decommissioning MP1 is provided by an external trust. Details on the schedule of annual amounts remaining to be collected, assumptions for rates of escalation and rates of earnings, and funding mechanisms are provided in the Decommissioning Funding Status Report (Reference 2) which was submitted pursuant to 10 CFR 50.75(f)(1).

A001

Please direct any questions regarding this submittal to Mr. Bryan Ford at (860) 437-5895.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY

F. C. Rothen
Vice President - Nuclear Work Services

Attachments: 1. Irradiated Fuel Management Plan
2. Site Specific Decommissioning Cost Estimate

cc: H. J. Miller, Region I Administrator
J. B. Hickman, NRC Project Manager, Millstone Unit No. 1
P. C. Cataldo, Resident Inspector, Millstone Unit No. 1

Attachment 1 to B18129

Millstone Nuclear Power Station, Unit No. 1

Irradiated Fuel Management Plan

IRRADIATED FUEL MANAGEMENT PLAN

Background

In accordance with 10 CFR 50.82(a)(1)(i), Northeast Utilities certified in Reference 1 that as of July 17, 1998, operations ceased as Millstone Unit 1 (MP1) and all fuel had been removed from the reactor vessel and placed in the spent fuel pool.

Congress passed the "Nuclear Waste Policy Act" in 1982, assigning the responsibility for disposal of spent nuclear fuel from commercial generating plants to the Department of Energy (DOE). This legislation also created a Nuclear Waste Fund to cover the cost of the program, which is funded, in part, by the sale of electricity from MP1. The current DOE estimate for the startup of the federal Waste Management System is 2010. Millstone Unit 1's spent fuel removal allocation priorities have been specified on the basis of oldest fuel first in a National Acceptance Priority Ranking. This ranking, used in conjunction with the annual spent fuel removal rates that are specified in proposed legislation, determines the quantities of spent fuel eligible to be removed from the site each year. Based on this schedule, all spent fuel will not be removed from MP1 until 2024.

Fuel Storage

Northeast Utilities has selected a modified SAFESTOR approach for the decommissioning of MP1. In this approach, decontamination and dismantlement activities may be undertaken early in the decommissioning whenever it makes economic sense. The construction and use of an Independent Spent Fuel Storage Installation (ISFSI) for long term storage is being used for planning purposes. However, the decision to construct and use an ISFSI has not been finalized.

The spent fuel is currently stored in the spent fuel pool. The design basis accident in the defueled state is a fuel handling accident. The consequences of this event is mitigated by the water above the spent fuel. Controls exist for water level and movement of heavy loads over the fuel. The pool cooling system and support systems are being maintained in service. Should a loss of cooling occur, ample time exists to initiate alternative cooling or replenish water. Additional details associated with spent fuel management can be found in the MP1 Defueled Safety Analysis Report (DSAR).

MP1 is presently transitioning to a spent fuel pool "island" where the spent fuel pool and cooling systems will be separated from the other plant systems. This will allow additional decommissioning activities to be performed without affecting the spent fuel. This configuration also provides flexibility in the schedule for construction of an ISFSI.

The planned approach includes the continued operation of the fuel storage pool as an interim wet storage facility until July 2006, with the construction of an ISFSI by 2004. Fuel will be transferred from the fuel storage pool to the ISFSI beginning in 2004 and continue until 2006. The ISFSI will operate until 2024 when all the fuel has been transferred to the DOE facility.

If a decision is made not to construct an ISFSI, we will update the staff appropriately.

Decommissioning Cost Estimate and Funding

Costs for the storage of irradiated fuel are included in the Site Specific Decommissioning Cost Estimate.

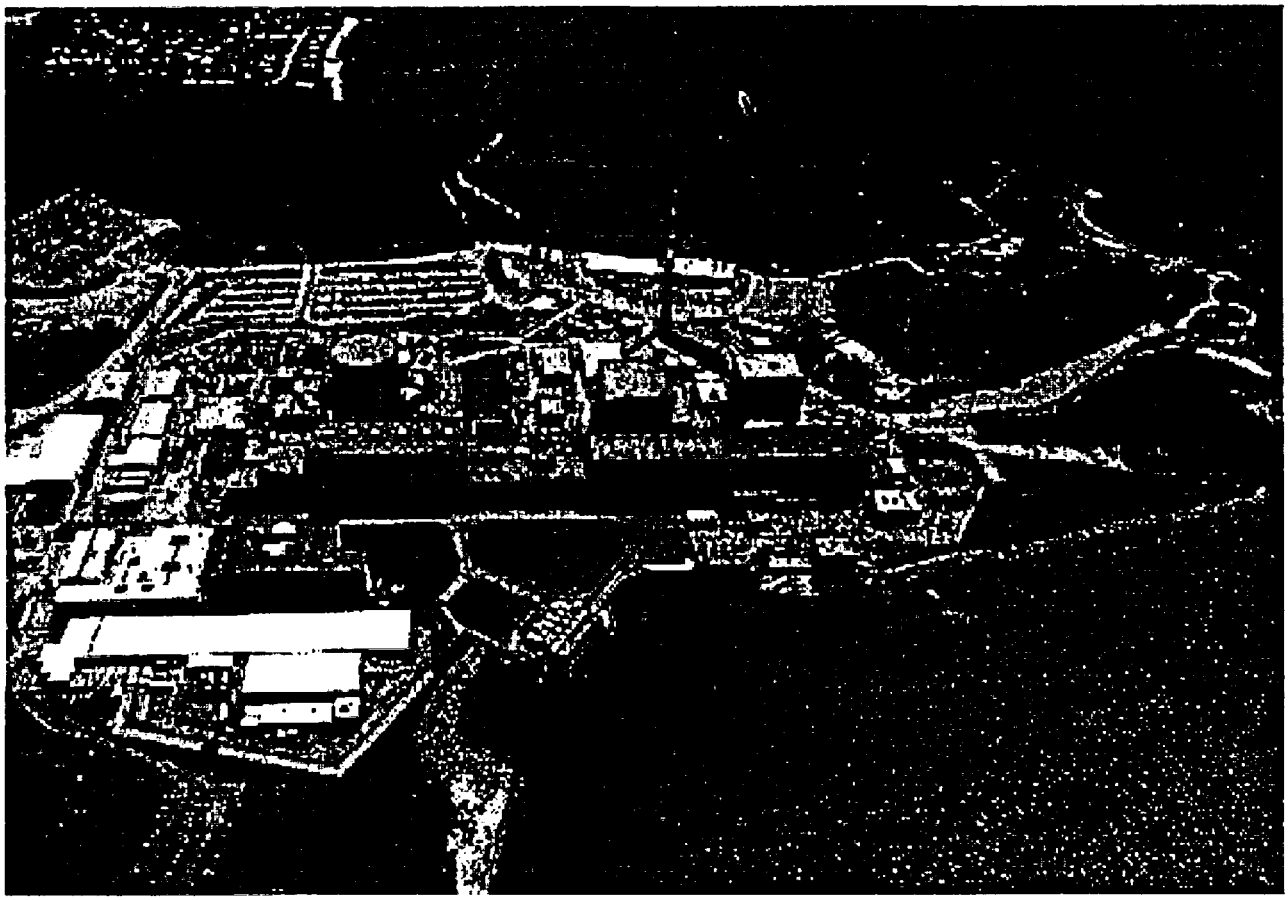
Funding for decommissioning MP1 is provided by an external trust. Details on the schedule of annual amounts remaining to be collected, assumptions for rates of escalation and rates of earnings, and funding mechanisms are provided in the Decommissioning Funding Status Report (Reference 2).

Attachment 2 to B18129

Millstone Nuclear Power Station, Unit No. 1

Site Specific Decommissioning Cost Estimate

DECOMMISSIONING COST STUDY
for the
MILLSTONE NUCLEAR POWER STATION
UNIT 1



prepared for

Northeast Utilities

August, 1999

prepared by

TLG Services, Inc.
Bridgewater, Connecticut

APPROVALS

Project Manager	Geoffrey M. Griffiths	8/16/99 Date
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REVISION LOG

No.	CRA No.	Date	Item Revised	Reason for Revision
0		8/16/99		Original Issue

EXECUTIVE SUMMARY

This study, prepared for Northeast Utilities (NU) by TLG Services, Inc., evaluates decommissioning Millstone Unit 1 Nuclear Power Plant following the early permanent shutdown of plant operations. The projected cost to decommission the unit is estimated at $700.6 million, in 1999 dollars, for the modified SAFSTOR alternative.

Although modified SAFSTOR is the alternative that was selected for development of the Unit 1 decommissioning estimate, the actual modified SAFSTOR schedule of decommissioning activities may vary from those presented in this study. The major cost contributors to the overall decommissioning cost are decommissioning staff labor, radioactive waste disposal, and removal costs. A summary of these major cost contributors is reported in Section 6. Schedules of annual expenditures are provided in Section 3, with the detailed activity costs, waste volumes, and removal man-hours provided in the Appendices. Cost and schedule summaries are also reported at the end of this summary.

The key areas that impact decommissioning costs include regulatory requirements, estimating methodology, contingency requirements, low-level radioactive waste disposal, high-level radioactive waste storage and disposal, and site restoration requirements. A brief discussion of these key issues follows and a complete discussion of the assumptions used in this estimate is presented in Section 3.

The modified SAFSTOR cost estimate includes the continued operation of the Unit 1 fuel storage pool as an interim wet fuel storage facility from January 2000 until July 2006. Also included in the cost estimate is the cost to design, construct, and license the Independent Spent Fuel Storage Installation (ISFSI) from January 2000 to January 2004 and then operate the ISFSI from January 2004 until January 2024. Fuel will be transferred from the Unit 1 fuel storage pool to the ISFSI facility from January 2004 until July 2006.

Regulatory Requirements

The Nuclear Regulatory Commission (NRC) provided general decommissioning guidance in the rule adopted on June 27, 1988 [1]. In this rule the NRC set forth technical and financial criteria for decommissioning licensed nuclear facilities. The regulations addressed planning needs, timing, funding methods, and

[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.

environmental review requirements for decommissioning. The rule also defined three decommissioning alternatives as being acceptable to the NRC - DECON, SAFSTOR and ENTOMB.

In 1996, the NRC published revisions[2] to the general requirements for decommissioning nuclear power plants to clarify ambiguities and codify procedures and terminology as a means of enhancing efficiency and uniformity in the decommissioning process. The amendments allow for greater public participation and better define the transition process from operations to decommissioning. The costs and schedules presented in this estimate follow the general guidance and sequence in the amended regulations.

Estimating Methodology

The methodology used to develop the decommissioning cost estimates for NU follows the basic approach originally presented in the cost estimating guidelines[3] developed by the Atomic Industrial Forum (now Nuclear Energy Institute). This reference describes a unit cost factor method for estimating decommissioning activity costs. The unit cost factors used in this study reflect site-specific costs, as well as the latest available information about worker productivity in decommissioning. The information obtained from the Shippingport Station Decommissioning Project, completed in 1989, as well as from TLG's involvement in the decommissioning planning and engineering for the Shoreham, Yankee Rowe, Trojan, Rancho Seco, Pathfinder, and Cintichem reactor facilities, is reflected within this estimate.

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

Contingency Requirements

Consistent with industry practice, contingencies are applied to the project costs developed as, "specific provision for unforeseeable elements of cost within the defined project scope, particularly important where previous experience relating estimates and actual costs has shown that unforeseeable events which will increase costs are

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2 U.S. Code of Federal Regulations, Title 10, Parts 2, 50 and 51, "Decommissioning of Nuclear Power Reactors," Nuclear Regulatory Commission, Federal Register Volume 61 (p39278+), July 29, 1996.

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

likely to occur."[4] The cost elements in this estimate are based on ideal conditions; therefore, the types of unforeseeable events that are almost certain to occur in decommissioning, based on industry experience and demonstrated at projects such as the Trojan Large Component Removal program, Yankee-Rowe Large Component Removal Program, and the Shippingport Station Decommissioning Project, are addressed through a percentage contingency applied on a line-item basis. This contingency factor is a nearly universal element in all large-scale construction and demolition projects. It should be noted that contingency, as used in this estimate, does not account for price escalation and inflation in the cost of decommissioning over the remaining operating life of the units.

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

Low-Level Radioactive Waste Disposal

The contaminated and activated material generated in the decontamination and dismantling of a commercial nuclear reactor is classified as low-level radioactive waste (LLRW), although not all of the material is suitable for "shallow-land" disposal. With the passage of the "Low-Level Radioactive Waste Disposal Act" in 1980 and its Amendments of 1985,[5] the states became ultimately responsible for the disposition of LLRW generated within their own borders.

Due to the lack of progress in siting a regional burial facility within the host state of Connecticut, all LLRW generated in the decommissioning of Unit 1 is assumed destined for disposal at either Chem Nuclear Systems' Barnwell LLRW Facility (Barnwell) in South Carolina, or the Envirocare facility at Clive, Utah, either directly or after off-site processing by a vendor. Much of the radioactive metallic waste shipped from Unit 1 will eventually be released as clean scrap by a recycling vendor. The weighted average burial cost per cubic foot, not including GTCC or contingency costs, is $145/cubic foot.

High-Level Radioactive Waste Storage and Disposal

For cost estimating purposes, the DOE is assumed to begin accepting spent fuel from the Millstone site starting in the year 2010. The basis for the (2010) start date

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

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

assumption was provided by the U.S. Department of Energy's (DOE) Contracting Officer in a May 18, 1998 letter to NUSCO. In that letter to NUSCO (and other disposal contract-holders), the Contracting Officer stated that receipt of spent fuel could be initiated at a repository, beginning in 2010. Thus, in the absence of a national interim storage facility (an absence which is consistent with the DOE's current program plan (DOE/RW-0504, Rev. 2) and by virtue of the Millstone's contractual spent fuel allocation priorities from the DOE, spent fuel may begin transfer from the Millstone site in 2010. Millstone's spent fuel removal-allocation priorities have been specified on the basis of oldest fuel first in a National Acceptance Priority Ranking. This ranking, used in conjunction with the annual spent fuel removal rates that are specified (on a national basis) in proposed legislation, determine the quantities of Millstone's spent fuel eligible to be removed from the site each year. Based on this assumption, spent fuel would be removed from Unit 1 by 2024 for the modified SAFSTOR decommissioning alternative.

Site Restoration Requirements

The efficient removal of the contaminated materials at the site may result in the degradation of many of the Unit 1 structures. Although performed in a controlled and safe manner that also ensures the safety of the adjacent operating unit, the coring, drilling, and other decontamination activities may degrade these structures, rendering them unfit for future use, requiring their eventual demolition. Since Unit 1 is adjacent to Unit 2, and demolition activities (explosives) at Unit 1 may adversely affect Unit 2 operations, the demolition of Unit 1 will be delayed and coordinated with the Unit 2 decommissioning schedule. This results in a "dormancy" period of approximately 15 years during which the Unit 1 building structures are secured. Periodic inspections and maintenance activities will be conducted during this dormancy period, to ensure that the buildings are maintained in a condition that precludes the release of radioactive materials. This study assumes that site structures will be removed to a nominal depth of three feet below the grade level, whenever possible. Foundation grade slabs greater than three feet in thickness will be abandoned in place and covered with a three-foot layer of backfill. The site will be graded and stabilized.

Summary

The modified SAFSTOR decommissioning alternative therefore provides for the decommissioning of Unit 1, with consideration for minimizing the impact on the safe operations of Unit 2. Selective early removal and disposal of highly activated components (such as the reactor vessel internals) at the Barnwell disposal facility will remove a large radioactive material source, and secure the availability of a disposal location. Selective early removal of large components designated for off-site recycling

(such as the Turbine/Generator, Main Condenser, and Feedwater Heaters) will take advantage of the currently competitive market for radioactive materials recycling. Both of these early removal activities can be completed without impact on Unit 1 spent fuel storage operations or Unit 2 plant operations. After Unit 1 is placed in a dormant condition, final systems removal activities and building demolition can be coordinated with the second unit's decommissioning schedule, thereby minimizing any impact on continuing operations.

This study provides an estimate for decommissioning Unit 1 under current requirements and is based on present-day costs and available technology. Table 1 summarizes the cost for the modified SAFSTOR decommissioning alternative. A cost summary by category is provided in Table 6.1, and the detailed cost estimate is provided in Appendix C. The schedule and sequence of decommissioning activities are identified in Section 4.

TABLE 1
SUMMARY OF MILLSTONE UNIT 1
DECOMMISSIONING COSTS
(Millions of 1999 Dollars)

	Cost Estimate	Schedule (Years)
Modified SAFSTOR		
Pre-Decommissioning (1998/1999)	7.8	1.5
Period 1 (SAFSTOR Operations)	170.0	2.0
Period 2 (SAFSTOR Dormancy)	156.8	14.7
Period 3 (Decommissioning Preparations)	73.3	1.5
Period 4 (Decommissioning Operations & License Termination)	222.7	3.1
Period 5 (Site Restoration)	70.0	3.2
Total	700.6	26.0

1. INTRODUCTION

This cost estimate analysis, prepared by TLG Services, Inc. (TLG), is designed to provide Northeast Utilities (NU) with sufficient information to prepare financial planning documents required by NU's regulators. It is not a detailed engineering document, but a cost estimate prepared in advance of the detailed engineering preparations required to carry out the decommissioning of Unit 1 of the Millstone Nuclear Power Station.

1.1 OBJECTIVE OF STUDY

The objective of this study is to prepare estimates of the cost, schedule, and waste volume generated to decommission Unit 1 under a modified SAFSTOR scenario.

This scenario assumes that Unit 1 initiates selected component removal activities and prepares the plant for a long-term dormancy status during Period 1. The plant is maintained in a SAFSTOR dormancy condition for approximately 15 years. During this dormancy period, spent fuel is transferred from the wet fuel pool to an on-site ISFSI, and eventually transferred from the ISFSI to a DOE repository. All fuel will be transferred to the ISFSI by July 2006 and to the DOE by the year 2024. Final decontamination and dismantling operations are scheduled to coincide with the final shutdown and decommissioning of Millstone Unit 2.

1.2 SITE DESCRIPTION

Unit 1 is located on Millstone Point in the Town of Waterford, Connecticut. The site, approximately 500 acres in area, is on the north shore of Long Island Sound and on the east side of Niantic Bay. The station is located about 3.2 miles west-southwest of New London and about 40 miles southeast of Hartford. Figure 1.1 shows the location and arrangement of the site and associated nuclear units. The station is comprised of three nuclear generating units and their supporting facilities. The three units are adjacent to each other, with Unit 1 located furthest out on the peninsula.

Unit 1 was designed and built by EBASCO Services, Inc. The unit is comprised of a General Electric boiling water reactor and turbine-generator set. The Nuclear Steam Supply System (NSSS) was licensed at a core thermal power level of 2,011 megawatt-thermal (MWth), with a corresponding turbine-generator net design electrical rating of 660 megawatt-electric (MWe). The

NSSS consists of a boiling water reactor with two recirculation loops, each of which contains a reactor recirculation pump and system isolation valves. The system is housed within a containment system. Primary containment includes the drywell and the pressure suppression chamber, while secondary containment is formed by the reactor building, a reinforced concrete structure with a steel superstructure.

A turbine-generator system converts the thermal energy of the steam into mechanical shaft power and then into electrical energy. The turbine-generator is a tandem-compound four-flow turbine, 1800-rpm unit. One high pressure and two low pressure turbines are coupled in tandem to drive the generator. The turbines are operated in a closed feedwater cycle which condenses the steam, while the heated feedwater returns to the reactor vessel. Heat rejected in the main condensers is removed by the Circulating Water System (CWS).

The Atlantic Ocean, via Long Island Sound, serves as the ultimate heat sink for all three units at the Millstone Station. In the CWS, cooling of the main condenser system is accomplished by water taken from Long Island Sound and pumped through the condenser shells located in the Turbine Building. The heated water is then returned to the Long Island Sound by means of the discharge channel.

1.3 REGULATORY GUIDANCE

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

The rule defined three decommissioning alternatives as being acceptable to the NRC: DECON, SAFSTOR and ENTOMB. The definitions of these three

options are provided below:

> DECON was defined as "the alternative in which the equipment, structures, and portions of a facility and site containing radioactive contaminants are removed or decontaminated to a level that permits the property to be released for unrestricted use shortly after cessation of operations." (Ref. 1)
>
> SAFSTOR was defined as "the alternative in which the nuclear facility is placed and maintained in a condition that allows the nuclear facility to be safely stored and subsequently decontaminated (deferred decontamination) to levels that permit release for unrestricted use." (Ref. 1)
>
> ENTOMB was defined as "the alternative in which radioactive contaminants are encased in a structurally long-lived material, such as concrete; the entombed structure is appropriately maintained and continued surveillance is carried out until the radioactive material decays to a level permitting unrestricted release of the property." (Ref. 1)

The rule also placed limits on the time allowed to complete the decommissioning process. For SAFSTOR, the process is restricted in overall duration to 60 years unless it can be shown that a longer duration is necessary to protect public health and safety. The guidelines for ENTOMB are similar, providing the NRC with both sufficient leverage and flexibility to ensure that these deferred options are only used in situations where it is reasonable and consistent with the definition of decommissioning. Consequently, with these restrictions, the SAFSTOR and ENTOMB options are no longer decommissioning alternatives in themselves, as neither terminates the license for the site. At the conclusion of a 60-year dormancy period (or longer for ENTOMB if the NRC approves such a case), the site would still require significant remediation to meet the definition of unrestricted release and license termination.

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

individually without clearly defined generic requirements. The NRC amended the decommissioning regulations in 1996 to clarify ambiguities and codify procedures and terminology as a means of enhancing efficiency and uniformity in the decommissioning process. The new amendments allow for greater public participation and better define the transition process from operations to decommissioning.

The approach that the NRC has chosen in its recently amended regulations is to divide decommissioning into three phases. The initial phase commences with the effective date of permanent cessation of operations and involves the transition of both plant and licensee from reactor operations, i.e., power production to facility de-activation and closure. Submittal of these notices would entitle the licensee to a fee reduction and eliminate the obligation to follow certain requirements needed only during operation of the reactor. During Phase I, notification is to be provided to the NRC certifying the permanent cessation within 30 days of final shutdown of operations and the removal of fuel from the reactor vessel. The licensee is then prohibited from reactor operation. Within two years of notification to cease reactor operations, the licensee is required to provide a Post-Shut down Decommissioning Activities Report (PSDAR). This report provides a description of the licensee's planned decommissioning activities, a corresponding schedule, and an estimate of expected costs. The PSDAR will also address whether environmental impacts associated with the proposed decommissioning scenario differ from those already considered in a previously prepared environmental statement(s). Ninety days following the NRC's receipt of the PSDAR, the licensee may initiate certain decommissioning activities, without specific NRC approval, under a modified Title 10 of the Code of Federal Regulations, Section 50.59 review process (all subsequent references to Title 10 of the Code will be by section number only, i.e. §50.59). The amended regulations permit the licensee to expend/recover up to 3% of the generic decommissioning cost for planning, with an additional 20% available 90 days after submittal of the PSDAR. Remaining funds would be available to the licensee with submittal of a detailed, site-specific cost estimate.

The second phase identified by the NRC addresses licensed activities during a storage period, applicable to the dormancy phase of the deferred decommissioning alternative SAFSTOR. Phase III pertains to the activities involved in license termination. The submittal of an application to terminate the license, along with a termination plan, marks the commencement of this phase. The termination plan contains a detailed site characterization, i.e., location, type, and amount of radioactivity, a description of any remaining dismantling activities to be accomplished, detailed plans for a final survey, and

any planned use of the site. An updated cost to complete decontamination and dismantling is required, along with the reporting of any new or altered environmental consequences.

The TLG methodology divides the decommissioning project into periods based on its major milestones. Phase I of the NRC's 1996 amended regulations corresponds roughly to Period 1 of DECON and SAFSTOR, with Phase III corresponding to Period 2 of DECON and Periods 3 and 4 of SAFSTOR. The NRC Phase II has no corresponding period in the DECON mode, being applicable only to the dormancy period of SAFSTOR (Period 2). Period 3 of DECON and Period 5 of SAFSTOR, Site Restoration, is not addressed in the amended regulations.

1.3.1 Nuclear Waste Policy Act

The Nuclear Waste Policy Act, enacted in 1983 (Ref. 4), assigned the responsibility for the disposal of spent nuclear fuel from the commercial generating plants to the Department of Energy (DOE). Two permanent disposal facilities were envisioned, as well as an interim facility. To recover the cost of permanent spent fuel disposal, this legislation created a Nuclear Waste Fund through which money was to be collected from the consumers of the electricity generated by commercial nuclear power plants. The date targeted for start-up of the federal Waste Management System was January 31, 1998.

After pursuing a national site selection process, the Act was amended in 1987 to designate Yucca Mountain, Nevada, as the only site to be evaluated for geologic disposal of high-level waste. Also in 1987, the DOE announced a five-year delay in the opening date for the repository, from 1998 to 2003. Two years later, in 1989, an additional seven year delay was announced. The DOE has projected additional delays as a result of proposed Congressional reductions in appropriations for the program.

Utilities have responded to this impasse by initiating legal action and constructing supplemental storage as a means of maintaining operating margins. The U.S. Court of Appeals for the D.C. Circuit recently confirmed (July, 1996) the DOE's statutory obligation to provide spent fuel disposal beginning in 1998, regardless of whether the agency has an operating repository. Since the agency is now in default, the courts may decide to prescribe "remedies" due to the DOE's failure to uphold its obligation.

For cost estimating purposes, the DOE is assumed to begin accepting spent fuel from the Millstone site starting in the year 2010. A basis for the (2010) start date assumption was provided by the DOE's Contracting Officer in a May 18, 1998 letter to NUSCO. In that letter to NUSCO (and other disposal contract-holders), the Contracting Officer stated that receipt of spent fuel could be initiated in 2010. Thus, in the absence of a national interim storage facility (an absence which is consistent with the DOE's current program plan, DOE/RW-0504, Rev. 2) (Ref. 5) and by virtue of the Millstone's contractual spent fuel allocation priorities from the DOE (see below), spent fuel may begin to be removed from the Millstone site in 2010.

Millstone's spent fuel removal-allocation priorities have been specified by the DOE, on the basis of oldest fuel first, in a National Acceptance Priority Ranking. This ranking is utilized in conjunction with the annual spent fuel removal rates that are specified (on a national basis) in proposed legislation to determine the quantities of Millstone's spent fuel that are eligible to be removed from the site each year.

Unit 1's fuel pool would be cleared by 2006 with the use of dry storage for fuel (modified SAFSTOR alternative). The dry storage facility will be maintained until 2024.

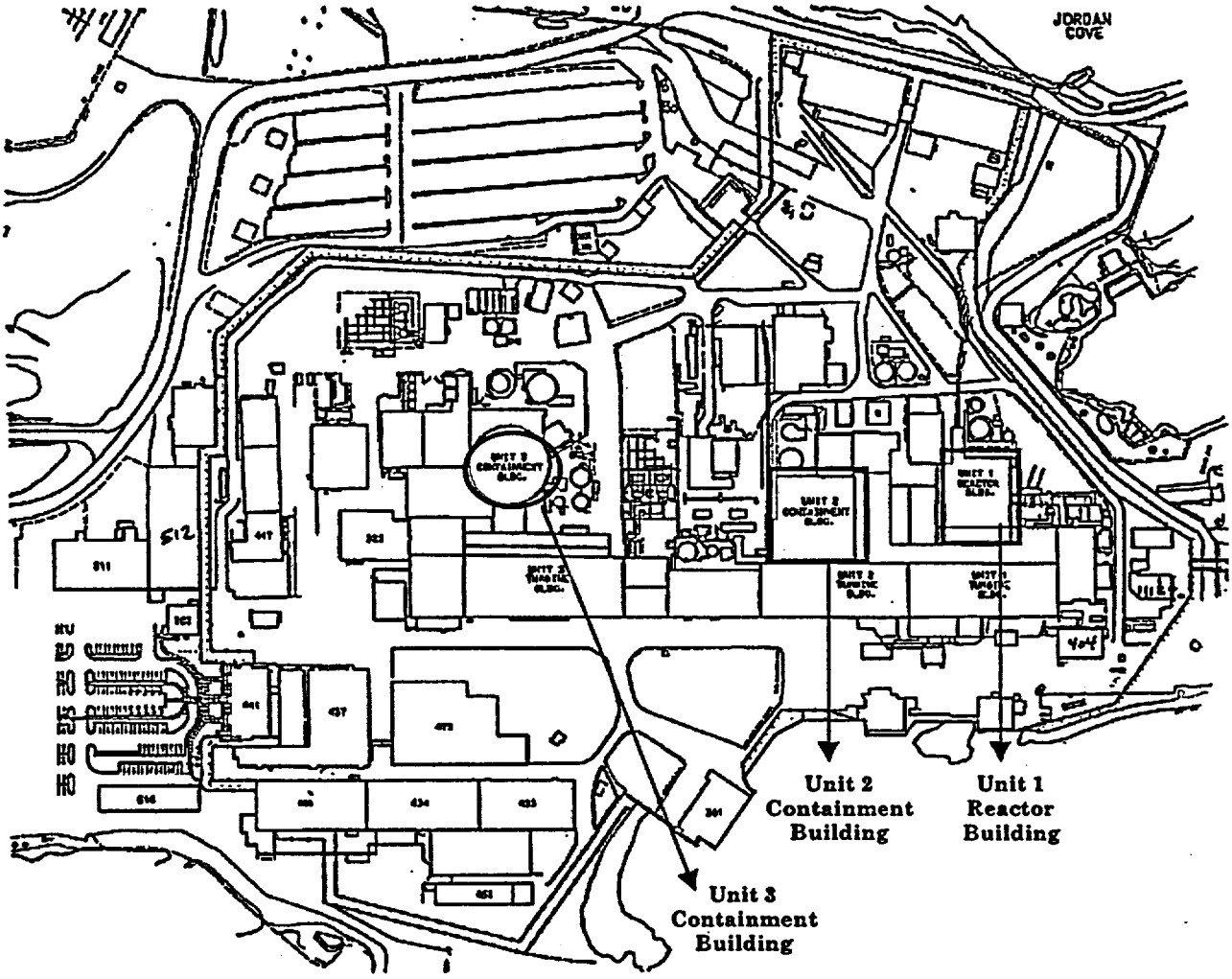
1.3.2 Low-Level Radioactive Waste Policy Amendments Act

Congress passed the "Low-Level Radioactive Waste Disposal Act" in 1980, declaring the states as being ultimately responsible for the disposition of low-level radioactive waste generated within their own borders. The federal law encouraged the formation of regional groups or compacts to implement this objective safely, efficiently and economically, and set a target date of 1986. With little progress, the "Amendments Act" of 1985 (Ref. 6) extended the target, with specific milestones and stiff sanctions for non-compliance. However, more than 14 years later, no new sites have been developed and even the most advanced program is far behind schedule.

Due to the lack of progress in siting a regional burial facility within the host state of Connecticut, all LLRW generated in the decontamination and dismantling of Unit 1 is assumed destined for disposal at either Chem-Nuclear's Barnwell LLRW Facility in Barnwell, South Carolina, or the Envirocare facility at Clive, Utah.

The weighted average burial cost per cubic foot, not including GTTC or contingency cost, is $145/cubic foot. Much of the radioactive metallic waste shipped from Unit 1 will eventually be released as clean scrap by a recycling vendor.

FIGURE 1.1
MILLSTONE NUCLEAR POWER STATION
SITE PLAN



2. MODIFIED SAFSTOR DECOMMISSIONING ALTERNATIVE

The duration of dormancy selected for the modified SAFSTOR decommissioning alternative is within the maximum allowable interval (60 years) between cessation of operations and termination of the site license(s). This alternative provides for the removal of all regulated radioactive material from the site and the ultimate release of the site for possible unrestricted use. The facility is left intact during the dormancy period, and structures are maintained in a sound condition. Systems not required to operate in support of the spent fuel pool or site surveillance and security are drained, de-energized, and secured. Minimal cleaning/removal of loose contamination and/or fixation and sealing of remaining contamination is performed. Access to contaminated areas is secured to provide controlled access for inspection and maintenance.

This study adopts the term "modified SAFSTOR" to reflect that selected components (including the reactor vessel internals, Main Condenser, Turbine-Generator, Main Transformer, and large components in the Heater Bay area) are to be removed prior to entering the SAFSTOR dormancy period. The actual modified SAFSTOR schedule of decommissioning activities may vary from those presented in this study.

The estimate also considers the continued operation of the Unit 1 fuel storage pool as an interim wet fuel storage facility from January 2000 until July 2006 (approximately 6.5 years). The duration of the SAFSTOR dormancy was selected such that Period 4 Decommissioning Operations will be scheduled in sequence with the Unit 2 decommissioning activities.

This study does not address the cost to remove spent fuel from the site; such costs are assumed to be funded through fees based on electrical generation (1 mill/kWhr). However, the study does recognize the constraint imposed by the spent fuel residing on site during the decommissioning process and also the costs associated with extended on-site caretaking of the fuel. Wet fuel storage continues at Unit 1 throughout the SAFSTOR operations and early dormancy periods, until the availability of an on-site dry storage Independent Spent Fuel Installation. All spent fuel is assumed to be transferred to the on-site ISFSI by July 2006. The Unit 1 delayed dismantling effort was scheduled so that Unit 1 license termination and Site Restoration activities would be performed in parallel with those for Unit 2. The ISFSI will be removed following the DOE acceptance of all spent fuel, estimated to occur in the year 2024.

The TLG estimating methodology is to divide the decommissioning project into periods based on its major milestones. Phase I and II of the NRC's 1996 amended

regulations corresponds roughly to Periods 1 and 2. Phase III corresponds roughly to Periods 3 and 4. Period 5, Site Restoration, is not addressed in the amended regulations. Modified SAFSTOR for Unit 1 encompasses activities from NRC Phase I and III into Period 1 of this study.

The following sections describe the basic activities associated within each period of work for the decommissioning alternative considered in this study. Although detailed procedures for each activity identified are not provided, and the actual sequence of work may vary, these activity descriptions provide a basis not only for estimating, but also for the expected scope of work, i.e., engineering and planning at the time of decommissioning.

2.1 PERIOD 1 - SAFSTOR OPERATIONS

In anticipation of initiating limited plant equipment removal activities, and placing the plant in a dormancy condition, preparations are undertaken to provide a smooth transition from plant operations to site decommissioning. These costs are included within the scope of this study. The organization required to manage the intended decommissioning activities is assembled from available plant staff and outside resources, as required. Preparations include revision of technical specifications applicable to the operating conditions and requirements, a characterization of the facility and major components, and the development of the Post Shutdown Decommissioning Activities Report (PSDAR).

The program outlined in the PSDAR will be designed to accomplish the required tasks within the ALARA guidelines for protection of personnel from exposure to radiation hazards. It also addresses the continued protection of the health and safety of the public and environment.

2.1.1 Engineering and Planning

Prior to the commencement of decommissioning operations the licensee will certify the permanent cessation of operations and the removal of fuel from the reactor vessel. The PSDAR, required to be submitted to the NRC within two years following the notice to cease operations, provides a description of the licensee's planned decommissioning activities, a timetable, and the associated financial requirements of the decommissioning program. Upon receipt of the PSDAR, the NRC will make the document available to the public for comment in a public meeting to be held in the vicinity of the reactor site. Full access to the decommissioning fund will require the preparation of a detailed site-

specific cost estimate for submittal to the NRC. In addition, a license termination plan must be prepared for submittal to the NRC at least two years prior to the license termination date.

Ninety days following submittal and NRC receipt of the PSDAR, the licensee may begin to perform major decommissioning activities under a modified §50.59 procedure, i.e., without specific NRC approval. Major activities are defined as any activity that results in permanent removal of major radioactive components (primary coolant system components/piping), permanently modifies the structure of the containment (removal of the biological shield), or results in dismantling components containing Greater-than-Class C waste (GTCC as defined under §61). Major radioactively-contaminated components are further defined as comprising the reactor vessel and internals, steam generators, pressurizer, large bore reactor coolant system piping, and other large components. The NRC includes the following additional criteria for use of the §50.59 process in decommissioning: the proposed activity must not 1) foreclose release of the site for possible unrestricted use, 2) significantly increase decommissioning costs, 3) cause any significant environmental impact, or 4) violate the terms of the licensee's existing license. Consequently, in conjunction with the development of the PSDAR is the assembly of activity specifications, cost-benefit and safety analyses, work packages and procedures, etc. in support of the proposed early decontamination and dismantling activities.

The NRC recognizes that the existing operational technical specifications will require review and modifications to reflect plant conditions and the safety concerns associated with permanent cessation of operations. The environmental impact associated with the planned decommissioning activities must also be considered; an environmental report on specific and unique concerns must be available to the NRC for consideration and possible preparation of an environmental impact statement.

Much of the work in preparing the PSDAR is also relevant to the development of the detailed engineering plans and procedures, particularly for the selected component removal activities scheduled to take place prior to placing the plant in a dormancy condition. This work includes, but is not limited to:

1. Site preparation plans for the selected component removal activities and placing the plant in a dormant condition.

2. Detailed procedures and sequences for removal of the selected systems and components.

3. Evaluation of the disposition alternatives for the reactor vessel internals.

4. Design/procurement and testing of tooling and equipment.

5. Identification/selection of specialty contractors.

6. Procedures for removal and disposal of selected radioactive materials.

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

2.1.2 Site Preparations for Dormancy and Selected Equipment Removal

Following final plant shut down and in preparation for the removal of selected components and placing the plant in a dormancy condition, the following activities are initiated.

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

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

3. Isolate (mechanically and electrically) the spent fuel storage services and fuel handling systems located in the reactor building, such that spent fuel storage systems can be maintained and controlled independent of the majority of other plant systems. This activity may be carried out by existing plant personnel in accordance with existing operating technical specifications.

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

5. Conduct asbestos remediation activities.

6. Conduct radiation surveys of work areas, major components selected for removal (including the reactor vessel and its internals),

and conduct sampling of internal piping contamination levels, and primary shield cores.

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

8. Determine transport and disposal container requirements for activated materials and/or hazardous materials, including shielding and stabilization. Fabricate or procure such required shipping canisters, cask liners, and Industrial Packages (IPs) from suppliers.

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

2.1.3 Equipment Removal Scheduled for Period 1

The study assumes that selected components or equipment will be removed during Period 1 of the decommissioning project. The material assumed to be removed during this period includes the following:

1. Segment reactor internals; package segments in shielded casks. These operations are performed remotely by cutting equipment located underwater in the refueling facilities. Package items that meet §61 "Class C" criteria or less.

2. Package §61 GTCC components into containers similar to fuel bundle containers for handling and storage along with the spent fuel assemblies. Transfer GTCC containers to the fuel handling facilities or suitable storage location.

3. Turbine/Generator

4. Main Transformer

5. Condenser/Waterbox

6. Equipment from the Condenser and Heater Bays

7. Miscellaneous Material stored in the Spent Fuel Pool

8. Miscellaneous Equipment located on the Refuel Floor

2.1.4 Establishing Conditions for Dormancy

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

1. Conduct wet fuel storage operations throughout SAFSTOR Period 1 and the early stages of the SAFSTOR dormancy period. All Unit 1 spent fuel on site will be transferred into an on-site ISFSI until shipment to the DOE can be completed. The existing Unit 1 spent fuel storage facility will continue to operate until all spent fuel is transferred to the ISFSI. Based on the study assumptions, the Unit 1 spent fuel pool would be clear of fuel by July 2006.

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

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

4. Drain reactor vessel (after the reactor vessel internals are removed).

5. Drain/de-energize/secure all contaminated systems not required to support dormancy operations. Decontaminate systems as required to achieve ALARA for future maintenance and inspection.

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

7. Clean loose surface contamination from building access pathways.

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

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

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

2.2 PERIOD 2 - SAFSTOR DORMANCY

The second phase identified by the NRC in its rule addresses licensed activities during a storage period and is applicable to the dormancy phase of the modified SAFSTOR alternative. Activities required during the planned dormancy period for the modified SAFSTOR alternative include continued wet spent fuel storage, transfer of spent fuel from the fuel pool to the ISFSI, a 24-hour per day guard force, preventive and corrective maintenance on operating systems, area lighting, general building maintenance, heating and ventilation of buildings, routine radiological inspections of contaminated structures, maintenance of structural integrity, and a site environmental and radiation monitoring program. The duration of the dormancy period for Unit 1 was selected such that the start of decommissioning periods 3 and 4 are coordinated with the Unit 2 decommissioning schedule.

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

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

Security during the dormancy period is conducted primarily to prevent unauthorized entry and to protect the public from the consequences of its own actions. Security will be provided by the security fence, sensors, alarms, surveillance equipment, etc., which must be maintained in good condition for the duration of this period. Fire and radiation alarms are also to be monitored and maintained. While remote surveillance is an option, it does not offer the

immediate response time of a physical presence and as such was not considered in the modified SAFSTOR alternative.

Variations in the length of the dormancy period are expected to have little effect upon the quantities of radioactive wastes generated from system and structure removal operations. While there will be a decrease in the contamination levels present on all surfaces due to radioactive decay over an increased dormancy duration, it is not expected that any material that is non-releasable at the time of shutdown will decay to a releasable state over the time frames estimated for Unit 1 (i.e., 15 years). It is not possible to make any further assumptions concerning contamination levels without detailed contamination characterization information.

The delay in decommissioning provides a period of decay for the residual radioactive material which yields lower working area radiation levels. Because this alternative provides a period of decay for the residual radioactive material, lower radiation fields are encountered than would be with a prompt decommissioning alternative.

2.3 PERIOD 3 - DECOMMISSIONING PREPARATIONS

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

A license termination plan must be prepared and submitted to the NRC at least two years prior to the anticipated date of license termination. Submitted as a supplement to the PSDAR, or equivalent, the plan must include a site characterization, description of the remaining dismantling activities, plans for site remediation, detailed plans for the final radiation survey, designation of the end-use of the site, an updated cost estimate to complete the decommissioning, and any associated environmental concerns. The NRC will publish notice of a receipt of the plan and make the plan available for public comment. A public meeting will also be scheduled. Plan approval will be subject to any conditions and limitations deemed appropriate by the NRC. The licensee may then commence with the final remediation of site facilities and plant services.

Although the initial radiation levels due to ^{60}Co will decrease significantly during the dormancy period, the activated reactor vessel will still exhibit sufficiently high radiation dose rates to require remote sectioning under water due to the presence of longer-lived radionuclides such as ^{137}Cs. Portions of the biological shield will still be radioactive due to the presence of activated trace elements with long half-lives (^{152}Eu and ^{154}Eu). Decontamination will require controlled removal and disposal. Given the levels of radioactivity and spectrum of radionuclides expected from twenty-five years of plant operation, no plant process system identified as being contaminated upon final shutdown will become releasable due to the decay period alone, i.e., there is no significant reduction in waste volume in delaying decommissioning. The majority of these systems and components will be shipped from the site to an off-site processor(s) for waste recovery/recycling and volume/weight reduction. The resulting residual wastes will be shipped by the processor(s) for disposal at either Barnwell or Envirocare. Systems and components deemed unacceptable by an off-site processor (i.e., irradiated components, Control Rod Blades, Nuclear Instrumentation, Reactor Vessel, non-GTCC Reactor Vessel Internal components, etc.) will be shipped directly from the site to Barnwell for disposal. Other material, such as contaminated soil and contaminated concrete may be shipped directly from the site to Envirocare for disposal.

Much of the work in developing a license termination plan is relevant to the development of the detailed engineering plans and procedures. The activities associated with this phase, as well as the follow-on decontamination and dismantling processes, are similar to the activities detailed in Section 2.1 for the removal of selected components and equipment. The timing of the Unit 1 delayed dismantling is such that Unit 1 license termination and Site Restoration activities would be performed in parallel with those for Unit 2.

Incorporated into the License Termination Plan, the Final Survey Plan details the radiological surveys to be performed once the decontamination activities are completed. The NRC will terminate the §50 licenses if it determines that site remediation has been performed in accordance with the license termination plan, and that the terminal radiation survey and associated documentation demonstrate that the facility is suitable for release.

2.4 PERIOD 4 - DECOMMISSIONING OPERATIONS AND LICENSE TERMINATION

Following the extended plant dormancy period, decommissioning activities will continue, based on a coordinated schedule with the Unit 2 shutdown and decommissioning. The project schedule for completing the decommissioning of

Unit 1 is based on initiating demolition activities for Units 1 and 2 in a coordinated project effort.

2.4.1 Decommissioning Activities

For the modified SAFSTOR alternative, the significant decommissioning activities scheduled to take place during Period 4 include the following tasks:

1. Construct temporary facilities and modify existing storage facilities to support the dismantling activities. These may include additional changing rooms and contaminated laundry facilities for increased work force, establishment of laydown areas to facilitate equipment removal and preparation for off-site transfer, upgrading roads to facilitate hauling and transportation, and modifications to the Reactor Building to facilitate access of large/heavy equipment.

2. Design and fabricate shielding in support of removal activities as well as contamination control envelopes; specify/procure specialty tooling and remotely operated equipment. Modify the refueling facilities to support segmentation activities and prepare rigging for segmentation and extraction of heavy components, including the reactor vessel.

3. Decontaminate components and piping systems as required to control (minimize) worker exposure. Remove, package, and ship all piping and components that are no longer essential to support decommissioning operations.

4. Segment reactor vessel closure head and vessel flange for shipment in cask liners. Load liners into shielded casks or place in shielded vans for transportation and disposal.

5. Segment/section the reactor vessel, placing segments into shielded containers. Transport the containers using shielded truck casks.

6. Remove the reactor recirculation piping and pumps. Package the piping in Industrial Packages (IPs); the reactor recirculation pumps may be sealed with steel plate so as to serve as their own containers. Ship piping and pumps for off-site processing and disposal.

7. Remove systems and associated components as they become non-essential to the vessel removal operation, related decommissioning activities, or worker health and safety (e.g., waste collection and processing systems, electrical and ventilation systems, etc.).

8. Remove activated concrete from the sacrificial shield and accessible contaminated concrete.

2.4.2 License Termination

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

1. Remove steel liners from the dryer/separator pool and containment, including any contaminated concrete behind liners, and route for controlled disposition.

2. Remove contaminated equipment and material from remaining auxiliary structures. Remediate until radiation surveys indicate that the structure can be released for unrestricted access.

3. Remove contaminated equipment and material from the wet fuel handling facilities following the transfer of all spent fuel to the on-site ISFSI. Remediate wet fuel handling facilities areas until radiation surveys indicate that the structure can be released for unrestricted access.

4. Decontaminate remaining site buildings and facilities. Remove all remaining LLRW along with any remaining hazardous and toxic materials. Material removed in the decontamination and dismantling of the nuclear unit may be characterized and segregated for additional off-site processing (disassembly, chemical cleaning,

volume reduction, waste treatment, etc.) and/or packaged for controlled disposal at a low-level radioactive waste disposal facility.

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

6. Conduct final radiation survey to ensure that all radioactive materials in excess of permissible residual levels have been remediated. This survey, which may coincide with final NRC site inspection is scheduled at the end of Period 4, the decommissioning operation phase.

Incorporated into the license termination plan, the final radiation survey plan details the radiological surveys to be performed once the decontamination activities are completed. The final radiation survey plan is developed using the guidance provided in the Multi-Agency Radiation and Site Investigation Manual (MARSSIM), which was issued in December 1997 in final form as NUREG-1575. These documents delineate the statistical approaches to survey design and data interpretation acceptable to the Environmental Protection Agency (EPA), and the NRC. They also identify state-of-the-art, commercially available, instrumentation and procedures for conducting radiological surveys. Using these guidelines ensures that the survey's design and implementation are conducted in a manner that provides a high degree of confidence that NRC criteria are satisfied. Once the survey is complete, the results are provided to the NRC in a format that can be verified. The NRC then reviews and evaluates the information, performs an independent confirmation of radiological site conditions, and makes a determination on final termination of the license.

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

2.5 PERIOD 5 - SITE RESTORATION

Site restoration activities may begin following completion of decommissioning operations. Efficient removal of the contaminated materials and verification that residual radionuclide concentrations are below the NRC limits will result in the degradation of many of the structures. Blasting, coring, drilling, scarification (surface removal), and the other decontamination activities will affect the power block structures, including the Reactor, Radwaste and

Turbine Buildings. Verifying that subsurface radionuclide concentrations meet NRC site release requirements may require additional removal of grade slabs and lower floors, potentially weakening footings and structural supports. Additional removal activities will be necessary for those facilities and plant areas for which historical records indicate the potential for contamination. This study assumes that Unit 1 license termination and Site Restoration activities would be performed in parallel with those for Unit 2.

This cost study presumes that non-essential structures and site facilities will be dismantled as a continuation of the decommissioning activity. Foundations and exterior walls are assumed to be removed to a nominal depth of three feet below grade whenever possible. Foundation grade slabs greater than three feet in thickness are abandoned in place and covered over with a three-foot layer of backfill. The three-foot depth allows for the placement of gravel for drainage, and topsoil so that vegetation can be established for erosion control. Site areas affected by the dismantling activities are cleaned and the plant area graded as required to prevent ponding and to inhibit the resurfacing of subsurface materials. Activities include:

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

2. Removing remaining buildings using conventional demolition techniques for above ground structures, including the Radwaste Building, Turbine Building and other site structures. The existing electrical switchyard will remain intact and in continued operation as part of the NU electrical distribution system.

3. Maintain an on-site ISFSI. The transfer of assemblies to a DOE facility is expected to continue until 2024. After all of the spent fuel has been removed from the site, the ISFSI will be decontaminated (if needed) to levels permitting termination of the Part §72 license.

4. Dismantle the ISFSI by conventional means. Following notification by NU, the NRC will verify that the Part §72 license termination criteria are satisfied. When the requirements are deemed satisfactory for the ISFSI,

the NRC can terminate the license for the site in coordination with the other two units.

5. Prepare the final dismantling report.

During the performance of Site Restoration, the Unit 1 ISFSI would remain operational and fuel transfers from Unit 1 to the DOE would be ongoing. Following the transfer of all Unit 1 fuel, the ISFSI would undergo separate decontamination and dismantlement, and site restoration phases. This would occur approximately 2.5 years after the completion of the Unit 1 power block dismantling described in this section. The ISFSI site restoration would be initiated in July 2024.

3. COST ESTIMATE

A site-specific decommissioning cost estimate was prepared to account for the unique features of Unit 1, including the primary coolant systems, electric power generation systems, unit buildings and structures. The basis of the estimate and its sources of information, methodology, site-specific considerations, assumptions, and total costs are described in this section.

3.1 BASIS OF ESTIMATE

The site-specific estimate was developed using the drawings and plant documents provided by NU, and a site walkdown and inventory performed by a crew of TLG engineers. Components (accessible) were inventoried during the walkdowns, with supporting information obtained from mechanical and electrical Piping & Instrument Diagrams, the master equipment database, Operations Procedures, construction reports, and other plant documents. Structural drawings and design documents were used to analyze the general arrangement of the facility and to determine estimates of building concrete volumes, steel quantities, numbers and sizes of major components, and areas of the plant to be addressed in remediation of the site.

Representative labor rates for each designated craft and salaried worker were provided by NU for use in construction of the unit removal factors, as well as for estimating the carrying costs for site management, worker supervision and essential support services, e.g., health physics and security.

For estimating purposes, all LLRW generated in the decontamination and dismantling of Unit 1 is assumed destined for recycling at off-site processing facilities, or disposed of at the existing Barnwell or Envirocare facilities. Much of the radioactive metallic waste shipped from the site will eventually be released as clean scrap by a recycling vendor.

3.2 METHODOLOGY

The methodology used to develop this cost estimate follows the basic approach originally presented in the AIF/NESP-036 study report, "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates," (Ref. 7) and the US DOE "Decommissioning Handbook" (Ref. 8). These references utilize a unit cost factor method which simplifies the calculations for estimating decommissioning activity costs. Unit cost factors for concrete removal ($/cubic yard), steel removal ($/ton), and cutting costs

($/inch) were developed from the labor cost information provided by NU and equipment and consumable costs provided by TLG. The activity-dependent costs are estimated by applying these unit cost factors to the item quantities (cubic yards, tons, inches, etc.) developed from the plant inventory.

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, as well as from TLG's involvement in the decommissioning planning and engineering for the Shoreham, Yankee Rowe, Trojan, Rancho Seco, Pathfinder, and Cintichem reactor facilities.

An activity duration critical path was used to determine the total decommissioning program schedule. The program schedule is used to determine the period-dependent costs for program management, administration, field engineering, equipment rental, quality assurance, and security. This study uses costs applicable to Unit 1 to determine the period-dependent costs (e.g. cost for utility staff, DOC staff, insurance, property taxes, etc.) Some of the costs for removal of radioactive components/structures were based on information obtained from the "Building Construction Cost Data," published by R. S. Means (Ref. 9). Examples of unit cost factor development are presented in the AIF/NESP-036 study. Appendix A presents the detailed development of a typical site-specific unit cost factor. Appendix B provides the values contained within one set of factors developed for the Unit 1 analysis.

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

3.3 FINANCIAL COMPONENTS OF THE COST MODEL

TLG's proprietary decommissioning cost model, DECCER, is composed of a number of distinct cost line items which are calculated using the unit cost factor methodology described earlier, as well as additional cost elements in support of the field activities. These calculated costs in and of themselves, however, do not comprise the total cost to accomplish the project goal, i.e., the license termination and site restoration of Unit 1.

Inherent in any cost estimate that does not rely on historical data is the inability to specify the precise source of costs imposed by factors such as tool breakage, accidents, illnesses, weather delays, labor stoppages, etc. Contingency fulfills this role in the DECCER cost model. Contingency is added to each line item to account for costs that are difficult or impossible to develop analytically. Such costs are historically inevitable over the duration of a job of this magnitude; therefore, this cost analysis includes funds to cover these types of expenses. Further discussion of this subject is presented in Section 3.3.1.

In addition to the routine uncertainties that contingency addresses, another cost element that is necessary to consider when answering the question of decommissioning costs relates to other types and levels of uncertainties. These consist of changes in work scope, pricing, job performance, and other variations that could conceivably, but not necessarily, occur. Consideration of such items may be necessary to address the question concerning how costly the decommissioning project could become, within a range of probabilities. TLG considers these types of costs under the broad term "financial risk." This cost study, however, does not add any additional costs to the estimate for financial risk.

3.3.1 Contingency

The activity- and period-dependent costs are combined to develop the total decommissioning costs. A contingency is then applied on a line-item basis, using one or more of the contingency types listed in the AIF/NESP-036 study. "Contingencies" are defined in the American Association of Cost Engineers "Project and Cost Engineers' Handbook" (Ref. 10) as "specific provision for unforeseeable elements of cost within the defined project scope; particularly important where previous experience relating estimates and actual costs has shown that unforeseeable events which will increase costs are likely to occur." The cost elements in this estimate are based upon ideal conditions and maximum efficiency; therefore, consistent with industry practice, a contingency factor has been applied. In the AIF/NESP-036 study, the types of unforeseeable events that are likely to occur in decommissioning are discussed and guidelines are provided for percentage contingency in each category. It should be noted that contingency, as used in this estimate, does not account for price escalation and inflation in the cost of decommissioning over the project duration.

The use and role of contingency within decommissioning estimates is not a "safety factor issue." Safety factors provide additional security

and address situations that may never occur. Contingency funds are expected to be fully expended throughout the program. They also provide assurance that sufficient funding is available to accomplish the intended tasks. Some of the rationale for (and need to incorporate) contingency within any estimate is offered in the following discussion. An estimate without contingency, or from which contingency has been removed, can disrupt the orderly progression of events and jeopardize a successful conclusion to the decommissioning process.

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

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

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

Incomplete or Changed Conditions:

- Surface coatings covering contamination which, could not have been identified by reasonable characterization, required additional cost and time to remediate.

- Additional decontamination, controlled removal, and disposition of previously undetected contamination due to enhanced access gained to formerly inaccessible areas and components.

Adverse Working Conditions:

- Lower than expected productivity due to heat exhaustion in underground vaults, resulting in a change in the working hours (shifting to cooler periods of the day) and additional manpower.

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

Maintenance, Repairs and Modifications

- Facility refurbishment required to support site operations, including those needed to provide new site services, as well as to maintain the integrity of existing structures.

- Damage control, repair, and maintenance from bird nestings and their fouling of equipment and controls.

- Building modification, i.e., re-supporting of floors to enhance loading capacity for heavily shielded casks.

- Roadway upgrades on site to handle heavier-than-expected and wider loads; roadway rerouting, excavation, and reconstruction.

- Unplanned-for requests by a vendor for additional safety margins.

- Requests to analyze accident scenarios beyond those defined by the removal scenario (requested by the NRC to comply with "total scope of regulation").

- Additional collection of site runoff and processing of such due to disturbance of natural site contours and drainage.

- Concrete coring for removal of embedments and internal conduit, piping, and other potentially contaminated material not originally identified through reasonable characterization.

- Modifications required to respond to higher-than-expected worker exposure, reduced water clarity, water disassociation, and hydrogen generation from high-temperature cutting operations.

- Additional waste containers needed to accommodate cutting particulates inefficient waste geometries, and excess material.

Labor

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

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

Schedule

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

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

Weather

- Destruction of an exterior asbestos containment enclosure due to violent winds.

- Frozen crane hydraulics prior to a major lift.

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

- Other weather-related delays.

The cost model incorporates considerations for items such as those described above, generating contingency dollars (at varying percentages of total line-item cost) with every activity.

3.3.2 Financial Risk

Financial risk refers to the possibility and associated probabilities of certain events occurring that could increase or decrease costs for decommissioning. TLG's methodology, when asked to perform a risk analysis, is to use a Monte Carlo simulation program such as @Risk (Ref. 11) for Microsoft Excel.

A Monte Carlo analysis of a decommissioning project examines the range of values that certain inputs could assume. The model requires the input of a distribution of values over this range; the distribution most often used for cost estimating is a triangular distribution. All independent variables to be examined are assigned a high endpoint, low

endpoint, and most likely midpoint to define their distribution. The actual analysis involves picking random values from within each range for each variable and recalculating the total cost at each iteration. The output of a Monte Carlo simulation typically includes a curve and range of probabilities for various cost estimates.

Included within the category of financial risk are:

- Transition activities and costs: ancillary expenses associated with eliminating 50% to 80% of the site labor force shortly after the cessation of plant operations, added cost for worker separation packages throughout the decommissioning program, and state- or company-mandated retraining.

- Delays in approval of the decommissioning plan due to intervention, public participation in local community meetings, legal challenges, state and local hearings, etc.

- Changes in the project work scope from the baseline estimate, involving the discovery of unexpected levels of contaminants, contamination in places not previously expected, contaminated soil previously undiscovered (either radioactive or hazardous material contamination), variations in plant inventory or configuration not indicated by the as-built drawings.

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

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

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

It has been TLG's experience that the results of a risk analysis, when compared with the base case estimate for decommissioning, indicate

that the chances of the base decommissioning estimate's being too high is a low probability, and the chances that the estimate is too low is a much higher probability. This is mostly due to the pricing uncertainty for LLRW burial, and to a lesser extent due to schedule increases from changes in plant conditions and to pricing variations in the cost of labor (both craft and staff). TLG did not perform a risk analysis for Millstone Unit 1 and therefore the cost estimates in this report do not include any increase in decommissioning costs as a result of any risk analysis performed for NU or any other TLG client.

3.4 SITE-SPECIFIC CONSIDERATIONS

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

3.4.1 Spent Fuel Disposition

For the basis of this cost study, the DOE is assumed to begin accepting spent fuel from the Millstone site starting in the year 2010. A basis for the (2010) start date assumption was provided by the DOE's Contracting Officer in a May 18, 1998 letter to NUSCO. In that letter to NUSCO (and other disposal contract-holders) the Contracting Officer stated that receipt of spent fuel could be initiated at a repository, beginning in 2010. Thus, in the absence of a national interim storage facility (an absence which is consistent with the DOE's current program plan (DOE/RW-0504, Rev. 2) and by virtue of the Millstone Units' contractual spent fuel allocation priorities from the DOE, spent fuel may begin to be removed from the Millstone site in 2010.

Millstone's spent fuel removal-allocation priorities have been specified by the DOE, on the basis of oldest fuel first, in a National Acceptance Priority Ranking. This ranking is utilized in conjunction with the annual spent fuel removal rates that are specified (on a national basis) in proposed legislation to determine the quantities of Millstone's spent fuel that are eligible to be removed from the site each year.

Unit 1's fuel pool would be cleared by July 2006 with the use of dry storage for Unit 1's fuel. The dry storage facility will need to be maintained until 2024.

3.4.2 Reactor Vessel and Internal Components

The reactor pressure vessel and reactor internal components are segmented for disposal, packaged, and shipped in shielded transportation casks. Segmentation and packaging of the internals' packages can be performed in the reactor well/dryer/separator pool where a turntable and remote cutter can be installed. The vessel can be segmented in place, using a mast-mounted cutter supported off the lower head and directed from a shielded work platform installed overhead in the reactor cavity. Transportation cask specifications and DOT regulations dictate segmentation and packaging methodology. All packages must meet the current physical and radiological limitations and regulations. Cask shipments will be made in DOT-approved, currently available, truck casks.

Recirculation and other connected system 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 applicable nozzle zone. The recirculation piping is boxed and shipped by shielded van to an off-site processor for processing and disposal. The recirculation pumps and motors are lifted out intact, packaged, and also transported to an off-site processor for recycling.

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

3.4.3 Transportation Methods

For the purposes of the cost estimate, it was assumed that the LLRW produced in the decontamination and dismantling of Millstone 1 will be moved overland by truck, or a shielded van, to an off-site processor, or to either of the two burial facilities. Transport costs were derived assuming Barnwell, SC as the destination for all Millstone reactor

vessel components and neutron-activated wastes destined for direct burial from the site. Contaminated soils and contaminated concrete debris are shipped for direct burial to Envirocare in Clive, UT. For wastes shipped to an off-site recovery vendor, the price of recycling includes truck rental and transportation costs to the recovery vendor's facility.

3.4.4 Low-Level Radioactive Waste Disposal

All LLRW generated in the decontamination and dismantling of the Millstone site is assumed disposed of by:

- off-site processing of metallic wastes by a recovery vendor.
- direct burial at the Barnwell facility.
- direct burial at the Envirocare facility in Clive, Utah.

Much of the radioactive metallic waste shipped from Millstone site will eventually be released as clean scrap by a recycling vendor. To the extent that it is cost-effective, non-compactable LLRW is treated to reduce the total volume of radioactive material requiring direct disposal. The treated material meeting the regulatory and site release criteria is released as clean scrap, requiring no further cost consideration. DAW, such as booties, glove liners, respirator filter cartridges, shipping containers, radiological controls survey materials, etc. will be assumed to be packaged on site and sent to a processor for volume reduction prior to disposal at the Envirocare facility. The weighted-average burial cost per cubic foot, not including GTCC waste or contingency, is $145/cubic foot.

3.4.5 Site Conditions Following Decommissioning

Following the decommissioning effort, the structures and remaining systems will meet the specified NRC site release limit. The NRC involvement in the decommissioning process typically will end at this point. Local building codes, state environmental regulations, and NU's own future plans for the site will dictate the next step in the decommissioning process. TLG assumed the total removal of all plant systems and all of the above-grade structures from the unit, with the exception of the existing electrical switchyard and the main stack. These non-radiological costs are a part of this study.

3.5 ASSUMPTIONS

The following are the major assumptions made in the development of the cost estimate for decommissioning Unit 1.

1. Costs are calculated in 1999 dollars. A present-value economic analysis is not included, nor is escalation or general inflation reflected within the costs reported.
2. Plant drawings, equipment and structural specifications, including construction details, were provided by NU.
3. Employee salary and craft labor rates for site administration, operations, construction, and maintenance personnel were provided by NU for positions identified by TLG.
4. NU provides the electrical power required to decommission the plant. Energy costs are included in the estimate.
5. Material and heavy equipment rental and operating costs were taken from R.S. Means Building Construction Cost Data (Ref. 9).
6. Radioactively contaminated piping, components, and structures other than the reactor vessel and internals are assumed to meet DOT limits for LSA or Surface Contaminated Object (SCO) material. For transportation calculations, the trucking distance from the plant site to the Barnwell site is 886 miles, 1,228 miles to a recycle facility, and 2,378 miles to the Envirocare burial site in Clive, UT. Rates for shipping radioactive wastes were provided by Tri-State Motor Transit in published tariffs for this cargo (Ref. 12).
7. All non-NSSS and NSSS system piping and components are shipped to a processor for decontamination, survey and release, or other forms of volume/weight reduction prior to disposal. Any scrap or recycle value is reflected in the processing fees.
8. The reactor vessel and internals' disposal costs were based on remote in-place segmentation, packaging in shielded casks, 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 is based upon the license limits of available shielded shipping casks. The number and curie content of vessel segments were selected to meet these limits. The number of cask shipments out of the Reactor Building is

expected to average three cask shipments per week. Decommissioning operations will not be impacted by the availability of the number or type of casks required.

9. All radioactive material is transported and disposed of in accordance with NRC and the U.S. Department of Transportation regulations. Any fuel cladding failure that has occurred during the lifetime of the plant is assumed:

   - to have released fission products at sufficiently low levels that the buildup of quantities of long-lived isotopes (e.g., cesium-137, strontium-90, or transuranics) has been prevented from reaching levels exceeding those which permit the major primary coolant system components to be shipped as LSA or SCO waste and to be buried within the requirements of 10 CFR 61 or the regional burial ground; or
   - to have necessitated systematic decontamination during the operating life of the plant; therefore, the radionuclide levels will be acceptable for transport as LSA or SCO waste and burial within the requirements of 10 CFR 61.

10. The estimated curie content of the vessel and internals at final shutdown was derived from those listed in NUREG/CR-3474 (Ref. 13). Actual estimates will be derived from the Ci/gram values in NUREG/CR-3474 and adjusted for the different mass of components and projected operating life, as well as for different periods of decay. Additional short-lived isotopes relevant to BWR's were derived from NUREG/CR-0130 (Ref. 14) and NUREG/CR-0672 (Ref. 15), and benchmarked to the long-lived values from NUREG/CR-3474.

11. This study estimates that some waste, resulting from disposal of the highly-activated sections of the reactor vessel internals will exceed 10 CFR 61 Class C quantities (GTCC). This low-level waste will most likely be disposed of in the DOE's deep geological repository unless an alternative solution is approved by the NRC. The cost of transportation and disposal, unlike that for the spent fuel, is not addressed by the DOE's 1 mill/kWhr surcharge, and has been estimated from equivalent disposal costs for spent nuclear fuel.

12. The control blades will be segmented and disposed of with the non-fuel bearing spent fuel pool inventory.

13. GTCC waste generated through segmentation of the reactor vessel internals will be transferred to an on-site storage facility. If the DOE were to default on its obligations to accept spent fuel and GTCC material,

decommissioning costs would almost certainly increase. Currently there are no licensed disposal sites for GTCC wastes. This fact necessitates the storage of this waste material on-site until a disposal method can be identified. The DOE has acknowledged that it may have the obligation to take possession of GTCC material. However, the DOE has not proposed a plan or a time frame for its acceptance and disposal of this material.

14. This study does not address the cost for the transportation of spent fuel from the site, or its subsequent disposal, which are the responsibility of the DOE. If the DOE delayed acceptance of spent fuel from Millstone beyond 2010, then decommissioning costs would increase.

15. Scrap generated during decommissioning is generally not included as a salvage credit line item in decommissioning studies. It is difficult to estimate the potential salvage value of a decommissioned nuclear power plant for the following reasons:

    - The acceptability of nuclear plant equipment to potential salvage equipment buyers is highly speculative, regardless of the ability to free release this material.
    - Much of the equipment at a nuclear plant, especially from older units, is too specific to that plant to be of use to potential salvage buyers.
    - The cost for removal of equipment to a configuration that is attractive to a salvage dealer is variable. Dismantling techniques assumed for equipment by TLG for this estimate are not consistent with removal techniques required for salvage (resale) of equipment. Yankee Rowe experience indicated that some buyers wanted equipment stripped down to very specific requirements before they would consider purchase. This required expensive rework after the equipment had been removed from its installation location.

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

    The following is an estimate of the potential credit to the project from the cost of recovery of selling the "clean" scrap metal taken from clean areas of Unit 1 and the estimated value of the free-released metal produced by the

off-site processor. Prices paid by scrap dealers fluctuate substantially and may vary significantly by locality, time of year, and "spot" demand.

Clean "Scrap Metal"
Estimated Recovery Value

Type of Material	Quantity[1] (tons)	Scrap Price[2] ($/ton)	Cost Recovery ($'s)
Carbon Steel	5,488	2	10,976
Stainless Steel	280	384	107,520
Copper	555	719	399,045
		Total	**517,541**

Note 1: Quantity of material released directly from "clean" areas of Unit 1.

Note 2: Scrap prices determined from "Iron Age Scrap Price Bulletin", New Steel, June 1999 (adjusted for transportation and handling costs and dealers profit).

Off-Site Processor "Free-Released Metal" Estimated Recovery Value

Type of Material	Quantity[1] (tons)	Scrap Price[2] ($/ton)	Cost Recovery[3] ($'s)
Carbon Steel	8,757	9	78,813
Stainless Steel	34	369	12,546
Copper	555	719	399,045
Titanium	154	8,000	1,232,000
		Total	1,722,404

Note 1: Quantity of Unit 1 scrap metal released from the off-site processor

Note 2: Scrap prices determined from "Iron Age Scrap Price Bulletin", New Steel, June 1999 (adjusted for transportation and handling costs and dealers profit).

Note 3: Off-site processing costs reflect all credits for scrap recovery value.

16. The NU staffing requirements during decommissioning vary with the level of effort associated with the various phases of the project. Once the decommissioning program commences, only those staff positions necessary to support the decommissioning program are included. There are no costs included in this study for staff transition from plant operations to decommissioning.

17. This study assumes that NU will hire a DOC for the decommissioning project. This DOC staff will provide for the preparatory demolition planning and scheduling, and will manage the decontamination, removal, survey and demolition efforts. Site security, radiological control oversight, quality assurance, and overall project oversight will be provided by NU during decommissioning.

18. Engineering services for such items as writing activity specifications, detailed procedures, detailed activation analyses, and structural modifications, etc. are assumed to be provided by outside contractors.

19. NU will remove items of personal property owned by NU that can be removed without the use of special equipment.
20. NU (or the DOC) is assumed to purchase or rent 100% of the scaffolding required to support the decommissioning project.
21. The decommissioning activities will be performed in accordance with current regulations, which are assumed to still be in place at the time of decommissioning. Changes in current regulations may have a cost impact on decommissioning.
22. 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. Changes to §20 worker exposure limits may impact the decommissioning cost and project schedule.
23. This study was performed in accordance with the published study from the Guidelines document. The contents of the 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.
24. 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. NU provided current nuclear liability and property insurance premiums which were factored to reflect lower coverage limits and return of premiums during decommissioning activities.
25. Nuclear property insurance currently carried by NU for the site will continue throughout the decommissioning period at a rate discounted from that in effect during operations.
26. Only existing site structures that are not currently leased will be considered in the decommissioning cost.
27. The perimeter fence and in-plant security barriers will be moved as appropriate to conform with the Site Security Plan in force at the various stages in the project.

28. The existing electrical switchyard will remain after decommissioning in support of the utility's electrical transmission and distribution system.
29. Underground metal and concrete piping will either be surveyed in place and released, or excavated and removed for survey. Any piping that exceeds the site release criteria will be removed.
30. Shallow portions of the concrete circulating water closed-loop piping will be exposed and the roof of the piping will be collapsed in place, while deep portions of the piping will be capped and abandoned in place.
31. Water drain holes are drilled in the bottom of all subgrade structures to be abandoned.
32. Road and parking areas with asphalt or concrete surfacing are broken up and the rubble used for backfill on site if needed.
33. Structures and site improvements will be removed to a depth of three feet below local grade wherever possible and backfilled to the local grade level. At-grade foundation slabs greater than three feet thick will be abandoned in place and covered over with a three-foot thick layer of backfill.
34. Property tax schedules for the decommissioning project were supplied by NU.
35. Significant plant equipment removal activities are scheduled to take place during Period 1 and Period 4 of the decommissioning project. The following equipment is scheduled to be removed during Period 1 of the project. All remaining equipment will be removed during Period 4.

    - Reactor Vessel Internals
    - Control Rod Drives and Nuclear Instrumentation
    - Turbine/Generator
    - Condenser/Waterbox
    - Large components in the Condenser and Heater bays
    - Main Transformer
    - Miscellaneous materials and equipment from the spent fuel pool, and refuel floor areas

    The equipment that is scheduled to be removed during Period 1 was selected based on the current availability of the Barnwell disposal facility (for highly activated components, such as portions of the reactor vessel internals and equipment stored in the spent fuel pool), and the availability of recycle facilities for the larger components, including the turbine/generator, condenser/waterbox, and the moisture separator and

feedwater heaters. The actual modified SAFSTOR schedule of decommissioning activities may vary from those presented in this study.

3.6 COST ESTIMATE SUMMARY

Summaries of the decommissioning and dismantling costs and annual expenditures are provided in Table 3.1. The costs were extracted from the detailed cost tables in Appendix C. The following should be considered when reviewing these tables:

- "Other" includes different types of costs which are not easily categorized. In most of the engineering preparatory activities the "Other" cost is strictly engineering labor; however, "Other" also includes taxes, insurance, plant energy budgets, and regulatory fees.

- The burial column does not include GTCC disposal, which is located under the "Other" column, because it is not assumed to be disposed of with the other low-level waste, but as a service provided by the DOE.

TABLE 3.1

SUMMARY OF DECOMMISSIONING COSTS[1] (1999 DOLLARS)

Year	Labor	Equipment & Materials	Energy	Burial/Processor	Other	Yearly Totals
1998	300,000					300,000
1999	7,500,000					7,500,000
2000	47,726,091	13,055,052	2,313,501	20,458,765	2,670,518	86,223,928
2001	43,819,502	12,882,197	2,313,501	20,458,765	2,319,985	81,793,950
2002	9,639,131	4,184,843	542,991	537,045	1,675,118	16,579,128
2003	6,918,770	4,465,622	495,451	2,124	1,663,987	13,545,954
2004	8,376,111	17,074,417	496,808	2,130	1,668,546	27,618,013
2005	8,361,882	17,073,210	495,451	2,124	1,663,987	27,596,654
2006	5,916,187	8,067,142	280,161	2,124	1,717,500	15,983,114
2007	3,722,407	342,519	67,180	2,124	1,770,439	5,904,668
2008	3,732,605	343,457	67,364	2,130	1,775,289	5,920,846
2009	3,722,407	342,519	67,180	2,124	1,770,439	5,904,668
2010	3,722,407	342,519	67,180	2,124	1,770,439	5,904,668
2011	3,722,407	342,519	67,180	2,124	1,770,439	5,904,668
2012	3,732,605	343,457	67,364	2,130	1,775,289	5,920,846
2013	3,722,407	342,519	67,180	2,124	1,770,439	5,904,668
2014	3,722,407	342,519	67,180	2,124	1,770,439	5,904,668
2015	3,722,407	342,519	67,180	2,124	1,770,439	5,904,668
2016	13,642,696	1,354,898	732,978	159,017	1,820,533	17,710,121
2017	39,957,479	3,940,614	2,435,034	560,231	1,903,854	48,797,213
2018	41,322,489	14,195,005	1,906,973	23,994,895	1,689,572	83,108,934
2019	41,178,997	17,085,971	1,758,099	30,601,704	1,627,097	92,251,868
2020	25,512,868	9,595,992	1,014,689	16,851,897	1,316,273	54,291,720
2021	16,946,789	3,051,972	120,896		1,145,381	21,265,038
2022	16,223,659	4,296,290	136,560		1,199,377	21,855,887
2023	8,471,775	4,550,794	136,560		977,582	14,136,712
2024	4,000,682	2,075,590	70,712	806,354	9,894,887	16,848,224
	379,337,164	140,034,154	15,855,352	114,456,309	50,897,847	700,580,827

Note 1: All costs are reported with contingency values included

4. SCHEDULE ESTIMATE

The schedule for the decommissioning scenario considered in this study follows the sequence presented in the AIF/NESP-036 study, with minor changes to reflect recent experience and site-specific constraints. The scheduling has also been revised to reflect the spent fuel management plan outlined for Unit 1.

Figure 4.1 presents a schedule for the Modified SAFSTOR decommissioning alternative. The assumptions supporting the schedule are listed herein. The key activities listed do not reflect a one-to-one correspondence with those activities in the Appendix C cost table, but reflect dividing some activities for clarity and combining others for convenience. The schedule was prepared using the "Microsoft Project for Windows" computer software (Ref. 16).

4.1 SCHEDULE ESTIMATE ASSUMPTIONS

The schedule estimate reflects the results of a precedence network developed for the site decommissioning activities, i.e., a PERT (Program Evaluation and Review Technique) Software Package. The durations used in the precedence network reflect the actual man-hour estimates from the cost tables in Appendix C. The following assumptions were made in the development of the decommissioning schedule.

- All work (except vessel and internals removal activities) is performed during an 8-hour workday, 5 days per week, with no overtime. There are 11 paid holidays per year.

- Reactor 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.

- Multiple crews work parallel activities to the maximum extent possible, consistent with: optimum efficiency; adequate access for cutting, removal and laydown space; and the stringent safety measures necessary during demolition of heavy components and structures.

- The watertight integrity of the reactor vessel cannot be compromised with spent fuel in the Reactor Building fuel storage facilities.

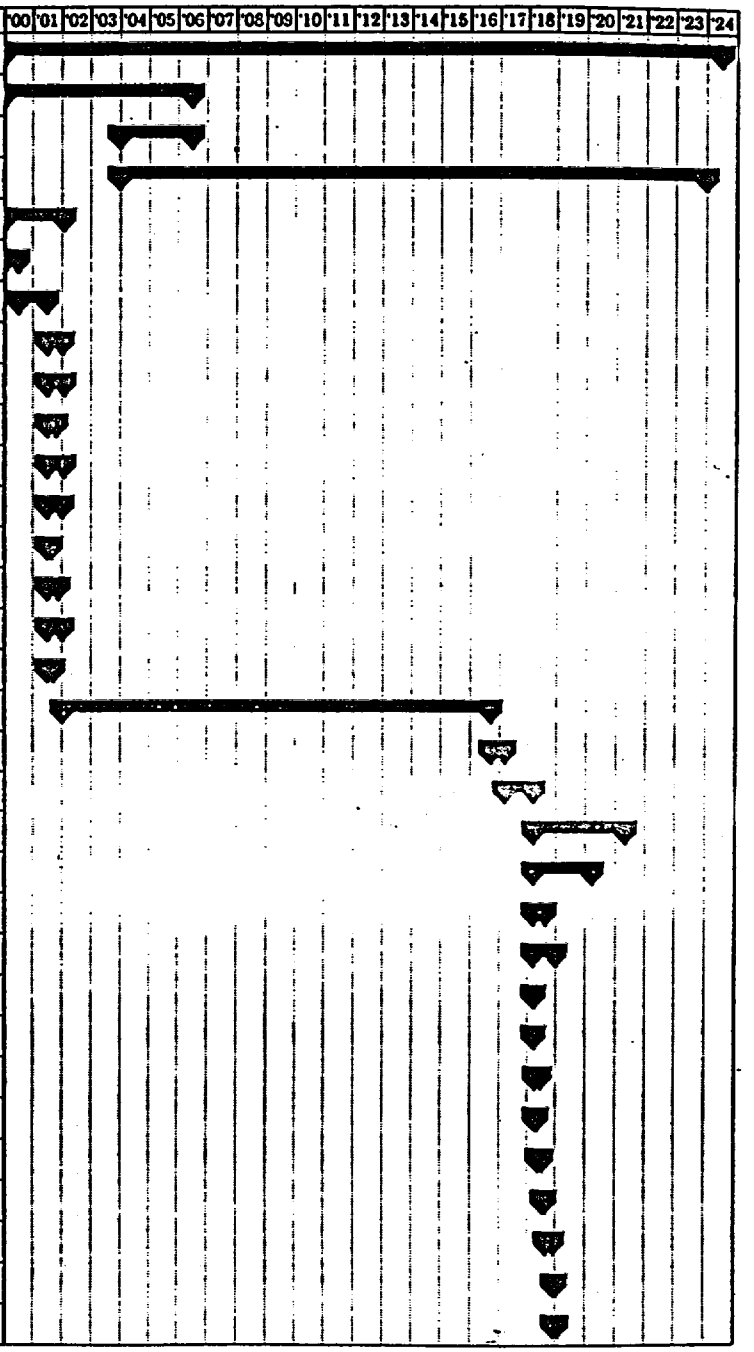
4.2 PROJECT SCHEDULE

The period-dependent costs presented in Appendix C are based upon the durations developed in the schedule. Durations are established between several milestones in each project period; these durations are used to establish a critical path for the entire project. In turn, the critical path duration for each period is used as the basis for determining the total costs for these period-dependent items. Refer to Appendix D of this report for Area designators.

A project timeline for the Modified SAFSTOR alternative is included as Figure 4.2. Milestone dates are based on a final plant shutdown date of November 4, 1995, and a start date of January 1, 2000 for Period 1 of the decommissioning project.

FIGURE 4.1
Decommissioning Activity Schedule

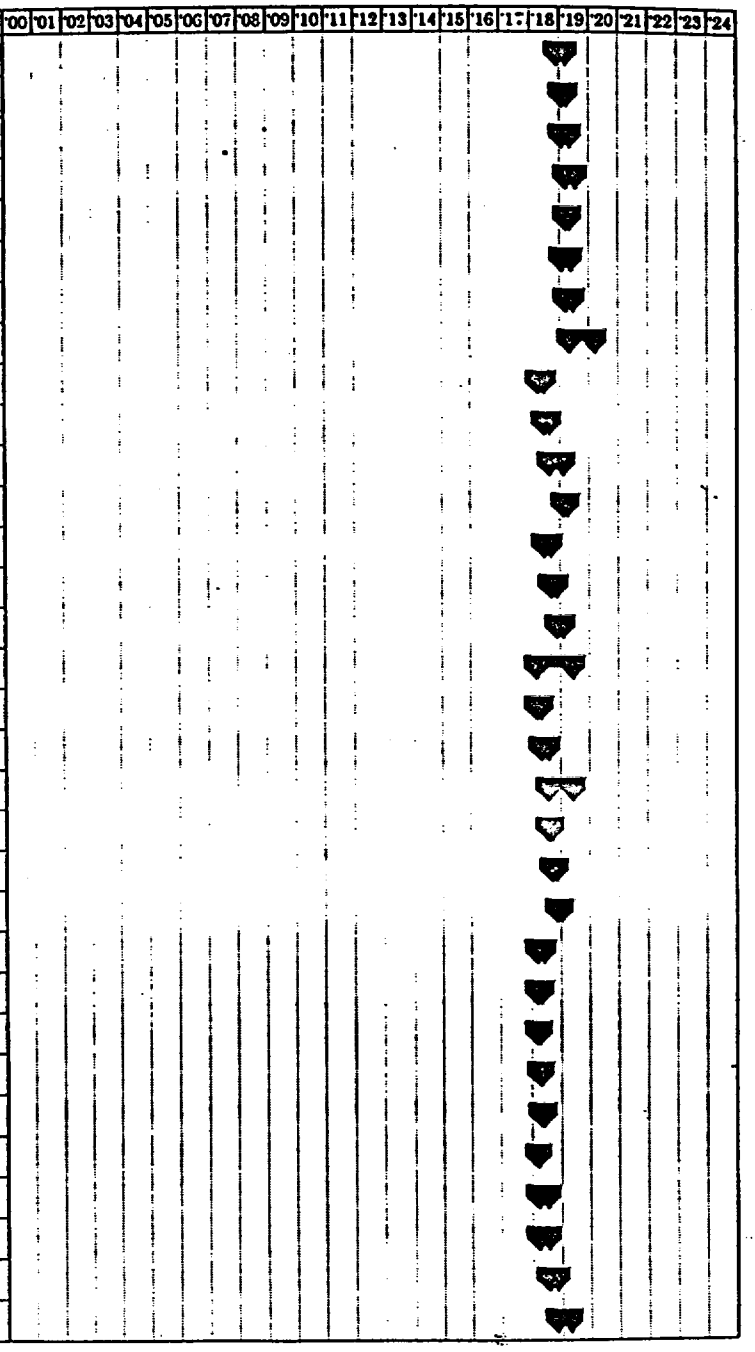
WBS	Task Name
1	Millstone Unit 1 Decommissioning (1)
1.1	Wet Fuel Storage
1.2	Move Fuel from Wet to Dry
1.3	Dry Fuel Storage
1.4	Period 1 Mothball Operations
1.4.1	Preparation
1.4.2	Operations
1.4.3	Period 1a - RPV Internals
1.4.4	Period 1b - Removal of Major Equipment
1.4.4.1	Rmv Turbine - Generator
1.4.4.2	Remove Condenser Unit 1
1.4.5	Period 1c - Disposal of Plant Systems
1.4.5.1	RB108A
1.4.5.2	TB14I
1.4.5.3	TB14H
1.4.5.4	SY14A
1.5	Period 2 Dormancy
1.6	Period 3 Preparations
1.7	Period 3 Operations
1.8	Period 4 D&D Operations
1.8.1	Reactor Building
1.8.1.1	Reactor Pressure Vessel
1.8.1.2	RB14A
1.8.1.3	RB14D
1.8.1.4	RB14B
1.8.1.5	RB-26D
1.8.1.6	RB-26E
1.8.1.7	RB14C
1.8.1.8	RB14E
1.8.1.9	RB65A
1.8.1.10	RB65C
1.8.1.11	RB65B



Note 1: See Appendix D for Area Descriptors

FIGURE 4.1
Decommissioning Activity Schedule
(continued)

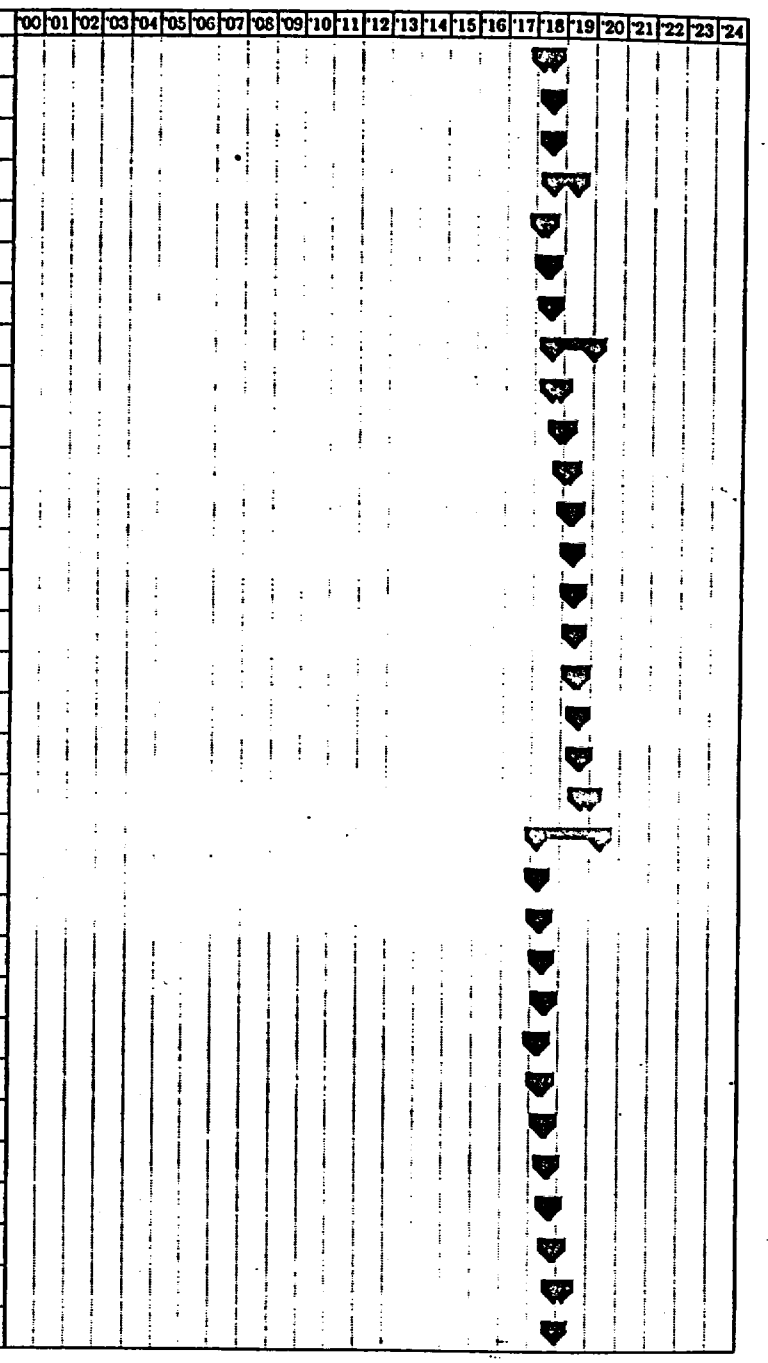
WBS	Task Name
1.8.1.12	RB65D
1.8.1.13	RB82B
1.8.1.14	RB82A
1.8.1.15	DW-8
1.8.1.16	DW-8 Recirc.
1.8.1.17	RB-26A
1.8.1.18	RB52A
1.8.1.19	Reactor Building Decon
1.8.1.20	RB-26C
1.8.1.21	RB-26B
1.8.1.22	RB42A
1.8.1.23	RB42E
1.8.1.24	RB42B
1.8.1.25	RB42C
1.8.1.26	RB42D
1.8.2	Turbine Building
1.8.2.1	MB14A
1.8.2.2	TB14M
1.8.2.3	TB14B
1.8.2.4	TB14F
1.8.2.5	TB14E
1.8.2.6	TB14A
1.8.2.7	TB14D
1.8.2.8	TB14L
1.8.2.9	TB14K
1.8.2.10	TB25A
1.8.2.11	TB36A
1.8.2.12	TB54A
1.8.2.13	TB54B
1.8.2.14	TB54C
1.8.2.15	TB34A
1.8.2.16	TB34B



Note 1: See Appendix D for Area Descriptors

FIGURE 4.1
Decommissioning Activity Schedule
(continued)

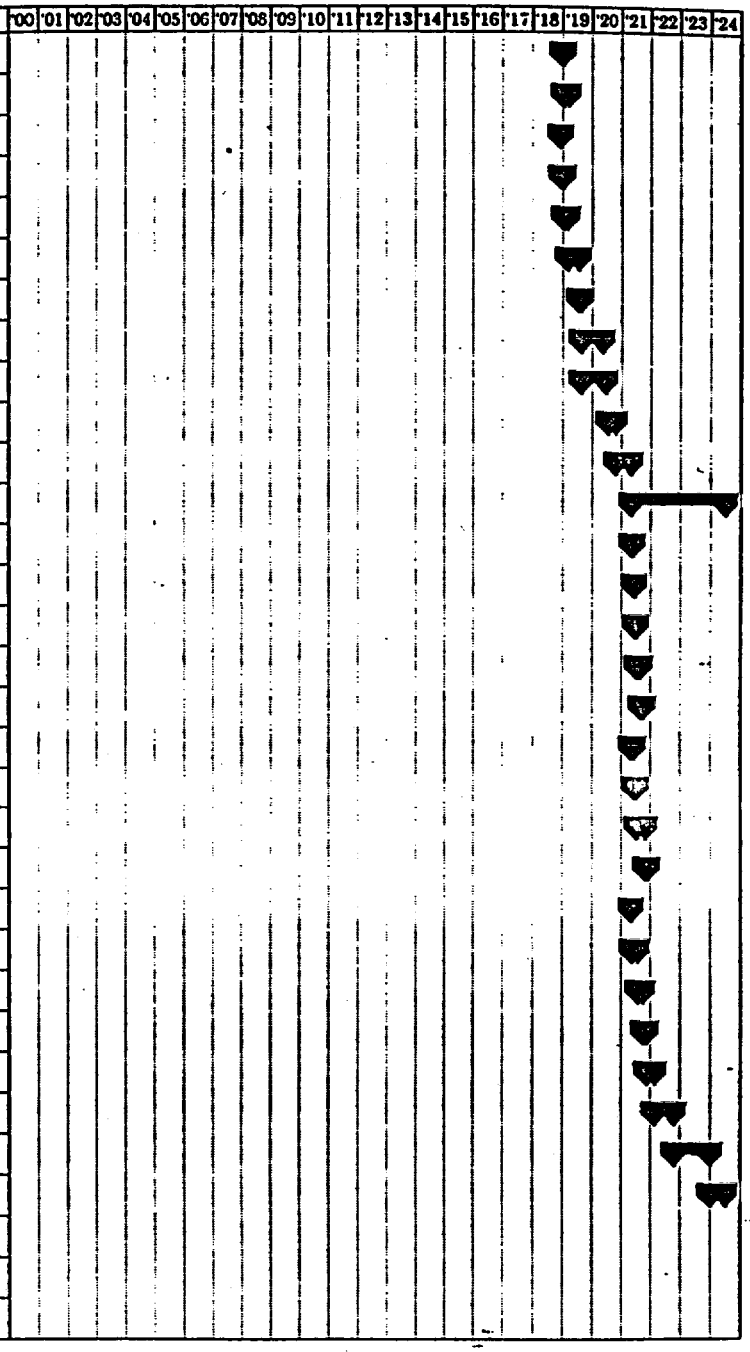
WBS	Task Name
1.8.2.17	TB14C
1.8.2.18	TB14G
1.8.2.19	TB14J
1.8.2.20	Turbine Building Decon
1.8.2.21	HR12A
1.8.2.22	TBROOF-C
1.8.2.23	TBROOF
1.8.3	Outside Structures
1.8.3.1	CD14A
1.8.3.2	YD14A-C
1.8.3.3	XK20A
1.8.3.4	YD14A
1.8.3.5	DS14A
1.8.3.6	GT14A
1.8.3.7	GTROOF
1.8.3.8	CW14A
1.8.3.9	CW14B
1.8.3.10	SP1A
1.8.3.11	Outside Structures Decon
1.8.4	Radwaste Building
1.8.4.1	WS14B
1.8.4.2	WS14A
1.8.4.3	WDROOF
1.8.4.4	WS38A
1.8.4.5	WD14A
1.8.4.6	WD-1A
1.8.4.7	WD-1C
1.8.4.8	WD-1E
1.8.4.9	WD-1D
1.8.4.10	WD-1B
1.8.4.11	WD-20B
1.8.4.12	WD-20E



Note 1: See Appendix D for Area Descriptors

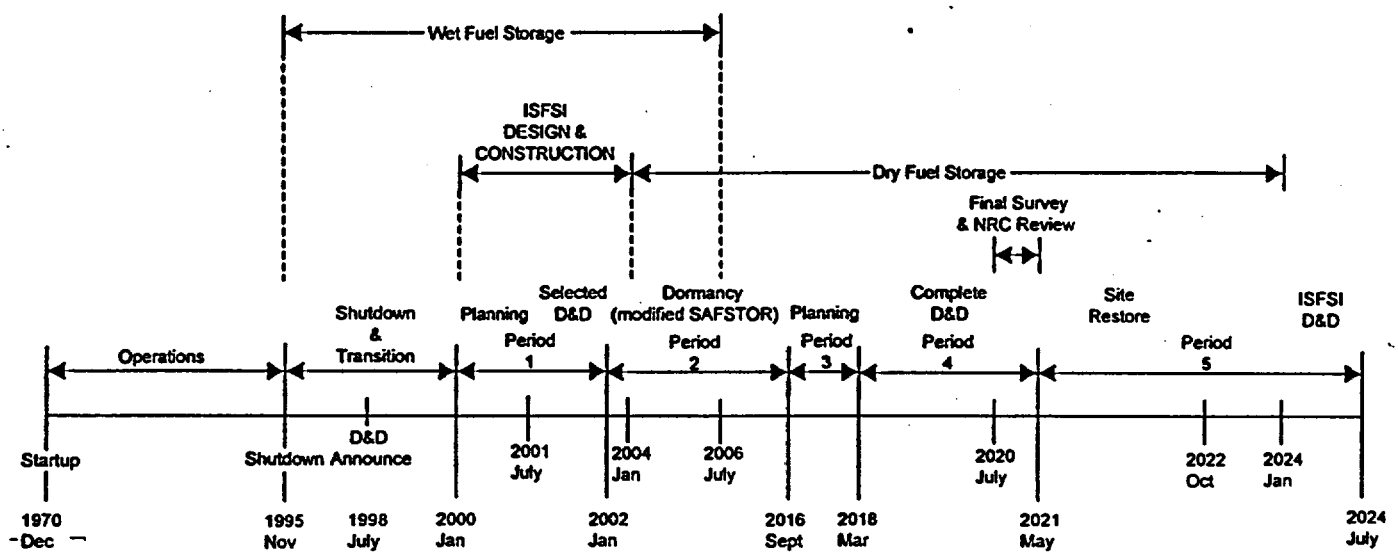
FIGURE 4.1
Decommissioning Activity Schedule
(continued)

WBS	Task Name
1.8.4.13	WD-20F
1.8.4.14	WD-20G
1.8.4.15	WD-20I
1.8.4.16	WD-20D
1.8.4.17	WD-20C
1.8.4.18	WD-20A
1.8.4.19	WD5A
1.8.4.20	Radwaste Building Decon
1.8.5	Control Building
1.8.6	Final Survey
1.8.7	NRC Review
1.9	Period 5 Site Restoration
1.9.1	Intake Structure
1.9.2	Discharge Stuctures
1.9.3	Emergency Gas Turbine Generator
1.9.4	Miscellaneous Structures
1.9.5	Xenon Krypton Building
1.9.6	Recombiner Building
1.9.7	Maintenance Shop
1.9.8	Turbine Building
1.9.9	Turbine Pedestal
1.9.10	Radwaste Shipment Building
1.9.11	Radwaste Storage Building
1.9.12	Liquid Radwaste Building
1.9.13	Control Building
1.9.14	Office Building
1.9.15	Reactor Building
1.10	Dry Fuel Storage
1.11	ISFSI D&D



Note 1: See Appendix D for Area Descriptors

FIGURE 4.2
Decommissioning Timeline
(Not To Scale)



5. RADIOACTIVE WASTES

The goal of any decommissioning program is the removal of all radioactive material from the site which would restrict termination of the NRC license for the site. This currently requires the remediation of all radioactive material at the site in excess of applicable legal limits. Under the Atomic Energy Act (Ref. 17), the NRC is responsible for protecting the public from sources of ionizing radiation. Title 10 of the Code of Federal Regulations delineates the production, utilization, and disposal of radioactive materials and processes. In particular, §61 controls the burial of low-level radioactive material and §71 defines transportation categories of radioactive material.

The resultant radioactive waste volumes are shown by line activity in the cost tables in Appendix C. Waste volume summaries, shown in Table 5.1, are quantified consistent with §61 classifications. Barnwell volumes are calculated based on the gross container dimensions or, for components serving as their own waste container, the volume is calculated based on the displaced volume of the component. Envirocare volumes are calculated based on the interior volume of shipping containers. Contaminated material sent to Envirocare is disposed without the shipping container.

Most of the materials being transported for off-site processing and controlled burial are categorized as LSA or SCO material containing Type A quantities, as defined in 49 CFR §173-178 (Ref. 18). Shipping containers are required to be Industrial Packages (IP-1 or IP-2). For this study, commercially-available steel containers are presumed to be used for the disposal of piping, small components, concrete, DAW, soil, and asbestos. Spent resins and filters are considered to be packaged in high-integrity containers which are cask shipped to a disposal site.

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

No process system that contains/handles radioactive substances at shut down is presumed to meet material release criteria by decay alone, i.e., systems radioactive at shut down will still be radioactive in a deferred decommissioning alternative due to the presence of long-lived radionuclides. While the dose rates decrease with time, radionuclides such as ^{137}Cs will still control the disposition requirements.

The waste volume generated in the decontamination and dismantling of any nuclear unit is primarily generated during Period 1 and Period 4 of the modified SAFSTOR alternative. Contaminated and activated material will be characterized on site, with a significant volume routed for off-site processing. Components with low levels of internal contamination will be shipped to a waste recycling center for disassembly, decontamination, volume reduction, and/or repackaging. Highly contaminated components and activated materials are routed for controlled disposal. The weighted average burial cost per cubic foot, not including GTCC waste or contingency, is $145/cubic foot.

Due to the lack of progress in siting a regional burial facility within the host state of Connecticut, all LLRW generated in the decontamination and dismantling of Unit 1 is assumed destined for disposal at either the Barnwell or Envirocare facility either directly or after processing by an off-site vendor. Much of the radioactive metallic waste shipped from Unit 1 will eventually be released as clean scrap by a recycling vendor.

Non-compactable (metallic) radioactive waste generated from removal of the plant equipment is assumed to be sent to an off-site vendor for recycling as a means of reducing the ultimate disposal volume and cost. Considering normal plant operating conditions and industry experience, the inventory of contaminated material at Unit 1 was segregated based on the likelihood of volume reduction and decontamination for radiological free release. The burial volumes reported in Tables 5.1 reflect the use of an off-site processor. Off-site processing of non-compactable metallic waste appears as a "waste processor" cost in the detailed decommissioning cost tables in Appendix C.

TABLE 5.1

RADIOACTIVE BURIAL/PROCESSOR and GTCC VOLUMES (Cubic Feet)

	Waste Class (1)	Direct Disposal Barnwell	Direct Disposal Envirocare	Direct Shipment to Processor (2)	GTCC
Modified SAFSTOR					
	A	22,975	187,156	476,147	
	B	6,773			
	C	861			
	>C				424
	Total	**30,609**	**187,156**	**476,147**	**424**

Note 1: Waste is classified according to the requirements delineated in Title 10 Code of Federal Regulations, Part 61.56

Note 2: Of these volumes, an estimated 1,022 ft^3 of processed waste will be shipped from the processor to Barnwell, and an estimated 89,838 ft^3 of processed waste will be shipped from the processor to Envirocare.

6. RESULTS

The projected cost for the modified SAFSTOR alternative to decommission Unit 1 (including approximately 6.5 years for operation of the fuel storage pool as an interim wet fuel storage facility) is estimated to be $700.6 million in 1999 dollars. The cost reflects the site-specific features of Unit 1, the local cost of labor, a schedule for spent fuel receipt, and current costs for recycling and LLRW disposal at Barnwell and Envirocare. A summary of the major cost categories contributing to the total cost is provided in Table 6.1.

Staffing, which includes management, security, technical support, and health physics combined with Engineering, Planning, and Removal labor represents the largest cost driver to decommission a nuclear unit. This is a direct result of the labor-intensive nature of the decommissioning process, as well as the management controls required to ensure a safe and successful program. Spent fuel and GTCC waste storage represents another significant cost driver. The costs associated with designing, licensing, and constructing an ISFSI to store spent fuel and GTCC waste, including the procurement of fuel assembly storage containers, are directly related to delays associated with the DOE spent fuel acceptance schedule. Combined, off-site LLRW processing and/or disposal (burial) represent the next largest cost component (excluding contingency). The costs in the estimate are indicative of the current recycling/disposal options, and reflect substantial savings from direct disposal. These costs are most sensitive to the disposal and waste recycling vendor(s) pricing structure, the waste volume generated in the decontamination and dismantling process, the volume reduction achieved, transport regulations for LLRW, and the final destination (i.e., distance to the disposal site).

Even with a modified SAFSTOR scenario, the construction of barriers, the removal of the highly-activated reactor vessel internals, removal of large secondary side components, and the general decontamination of plant areas in preparation for dormancy does not alleviate the need for continued surveillance. The structural integrity of facilities must be maintained to support eventual final decontamination and dismantling activities. Peripheral structures will have to be maintained or remediated where asbestos and other hazardous or toxic material could enter the environment through degradation, or weathering, of site structures.

The need to maintain a wet fuel storage support facility until July 2006 (6.5 years) is influenced by NU's fuel disposal contracts with the DOE, irrespective of the intended decommissioning plans for the facility. This will require the continued operation of several plant systems and a cognizant operations staff. Significant dismantling activities (systems/components nonessential to spent fuel storage) have been scheduled during the initial wet storage period in the modified SAFSTOR alternative.

The actual modified SAFSTOR schedule of decommissioning activities may vary from that presented in this study.

Licensees are currently required to complete the decommissioning process (culminating in the termination of the NRC site licenses) within a period of 60 years. The modified SAFSTOR alternative schedule completes the decommissioning process in 24.5 years, well before the 60-year NRC limit.

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

TABLE 6.1

Summary of Decommissioning Costs (thousands of 1999 dollars)

Work Category	Total Cost	Percent of Total Costs
Staffing	151,830	21.672
Contingency	104,608	14.932
Spent Fuel & GTCC Storage Costs	77,234	11.024
Administrative & General Costs	71,135	10.154
Waste Processor (note 1)	56,852	8.115
Removal (note 2)	38,459	5.490
Engineering & planning costs	25,732	3.673
LLRW Burial (note 3)	23,212	3.313
Non-Construction M&S	21,427	3.058
Property Taxes	16,205	2.313
Decontamination	14,827	2.116
Insurance	14,800	2.113
Plant Energy Budget	13,787	1.968
Soil Remediation	11,059	1.579
Heavy Equipment Rental	8,103	1.157
NRC Fees	7,042	1.005
Packaging (note 4)	6,974	0.995
GTCC disposal	6,269	0.895
License Termination Survey	6,216	0.887
Incentive Program Costs	5,088	0.726
Health Physics Supplies	4,691	0.670
ISFSI License Termination & Demo	4,348	0.621
Shipping (note 5)	2,836	0.405
Asbestos abatement	2,642	0.377
Emergency Planning Fees	1,800	0.257
Site Characterization Survey	1,253	0.179
Remaining Costs	2,154	0.307
Total	700,581	100%

Note:
1. Less costs of asbestos processing.
2. Less removal costs of asbestos, HP supplies, heavy equipment rental and soil.
3. Less disposal costs of soil.
4. Less packaging costs of soil.
5. Less shipping costs of soil.

7. REFERENCES

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

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

3. U.S. Code of Federal Regulations, Title 10, Parts 2, 50 and 51, "Decommissioning of Nuclear Power Reactors," Nuclear Regulatory Commission, Federal Register Volume 61 (p39278+), July 29, 1996.

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

5. DOE/RW-0504, Revision 2, "Civilian Radioactive Waste Management Program Plan", July 1998.

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

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

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

9. "Building Construction Cost Data 1999," Robert Snow Means Company, Inc., Kingston, Massachusetts.

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

11. "@Risk Users Manual," Version 3.1, Palisade Corporation, Newfield, NY 1995.

12. Tri-State Motor Transit Company, published tariffs, Interstate Commerce Commission (ICC), Docket No. MC-109397 and Supplements, 1997.

7. REFERENCES
(continued)

13. J.C. Evans et al., "Long-Lived Activation Products in Reactor Materials," NUREG/CR-3474, Pacific Northwest Laboratory for the Nuclear Regulatory Commission, August, 1984.

14. R.I. Smith, G.J. Konzek, W.E. Kennedy, Jr., "Technology, Safety and Costs of Decommissioning a Reference Pressurized Water Reactor Power Station," NUREG/CR-0130 and addenda, Pacific Northwest Laboratory for the Nuclear Regulatory Commission, June, 1978.

15. H.D. Oak, et al., "Technology, Safety and Costs of Decommissioning a Reference Boiling Water Reactor Power Station," NUREG/CR-0672 and addenda, Pacific Northwest Laboratory for the Nuclear Regulatory Commission, June, 1980.

16. "Microsoft Project for Windows 95," Version 4.1, Microsoft Corporation, Redmond, WA, 1995.

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

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

APPENDIX A

UNIT COST FACTOR DEVELOPMENT

APPENDIX A
UNIT COST FACTOR DEVELOPMENT

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

1. SCOPE

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

2. CALCULATIONS

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

Duration adjustment(s):

+ Respiratory protection adjustment (25% of critical duration)	64
+ Radiation/ALARA adjustment (10% of critical duration)	26
Adjusted work duration	345
+ Protective clothing adjustment (30% of adjusted duration)	104
Productive work duration	449
+ Work break adjustment (8.33 % of productive duration)	37
Total work duration min	486 min

*** Total duration = 8.100 hr ***

APPENDIX A
(continued)

3. LABOR REQUIRED

Crew	Number	Duration (hr)	Rate ($/hr)	Cost
Laborers	3.00	8.100	$27.91	$678.21
Craftsmen	2.00	8.100	$39.53	$640.39
Foreman	1.00	8.100	$41.56	$336.64
General Foreman	0.25	8.100	$45.81	$92.77
Fire Watch	0.05	8.100	$27.91	$11.30
Health Physics Technician	1.00	8.100	$30.30	$245.43
Total labor cost				$2,004.74

4. EQUIPMENT & CONSUMABLES COSTS

Equipment Costs	none
Consumables/Materials Costs	
-Blotting paper 50 @ $0.45 sq ft {2}	$22.50
-Plastic sheets/bags 50 @ $0.10/sq ft {3}	$5.00
-Gas torch consumables 1 @ $7.72/hr x 1 hr {1}	$7.72
Subtotal cost of equipment and materials	$35.22
Overhead & profit on equipment and materials @ 16.00%	$5.64
Total costs, equipment & material	$40.86
TOTAL COST Removal of contaminated heat exchanger <3000 pounds:	**$2,045.60**
Total labor cost:	$2,004.74
Total equipment/material costs:	$40.86
Total adjusted exposure manhours incurred	33.379
Total craft labor man-hours required per unit:	59.130

APPENDIX A
(continued)

5. NOTES AND REFERENCES

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

2. Work difficulty factors were developed in conjunction with the AIF program to standardize decommissioning cost studies and are delineated in the "Guidelines" study (Ref. 7, Vol. 1, Ch. 5).

3. Adjusted for regional material costs for New London,CT.

4. References:

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

APPENDIX B

UNIT COST FACTOR LISTING

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Removal of clean instrument and sampling tubing, $/linear foot	0.73
Removal of clean pipe 0.25 to 2 inches diameter, $/linear foot	7.94
Removal of clean pipe >2 to 4 inches diameter, $/linear foot	9.27
Removal of clean pipe >4 to 8 inches diameter, $/linear foot	20.02
Removal of clean pipe >8 to 14 inches diameter, $/linear foot	36.67
Removal of clean pipe >14 to 20 inches diameter, $/linear foot	47.40
Removal of clean pipe >20 to 36 inches diameter, $/linear foot	69.85
Removal of clean pipe >36 inches diameter, $/linear foot	82.86
Removal of clean valves >2 to 4 inches	94.19
Removal of clean valves >4 to 8 inches	200.21
Removal of clean valves >8 to 14 inches	366.74
Removal of clean valves >14 to 20 inches	474.05
Removal of clean valves >20 to 36 inches	698.53
Removal of clean valves >36 inches	828.63
Removal of clean pipe hangers for small bore piping	43.61
Removal of clean pipe hangers for large bore piping	145.74
Removal of clean pumps, <300 pound	345.13
Removal of clean pumps, 300-1000 pound	923.40
Removal of clean pumps, 1000-10,000 pound	3,274.48
Removal of clean pumps, >10,000 pound	6,313.08
Removal of clean pump motors, 300-1000 pound	396.22
Removal of clean pump motors, 1000-10,000 pound	1,369.23
Removal of clean pump motors, >10,000 pound	3,083.07
Removal of clean turbine-driven pumps < 10,000 pound	3,953.83
Removal of clean turbine-driven pumps > 10,000 pounds	8,842.35

APPENDIX B
(continued)

Unit Cost Factor	Cost/Unit($)
Removal of clean PWR turbine-generator	N/A
Removal of clean heat exchanger <3000 pound	1,889.96
Removal of clean heat exchanger >3000 pound	4,742.49
Removal of clean feedwater heater/deaerator	12,443.34
Removal of clean moisture separator/reheater	25,146.70
Removal of clean PWR main condenser	N/A
Removal of clean tanks, <300 gallons	439.49
Removal of clean tanks, 300-3000 gallon	1,349.94
Removal of clean tanks, >3000 gallons, $/square foot surface area	10.90
Removal of clean electrical equipment, <300 pound	192.78
Removal of clean electrical equipment, 300-1000 pound	638.90
Removal of clean electrical equipment, 1000-10,000 pound	1,274.71
Removal of clean electrical equipment, >10,000 pound	2,854.60
Removal of clean electrical transformers < 30 tons	2,076.54
Removal of clean electrical transformers > 30 tons	5,716.64
Removal of clean standby diesel-generator, <100 kW	2,029.20
Removal of clean standby diesel-generator, 100 kW to 1 MW	4,523.78
Removal of clean standby diesel-generator, >1 MW	9,367.66
Removal of clean electrical cable tray, $/linear foot	16.94
Removal of clean electrical conduit, $/linear foot	7.24
Removal of clean mechanical equipment, <300 pound	192.78
Removal of clean mechanical equipment, 300-1000 pound	638.90
Removal of clean mechanical equipment, 1000-10,000 pound	1,274.71
Removal of clean mechanical equipment, >10,000 pound	2,854.60
Removal of clean HVAC equipment, <300 pound	192.78

APPENDIX B
(continued)

Unit Cost Factor	Cost/Unit($)
Removal of clean HVAC equipment, 300-1000 pound	638.90
Removal of clean HVAC equipment, 1000-10,000 pound	1,274.71
Removal of clean HVAC equipment, >10,000 pound	2,854.60
Removal of clean HVAC ductwork, $/pound	1.34
Removal of contaminated instrument and sampling tubing, $/linear foot	0.73
Removal of contaminated pipe 0.25 to 2 inches diameter, $/linear foot	18.95
Removal of contaminated pipe >2 to 4 inches diameter, $/linear foot	32.94
Removal of contaminated pipe >4 to 8 inches diameter, $/linear foot	54.27
Removal of contaminated pipe >8 to 14 inches diameter, $/linear foot	106.33
Removal of contaminated pipe >14 to 20 inches diameter, $/linear foot	127.79
Removal of contaminated pipe >20 to 36 inches diameter, $/linear foot	178.17
Removal of contaminated pipe >36 inches diameter, $/linear foot	212.02
Removal of contaminated valves >2 to 4 inches	158.09
Removal of contaminated valves >4 to 8 inches	257.16
Removal of contaminated valves >8 to 14 inches	531.67
Removal of contaminated valves >14 to 20 inches	672.35
Removal of contaminated valves >20 to 36 inches	890.83
Removal of contaminated valves >36 inches	1,060.12
Removal of contaminated pipe hangers for small bore piping	55.52
Removal of contaminated pipe hangers for large bore piping	185.08
Removal of contaminated pumps, <300 pound	451.34
Removal of contaminated pumps, 300-1000 pound	1,045.12
Removal of contaminated pumps, 1000-10,000 pound	3,510.94
Removal of contaminated pumps, >10,000 pound	8,514.10
Removal of contaminated pump motors, 300-1000 pound	460.02

APPENDIX B
(continued)

Unit Cost Factor	Cost/Unit($)
Removal of contaminated pump motors, 1000-10,000 pound	1,433.03
Removal of contaminated pump motors, >10,000 pound	3,226.62
Removal of contaminated turbine-driven pumps < 10,000 pounds	4,155.61
Removal of contaminated turbine-driven pumps > 10,000 pounds	9,485.94
Removal of contaminated BWR turbine-generator	244,404.02
Removal of contaminated heat exchanger <3000 pound	2,045.60
Removal of contaminated heat exchanger >3000 pound	5,928.72
Removal of contaminated feedwater heater/deaerator	15,137.54
Removal of contaminated moisture separator/reheater	33,011.94
Removal of contaminated BWR main condenser	594,707.88
Removal of contaminated tanks, <300 gallons	751.58
Removal of contaminated tanks, >300 gallons, $/square foot	15.19
Removal of contaminated electrical equipment, <300 pound	342.67
Removal of contaminated electrical equipment, 300-1000 pound	835.85
Removal of contaminated electrical equipment, 1000-10,000 pound	1,601.35
Removal of contaminated electrical equipment, >10,000 pound	3,272.63
Removal of contaminated electrical cable tray, $/linear foot	17.00
Removal of contaminated electrical conduit, $/linear foot	15.07
Removal of contaminated mechanical equipment, <300 pound	393.48
Removal of contaminated mechanical equipment, 300-1000 pound	957.19
Removal of contaminated mechanical equipment, 1000-10,000 pound	1,837.89
Removal of contaminated mechanical equipment, >10,000 pound	3,272.63
Removal of contaminated HVAC equipment, <300 pound	393.48
Removal of contaminated HVAC equipment, 300-1000 pound	957.19
Removal of contaminated HVAC equipment, 1000-10,000 pound	1,837.89

APPENDIX B
(continued)

Unit Cost Factor	Cost/Unit($)
Removal of contaminated HVAC equipment, >10,000 pound	3,272.63
Removal of contaminated HVAC ductwork, $/pound	1.66
Removal/plasma arc cut of contaminated thin metal components, $/linear in.	1.91
Additional decontamination of surface by washing, $/square foot	4.01
Additional decontamination of surfaces by hydrolasing, $/square foot	17.71
Decontamination rig hook-up and flush	3,322.03
Chemical flush of components/systems, $/gallon	9.15
Removal of clean standard reinforced concrete, $/cubic yard	217.13
Removal of grade slab concrete, $/cubic yard	279.09
Removal of clean concrete floors, $/cubic yard	377.03
Removal of sections of clean concrete floors, $/cubic yard	1,225.29
Removal of clean heavily rein concrete w/#9 rebar, $/cubic yard	286.97
Removal of contaminated heavily rein concrete w/#9 rebar, $/cubic yard	1,072.24
Removal of clean heavily rein concrete w/#18 rebar, $/cubic yard	365.25
Removal of contaminated heavily rein concrete w/#18 rebar, $/cubic yard	1,421.09
Removal heavily rein concrete w/#18 rebar & steel embedments, $/cu yd	539.17
Removal of below-grade suspended floors, $/square foot	377.03
Removal of clean monolithic concrete structures, $/cubic yard	1,071.27
Removal of contaminated monolithic concrete structures, $/cu yd	1,070.37
Removal of clean foundation concrete, $/cubic yard	872.40
Removal of contaminated foundation concrete, $/cubic yard	996.18
Explosive demolition of bulk concrete, $/cubic yard	41.41
Removal of clean hollow masonry block wall, $/cubic yard	140.65
Removal of contaminated hollow masonry block wall, $/cubic yard	140.65
Removal of clean solid masonry block wall, $/cubic yard	140.65

APPENDIX B
(continued)

Unit Cost Factor	Cost/Unit($)
Removal of contaminated solid masonry block wall, $/cubic yard	140.65
Backfill of below-grade voids, $/cubic yard	14.92
Removal of subterranean tunnels/voids, $/linear foot	207.14
Placement of concrete for below-grade voids, $/cubic yard	98.23
Excavation of clean material, $/cubic yard	4.78
Excavation of contaminated material, $/cubic yard	21.75
Excavation of submerged concrete rubble, $/cubic yard	17.52
Removal of clean concrete rubble, $/cubic yard	81.48
Removal of contaminated concrete rubble, $/cubic yard	17.02
Removal of building by volume, $/cubic foot	0.34
Removal of clean building metal siding, $/square foot	2.34
Removal of contaminated building metal siding, $/square foot	2.34
Removal of standard asphalt roofing, $/square foot	3.07
Removal of transite panels, $/square foot	3.24
Scarifying contaminated concrete surfaces (drill & spall)	7.26
Scabbling contaminated concrete floors, $/square foot	4.15
Scabbling contaminated concrete walls, $/square foot	4.72
Scabbling contaminated ceilings, $/square foot	42.47
Scabbling structural steel, $/square foot	3.43
Removal of clean overhead cranes/monorails < 10 ton capacity	895.36
Removal of contaminated overhead cranes/monorails < 10 ton capacity	895.36
Removal of clean overhead cranes/monorails >10-50 ton capacity	2,142.68
Removal of contaminated overhead cranes/monorails >10-50 ton capacity	2,142.68
Removal of polar cranes > 50 ton capacity, each	8,032.63
Removal of gantry cranes > 50 ton capacity, each	33,238.04

APPENDIX B
(continued)

Unit Cost Factor	Cost/Unit($)
Removal of structural steel, $/pound	0.48
Removal of clean steel floor grating, $/square foot	4.96
Removal of contaminated steel floor grating, $/square foot	4.96
Removal of clean free-standing steel liner, $/square foot	16.23
Removal of contaminated free-standing steel liner, $/square foot	17.57
Removal of clean concrete-anchored steel liner, $/square foot	8.18
Removal of contaminated concrete-anchored steel liner, $/square foot	20.44
Placement of scaffolding in clean areas, $/square foot	7.18
Placement of scaffolding in contaminated areas, $/square foot	7.64
Landscaping w/o topsoil, $/acre	2,848.61
Cost of CPC B-88 LSA box & preparation for use	867.27
Cost of CPC B-25 LSA box & preparation for use	924.85
Cost of CPC B-12V 12 gauge LSA box & preparation for use	719.29
Cost of CPC B-144 LSA box & preparation for use	3,815.25
Cost of LSA drum & preparation for use	111.41
Cost of cask liner for CNSI 8-120A cask (resins)	6,341.78
Cost of cask liner for CNSI 8-120A cask (filters)	6,341.78
Decontamination of surfaces with vacuuming, $/square foot	0.93

APPENDIX C

MODIFIED SAFSTOR DECOMMISSIONING COST ESTIMATE

TABLE C-1
MILLSTONE NUCLEAR POWER STATION - UNIT 1
MODIFIED SAFSTOR – DECOMMISSIONING COST ESTIMATE
(Thousands of 1999 Dollars)

ID Number	Activity/Area Description	Decon	Remove	Pack	Ship	Burial/Processor Costs: Barnwell	Burial/Processor Costs: Envirocare	Burial/Processor Costs: Waste Processor	Other	Contingency	Total	NRC Lic/Term	Site Restore
Pre-Decommissioning Costs													
	1996	-	-	-	-	-	-	-	300	-	300	300	-
	1999	-	-	-	-	-	-	-	7,500	-	7,500	7,500	-
PERIOD 1: Mothballing Activities													
1	Prepare preliminary decommissioning cost	-	-	-	-	-	-	-			Note 2		
2	Notification of Cessation of Operations										Note 4		
3	Remove fuel & source material										Note 2		
4	Notification of Permanent Defueling										Note 4		
5	Deactivate plant systems & process waste										Note 1		
6	Prepare and submit PSDAR	-	-	-	-	-	-	-			Note 4		
7	Review plant dwgs & specs.	-	-	-	-	-	-	-	130	20	150	150	-
8	Perform detailed rad survey	-	-	-	-	-	-	-	-	-	Note 1	-	-
9	Estimate by-product inventory	-	-	-	-	-	-	-	100	15	115	115	-
10	End product description	-	-	-	-	-	-	-	100	15	115	115	-
11	Detailed by-product inventory	-	-	-	-	-	-	-	150	23	173	173	-
12	Define major work sequence	-	-	-	-	-	-	-	100	15	115	115	-
13	Perform SER and EA	-	-	-	-	-	-	-	310	47	357	357	-
14	Perform Site-Specific Cost Study	-	-	-	-	-	-	-			Note 4		
15	Prepare/submit License Termination Plan	-	-	-	-	-	-	-	410	61	471	471	-
16	Receive NRC approval of termination plan										Note 1		
Activity Specifications													
17.1	Prepare plant and facilities for SAFSTOR	-	-	-	-	-	-	-	492	74	566	566	-
17.2	Plant systems	-	-	-	-	-	-	-	417	63	479	479	-
17.3	Plant structures and buildings	-	-	-	-	-	-	-	312	47	359	359	-
17.4	Waste management	-	-	-	-	-	-	-	200	30	230	230	-
17.5	Facility and site dormancy	-	-	-	-	-	-	-	200	30	230	230	-
17.6	Reactor Internals	-	-	-	-	-	-	-	710	107	817	817	-
17.7	Moisture separators/reheaters	-	-	-	-	-	-	-	100	15	115	115	-
17.8	Turbine & condenser	-	-	-	-	-	-	-	417	63	479	479	-
17	Total	-	-	-	-	-	-	-	2,847	427	3,274	3,274	-
Planning & Site Preparations													
18	Plant prep. & temp. svces	-	-	-	-	-	-	-	995	149	1,144	1,144	-
19	Rigging/Cont. Cntrl Envlpe/tooling/etc.	-	-	-	-	-	-	-	842	126	969	969	-
20	Procure casks/liners & containers	-	-	-	-	-	-	-	123	18	141	141	-
Detailed Work Procedures													
21.1	Plant systems	-	-	-	-	-	-	-	473	71	544	544	-
21.2	Facility closeout & dormancy	-	-	-	-	-	-	-	120	18	138	138	-
21.3	Reactor Internals	-	-	-	-	-	-	-	400	60	460	460	-
21.4	CRD housings & NIs	-	-	-	-	-	-	-	100	15	115	115	-
21.5	Incore Instrumentation	-	-	-	-	-	-	-	100	15	115	115	-
21.6	Turbine & condensers	-	-	-	-	-	-	-	417	63	479	479	-
21.7	Moisture separators & reheaters	-	-	-	-	-	-	-	200	30	230	230	-
21	Total	-	-	-	-	-	-	-	1,810	272	2,082	2,082	-
22	Procure vacuum drying system	-	-	-	-	-	-	-	10	2	12	12	-
23	Drain/de-energize non-cont. systems										Note 1		
24	Drain & dry NSSS										Note 1		
25	Drain/de-energize contaminated systems										Note 1		
26	Decon/secure contaminated systems										Note 1		
Decontamination of Site Buildings													
27.1	Reactor Building-Contaminated	2,718	-	-	-	-	-	-	-	1,359	4,077	4,077	-
27.2	Control Building - Contaminated	39	-	-	-	-	-	-	-	20	59	59	-
27.3	Liquid Radwaste Building - Contaminated	50	-	-	-	-	-	-	-	25	75	75	-
27.4	Radwaste Store & Ship Bldg-Contaminated	60	-	-	-	-	-	-	-	30	90	90	-
27.5	Recombiner Building - Contaminated	5	-	-	-	-	-	-	-	3	8	8	-
27.6	Turbine Building - Contaminated	531	-	-	-	-	-	-	-	266	797	797	-
27.7	Xenon Krypton Building - Contaminated	9	-	-	-	-	-	-	-	4	13	13	-
27.8	Yard Tanks, etc. - Contaminated	24	-	-	-	-	-	-	-	12	35	35	-
27	Totals	3,436	-	-	-	-	-	-	-	1,718	5,154	5,154	-

TABLE C-1
MILLSTONE NUCLEAR POWER STATION - UNIT 1
MODIFIED SAFSTOR – DECOMMISSIONING COST ESTIMATE
(Thousands of 1999 Dollars)

ID Number	Activity/Area Description	Direct disposal at the Barnwell site				Direct to Envirocare		Direct to Waste Processor		10 CFR 61	Craft Labor
		A CF	B CF	C CF	pounds	cubic ft	pounds	cubic ft	pounds	GTCC Cu Ft	Hours
Pre-Decommissioning Costs											
	1998	-	-	-	-	-	-	-	-	-	-
	1999	-	-	-	-	-	-	-	-	-	-
PERIOD 1: Mothballing Activities											
1	Prepare preliminary decommissioning cost	-	-	-	-	-	-	-	-	-	-
2	Notification of Cessation of Operations										
3	Remove fuel & source material										
4	Notification of Permanent Defueling										
5	Deactivate plant systems & process waste										
6	Prepare and submit PSDAR	-	-	-	-	-	-	-	-	-	-
7	Review plant dwgs & specs.	-	-	-	-	-	-	-	-	-	-
8	Perform detailed rad survey	-	-	-	-	-	-	-	-	-	-
9	Estimate by-product inventory	-	-	-	-	-	-	-	-	-	-
10	End product description	-	-	-	-	-	-	-	-	-	-
11	Detailed by-product inventory	-	-	-	-	-	-	-	-	-	-
12	Define major work sequence	-	-	-	-	-	-	-	-	-	-
13	Perform SER and EA	-	-	-	-	-	-	-	-	-	-
14	Perform Site-Specific Cost Study	-	-	-	-	-	-	-	-	-	-
15	Prepare/submit License Termination Plan	-	-	-	-	-	-	-	-	-	-
16	Receive NRC approval of termination plan										
Activity Specifications											
17.1	Prepare plant and facilities for SAFSTOR	-	-	-	-	-	-	-	-	-	-
17.2	Plant systems	-	-	-	-	-	-	-	-	-	-
17.3	Plant structures and buildings	-	-	-	-	-	-	-	-	-	-
17.4	Waste management	-	-	-	-	-	-	-	-	-	-
17.5	Facility and site dormancy	-	-	-	-	-	-	-	-	-	-
17.6	Reactor internals	-	-	-	-	-	-	-	-	-	-
17.7	Moisture separators/reheaters	-	-	-	-	-	-	-	-	-	-
17.8	Turbine & condenser	-	-	-	-	-	-	-	-	-	-
17	Total	-	-	-	-	-	-	-	-	-	-
Planning & Site Preperations											
18	Plant prep. & temp. svces	-	-	-	-	-	-	-	-	-	-
19	Rigging/Cont. Cntrl Envlpe/tooling/etc.	-	-	-	-	-	-	-	-	-	-
20	Procure casks/liners & containers	-	-	-	-	-	-	-	-	-	-
Detailed Work Procedures											
21.1	Plant systems	-	-	-	-	-	-	-	-	-	-
21.2	Facility closeout & dormancy	-	-	-	-	-	-	-	-	-	-
21.3	Reactor internals	-	-	-	-	-	-	-	-	-	-
21.4	CRD housings & NIs	-	-	-	-	-	-	-	-	-	-
21.5	Incore instrumentation	-	-	-	-	-	-	-	-	-	-
21.6	Turbine & condensers	-	-	-	-	-	-	-	-	-	-
21.7	Moisture separators & reheaters	-	-	-	-	-	-	-	-	-	-
21	Total	-	-	-	-	-	-	-	-	-	-
22	Procure vacuum drying system	-	-	-	-	-	-	-	-	-	-
23	Drain/de-energize non-cont. systems										
24	Drain & dry NSSS										
25	Drain/de-energize contaminated systems										
26	Decon/secure contaminated systems										
Decontamination of Site Buildings											
27.1	Reactor Building-Contaminated	-	-	-	-	-	-	-	-	-	71,172
27.2	Control Building - Contaminated	-	-	-	-	-	-	-	-	-	1,116
27.3	Liquid Radwaste Building - Contaminated	-	-	-	-	-	-	-	-	-	1,418
27.4	Radwaste Store & Ship Bldg-Contaminated	-	-	-	-	-	-	-	-	-	1,711
27.5	Recombiner Building - Contaminated	-	-	-	-	-	-	-	-	-	148
27.6	Turbine Building - Contaminated	-	-	-	-	-	-	-	-	-	15,103
27.7	Xenon Krypton Building - Contaminated	-	-	-	-	-	-	-	-	-	249
27.8	Yard Tanks, etc. - Contaminated	-	-	-	-	-	-	-	-	-	671
27	Totals	-	-	-	-	-	-	-	-	-	91,588

TABLE C-1
MILLSTONE NUCLEAR POWER STATION - UNIT 1
MODIFIED SAFSTOR -- DECOMMISSIONING COST ESTIMATE
(Thousands of 1999 Dollars)

ID Number	Activity/Area Description	Decon	Remove	Pack	Ship	Burial/Processor Costs: Barnwell	Burial/Processor Costs: Envirocare	Burial/Processor Costs: Waste Processor	Other	Contingency	Total	NRC LicTerm	Site Restore
28	Prepare support equipment for storage	-	326	-	-	-	-	-	-	49	375	375	-
29	Install containment pressure equal. lines	-	28	-	-	-	-	-	-	4	32	32	-
30	Interim survey prior to dormancy	-	-	-	-	-	-	-	294	44	338	338	-
31	Secure building accesses										Note 1		
32	Prepare & submit interim report	-	-	-	-	-	-	-	58	9	67	67	-
Period 1	Selected Dismantlement												
33.1	CRDMs & Nis Removal	101	89	140	35	485	-	-	-	214	1,064	1,064	-
33.2	Reactor Vessel Internals	67	1,463	586	550	4,462	-	-	-	3,646	10,773	10,773	-
33.3	Main Turbine/Generator	-	170	-	-	-	-	10,313	-	2,621	13,105	13,105	-
33.4	Main Condensers	-	310	-	-	-	-	2,574	-	721	3,604	3,604	-
33.5	RB108A	-	132	-	-	-	-	186	-	79	397	397	-
33.6	TB14H	-	2,084	-	-	-	-	3,819	-	1,476	7,380	7,380	-
33.7	TB14I	-	968	-	-	-	-	3,582	-	1,137	5,687	5,687	-
33.8	SY14A	-	82	-	-	-	-	-	-	12	94	-	94
	Total	168	5,298	726	584	4,947	-	20,474	-	9,906	42,104	42,009	94
Period 1	Additional Costs												
34	Site Characterization	-	-	-	-	-	-	-	164	49	213	213	-
35	Misc. Waste	-	-	-	-	-	-	741	-	185	926	926	-
36	Wet Spent Fuel Island	-	-	-	-	-	-	-	5,930	890	6,820	6,820	-
37	Asbestos Removal	-	1,769	-	-	-	-	873	-	660	3,302	3,302	-
38	Removal Spent Fuel Pool Inventory	-	933	5,454	985	3,214	-	71		2,546	13,203	13,203	-
39	Material in Storage	-	-	-	-	-	-	50	-	13	63	63	-
40	Fuel Dry Storage Expenditures	-	-	-	-	-	-	-	4,200	630	4,830	4,830	-
41	Cost Recovery - Salvage	-	-	-	-	-		-	(57)		(57)	-	(57)
Subtotal Period 1 Activity Costs		3,604	8,354	6,180	1,570	8,161	-	22,209	18,516	17,892	86,486	86,449	37
Period 1	Undistributed Costs												
1	Decon equipment	605	-	-	-	-	-	-	-	91	695	695	-
2	Decon supplies	1,433	-	-	-	-	-			358	1,791	1,791	-
3	Process liquid waste	333	-	121	265	1,255	-	-	-	532	2,506	2,506	-
4	Insurance	-	-	-	-	-	-	-	1,290	129	1,419	1,419	-
5	Property taxes	-	-	-	-	-	-	-	2,172	217	2,390	2,390	-
6	Health physics supplies	-	731	-	-	-	-			183	914	914	-
7	Small tool allowance	-	61	-	-	-	-	-	-	9	70	70	-
8	Disposal of DAW generated	-	-	-	-	-	-	627	-	157	783	783	-
4	Heavy equipment rental	-	549	-	-	-	-	-	-	82	631	631	-
9	Plant energy budget	-	-	-	-	-			4,076	611	4,687	4,687	-
10	NRC Fees	-	-	-	-	-	-	-	855	86	941	941	-
11	Emergency Planing Fees	-	-	-	-	-	-	-	152	15	167	167	-
12	Non-Construction M&S	-	-	-	-	-	-	-	5,323	799	6,122	6,122	-
13	Incentive Program	-	-	-	-	-	-	-	1,818	273	2,091	2,091	-
14	Administrative & General Costs	-	-	-	-	-	-	-	11,925	596	12,521	12,521	-
15	Separation Study	-	-	-	-	-	-	-		Note 4			-
16	Decommissioning Plan	-	-	-	-	-				Note 4			-
17	Burial Access Fees	-	-	-	-	-			100	15	115	115	-
18	DOC Staff Relocation								850	128	978	978	-
Subtotal Undistributed Costs Period 1		2,371	1,341	121	265	1,255	-	627	28,563	4,260	38,822	38,822	-
Staff Costs													
	DOC Staff Cost	-	-	-	-	-	-	-	6,467	970	7,437	7,437	-
	Utility Staff Cost	-	-	-	-	-	-	-	32,412	4,862	37,274	37,274	-
TOTAL COST TO SAFSTOR		5,975	9,694	6,300	1,835	9,417	-	22,836	85,958	28,004	170,019	169,982	37

Total cost to SAFSTOR with	19.72%	contingency:	$170,018,658	
Total Barnwell site radwaste weight buried			711,364	pounds
Total Envirocare site radwaste volume buried			-	cubic feet
Total shipped to processer			9,905,032	pounds
Total craft labor requirements			273,574	person hours

TABLE C-1
MILLSTONE NUCLEAR POWER STATION - UNIT 1
MODIFIED SAFSTOR -- DECOMMISSIONING COST ESTIMATE
(Thousands of 1999 Dollars)

ID Number	Activity/Area Description	Direct disposal at the Barnwell site A CF	B CF	C CF	pounds	Direct to Envirocare cubic ft	pounds	Direct to Waste Processor cubic ft	pounds	10 CFR 61 GTCC Cu Ft	Craft Labor Hours
28	Prepare support equipment for storage	-	-	-	-	-	-	-	-	-	3,000
29	Install containment pressure equal. lines	-	-	-	-	-	-	-	-	-	700
30	Interim survey prior to dormancy	-	-	-	-	-	-	-	-	-	-
31	Secure building accesses										
32	Prepare & submit interim report	-	-	-	-	-	-	-	-	-	-
Period 1 Selected Dismantlement											
33.1	CRDMs & NIs Removal	3,715	-	-	110,306	-	-	-	-	-	5,174
33.2	Reactor Vessel Internals	655	1,700	-	273,810	-	-	-	-	-	11,832
33.3	Main Turbine/Generator	-	-	-	-	-	-	58,934	4,125,391	-	4,766
33.4	Main Condensers	-	-	-	-	-	-	22,792	1,595,424	-	8,806
33.5	RB108A	-	-	-	-	-	-	1,317	92,206	-	3,804
33.6	TB14H	-	-	-	-	-	-	27,185	1,902,975	-	61,442
33.7	TB14I	-	-	-	-	-	-	24,834	1,738,375	-	28,126
33.8	SY14A	-	-	-	-	-	-	-	-	-	2,420
	Total	4,370	1,700	-	384,116	-	-	135,062	9,454,371	-	126,370
Period 1 Additional Costs											
34	Site Characterization	-	-	-	-	-	-	-	-	-	6,093
35	Misc. Waste	-	-	-	-	-	-	-	-	-	-
36	Wet Spent Fuel Island	-	-	-	-	-	-	-	-	-	-
37	Asbestos Removal	-	-	-	-	-	-	10,833	218,265	-	44,168
38	Removal Spent Fuel Pool Inventory	-	134	861	41,971	-	-	394	28,290	-	-
39	Material in Storage	-	-	-	-	-	-	358	25,048	-	-
40	Fuel Dry Storage Expenditures	-	-	-	-	-	-	-	-	-	-
41	Cost Recovery - Salvage	-	-	-	-	-	-	-	-	-	-
Subtotal Period 1 Activity Costs		4,370	1,834	861	426,087	-	-	146,647	9,725,964	-	271,919
Period 1 Undistributed Costs											
1	Decon equipment	-	-	-	-	-	-	-	-	-	-
2	Decon supplies	-	-	-	-	-	-	-	-	-	-
3	Process liquid waste	-	2,263	-	285,277	-	-	-	-	-	949
4	Insurance	-	-	-	-	-	-	-	-	-	-
5	Property taxes	-	-	-	-	-	-	-	-	-	-
6	Health physics supplies	-	-	-	-	-	-	-	-	-	-
7	Small tool allowance	-	-	-	-	-	-	-	-	-	-
8	Disposal of DAW generated	-	-	-	-	-	-	25,581	179,068	-	706
4	Heavy equipment rental	-	-	-	-	-	-	-	-	-	-
9	Plant energy budget	-	-	-	-	-	-	-	-	-	-
10	NRC Fees	-	-	-	-	-	-	-	-	-	-
11	Emergency Planing Fees	-	-	-	-	-	-	-	-	-	-
12	Non-Construction M&S	-	-	-	-	-	-	-	-	-	-
13	Incentive Program	-	-	-	-	-	-	-	-	-	-
14	Administrative & General Costs	-	-	-	-	-	-	-	-	-	-
15	Separation Study	-	-	-	-	-	-	-	-	-	-
16	Decommissioning Plan	-	-	-	-	-	-	-	-	-	-
17	Burial Access Fees	-	-	-	-	-	-	-	-	-	-
18	DOC Staff Relocation										
Subtotal Undistributed Costs Period 1		-	2,263	-	285,277	-	-	25,581	179,068	-	1,655
Staff Costs											
	DOC Staff Cost	-	-	-	-	-	-	-	-	-	-
	Utility Staff Cost	-	-	-	-	-	-	-	-	-	-
TOTAL COST TO SAFSTOR		4,370	4,097	861	711,364	-	-	172,228	9,905,032	-	273,574

TABLE C-1
MILLSTONE NUCLEAR POWER STATION - UNIT 1
MODIFIED SAFSTOR -- DECOMMISSIONING COST ESTIMATE
(Thousands of 1999 Dollars)

ID Number	Activity/Area Description	Decon	Remove	Pack	Ship	Burial/Processor Costs: Barnwell	Burial/Processor Costs: Envirocare	Burial/Processor Costs: Waste Processor	Other	Contingency	Total	NRC LicTerm	Site Restore
PERIOD 2: Safstor Annual Maintenance Cost													
1	Quarterly inspection										Note 1		
2	Semi-annual environmental survey										Note 1		
3	Prepare reports										Note 1		
4	Health physics supplies	-	-	-	-	-	-	-	48	12	60	60	-
5	Insurance	-	-	-	-	-	-	-	636	64	700	700	-
6	Property taxes	-	-	-	-	-	-	-	740	74	814	814	-
7	Disposal of contaminated solid waste	-	-	1	-	-	-	2	-	1	3	3	-
8	Bituminous roof replacement	-	-	-	-	-	-	-	25	4	29	29	-
9	Maintenance supplies	-	-	-	-	-	-	-	103	26	129	129	-
10	Plant energy budget	-	-	-	-	-			172	26	198	198	-
11	NRC Fees	-	-	-	-	-	-	-	265	27	292	292	-
12	Emergency Planning Fees	-	-	-	-	-	-	-	75	8	83	83	-
13	Non-Construction M&S	-	-	-	-	-	-	-	292	44	335	335	-
14	Incentive Program	-	-	-	-	-	-	-	23	3	26	26	-
15	Administrative & General Costs	-	-	-	-	-	-	-	1,949	97	2,046	2,046	-
16	Utility Staff	-	-	-	-	-	-	-	1,538	231	1,769	1,769	-
17	Fuel Dry Storage & GTCC Storage Expenditures							-	3,638	546	4,184	4,184	
PERIOD 2 ANNUAL MAINTENANCE TOTALS		-	-	1	-	-	-	2	9,505	1,161	10,668	10,668	-

Total cost SAFSTOR dormancy with	14.6936	years equals	$156,757,468	
Total Barnwell site radwaste weight buried			-	pounds
Total Envirocare site radwaste volume buried			-	cubic feet
Total shipped to processer			7,140	pounds
Total craft labor requirements			407	person hours

TABLE C-1
MILLSTONE NUCLEAR POWER STATION - UNIT 1
MODIFIED SAFSTOR -- DECOMMISSIONING COST ESTIMATE
(Thousands of 1999 Dollars)

ID Number	Activity/Area Description	Direct disposal at the Barnwell site				Direct to Envirocare		Direct to Waste Processor		10 CFR 61	Craft Labor
		A CF	B CF	C CF	pounds	cubic ft	pounds	cubic ft	pounds	GTCC Cu Ft	Hours
PERIOD 2: Safstor Annual Maintenance Cost											
1	Quarterly inspection										
2	Semi-annual environmental survey										
3	Prepare reports										
4	Health physics supplies	-	-	-	-	-	-	-	-	-	-
5	Insurance	-	-	-	-	-	-	-	-	-	-
6	Property taxes	-	-	-	-	-	-	-	-	-	-
7	Disposal of contaminated solid waste	-	-	-	-	-	-	69	486	-	28
8	Bituminous roof replacement	-	-	-	-	-	-	-	-	-	-
9	Maintenance supplies	-	-	-	-	-	-	-	-	-	-
10	Plant energy budget	-	-	-	-	-	-	-	-	-	-
11	NRC Fees	-	-	-	-	-	-	-	-	-	-
12	Emergency Planning Fees	-	-	-	-	-	-	-	-	-	-
13	Non-Construction M&S	-	-	-	-	-	-	-	-	-	-
14	Incentive Program	-	-	-	-	-	-	-	-	-	-
15	Administrative & General Costs	-	-	-	-	-	-	-	-	-	-
16	Utility Staff	-	-	-	-	-	-	-	-	-	-
17	Fuel Dry Storage & GTCC Storage Expenditures										
PERIOD 2 ANNUAL MAINTENANCE TOTALS		-	-	-	-	-	-	69	486	-	28

TABLE C-1
MILLSTONE NUCLEAR POWER STATION - UNIT 1
MODIFIED SAFSTOR – DECOMMISSIONING COST ESTIMATE
(Thousands of 1999 Dollars)

ID Number	Activity/Area Description	Decon	Remove	Pack	Ship	Burial/Processor Costs: Barnwell	Burial/Processor Costs: Envirocare	Burial/Processor Costs: Waste Processor	Other	Contingency	Total	NRC LicTerm	Site Restore
PERIOD 3													
1	Review plant dwgs & specs.	-	-	-	-	-	-	-	460	69	529	529	-
2	Perform detailed rad survey										Note 1		
3	End product description	-	-	-	-	-	-	-	100	15	115	115	-
4	Detailed by-product inventory										Note 5		
5	Define major work sequence	-	-	-	-	-	-	-	750	113	863	863	-
6	Perform SER and EA	-	-	-	-	-	-	-	310	47	357	357	-
7	Perform Site-Specific Cost Study	-	-	-	-	-	-	-	500	75	575	575	-
8	Prepare/submit License Termination Plan	-	-	-	-	-	-	-	410	61	471	471	-
9	Receive NRC approval of termination plan										Note 1		
Activity Specifications													
10.1	Re-activate plant & temporary facilities	-	-	-	-	-	-	-	737	111	848	763	85
10.2	Plant systems	-	-	-	-	-	-	-	417	63	479	431	48
10.3	Reactor vessel	-	-	-	-	-	-	-	650	98	748	748	-
10.4	Sacrificial shield	-	-	-	-	-	-	-	50	8	58	58	-
10.5	Reinforced concrete	-	-	-	-	-	-	-	160	24	184	92	92
10.6	Pressure suppression structure	-	-	-	-	-	-	-	200	30	230	230	-
10.7	Drywell	-	-	-	-	-	-	-	160	24	184	184	-
10.8	Plant structures & buildings	-	-	-	-	-	-	-	312	47	359	179	179
10.9	Waste management	-	-	-	-	-	-	-	460	69	529	529	-
10.10	Facility & site closeout	-	-	-	-	-	-	-	90	14	104	52	52
10	Total	-	-	-	-	-	-	-	3,236	485	3,721	3,265	456
Planning & Site Preparations													
11	Prepare dismantling sequence	-	-	-	-	-	-	-	240	36	276	276	-
12	Plant prep. & temp. svces	-	-	-	-	-	-	-	995	149	1,144	1,144	-
13	Design water clean-up system	-	-	-	-	-	-	-	140	21	161	161	-
14	Rigging/Cont. Cntrl Envips/tooling/etc.	-	-	-	-	-	-	-	842	126	969	969	-
15	Procure casks/liners & containers	-	-	-	-	-	-	-	-	-	Note 5	-	-
Detailed Work Procedures													
16.1	Plant systems	-	-	-	-	-	-	-	473	71	544	490	54
16.2	Remaining buildings	-	-	-	-	-	-	-	135	20	155	39	116
16.3	Removal primary containment	-	-	-	-	-	-	-	200	30	230	230	-
16.4	Reactor vessel	-	-	-	-	-	-	-	363	54	417	417	-
16.5	Facility closeout	-	-	-	-	-	-	-	120	18	138	69	69
16.6	Sacrificial shield	-	-	-	-	-	-	-	120	18	138	138	-
16.7	Reinforced concrete	-	-	-	-	-	-	-	100	15	115	58	58
16.8	Radwaste building	-	-	-	-	-	-	-	273	41	314	283	31
16.9	Reactor building	-	-	-	-	-	-	-	273	41	314	283	31
16	Total	-	-	-	-	-	-	-	2,057	309	2,366	2,006	360
Period 3 Additional Costs													
17	Site Characterization	-	-	-	-	-	-	-	545	164	709	709	-
18	Fuel Dry Storage Expenditures	-	-	-	-	-	-	-	1,333	200	1,533	1,533	-
Subtotal Period 3 Activity Costs		-	-	-	-	-	-	-	11,918	1,869	13,787	12,971	816
Period 3 Undistributed Costs													
1	Insurance	-	-	-	-	-	-	-	954	95	1,050	1,050	-
2	Property taxes	-	-	-	-	-	-	-	702	70	772	772	-
3	Health physics supplies	-	286	-	-	-	-	-	-	72	358	358	-
4	Heavy equipment rental	-	549	-	-	-	-	-	-	82	631	631	-
5	Disposal of DAW generated	-	-	-	-	-	-	627	-	157	783	783	-
6	Plant energy budget	-	-	-	-	-	-	-	3,178	477	3,655	3,655	-
7	NRC Fees	-	-	-	-	-	-	-	637	64	701	701	-
8	Emergency Planning Fees	-	-	-	-	-	-	-	113	11	124	124	-
9	Non-Construction M&S	-	-	-	-	-	-	-	4,166	625	4,791	4,791	-
10	Incentive Program	-	-	-	-	-	-	-	1,059	159	1,218	1,218	-
11	Administrative & General Costs	-	-	-	-	-	-	-	9,630	482	10,112	10,112	-
12	Burial Access Fees	-	-	-	-	-	-	-	50	8	58	58	-
13	DOC Staff Relocation	-	-	-	-	-			850	128	978	978	-
Subtotal Undistributed Costs Period 3		-	835	-	-	-	-	627	21,340	2,426	25,230	25,230	-

TABLE C-1
MILLSTONE NUCLEAR POWER STATION - UNIT 1
MODIFIED SAFSTOR – DECOMMISSIONING COST ESTIMATE
(Thousands of 1999 Dollars)

ID Number	Activity/Area Description	Direct disposal at the Barnwell site A CF	B CF	C CF	pounds	Direct to Envirocare cubic ft	pounds	Direct to Waste Processor cubic ft	pounds	10 CFR 61 GTCC Cu Ft	Craft Labor Hours
PERIOD 3											
1	Review plant dwgs & specs.	-	-	-	-	-	-	-	-	-	-
2	Perform detailed rad survey										
3	End product description	-	-	-	-	-	-	-	-	-	-
4	Detailed by-product inventory										
5	Define major work sequence	-	-	-	-	-	-	-	-	-	-
6	Perform SER and EA	-	-	-	-	-	-	-	-	-	-
7	Perform Site-Specific Cost Study	-	-	-	-	-	-	-	-	-	-
8	Prepare/submit License Termination Plan	-	-	-	-	-	-	-	-	-	-
9	Receive NRC approval of termination plan										
Activity Specifications											
10.1	Re-activate plant & temporary facilities	-	-	-	-	-	-	-	-	-	-
10.2	Plant systems	-	-	-	-	-	-	-	-	-	-
10.3	Reactor vessel	-	-	-	-	-	-	-	-	-	-
10.4	Sacrificial shield	-	-	-	-	-	-	-	-	-	-
10.5	Reinforced concrete	-	-	-	-	-	-	-	-	-	-
10.6	Pressure suppression structure	-	-	-	-	-	-	-	-	-	-
10.7	Drywell	-	-	-	-	-	-	-	-	-	-
10.8	Plant structures & buildings	-	-	-	-	-	-	-	-	-	-
10.9	Waste management	-	-	-	-	-	-	-	-	-	-
10.10	Facility & site closeout	-	-	-	-	-	-	-	-	-	-
10	Total	-	-	-	-	-	-	-	-	-	-
Planning & Site Preparations											
11	Prepare dismantling sequence	-	-	-	-	-	-	-	-	-	-
12	Plant prep. & temp. svces	-	-	-	-	-	-	-	-	-	-
13	Design water clean-up system	-	-	-	-	-	-	-	-	-	-
14	Rigging/Cont. Cntrl Envips/tooling/etc.	-	-	-	-	-	-	-	-	-	-
15	Procure casks/liners & containers	-	-	-	-	-	-	-	-	-	-
Detailed Work Procedures											
16.1	Plant systems	-	-	-	-	-	-	-	-	-	-
16.2	Remaining buildings	-	-	-	-	-	-	-	-	-	-
16.3	Removal primary containment	-	-	-	-	-	-	-	-	-	-
16.4	Reactor vessel	-	-	-	-	-	-	-	-	-	-
16.5	Facility closeout	-	-	-	-	-	-	-	-	-	-
16.6	Sacrificial shield	-	-	-	-	-	-	-	-	-	-
16.7	Reinforced concrete	-	-	-	-	-	-	-	-	-	-
16.8	Radwaste building	-	-	-	-	-	-	-	-	-	-
16.9	Reactor building	-	-	-	-	-	-	-	-	-	-
16	Total	-	-	-	-	-	-	-	-	-	-
Period 3 Additional Costs											
17	Site Characterization	-	-	-	-	-	-	-	-	-	20,311
18	Fuel Dry Storage Expenditures	-	-	-	-	-	-			-	-
Subtotal Period 3 Activity Costs		-	-	-	-	-	-	-	-	-	20,311
Period 3 Undistributed Costs											
1	Insurance	-	-	-	-	-	-	-	-	-	-
2	Property taxes	-	-	-	-	-	-	-	-	-	-
3	Health physics supplies	-	-	-	-	-	-	-	-	-	-
4	Heavy equipment rental	-	-	-	-	-	-	-	-	-	-
5	Disposal of DAW generated	-	-	-	-	-	-	25,581	179,068	-	706
6	Plant energy budget	-	-	-	-	-	-	-	-	-	-
7	NRC Fees	-	-	-	-	-	-	-	-	-	-
8	Emergency Planning Fees	-	-	-	-	-	-	-	-	-	-
9	Non-Construction M&S	-	-	-	-	-	-	-	-	-	-
10	Incentive Program	-	-	-	-	-	-	-	-	-	-
11	Administrative & General Costs	-	-	-	-	-	-	-	-	-	-
12	Burial Access Fees	-	-	-	-	-	-	-	-	-	-
13	DOC Staff Relocation	-	-	-	-	-	-	-	-	-	-
Subtotal Undistributed Costs Period 3		-	-	-	-	-	-	25,581	179,068	-	706

TABLE C-1
MILLSTONE NUCLEAR POWER STATION - UNIT 1
MODIFIED SAFSTOR – DECOMMISSIONING COST ESTIMATE
(Thousands of 1999 Dollars)

ID Number	Activity/Area Description	Decon	Remove	Pack	Ship	Burial/Processor Costs: Barnwell	Burial/Processor Costs: Envirocare	Burial/Processor Costs: Waste Processor	Other	Contingency	Total	NRC LicTerm	Site Restore
Staff Costs													
	DOC Staff Cost	-	-	-	-	-	-	-	4,706	706	5,411	5,411	-
	Utility Staff Cost	-	-	-	-	-	-	-	25,116	3,767	28,884	28,884	-
TOTAL PERIOD 3 COST		-	835	-	-	-	-	627	63,079	8,771	73,312	72,496	816
PERIOD 4													
Nuclear Steam Supply System Removal													
19.1	Recirculation System Piping & Valves	54	79			-	-	175	-	90	398	398	-
19.2	Recirculation Pumps & Motors	49	25			-	-	455	-	144	673	673	-
19.3	CRDMs & NIs Removal										Note 5		
19.4	Reactor Vessel Internals										Note 5		
19.5	Reactor Vessel	179	4,936	271	455	5,883	-	-	-	6,914	18,637	18,637	-
19	Totals	282	5,040	271	455	5,883	-	630	-	7,149	19,708	19,708	-
20	Remove spent fuel racks	384	42	-	-	-	-	2,192	-	532	3,150	3,150	-
Removal of Major Equipment													
21	Main Turbine/Generator										Note 5		
22	Main Condensers										Note 5		
Disposal of Plant Systems													
23.1	CB14A	-	23	-	-	-	-	-	-	3	26	-	26
23.2	CB14B	-	69	-	-	-	-	42	-	28	139	139	-
23.3	CB25A	-	85	-	-	-	-	-	-	13	98	-	98
23.4	CB36A	-	32	-	-	-	-	-	-	5	36	-	36
23.5	CD14A	-	444	-	-	-	-	750	-	298	1,492	1,492	-
23.6	CW14A	-	106	-	-	-	-	-	-	16	122	-	122
23.7	CW14B	-	3	-	-	-	-	-	-	0	3	-	3
23.8	DS14A	-	2	-	-	-	-	-	-	0	2	-	2
23.9	DW-8	-	439	-	-	-	-	1,056	-	374	1,869	1,869	-
23.10	GT14A	-	39	-	-	-	-	-	-	6	45	-	45
23.11	GTROOF	-	2	-	-	-	-	-	-	0	2	-	2
23.12	HR12A	-	108	-	-	-	-	185	-	73	366	366	-
23.13	MB14A	-	43	-	-	-	-	-	-	6	49	-	49
23.14	OB14A	-	15	-	-	-	-	-	-	2	18	-	18
23.15	RB-26A	-	493	-	-	-	-	1,228	-	430	2,151	2,151	-
23.16	RB-26B	-	129	-	-	-	-	466	-	149	744	744	-
23.17	RB-26C	-	66	-	-	-	-	105	-	43	214	214	-
23.18	RB-26D	-	142	-	-	-	-	461	-	151	754	754	-
23.19	RB-26E	-	71	-	-	-	-	217	-	72	361	361	-
23.20	RB108A										Note 5		
23.21	RB14A	-	1,347	-	-	-	-	1,501	-	712	3,561	3,561	-
23.22	RB14B	-	16	-	-	-	-	16	-	8	39	39	-
23.23	RB14C	-	97	-	-	-	-	189	-	71	357	357	-
23.24	RB14D	-	15	-	-	-	-	12	-	7	34	34	-
23.25	RB14E	-	94	-	-	-	-	336	-	107	537	537	-
23.26	RB42A	-	582	-	-	-	-	1,346	-	482	2,409	2,409	-
23.27	RB42B	-	126	-	-	-	-	315	-	110	551	551	-
23.28	RB42C	-	73	-	-	-	-	66	-	35	173	173	-
23.29	RB42D	-	81	-	-	-	-	228	-	77	366	366	-
23.30	RB42E	-	95	-	-	-	-	184	-	70	349	349	-
23.31	RB52A	-	83	-	-	-	-	162	-	61	306	306	-
23.32	RB65A	-	281	-	-	-	-	436	-	179	896	896	-
23.33	RB65B	-	56	-	-	-	-	46	-	26	128	128	-
23.34	RB65C	-	42	-	-	-	-	40	-	20	102	102	-
23.35	RB65D	-	87	-	-	-	-	146	-	58	291	291	-
23.36	RB82A	-	275	-	-	-	-	504	-	195	973	973	-
23.37	RB82B	-	96	-	-	-	-	127	-	56	280	280	-
23.38	SP1A	-	14	-	-	-	-	-	-	2	16	-	16
23.39	SY14A										Note 5		
23.40	TB14A	-	117	-	-	-	-	331	-	112	559	559	-
23.41	TB14B	-	1,679	-	-	-	-	4,305	-	1,496	7,480	7,480	-
23.42	TB14C	-	197	-	-	-	-	493	-	172	862	862	-
23.43	TB14D	-	130	-	-	-	-	237	-	92	460	460	-
23.44	TB14E	-	81	-	-	-	-	123	-	51	255	255	-
23.45	TB14F	-	39	-	-	-	-	258	-	74	371	371	-
23.46	TB14G	-	8	-	-	-	-	4	-	3	15	15	-
23.47	TB14H										Note 5		
23.48	TB14I										Note 5		

TABLE C-1
MILLSTONE NUCLEAR POWER STATION - UNIT 1
MODIFIED SAFSTOR – DECOMMISSIONING COST ESTIMATE
(Thousands of 1999 Dollars)

ID Number	Activity/Area Description	Direct disposal at the Barnwell site A CF	B CF	C CF	pounds	Direct to Envirocare cubic ft	pounds	Direct to Waste Processor cubic ft	pounds	10 CFR 61 GTCC Cu Ft	Craft Labor Hours
Staff Costs											
	DOC Staff Cost	-	-	-	-	-	-	-	-	-	-
	Utility Staff Cost	-	-	-	-	-	-	-	-	-	-
TOTAL PERIOD 3 COST		-	-	-	-	-	-	25,581	179,068	-	21,017
PERIOD 4											
Nuclear Steam Supply System Removal											
19.1	Recirculation System Piping & Valves	-	-	-	-	-	-	1,250	87,480	-	3,814
19.2	Recirculation Pumps & Motors	-	-	-	-	-	-	1,500	105,000	-	2,244
19.3	CRDMs & Nis Removal										
19.4	Reactor Vessel Internals										
19.5	Reactor Vessel	8,646	-	-	1,237,762	-	-	-	-	-	27,423
19	Totals	8,646	-	-	1,237,762	-	-	2,750	192,480	-	33,481
20	Remove spent fuel racks	-	-	-	-	-	-	8,949	626,426	-	12,430
Removal of Major Equipment											
21	Main Turbine/Generator										
22	Main Condensers										
Disposal of Plant Systems											
23.1	CB14A	-	-	-	-	-	-	-	-	-	656
23.2	CB14B	-	-	-	-	-	-	284	19,905	-	1,973
23.3	CB25A	-	-	-	-	-	-	-	-	-	2,494
23.4	CB36A	-	-	-	-	-	-	-	-	-	907
23.5	CD14A	-	-	-	-	-	-	5,288	370,156	-	12,428
23.6	CW14A	-	-	-	-	-	-	-	-	-	3,120
23.7	CW14B	-	-	-	-	-	-	-	-	-	87
23.8	DS14A	-	-	-	-	-	-	-	-	-	63
23.9	DW-8	-	-	-	-	-	-	7,087	496,110	-	12,741
23.10	GT14A	-	-	-	-	-	-	-	-	-	1,137
23.11	GTROOF	-	-	-	-	-	-	-	-	-	54
23.12	HR12A	-	-	-	-	-	-	1,309	91,614	-	3,112
23.13	MB14A	-	-	-	-	-	-	-	-	-	1,261
23.14	OB14A	-	-	-	-	-	-	-	-	-	447
23.15	RB-26A	-	-	-	-	-	-	8,741	611,844	-	14,759
23.16	RB-26B	-	-	-	-	-	-	2,784	194,886	-	3,779
23.17	RB-26C	-	-	-	-	-	-	664	46,501	-	1,923
23.18	RB-26D	-	-	-	-	-	-	2,725	190,716	-	4,227
23.19	RB-26E	-	-	-	-	-	-	1,161	81,303	-	2,077
23.20	RB108A										
23.21	RB14A	-	-	-	-	-	-	10,003	700,202	-	38,212
23.22	RB14B	-	-	-	-	-	-	100	6,984	-	451
23.23	RB14C	-	-	-	-	-	-	1,021	71,477	-	2,794
23.24	RB14D	-	-	-	-	-	-	83	5,784	-	403
23.25	RB14E	-	-	-	-	-	-	2,396	167,725	-	2,796
23.26	RB42A	-	-	-	-	-	-	8,359	585,157	-	16,673
23.27	RB42B	-	-	-	-	-	-	1,595	111,662	-	3,654
23.28	RB42C	-	-	-	-	-	-	288	20,186	-	2,057
23.29	RB42D	-	-	-	-	-	-	1,601	112,076	-	2,255
23.30	RB42E	-	-	-	-	-	-	1,312	91,868	-	2,753
23.31	RB52A	-	-	-	-	-	-	1,039	72,753	-	2,404
23.32	RB65A	-	-	-	-	-	-	2,932	205,243	-	7,896
23.33	RB65B	-	-	-	-	-	-	297	20,756	-	1,520
23.34	RB65C	-	-	-	-	-	-	222	15,567	-	1,126
23.35	RB65D	-	-	-	-	-	-	725	50,733	-	2,482
23.36	RB82A	-	-	-	-	-	-	3,444	241,090	-	7,839
23.37	RB82B	-	-	-	-	-	-	782	54,719	-	2,754
23.38	SP1A	-	-	-	-	-	-	-	-	-	422
23.39	SY14A										
23.40	TB14A	-	-	-	-	-	-	2,209	154,656	-	3,293
23.41	TB14B	-	-	-	-	-	-	24,702	1,729,171	-	48,697
23.42	TB14C	-	-	-	-	-	-	3,501	245,065	-	5,686
23.43	TB14D	-	-	-	-	-	-	1,695	118,676	-	3,760
23.44	TB14E	-	-	-	-	-	-	774	54,211	-	2,330
23.45	TB14F	-	-	-	-	-	-	1,561	109,261	-	1,174
23.46	TB14G	-	-	-	-	-	-	25	1,718	-	226
23.47	TB14H										
23.48	TB14I										

TABLE C-1
MILLSTONE NUCLEAR POWER STATION - UNIT 1
MODIFIED SAFSTOR -- DECOMMISSIONING COST ESTIMATE
(Thousands of 1993 Dollars)

ID Number	Activity/Area Description	Decon	Remove	Pack	Ship	Burial/Processor Costs: Barnwell	Burial/Processor Costs: Envirocare	Burial/Processor Costs: Waste Processor	Other	Contingency	Total	NRC LicTerm	Site Restore
23.49	TB14J	-	15	-	-	-	-	90	-	26	131	131	-
23.50	TB14K	-	25	-	-	-	-	24	-	12	61	61	-
23.51	TB14L	-	30	-	-	-	-	101	-	33	164	164	-
23.52	TB14M	-	193	-	-	-	-	1,154	-	337	1,684	1,684	-
23.53	TB25A	-	11	-	-	-	-	-	-	2	12	-	12
23.54	TB34A	-	278	-	-	-	-	553	-	208	1,038	1,038	-
23.55	TB34B	-	655	-	-	-	-	1,896	-	638	3,188	3,188	-
23.56	TB36A	-	43	-	-	-	-	-	-	6	50	-	50
23.57	TB54A	-	10	-	-	-	-	481	-	123	614	614	-
23.58	TB54B	-	288	-	-	-	-	260	-	137	685	685	-
23.59	TB54C	-	457	-	-	-	-	917	-	344	1,718	1,718	-
23.60	TBROOF	-	11	-	-	-	-	-	-	2	12	-	12
23.61	TBROOF-C	-	42	-	-	-	-	31	-	18	91	91	-
23.62	WD-1A	-	50	-	-	-	-	33	-	21	104	104	-
23.63	WD-1B	-	66	-	-	-	-	93	-	40	199	199	-
23.64	WD-1C	-	44	-	-	-	-	18	-	15	77	77	-
23.65	WD-1D	-	58	-	-	-	-	84	-	35	177	177	-
23.66	WD-1E	-	26	-	-	-	-	36	-	15	77	77	-
23.67	WD-20A	-	241	-	-	-	-	303	-	136	680	680	-
23.68	WD-20B	-	154	-	-	-	-	197	-	88	439	439	-
23.69	WD-20C	-	78	-	-	-	-	122	-	50	250	250	-
23.70	WD-20D	-	49	-	-	-	-	77	-	32	158	158	-
23.71	WD-20E	-	14	-	-	-	-	7	-	5	26	26	-
23.72	WD-20F	-	14	-	-	-	-	7	-	5	27	27	-
23.73	WD-20G	-	65	-	-	-	-	52	-	29	146	146	-
23.74	WD-20I	-	7	-	-	-	-	3	-	3	13	13	-
23.75	WD14A	-	51	-	-	-	-	88	-	35	174	174	-
23.76	WD5A	-	35	-	-	-	-	20	-	14	69	69	-
23.77	WDROOF	-	39	-	-	-	-	83	-	30	152	152	-
23.78	WS14A	-	129	-	-	-	-	134	-	66	328	328	-
23.79	WS14B	-	33	-	-	-	-	36	-	17	87	87	-
23.80	WS38A	-	32	-	-	-	-	49	-	20	100	100	-
23.81	XK20A	-	147	-	-	-	-	218	-	91	454	454	-
23.82	YD14A	-	77	-	-	-	-	-	-	11	88	-	88
23.83	YD14A-C	-	213	-	-	-	-	339	-	138	690	690	-
23	Totals	-	11,699	-	-	-	-	23,418	-	8,729	43,845	43,265	581
24	Erect scaffolding for systems removal	-	1,763	-	-	-	-	39	-	450	2,252	2,252	-
Decontamination of Site Buildings													
25.1	Reactor Building-Contaminated	3,250	1,745	139	99	4,966	309	5,242		4,724	20,495	20,495	-
25.2	Control Building - Contaminated	47	-	1	1	-	7	-		26	82	82	-
25.3	Liquid Radwaste Building - Contaminated	568	2	17	21	-	123	8		322	1,061	1,061	-
25.4	Maintenance Shop - Contaminated	7	-	1	1	-	5	-		5	18	18	-
25.5	Radwaste Store & Ship Bldg-Contaminated	394	2	16	19	-	113	18		235	797	797	-
25.6	Recombiner Building - Contaminated	32	0	1	2	-	10	1		19	66	66	-
25.7	Turbine Building - Contaminated	1,206	39	66	81	-	473	163		790	2,816	2,816	-
25.8	Xenon Krypton Building - Contaminated	74	1	2	3	-	16	2		42	140	140	-
25.9	Yard Tanks, etc. - Contaminated	155	-	5	6	-	36	-		88	290	290	-
25	Totals	5,733	1,788	248	233	4,966	1,092	5,434	-	6,251	25,766	25,766	-
26	ORISE confirmatory survey	-	-	-	-	-	-	-	1,040	-	1,040	1,040	-
27	Terminate license										Note 1		
Period 4 Additional Costs													
28	License Termination Survey	-	-	-	-	-	-	-	5,176	1,553	6,729	6,729	-
29	Contaminated Soil	-	64	1,356	1,595	-	8,045	-	-	2,402	13,461	13,461	-
30	Fuel Dry Storage Expenditures	-	-	-	-	-	-	-	5,757	864	6,621	6,621	-
Subtotal Period 4 Activity Costs		6,399	20,395	1,874	2,283	10,869	9,137	31,714	11,973	27,930	122,574	121,993	581
Period 4 Undistributed Costs													
1	Decon equipment	605	-	-	-	-	-	-	-	91	695	695	-
2	Decon supplies	1,440	-	-	-	-	-			360	1,800	1,800	-
3	Process liquid waste	393	-	143	314	1,484	-	-	-	629	2,963	2,963	-
4	Insurance	-	-	-	-	-	-	-	1,560	156	1,717	1,717	-
5	Property taxes	-	-	-	-	-	-	-	1,274	127	1,401	1,401	-
6	Health physics supplies	-	2,966	-	-	-	-			742	3,708	3,708	-
7	Heavy equipment rental	-	4,435	-	-	-	-			665	5,100	4,590	510
8	Small tool allowance	-	423	-	-	-	-	-	-	64	487	438	49

TABLE C-1
MILLSTONE NUCLEAR POWER STATION - UNIT 1
MODIFIED SAFSTOR -- DECOMMISSIONING COST ESTIMATE
(Thousands of 1999 Dollars)

ID Number	Activity/Area Description	Direct disposal at the Barnwell site A CF	B CF	C CF	pounds	Direct to Envirocare cubic ft	pounds	Direct to Waste Processor cubic ft	pounds	10 CFR 61 GTCC Cu Ft	Craft Labor Hours
23.49	TB14J	-	-	-	-	-	-	533	37,287	-	450
23.50	TB14K	-	-	-	-	-	-	156	10,889	-	702
23.51	TB14L	-	-	-	-	-	-	662	46,367	-	905
23.52	TB14M	-	-	-	-	-	-	7,854	549,805	-	5,471
23.53	TB25A	-	-	-	-	-	-	-	-	-	317
23.54	TB34A	-	-	-	-	-	-	3,864	270,478	-	7,965
23.55	TB34B	-	-	-	-	-	-	11,477	803,356	-	18,780
23.56	TB36A	-	-	-	-	-	-	-	-	-	1,266
23.57	TB54A	-	-	-	-	-	-	3,437	240,580	-	290
23.58	TB54B	-	-	-	-	-	-	1,848	129,326	-	7,918
23.59	TB54C	-	-	-	-	-	-	5,825	407,725	-	12,903
23.60	TBROOF	-	-	-	-	-	-	-	-	-	312
23.61	TBROOF-C	-	-	-	-	-	-	202	14,114	-	1,046
23.62	WD-1A	-	-	-	-	-	-	233	16,321	-	1,365
23.63	WD-1B	-	-	-	-	-	-	646	45,251	-	1,860
23.64	WD-1C	-	-	-	-	-	-	118	8,237	-	1,180
23.65	WD-1D	-	-	-	-	-	-	521	36,448	-	1,654
23.66	WD-1E	-	-	-	-	-	-	226	15,851	-	744
23.67	WD-20A	-	-	-	-	-	-	2,000	140,011	-	7,213
23.68	WD-20B	-	-	-	-	-	-	1,316	92,142	-	4,393
23.69	WD-20C	-	-	-	-	-	-	868	60,772	-	2,249
23.70	WD-20D	-	-	-	-	-	-	551	38,551	-	1,412
23.71	WD-20E	-	-	-	-	-	-	49	3,447	-	400
23.72	WD-20F	-	-	-	-	-	-	40	2,804	-	402
23.73	WD-20G	-	-	-	-	-	-	260	18,197	-	1,833
23.74	WD-20I	-	-	-	-	-	-	24	1,650	-	206
23.75	WD14A	-	-	-	-	-	-	593	41,499	-	1,260
23.76	WD5A	-	-	-	-	-	-	146	10,221	-	1,002
23.77	WDROOF	-	-	-	-	-	-	496	34,694	-	1,099
23.78	WS14A	-	-	-	-	-	-	853	59,701	-	3,679
23.79	WS14B	-	-	-	-	-	-	221	15,461	-	969
23.80	WS38A	-	-	-	-	-	-	314	21,956	-	918
23.81	XK20A	-	-	-	-	-	-	1,419	99,358	-	4,240
23.82	YD14A	-	-	-	-	-	-	-	-	-	2,343
23.83	YD14A-C	-	-	-	-	-	-	2,423	169,605	-	6,047
23	Totals	-	-	-	-	-	-	149,884	10,491,899	-	335,758
24	Erect scaffolding for systems removal	-	-	-	-	-	-	225	15,754	-	44,723
Decontamination of Site Buildings											
25.1	Reactor Building-Contaminated	9,959	-	-	1,138,419	4,412	462,938	37,441	2,620,836	-	133,051
25.2	Control Building - Contaminated	-	-	-	-	105	10,991	-	-	-	1,267
25.3	Liquid Radwaste Building - Contaminated	-	-	-	-	1,758	184,425	58	4,060	-	12,388
25.4	Maintenance Shop - Contaminated	-	-	-	-	65	6,809	-	-	-	157
25.5	Radwaste Store & Ship Bldg-Contaminated	-	-	-	-	1,620	169,925	129	9,000	-	8,780
25.6	Recombiner Building - Contaminated	-	-	-	-	148	15,513	7	480	-	718
25.7	Turbine Building - Contaminated	-	-	-	-	6,750	708,259	1,164	81,480	-	30,031
25.8	Xenon Krypton Building - Contaminated	-	-	-	-	226	23,741	18	1,240	-	1,842
25.9	Yard Tanks, etc. - Contaminated	-	-	-	-	515	54,081	-	-	-	3,430
25	Totals	9,959	-	-	1,138,419	15,599	1,636,681	38,816	2,717,096	-	191,464
26	ORISE confirmatory survey	-	-	-	-	-	-	-	-	-	-
27	Terminate license										
Period 4 Additional Costs											
28	License Termination Survey	-	-	-	-	-	-	-	-	-	149,840
29	Contaminated Soil	-	-	-	-	169,373	15,243,525	-	-	-	5,454
30	Fuel Dry Storage Expenditures	-	-	-	-	-	-	-	-	-	-
Subtotal Period 4 Activity Costs		18,605	-	-	2,376,181	184,972	16,880,206	200,624	14,043,655	-	773,150
Period 4 Undistributed Costs											
1	Decon equipment	-	-	-	-	-	-	-	-	-	-
2	Decon supplies	-	-	-	-	-	-	-	-	-	-
3	Process liquid waste	-	2,676	-	337,265	-	-	-	-	-	1,123
4	Insurance	-	-	-	-	-	-	-	-	-	-
5	Property taxes	-	-	-	-	-	-	-	-	-	-
6	Health physics supplies	-	-	-	-	-	-	-	-	-	-
7	Heavy equipment rental	-	-	-	-	-	-	-	-	-	-
8	Small tool allowance	-	-	-	-	-	-	-	-	-	-

TABLE C-1
MILLSTONE NUCLEAR POWER STATION - UNIT 1
MODIFIED SAFSTOR -- DECOMMISSIONING COST ESTIMATE
(Thousands of 1999 Dollars)

ID Number	Activity/Area Description	Decon	Remove	Pack	Ship	Burial/Processor Costs: Barnwell	Burial/Processor Costs: Envirocare	Burial/Processor Costs: Waste Processor	Other	Contingency	Total	NRC LicTerm	Site Restore
9	Pipe cutting equipment	-	787	-	-	-	-	-	-	118	905	905	-
10	Disposal of DAW generated	-	-	-	-	-	-	1,774	-	443.50	2,218	2,218	-
11	Decommissioning Equipment Disposition	-	-	-	-	-	-	750	-	187.50	938	938	-
12	Plant energy budget	-	-	-	-	-			3,630	544	4,174	3,757	417
13	NRC Fees	-	-	-	-	-	-	-	1,050	105	1,155	1,155	-
14	Emergency Planning Fees	-	-	-	-	-	-	-	234	23	257	257	-
15	Non-Construction M&S	-	-	-	-	-	-	-	5,662	849	6,511	6,511	-
16	Incentive Program	-	-	-	-	-	-	-	1,672	251	1,922	1,922	-
17	LLRW Processing Equipment	-	-	-	-	-	-	-	839	126	964	964	-
18	Administrative & General Costs	-	-	-	-	-	-	-	12,799	640	13,439	13,439	-
19	Burial Access Fees	-	-	-	-	-	-	-	150	23	173	173	-
Subtotal Undistributed Costs Period 4		2,439	8,612	143	314	1,484	-	2,524	28,868	6,144	50,526	49,550	976
Staff Costs													
	DOC Staff Cost	-	-	-	-	-	-	-	7,938	1,191	9,128	9,128	-
	Utility Staff Cost	-	-	-	-	-	-	-	35,216	5,282	40,499	40,499	-
TOTAL PERIOD 4		8,837	29,007	2,017	2,596	12,353	9,137	34,238	83,995	40,546	222,728	221,171	1,557
PERIOD 5													
Demolition of Remaining Site Buildings													
31.1	Reactor Building-Contaminated	-	162	-	-	-	-	-	-	24	187	-	187
31.2	Reactor Building	-	3,219	-	-	-	-	-	-	483	3,702	-	3,702
31.3	Control Building	-	212	-	-	-	-	-	-	32	243	-	243
31.4	Discharge Structure	-	226	-	-	-	-	-	-	34	260	-	260
31.5	Emergency Gas Turbine Generator	-	97	-	-	-	-	-	-	14	111	-	111
31.6	Intake Structure	-	434	-	-	-	-	-	-	65	500	-	500
31.7	Liquid Radwaste Building	-	215	-	-	-	-	-	-	32	247	-	247
31.8	Maintenance Shop	-	278	-	-	-	-	-	-	42	320	-	320
31.9	Miscellaneous Structures	-	243	-	-	-	-	-	-	36	279	-	279
31.10	Office Building	-	333	-	-	-	-	-	-	50	383	-	383
31.11	Radwaste Shipment	-	16	-	-	-	-	-	-	2	18	-	18
31.12	Radwaste Storage Building	-	294	-	-	-	-	-	-	44	338	-	338
31.13	Recombiner Building	-	111	-	-	-	-	-	-	17	128	-	128
31.14	Turbine Building	-	2,264	-	-	-	-	-	-	340	2,604	-	2,604
31.15	Turbine Pedestal	-	538	-	-	-	-	-	-	81	618	-	618
31.16	Xenon Krypton Building	-	102	-	-	-	-	-	-	15	117	-	117
31	Totals	-	8,743	-	-	-	-	-	-	1,311	10,055	-	10,055
Site Closeout Activities													
32	Remove Rubble	-	1,350	-	-	-	-	-	-	203	1,553	-	1,553
33	Grade & landscape site	-	92	-	-	-	-	-	-	14	106	-	106
34	Final report to NRC	-	-	-	-	-	-	-	156	23	179	179	-
Period 5 Additional Costs													
35	GTCC Transfer and Storage Expenditure	-	-	-	-	-	-		640	96	736	736	-
36	Fuel Dry Storage Expenditures	-	-	-	-	-	-		5,917	888	6,805	6,805	-
37	Scrap Metal Recovery	-	-	-	-	-	-	-	(518)		(518)	-	(518)
38	ISFSI License Termination	15	1,425	99	39	-	599	-	1,016	592	3,786	3,786	-
39	ISFSI Demolition and Site Restoration	-	784	-	-	-	-	-	385	58	1,227	-	1,227
40	Vessel & Internals GTCC Disposal	-	-	-	-		-		6,269	3,134	9,403	9,403	-
Subtotal Period 5 Activity Costs		15	12,394	99	39	-	599	-	13,865	6,319	33,331	20,909	12,423
Period 5 Undistributed Costs													
1	Insurance	-	-	-	-	-	-	-	146	15	161	161	-
2	Property taxes	-	-	-	-	-	-	-	1,182	118	1,300		1,300
3	Heavy equipment rental	-	2,570	-	-	-	-	-	-	385	2,955	-	2,955
4	Small tool allowance	-	85	-	-	-	-	-	-	13	98	-	98
5	Plant energy budget	-	-	-	-	-			378	57	435	-	435
6	NRC Fees								600	60	660	660	-
7	Emergency Planning Fees								200	20	220	220	-
8	Non-Construction M&S	-	-	-	-	-	-	-	1,990	298	2,288		2,288
9	Incentive Program	-	-	-	-	-	-	-	201	30	232		232
10	Administrative & General Costs	-	-	-	-	-	-	-	8,147	407	8,555		8,555
11	Burial Access Fees								50	8	58	58	-
12	Nuclear Liability Insurance Taller	-	-	-	-	-	-	-	1,500	150	1,650	-	1,650
Subtotal Undistributed Costs Period 5		-	2,655	-	-	-	-	-	14,395	1,561	18,611	1,098	17,513

TABLE C-1
MILLSTONE NUCLEAR POWER STATION - UNIT 1
MODIFIED SAFSTOR -- DECOMMISSIONING COST ESTIMATE
(Thousands of 1999 Dollars)

ID Number	Activity/Area Description	Direct disposal at the Barnwell site A CF	B CF	C CF	pounds	Direct to Envirocare cubic ft	pounds	Direct to Waste Processor cubic ft	pounds	10 CFR 61 GTCC Cu Ft	Craft Labor Hours
9	Pipe cutting equipment	-	-	-	-	-	-	-	-	-	-
10	Disposal of DAW generated	-	-	-	-	-	-	72,409	506,862	-	1,319
11	Decommissioning Equipment Disposition	-	-	-	-	-	-	4,286	300,000	-	735
12	Plant energy budget	-	-	-	-	-	-	-	-	-	-
13	NRC Fees	-	-	-	-	-	-	-	-	-	-
14	Emergency Planning Fees	-	-	-	-	-	-	-	-	-	-
15	Non-Construction M&S	-	-	-	-	-	-	-	-	-	-
16	Incentive Program	-	-	-	-	-	-	-	-	-	-
17	LLRW Processing Equipment	-	-	-	-	-	-	-	-	-	-
18	Administrative & General Costs	-	-	-	-	-	-	-	-	-	-
19	Burial Access Fees	-	-	-	-	-	-	-	-	-	-
Subtotal Undistributed Costs Period 4		-	2,676	-	337,285	-	-	76,695	806,862	-	3,177
Staff Costs											
	DOC Staff Cost	-	-	-	-	-	-	-	-	-	-
	Utility Staff Cost	-	-	-	-	-	-	-	-	-	-
TOTAL PERIOD 4		18,605	2,676	-	2,713,466	184,972	16,880,206	277,318	14,850,517	-	776,326
PERIOD 5											
Demolition of Remaining Site Buildings											
31.1	Reactor Building-Contaminated	-	-	-	-	-	-	-	-	-	4,240
31.2	Reactor Building	-	-	-	-	-	-	-	-	-	49,269
31.3	Control Building	-	-	-	-	-	-	-	-	-	2,675
31.4	Discharge Structure	-	-	-	-	-	-	-	-	-	578
31.5	Emergency Gas Turbine Generator	-	-	-	-	-	-	-	-	-	1,475
31.6	Intake Structure	-	-	-	-	-	-	-	-	-	4,796
31.7	Liquid Radwaste Building	-	-	-	-	-	-	-	-	-	3,450
31.8	Maintenance Shop	-	-	-	-	-	-	-	-	-	4,777
31.9	Miscellaneous Structures	-	-	-	-	-	-	-	-	-	4,807
31.10	Office Building	-	-	-	-	-	-	-	-	-	4,560
31.11	Radwaste Shipment	-	-	-	-	-	-	-	-	-	343
31.12	Radwaste Storage Building	-	-	-	-	-	-	-	-	-	4,427
31.13	Recombiner Building	-	-	-	-	-	-	-	-	-	1,612
31.14	Turbine Building	-	-	-	-	-	-	-	-	-	40,860
31.15	Turbine Pedestal	-	-	-	-	-	-	-	-	-	7,717
31.16	Xenon Krypton Building	-	-	-	-	-	-	-	-	-	1,462
31	Totals	-	-	-	-	-	-	-	-	-	137,066
Site Closeout Activities											
32	Remove Rubble	-	-	-	-	-	-	-	-	-	4,623
33	Grade & landscape site	-	-	-	-	-	-	-	-	-	1,069
34	Final report to NRC	-	-	-	-	-	-	-	-	-	-
Period 5 Additional Costs											
35	GTCC Transfer and Storage Expenditure	-	-	-	-	-	-	-	-	-	-
36	Fuel Dry Storage Expenditures										
37	Scrap Metal Recovery	-	-	-	-	-	-	-	-	-	-
38	ISFSI License Termination	-	-	-	-	2,184	193,494	-	-	-	17,548
39	ISFSI Demolition and Site Restoration	-	-	-	-	-	-	-	-	-	6,088
40	Vessel & Internals GTCC Disposal	-		-	-	-	-	-	-	424	-
Subtotal Period 5 Activity Costs		-	-	-	-	2,184	193,494	-	-	424	166,394
Period 5 Undistributed Costs											
1	Insurance	-	-	-	-	-	-	-	-	-	-
2	Property taxes	-	-	-	-	-	-	-	-	-	-
3	Heavy equipment rental	-	-	-	-	-	-	-	-	-	-
4	Small tool allowance	-	-	-	-	-	-	-	-	-	-
5	Plant energy budget	-	-	-	-	-	-	-	-	-	-
6	NRC Fees										
7	Emergency Planning Fees										
8	Non-Construction M&S	-	-	-	-	-	-	-	-	-	-
9	Incentive Program	-	-	-	-	-	-	-	-	-	-
10	Administrative & General Costs	-	-	-	-	-	-	-	-	-	-
11	Burial Access Fees										
12	Nuclear Liability Insurance Taller	-	-	-	-	-	-	-	-	-	-
Subtotal Undistributed Costs Period 5		-	-	-	-	-	-	-	-	-	-

TABLE C-1
MILLSTONE NUCLEAR POWER STATION - UNIT 1
MODIFIED SAFSTOR -- DECOMMISSIONING COST ESTIMATE
(Thousands of 1999 Dollars)

ID Number	Activity/Area Description	Decon	Remove	Pack	Ship	Burial/Processor Costs: Barnwell	Burial/Processor Costs: Envirocare	Burial/Processor Costs: Waste Processor	Other	Contingency	Total	NRC LicTerm	Site Restore
Staff Costs													
	DOC Staff Cost	-	-	-	-	-	-	-	4,003	600	4,604	4,143	460
	Utility Staff Cost	-	-	-	-	-	-	-	11,669	1,750	13,419	12,077	1,342
TOTAL PERIOD 5		15	15,049	99	39	-	899	-	43,932	10,231	69,965	38,227	31,738
TOTAL COST TO DECOMMISSION		14,827	54,586	8,429	4,471	21,770	9,736	57,725	424,429	104,608	700,581	666,433	34,148

Total cost to decommission with 17.55% contingency: $700,580,827

Total NRC license termination cost is 95.13% or $666,433,292
Non-nuclear demolition cost is 4.87% or $34,147,535

Total craft labor requirements 1,237,718 person hours

Disposition of waste from Millstone Unit 1 site:	Period 1	Period 2	Period 3	Period 4	Period 5	Totals
Radwaste volume buried at Barnwell (cubic feet)	9,328	-	-	21,281	-	30,609
Radwaste weight buried at Barnwell (pounds)	711,364	-	-	2,713,466	-	3,424,830
Radwaste volume buried at Envirocare (cubic feet)	-	-	-	184,972	2,184	187,156
Radwaste weight buried at Envirocare (pounds)	-	-	-	16,880,206	193,494	17,073,700
Volume sent to processer (cubic feet)	172,228	1,020	25,581	277,318	-	476,147
Weight sent to processor (pounds)	9,905,032	7,140	179,068	14,850,517	-	24,941,756
10CFR61 GTCC waste buried (cubic feet)	-	-	-	-	424	424

Disposition of waste from processor:	Period 1	Period 2	Period 3	Period 4	Period 5	Totals
Radwaste volume buried at Barnwell (cubic feet)	26			996		1,022
Radwaste weight buried at Barnwell (pounds)	1,660	-	-	64,467	-	66,127
Radwaste volume buried at Envirocare (cubic feet)	35,676	102	2,558	51,302	-	89,638
Radwaste weight buried at Envirocare (pounds)	2,321,006	7,140	179,068	3,318,928	-	5,826,142

Total Barnwell site radwaste volume buried	31,631	cubic feet
Total Barnwell site radwaste weight buried	3,490,957	pounds
Total Envirocare site radwaste volume buried	276,994	cubic feet
Total Envirocare site radwaste weight buried	22,899,842	pounds
Total 10CFR61 greater than class C waste buried	424	cubic feet
Total scrap metal released from Millstone Unit 1 site:	6,326	tons
Total scrap metal released from processor:	9,525	tons

NOTES:
1) This activity is performed by the decommissioning staff following plant shutdown; the costs for this are included in this period's staff cost.
2) This activity, while performed after final plant shutdown, is considered part of operations and therefore no decommissioning costs are included for this activity.
3) Table entries shown as "-" are zero in value; entries show as 0 are actually in the range of 0.001 to 0.5, but rounded down to zero.
4) This activity is performed by the decommissioning staff following plant shutdown; the costs for this are included in the 1998 and 1999 Pre-Decommissioning Costs.
5) This activity is performed during Period 1; the costs are included in Period 1 costs.

TABLE C-1
MILLSTONE NUCLEAR POWER STATION - UNIT 1
MODIFIED SAFSTOR – DECOMMISSIONING COST ESTIMATE
(Thousands of 1999 Dollars)

ID Number	Activity/Area Description	Direct disposal at the Barnwell site				Direct to Envirocare		Direct to Waste Processor		10 CFR 61	Craft Labor
		A CF	B CF	C CF	pounds	cubic ft	pounds	cubic ft	pounds	GTCC Cu Ft	Hours
Staff Costs											
	DOC Staff Cost	-	-	-	-	-	-	-	-	-	-
	Utility Staff Cost	-	-	-	-	-	-	-	-	-	-
TOTAL PERIOD 5		-	-	-	-	2,184	193,494	-	-	424	168,394
TOTAL COST TO DECOMMISSION		22,975	6,773	861	3,424,830	187,156	17,073,700	476,147	24,941,756	424	1,237,718

APPENDIX D
WORK AREA
WORK DIFFICULTY FACTOR ADJUSTMENTS

GUIDELINES FOR APPLYING WORK DURATION ADJUSTMENT FACTORS

TLG has historically applied work duration adjustment factors in determining unit cost factors to account for working in a radiologically controlled environment. In performing an area-by-area decommissioning estimate, the work duration factors are applied on an "area" basis based on the nominal area conditions. Where practical, areas are established based on similar working conditions.

The WDFs fall into five categories: access, respiratory protection, ALARA, protective clothing (PC), and work breaks. The guidelines of how these factors are assessed for each area is described below. Table D-1 outlines the WDFs for each area of the Millstone Unit 1 plant.

1) Access Factor:

Controlling Variables:
- Height of the component above the working floor
- Difficulty in working around the component (restricted access)

Source of Variable Information:
- Estimators observation or judgment
- Plant drawings
- Millstone Unit 1 Radiation Protection Staff Representation

Range of Access Factor Adjustments:
0% - Components are accessible and located near a working level floor or platform

10% - Scaffolding (component less than <12 feet above floor) is required to access the majority of the components *or* the area around the components is congested.

20% - Scaffolding (component less than <12 feet above floor) is required to access the majority of the components *and* the area around the components is congested.

30% - Scaffolding (component between 12 - 20 feet above floor) is required to access the majority of the components *or* the area around the components are extremely congested.

40% - Scaffolding (component between 20 - 45 feet above floor) is required to access the majority of the components).

50% - Scaffolding (component greater than 45 feet above floor) is required to access the majority of the components).

2) Respiratory Protection Factor:

Controlling Variables:
- Component surface contamination levels (internal or external)
- Type of work (potential to create an airborne problem)
- General area surface contamination levels
- Site specific requirements for maintaining respirator qualifications (initial qualification, requalification, etc.)
- Personal air sampler requirements

Sources of Variable Information:
- Radiation Work Permit Requirements
- Area Survey Maps
- Site Radiation Protection Program Manual
- Millstone Unit 1 Radiation Protection Staff Representation

Range of Respiratory Protection Factor Adjustments:
0% - Respiratory protection is not required (clean system or loose surface contamination has been removed).
25% - Respiratory protection is only required during limited segments of the work (i.e. physical cutting)
50% - Respiratory protection is continuously required while working on the component.

3) Radiation/ALARA Factor:

Controlling Variables:
- Component contact dose rate
- General area dose rate
- Site specific requirements for maintaining radiation worker qualification (initial qualification, requalification, etc.)
- Dosimetry requirements

Sources of Variable Information:
- Area Survey Maps
- Site Radiation Protection Program Manual
- Radiation Work Permit Requirements

- Millstone Unit 1 Radiation Protection Staff Representation

Range of Radiation/ALARA Factor Adjustments:
(Note that surface contamination levels are principally accounted for in protective clothing requirements and respiratory protection requirements)

0% - The component is clean and is not located in a radiologically controlled area

10% - The component is located in a radiologically controlled area (General Area Radiation field < 2.5 mrem/hr).

20% - The component is located in a radiologically controlled area (General Area Radiation field between 2.5 to 15 mrem/hr).

40% - The component is located in a radiologically controlled area (General Area Radiation field between 16 and 99 mrem/hr).

100% - The component is located in a radiologically controlled area (General Area Radiation field > 100 mrem/hr).

4) Protective Clothing Factor:

Controlling Variables:
- Component surface contamination levels (internal or external)
- General area surface contamination levels
- Type of activity (wet/dry work, potential to create a surface contamination problem)
- Site specific work schedule arrangements
- Millstone Unit 1 Radiation Protection Staff Representation

Sources of Variable Information:
- Radiation Work Permit Requirements
- Area Survey Maps
- Site Radiation Protection Program Manual

Range of Protective Clothing Factor Adjustments (alternate site-specific schedules may dictate alternate adjustments):

0% - The component is clean and is not located in a radiologically controlled area.
30% - The component is clean or contaminated and is located in a surface contamination controlled area. Work is to be completed in accordance with

the requirements of an RWP, which specifies a single or double set of "PCs", or "PCs" with plastics.

50% - The components is located in a surface contamination controlled area. Work is to be completed in accordance with the requirements of an RWP, which specifies "plastics" in addition to double PCs for protective clothing.

100% - The component is located in a surface contamination controlled area. Work is to be completed in accordance with the requirements of an RWP, which specifies double "PCs" and double "plastics". (extremely wet or humid working environment).

5) Work Break Factor:

Controlling Variables:
- Site specific work schedule arrangements

Sources of Variable Information:
- Typical site work schedule

Range of Work Break Factor Adjustments:

8.33% - Workday schedule outlined in AIF/NESP-036 (alternate site-specific schedules may dictate alternate adjustments).

TABLE D-1
WORK DIFFICULTY ADJUSTMENT FACTORS (Systems)

Work Area	Area Description	Work Difficulty Factors (%) Access	Respiratory Protection	ALARA	Protective Clothing	Workbreak
CB14A	Computer Tech / Electrical/Storage Rm	10%	0%	0%	0%	8.33%
CB14B	Chemistry Lab / Office Area	0%	25%	10%	30%	8.33%
CB25A	Cable Vault	10%	0%	0%	0%	8.33%
CB36A	Control Room	0%	0%	0%	0%	8.33%
CD14A	Radwaste Yard / Waste Surge Tank	30%	25%	10%	30%	8.33%
CW14A	Intake Structure	10%	0%	0%	0%	8.33%
CW14B	Hypo-Chlorite Room	0%	0%	0%	0%	8.33%
DS14A	Discharge Structure	0%	0%	0%	0%	8.33%
DW-8	Drywell	40%	25%	40%	30%	8.33%
GT14A	Gas Turbine Generator RM	10%	0%	0%	0%	8.33%
GTROOF	Gas Turbine Gen. Roof	10%	0%	0%	0%	8.33%
HR12A	Gas Recombiner Room "A" & "B"	10%	25%	40%	30%	8.33%
MB14A	Maint BLDG / Machine Shop	10%	0%	0%	0%	8.33%
OB14A	Unit 1&2 OPS Office	0%	0%	0%	0%	8.33%
RB-26A	Torus Room	30%	25%	40%	30%	8.33%
RB-26B	SW Corner Room -8', -26' Elev	30%	25%	10%	30%	8.33%
RB-26C	SE Corner Room -8', -26' Elev	30%	25%	10%	30%	8.33%
RB-26D	NE Corner Room -8', -26' Elev	30%	25%	10%	30%	8.33%
RB-26E	NW Corner Room -8', -26' Elev	30%	25%	10%	30%	8.33%
RB108A	Refuel Floor	30%	25%	20%	30%	8.33%
RB108B	Spent Fuel / Dryer Separator Pools	30%	50%	40%	50%	8.33%
RB14A	RB14-6 First Floor	0%	25%	10%	30%	8.33%
RB14B	Tip Shield & Machine Rooms	0%	25%	20%	30%	8.33%
RB14C	Shutdown PMP RM	30%	25%	20%	30%	8.33%

TABLE D-1
WORK DIFFICULTY ADJUSTMENT FACTORS (Systems)
(Continued)

Work Area	Area Description	Work Difficulty Factors (%) Access	Respiratory Protection	ALARA	Protective Clothing	Workbreak
RB14D	RB Railroad Access	0%	0%	10%	0%	8.33%
RB14E	Steam Tunnel	40%	25%	20%	30%	8.33%
RB42A	RB42-6 Second Floor	20%	25%	20%	30%	8.33%
RB42B	CU Pump Room	20%	25%	10%	30%	8.33%
RB42C	Clean Up Filter Sludge Reservoir	10%	50%	100%	50%	8.33%
RB42D	CU HT Exchanger Room / PCV Room	20%	25%	40%	30%	8.33%
RB42E	Shutdown HT Exchanger Room	20%	25%	20%	30%	8.33%
RB52A	Fuel Pool Pump Mezzanine Level	20%	25%	40%	30%	8.33%
RB65A	RB 3rd Floor Area	10%	25%	10%	30%	8.33%
RB65B	CU Valve Room	10%	25%	20%	30%	8.33%
RB65C	Fuel Pool Demin Room	10%	25%	40%	30%	8.33%
RB65D	CU Demin / CU Filters	10%	25%	40%	30%	8.33%
RB82A	RB 4th Floor Area / East	10%	25%	10%	30%	8.33%
RB82B	RB 4th Floor Area / West	10%	25%	10%	30%	8.33%
RBROOF	Reactor BLDG Roof	10%	0%	0%	0%	8.33%
SP1A	Strainer Pit	30%	0%	0%	0%	8.33%
Sy14A	Transformer Area	0%	0%	0%	0%	8.33%
TB14A	Turbine Lube Oil System Room	10%	25%	10%	0%	8.33%
TB14B	TB 14-6 First Floor	20%	25%	10%	30%	8.33%
TB14C	SJAE Room	20%	25%	10%	30%	8.33%
TB14D	Condensate Demineralizers	10%	25%	10%	30%	8.33%
TB14E	Regen Room	20%	25%	10%	30%	8.33%
TB14F	Emergency Diesel Generator	20%	25%	0%	0%	8.33%
TB14G	Maint. Decon Room	0%	25%	10%	30%	8.33%
TB14H	Condenser Bay	40%	25%	10%	30%	8.33%

TABLE D-1
WORK DIFFICULTY ADJUSTMENT FACTORS (Systems)
(Continued)

Work Area	Area Description	Work Difficulty Factors (%) Access	Respiratory Protection	ALARA	Protective Clothing	Workbreak
TB14I	Feedwater Heaters Bay	40%	25%	10%	30%	8.33%
TB14J	TB Railroad Access	10%	25%	10%	0%	8.33%
TB14K	RB RCA Access	0%	25%	10%	0%	8.33%
TB14L	Office/Locker RM	0%	0%	0%	0%	8.33%
TB14M	Boiler Room	10%	25%	10%	30%	8.33%
TB25A	Offices / I&C Shop	0%	0%	0%	0%	8.33%
TB34A	TB 34' Level North	10%	25%	10%	0%	8.33%
TB34B	TB 34' Level South Switch Gear Area	10%	25%	10%	0%	8.33%
TB36A	Instrument Shop/ Offices/Corridor (1M)	0%	0%	0%	0%	8.33%
TB54A	Turbine - Generator	0%	25%	10%	30%	8.33%
TB54B	Turbine Deck\	10%	25%	10%	0%	8.33%
TB54C	H&V Room Upper/Lower Levels	20%	25%	10%	30%	8.33%
TBROOF	Turbine BLDG & Maint BLDG Roofs	10%	0%	0%	0%	8.33%
TBROOF-C	Turbine BLDG Roof-Contaminated	10%	25%	10%	30%	8.33%
WD-1A	Waste Demin Tank	20%	25%	40%	30%	8.33%
WD-1B	Valve Alley	0%	25%	20%	30%	8.33%
WD-1C	RW Filter/FLR Drain FLTR/Waste FLTR	20%	25%	40%	30%	8.33%
WD-1D	Liquid Rad Waste Control Room	0%	25%	20%	30%	8.33%
WD-1E	Precoat and Filter Aid Area	0%	25%	20%	30%	8.33%
WD-20A	Waste Sampling Tanks	30%	25%	20%	30%	8.33%
WD-20B	Lower Rad Waste	10%	25%	20%	39%	8.33%
WD-20C	Waste Collector Tanks	30%	25%	20%	30%	8.33%
WD-20D	Floor Drain Collector Tanks	30%	25%	40%	30%	8.33%
WD-20E	Lower Rad Waste / Sludge Tank Room	30%	25%	40%	30%	8.33%

TABLE D-1
WORK DIFFICULTY ADJUSTMENT FACTORS (Systems)
(Continued)

Work Area	Area Description	Work Difficulty Factors (%) Access	Respiratory Protection	ALARA	Protective Clothing	Workbreak
WD-20F	Spent Resin Pump Room	10%	25%	40%	30%	8.33%
WD-20G	Waste Concentrator / Spent Resin Tanks	30%	50%	100%	50%	8.33%
WD-20I	Lower Rad Waste / Concentrator Room	10%	25%	20%	30%	8.33%
WD14A	AHU / Radwaste Access Plugs	10%	25%	0%	0%	8.33%
WD5A	Pipe Chase	20%	25%	20%	30%	8.33%
WDROOF	Solid Rad Waste Roof	10%	25%	10%	30%	8.33%
WS14A	Rad Waste Storage BLDG	0%	25%	10%	30%	8.33%
WS14B	Radwaste Loading Bay	10%	25%	10%	30%	8.33%
WS38A	Centrifuge / Hopper Elv. 27-2	10%	25%	20%	30%	8.33%
XK20A	Xe-Kr BLDG - Upper / Lower Levels 20'6", 8'0"	10%	25%	40%	30%	8.33%
YD14A	Yard	0%	0%	0%	0%	8.33%
YD14A-C	Yard - Contaminated	0%	25%	10%	30%	8.33%