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Decommissioning Pre-Planning Manual

Final Report

Technical Report

Decommissioning Pre-Planning Manual

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EPRI Project Manager
C. Wood

EPRI • 3412 Hillview Avenue, Palo Alto, California 94304 • PO Box 10412, Palo Alto, California 94303 • USA
800.313.3774 • 650.855.2121 • askepri@epri.com • www.epri.com

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ORGANIZATION(S) THAT PREPARED THIS DOCUMENT

Duke Engineering & Services, Inc.

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CITATIONS

This report was prepared by

Duke Engineering & Services, Inc.
Solomon Pond Park
400 Donald Lynch Boulevard
Marlborough, MA 01752

Principal Investigators
E. Heath
J. Kay
L. Lessard
W. Metevia
J. Oddo
F. Quinn

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REPORT SUMMARY

Utility experiences in recent years show that significant cost savings will result from advance planning for the eventual closure of nuclear power plants. This report provides a framework for planning ahead for plant decommissioning by drawing upon the experiences of utilities currently involved in decommissioning. It identifies important advance planning decisions, tasks, and contributing disciplines, establishes activity precedence relationships and defines data requirements. The report also describes actions that utilities can take prior to plant shutdown to ease the transition to decommissioning status.

Background

Industry models for planning the efficient decommissioning of a nuclear power plant continue to evolve. Effective planning is a key to cost control, a critical aspect of decommissioning. EPRI commissioned this study to capture the pre-planning lessons learned from in-progress plant decommissioning projects. State-of-the-art decommissioning planning at Oyster Creek (which continued operation after purchase by a new owner), discussed in EPRI Technical Report 1000093, also provided input to this task. The project team also solicited and incorporated industry input for this report. Interim Report TR-1001030 (December 2000) reported the first phase of this project. This final report completes the project and incorporates all the earlier work.

Objective

To develop a framework for use in pre-planning the decommissioning of a nuclear power plant.

Approach

The project team developed a framework covering the following specific tasks for use in pre-planning decommissioning:

- Identifying key decisions and tasks in the advance planning process
- Establishing ordered relationships and dependencies between the key decisions and tasks
- Identifying the key disciplines required to support the decision process and tasks
- Identifying data inputs to support the decision process and tasks

Results

Pre-planning or advance planning is defined as a summary of detailed management planning, strategic decisions, and activities, prior to shutdown, that enable a utility to decommission more efficiently. This report approaches the advance planning effort with a focus on economy and efficiency. It describes decommissioning pre-planning from both strategic and tactical perspectives. The team identified sixty-five Decommissioning Activities to support the tactical

level pre-planning, and consolidated them into thirty-two pre-planning tasks which are described in Appendix A as Decommissioning Task Outlines (DTOs). The DTOs define advance-planning requirements at the discipline level. The project team displayed the DTOs in a precedence network that provides order to the decision processes. Lessons learned from current decommissioning efforts suggest that more advance planning is needed for both the radiological (site survey) and non-radiological (hazardous materials) aspects of decommissioning. The DTOs and Appendices describe these tasks.

EPRI Perspective

The goal of this project is to provide guidance on pre-planning for decommissioning, with the objective of reducing delays in the move to decommissioning status, including actions to take to cope effectively with premature plant closures. This report includes discussion of work that utility management can perform during operation to reduce eventual Decontamination and Dismantlement (D&D) costs. Guidance for three time frames; premature shutdown, planned shutdown in three to five years and long-term operation (data collection and contingency planning), will aid utilities in preparing for eventual plant closure.

This decision framework for decommissioning pre-planning provides the nuclear power plant operator with the opportunity to substantially lower both the cost and risk of the decommissioning process. Utility managers currently involved in decommissioning power plants offered considerable input and advice during this project. This report captures the best practices of utilities in the decommissioning phase, for use when further plant closures occur in the distant future.

Keywords

Decommissioning planning

ABSTRACT

This EPRI report approaches decommissioning pre-planning with a focus on economy and efficiency. Decommissioning pre-planning is described from both strategic and tactical perspectives. A framework for pre-planning the decommissioning of a nuclear power plant is described, identifying the key planning decisions, tasks, contributing disciplines, activity precedence relationships and data requirements. Sixty-five Decommissioning Activities were identified and consolidated into thirty-two Decommissioning Tasks which have been outlined at the discipline level.

This report incorporates lessons learned from current in-process decommissioning projects, including the opportunity to reduce economic risk though improved initial site characterization for both radiological and non-radiological (hazardous) materials.

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1 INTRODUCTION

1.1 Report Introduction

The purpose of this EPRI Technical Report is to provide a framework for pre-planning the decommissioning of a nuclear power plant with the goal of reducing delays in moving to decommissioning, including premature plant closures. "Pre-planning" is a term of art used in this report to describe *strategic* planning done at the senior management level well before the plant actually needs to decommission. Indeed, it is the thesis of this report that such "pre-planning" if done properly, will provide dividends in terms of time and money saved when the plant must inevitably begin the decommissioning effort. Pre-planning is <u>not</u> developing a detailed work plan, but rather a higher level type of planning aimed at addressing basic issues which, once identified and evaluated, will enable an operating plant to pursue essential tasks *while it is still operating* and when it is easier and less expensive to do so.

Note that certain detailed-level decommissioning work planning can also be performed prior to shutdown. Some detailed planning guidance is also included in this pre-planning manual. Pre-planning or advance planning can occur at any time prior to shutdown. Except for certain key long range considerations, the bulk of pre-planning would typically occur in the three to five year period preceding a known shutdown date. Guidance is also included for long range pre-planning (long term operation), and for premature shutdown.

The report is divided into five topical areas and four appendices. Section 1, the "Strategic Plan," describes the major objectives and milestones of decommissioning planning from the corporate owners' perspective.

Section 2, the "Tactical Plan," describes issues encountered at the implementation stage and looks at the detailed scheduling of activities. This section is targeted at the management responsible for implementing specific tasks associated with the objectives described in the Strategic Plan.

Section 3, "Special Considerations for Near Term Potential Shutdowns," is targeted at the nuclear power plants which are forced into an unplanned plant closure without prior decommissioning planning. In the future, it is hoped that there will be relatively few plants that follow this scenario, given the economic benefits of pre-planning.

Section 4, "Decommissioning Lessons Learned," summarizes some key lessons from decommissioning experience. This section focuses on the importance of early planning and on so-called "soft issues." These would include the change in the corporate culture which occurs post-shutdown, as well as evolving interactions among employees and a large contractor work force, other stakeholders, and, finally, the public.

The first Appendix, Appendix A, can be viewed as an extension of the Tactical Plan. Appendix A comprises the treatment of sixty-five decommissioning tasks which have been consolidated into thirty-two Decommissioning Task Outlines (DTOs). These are individual working documents that describe specific decommissioning tasks and incorporate lessons learned from the current decommissioning body of knowledge.

Appendices, B and C, provide additional detail on the environmental site characterization processes. Both radioactive and non-radioactive environmentally sensitive waste products are addressed.

Finally, Appendix D is a bibliography of EPRI, NRC, NEI and ANS documents which provide decommissioning experience and guidance.

1.2 Use of Current Regulations and Regulatory Guidance

Decommissioning regulations and guidance have evolved substantially over the last several years and may continue to evolve. Future changes may affect decommissioning options as well as options and requirements for fuel storage, high- and low-level waste handling and disposal, decontamination techniques, dismantlement processes and site release criteria, i.e., fundamental aspects of decommissioning. To assure effective planning, the guidance in this report should be updated to reflect the changing body of knowledge. Active participation in EPRI and NEI industry activities is one avenue to remaining knowledgeable.

2
STRATEGIC PLAN

2.1 Key Pre-Planning Prerequisites

Table 2-1 introduces a list of ten basic assumptions, decisions, or questions that must be addressed at the outset of the decommissioning planning process. Many of these key issues cannot be addressed without investing some time and money. The determination of these Pre-Planning bases is necessary for the development of the strategic and subsequent planning.

These key bases are further discussed throughout the Pre-Planning manual.

Table 2-1
Key Pre-Planning Bases

- What is the planned final shutdown date?
- Will the plant be immediately dismantled (DECON option), put into a SAFSTOR condition, or ENTOMBED?
- Is there sufficient capacity in the spent fuel pool to off-load the final core?
- What is the planned site release criteria, unrestricted or restricted? Will the State impose release standards more rigorous than the NRC?
- What date is assumed for the final acceptance of the spent nuclear fuel by the DOE?
- What is the availability of a low-level wasted disposal site?
- To what extent does the plant intend to rely on utilization of in-house personnel for the Decontamination & Dismantlement program?
- Is the estimate for decommissioning cost current?
- Is the projected cost estimate for decommissioning consistent with the funding expected to be available at the targeted shutdown date?
- Can sufficient in-house resources (time and skills) be made available to execute effective pre-planning for decommissioning or should this effort be out-sourced under plant oversight?

2.2 Strategic Plan

From a business perspective, a fundamental difference exists between an operating nuclear power plant and one that is undergoing Decontamination and Dismantlement (D&D) – that this is no longer an "on-going business." This is an important consideration that is overlooked by many and a difficult proposition to adjust to, even for those who understand the implications. This distinction is even more important for a plant that is deregulated and may have no avenue to collect additional decommissioning funds from the rate base in the event of a shortfall. A first step toward effective decommissioning planning is the development of a “Strategic Plan.” Such a plan summarizes top-level corporate objectives for the facility, e.g., final disposition of the site, selected decommissioning method, commitments to existing work forces. It provides major time frames for the decommissioning project, e.g., shutdown date. The strategic plan also establishes organizational responsibilities for decision-making.

For the purposes of the strategic plan it is prudent to view the funds available at the time of cessation of power operations as essentially fixed. This constraint forces an increased emphasis on pre-planning as the Decontamination & Dismantlement of the plant must be performed to a fixed budget.

Unlike an operating plant, investments in decommissioning cannot be "recovered" over the remaining life of the plant. Every dollar expended on Decontamination & Dismantlement is one less dollar in the decommissioning fund. While safety continues to be important in the Decontamination & Dismantlement effort, the risk presented to the health and safety of the public are orders of magnitude below that of an operating facility. In recognition of this, is it not just advisable to increase emphasis on cost control, but essential, if Decontamination & Dismantlement is to be accomplished within the fixed budget.

Therefore, the principal parameter to optimize is cost. For practical purposes this is equivalent to achieving the Decontamination & Dismantlement and site remediation in the shortest possible time with a minimum of staffing. That is, schedule and cost are virtually interchangeable (within limits) for the purposes of Decontamination & Dismantlement financial risk. The duration of decommissioning activities can be minimized through effective pre-planning.

The following subsections discuss issues that should be addressed in a Strategic Plan.

2.3 Staffing - the Key to Cost Control

A large fraction of the controllable plant costs are determined by staffing requirements. Unlike the operating plant, large capital investments are seldom an issue. An operating plant normally maintains a constant staffing level and, importantly, a constant mix of expertise. For example, the operating plant does not need 50 licensed reactor operators one year and 10 the next. But a decommissioning project can require significantly varying numbers of personnel from year-to-year. Not only does the number of personnel required change dramatically, but also the required personnel skills also undergo transformation, with some disciplines growing and others shrinking.

Staffing requirements will vary with the specifics of the Decontamination & Dismantlement Plan. Management must deal with a dynamic target when trying to optimize such an important cost parameter.

2.3.1 Prerequisites to Developing a Staffing Plan

A key to minimizing costs is to develop a staffing plan for the span of the Decontamination & Dismantlement effort. This staffing plan would be expressed in terms of quantity and skills, all as a function of time. The successful development of a sound staffing plan depends on the prior resolution of a number of fundamental issues such as those in Table 2-1, “Key Pre-Planning Bases.”

2.4 Key Issues for Decommissioning Planning

Since cost and the decommissioning planning process are interdependent, minimizing the cost of Decontamination & Dismantlement entails an iterative evaluation of alternatives. Nor is it always possible to readily establish comparable costs when alternatives entail substantially different cash flows, for example, "wet vs. dry" long term fuel storage. The decision on this issue significantly affects projected cash flows whereas the present value of the alternatives may not differ substantially. Since each plant owner faces unique financial challenges, brief perspectives on the issues are provided below. For those issues upon which the industry has achieved some consensus, recommendations are provided.

2.4.1 Planned Shutdown Date

Being able to plan in advance for the shutdown and decommissioning of a nuclear power plant permits time for development of a cost-optimized decommissioning plan. Unfortunately, several plants have encountered situations that resulted in premature, unplanned shutdowns. This can result in a very slow start for the decommissioning process, with significant cost incurred as a result of a large idle plant staff. The going-forward strategy is necessarily different for these two categories of plants.

Where the option exists for selection of a shutdown date, three to five years of pre-planning would be an appropriate window to target to permit effective pre-planning. In any event, the course of action available to the plant owner is closely coupled to the width of the planning window. With a shorter planning window, many more tasks than desirable will need to proceed in parallel ("fast-tracking"). The consequence may be increased project risk, which frequently translates to increased project cost.

An excessively long planning window may result in difficulties in maintaining project focus. In addition, since the regulatory environment is evolving, as are the options for storage of fuel and the options for disposal of low-level waste, there is some risk that long term planning will be subjected to periodic revision. However, since so few staff are typically involved in a longer term planning effort, this presents a smaller financial risk to the company than the consequences of a too-short planning window.

Consideration should also be given to strategic planning for contingencies. Certain alternative situations may arise as a result of plant options such as plant sale versus decommissioning. Also, the number of cycles remaining, even for a planned shutdown, may require strategic contingency planning.

Special issues for decommissioning can arise from certain plant situations which will also require strategic planning. Examples include a plant shutdown date which is extended because of a license renewal program. An impact of license renewal would be extension of the time period over which decommissioning funding collections occur. Conversely, a premature shutdown of a relatively newer plant can be envisioned in the current deregulated environment. A premature plant shutdown would have the opposite impact on decommissioning funding collections.

2.4.2 DECON, SAFSTOR, or ENTOMB

The currently favored options do not include ENTOMB[1], leaving the choice as either DECON or SAFSTOR.

Single-unit plants with access to low-level waste disposal options generally will choose the DECON option. The DECON option results in the most rapid return of the site to original condition. Cost studies have generally shown this option to be less expensive than the SAFSTOR option. Multiple-unit sites with one or more reactors still in operation have generally elected a modified DECON (or temporary SAFSTOR) option. Many multiple-unit sites have extensive interdependencies as a consequence of shared systems. Decommissioning one of the units with such interdependencies between units may present unacceptable risks. In such instances, most of the systems in the shutdown and defueled unit, i.e., those not shared with the sister unit or required for long-term fuel storage, are placed in lay up to await the joint decommissioning of the units upon the permanent shutdown and defueling of the last unit on-site.

An extended SAFSTOR option is being exercised, even for some single reactor sites. Heightened interest in this option is being driven by economics associated with both the limited availability of low-level waste disposal facilities and the need for extended fuel storage on the reactor site. Extended SAFSTOR may create special needs such as long-term surveillance and maintenance programs, retention of knowledgeable staff, and extended maintenance of corporate records.

As a result of the continued inability by the DOE to meet its contractual obligations to accept commercial spent nuclear fuel, the length of time that the licensee must maintain a spent fuel storage facility has become indeterminate. Until the fuel is removed from the site, the site cannot be fully remediated. Piece-wise site remediation, i.e., release of parcels may prove more costly than postponing final site remediation.

[1] At the present time, the Entombment option is essentially precluded by the 60-year provision in 10 CFR 50.82(a)(3) which would need to be revised to reflect the period of time required for reduction of dose to meet the license termination rule (10 Part 20, Subpart E). However, the NRC is embarking on rulemaking to address the Entombment option and current sources should be consulted to ascertain progress. See NRC Advanced Notice of Proposed Rulemaking (ANPR), "Entombment Options for Power Reactors," 10 CFR Parts 20 and 50, October 16, 2001, Page 52551-52554

2.4.3 Spent Fuel Pool Capacity

For some units this is an extremely important issue, specifically those who are operating without the capability to fully discharge all fuel from the reactor vessel for lack of sufficient storage in the spent fuel pool. Should such a unit find itself forced into early retirement, but with the inability to immediately defuel, it will not be able to comply with the regulatory requirements to qualify as a permanently shutdown and defueled reactor facility. This will present a serious cost burden as the plant owner will not be able to recognize the many opportunities for cost savings allowed by the regulations. For some plants there is no safety based or legal requirement to maintain the capability for full core discharge. Nevertheless there is a prudency issue. Certainly a key pre-planning consideration for decommissioning is the projected capacity of the spent fuel pool (or dry fuel storage facility if available, or potentially available) at the shutdown date.

Where pre-planning time permits, the alternative of transferring all spent fuel to an Independent Spent Fuel Storage Installation (ISFSI) on the site as soon as possible after shutdown should be evaluated. Transferring all the fuel to the ISFSI avoids development of a nuclear island and could reduce the cost of the decommissioning. Some BWRs may be particularly dependent on the development of an ISFSI because of the integral construction of the spent fuel pool with the reactor building.

A number of issues associated with the ISFSI option would need to be considered. All dry storage casks have design limits for the energy release rates from the stored fuel. The energy released from the fuel is a function of the initial enrichment, the achieved burnup, and, most importantly, the time since discharge from the core. Enrichment and target burnup are operational parameters that are selected to achieve power production efficiencies. While it would be possible to reduce somewhat the post-shutdown heatload by modifying the end-of-life core design, this is unlikely to prove economical. Instead, we face a minimum post-shutdown cooling time that is required before fuel can be transferred to dry storage. Even for a plant that has established an ISFSI before plant shutdown, the most recently discharged fuel constrains completion of the transfer to the ISFSI and the dismantlement of the spent fuel pool. This is a key factor in decommissioning planning.

The funding for the ISFSI system for an operating plant is typically treated as an operating expense. A shutdown plant may be able to access the decommissioning fund for construction of an ISFSI. An ISFSI can be dry or wet.

Finally, if the licensee were confident that the DOE would accept spent fuel consistent with their decommissioning schedule needs, investment in an ISFSI would be unnecessary.

2.4.4 Site Release Criteria

The NRC regulations establish criteria for both unrestricted release (general use) and restricted release (industrial use) of the site. Unrestricted release of the site requires a higher standard of site remediation and entails higher cost than does restricted release. However, political as well as economic factors must be considered in establishing release criteria for the site. This decision is further complicated by the potential for State and EPA intervention in the final release of the site.

Recent lessons learned from current decommissioning efforts suggest that more planning is needed for both radiological and non-radiological site surveys. Pre-planning information for site characterization, both non-radiological and radiological, is introduced in DTO-18, Appendices B and C, respectively. Thoroughly developing 10 CFR 50.75g records, with a focus towards decommissioning, will be beneficial for the historical site assessment as described in DTO-17.

2.4.5 Assumed Removal Date for Spent Fuel

As indicated above, the date assumed for final removal of all spent fuel from the site can influence a number of decommissioning issues. In addition to the general approach to decommissioning (DECON or SAFSTOR), and the site release schedule, and even the site release criteria, the assumed date for the removal of spent fuel also influences a decision to develop a dry storage Independent Spent Fuel Storage Installation (ISFSI). Development of an ISFSI, with dual-purpose or multi-purpose canisters, would allow extended storage of fuel on the site while permitting the full decommissioning of the reactor facility including removal of the spent fuel pool.

While dependent on a number of site-specific criteria, in general the cost breakeven for developing an ISFSI for a decommissioning plant occurs when there is an expectation that storage requirements will extend beyond a dozen years after shutdown.

Obviously, other factors are at play if the ISFSI is under consideration to support continued operation or life extension. As a consequence of the complexity of the issues associated with the final fuel removal date, several plausible scenarios must be outlined and evaluated against cost and risk criteria.

2.4.6 Availability of a Low-Level Waste Disposal Site

Perhaps this issue more than any other, constrains the rapid dismantling and decontamination (DECON) option. If there is no low-level waste (LLW) disposal site available to the licensee, the DECON option is, for practical purposes, precluded.[2] However, at Oyster Creek, they concluded that they had enough low-level waste storage capability on-site to dismantle the plant if necessary. Indeed, that may well be the preferred option if no remote LLW site is available. It allows removal of industrial hazard and simplifies site maintenance. (Most of the plant material goes to clean waste site or recycler for compaction.) Similarly, if the cost to access an existing low-level waste site is determined to be excessive, but other options are on the horizon, the licensee may elect the SAFSTOR option. As a rule, there is little short-term uncertainty regarding access availability and cost since many operating reactors are routinely shipping to such sites. However, the longer the planning horizon the more uncertain will be the projections for availability and cost.

[2] If permitted by State and Federal authorities, some sites may be able to set aside an on-site area for long-term storage of LLW, allowing dismantlement of the plant even without access to off-site disposal.

2.4.7 Use of In-House Staff for Decommissioning

This is a more complex issue than may at first be recognized. Plant closures present a number of serious human resource challenges to management. One of the largest going-forward variable costs, post-shutdown, will be staffing. However, until the plant is actually shut down, the staffing requirements change little. Therefore, when a plant shutdown is announced (or perceived by the staff as probable), it may be necessary to develop special retention policies for key employees in order to assure the continued plant viability.

At the same time, pre-planning for the shutdown also permits the licensee to determine the skills required to execute the decommissioning. As a result, many licensees have been creative in developing retention/severance/early retirement packages to shape the evolution of the plant staffing to meet their projected requirements. This can prove to be cost-effective for the company while also easing the transitional burdens for employees.

One of the key factors in development of such human resource management programs is the pre-determination of the role to be played by the existing plant staff in the decommissioning process. At present two models are being tested in field application. One model (e.g. the initial Yankee Rowe decommissioning as well as Big Rock Point) is heavily dependent on the use of existing plant staff both for managing and executing much of the decommissioning work. The second model (Maine Yankee as well as Connecticut Yankee) features an outside management firm that acts as Decommissioning Operations Contractor (DOC). The DOC selects and manages one or more decommissioning contractors. The benefit of one alternative over the other has yet to be established.

2.4.8 Estimates for Decontamination & Dismantlement

Nearly all operating units have plant-specific cost estimates, although the regulations permit the use of a formula for estimating decommissioning costs. In addition, some have some form of a decommissioning plan which permits continued refinement of the projected decommissioning cost estimates. All licensees will be regularly updating decommissioning cost estimates in accordance with the annual reporting requirement under 10 CFR 50.75. Some will use the escalators provided in the regulations which have factors keyed to labor, energy, and waste burial costs.

All escalation factors suffer from the limitation of projecting the future by looking at the past. The decommissioning cost adjustment factors in the regulations may be inadequate for radical changes in the political/economic environment such as closure of a waste repository to those plants outside a regional waste disposal "compact." The regulations permit use of plant-specific cost estimates. This approach is encouraged as part of an effective pre-planning process.

Three areas warrant regional attention in pre-planning. All three are driven by Federal and State actions (or inactions). The first is fuel disposal cost. This is a two-part issue covering on-site storage options as well as the schedule and cost for the ultimate disposal of the fuel. The second is the disposal of low-level waste. What is the availability of a disposal site? What are the rates? The third area warranting attention when projecting costs is the site release criteria. With the States playing a larger role, perhaps setting release criteria more stringent than the NRC, there is the potential for a step change in the projected cost for final site remediation. Interactions between the NRC and EPA also warrant attention until such time as they agree on-site release criteria.

An accurate cost estimate should be available to support expeditious preparation of the Post-Shutdown Activities Report (PSDAR) prior to final shut down. One of the components of the PSDAR is a cost estimate. The PSDAR must be submitted to the NRC as a prerequisite to obtain access to the next increment (20%) of the decommissioning fund. (Access to the remaining balance of the fund is dependent upon the submittal of a site-specific cost estimate.)

2.4.9 Funding Adequacy

There are two aspects to funding adequacy. The first is for pre-planning expenses and the second for the actual physical deconstruction and decontamination of the plant. The current regulations recognize the value to the licensee of pre-planning for decommissioning by authorizing the expenditure of up to 3% of the projected cost of decommissioning for "paper studies" (10 CFR 50.82(a)(8)(i)(C)(ii)).

Some plants will undergo permanent shutdown significantly in advance of the original license end date. In these instances a significant shortfall is to be expected in the decommissioning fund. One of the uses of the 3% pre-planning fund is to determine the viable options for the owner given the projected cash flow requirements for alternative decommissioning scenarios.

For a regulated utility, the DECON option may be effectively precluded by the funding shortfall without the support of the Public Utility Commission, or equivalent body. One of the justifications for a thorough pre-planning effort for decommissioning is that it establishes sound bases for discussions with the funding authorities; it is a "business plan" for decommissioning.

Effective pre-planning can create options for the owner that would be otherwise precluded by funding constraints.

2.4.10 Pre-Planning: In-house or Consultant?

A combination work team comprised of in-house staff and consultants may be the best option for developing an effective pre-planning document for decommissioning. Not surprisingly, operational plant staff have an operational focus. The decommissioning process is much more akin to a construction project than operating a nuclear power plant, demanding different skills both in planning and execution of the project. On the other hand, it is important to any project planning process that those who will execute a plan have a share in the development of the plan.

As a practical matter, few operating plants could dedicate all the necessary representatives from the operating staff for the time necessary to develop a decommissioning pre-planning document. However, formation of a small separate group of plant staff from key disciplines can be combined with an experienced decommissioning contractor to efficiently jump-start the structuring of a "level 1" site-specific decommissioning pre-plan. The resultant plan can subsequently be detailed through selective participation of plant staff.

This approach minimizes the burden on the operating staff and, at the same time, encourages stakeholder buy-in. It also results in internalizing the skills necessary to maintain and revise the plan in the future, minimizing reliance on outside resources.

2.4.11 Hiring a Decommissioning Operations Contractor

Decommissioning a nuclear power plant demands a totally different skill set than *operating* a power plant. It also demands a different management structure. In this regard it is similar to a construction project with its prioritized schedule and critical path issues. This is why decommissioning typically entails the use of a Decommissioning Operations Contractor (DOC). A DOC team can be assembled three ways: It can consist only of existing plant staff, or it can be mostly plant staff augmented with specialists, or it can be an independent management organization contracted totally from the outside. The choice represents the classic procurement problem for executive management: *whether* to procure, *how* to procure, *how much* to procure and *when* to procure.

***Whether* to procure:** A plant owner who is broadly integrated and construction-oriented may well have the internal *capability* to license and engineer a major decommissioning project. But even so, it may still be quicker and cheaper to bring in experienced specialists as soon as possible, especially to focus on the critical path issues. Almost every plant owner will benefit from some outside assistance, if only for the planning stage.

***How* to procure:** This most likely would be accomplished through a competitive bid process. Experience has shown that the effort expended in creating a thorough bid specification will pay dividends in the quality of bids received. It also helps the owner better crystallize his own needs and expectations. The bid specification is described in greater detail below.

***How much* to procure:** As noted, the plant owner must decide how little or how much to seek in support from external contractors. Again, this depends both on the extent of in-house capabilities and the extent to which the plant owner is willing to commit to the direct management of a major construction-type project. If the plant owner decides to serve as his own DOC, then the complexity of procuring coordinated services from a multitude of specialized subcontractors becomes his responsibility. If the plant owner retains a team to oversee the activities of a contracted DOC, then hiring the DOC, negotiating the schedule and terms and overseeing his progress becomes the major procurement activity. Only a handful of US heavy construction companies are large enough to accept the responsibility for decommissioning a nuclear power plant. These companies are well known and readily contacted.

***When* to procure:** In the case of a single-unit site, expeditious dismantling (the DECON option) is probably the most cost-effective strategy. This might also be true for multiple-unit sites. In such instances where prompt dismantling is the objective, and the plant owner already knows in advance when the plant will permanently shutdown, it is not unreasonable to begin developing a bid specification for an external DOC two years before the planned shutdown date. An internal DOC/Decommissioning planning group should also begin work at about the same time.

Bid Specification Development

Once decisions are made on the questions of *whether, how, how much and when*, a bid specification must be prepared. Whether the procurement decision process has resulted in total or minimal reliance on internal resources for the decommissioning project, the preparation of the bid specification, and particularly the definition of the project scope, is a significant effort. Unless the plant owner has substantial construction project experience on which to draw, the development of a bid specification for a complete nuclear plant decommissioning will almost certainly require outside assistance.

From the perspective of both the buyer and seller of decommissioning services, scope definition is key to a successful project. Unfortunately, this has proven to be an elusive goal.

A detailed project plan at the pre-bid stage would minimize the potential for misjudgment of the project scope by either party. However, this would constitute a heavy cost burden for the plant owner. Furthermore, the lack of participation in the plan's development reduces the ownership of the supplier in the plan. There is, therefore, an incentive for both parties to jointly define the project work scope.

This cooperative technique worked well for Maine Yankee where a short list of bidders participated in preliminary site characterization. This creative approach provided the bidders with first-hand knowledge of the location and levels of site contaminants, permitting each to minimize the imbedded contingency costs for scope uncertainty. In addition to getting lower bids, it also provided Maine Yankee with a scoping-level site characterization at virtually no expense.

A forward thinking management can apply such innovative scope definition techniques to other aspects of the decommissioning project, including the development of the overall project management plan. Both parties "win" when project scope uncertainties are minimized. Neither party wins, even under a "fixed priced" contract arrangement, when an underestimated scope delays completion and adds to the costs for both parties.

2.5 Moving to the Next Step: Tactical Planning

With the first round of key planning basis assumptions in hand, one can move on to the specifics of planning for the critical individual tasks. The development of these tasks will directly support both the final decisions on key planning assumptions and will position the plant for rapid, efficient and cost-effective initiation of the decommissioning and dismantlement process. In this report, these task documents, termed Decommissioning Task Outlines (DTOs), are the building blocks that collectively create an integrated tactical plan. (See Appendix A.)

Development of DTOs will undoubtedly result in revisiting some of the initial responses to the key planning issues described earlier. This is to be expected and is a necessary part of the planning evolution. Performing such iterations well in advance of shutdown, is far preferable to the same exercise post-shutdown with several hundred staff virtually idle during plan development.

3
TACTICAL PLANNING

3.1 Overview

A tactical planning process is distinguished from Strategic Planning principally by level of detail. Tactical planning establishes the required activities to achieve the higher level goals established in the Strategic Plan. In this pre-planning report, the development of a tactical plan is initiated by identifying all of the major tasks that are required to decommission a nuclear power plant. This list is based on industry lessons learned from planning, scheduling and implementing Decontamination & Dismantlement activities.

Equally important to the process is knowledge of the order in which such tasks must be performed. To serve this need, precedence relationships are suggested based on past experience. In some instances this order is inviolate; for example, relaxation of emergency planning requirements cannot precede reevaluation of plant accidents. Some as a matter of prudence come early, such as establishing an effective program for communication with all stakeholders. Others may appear to logically come very late in the process, for example, the License Termination Plan. However, with the good practice of always "beginning with the end in sight," plants should move that effort well forward. All plants must comply with 10 CFR 50.75, "Reporting and Record Keeping for Decommissioning Planning," and should consider the planning (e.g., contingency planning) described in Section 2.4.1.

Completion of some tasks can be delayed until just before needed. For example, the deconstruction effort usually entails the use of a large, contractor work force with an industrial background. This may demand an Occupational Safety Program of a different character than has been in place at the plant for many years for the work force trained to commercial nuclear power requirements. The plan for development of this program, while certainly important, can come later in the planning process without ill effect.

With all of that said, the optimal ordering of decommissioning planning tasks remains somewhat variable. Regardless of how successful a particular plan was at a previous Decontamination & Dismantlement project, plant-specific considerations must always prevail.

3.2 Time Available Before Permanent Shutdown

Perhaps no issue shapes the pre-planning process more than the time remaining before the plant will permanently cease operations. This report is principally focused on those plants having several years of power operation remaining. However, by appropriate selection of tasks, the guidance in this report is also useful, both for plants facing nearer term shutdown, and those anticipating license renewal. As noted below, it is the schedule of activities most affected, not the activities themselves.

3.3 Decommissioning Task Outlines - Overview

Sixty-five Decommissioning Activities have been identified through review of Connecticut Yankee, Oyster Creek, Maine Yankee, and Yankee Rowe decommissioning task lists. These are listed in Table 3-1. All of these activities are necessary to fully develop a Decontamination & Dismantlement program and most will require some measure of attention. The Decommissioning Activities that are listed in Table 3-1 are consolidated into pre-planning tasks which are described as Decommissioning Task Outlines (DTOs). Table 3-2 shows the consolidation of the sixty-five Decommissioning Activities into thirty-two Decommissioning Task Outlines. Table 3-3 portrays the same information in the reverse correlation. Each of the sixty-five Decommissioning Activities is assigned to a DTO. Note that this grouping results, in some cases, in the primary Decommissioning Activities being explicitly treated in the DTO with relevance to the remaining activities indicated.

The DTOs have been further grouped, by responsible organization for planning purposes, into elements on a Precedence Diagram. The Precedence Diagram grouping is based on similarity of content/discipline and timing. Figure 3-1 shows the DTOs in the Precedence Diagram format using a relative importance hierarchy (i.e., logic of rough chronology) for the purpose of timing, decision-making, and implementation. Figures 3-2 through 3-5 show the same DTOs by lead discipline, which is useful for staffing the pre-planning effort. Many of these tasks, of course, entail coordinated inputs from several plant departments. In all of the Precedence Diagrams, pre-planning tasks which should be performed approximately in sequence and those which can be performed roughly in parallel are indicated.

Discussions with those who have managed plant Decontamination & Dismantlement projects suggest that the actual scope of decommissioning a power plant will be the same whether the decommissioning is pre-planned years in advance or occurs with little notice. Pre-planning does, however, impact the quality and completeness of the documented scope of the project. An accurately documented scope of work will minimize future inefficiencies resulting from rework and improve project efficiency, and thus reduce costs. The level of resources committed to pre-planning must be a plant-specific decision based on need and circumstance. Neither the tasks nor their ordering will change significantly as a result of the available time to shutdown.

Figure 3-1 depicts the DTOs, with the pre-planning tasks ordered consistent with the assumption of three to five years planning horizon to shutdown. The precedence relationship in these figures suggests (very approximately) the order of the pre-planning tasks which should be the first to be initiated. The initial focus (first sheet) is on those which are important for the first six months of the post-shutdown activities as this is the most crucial time period, i.e., it reflects the transition from operations to permanent shutdown and decommissioning. This is the time frame in which the gains from pre-planning will be most evident. Note that DTOs 7-16 may also be performed even more in parallel, and that the order of the DTOs must be considered in the context of the description of their scope.

3.4 Decommissioning Task Outlines - the Specifics

Each of the DTOs in Appendix A is a stand-alone document. The DTOs are organized as follows:

- DTO Number
- Title
- Objective
- Value
- Prerequisites
- Task Description
- Resources
- Product
- References

Note that the product for each DTO can vary from cognizance of the issues through preliminary preparations (e.g., outlines of the final product), to the final product itself. Similarly, the prerequisites can consist of items necessary to be completed prior to the pre-planning or prior to the actual final product.

Table 3-1
List of Decommissioning Activities

Management/Finance/Human Resources

1. Strategic Planning
2. Tactical Planning
3. Management Structure
4. Schedule
5. DOC/Decom Bid Specification Development
6. Decommissioning Cost Estimate
7. Decommissioning Oversight
8. Funding Assurance
9. Contingencies
10. Decommissioning Vendor Selection and Assessment Recommendation
11. Financial Administration
12. Community Relations and Stakeholder Communication
13. Cultural Transition
14. Decommissioning Organization and Staffing Plan
15. Employee Retention/Release Policies
16. Special Issues for Decommissioning
17. Decommissioning Performance Indicators

Licensing/Ops/Training/QA

18. Certification of Cessation of Operations
19. Defueled Technical Specifications
20. Federal and Local Permits
21. State Compliance
22. Exemptions Requests
23. License Basis/Design Basis Review
24. Tax Status Modification
25. FSAR Update Plan
26. PSDAR Preparation Plan
27. Relief from Operational Fees
28. Revisions to License Commitments
29. Withdrawal: Licensing Submittals Supporting Operations
30. Ops (Fuel Handler) Training Program
31. License Termination Plan (LTP)
32. E-Plan Program
33. Fire Protection Program
34. Security Program
35. Station Blackout
36. Maintenance Rule Program
37. Fitness for Duty Program
38. Safety Reviews (50.59)
39. QA Program
40. Pre-Shutdown Operations/Maintenance Activities
41. Engineering Support Personnel (ESP) Training Program

Table 3-1 (continued)
List of Decommissioning Activities

Engineering

42. Procedure Revisions Related to Declassification
43. Spent Fuel Storage Strategy
44. Spent Fuel Island Studies)
45. Accident Analysis and Spent Fuel Pool (SFP) Heatup Calculation
46. Reactor Pressure Vessel (RPV) and Large Component Removal
47. Reactor Pressure Vessel/Steam Generator (RPV/SG) Shipping
48. Systems Decontamination Studies
49. Identification of Support Systems
50. Deconstruction Power Supply
51. Systems Reclassification
52. Procedure Review Plan
53. Work Process Simplification
54. Integrated Schedule
55. Area Based Work Plan
56. Dismantlement Major Task Sequence

Environmental Management and Occupational Health and Safety

57. Historical Site Characterization/Assessment (Rad)
58. Historical Site Characterization/Assessment (Non-Rad)
59. Exposure Estimate Plan
60. Low-Level Liquid Waste Disposal
61. Low-Level Solid Waste Disposal
62. Hazardous Waste Disposal (Non-Rad)
63. Mixed Waste Disposal
64. Environmental Assessment (Environmental Report) Plan
65. Occupational Safety Program

Table 3-2
Decommissioning Task Outlines (DTOs) versus Decommissioning Activities

DTO NO.	DTO NAME	ACTIVITY NO.	ACTIVITY NAME
1	Cost Estimate & Funding Assurance	6 8 24	Decomm Cost Estimate Funding Assurance Tax Status Modification
2	Summary-Level Schedule	4	Schedule
3	Management Issues	3 7 13 17	Management Structure Decomm Oversight Cultural Transition Decomm Performance Indicators
4	Pre-Shutdown Recommended Practices	40	Pre-Shutdown Operations/Maintenance Activities
5	Organization & Staffing Plan	14 15	Decomm Org & Staffing Employee Retention/Release Policies
6	Community Relations & Stake-holder Communications	12	Community Relations & Stakeholder Communications
7	Certifications, Exemptions Requests & Fee Relief	18 22 27	Certification of Cessation of Operations Exemptions Requests Relief from Operational Fees
8	Exposure Estimate	59	Exposure Estimate
9	Environmental Assessment [Environmental Report]	64	Environmental Assessment [Environmental Report] Plan
10	Post-Shutdown Decommissioning Activities Report (PSDAR) Preparation	26	PSDAR Preparation
11	Spent Fuel Storage	43 44	Spent Fuel Storage Strategy Spent Fuel Pool Island Studies
12	Accident Analysis & Spent Fuel Pool (SFP) Heatup Calculation	45	Accident Analysis and Spent Fuel Pool Heatup Calculation
13	Defueled Technical Specifications	19	Defueled Technical Specifications
14	Occupational Safety	65	Occupational Safety Program
15	Vendor Assessment & Selection Recommendations	10	Decommissioning Vendor Selection and Assessment Recommendation
16	Project Controls	11	Financial Administration
17	Historical Site Assessment	57 58	Historical Site Characterization Plan [Rad] Historical Site Characterization Plan [Non- Rad]
18	Site Characterization	57 58	Historical Site Characterization Plan [Rad] Historical Site Characterization Plan [Non- Rad]

Table 3-2 (continued)
Decommissioning Task Outlines (DTOs) versus Decommissioning Activities

DTO NO.	DTO NAME	ACTIVITY NO.	ACTIVITY NAME
19	Federal/State/Local Regulatory Compliance	20 21	Federal and Local Permits State Compliance
20	FSAR Update Plan	25	FSAR Update Plan
21	License Termination Plan (LTP)	31	LTP
22	Systems Identification & Reclassification	42 49 51	Procedure Revisions Related to Declassification Identification of Support Systems Systems Reclassification
23	Programmatic Revisions	23 28 29 30 32 33 34 35 36 37 38 41	License Basis/Design Basis Review Revisions to License Commitments Withdrawal: Licensing Submittals Supporting Operations Ops (Fuel Handler) Training Program E-Plan Program Fire Protection Security Program Station Blackout Maintenance Rule Program Fitness for Duty Program Safety Reviews (50.59) Engineering Support Personnel (ESP) Training Program
24	QA Program Plan	39	QA Program
25	Work Processes & Procedures Reviews	52 53	Procedure Review Plan Work Process Simplification
26	Systems & Structures Decontamination	48	Systems Decontamination Studies
27	Reactor Pressure Vessel (RPV) & Large Component Removal & Shipping	46 47	RPV and Large Component Removal RPV/Steam Generator (SG) Shipping
28	Deconstruction Power Supply	50	Deconstruction Power Study
29	Area Based Work Plan & Integrated Schedule	54 55	Integrated Schedule Area Based Work Plan
30	Dismantlement Major Task Sequence	56	Dismantlement Major Task Sequence
31	LLW Liquids, Solids & Mixed Radioactive Waste	60 61 63	Low-Level Liquid Waste Disposal Low-Level Solid Waste Disposal Mixed Waste Disposal
32	Hazardous Waste Disposal (Non-Rad)	62	Hazardous Waste Disposal (Non-Rad)

Table 3-3
Decommissioning Activities versus Decommissioning Task Outlines (DTOs)

ACTIVITY NO.	ACTIVITY NAME	DTO NO.	DTO NAME
Management/Finance/Human Resources			
1	Strategic Planning	–	Strategic Text
2	Tactical Planning	–	Tactical Text
3	Management Structure	3	Management Issues
4	Schedule	2	Summary-Level Schedule
5	DOC/Decom Bid Specification Development	–	Strategic Text
6	Decommissioning Cost Estimate	1	Cost Estimate & Funding Assurance
7	Decommissioning Oversight	3	Management Issues
8	Funding Assurance	1	Cost Estimate & Funding Assurance
9	Contingencies	–	Strategic Text
10	Decommissioning Vendor Assessment and Selection Recommendation	15	Vendor Assessment & Selection Recommendations
11	Financial Administration	16	Project Controls
12	Community Relations and Stake-holder Communication	6	Community Relations & Stake-holder Communications
13	Cultural Transition	3	Management Issues
14	Decommissioning Organization and Staffing Plan	5	Organization & Staffing Plan
15	Employee Retention/Release Policies	5	Organization & Staffing Plan
16	Special Issues for Decommissioning	–	Strategic Text
17	Decommissioning Performance Indicators	3	Management Issues
Licensing/Ops/Training/QA			
18	Certification of Cessation of Operations	7	Certifications, Exemptions Requests & Fee Relief
19	Defueled Technical Specifications	13	Defueled Technical Specifications
20	Federal and Local Permits	19	Federal/State/Local Regulatory Compliance
21	State Compliance	19	Federal/State/Local Regulatory Compliance
22	Exemptions Requests	7	Certifications, Exemptions Requests & Fee Relief
23	License Basis/Design Basis Review	23	Programmatic Revisions
24	Tax Status Modification	1	Cost Estimate & Funding Assurance
25	FSAR Update Plan	20	FSAR Update Plan
26	PSDAR Preparation Plan	10	PSDAR Preparation
27	Relief from Operational Fees	7	Certifications, Exemptions Requests & Fee Relief
28	Revisions to License Commitments	23	Programmatic Revisions
29	Withdrawal: Licensing Submittals Supporting Operations	23	Programmatic Revisions

Table 3-3 (continued)
Decommissioning Activities versus Decommissioning Task Outlines (DTOs)

ACTIVITY NO.	ACTIVITY NAME	DTO NO.	DTO NAME
30	Ops (Fuel Handler) Training Program	23	Programmatic Revisions
31	License Termination Plan (LTP)	21	LTP
32	E-Plan Program	23	Programmatic Revisions
33	Fire Protection Program	23	Programmatic Revisions
34	Security Program	23	Programmatic Revisions
35	Station Blackout	23	Programmatic Revisions
36	Maintenance Rule Program	23	Programmatic Revisions
37	Fitness for Duty Program	23	Programmatic Revisions
38	Safety Reviews (50.59)	23	Programmatic Revisions
39	QA Program	24	QA Program Plan
40	Pre-Shutdown Operations/Maintenance Activities	4	Pre-Shutdown Recommended Practices
41	Engineering Support Personnel (ESP) Training Program	23	Programmatic Revisions
Engineering			
42	Procedure Revisions Related to Declassification	22	Systems Identification & Reclassification
43	Spent Fuel Storage Strategy	11	Spent Fuel Storage
44	Spent Fuel Pool Island Studies	11	Spent Fuel Storage
45	Accident Analysis and Spent Fuel Pool (SFP) Heatup Calculation	12	Accident Analysis & SFP Heatup Calculation
46	Reactor Pressure Vessel (RPV) and Large Component Removal	27	RPV & Large Component Removal & Shipping
47	RPV/Steam Generator Shipping	27	RPV & Large Component Removal & Shipping
48	Systems Decontamination Studies	26	Systems & Structures Decontamination
49	Identification of Support Systems	22	Systems Identification & Reclassification
50	Deconstruction Power Supply	28	Deconstruction Power Supply
51	Systems Reclassification	22	Systems Identification & Reclassification
52	Procedure Review Plan	25	Work Processes & Procedures Reviews
53	Work Process Simplification	25	Work Processes & Procedures Reviews
54	Integrated Schedule	29	Area Based Work Plan & Integrated Schedule
55	Area Based Work Plan	29	Area Based Work Plan & Integrated Schedule
56	Dismantlement Major Task Sequence	30	Dismantlement Major Task Sequence

Table 3-3 (continued)
Decommissioning Activities versus Decommissioning Task Outlines (DTOs)

ACTIVITY NO.	ACTIVITY NAME	DTO NO.	DTO NAME
Environmental Management and Occupational Health and Safety			
57	Historical Site Characterization/Assessment (Rad)	17 18	Historical Site Assessment Site Characterization
58	Historical Site Characterization/Assessment (Non-Rad)	17 18	Historical Site Assessment Site Characterization
59	Exposure Estimate Plan	8	Exposure Estimate
60	Low-Level Liquid Waste Disposal	31	LLW Liquids, Solids & Mixed Radioactive Waste
61	Low-Level Solid Waste Disposal	31	LLW Liquids, Solids & Mixed Radioactive Waste
62	Hazardous Waste Disposal (Non-Rad)	32	Hazardous Waste Disposal (Non-Rad)
63	Mixed Waste Disposal	31	LLW Liquids, Solids & Mixed Radioactive Waste
64	Environmental Assessment [Environmental Report] Plan	9	Environmental Assessment [Environmental Report]
65	Occupational Safety Program	14	Occupational Safety

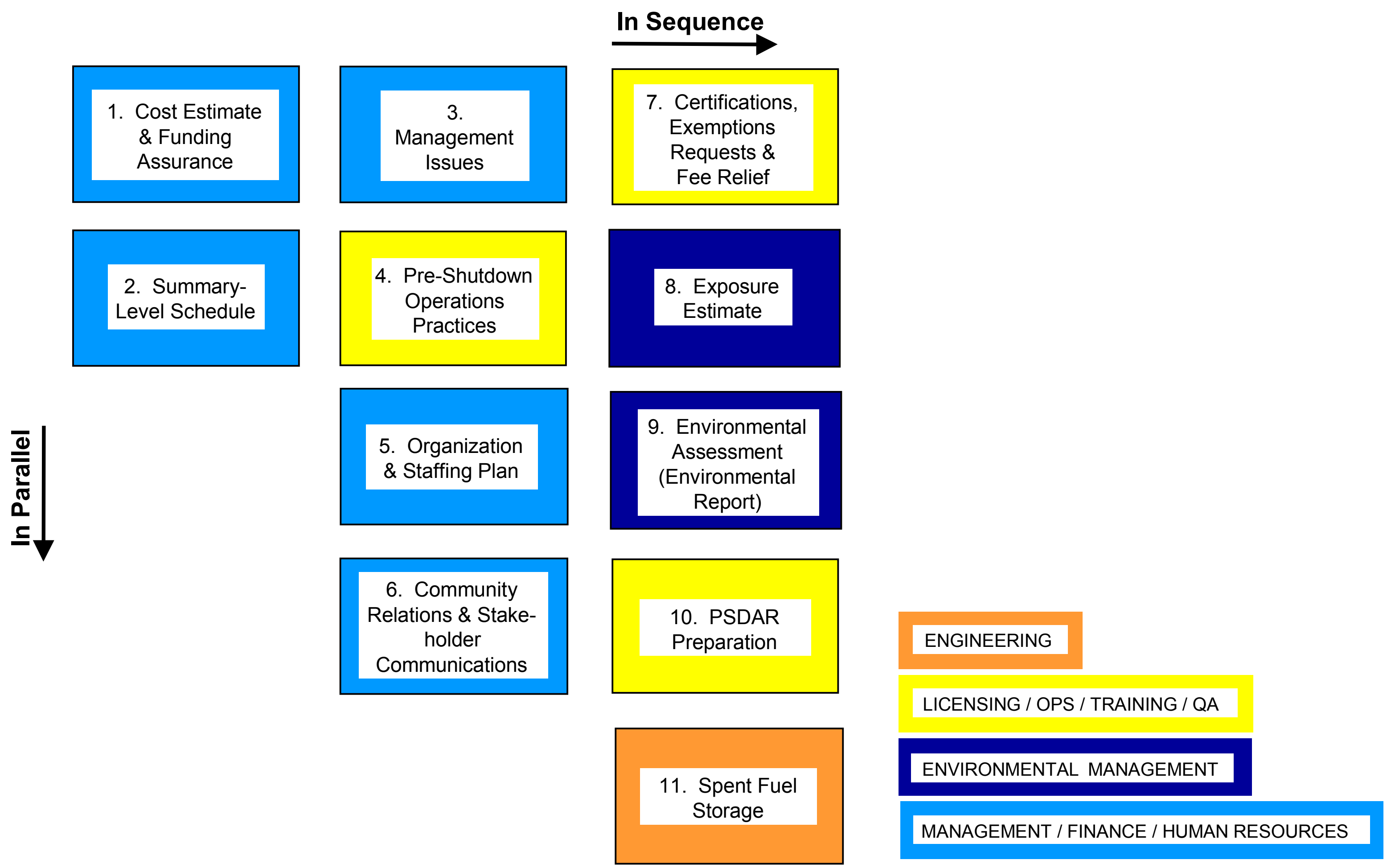

Figure 3-1
Decommissioning Pre-Planning Precedence Diagram

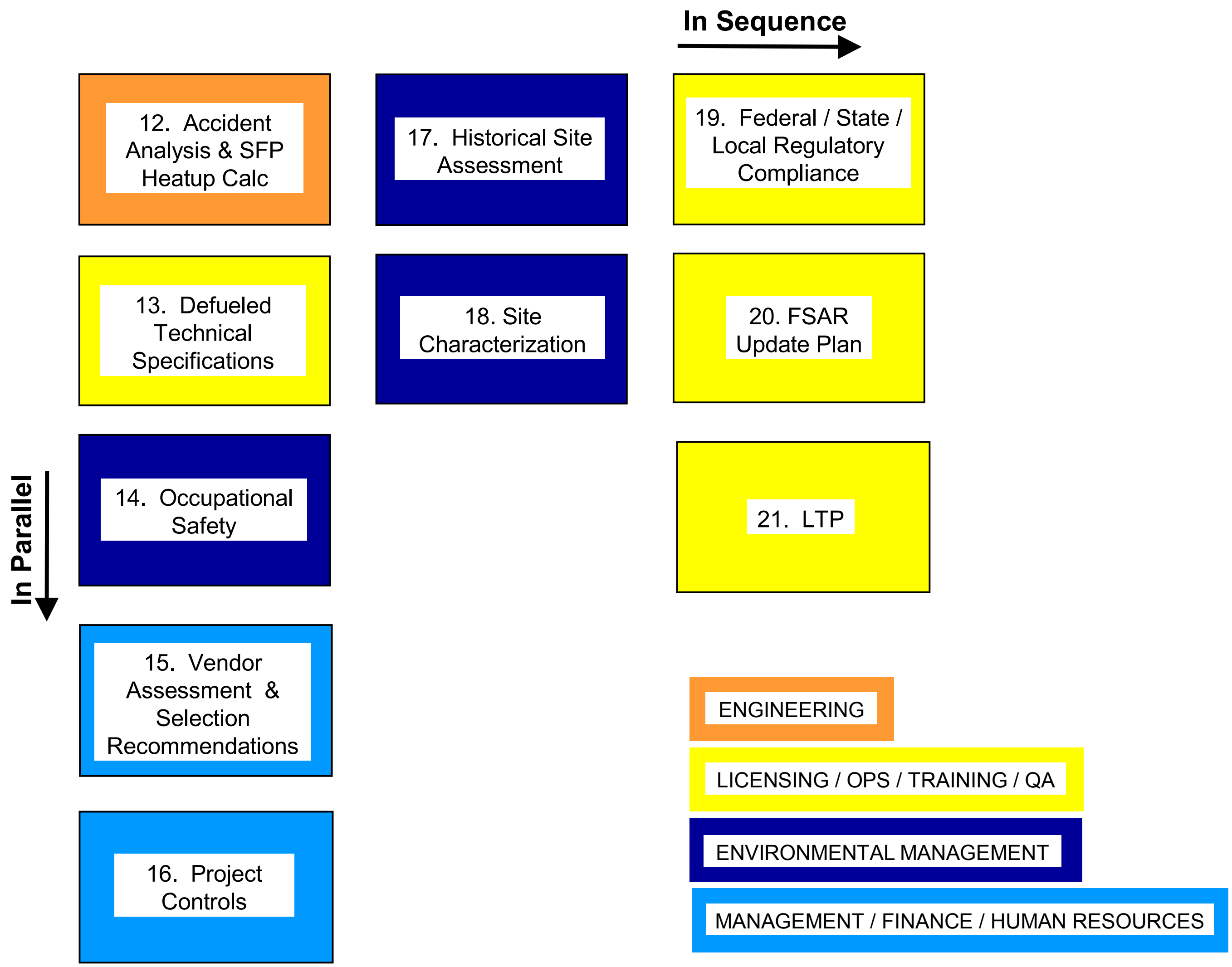

Figure 3-1 (continued)
Decommissioning Pre-Planning Precedence Diagram

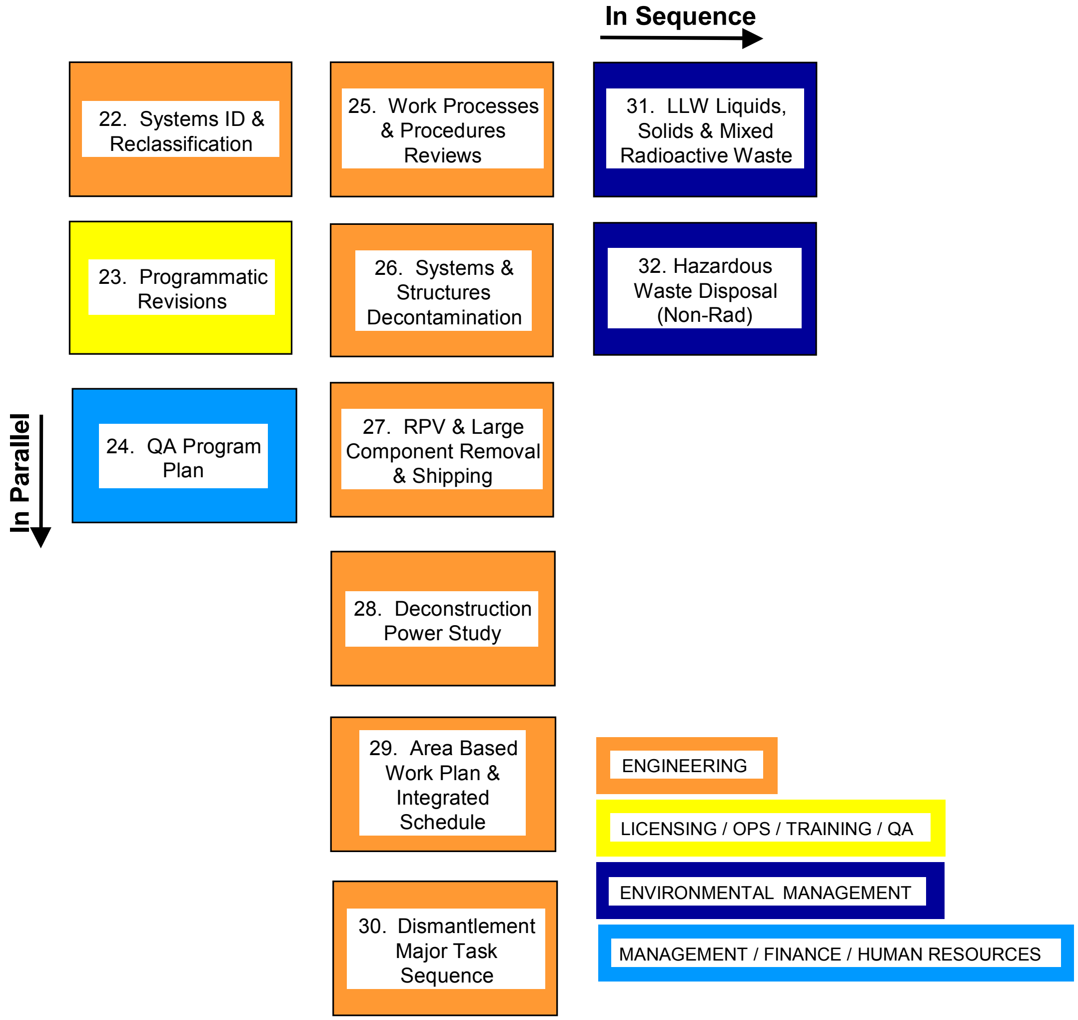

Figure 3-1 (continued)
Decommissioning Pre-Planning Precedence Diagram

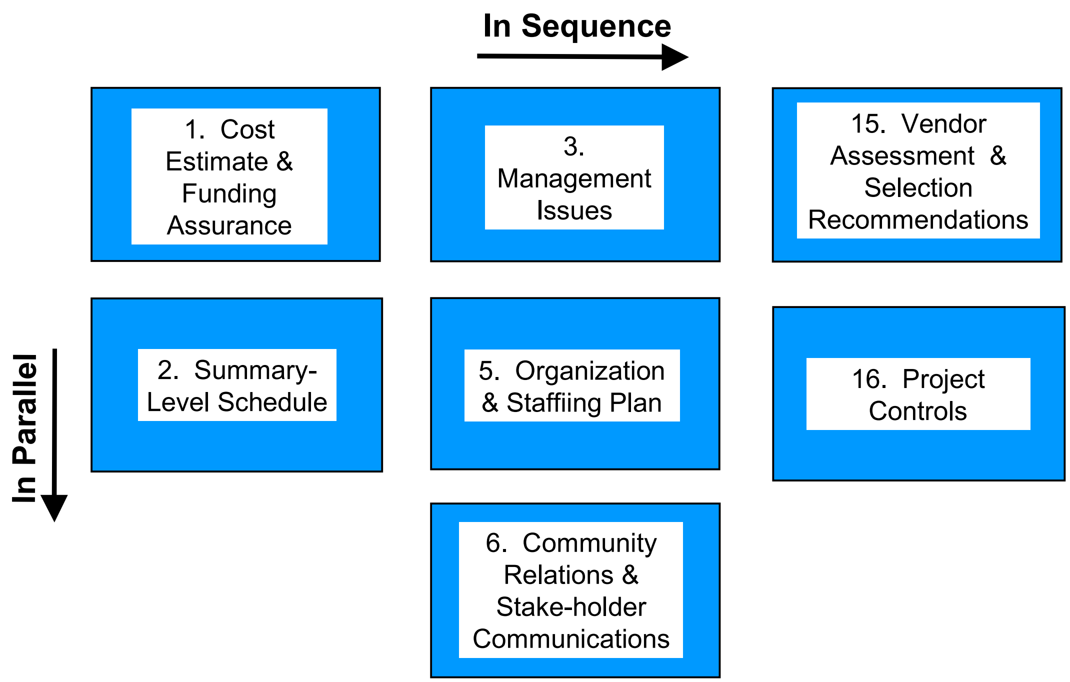

Figure 3-2
Decommissioning Pre-Planning Precedence Diagram - Discipline Focus Management/Finance/Human Resources

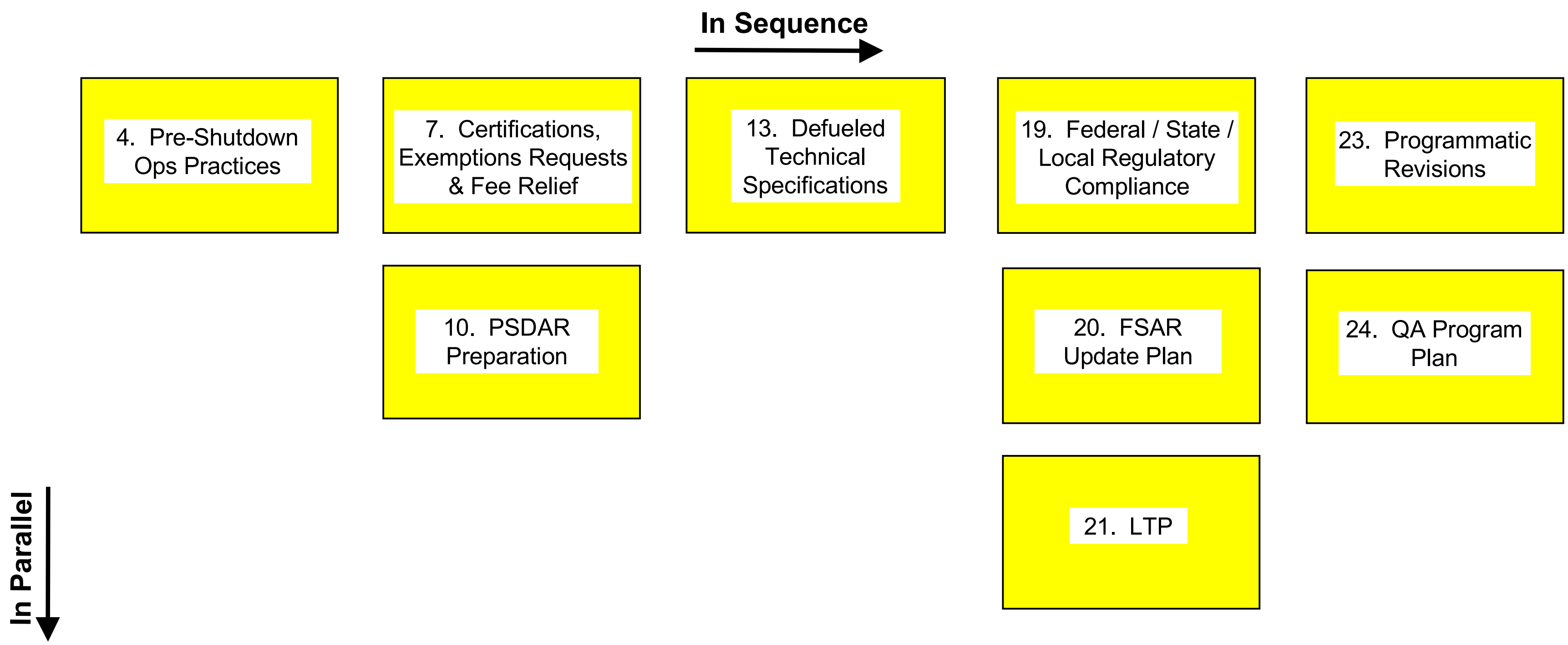

Figure 3-3
Decommissioning Pre-Planning Precedence Diagram - Discipline Focus Licensing/Operations/Training

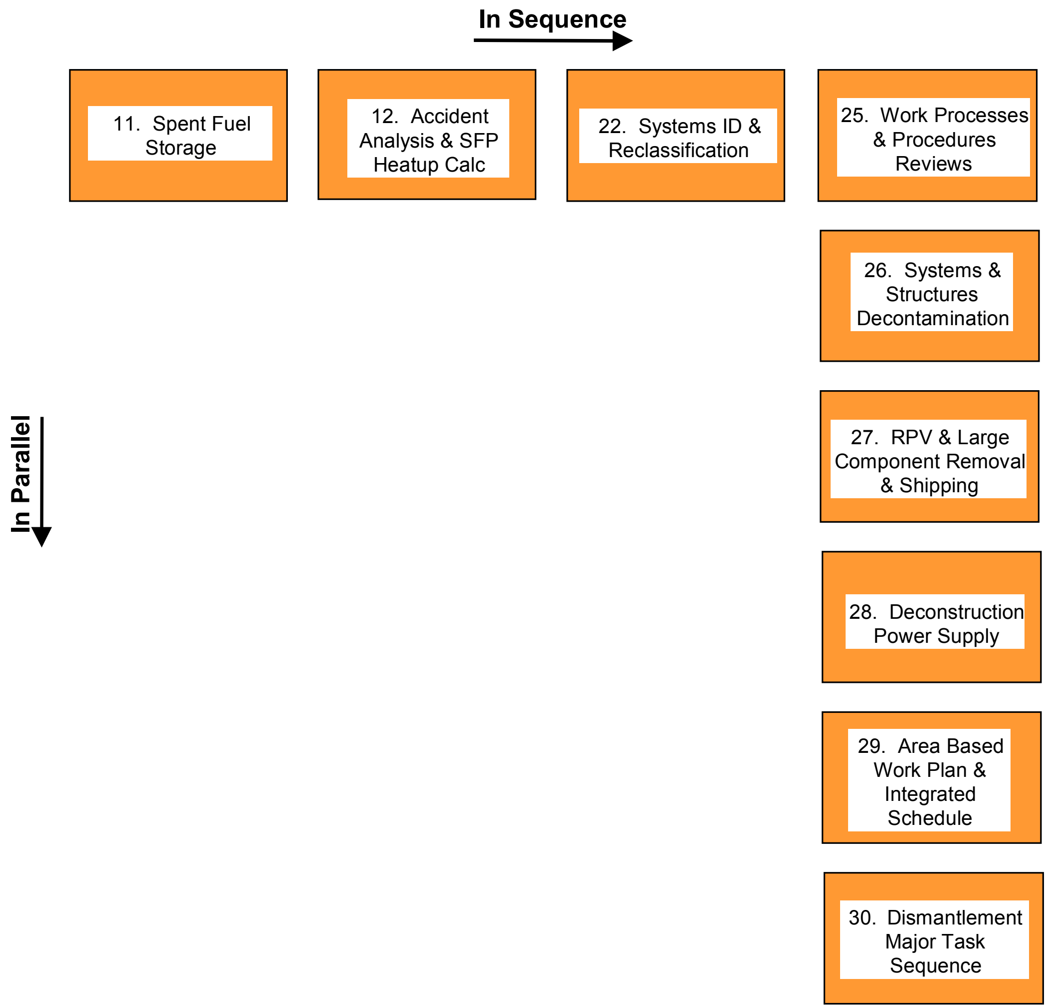

Figure 3-4
Decommissioning Pre-Planning Precedence Diagram - Discipline Focus Engineering

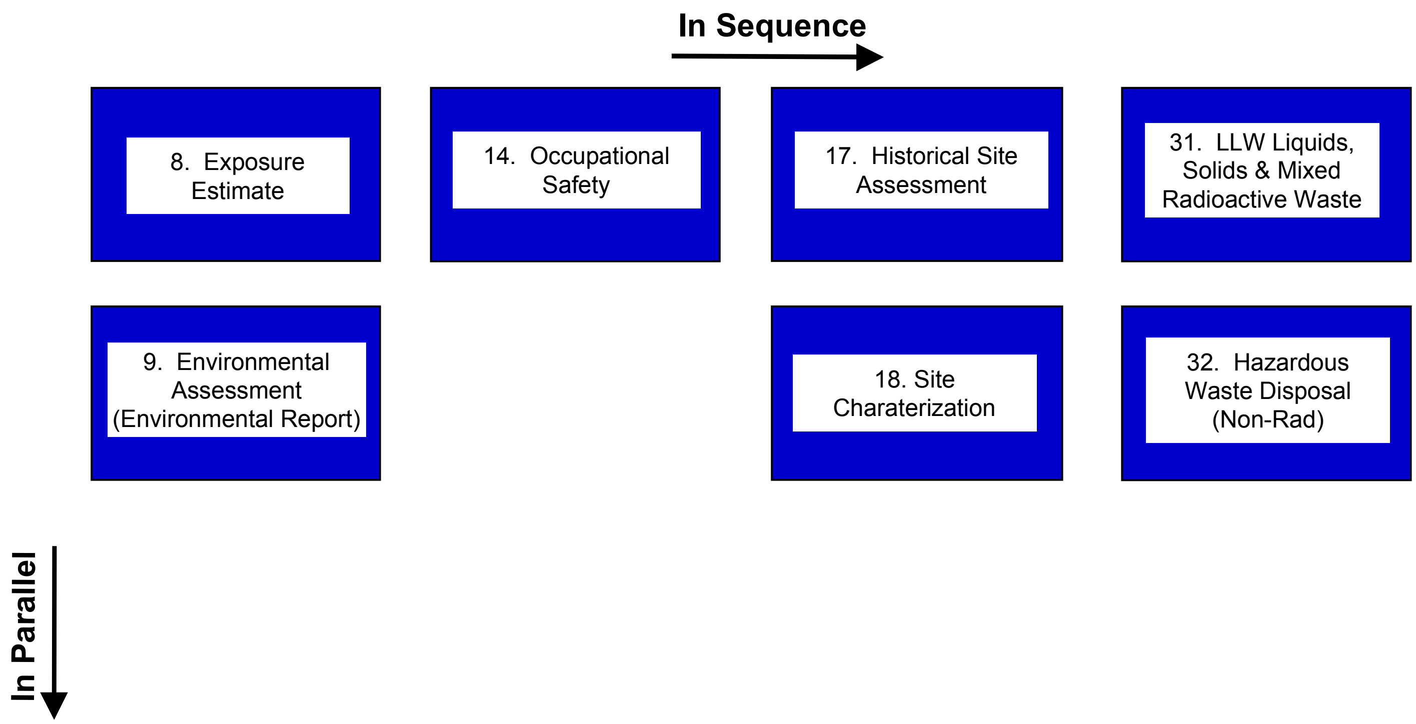

Figure 3-5
Decommissioning Pre-Planning Precedence Diagram - Discipline Focus Environmental Management and Occupational Health and Safety

4
SPECIAL CONSIDERATIONS FOR POTENTIAL NEAR TERM SHUTDOWNS

The primary thrust of this pre-planning manual is to provide structure and order to the complex challenge of permanently closing a nuclear power plant and safely and economically phasing into a decommissioning mode. The degree to which an organization will be prepared to address these challenges is a function of the amount of time between the beginning of the planning efforts and the actual shutdown date. Based on evidence from industry experience to date, it would appear that planning for decommissioning would be most effective if initiated three to five years prior to plant shutdown. This has the potential for economic savings in the millions of dollars.

The spectrum of plant shutdown scenarios includes a distant future shutdown at one extreme, to a completely unplanned near-term or immediate shutdown at the other. In between exists a continuum of scenarios and circumstances that will impact the effectiveness of planning efforts.

For illustration purposes, a list of some shutdown scenarios are presented below in increasing order of urgency:

- Planned shutdown greater than five years away, ISFSI installed.
- Planned shutdown greater than five years away, but issues could shorten timeline, no ISFSI.
- Planned shutdown in less than one to three years, no ISFSI.
- Immediate, unplanned shutdown, no ISFSI.

The last scenario presents the worst case and the one requiring the most urgent response. In the event that a licensee would be confronted with this extreme scenario, what actions and sequence would be required to achieve an orderly and expeditious transition into DECON decommissioning?

In order to answer that question and present a realistic case, two important assumptions must be made:

1. The licensee already has a nuclear decommissioning trust fund that complies with NRC regulations for funding adequacy. However, since plant shutdown was not planned until some distant future date, the trust is not currently funded to meet all of the financial obligations required to complete all of the decommissioning. This would likely delay the initiation of any major field decommissioning activities.

2. The licensee's spent fuel pool provides sufficient space to support defueling the reactor. Should such a unit find itself forced into early retirement, but with the inability to immediately defuel, it will not be able to comply with the regulatory requirements to qualify as a permanently shutdown and defueled reactor facility. This will present a serious cost burden as the plant owner will not be able to recognize the many opportunities for cost savings presented by the regulations.

Based on these assumptions, a licensee confronted with an immediate permanent shutdown would initiate the following priority tasks in approximate order in the first six months. The order of these activities differs somewhat from the order of the pre-planning approach because of time urgency. Note also that, as in the pre-planning case, many can be also done in parallel.

- Plant Shutdown
- Defuel
- Prepare Certifications of Cessation of Operations and permanent removal of fuel (DTO-7)
- Submit Exemptions Requests to NRC (DTO-7)
- Address Organization and Staffing Issues (DTO-5)
- Address Spent Fuel Storage (DTO-11)
- Prepare Revised Accident Analysis (DTO-12)
- Prepare Systems Identification and Reclassification (DTO-22)
- Prepare Defueled Technical Specifications (DTO-13)
- Prepare Updated Final Safety Analysis Report (DTO-20)
- Prepare PSDAR (DTO-10)
    a. Prepare Decommissioning Schedule (DTO-2)
    b. Update Decommissioning Cost Estimate (DTO-1)
- Initiate and continue other tasks involving decommissioning planning, engineering, and procurement.

There are several important observations to be made from the presented task sequence.

First and foremost, the tasks are highly concentrated in the licensing area. This is not surprising since all plant operations are driven by strictly defined license commitments and performance standards. Since significant changes to plant configuration require regulatory approval prior to implementation, meaningful cost reductions resulting from corresponding reductions in staffing cannot be realized until approved by the NRC.

Secondly, the sequence of activities presented is very similar to that which was followed by the many plants that were shut down unexpectedly during the 1990's, such as Yankee Rowe, Trojan, and Connecticut Yankee. Since the primary purpose of this pre-planning guide is to assist licensees to better plan for decommissioning, the focus is on avoiding the reactionary nature of this sequence of activities in a crisis mode.

Finally, the other elements of good decommissioning planning that deal with strategic planning and internal and external communications are very important, and should be undertaken in parallel with the other tasks listed. These activities should be undertaken at the earliest possible opportunity and managed simultaneously with the other tasks to achieve a safe and orderly transition from power operations to decommissioning.

5
DECOMMISSIONING LESSONS LEARNED

This section of the report is devoted to summarizing some key "lessons learned" from actual plant decommissioning projects. Material provided in this section was derived from a combination of interviews with experienced decommissioning management staff and reviews of documentation both public and private. Oyster Creek, Maine Yankee, Connecticut Yankee and Yankee Rowe were the principal "experience" sources, both because they are the most current and their experience is the most accessible to the authors. Lessons learned for Oyster Creek are described in EPRI Technical Report, TR-000093, "Preparing for Decommissioning: the Oyster Creek Experience." From their planning process, in which planning was performed while the plant was operating with an announced possible shutdown date, lessons learned are offered in the areas of management, licensing, engineering, site release, spent fuel and communications. In several instances, the recommendations below result from lessons learned the hard way, i.e., "Do as we recommend, not as we did."

The DTOs contain more specific lessons learned. Also, the Bibliography (Appendix D) contains a list of EPRI Reports which have captured lessons learned from plants such as Shoreham, Trojan and Fort St. Vrain. Additional input from other decommissioning plants was obtained by survey and by comments on the 2000 EPRI Interim Decommissioning Pre-Planning Manual.

5.1 More Detailed Planning and Scheduling Should be Done Earlier

This is a common theme whether from Management, Engineering, Project Management, or Radiation Protection, i.e., almost any plant functional area. The plans developed for the purpose of decommissioning cost estimates were wholly inadequate for actually doing the decommissioning.

In order to get the job done at the lowest possible costs, more time needs to be spent developing detailed decommissioning sequences and logic long before the actual dismantling takes place. Several years before is not too early. While some may argue that such activity is premature, it has great value in providing substantial insight into exactly how the work will proceed. This permits sufficient lead time to adequately prepare designs, procure long-lead time materials at reasonable prices, and to develop and evaluate alternatives ("what if" analysis). Advanced development of "micro-plans" also assists in the identification and cost-effective resolution of potentially expensive problem areas or technical issues.

But what if decommissioning is delayed for several years? In that event, the dismantling logic can be "safe stored" until needed. Since significant engineering staff changes are inevitable, the early development of detailed dismantlement logic assures that a well thought out decommissioning process is documented for future staff. Very little is risked by such a pre-planning effort, and much stands to be gained.

5.2 Increase Emphasis on the Importance of Industrial Safety

Decommissioning is basically a construction activity. Task and skill requirements differ significantly from those required for operations. As a construction activity, the role of safety personnel takes on new importance. Safety personnel need to be an integral part of any deconstruction planning team.

Since the contractor work force will be the people doing most of the “hands-on” work, the safety programs and rating of the contractor become very important and warrant specific attention in contractor selection.

Involve safety personnel early in the planning, engineering and implementing processes. This will pay such dividends as a safer working environment, fewer lost time accidents, fewer injury claims, and generally higher, more stable productivity.

Another lesson learned concerns electrical safety. Personnel, no matter the experience level, can become complacent with electrical safety once a plant is shut down. The higher the experience level, the more over-confident a person may become. Awareness of this potential risk affords opportunity to combat it through aggressive standards and training programs.

5.3 Communications with the Stakeholders

Decommissioning and dismantlement activities are almost certain to draw the attention of various stakeholders, including community members, the media, activists, political and business leaders and the employees themselves. The attention will not always be positive.

Regardless of the nature of the interest group, the plant's communications programs must be tailored to meet its needs. Communication programs must not be static nor can they be one-size-fits-all. Stakeholder needs are both unique and evolving.

In designing a program to communicate with either employees or the public it is essential to first determine what they want to know. This knowledge is best developed through a well-designed professional survey. Given such insight, one can develop a targeted communication plan that assures consistent, timely, and accurate messages reach the respective stakeholders.

Expect to find a need for periodic re-surveys. These are essential to keep the information supplied by the plant owner consistent with the evolving information needs of the stakeholders.

5.4 Regulator Interaction

A firmly adhered to "no surprises" policy is as important for a decommissioning plant as for an operating plant. Appropriate communication processes should be in place to assure that all regulatory bodies are promptly informed of any information important to their respective oversight functions. It is critical that potentially high profile issues (plant events) reach them directly from plant management, not via the media.

It is equally important to keep the regulatory contacts informed well in advance of all major decommissioning activities (e.g. chemical cleaning of RCS, segmentation of RPV, movement of large pressure vessels). A knowledgeable regulator is a valued asset to the plant.

5.5 Human Resources Issues

Without a doubt "people issues" present the single largest challenge to management in the decommissioning process. Two challenges are to be confronted. First, employees are well aware that plant staffing will be dramatically reduced shortly (within months) after shutdown, and second, that the decommissioning process involves "working oneself out of a job." Pre-planning can blunt the negative impact of both.

For the first issue, experience has shown that a combination of three special benefit plans, a retention plan, a special severance plan and an early retirement plan, can materially assist management in maintaining the necessary measure of control over staffing. This facilitates a safe transition from operations to permanent shutdown.

The compensatory retention reward is normally sized by considering both the value of the employee to the plant and his or her value to the market place, principally other operating plants. Licensed operators require special consideration in retention policy pre-planning, both for their importance to continue safe operation of the plant and their intrinsic "market value."

The longer term second issue can also be effectively managed through pre-planning. The retention issue is addressed in two ways. First, individual retention packages can be tailored to give a high assurance that specific key skills will remain on staff until the need is past. Second, by early identification of roles and responsibilities for the decommissioning staff, and following that with "names in the organizational blocks," the company communicates a message of continued value and longevity to key staff.

For some employees, selection for an assignment to the decommissioning team may be particularly attractive. For example, for the highly experienced employees, such a role may create the potential for transition to early retirement coincident with the completion of the assignment. This is a powerful incentive that management should fully utilize to meet and maintain particularly critical staffing needs. It creates a win-win situation for both employee and company.

The less experienced employee can also be a valued resource and often represents a more mobile group. Specific motivational and retention incentive plans need to be tailored for this group as well.

This task is simplified by first identifying those individuals who want to contribute and to be involved in decommissioning - many will. Certainly, one must use a fair and equitable process to staff the decommissioning organization, but it is appropriate to favor motivated individuals over others. Experience also suggests that early establishment of the decommissioning organization quickly will encourage key individuals to stay.

Well designed and executed goal-based incentive programs will return the investment in their development many times over.

5.6 Spent Fuel Characterization and Documentation

Consideration should be given to characterizing the condition of the spent fuel while the plant is still operating. NRC Staff Guidance ISG-1 - Damaged Fuel, requires that damaged fuel be "canned" before it is loaded into dry storage casks. Damaged fuel is defined as "Spent nuclear fuel with known or suspected cladding defects greater than a hairline crack or pinhole leak." Furthermore, the NRC requires:

"As proof that the fuel to be loaded is undamaged, the staff will accept, as a minimum, a review of the records to verify that the fuel is undamaged, followed by an external visual examination of the fuel assembly prior to loading for any obvious damage. For fuel assemblies where reactor records are not available, the level of proof will be evaluated on a case-by-case basis."

In other words, the NRC requires that a records review be conducted on all spent fuel assemblies (and the review presumably is to be documented) before the fuel assembly can be loaded into casks for storage or transportation off-site.

In addition to the NRC requirements, the DOE plans to require thirty-nine pieces of data for each spent fuel assembly and nine more for each spent fuel canister. These requirements are given in the 1983 Waste Contract and in DOE's 1997 Spent Nuclear Fuel Verification Plan.

Experience has shown that retrieving and organizing this amount of information is far easier and more efficient when it is done while the plant is still operating. Waiting, perhaps decades, until after the plant has permanently shutdown, after much of the nuclear staff has been dismissed, after records have been destroyed or misplaced, and the institutional memory is lost, will obviously increase the difficulty and cost tremendously. Incorporating this fuel documentation effort during the pre-planning phase will not only lower costs later but will also provide valuable input for future spent fuel storage decisions which may need to be made before permanent shutdown.

5.7 Historical Site Assessment and Characterization

The importance of understanding the nature and extent of radiological contamination on a site is self-evident. One surprise, however, has been the depth to which radiological contaminants have penetrated concrete. This has resulted in repeated underestimates of the quantities of concrete requiring special processing.

The accurate pre-characterization of hazardous materials such as asbestos, lead, PCBs, and hydrocarbons is equally important. Hazardous material remediation requires additional work controls, special material handling and packaging and special training for workers. Experience has shown that the late discovery of hazardous material contamination has seriously affected the decommissioning process and budget.

A

DECOMMISSIONING TASK OUTLINES (DTO)

DTO-1: Cost Estimate and Funding Assurance

Objective:

The objective of this task is to assess the adequacy of decommissioning funding based on a site specific decommissioning cost estimate, a shutdown date, and the alternative methods of decommissioning – immediate Decontamination & Dismantlement, extended SAFSTOR, or brief SAFSTOR followed by Decontamination & Dismantlement.

Value:

Following full license-term operation, funding the Nuclear Decommissioning Trust (NDT) should be adequate to support consideration of any decommissioning option. If a plant faces premature permanent closure prior to the original license termination date, a funding shortfall could occur, thus affecting decommissioning options. Adverse consequences can be minimized with pre-planning.

With license renewal extending operation as much as another twenty years, some Public Utility Commissions have questioned the potential for over-collecting decommissioning funds and are seeking funding reductions or shared return of decommissioning monies. Thus, there is an equally important need for this class of plant to monitor funding and projected decommissioning costs.

Federal and State tax laws relating to the treatment of decommissioning fund contributions and earnings have become more complicated as a result of the restructuring of the electric utility industry. Current areas of industry debate include traditional cost of service issues, NRC license transfers, plant age considerations, and conflicts between State and Federal law and the Federal tax code. Understanding the current and emerging decommissioning funding tax laws is important to maximize the total return of the NDT.

Prerequisites:

Prerequisites for the assessment of funding assurance are a current cost estimate and an understanding of the tax laws. Preparation of an accurate cost estimate requires that a decommissioning option be selected, but not necessarily a specific timetable. Estimates can be developed on the basis of unit cost factors or via area-by-area assessment. Economic evaluations can be based on present values and escalated to alternative shutdown dates.

Task Description:

All operating plants are required to develop decommissioning estimates and to periodically report their decommissioning funding status to the NRC pursuant to 10 CFR 50.75. Depending on decommissioning options selected, potential costs could include costs for operating the facility through a safe storage period, decommissioning the facility, restoring the site to "green field," and storing spent fuel until transfer to the DOE.

While the NRC provides generic guidelines for estimating decommissioning costs (10 CFR 50.75(c)), virtually all plants have funded the development of plant-specific estimates. However, unless recently updated, these estimates may not accurately reflect true costs.

Therefore, this aspect of pre-planning consists of maintaining a current estimate of decommissioning cost and, furthermore, assuring that the projected funding matches need. A biennial update should be sufficient. However, significant changes in projected plant life, longer or shorter, should prompt reevaluation of both decommissioning cost and funding assurance, as should activities by public oversight bodies to modify the funding process or funding availability.

Licensees have generally provided funds to NDTs through utility charges to customers. Traditionally, the electric utility industry has functioned as a regulated monopoly. It has provided essential electrical services under an exclusive franchise, with the rates closely regulated by State Public Utility Commissions (PUC) and the Federal Energy Regulatory Commission (FERC). Utilities and their rate commissions have factored the cost of decommissioning into current utility rates.

Internal Revenue Service (IRS) regulations regarding the tax treatment of NDTs has changed over time. NDT fund contributions created before a 1984 change in regulations were considered "non-qualified" funds, and subsequently created NDTs were called "qualified funds." Money deposited in non-qualified funds is taxed at the general corporate tax rate, and earnings of those funds are taxed at the corporate capital gains tax rate. Money deposited in qualified funds is not taxed as income, but treated as a deductible business expense, and earnings on the qualified fund are taxed at a lower capital gains tax rate of 20%.

Given the complex nature of decommissioning financial planning, and the emerging complications resulting from the industry trend from regulation to a deregulated environment, licensees must become well informed on decommissioning cost estimates, financial assurance requirements, and the tax consequences of funding decisions.

Resources:

Lead: Corporate Finance/Licensing

Support: Engineering

Product:

Estimated cost of decommissioning (including fuel storage) and source and use of funds.

References:

(1) NRC Draft Regulatory Guide –1106, "Assuring the Availability of Funds for Decommissioning Nuclear Reactors," May 2001

(2) NRC Regulatory Issue Summary 2001-07, "10 CFR 50.75 (f)(1) Reports on the Status of Decommissioning Funds (due March 31, 2001)," February 23, 2001

(3) NRC NUREG-1577, Rev. 1, "Standard Review Plan on Power Reactor Licensee Financial Qualifications and Decommissioning Funding Assurance," February 1999

(4) NEI-NESP-036, "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates," May 1986, 2 Vols.

(5) ANS Executive Conference: Nuclear Facility Decommissioning and Used Fuel Management, July 2000

DTO-2: Summary-Level Schedule

Objective:

The objective of this pre-planning task is to prepare a summary-level schedule of those tasks necessary for decommissioning of the facility. These tasks include planning for key decision-making; process, plans and program revisions, as well as any necessary plant modifications.

Value:

This task is important for the pre-planning management team. This task develops a hierarchical schedule of those activities necessary to plan for the effective use of resources to decommission the facility (see Section 2.0, “Strategic Plan). It will be useful to estimate the cost of decommissioning (DTO-1).

Prerequisites:

Determination of SAFSTOR or DECON as well as continued fuel pool storage versus an ISFSI.

Task Description:

The process leading to decommissioning the facility is complex. The summary-level schedule resulting from this planning effort is directed at identifying the major phases, events and milestones. This task integrates key decision-making activities into a summary-level schedule. A partial list of events and milestones to be incorporated in a summary-level schedule include:

<u>Milestones</u>

- Plant shutdown
- Defueling complete
- Spent fuel building isolated
- Reactor vessel removed
- ISFSI construction complete
- Spent fuel in ISFSI
- Decontamination and equipment removal complete
- Final status survey complete
- License terminated

<u>Activities</u>

- Studies resulting in decommissioning option decision
- Develop decommissioning cost estimate
- Develop area-based and integrated dismantling schedule
- Develop and implement organizational and staffing transition
- Perform engineering studies for licensing submittals
- Licensing submittals and exemptions requests
- Develop and implement radiological characterization plan
- Design, license and construct ISFSI
- Procurement of major contractors and equipment suppliers
- Engineering studies for large component removal options
- Large component removal, packaging and disposal sequences
- Implement decontamination and dismantling operations (presented by building)
- Perform final status survey
- License termination activities
- Perform site restoration

Each of the identified DTOs in this report should be reviewed to determine the appropriate input for development of the summary-level schedule.

Resources:

Lead: Management, Licensing

Support: Engineering and Operations staff

Product:

A summary-level schedule that identifies the major phases, activities, and milestones, including precedence relationships.

References:

(1) EPRI Technical Report, TR-112143, “A Methodology for Decommissioning Project Management,” October 1999

(2) EPRI Technical Report, TR-1000093, “Decommissioning Planning – Oyster Creek Experience,” February 2000

DTO-3: Management Issues

Objective:

The objective of this task is to provide guidance to management on the development of a strategy to create an organization capable of transitioning from a power operation orientation to a decommissioning culture. The resulting decommissioning organization is expected to provide oversight of decommissioning operations utilizing traditional project management techniques, including performance indicators.

Value:

Concerns with maintaining a high level of nuclear safety shape the culture of an operating power plant. This is as it should be, since serious adverse consequences could result from a nuclear event in an operating plant.

Once a nuclear power plant is permanently shutdown and the fuel transferred to either the spent fuel pool or to other permanent storage, accident risk is reduced by many orders of magnitude. However, the risk reduction perspectives and processes that have served the plant so well during power operation can contribute to significant delays, and higher costs, in the deconstruction of the power plant.

An organizational structure that is uniquely designed to effectively accomplish decommissioning objectives, while achieving a smooth cultural transition from power operations, offers the greatest hope for achieving desired decommissioning goals.

Prerequisites:

Since plant culture is shaped by staffing selection, both in terms of skills, experience, and perspective, the culture change plan cannot be decoupled from the staffing plan (see DTO-5). In fact, not only is the staffing plan a prerequisite for the culture change plan, the staffing plan can, and should be, used to shape the desired decommissioning culture.

Of course, while groundwork for the culture change can be completed prior to shutdown, implementation must await the reduced risk condition associated with permanent closure and reactor de-fueling.

Task Description:

Development of a management strategy to transition from a power operation regime to a full-scale decommissioning environment is one of the first and most important tasks that needs to be addressed. The management strategy takes into consideration the totality of assets and resources available to the enterprise, a definition of the desired short- and long-term goals, development of a realistic timeline, and the deployment of an effective organizational structure.

The management strategy may be documented in a "decommissioning strategic plan" that describes the overall plan for decommissioning including key assumptions and decisions, base case schedule, and cash flow. Some of the planning assumptions include when final shutdown will occur, the selected decommissioning option (i.e., DECON vs. SAFSTOR), the spent fuel storage strategy, the Decommissioning Operations Contractor (DOC) strategy, and the desired end state of the site.

The objective of the culture change task is to create a reorientation from operations to deconstruction. It may be very difficult to change the attitudes and methods of work of employees with many years of service in an operating facility. Some of these individuals may have internalized the nuclear safety culture, a culture appropriate for operations, but unduly conservative for the lower risk presented by decommissioning.

The decommissioning staff needs to be populated with individuals that recognize this is a project, i.e., a task with a defined beginning and end date, not an on-going business. Look for people with strong project management and construction skills with a mix of both nuclear and non-nuclear experience. Establish selection criteria that give preference to a production vs. process orientation, to mold an efficient decommissioning culture.

Conversance with safe *operating* plant procedures and processes, in more than a few key people, may prove detrimental to the project. OSHA requirements will predominate in shaping the new safety culture. State and Federal environmental regulations will also take on heightened importance. Seek personnel that have experience in the skills necessary to interact with this new group of regulators.

It is important to the success of the project that these new skills and attitudes are broadly distributed throughout the organization, not localized either in top management or in a minority of members of the workforce.

Management's role in decommissioning will involve both the direct supervision of resources and the oversight of organizations hired to perform defined portions of work. If an owner elects to hire a Decommissioning Operations Contractor to perform "turnkey decommissioning," the owner's organizational structure should be designed to implement an effective contractor oversight capability. Personnel functioning in oversight roles should be well-versed in dimantlement processes, project management tools, and construction management. If an owner elects to self-manage decommissioning utilizing numerous specialty contractors, then the organization should be structured to maximize the deployment and coordination of resources performing the hands-on decontamination and dismantling activities. Personnel functioning in this role would be experienced in engineering and construction processes, and possess strong labor management skills.

The use of performance indicators should be considered to measure the progress of decommissioning relative to the pre-defined goals and objectives. Performance indicators relating to industrial safety, radiation exposure, cost, and schedule performance are considered obvious choices. Examples of other performance indicators include the measurement of waste volumes, consumables, expended labor hours, and head count. It is highly recommended that other decommissioned sites be consulted to identify the full spectrum of performance indicators used and their effectiveness.

Resources:

The development of plans and strategies involving management structure, cultural transition, and decommissioning oversight will require input from a team of project representatives that include executive management and senior managers from Radiation Protection, Radioactive Waste Management, Licensing, Engineering, Planning and Scheduling, Operations and Human Resources, and Health and Safety. Additional support from consultants experienced in decommissioning, corporate downsizing, and human resource issues would be valuable and highly desirable.

Product:

A Decommissioning Strategic Plan or comparable Management Plan should be developed that defines the goals and objectives of plant shutdown and the pending transition to decommissioning. The plan should address how the organizational structure will evolve during each phase of transition, and the steps to be taken to deal with the cultural impact of the changes. The plan should define the expectations of the resulting organization and the tools and techniques to be deployed to successfully accomplish decommissioning. Recognition of the potential introduction of a turnkey DOC should be incorporated early in the planning process in order to maximize the effectiveness of the owner's organizational design.

References:

(1) EPRI Technical Report, TR-109030, "Fort St. Vrain Public Relations and Human Resources Issues," February 1998

(2) EPRI Technical Report, TR-107917-V2, "Yankee Rowe Decommissioning Experience Record," December 1998

(3) EPRI Technical Report, TR-1000093, "Decommissioning Planning – Oyster Creek Experience," 2000

DTO-4: Pre-Shutdown Recommended Practices

Objective:

The objective of this effort is to facilitate decommissioning through the initiation (or continuation) of a number of good practices. These activities are essential to an efficient decommissioning project and especially affect the "front end" of the project.

Value:

An efficient project is a cost-effective project. The set of activities described below are best performed early in the planning stage if maximum benefit is to be derived.

Prerequisites:

None. These are on-going activities that may be performed as good practices at any operating plant.

Task Description:

A multi-disciplinary set of on-going activities that draws on the talents of a number of plant departments. The first two are management/HR tasks while the balance establish a knowledge base for the efficient decontamination of the plant Systems, Structures and Components (SSCs) and site.

1. Maintain good relationships with internal and external stakeholders. (DTO-6)

2. Establish an employee retention plan. (DTO-5)

3. Baseline Historical Site Assessment and Site Characterization. Through sampling determine:
   - Extent of radiological contamination: type, isotopic mixtures and locations. (DTO-17 & DTO-18)
   - Extent of hazardous material contamination: type (lead, asbestos, chromates, PCBs, petroleum products, VOCs) and locations. Address entire station: SSCs, soil, groundwater. (DTO-17 & DTO-18)

4. Characterize low-level waste on-site, type, volume, weight, isotopic mix.

5. Identify and characterize mixed waste on-site.

6. Inspect and characterize spent fuel for damage.

7. Prepare (or verify existence of) a “Design Basis Document” for the spent fuel storage and handling system(s).

8. Locate and characterize "spills."

9. Locate and characterize previous on-site disposals (on-site burial, exemptions under 10 CFR 20.2002).

Maintain and update the above.

Resources:

Lead: Management

Support: Rad Protection, Environmental, Human Resources, Operations, Maintenance

Product:

Identification of good practices to implement and follow during operation.

References:

(1) EPRI Technical Report, TR-107917-V2, "Yankee Rowe Decommissioning Experience Record," December 1998

DTO-5: Organization and Staffing Plan

Objective:

The objective of this task is to prepare to transition from the organization and staffing necessary for power operation to the organization and staffing appropriate for decommissioning.

Value:

Staffing is a significant fixed expense for an operating nuclear power plant. Following the permanent cessation of operations, and associated revisions to the license, staffing needs are altered in terms of skills and numbers. The early identification of a decommissioning organizational structure enables the development of transition plans, particularly retention opportunities, which promote stability and cost-optimized decommissioning staffing.

The timely and effective transition to the new decommissioning organization reduces decommissioning costs. Accomplishing this is an important task for the pre-planning management team.

Prerequisites:

Consideration should be given to the nature of the personnel transition from the operating to the decommissioning mode. An operating mode organization is characterized by a functionally structured hierarchy and a large, stable workforce. Job scopes are narrowly defined and there is a strong focus on nuclear safety. The decommissioning mode is characterized by a project management-based organization with fewer job descriptions and cross-functional job scopes. The smaller decommissioning staff, with broad skill sets and a defined career end state, is focussed primarily on industrial health and safety.

Task Description:

Development of a decommissioning staffing plan is a complex activity that requires inputs from numerous disciplines. It is necessary that there be considerable progress in development of a decommissioning project schedule, as the staffing requirements, which change over time, are best derived from the resource estimates required to accomplish schedule activities and milestones.

The process of transitioning to and staffing the decommissioning organization consists of retaining employees with the needed skill sets, and releasing the remaining employees. Special considerations are required to address union employees and associated labor agreements.

An effective employee retention program includes an enhanced employee communication plan, posting of job openings, modified compensation plans, and other incentive mechanisms to reward employees for committing to the new decommissioning mission.

Elements of employee release programs include enhanced employee communication plans, employee assistance programs, outplacement support, early retirement compensation plans, and other plans directed at implementing a fair and equitable staff reduction process.

Development of the staffing plan may be thought of as parts two and three of a three-phased project:

Phase I Define the mission and scope of work

Phase II Define staffing needs (development of a decommissioning staffing plan)

Phase III Develop (or revise) programs for staffing retention, reassignment, or release to facilitate implementation of the staffing plan.

Resources:

Development of a decommissioning staffing plan will require input from a team of project representatives that consists of a senior manager with support from Radiation Protection, Radioactive Waste Management, Licensing, Engineering, Planning and Scheduling, Operations and Human Resources. Additional support from consultants experienced in decommissioning, corporate downsizing, and human resource issues would be valuable and highly desirable.

Product:

A Staffing Plan that identifies the number of personnel and skill sets required to support the decommissioning project over the life of the project.

A Communication Plan that provides accurate and timely information concerning the personnel transition from power operations to decommissioning. (DTO-6)

Various plans related to recruiting for new positions, employee retention, employee severance, and incentives.

References:

(1) EPRI Technical Report, TR-109030, "Fort St. Vrain Public Relations and Human Resources Issues," February 1998

(2) EPRI Technical Report, TR-107917-V2, "Yankee Rowe Decommissioning Experience Record," December 1998

(3) EPRI Technical Report, TR-1000093, "Decommissioning Planning – Oyster Creek Experience," 2000

DTO-6: Community Relations and Stakeholder Communications

Objective:

The objective of this effort is to establish the appropriate structure to assure effective communications with key public stakeholders in the public both in the pre-planning of decommissioning and during the decommissioning/dismantlement of the plant.

Value:

An operating nuclear facility contributes significantly to the local economy. In addition to the creation of jobs for local residents, it is a significant tax base for the community and/or State in which it resides. The permanent shutdown of the unit necessarily results in a large negative economic impact. As a consequence, citizens have a vested interest in the economic impacts of decommissioning.

In addition, decommissioning a nuclear facility is often perceived as presenting new risks to the public as a result of the deconstruction activities and also the transportation and disposal of significant quantities of radioactive wastes. Involvement in the process leads to greater understanding, and, usually, an increased confidence in the plant owner, and thereby a reduction in perceived risk.

While it is very much in the interest of the plant owner, establishing a reliable method of soliciting input from authorized representatives of the public stakeholders may be required by law.

Finally, experience indicates that effective citizen advisory boards will more then pay for their small support costs in reductions in project delay by avoiding, or at least minimizing, judiciary involvement.

Prerequisites:

None.

An operating plant can, and should have, a suitable interface established with community representatives to assure reliable, effective communications between the plant owner and the State and local community in which it resides.

Task Description:

A communications plan should be developed to provide guidance for all forms of internal and external communications. A variety of methods of communication should be employed in interactions with stakeholders. Specific communication methods include public meetings, development of informational publications, presentation of papers as well as newspaper articles.

A number of models exist for the development of a citizens advisory panel (CAP) or citizens advisory board (CAB) as it has been common practice for decommissioning plants to establish such boards. Copies of charters should be solicited from several plants to determine what format best suits the local culture.

There are several general principles that can be used as guidance. First, a board should be established early in the decommissioning planning stage. At the latest, an advisory board should be established at least one year before the planned shutdown of the plant.

A formal charter should be prepared that describes the function of the committee members, both those from the plant staff and the public members. The process for adding or removing committee members should be established in the charter. The authority of the committee should also be unambiguously defined. It must be a fair process, but the plant owner need not, and cannot, shift away responsibility for decommissioning decisions.

It is a good practice to hold some advisory board meetings at the plant site. This increases familiarity with the site. It also is more cost-effective from the owner perspective.

Key public sectors should be represented on the board. This includes representation by plant opponents as well as more neutral members of local and State government or citizenry.

Members of the board must have high credibility with their respective peer group.

Independent consultants should be made available to the board. Local universities can be an excellent source of technically qualified individuals who will have high credibility with the board members.

The senior plant manager should consistently participate in the meetings of the board. This responsibility should be delegated only rarely and then only under extenuating circumstance.

Resources:

Lead: Public Communications Officer or Senior Plant Manager

Support: Communications Specialists, Plant Technical Specialists

Product:

A Communications Plan that provides accurate and timely information concerning the transition from power operation to decommissioning.

Communications Plan and Citizens Advisory Panel Charter.

References:

(1) EPRI Technical Report, TR-107917-V2, “Yankee Rowe Decommissioning Experience Record,” December 1998

DTO-7: Certifications, Exemptions Requests, and Fee Relief

Objective:

The objective of this pre-planning task is to identify decommissioning-related regulatory submittals, including the certifications required by 10 CFR 50.82, possible exemptions from regulatory requirements and request for fee relief.

Value:

The identification and understanding of these submittals aids in the overall strategy development and development of the time line for the filings.

Industry precedent has been established for exemption from certain requirements of Federal regulations, once a plant has notified the NRC of permanent cessation of operations, has informed the NRC that all fuel has been permanently removed from the reactor vessel, and meets other specific criteria.

Costs associated with compliance with regulations not applicable to a permanently shutdown facility are substantially reduced or eliminated.

Prerequisites:

It is recommended that developing regulation and regulatory guidance be monitored for most current status.

Prerequisites for relaxation of the compliance requirements are linked to specific notifications to the NRC, time since shutdown, and plant-specific analyses of accident events and consequences. Elements or drafts of these prerequisites can be prepared in advance. These would include such prerequisite actions as:

- Formal notification of the NRC that the plant has permanently ceased operations.
- Formal notification of the NRC that fuel has been permanently removed from the reactor vessel.
- Revisions to license basis and design basis, consistent with a permanently shutdown and defueled plant.
- Accident Analysis

Task Description:

A. Certifications

Once a licensee decides to permanently cease power operations, written certification within 30 days is required in accordance with 10 CFR 50.82(a)(1)(i). Once fuel has been removed permanently from the reactor vessel, another certification is required in accordance with 10 CFR 50.82(a)(1)(ii). The first certification can be submitted prior to the facility actually ceasing operation. The later certification can only be submitted once the fuel has been permanently removed. Once both of these certifications have been submitted, operation of the reactor and movement of fuel into the reactor vessel is prohibited, and programs and procedures no longer needed (due to the inapplicability of certain requirements) may be eliminated and/or revised.

B. Exemptions and Fee Relief

Licensees should prepare relief requests from the following regulations. Additional details concerning the basis for relief and key issues to address in the relief requests are amplified in the references below. Also, since several of these regulations are currently targeted for revision, the licensee should determine the current rule status to ascertain if exemptions remain necessary.

- Emergency Planning (10 CFR 50.54(q), (t), Appendix E)
- Operator Requalification and Staffing (10 CFR 50.54(i), (j), (k), (l), and (m))
- Onsite Property Damage Insurance (10 CFR 50.54(w))
- Financial Protection Requirement (10 CFR 140)
- Security (10 CFR 73) (Requirements may be reduced and yet may find the regulation satisfied without an exemption request)
- Annual Fees imposed by Part 171
- Station Blackout Rule (10 CFR 50.63)

Resources:

Lead: Licensing

Support: Engineering, Operations, Finance, Security, Emergency Planning

Product:

Identification of submittals required for input into the overall strategy development and initiation of decommissioning activities.

References:

(1) EPRI Technical Report TR-109032/NEI 98-02, "Regulatory Process for Decommissioning Nuclear Power Reactors," March 1998

(2) EPRI Technical Report, TR-1000093, "Decommissioning Planning – Oyster Creek Experience," 2000

(3) NRC Regulatory Guide 1.184, "Decommissioning of Nuclear Power Reactors," August 2000

(4) NRC Regulatory Guide 1.185, "Standard Format and Content for Post-Shutdown Decommissioning Activities Report," July 2000

(5) SECY 01-0100, "Policy Issues Related to Safeguards, Insurance and Emergency Preparedness Regulations at Decommissioning Nuclear Power Plants Storing Fuel in Spent Fuel Pools," July 24, 2001

(6) NRC Regulatory Guide 1.191, "Fire Protection Program for Nuclear Power Plants During Decommissioning and Permanent Shutdown," May 2001

(7) NEI 99-01, R4, "Methodology for Development of Emergency Action," Section D and Appendix D, August 2000

DTO-8: Exposure Estimate

Objective:

The objective of this task is to identify and emphasize the issues that influence integrated decommissioning dose and to assure the expectation for close comparison with (bounded by) the Final Generic Environmental Impact Assessment (FGEIS). Specific quantification of the exposure estimate for decommissioning is an activity which is accomplished as part of the Post-Shutdown Decommissioning Activities Report (PSDAR). (See DTO-10.)

Value:

The NRC's Final Generic Environmental Impact Assessment establishes expectations for the net decommissioning dose for the various decommissioning options. There are financial and political incentives to remain within these guidelines.

Prerequisites:

Fundamental prerequisites include establishing a target end state for the site (e.g., green field, or industrial use only), and selecting between the regulatory permitted decommissioning strategies. For worker dose, the decommissioning strategy decision (DECON/SAFSTOR) is a prerequisite.

Task Description:

The FGEIS has established acceptable targets for decommissioning dose budgets. In the detailed planning of area-based decommissioning, each area-based dose budget can be rolled up to develop a site-wide decommissioning dose budget. This is the most accurate method to develop a decommissioning dose budget and will be used to prepare the PSDAR. The PSDAR will provide a discussion of the key issues that factored into the development of decommissioning dose budget and assure conformance with the FGEIS.

Cost optimization of the decommissioning process entails evaluation of a number of tradeoffs. The exposure incurred in decommissioning a reactor facility is dependent upon the choice of decommissioning methodologies. Extensive use of robotics or pre-dismantlement decontamination techniques can significantly affect the dismantlement exposure. It is the task of management to optimize the use of such techniques.

For the purpose of cost/benefit evaluations the person-rem dose unit is assigned a dollar value, e.g. $2000/person rem. One of the key challenges in pre-planning is determining the cost assigned to a person-rem. Historical estimates have varied significantly between sites (by a factor of two or more). The value assigned to person-rem cost can influence the extent to which remote manipulators (robotics) and pre-dismantlement decontamination will be utilized and affects, thereby, the area-based dose and the net decommissioning dose.

For example, the cost assigned to industrial worker dose for dismantlement of the primary coolant system is reduced by a chemical decontamination of the primary coolant system. The justification for the expense of this decontamination is provided by the reduction in the cost of the worker dose, i.e, there is a cost/benefit basis.

Since the per unit dose cost influences the choice of dismantlement techniques, exposure estimates and integrated dose can be seen to interact. Up to the break even point, the greater the investment in pre-dismantlement decontamination, the lower the integrated dose. This cost/benefit inflection point is a function of the assumed cost of a person-rem.

Development of a site-specific person-rem cost is, therefore, a key prerequisite to exposure estimating and becomes a pre-planning issue.

With regard to the FGEIS, there are four basic compliance issues that should be verified as part of a pre-planning effort:

1. The decommissioning method must have been considered in the FGEIS.
2. There should be no unique aspects of the plant or decommissioning techniques to be utilized that would invalidate the conclusions reached in the FGEIS.
3. The methods employed to dismantle and decontaminate the site should be standard construction-based techniques fully considered in the FGEIS.
4. The site-specific person-rem estimates for all decommissioning activities should be developed using methods similar to and consistent with the FGEIS.

Resources:

Lead: Engineering (ALARA)

Support: Licensing/Environmental

Product:

5. Site-specific cost-per-person-rem estimate for decommissioning.

Confirmation that there are no site-unique circumstances that could challenge the FGEIS.

References:

(1) NRC NUREG-0586, “Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities,” August 1988

(2) NEI NESP-034, “Intact Decommissioning of Nuclear Power Plants: A Dose Assessment,” March 1986

DTO-9: Environmental Assessment (Environmental Report)

Objective:

The objective of this pre-planning task is to identify the activities required to demonstrate that planned decommissioning activities, including safe fuel storage and Decontamination & Dismantlement (D&D) are enveloped by prior environmental reviews.

Value:

Directly supports development and submittal of the PSDAR pursuant to 10 CFR 50.82(a)(4).

Demonstrates that planned decommissioning activities are bounded by previous assessments.

Prerequisites:

The environmental impact assessment can be mapped out in outline form at any time. However, since the specifics of the evaluation are dependent on planned Decontamination & Dismantlement methodologies, the assessment cannot be completed until decommissioning strategies are developed.

Accident analysis may also be a prerequisite (DTO-12).

Task Description:

The overall task will be to compare the types of activities conducted during decommissioning with those conducted during plant operation to conclude that they are bounded by the applicable environmental impact statement. The steps which are necessary include:

1. Assemble the most recent environmental information, i.e., environmental impact statements while the plant was operating, including the Environmental Report (and NRC environmental statement).
2. Prepare an outline consistent with the existing Plant Environmental Report.
3. Complete the necessary impact assessments for (1) radiological exposure estimates, (2) LLW disposal, (3) water use, (4) transportation network, (5) decommissioning workforce, and (6) accidents.

   Examples of areas that need to be assessed are:

   - Dose to biota other than man – discuss operational experience – conclude that decommissioning impact is less.
   - Occupational exposure – discuss estimates of exposure during decommissioning. Compare with operating exposure history and conclude that overall impact is less for decommissioning – i.e., conformance with NUREG-0586 conclusions.

- Public Exposure- discuss estimates of public exposure directly from decommissioning activities and from transportation of LLW for processing or disposal. Conclude no significant impact during decommissioning – i.e., conformance with NUREG-0586 conclusions.
- Chemical and biocide discharges during decommissioning – discuss potential discharges and compare with operational experience – conclude decommissioning has significantly less impact.
- LLW Disposal – discuss LLW projections and processing and provide comparison with NUREG – 0586 and industry projections. Discuss overall impact of LLW Management Program, i.e., conformance with NUREG – 0586 conclusions.
- Water use – compare water use during decommissioning with that during operations. Demonstrate conformance with NUREG – 0586 conclusions.
- Transportation network – discuss transportation plan – assess impact during decommissioning – LLW shipments, etc. Evaluate environmental concerns.
- Decommissioning work force – compare decommissioning work force with operational levels.
- Environmental impacts of accidents – discuss impacts of accidents. Compare with operational accident sequences. Conclude significant reduction in probabilities and consequences.

4. Assess alternatives to proposed actions. Discuss in the context of options being reasonable and acceptable alternatives, as concluded in NUREG – 0586.

5. Determine what environmental approvals and/or requirements are necessary from the Federal, State and Local agencies.

For the purposes of pre-planning, it is recommended that preparation include a review of the pertinent current regulatory guidance documents and published decommissioning experience. Plant-unique issues, if any, should be identified.

Resources:

Lead: Licensing

Support: Environmental Sciences, Engineering

Product:

A topical outline for the planned assessment. Identification of potential plant-unique environmental issues.

References:

(1) NRC NUREG-0586, "Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities," August 1988

DTO-10: Post Shutdown Decommissioning Activities Report (PSDAR) Preparation

Objective:

The objective of this effort is the preparation of the Post-Shutdown Decommissioning Activities Report.

Value:

Initially 3% of the decommissioning fund is available for decommissioning planning ("paper studies") without any action by the licensee. The economic value of the filing of the PSDAR is that an additional 20% of the decommissioning fund may be accessed (after a 90-day wait). The balance of the decommissioning fund becomes available after submittal of the Site-Specific Cost Estimate.

PSDAR submittal presages allowance of "major decommissioning activities" at the site. Major decommissioning activities include removal of major radioactive components as well as permanent modification of plant structures and dismantlement of components containing Greater Than Class C (GTCC).

Prerequisites:

NRC notification of permanent cessation of operations of the nuclear power plant.

NRC notification that all fuel has been permanently removed from the reactor vessel.

Completion of cost estimate studies, dismantlement and decontamination studies and environment studies.

Task Description:

The PSDAR consists of the compilation of information from four major subtasks. There is no NRC approval required. There is a required public meeting but this is not an adjudicatory hearing process.

The purpose of the PSDAR is to provide a general overview of a licensee's proposed decommissioning activities, a schedule of key decommissioning events, an estimate of the cost, and assurance that the environmental impacts are bounded by the existing plant-specific and generic Environmental Impact Statements. It is important to note that the NRC staff will use the PSDAR to schedule inspections and other oversight activities.

The following outlines the four major components of the PSDAR and provides example subtasks:

- I. Description of Planned Decommissioning Activities
  - A. Decommissioning Approach
    - 1. Dismantlement Option
  - B. Major Activities
    - 1. Reactor Vessel Internals
    - 2. Reactor Vessel
    - 3 Steam Generator
  - C. Minor Activities
- II. Schedule for Decommissioning Activities
  - A. Overall Schedule
  - B. Major Activities Schedule
    - 1. Components
      - a) Reactor Vessel Internals
      - b) Reactor Vessel
    - 2. Systems
      - a) Main Coolant System
    - 3. Structures
      - a) Containment
      - b) Spent Fuel Pool
    - 4. Site Characterization
- III. Estimate of Decommissioning Cost
  - A. Overall
  - B. Major Activities
- IV. Environmental Impacts
  - A. Comparison to other Environmental Impact Statements
  - B. Occupational Exposure
    - 1. Estimated for 40-yr operating life
    - 2. On-site personnel exposure for decommissioning
  - C. Public Exposure
  - D. Radioactive waste projections
  - E. Non-Radiological Effects
  - F. Environmental Impacts of Accidents

Resources:

Lead: Decommissioning Manager/Director, Senior Licensing Manager/Engineer

Support: Design Engineering, Plant Engineering, Operations, Planning and Scheduling, Cost Engineering, Environmental Engineering

Product:

A more detailed outline or draft of the planned PSDAR submittal.

References:

(1) NRC Regulatory Guide - 1.185, "Standard Format and Content for Post-Shutdown Decommissioning Activities Report," July 2000

(2) EPRI Technical Report, TR-1000093, "Decommissioning Planning – Oyster Creek Experience," February 2000

(3) EPRI Technical Report, TR-109032/NEI 98-02, "Guide to Regulatory Process for Decommissioning Power Plants," April 1998

DTO-11: Spent Fuel Storage

Objective:

The objective of this pre-planning task focuses on the strategy for spent fuel storage, evaluating possible storage alternatives in terms of the selected decommissioning options, and the potential for establishing a spent fuel island or an ISFSI to permit decommissioning activities to continue without impacting spent fuel storage.

Value:

Evaluations of long-term spent fuel storage options provide input to the overall decommissioning strategy development, and to the submittal required by 10 CFR 50.54(bb) relative to spent fuel management, following cessation of power operations.

The value in establishing a separate Spent Fuel Island or ISFSI is that decommissioning activities in other areas of the plant can be conducted without disrupting any activities associated with the protection of the spent nuclear fuel. This significantly facilitates the decontamination and dismantlement efforts for the balance of the plant. Through pre-planning, knowledge of the Island design (i.e., which systems, structures and equipment will be relied upon) can be factored into subsequent design modifications during the remaining life of the plant. Knowledge of the planned configuration of the Island also adds to the accuracy of the decommissioning cost estimates.

Prerequisites:

Several of the subtask studies within this DTO are interdependent (see below), however there are no external prerequisites.

Task Description:

A. Spent Fuel Storage

Studies should be initiated (or planned) to evaluate spent fuel storage options (wet vs. dry storage), including assessment of licensing options (Part 50 vs. Part 72) for the chosen storage option. These options should be evaluated considering:

- Staff requirements for on-site storage,
- estimated duration of on-site storage,
- limitations of the existing or planned on-site dry-storage,

- potential for future removal of spent fuel,
- construction and O&M costs for any new system, and
- active heat removal performance issues such as noise monitoring.

(1) Wet vs. Dry

Two on-site storage options should be considered: 1) continued wet storage in the spent fuel pool, and 2) dry storage in an Independent Spent Fuel Storage Installation (ISFSI). The study should consider the following:

- current spent fuel storage issues,
- spent fuel pool longevity concerns (i.e., age related degradation),
- impact of timing of fuel removal and acceptance by DOE,
- impact of the storage option on the balance of the decommissioning,
- relative economics, including schedules and bases for the associated costs,
- uncertainties and risks of each option, and
- licensing strategies (see below).

Note: The wet option requires minimal up-front expenditures, while the dry option requires a more significant investment for ISFSI construction and implementation. Operations and maintenance costs for continued wet storage, however, are higher than for dry storage. The evaluation is sensitive to the timing of fuel removal and placement on the ISFSI and when the fuel is removed by DOE, i.e., the longer the period between these dates, the more favorable dry storage becomes.

(2) Part 50 vs. Part 72

This task evaluates the several alternatives that may be pursued for spent fuel storage. These alternatives are as follows:

- wet storage under the current 10 CFR Part 50 license until all fuel is removed from the site,
- maintain the current 10 CFR Part 50 license and use the 10 CFR Part 50 general license provision to store spent fuel in a dry cask facility,
- maintain the current 10 CFR Part 50 license and use the 10 CFR Part 50 general license provision until sometime later when a Site-Specific 10 CFR Part 72 license would be obtained to store spent fuel in a dry cask facility, or
- obtain a Site-Specific 10 CFR Part 72 license to store spent fuel in a dry cask facility.

This evaluation should consider the impact of the time lines for licensing various processes, hearing and public comment opportunities, any pertinent State Statutes and Regulations applicable to dry cask storage, and industry experience.

B. Spent Fuel Island Studies

This task consists of the necessary studies to develop a new design and licensing basis for storage of spent nuclear fuel in a Spent Fuel Pool Island. One plant owner (Connecticut Yankee) has identified nine essential studies that, taken collectively, comprise this task.

1. Spent Fuel Pool Licensing Basis/Design Basis

   This study reviews the license basis documents and establishes a concise summary of commitments from which future changes can be properly evaluated.

2. Spent Fuel Pool Heatload/Heatup Study

   This study develops accurate estimates of projected pool heat generation rates post-shutdown as well as pool heat up rates in the event of temporary loss of spent fuel pool cooling. This information is necessary for design of heat removal systems, for accident analysis, and, for addressing the potential for zirconium fires at the plant.

3. Spent Fuel Pool Cooling

   This study develops alternative ways of cooling the spent fuel pool that would rely less on active components. Ideally, an entirely passive cooling system could be shown to be feasible after a defined post-shutdown heat decay period.

4. Electric Power

   The purpose of this study is to determine the best ways in which to "divorce" the Spent Fuel Pool Island from the balance of plant power distribution system.

5. Winter Heating

   The spent fuel pool area must be protected from freezing temperatures. It is unlikely that continued use of the house boilers would be optimal during decommissioning. This study develops alternatives.

6. Auxiliaries

   This study identifies alternative ways to provide such services as ventilation, make up water, and radwaste processing without relying on the remainder of the plant.

7. Security

   Security boundaries will change with decommissioning. The Island may become the only secure area on the site. This study develops means of providing access control to, and protection for, vital equipment within the Island.

8. Instrumentation

   The purpose of this study is to determine the Island process variables that should be provided with local and external monitoring capability.

9. Control Room Abandonment

   The Operating Control Room will be abandoned and replaced with a Control Station which will monitor spent fuel pool conditions. The purpose of this study is to determine the location and requirements for the Control Station.

   Without fuel in an operating core, nearly all of the original 10 CFR 100 limiting events as evaluated and described in the FSAR are eliminated. The fuel handling accident(s) remain, as well as potential for new heavy load events as a consequence of cask use. Unless a current heavy loads analysis exists for the planned cask and handling system (including potential crane upgrades), a revised heavy loads analysis would also be part of this task.

In BWRs, the proximity of the spent fuel pool to the reactor cavity, as well as the structure layout may require special considerations for establishing a spent fuel island concept. Temperature differentials through walls and floors should be examined to determine any impact on structural integrity. Alternative cooling systems may require a high reliability to assure that complete loss of pool cooling is not a credible event. Additionally, maintaining differential temperatures in the winter will require heating the Reactor Building. Safeguards assessments, specifically structural damage due to sabotage, should be conducted and security areas designated as appropriate.

Resources:

Lead: Management, Licensing

Support: Engineering, Operations, Security, Health Physics

Product:

The product is a strategy (or plan) for spent fuel storage based on evaluations of storage options, licensing options, and the potential plant modifications (spent fuel island) to permit continued decommissioning.

References:

(1) EPRI Technical Report, TR-109032/NEI 98-02, "Regulatory Process for Decommissioning Nuclear Power Reactors," March 1998

(2) EPRI Technical Report, TR-1000093, "Decommissioning Planning – Oyster Creek Experience," 2000

(3) EPRI Technical Report, TR-107917-V2, "Yankee Rowe Decommissioning Experience Record," December 1998

(4) EPRI Technical Report, TR-112351, "Spent Fuel Pool Cooling and Cleanup System During Decommissioning," March 1999

(5) NRC NUREG-1567, "Standard Review Plan for Spent Fuel Storage Facilities," March 2000

(6) NRC NUREG-1727, "NMSS Decommissioning Standard Review Plan," September 2000

(7) NEI 98-01 Rev. 04, "Industry Spent Fuel Storage Handbook," May 1998

DTO-12: Accident Analysis and Spent Fuel Pool Heatup Calculations

Objective:

The objective of this effort is to develop an accident analysis that is applicable to decommissioning and fuel storage activities. This evaluation is necessary to support revisions to the FSAR.

Value:

A decommissioning-specific accident analysis is essential to realizing early cost savings associated with the changes to the license basis from operations to decommissioning. Most significantly, revisions to the accident analysis directly support reductions in insurance premiums, E-plan, E-drills and safety system declassification activities.

Prerequisites:

Identification of systems, structures and components necessary for the safe storage of the fuel.

Identification of potential accidents associated with decommissioning activities. However, "new" events may be identified, such as those associated with the removal of the reactor vessel or with the accumulation of larger volumes of liquid radwaste than would normally be associated with an operational site.

Task Description:

Accident evaluations need to consider both decommissioning activities, and those activities associated with handling and maintaining the spent fuel. For the purpose of pre-planning and early cost reductions, evaluation of accidents associated with the handling and storage of fuel will bring the greatest near-term cost savings. This is because accidents associated with the fuel generally establish the off site dose consequences. Reduction in off site dose consequences link directly to reductions in insurance premiums and emergency plans and exercises.

Since risk associated with fuel events declines with radioactive decay, fuel-related events are of greatest importance at shutdown. It is important to understand the risk presented by fuel events as a function of time since this is direct input to relaxing the costs associated with the off-site consequences of such potential events.

From a pre-planning standpoint, fuel-related accidents during decommissioning differ little from those originally described in the FSAR. The principal difference is that the steady decay of the fuel post-shutdown which leads to a dramatic reduction in the potential consequences of the fuel handling event (bundle, or assembly, drop), which is normally the limiting fuel-related accident.

Accidents that differ from those described in the FSAR may arise, however, as a result of reconfiguring the Spent Fuel Island, and would need to be considered on a case by case basis. In addition, the NRC has argued that the reduction in staffing and loss of redundant heat removal sources for the spent fuel pool which may result during decommissioning, increases the probability of the loss of pool water event, with the potential for a zirc "fire." Therefore, this "new" accident must be considered. Individual plants, while resistant to such backfit requirements, have nonetheless performed extensive new analyses of spent fuel pool heat up for various loss-of-water scenarios in order to accelerate reductions in insurance premiums and emergency planning expenses.

Decommissioning entails the handling of larger than normal quantities of both dry and liquid radioactive waste. While the existing FSAR accident analysis may bound any decommissioning-related waste handling events, it may be of value to the plant owner to establish new, reduced-consequence limits permitting cost savings in a number of areas previously cited.

Large component removal, such as the reactor vessel, entails a combination of heavy loads and strong sources. Again, while the existing FSAR off-site limits for a LOCA would be bounding in nearly all conceivable events, it is essential that the owner understand the unique risks and consequences related to large component removal if risk-associated costs are to be minimized.

Resources:

Lead: Engineering

Support: Licensing, Systems, Operations

Product:

Decommissioning Accident Analyses.

References:

(1) NRC NUREG-1726, "Predictions of Spent Fuel Heatup After A Complete Loss Of Spent Fuel Pool Coolant" July 2000

(2) NRC NUREG-1738, "Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants," February 2001

(3) NRC Regulatory Guide – 3.54, Rev. 1, "Spent Fuel Heat Generation in an Independent Spent Fuel Storage Installation," January 1999

DTO-13: Defueled Technical Specifications

Objective:

The purpose of this task is to draft the Technical Specifications that will apply to the permanently defueled plant after shutdown. (To fully benefit the plant, these Decommissioning Technical Specifications should be submitted and approved prior to plant shutdown.)

Value:

Having the new mode (decommissioning) Technical Specifications pre-approved:

- avoids the delay in an orderly transition to a new mode, decommissioning,
- affords immediate relief on staff resource issues,
- facilitates decommissioning activities pursuant to the PSDAR, and
- maximizes the potential for cost savings.

In essence, program/procedure simplification and/or elimination and staffing realignment can begin almost coincident with plant shutdown and realize associated cost savings.

Prerequisites:

A revised accident analysis and completion of system reclassification is necessary to permit the preparation and submittal of the defueled Technical Specifications to the NRC for approval. Implementation would be pending both the required notifications to the NRC of permanent shutdown and defueling of the vessel and, of course, approval of the Technical Specifications.

Other prerequisite restrictions may also apply, for example, reclassification of the operators and development of suitable continuous training programs for both fuel handlers and engineering support staff.

Task Description:

This task facilitates the development of new defueled technical specifications and their associated bases. Preparation of these specifications is greatly simplified by using recent decommissioning experience with the "Standard Technical Specifications." Another option is to start with a "clean sheet of paper" much as Maine Yankee did. TMI-2 Technical Specifications also used this approach and were based on the Safety Analysis Report (SAR) and industry guidance on Technical Specification content and structure. In this manner, the SAR is written first and the Technical Specifications based on what you have to protect and the limits in the revised accident analyses. Alternatively, the actual Maine Yankee defueled technical specifications could be used as a starting template.

Technical specifications for defueled facilities are still evolving. It is, therefore, still possible to tailor a set of plant-specific technical specifications. Regardless of the approach, the final product should sharply focus on the safe maintenance and storage of the spent nuclear fuel.

Resources:

Lead: Licensing

Support: Operations, Engineering

Product:

A draft set of Technical Specifications applicable to the defueled condition.

References:

(1) EPRI Technical Report, TR-109032/NEI 98-02, "Regulatory Process for Decommissioning Nuclear Power Reactors," March 1998

(2) EPRI Technical Report, TR-1000093, "Decommissioning Planning – Oyster Creek Experience," 2000

(3) NRC Draft NUREG-1625, "Proposed Standard Technical Specifications for Permanently Defueled Westinghouse Plants," dated March 1998

(4) EPRI Technical Report, TR-1001238, "Plant Engineering Management Workshop Proceedings," October 2000

(5) NRC, "Proposed Standard Technical Specifications for Defueled BWRs," (drafted, not formally issued)

(6) NUMARC 93-03, "Writer's Guide for the Restructured Technical Specifications"

(7) NRC Final Policy Statement on Technical Specifications Improvements for Nuclear Power Reactors (SECY-93-067, 58 FR 39132; July 22, 1993).

DTO-14: Occupational Safety

Objective:

The objective of this task is to pre-plan for the ultimate changes that will be required in the station's occupational safety program to reflect the broadened work activities associated with plant decommissioning.

Value:

A sound safety program embodying the elements of the OSHA Construction Standards minimizes the risks from the construction-related hazards encountered during site decommissioning activities.

Prerequisites:

None.

Task Description:

Decommissioning a power reactor is essentially a "de-construction" project. The size of the staff and the work force skill set differs significantly from that of an operating project. Craft labor plays a much larger role in deconstruction than in operation. The scope of activities that present potential risk to the work force is also broadened. Deconstruction can bring the work force into potential contact with a number of hazardous materials including PCBs, lead paint, and asbestos – materials, that while present in the operating plant, are normally isolated from contact with the work force.

Change is also necessary to transition from OSHA General Industry Standards to the OSHA Construction Standards. Specific change management tasks include:

- Revise the "Safety Manual" and site-specific procedures to incorporate construction standards
- Consider retaining safety professionals with experience in construction standards
  - Establish strong field safety support
  - Establish expectations and communications for heightened safety awareness
  - Establish plans for contractor safety programs and associated monitoring

Scaffolding erection and use, rigging and management of heavy loads are all potential high-risk evolutions, comparatively infrequent during operations, that become intensive during deconstruction.

Existing training programs will likely focus on avoidance of contact with various hazardous materials. These programs will describe many if not all of the potential hazards associated with site work activities, but are unlikely to provide the detail necessary to qualify workers to safely remove the hazardous material. Handling such materials demands training of a much more comprehensive nature. Contracted waste removal specialists will almost certainly be required.

Often, State or Federal statutes will establish certification requirements for hazardous waste workers and require permitting before allowing deconstruction of structures or components that house such hazards. Specific certifications may be required for removal of PCBs, lead paint and asbestos, for example.

Experience shows, however, that even such certified craft workers will require close supervision to assure compliance with OSHA Construction Standards. Problems should be expected related to scaffolding construction and usage. Craft workers outside the nuclear industry are often unaccustomed to the compliance rigor expected in a nuclear facility. Maintaining compliance requires training and retraining as well as active field oversight. Experience also suggests that the work force will exhibit much higher turnover than the normal plant staff. High turnover places additional burden on the training organization.

It is also known from experience that removal of lead, PCBs and asbestos will require close monitoring to limit personnel exposure and contaminations. Respirator usage will far exceed that encountered in an operating facility.

It is important to equip both the work planners and field supervisors with the knowledge to effectively plan and control hazardous waste removal. Training in OSHA Construction Standards is recommended well in advance of the planned initiation of decommissioning. OSHA Course Number 500, "Trainer Course in Occupational Safety and Health Standards in the Construction Industry" provides both a sound foundation and qualifies the participants as trainers.

Resources:

Lead: Safety Officer, Environmental

Support: Systems Engineering

Product:

Revised Occupational Safety Program

The Safety Officer, members of his or her staff, and selected work planners trained in OSHA Construction Standards.

References:

(1) EPRI Technical Report, TR-107917, Volume 2, Chapter 7, "Yankee Rowe Decommissioning Experience Record," December 1998

DTO-15: Vendor Assessment and Selection Recommendations

Objective:

The goal of this task is to address the activities necessary to competitively bid selected decommissioning work that is beyond the capability of the current workforce.

Value:

The process of decontaminating and dismantling a nuclear power plant is a complex undertaking. Decommissioning tasks involve a different set of skills, tools and processes than are normally required during plant operation. Owner strategies for performing decommissioning may involve securing the services of a Decommissioning Operations Contractor (DOC) on a turnkey basis, or self-managing the project and securing the services of numerous specialty contractors. (See Sections 2.4.7 and 2.4.11.) Selecting the best qualified contractor(s) will maximize the potential for completing the decommissioning safely, on time, and within budget, while minimizing project risks. (See Section 2.4.11.)

Prerequisites:

A Decommissioning Strategic Plan (Section 2) or comparable management plan that describes, in part, a contracting strategy, and the overall approach to performing decommissioning operations.

A description of scope, cost estimate and schedule requirements for the required work.

An owner organization qualified to work through the contract procurement process and provide oversight after contract award.

Task Description:

Selecting the best qualified contractor(s) requires a thorough understanding of the work to be accomplished and a complete evaluation of the contractors' qualifications to accomplish the stated tasks.

Evaluation of various commercial contracting models should be performed to determine which model is best suited to accomplish the decommissioning mission. Some examples of contracting models include: 1) owner as the DOC with assignment of work to contractors and subcontractors, 2) owner performs project oversight of a DOC, and 3) owner and management contractor function as an integrated team to fulfill DOC role as in 1.

When feasible, plan to utilize firm fixed-price contracts for decommissioning activities by developing definitive and outcome-oriented performance-based scopes of work. Allow the competitive bid process to drive innovation.

The contracting arrangement should reflect equitable sharing of risk between the buyer and the seller. The framing of the contract should reflect the risk exposure of the parties. For routine work that is well understood, fixed cost contracts make sense. For first-of-a-kind application, or where field conditions are not totally characterized, a risk-shared cost/plus contract is fully appropriate.

Develop a list of "best value" methods and techniques through the use of pre-qualified vendors known for their decommissioning capabilities and performance. Utilize proven and known technology for performing decommissioning activities while keeping it simple.

Involve key team members early in the planning stages of a project. Decommissioning work should be approached with a project mentality, requiring a different set of management skills than needed for normal plant operations.

Incorporate strong and effective safety, environmental compliance and quality performance in the contractor pre-qualification process. This must be demonstrated through past performance and is an expectation throughout the performance period on the project.

Manage and eliminate risks by identifying, analyzing, and responding to risk through decision analysis and innovative contracting methods. Align procurement strategies and technical initiatives through integration of the engineering and procurement functions.

Develop selection criteria to objectively evaluate and select the best contractors. Examples of selection criteria might include:

1. Overall evaluated cost
2. Ability to meet schedule
3. Safety record (i.e., industrial, radiological, hazardous)
4. Specific task experience record
5. Management personnel qualifications
6. Technical personnel qualifications
7. Rate structure for delays and extra work
8. Prior experience at the owner's site

Resources:

Senior management establishes procurement strategy based on the desired decommissioning goals. Representatives from contract administration, engineering and operations develop working models of the vendor assessment and selection processes.

Product:

Development of a guideline that establishes the approach for securing the various contractors and vendors required for decommissioning. The guideline would also include specific criteria against which contractors will be evaluated.

References:

(1) Report entitled, “Benchmarking Decontamination & Dismantlement Procurement Best Practices at Four Commercial Nuclear Power Plants, U.S. Department of Energy Benchmarking and Strategic Purchasing Initiatives,” October 1998

(2) EPRI Technical Report, TR-107917-V2, “Yankee Rowe Decommissioning Experience Record,” December 1998

(3) EPRI Technical Report, TR-1000093, “Decommissioning Planning – Oyster Creek Experience,” 2000

DTO-16: Project Controls

Objective:

The objective of this task is to provide guidance on the development and implementation of project control functions, directed at planning, monitoring, and controlling decommissioning costs.

Value:

Conventional utility budgeting and cost tracking systems employed during plant operations are inadequate for effective decommissioning cost management. To be successful in decommissioning, a licensee must build infrastructure employing project-based cost management techniques, similar to those used on large fixed-price construction projects. This type of cost management offers an integrated, multi-level cost structure that measures funds expended relative to the progress made against the project goals, all while utilizing consistent reporting formats. Use of these tools offers the best opportunity for licensees to accomplish decommissioning at the lowest cost.

Prerequisites:

Preparation of a site-specific decommissioning cost estimate (DTO-1).

Task Description:

Decommissioning is the largest single project a nuclear plant will undertake after construction. The project's success will be measured in terms of management's ability to terminate the license within a fixed decommissioning fund. The success will greatly depend on the management personnel involved and their ability to lead the transition from power operations to a large capital project environment. This can only be accomplished by implementing a comprehensive project management infrastructure.

The goal of the decommissioning project control system is prioritizing, monitoring and controlling the project's four primary variables: scope, schedule, cost and risk. These four variables are dynamic and must be considered in an integrated model to be properly managed. Attempts to control any one variable must consider all four in order to be effective. Even though the decommissioning project manager has an overriding goal of completing the project for the least cost, the ultimate cost of decommissioning will be determined by how well each of these elements are managed.

Some of the major required elements in planning for and developing an effective decommissioning project control system include:

1. Staffing the project organization with personnel who have significant, hands-on experience in deploying and implementing state-of-the-art project management tools and techniques on large projects.

2. Reviewing and incorporating project management principles and practices promoted by the Project Management Institute (PMI) and the Project Management Body of Knowledge (PMBOK). These principles suggest using a system comprised of modules that separate project information by function (e.g., estimating, budgeting, scheduling, actual costs) so that it can be consolidated and grouped into information that can be more easily assimilated. Each module serves its own purpose, but is linked within the system to other modules. The summation of all information from all the modules comprises an overall picture of the project status including cost, scope, schedule and risk.

3. Gaining a full understanding of the scope, structure and content of the latest site-specific Decommissioning Cost Estimate (DCE) of record.

4. Developing a decommissioning Work Breakdown Structure (WBS) that accurately represents the structure of how decommissioning will actually be implemented. This would include the transition from power operations to decommissioning. It should be recognized that decommissioning cost estimates utilized for long term financial planning are not usually constructed in a manner and level of detail that is useful for performing decommissioning.

5. Developing an Organizational Breakdown Structure (OBS) that mirrors the decommissioning organization and defines who in the project organization will perform each element of work defined in the WBS.

6. Develop a Cost Breakdown Structure (CBS) that incorporates and links the WBS, OBS, and other useful cross-referenced database, such as the Decommissioning Cost Estimate. This approach will permit the planning, monitoring and reporting of what the work is, who is doing it, and a classification of the type of expenditure.

7. Develop a Decommissioning Project Schedule that accurately depicts the planned sequence of activities, estimated activity durations, schedule milestones and resource requirements. This schedule is prepared and integrated with the WBS, OBS, and CBS. (See DTO-2.)

The specific design and implementation of a project management infrastructure and project control system will be largely determined by the unique configuration of the project and contracting strategy. The incorporation of a Decommissioning Operations Contractor may greatly simplify the complexity of developing the various elements. However, the content of each element will need to be addressed by the ultimate organization responsible for performing the work.

Resources:

Development of a decommissioning project control system should be performed under the leadership of personnel with significant project management experience. Representatives from all other organizational units are expected to provide subject matter input into the planning process.

Product:

Decommissioning Work Breakdown Structure

Decommissioning Cost Breakdown Structure

Performance Indicators

References:

(1) Project Management Institute (PMI), “A Guide to the Project Management Body of Knowledge (PMBOK Guide) ,” 2000

(2) EPRI Technical Report, TR-112143, “A Methodology for Decommissioning Project Management,” October 1999

DTO-17: Historical Site Assessment

Objective:

The primary purpose of pre-planning the Historical Site Assessment (HSA) task is to collect existing information concerning the site and its surroundings. This permits efficient planning for scoping surveys, remediation, site characterization and final status survey in accordance with the guidelines in NUREG 1575 "Multi-agency Radiation Survey and Site Investigation Manual" (MARSSIM). This assessment may also be used to identify potential areas where non-radioactive hazardous or mixtures of hazardous and radioactive contamination exist. These hazardous contaminants may include; PCBs, VOCs, petroleum products, lead, asbestos, chromate, Freon and other hazardous materials. (See DTO-18 and Appendices B and C.)

Value:

1. Demonstrates and supports compliance with 10 CFR 50.75(g) (records important to decommissioning) which requires maintenance of records of the location of nuclides, quantities, forms, and concentrations both for normal storage and for spills or other unintended contamination.

2. Provides the opportunity to review and document the use, storage and potential spills of non-radioactive hazardous material at the site. This includes but is not limited to assessment of building material composition, coatings, decontamination materials, corrosion inhibitors and any use of solvents.

3. More accurate decommissioning (remediation) cost estimates are possible with a better understanding of the nature and extent of potential radiological and non-radiological contamination on the site.

4. The station will be better prepared to conduct subsequent site characterization under MARSSIM as this task consolidates information and records and provides direct inputs to the planning and scoping surveys for site characterization. (DTO-18 and Appendices B and C)

5. Positions the station for the option of early submittal of the LTP should that become a licensing objective. Positions the site to plan for and to comply with local, State and Federal regulations regarding proper remediation and disposal of hazardous material.

Prerequisites:

Station records with a focus towards decommissioning as well as pursuant to 10 CFR 50.75(g) and applicable Hazardous Material regulations

Task Description:

The MARRSIM program is becoming established as the de facto standard for demonstrating compliance with the radiological site release criteria of 10 CFR 20.1402. An Historical Site Assessment is the fundamental component to initiate the MARSSIM process (Appendix C).

The MARSSIM site evaluation process as described in NUREG-1575 consists of five component activities:

1. Historical Site Survey
2. Scoping Survey
3. Characterization Survey
4. Remedial Action Support Survey
5. Final Status Survey

Pre-planning for decommissioning would entail the implementation of (1), and in some special circumstances part, or all, of (2) above. In practice, this would entail:

1. Audit of records, (including Radiological Environmental Monitoring Program (REMP) and applications of 10 CFR 20.302, 10 CFR 20.2002 "Method for obtaining approval of proposed disposal procedures," if any)
2. Collection and consolidation of information
3. Debriefs and interviews
4. Review of hazardous material disposal records
5. Review of survey data and incident logs

The primary purpose of the Historical Site Assessment is to collect existing information concerning the site and its surroundings.

The primary objectives of the HSA are to:

1. Identify potential sources of contamination,
2. Determine whether or not sites pose a threat to human health and the environment,
3. Differentiate impacted from non-impacted areas,
4. Provide input to scoping and characterization survey designs, and
5. Provide an assessment of the likelihood of contaminant migration.

The HSA typically consists of two phases: preliminary investigation of the facility or site, and site visits or inspections. The HSA is followed by an evaluation of the site based on information collected during the HSA.

Hazardous Material Identification (non-radioactive)

It is prudent to include a review of the potential hazardous material present in the HSA. Experience has shown that the late discovery of hazardous material contamination has seriously impacted the decommissioning process and budget. EPA, State and local regulations should be consulted to evaluate the site as any other industrial facility. "Knowledge of process" is a legitimate means to identify areas where such contamination may exist and plan for targeted sampling in subsequent programs implemented to evaluate the site. Hazardous material remediation requires additional work controls, special waste handling and packaging as well as special training for workers (Appendix B).

Resources:

Lead: Radiological Engineering/Radiation Protection, and Environmental Professionals

Support: Operations, Maintenance, Health & Safety and Chemistry

Product:

The result of the Historical Site Assessment should be a comprehensive report of the locations and types of contaminants covering all aspects of facility operation from start up to final shutdown. This report will provide the basis for remediation planning efforts as well as provide inputs to the design of site characterization and final status surveys.

References:

(1) NRC NUREG-1575, “Multi-agency Radiation Survey and Site Investigation Manual,” December 1997

(2) NRC 10 CFR 50.75(g), “Reporting and Record Keeping for Decommissioning Planning” February 23, 2001

DTO-18: Site Characterization

Objective:

The primary purpose of the pre-planning Site Characterization task is to collect analytical data concerning the site and its surroundings to permit efficient planning for site remediation. These data are also used to develop the final status survey for license termination in accordance with the guidelines in the Multi-agency Radiation Survey and Site Investigation Manual (MARSSIM) as well as to determine strategies for compliance with hazardous material regulations. A Site Characterization survey is planned based on the results of the Historical Site Assessment (HSA) (DTO-17) and the scoping survey. (See DTO-17 and Appendices B and C.)

Value:

1. Demonstrates and supports compliance with 10 CFR 50.75(g) (records important to decommissioning) which requires maintenance of records of the location of nuclides, quantities, forms, and concentrations both for normal storage and for spills or other contamination.

2. Is designed so that the nature and extent of radiological and non-radiological contamination at the site is accurately determined. The survey data may then be used to prescribe appropriate remediation technologies and to evaluate remediation alternatives.

3. Provide input to dose assessment models and determination of the site-specific Derived Concentration Guideline Levels (DCGLs) (Appendix C).

4. Provide an opportunity to optimize the Site Characterization survey so that data collected may be used in the final status survey as well as to provide input to the design of the final status survey.

5. More accurate decommissioning (remediation) cost estimates are possible with a better understanding of the nature and extent of potential radiological and non-radiological contamination on the site.

Prerequisites:

A detailed Historical Site Assessment for planning the site characterization survey.

Task Description:

The Site Characterization survey is planned on the information contained in the HSA report and targets impacted site areas. The HSA is used to classify site areas in accordance with definitions found in NUREG 1575 "Multi-Agency Radiation Survey and Site Investigation Manual" (MARSSIM). The classification of an area is based on the degree of or potential for the presence of radioactive contamination from plant operation (DTO-17 and Appendix C).

A scoping survey as described in MARSSIM is frequently performed prior to the Site Characterization survey. The results of this survey confirm information on the site condition as presented in the HSA and support area classification. This survey may also be used to support classification of areas as non-impacted or Class 3. The scoping survey may also be used to confirm assumptions made in the HSA regarding hazardous material presence in building materials and areas of potential contamination such as locations of reported spills or storage areas.

Scoping Survey

If the data collected during the HSA indicate an area is impacted, a scoping survey could be performed to permit refining the cost estimate. Scoping surveys provide site-specific information based on limited measurements.

The primary objectives of a scoping survey are to:

1. Perform a preliminary hazard assessment,

2. Support classification of all or part of the site,

3. Evaluate opportunities to optimize the survey plan for use in the final site survey, and

4. Provide input to the Site Characterization survey design.

Site Characterization Survey Design

1. Identify Data Quality Objectives (DQOs) for the information that is to be gathered in accordance with MARSSIM guidance. Review the HSA and scoping survey results (if available) to identify areas for survey and radioactive and non-radioactive contaminants of interest.

2. Generate a site map showing boundaries, structures, effluent pathways, hydrogeologic features and any other site feature that could influence hazardous material migration.

3. Select instrumentation and survey techniques appropriate for the contaminants of interest and the site specific DCGL. Identify laboratories for analysis of non-radioactive contaminants and hard to detect radionuclides. Ensure procedures are in place for the collection and preservation of samples sent for analysis in accordance with EPA guidance. Implement chain of custody requirements.

4. Identify the media for survey such as various building materials, soil, asphalt and establish appropriate background values for radioactive measurements (see EPRI Report, "Guideline for Determination of Background Radiation Levels in Support of Decommissioning Nuclear Power Facilities")

5. Design survey requirements for each area to be surveyed. Include instructions for survey area gridding, sample collection locations etc.

Resources:

Lead: Radiological Engineering/Radiation Protection and Environmental Professionals

Support: Operations, Maintenance, Health & Safety and Chemistry

Product:

A characterization plan (some of which is conducted post-shutdown).

The Site Characterization survey should yield a detailed report determining the extent and nature of radioactive and non-radioactive contamination at the site. Site specific DCGLs should be presented in this report as well as evaluation of remediation alternatives (i.e. unrestricted vs. restricted site release).

References:

(1) NRC NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual," December 1997

(2) ASTM E 1527-97, "Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process"

(3) EPRI Technical Report, "Guideline for Determination of Background Radiation Levels in Support of Decommissioning Nuclear Facilities," to be published

DTO-19: Federal/State/Local Regulatory Compliance

Objective:

This pre-planning task develops a plan to identify specific compliance issues associated with Federal, State and Local requirements pertinent to the facility. Additionally, this task identifies any associated permit requirements for anticipated decommissioning work activities.

Value:

Understanding all Federal, State and Local compliance issues and permit requirements assures that these issues and requirements are properly recognized and integrated into work planning functions. This task also identifies potential stakeholders and their specific areas of interest.

Prerequisites:

None.

Task Description:

This task reviews Federal, State and Local requirements and identifies any regulatory compliance issues and/or permit requirements specific to planned decommissioning activities.

Note that Agreement States may have requirements different than Federal requirements (above and/or beyond) which may conflict, both in terms of jurisdiction and acceptance values. In these cases, early understanding of the requirements and communication with appropriate stakeholders is essential for developing the strategy for decommissioning success and ultimate release of the site.

Some examples of conflicting requirements are as follows:

- site release criteria differences between NRC and EPA,
- State site release criteria more restrictive than NRC,
- far reaching Agreement State jurisdiction.

Proposed and/or pending legislation, at both the Federal and State level, should be examined to determine the potential impact on planned activities, especially those potentially involving long term spent fuel storage and construction of an ISFSI. Permits required from State agencies and local entities (i.e., Town Conservation Commission, Planning Commission) for construction of an ISFSI should be identified.

Occupational safety compliance issues, specific to changes due to the nature of planned deconstruction activities (see DTO-14), as well as permits and issues specific with the handling and transportation of large components (i.e., heavy loads) over local transportation routes should be identified.

Resources:

Lead: Licensing

Product:

A list of compliance issues and permit requirements is prepared for integration into the overall strategy development as well as plant work processes.

DTO-20: Final Safety Analysis Report (FSAR) Update Plan

Objective:

The FSAR for a decommissioning plant, just as for an operating plant, should accurately reflect the current license and design basis of the plant. The objective of this task is provide a sense of the magnitude and extent of changes that will be required to the FSAR as a result of permanent shutdown of the plant and initiation of decommissioning. This will facilitate the development of processes appropriate to the maintenance of the rapidly evolving decommissioning FSAR, and should the option be selected, permit preparation of many of the major component parts of the FSAR.

Value:

Maintenance of the FSAR is required by the regulations, as is periodic submittal of the updates to the NRC. All operating plants will have in place a process for maintenance of their FSAR. However, absent prior planning they are unlikely to have a process sufficiently robust to efficiently handle the magnitude of changes that will occur as a result of permanent plant shutdown and decommissioning.

Prerequisites:

There are no prerequisites for the purpose of creating a *process* for developing and maintaining a decommissioning FSAR.

For the purpose of *preparing* the FSAR the following tasks must be completed:

1. Revised Accident Analysis. These accidents will define the Technical Specifications, Systems, Structures and Components (SSCs), Programs and any regulatory requirements that must be retained.

2. Assessment of the applicability of regulatory requirements if/as the plant evolves to a spent fuel storage facility.

3. Identification of SSCs and programs necessary for a spent fuel storage facility and those operational SSCs and programs no longer required at all.

4. Identification of Systems, Structures, Components (SSCs) and programs that will be required to effect the decontamination/decommissioning.

Task Description:

Advanced preparation of the defueled FSAR entails (1) identification of the types of changes that will be required to maintain the FSAR during decommissioning, (2) implementing a process to facilitate such changes, and (3) drafting a decommissioning FSAR. For most situations, only step 1 and, possibly, step 2 would prove to be cost-effective pre-planning. However, special circumstances may be present that would encourage the early preparation of the draft decommissioning FSAR, for example, potential for loss of critical skill sets through unintended staffing losses post-shutdown.

This is also a logical continuation task for a plant group that is dedicated to decommissioning pre-planning when the project has already largely completed the tasks listed under the "Prerequisites" category above.

Resources:

Lead: Licensing

Support: All plant departments

Product:

Identification of required FSAR changes, including a modified Table of Contents, at a minimum, up through drafts of the changes.

References:

(1) NEI 98-03, Rev. 1, “Guidelines for Updating Final Safety Analysis Reports,” published June 1999

DTO-21: License Termination Plan (LTP)

Objective:

The objective of this task is to develop a plan and outline the considerations important to the preparation and eventual submittal of the final request for termination of the license.

Value:

Several options are permitted under existing regulations for the final termination of the Part 50 license. The option selected influences the decommissioning process and decommissioning schedule. Process and schedule affect cash flow and total project cost. Development of an LTP strategy becomes an important part of pre-planning for decommissioning.

Prerequisites:

None.

Task Description:

Background:

Decommissioning activities for power reactors may be divided into three phases: (1) initial activities, (2) major decommissioning activities, and (3) license termination activities. Application for license termination must be preceded by a license termination plan (LTP) which is subject to NRC review and approval. The LTP must be submitted at least two years prior to license termination. The principle components of the LTP are (1) a final site characterization, (2) dose assessment, (3) identification of any remaining remediation activities and supporting plan, and (4) the final site survey plan.

A public meeting local to the site is part of the NRC approval process.

LTP Strategic Issues:

The regulatory process permits the LTP to be submitted concurrently with the Post-Shutdown Activities Report (PSDAR). This option should be carefully considered in the pre-planning activities as it affords the option for public participation during the early stages of decommissioning which favors both the public and the licensee. Surfacing and resolving issues early in the decommissioning process may well avoid costly delays in the in the final release of the site.

Current regulations present the licensee with three license termination alternatives, the selection of which influences the decommissioning process. Free Release (Green Field) and two options for Restricted Release (industrial use) are currently permitted under 10 CFR 20. The guide currently favored for demonstrating compliance with the site release criteria is the Multi Agency Radiation Survey and Site Investigation Manual (MARSSIM).

Free release or unrestricted use criteria are provided in § 20.1402 where it states, in part,:

> "A site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a TEDE to an average member of the critical group that does not exceed 25 mrem (0.25 mSv) per year, including that from groundwater sources of drinking water, and the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA)"

An option for restricted site release is provided in § 20.1403 (in part) as follows:

A site will be considered acceptable for license termination under restricted conditions if:

1. The licensee can demonstrate that further reductions in residual radioactivity necessary to comply with the provisions of § 20.1402 would result in net public or environmental harm or were not being made because the residual levels associated with restricted conditions are ALARA.

2. The licensee has made provisions for legally enforceable institutional controls that provide reasonable assurance that the TEDE from residual radioactivity distinguishable from background to the average member of the critical group will not exceed 25 mrem (0.25 mSv) per year;

3. The licensee has provided sufficient financial assurance to enable an independent third party, including a governmental custodian of a site, to assume and carry out responsibilities for any necessary control and maintenance of the site.

4. The licensee has submitted a decommissioning plan or License Termination Plan (LTP) to the Commission indicating the licensee's intent to decommission in accordance with §§ 30.36(d), 40.42(d), 50.82 (a) and (b), 70.38(d), or 72.54 of this chapter, and specifying that the licensee intends to decommission by restricting use of the site.

A third restricted release option termed "alternate criteria" is provided in § 20.1404, which states (in part):

(a) The Commission may terminate a license using alternate criteria greater than the dose criterion of §§ 20.1402, 20.1403(b), and 20.1403(d)(1)(i)(A), if the licensee--

(1) Provides assurance that public health and safety would continue to be protected, and that it is unlikely that the dose from all man-made sources combined, other than medical, would be more than the 1 mSv/y (100 mrem/y) limit of subpart D, by submitting an analysis of possible sources of exposure;

(2) Has employed to the extent practical restrictions on-site use according to the provisions of § 20.1403 in minimizing exposures at the site; and

(3) Reduces doses to ALARA levels, taking into consideration any detriments such as traffic accidents expected to potentially result from decontamination and waste disposal.

(4) Has submitted a decommissioning plan or License Termination Plan (LTP) to the Commission indicating the licensee's intent to decommission in accordance with §§ 30.36(d), 40.42(d), 50.82 (a) and (b), 70.38(d), or 72.54 of this chapter, and specifying that the licensee proposes to decommission by use of alternate criteria.

The LTP strategy also shapes the plan and schedule for long term storage and final disposal of the spent nuclear fuel and the intended as-left final site release condition.

LTP strategy development entails a fundamental licensing component. A license is required to store nuclear fuel and nuclear by-product material. Operating plants hold the required authorization under their Part 50 license. The LTP is a plan to terminate the Part 50 license. However, terminating the Part 50 license while still intending possession of nuclear fuel and nuclear by-product material presents another set of issues:

By way of explanation, the Part 50 licensee holds a concurrent Part 30 licensee. This authorizes the licensee to continue to possess (store) both fuel (under Part 50) and nuclear by-product material (under Part 30). If the Part 50 licensee were to be terminated, the licensee would be required to secure a Part 30 license to continue to store nuclear by-product material. In an agreement state, this licensing process would require State approvals. Termination of the Part 50 license would also necessitate the licensee to secure a Part 72 license in order to continue to store spent nuclear fuel. Securing a Part 72 fuel storage license could also entail complex political issues.

LTP strategy development must consider these constraints. At the present time, the favored alternative to Part 50 license termination is progressive site release. Under this process it is possible for the licensee to decommission and selectively release progressively more of the original reactor site until the only part of the physical area remaining under the Part 50 license is that required to store fuel and any remaining nuclear by-product material.

EPRI is preparing a guide (Reference 2, below) to assist plant personnel in preparing the radiological sections of a license termination plan. The report will be based on lessons learned from existing LTPs submitted to the NRC for approval. The guide will specifically address the appropriate regulatory requirements, site characterization, dose modeling, site remediation and final status survey.

Resources:

Lead: Management, Licensing,

Support: Environmental, Radiation Protection

Product:

A plan for eventual termination of all Federal and State licenses associated with the possession and storage of nuclear fuel and by-product material, and the ultimate release of the site. A cost/benefit and risk evaluation of the various alternatives may be necessary.

References:

(1) NRC NUREG-1575, EPA 402-R-97-016, "Multi Agency Radiation Survey and Site Investigation Manual (MARSSIM)," December 1997

(2) EPRI Technical Report, "Radiological Guide for Nuclear Power Plant License Termination," (to be published)

(3) NRC NUREG-1700, "Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans," April 2000

(4) NRC Draft Regulatory Guide-4006, "Demonstrating Compliance with the Radiological Criteria for License Termination," August 1998

DTO-22: Systems Identification and Reclassification

Objective:

Identify systems, structures and components necessary to support decommissioning and the safe storage of the fuel. Develop a method for reclassifying the plant systems based on their decommissioning (vs. power operations) function. Identify potential procedural revisions.

Value:

Plant maintenance cost is reduced by limiting the operational systems to only those necessary to support decommissioning. Further savings results from reclassification of safety systems to Non-Nuclear Safety (NNS). Further contributing to the cost savings will be a reduction in the number of Technical Specification-driven surveillance and maintenance activities required for the former safety class systems.

Prerequisites:

Accident analysis supporting the defueled condition.

Revisions to license basis and design basis consistent with a permanently shutdown and defueled plant.

Task Description:

Develop a plant procedure for declassification/reclassification. Define any special requirements associated with any potential new classifications.

For example, evaluate each of the plant systems for classification as:

- Operable
- Available
- Isolated/in Lay-up
- Abandoned

Systems that continue to be necessary to support decommissioning activities and spent fuel storage are identified in the course of this screening. Decommissioning support systems may include both NNS and safety class systems, if any.

Re-evaluate the safety function of those safety systems identified as necessary for decommissioning support. In most instances, it will be possible to reclassify the safety system to NNS based on the limited safety significance of its post-shutdown function. Procedures that are driven by safety classification (e.g., surveillances and maintenance) may be relaxed concurrent with system reclassification.

Resources:

Lead: Senior systems engineer(s), SRO, Design Engineering

Support: Licensing, Operations, QA

Product:

For the purpose of pre-planning, the goal should be the development of the systems screening, evaluation and reclassification process.

References:

(1) EPRI Technical Report, TR-1001238, “Plant Engineering Management Workshop Proceedings,” October 2000

DTO-23: Programmatic Revisions

Objective:

The objective of this task is to identify the principal programs and associated procedures that will require modification and to outline the nature of the changes that will be required.

Value:

Once an operating nuclear power plant is permanently shutdown and the fuel off-loaded to either the spent fuel pool or to other permanent storage, accident risk is reduced by many orders of magnitude. The NRC has recognized the risk reduction associated with the permanently defueled condition and permits a number of commensurate programmatic modifications. It is in the licensee's financial interest to implement these changes as soon as permitted.

Prerequisites:

Revisions to programmatic documents to support Decontamination & Dismantlement can be prepared at any time. Certification of the defueling of the reactor core and permanent cessation of power operation in accordance with 10 CFR 50.82(a)(1) and 10 CFR 50.4 b (1,9) is required before programmatic revisions can be implemented.

Task Description:

Many plant programs can be revised to reflect the reduced scope of Decontamination & Dismantlement activities as contrasted to power operation. With the exception of those programmatic requirements that protect public health and safety, or site personnel, or the spent nuclear fuel, which are not relaxed, NRC permitted revisions result in fewer and less stringent requirements.

Revisions to programs will necessitate making conforming changes to implementing procedures. Details of the required procedure revisions will vary from program to program, however, general guidance is provided below.

Decommissioning costs will be minimized by early revision of the following documentation:

- License Basis/Design Basis Review: Maintenance of documentation supporting the license/design basis can be reduced to those documents associated with the safe storage of the fuel. Design basis documents for systems, structures and components exclusively required for power operation need no longer be maintained (unless supportive of decommissioning). Reclassification of many if not all safety class systems to NNS falls under this task.

- Revisions to License Commitments: All licensing commitments that are uniquely associated with power operation can be rescinded. In general, it is sufficient to simply document the basis for the revision of commitments. No submittal to the NRC is necessary.
- Withdrawal of Licensing Submittals Supporting Operations: Outstanding licensing submittals supporting power operation can be withdrawn.
- Ops (Fuel Handler) Training Program: The reactor operator training and requalification program can be replaced with a training program that supports Certified Fuel Handlers.
- Emergency Plan Program: Following the completion of revised accident analyses, the emergency plan can be reduced to reflect the minimal off-site dose consequences presented by the defueled condition.
- Fire Protection Program: The focus of the fire protection program can be reduced to the protection of the stored nuclear fuel and the necessary controls to minimize potential for fire-induced spread of contamination.
- Security Program: Protection requirements for the site are limited to the fuel storage facilities. Typically, the security-controlled area can be sharply reduced.
- Maintenance Rule Program: The applicability of the maintenance rule is limited to those systems, structures and components that are necessary for the protection, storage, and handling of the spent nuclear fuel.
- Fitness for Duty Program: The fitness for duty program can be eliminated. However, management may wish to continue such a program to reduce one of the risk contributions associated with the use of a large contractor workforce.
- Safety Reviews (50.59): The process is the same. The application may be simpler.
- Engineering Support Personnel Training Program: Engineering support personnel training can be reduced to focus on those activities necessary to support safe storage of the fuel and decommissioning of the plant. Training program commitments can be streamlined and tailored specific to individual tasks.

Resources:

Lead: Operations, Training, Engineering

Support: Licensing

Product:

Applicable plan changes to support decommissioning and license submittals.

References:

(1) NRC Regulatory Guide-1.191, "Fire Protection Program for Nuclear Power Plants During Decommissioning and Permanent Shutdown," May 2001

(2) NRC Draft Regulatory Guide- 1075, "Emergency Planning and Preparedness for Nuclear Power Reactors," March 2000

(3) NRC Regulatory Guide 1.187, "Guidance for Implementation of 10 CFR 50.59, Changes, Tests, and Experiments," November 2000

(4) NEI 99-01 Rev. 4, "Methodology for Development of Emergency Action," August 2000

(5) NEI 96-07, Rev 1,"Guidelines for 10 CFR 50.59 Implementation," November 2000

(6) NEI 99-04, Rev 0, "Guidelines for Managing NRC Commitment Changes," July 1999

DTO-24: Quality Assurance Program Plan

Objective:

The objective of this effort is to reduce the costs associated with the application of the existing Appendix B Quality Assurance plan. This is possible because of the reduced requirements for a plant undergoing decommissioning.

Value:

A substantial reduction in on-going plant support costs is possible if the requirements for compliance with 10 CFR 50 Appendix B can be eliminated by reclassifying safety-related equipment to non-nuclear safety (NNS) or, at least, by limiting applicability to a small set of Systems, Structures, and Components (SSCs), principally those directly supporting the safe storage of the fuel.

Prerequisites:

Completion of the accident analysis supporting the defueled condition.

Identification of systems, structures and components necessary for the safe storage of the fuel.

Revisions to license basis and design basis, consistent with a permanently shutdown and defueled plant.

Task Description:

A number of options may be considered.

The first option presumes that a strict interpretation of the regulations concludes (after suitable assessments) that no safety-related systems, structures or components (SSCs) remain at the plant. With no safety-related SSCs at the plant, the Appendix B program which is required to be maintained as a 10 CFR 50 licensee, is moot as it has no applicability to the site equipment. No changes to the plan are necessary.

A second option would be to establish or retain a "safety-related" classification for certain SSCs that directly support the maintenance of the spent fuel. Under this second option, the normal Appendix B requirements are applied to selected SSCs. Cost savings result principally from a sharp reduction in the number of SSCs requiring Appendix B coverage. The savings is achieved through the reclassification task and not through significant revision to the Appendix B program. (Note, SSCs need not be expressly classified as "Safety Class" for application of Appendix B, although management always has this option.)

A third option combines reclassification of SSCs with a simplification of the Appendix B program to be consistent with the risk presented by a decommissioning unit. In this process a new SSC classification may be established. This is variously termed "management Q" or "Important to the Defueled Condition" or "safety significant." Some challenge will be encountered, however, in attempting to "simplify" an existing Appendix B program as it is difficult to identify those aspects of Appendix B that can be omitted and still retain an effective QA program. While there is some risk of regulatory challenge, this approach has been successful at TMI-2 and Saxton.

Variations on the second option have been successful at Yankee Rowe and Maine Yankee. The Appendix B QA program was not modified. However, applicability was sharply reduced to that small subset of SSCs whose failure, as determined by the revised accident analysis, could potentially significantly adversely affect the health and safety of the public.

Resources:

Resources required are dependent on the option selected. Those options that entail revision of the QA program or the development of an alternative program, demand greater involvement of quality professionals. Where there is no change to the existing Appendix B program (the second option) the principal effort is that of system reclassification by operations and engineering staff.

Lead: Senior systems engineer(s), QA

Support: Licensing, Operations

Product:

A plan for reducing the scope of the approved Appendix B QA Program based on the decommissioning strategy. Further development of the revisions to the QA Program are dependent on the decisions described above.

DTO-25: Work Processes and Procedures Reviews

Objective:

Describe pre-shutdown planning actions to facilitate and expedite changing and reducing work processes and procedures to be used during decommissioning.

Value:

Work focus changes during decommissioning consistent with the reduced risk profile and the industrial requirements of deconstruction. Work processes likewise change. Simplification of unnecessary and burdensome plant change processes, including the safety evaluation process, to support decommissioning activities reduces staffing needs and costs, as well as shortens the time to accomplish these tasks. Reductions in procedures from several thousand to several hundred have been accomplished at decommissioning plants although this process has occurred over years after shutdown.

Prerequisites:

Consideration must be given to the following fundamental changes in focus from operating to decommissioning. Understanding the basic changes provides the proper perspective for review of procedures and processes.

Operating	Decommissioning
Reactor Safety	Safe Storage of Spent Fuel
Multiple Systems	Limited Systems
Design Basis Maintenance	Deconstruction
Off-Site Risk	Worker Health and Safety
Operational Waste Stream	Large Volume Waste Disposal

Task Description:

The task is to review plant programs and procedures, with the perspective described in the Prerequisites section to achieve changes and reductions. Operations, Maintenance, Reactor Engineering, and HP/Chemistry procedures should be reviewed. It is necessary to re-focus the plant staff to accept and promote change (See DTO-5, “Organization and Staffing”). An assessment of applicable accidents should first be performed. Previous industry experience, in lieu of plant specific analysis, can be used to some extent, at the pre-planning stage. A Systems, Structures and Components (SSCs) Reclassification should then be performed. (See DTO-22 "Systems Identification and Reclassification")

The SSC Reclassification provides the framework for work process reductions. A dedicated, cross-discipline, team approach should be taken. The team should consider decommissioning requirements, applicable accident, and revised technical specifications [again previous decommissioning experience can be used] in their evaluation of work processes. SSCs that are required for defueled operations, or to support decommissioning activities, are designated. Any other SSCs, which are no longer needed, can be isolated and abandoned.

Examples of plant change process reductions have been:

- Substantial reduction in number of design basis documents
- Simplification of the FSAR
- "Early Release" (fast track) of construction work, prior to final approval of change documents
- Reduction of the number of 'Operations Critical" drawings
- Simplification of the review and approval process

An example of a reduced plant change process is the transition from the operating Appendix B "Engineering Design Change Package" consisting of extensive documentation, forms, analyses and a detailed 10 CFR 50.59 to the briefer Non-Nuclear Safety (NNS) "Decommissioning Change Package" consisting of less documentation, fewer forms and a simplified 10 CFR 50.59.

Key lessons from previous efforts are: The reduction and/or consolidation of Fuel Pool support SSCs is important. SSC reclassification is facilitated by a simplification of the 50.59 evaluation process and reference to bounding evaluations. Reaching the cold, dark, and dry condition will expedite the decommissioning process. Plant wide systems, e.g., Fire Protection, water make-up and processing, potable water and communications present special challenges.

Resources:

The initial team reviewing the work processes and procedures should be a separate task group and consist of engineering, operations, and licensing at a minimum. As the identification of non-required SSCs progresses, the owners of procedures in each Department should become involved in the performance of the reviews for reduction and deletion.

Product:

Beginning with the identification of regulatory commitments [See DTO-19, "Federal/State/Local Regulatory Compliance"] and SSCs reclassification [See DTO-22 "Systems Identification and Reclassification"], the products are the identification of programs, processes and procedures to be modified and/or deleted, the establishment of the decommissioning design control process, and can include preparation of the actual changes.

Procedure disposition plan including procedures to be deleted or modified post-shutdown and the method for disposition (e.g., group safety evaluations).

Work Process Changes.

References:

(1) EPRI Workshop, "Proceedings: Decommissioning – Plant Reconfiguration and Engineering Processes Workshop," EPRI Report 1001238, January 2001

(2) EPRI Technical Report, TR-1000093, "Decommissioning Planning – Oyster Creek Experience," February 2000

DTO-26: Systems and Structures Decontamination

Objective:

The objective of this task is to describe the issues and choices associated with planning for decontamination of systems, structures and components prior to dismantlement.

Value:

Judicious application of decontamination techniques can materially reduce the overall cost of decommissioning. The processes relied upon for decontamination of decommissioned facilities continue to evolve. Pre-planning, at least to the extent of being conversant with options, facilitates the use of optimal techniques.

Prerequisites:

Decommissioning strategy (DECON vs. SAFSTOR) .

Release criteria (i.e., free release, requirements for vendor or recycler).

Task Description:

The objective of a decontamination effort is to minimize the radiation exposure to personnel, to minimize the amount of radioactive waste, and to reduce the overall cost of the decommissioning process. Pre-planning for pre-dismantlement decontamination seeks to optimize the investment in decontamination equipment and personnel.

As early as possible in the decommissioning process, the amount and location of site contamination should be identified. Detailed surveys of the more highly contaminated systems, structures and components, should be performed as early as possible to aid in planning their decommissioning.

Decontamination for decommissioning differs from that for operating reactors both qualitatively and quantitatively. New options for chemical cleaning become available for a permanently closed facility, contamination on interior surfaces becomes important, and finally, much larger volumes and surface areas require remediation. The existing radiation procedures used during operation are generally inadequate to deal with the labeling, marking, and posting of the large volumes of potentially contaminated materials that will be created by the decontamination, and subsequent, dismantlement processes.

Remediation prior to dismantlement can be categorized as follows:

1. Chemical Decontamination

Chemical decontamination methods can be used to clean the interior surfaces of systems, such as the Reactor Coolant System (RCS) and associated systems. These processes are well understood. The resulting waste is administratively controlled and disposed of in accordance with plant procedures and applicable Federal and State regulations. Several-fold reductions in contamination have been attained in practice.

2. Structural Material Removal

   Material surfaces, such as concrete, may be contaminated to a depth of inches. Surfaces, which cannot be cleaned, must be removed by mechanical methods and packaged for disposal as radioactive waste. Removal methods include: concrete surface scrabbling, flame cutting, sand or dry ice blasting, thermic lance cutting, core boring, and rock splitting. Each method has unique advantages and penalties and requires application-specific evaluation. If it is possible to meet applicable regulatory requirements for final site release, an option that should be considered is rubblizing and on-site burial of residually contaminated concrete.

3. Surface Cleaning

   HEPA filtered vacuum cleaners may be used in areas of high loose surface contamination.

   Several methods can be used to remove more adherent exterior surface contamination. These include the use of sweeping compounds, household detergents, and high velocity water jets. Strippable coatings can also be used to lift radionuclides from contaminated surfaces. The stripped film is packaged and processed as a solid waste.

   If the surface contamination cannot be removed, then the surface material may be removed by one or more of the methods noted in (2) above, and the material disposed of as radioactive waste.

Finally, in weighing the extent to which investment in pre-decommissioning decontamination is justified, it is necessary to consider the cost of the option for off-site processing of the generated radioactive waste materials. Examples include:

<u>Specialized Decontamination Facilities</u>

A variety of services are available which allow selection of appropriate technologies for each component in the decommissioning waste steam.

<u>Volume Reduction</u>

Volume reduction facilities provide various processes to reduce the volume of material ultimately sent to the disposal facility.

<u>Incineration</u>

Incineration facilities can produce very high volume reductions. Suitable materials for the process include paper, certain plastics, oils and solvents.

<u>Metal Melting</u>

Metal melting facilities process low specific activity metals for recycling within the nuclear industry, often for use in shielding applications.

Resources:

Lead: Systems Engineering

Support: Radiation Protection, Environmental, and Safety

Product:

This is largely a knowledge development task that is a necessary prerequisite to planning for decontamination of major systems, structures and components. A useful product would be an assessment of the lessons learned from recent decommissioning activities, a survey for new decontamination techniques, and a tentative plan for on-site decontamination versus use of specialty off-site service organizations. Cost/benefit and risk evaluations of the various alternatives should be included.

References:

(1) EPRI Technical Report, TR-1000648, “Decontamination, ALARA, Worker Safety Workshop Proceedings,” 2000

(2) EPRI Technical Report, TR-109036, “Review of Experience with the EPRI DFD Process,” December 1998

(3) EPRI Technical Report, TR-112877, “Upgrading the EPRI DFD Process,” December 1999

(4) EPRI Technical Report, TR-1000884, “Technology Demonstration Experience Reports,” 2000

(5) EPRI Technical Report, TR-111596, "Concrete Decontamination Technology Workshop Proceedings"[3] January 1999

(6) NRC NUREG-1307, Rev. 9, "Report on Waste Burial Charges: Changes in Decommissioning Waste Disposal Costs at Low-Level Waste Burial Facilities," September 2000

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[3] The Concrete Decontamination Technology Workshop was the first in a series of technical workshops held to evaluate current utility practice, new techniques and requirements for improved technology. This workshop, on concrete decontamination, was held in fall 1998. The proceedings provide a useful reference document on the status of the technology.

DTO-27: Reactor Pressure Vessel (RPV) and Large Component Removal and Shipping

Objective:

The goal of this task is to develop strategies and options for the removal and shipping of large components such as the steam generators, pressurizers, transformers, reactor vessels and other large, possibly contaminated or activated components.

Value:

Removal and disposal of the large components at a nuclear plant are among the most complex and capital intensive decommissioning tasks. Advanced planning develops removal, packaging, transportation, and disposal options, improves the accuracy of cost estimates, and facilitates the planning and scheduling of decommissioning activities around the constraints imposed by the large component removal process.

Prerequisites:

None.

Task Description:

This task consists of studies to develop the options available for removal of large components for both the BWR and PWR. This could include transformers, pressurizers, steam generators, reactor pressure vessels, turbines, condensers and other components. Since some of these components will be both contaminated and activated, the removal, packaging and transport to a disposal site requires the contributions from a number of specialties.

All activities associated with this task must be performed with consideration of the requirements of 10 CFR 71, 10 CFR 61, the applicable 49 CFRs, Waste Site Burial Requirements as well as site-specific license requirements. In addition to licensing constraints, evaluations must consider ALARA, safety, cost and schedule.

The following is an example of pre-planning issues that warrant consideration for the RPV pre-planning task.

Three options are typically evaluated for reactor vessel removal:

- Segmentation of the internals and intact removal of the RPV
- Segmentation of both the RPV and the internals, and
- Intact removal of the RPV with the internals inside.

The optimal choice is very much site-specific. Important inputs would include the acceptance criteria of the targeted disposal site and the available transportation facilities and routes to the disposal site.

Transportation alone is a challenging task as the extreme weight and dimensions of very large components restrict both the route and the mode of transport. Transport may require the use of truck, rail, or barge, and, sometimes, all three.

Heavy haul movers must be scheduled many months in advance and will result in stringent schedule adherence requirements for the associated plant deconstruction work. Careful planning and control is mandatory since missing the window of opportunity for the heavy hauler may lead to considerable project delay and cost increases. Logistics can become complex. Should the company have a fossil side, it will be found advantageous to utilize coal shipping contacts and experience in working with the railroads.

Activation analysis to characterize the RPV and internals, as well as Biological Shield, etc. is also an important component of this task. This, and the assessment of the amount of Greater Than Class C material that would result from the segmentation of the RPV internals along with the Greater Than Class C storage or disposal options, are all important inputs to the optimal option for RPV disposal.

Challenges for the removal of other large components are similar to those for the RPV. For components that are contaminated but not activated, evaluations will also include a radiological characterization. This is an essential input to the cost/benefit of an aggressive decontamination plan. Generally these other large components are removed intact. However, segmentation is possible and may be an alternative to be considered in a pre-planning effort.

Resources:

Lead: Engineering/Health Physics/Licensing

Support: Operations, Maintenance

Product:

A Reactor Pressure Vessel Removal Plan that evaluates the various options available for removal and packaging of the RPV during decommissioning.

A Reactor Pressure Vessel Disposal Plan that evaluates the various options available for packaging, shipping and disposal of the RPV.

A Large Component Removal, Packaging and Disposal Plan that evaluates the various options available for the removal and handling of all other large equipment and components that need to be removed during the decommissioning process.

References:

(1) EPRI Technical Report, TR-107917-V2, "Yankee Rowe Decommissioning Experience Record," December 1998.

(2) EPRI Technical Report, TR-1000093, "Decommissioning Planning – Oyster Creek Experience," 2000.

(3) EPRI Technical Report, TR-107916, "Trojan PWR Decommissioning: Large Component Removal Project," March 1997.

DTO-28: Deconstruction Power Supply

The objective of this task is to describe the considerations for site electrical power during the decommissioning process.

Value:

Supports area by area dismantlement. Supports isolation of the Spent Fuel Pool, if this is desired. Allows continued decommissioning (including electrical circuits) of remainder of site minimizing the risk of electrical shock.

Prerequisites:

Identification of support systems and load requirements as a function of decommissioning phase and/or activities.

Task Description:

There exist two fundamentally different approaches to site powering during decommissioning. In the first approach, systems are selectively deactivated and dismantled. That is, there is surgical-like removal of individual systems and components while the site as a whole remains powered. The surgical-like approach may be applicable to multiple unit sites with shared systems. In the second approach, a minimal set of required equipment, the “spent fuel pool island’ (see DTO-11) and the specific equipment required to support dismantlement activities, is selectively repowered with the balance of the plant left “cold and dark.” There is arguably some reduction in risk to the workers if there is a clear physical or geographic delineation between the powered block and the non-powered block.

In both instances, the electrical system serves to provide power to equipment which must remain energized during decommissioning and while fuel remains located in the spent fuel pool. Examples include the ventilation and purge systems and cooling pumps for the fuel pool. The site electrical system also provides service to the building facilities, including the security system. Systems requiring power are identified in DTO-22, “Systems Identification and Reclassification.”

Off-site lines would supply the normal loads. Safety systems, if any, would require reliable backup, typically a diesel driven generator. A separate diesel is most likely required for backup electrical power for the gatehouse and security systems.

During dismantlement, the plant tag out procedures must be maintained and utilized to de-energize electrical and control equipment. Prior to their dismantlement, electrical services must be systematically isolated from the systems, structures and components prior to deconstruction. Pumps, fans, heaters, motor operated valves, motor operated dampers and instrumentation power sources must be isolated and disconnected from station electrical and control systems at the motor control centers, supply breakers, fuse blocks, and at the equipment.

Resources:

Lead: Electrical Engineering

Support: Systems Engineering

Product:

One of the products from this planning effort is a general strategy for the powering of important support equipment during dismantlement. A second is a logistical plan and cost/benefit evaluation for reuse of existing station equipment such as diesel generators, motor control centers, breakers, etc.

References:

(1) EPRI Technical Report, TR-107917-V2, "Yankee Rowe Decommissioning Experience Record," December 1998

DTO-29: Area Based Work Plan and Integrated Schedule

Objective:

The objective of this task is to outline the factors considered important in the development of area-based decommissioning schedules and plans, and the incorporation of these plans into an integrated schedule.

Value:

Judicious planning, tailored to the decommissioning processes and effective use of labor results in significant savings. Approximately 50% of post-shutdown costs are associated with craft activities. Project duration is closely tied to labor-intensive bulk dismantlement activities.

Decommissioning schedules that depict the removal of all of the equipment within a specified room or area have been demonstrated to be the optimal approach for decontaminating and dismantling a nuclear power plant. In contrast to other approaches, such as system-by-system removal campaigns, area-based removal strategies result in shorter schedule duration and lower costs.

Prerequisites:

This task can be performed at any time prior to decommissioning. The optimum start time should be a few years prior to shutdown. Consideration should be given to the significant utility labor force available on-site. Recognition must also be given to the deconstruction environment and processes which involve different skill sets, training and safety considerations. Completing a review of selected key issues for decommissioning (see Strategic Plan, Section 2.4), the Spent Fuel Storage Pre-Planning Task (see DTO-11), the Dismantlement Major Task Sequence (see DTO-30) the Systems Identification and Reclassification Pre-Planning Task (see DTO-22), and the Deconstruction Power Study (see DTO-28) should also be prerequisites.

Task Description:

An integrated decommissioning schedule requires the prior development of dismantling sequences (i.e., precedence logic) and timelines for all plant areas, systems, components and buildings. (See DTO-30.) These dismantling sequences and timelines are normally depicted in area-based decommissioning schedules that require the incorporation of many elements and factors, some which are summarized below:

1. Occupational health and safety requirements and regulations

2. Radiation dose rates and ALARA considerations

3. Extent of radiological contamination

4. Plant technical specification restrictions
5. Plant operational requirements
6. Regulatory and licensing constraints
7. Personnel and material flow paths
8. Laydown and staging areas
9. Procurement lead time for special equipment and packaging
10. Area congestion considerations
11. Systems, structures and components required to support spent fuel pool operation
12. Proximity of decommissioning operations to fuel pool
13. Final status survey requirements
14. Identification of special rigging requirements
15. Low-level radwaste packaging and interim storage
16. Plant modifications required to support decommissioning
17. Isolation of plant electrical and mechanical systems
18. Inventory of equipment within specified rooms and/or areas
19. Overall “exit strategy”
20. Resource “leveling” of craft and specialty equipment
21. Lead time required for engineering and procurement cycles
22. Licensing-related intervals allowing time for regulatory review and approval

Once developed, area-based dismantling logic and schedules must be assembled into a cohesive and efficient network of linked activities that minimizes the overall schedule duration, while meeting the goals and objectives of the project. The product resulting from this process is commonly referred to as an “integrated schedule” because it includes the linkage of all the tasks required to perform the work.

Resources:

Lead: Engineering

Support: Project Management
Craft Management and Labor

Product:

The products of this planning activity include decontamination and dismantling schedules for each building and area within the plant, and an integrated schedule that includes all site and non-site activities.

References:

(1) Report entitled, “Benchmarking Decontamination & Dismantlement Procurement Best Practices at Four Commercial Nuclear Power Plants, U.S. Department of Energy Benchmarking and Strategic Purchasing Initiatives,” October, 1998

(2) EPRI Technical Report, TR-107917-V2, “Yankee Rowe Decommissioning Experience Record,” December 1998

(3) EPRI Technical Report, TR-1000093, “Decommissioning Planning – Oyster Creek Experience,” 2000

DTO-30: Dismantlement Major Task Sequence

Objective:

This pre-planning effort identifies the impacts and assumptions as well as develops the preliminary sequence for the major decontamination and dismantlement activities. It is a subset of the "Summary Level Schedule" (DTO-2) for decommissioning.

Value:

Establishes the order in which to plan and execute the major decontamination and dismantlement engineering construction tasks. This is an essential component of Decommissioning Pre-Planning.

Prerequisites:

1. Decommissioning strategy
2. Summary Level Schedule (DTO-2)
3. Decommissioning cost estimate (period descriptions)
4. Engineering studies

Task Description:

The decontamination and dismantlement is usually characterized as an intermediate step in the project plan. Decontamination and dismantlement typically begins in earnest during the second year of the project and is the immediate predecessor task to Site Restoration, typically the final phase of the project.

The pre-planning task identifies and uses the following key inputs and assumptions to develop a preliminary dismantlement sequence:

Key input and assumptions:

- identification of work areas (including constraints, workarounds, and lay down considerations)
- ability to process wastes and dispose of radioactive materials
- consideration of impacts of spent fuel storage options, including potential consolidation of the wet storage systems and facilities
- large component removal strategies and appropriate decontamination of systems and equipment for overall exposure control and ALARA

The dismantlement activity is a series of sequential activities: planning, decontamination, and equipment removal. The planning activity includes the development of engineering deconstruction work packages[4] for removal of equipment and, in some instances, for new installations necessary for decommissioning support. Decontamination plans are an integral component of the deconstruction work packages.

The following is a typical dismantlement sequence, ordered by major activity or component type, for a PWR:

- Main Coolant System Decon
- SFP Island/Repowering Modifications
- Asbestos Abatement
- Large Component Removal (Rx vessel, internals, SGs)
- Secondary Side Component Removal
- Contaminated Systems Removal
- Main Coolant System Removal
- RCA Building DECON/Removal
- Containment DECON/Removal

The sequence for a BWR is essentially similar. There are, of course, some major component hardware differences. The turbine generator is more likely to be contaminated and will need to be handled accordingly. In some BWR designs, the BWR spent fuel pool is structurally contiguous with the reactor building, and this needs to be considered in planning the removal of structures.

Resources:

Lead: Design Engineering, Rad Protection, Systems Engineers

Support: Licensing, Operations, QA

Product:

A basic order in which to execute the major decommissioning and dismantlement engineering task. An awareness of the necessary inputs, assumptions and preliminary process. As a Phase II aspect of decommissioning, it is unlikely to be cost beneficial to devote resources to pre-planning the engineering design packages for decontamination and dismantlement.

[4] A "Decommissioning Work Permit" may prove useful. This single permit captures all of the safety, industrial hygiene, clearance, radiation protection, radwaste and other requirements for a particular work package.

DTO-31: Low-Level Waste Liquids, Solids and Mixed Radioactive Waste

Objective:

The objective of this task is to pre-plan the activities necessary to efficiently dispose of low-level liquid, solid and mixed radioactive waste. Mixed waste is defined as radioactive waste containing one or more hazardous constituents as determined by EPA regulations.

Value:

Waste handling and disposal are important components of the decommissioning process with significant financial implications. The large volumes involved present unique challenges. Negative commercial, political and regulatory compliance impact can be minimized through pre-planning. Financial advantages can be realized through negotiation of bulk disposal rates with disposal sites and waste processing vendors. Cost estimates can be better validated.

Prerequisites:

None.

Task Description:

Decommissioning requires the handling of a large volume of radioactive materials to reduce residual radioactivity to a level acceptable for site release and eventual termination of the license. Materials that cannot be decontaminated and released are processed as radioactive waste. Radioactive waste is subject to regulatory and procedural control for classification, treatment, packaging and shipment.

The pre-planning for this task consists of five separate activities:

1. Developing a knowledge of the Federal, State and local regulations that control the handling, transport and disposal of low-level liquid and solid radioactive material, and mixed waste.

2. Maintaining cognizance of the current and projected cost and availability of radioactive waste processing and disposal sites.

3. Developing estimates of low-level waste quantities and identities.

4. Reviewing the historical assessment database to identify any legacy waste and the chemical composition of any mixed waste.

5. Developing special considerations for the large volumes of low-level radioactive waste that will be generated by decommissioning.

6. Reviewing the adequacy of the radiation protection procedures to facilitate the labeling, marking, and posting of large volumes of potentially contaminated material.

   Potential enhancements could include:

- special postings to convey the status of dismantled systems,
- sensitive radiation monitors at the site exit to automatically monitor all materials being removed from the site,
- pre-characterization of contamination levels before opening closed systems to permit development of appropriate controls,
- acceptable methods of monitoring inaccessible surfaces, and
- streamlining documentation processes.

Plant operating staffs should already be trained and qualified in regulatory requirements for waste packaging, shipment and disposal and, therefore, minimal pre-planning is associated with the first activity. Because of the large volume of waste generated, the cost and availability of disposal sites is of great importance to the decommissioning plant and warrants pre-planning attention. Lack of a suitable disposal site can preclude the immediate DECON option and necessitate a SAFSTOR option or a combination DECON/SAFSTOR alternative.

Generic estimates are available for the volumes of low-level liquid, solid and mixed waste generated during decommissioning from NUREG-0586**.** Volumes of mixed waste may vary from decommissioning site-to-site depending on the age of the facility and construction materials. Knowledge of process may be used to identify waste streams containing potentially hazardous constituents and disposal volumes estimated. These waste streams must be analyzed for concentrations of the hazardous material present in addition to radioactivity during the waste classification process and an appropriate disposal venue selected based on the analytical result. Note that the presence of hazardous constituents in a particular waste stream such as lead, PCB or asbestos will impact the waste generation and handling process requiring special containment controls, packaging and training of workers performing the demolition or decontamination. These generic estimates suffice for the pre-planning to support the fifth activity, large volume disposal.

Because of the larger quantities involved, cost optimization may demand the development of volume reduction and innovative disposal methods unnecessary at an operating site. For example, an operating plant may occasionally need to dispose of contaminated concrete. A decommissioning plant will need to dispose of a significant volume of contaminated concrete. Similarly, when handling large quantities of low-level liquid radioactive waste, existing equipment and techniques may no longer suffice or prove cost-effective. Mixed waste requires special processing to either remove or render the hazardous constituent non-hazardous and may require shipment to a special facility prior to permanent disposal. Vendors should be identified that offer mixed waste processing services or special decontamination techniques that significantly reduce disposal volume. Therefore, cost and availability of waste disposal and processing sites as well as large-volume waste handling and disposal techniques are all aspects of an effective pre-plan.

The large quantity of radioactive material handled and disposed of during decommissioning also garners more political attention than routine plant shipments. Frequent communications with local and regional stakeholders, also a good practice during operation, will help to maintain favorable relationships.

The smaller volumes of mixed waste will have the highest per unit cost. Some of the mixed waste may not have a disposal alternative at the onset of decommissioning but may have before the end of decommissioning. Unlike radioactive waste, mixed waste planning activities include a specific knowledge of the waste's chemical composition, and knowledge of pending treatment technologies. Also, planning provisions for interim storage may be required.

Resources:

Lead: Radiation Protection, Licensing, Environmental

Support: Management

Product:

A plan should be prepared outlining the projected cost and availability of waste disposal and processing sites for the targeted decommissioning period. Alternative strategies and techniques for large-volume waste handling, volume reduction, and disposal should be included.

References:

(1) EPRI Technical Report, TR-110234, "Decommissioning Waste Reduction Guide," October 1999

(2) EPRI Technical Report, WM-112875, "Remediation Technology: Hazardous Waste Workshop Proceedings," December 1999

(3) EPRI Technical Report, TR107917-V2, "Yankee Rowe Decommissioning Experience Record," December 1998

(4) EPRI Technical Report, TR-111596, "Concrete Decontamination Technology Workshop Proceedings"[5] January 1999

(5) NRC NUREG-1307, Rev. 9, "Report on Waste Burial Charges: Changes in Decommissioning Waste Disposal Costs at Low-Level Waste Burial Facilities," published September 2000

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[5] The Concrete Decontamination Technology Workshop was the first in a series of technical workshops held to evaluate current utility practice, new techniques and requirements for improved technology. This workshop, on concrete decontamination, was held in the fall of 1998. The proceedings provide a useful reference document on the status of the technology.

DTO-32: Hazardous Waste Disposal (Non-Rad)

Objective:

The objective of this task is to pre-plan the activities necessary to efficiently dispose of hazardous waste (non-rad). This pre-planning task will also assure that the plant remains in conformance with all applicable State and Federal regulations that govern the use, removal, storage, and disposal of non-rad hazardous substances that are potentially detrimental to the environment.

Value:

Many of the materials and substances now controlled under various governmental regulations were not recognized as hazardous at the time of plant construction. For example, PCBs were widely used in paints, and asbestos in piping insulation, with few, if any, controls during plant construction. While we have ceased the introduction, and, therefore, minimized the need for handling of such hazardous materials in the plant, the decommissioning process reintroduces the potential for extensive personal contact during deconstruction. Dismantlement also presents new opportunities for unintended release into the environment of such hazardous materials. Pre-planning is necessary to assure that the plant is fully conversant and compliant with all regulations that govern the safe handling and disposal of hazardous materials.

For an operating plant such pre-planning will include taking steps to:

1. minimize the use of substances on-site that require special disposal,
2. plan for the ultimate removal of such substances, and
3. plan for disposal through identification and consideration of options.

Prerequisites:

None.

Task Description:

This task focuses on the compliance aspects of hazardous waste handling and disposal. The historical site characterization for hazardous waste involves the identification and location of hazardous substances on the site.

This task adds the evaluation of the current hazard, develops techniques to prevent the hazard from spreading (containment) and develops options for disposal, considering the pros and cons of immediate vs. delayed removal and disposal.

Experience has shown that it is important to charge specific individuals or departments with the responsibility of understanding and establishing plant conformance to each of the pertinent Federal and State regulations. Therefore, an important part of this pre-planning task is (1) the identification of all such governing State and Federal regulations and (2) the assignment of a responsible party to ensure programmatic compliance to each.

The complexity of demonstrating compliance is compounded by overlapping jurisdictional responsibilities between State and Federal agencies. For example, most states will have established regulations for hazardous materials that parallel those of OSHA or EPA. However, State requirements frequently differ from those of the Federal government, sometimes being more stringent. It is important to identify and resolve such potential differences between regulatory bodies in advance to avoid adverse impact on the decommissioning schedule.

Resources:

Lead: Chemistry, Industrial Health and Safety, Licensing

Support: Engineering, Operations, Maintenance

Product:

Plan for handling of hazardous wastes. Matrix of regulatory requirements and materials.

References:

(1) State-specific hazardous waste regulators, in states authorized by EPA.

(2) General Federal hazardous waste regulations 40 CFR 260-282, in states not authorized by EPA.

(3) General Federal regulation 40 CFR 761 for PCBs.

B

OVERVIEW AND STATUS - NON-RAD ENVIRONMENTAL CHARACTERIZATION - YANKEE NUCLEAR POWER PLANT SITE

1.0 Introduction

This appendix provides an overview of characterization activities conducted by Duke Engineering and Services (DE&S) at the Yankee Nuclear Power Station (YNPS) using information over its 33-year history of plant operation and focusing on the release of non-radiological materials to the environment (DTO-18).

Like all commercial nuclear power plants, YNPS received regular scrutiny with regard to the release of non-radiological materials to the environment in and around the plant. However, investigation and verification is required to assess the status of the building and the environment prior to the demolition as part of the decommissioning process and the site's ultimate release. A non-radiological assessment was therefore performed to document numerous site environmental media.

The purpose of environmental characterization of soil and ground water is to determine whether the operation and maintenance of the YNPS resulted in a release of non-radiological contaminants, i.e., hazardous materials, or the release of oil, to the environment.

1.1 Purposes of Site Characterization

Environmental Site Characterization is defined as an investigation to determine whether contaminants of any kind are present and require removal from environmental media. The goal of this Site Characterization for YNPS is to provide an assessment of conditions at the facility for various media, which could be left in place following plant decommissioning. In addition, consideration is given for conditions that might impact site workers during the demolition process. This assessment is based on regulatory criteria, as well as specific commitments by the facility owner. The objectives used to reach this goal include:

- Identification of the items to be characterized
- Determination of the analytes of interest
- Sampling of appropriate materials
- Laboratory analysis of samples
- Analysis and interpretation of laboratory results

- Re-sampling as dictated by results of analysis
- Recommending remediation of those media that exceed regulatory criteria
- Providing a non-radiological survey to document compliance with applicable regulations for site release

While initial characterization activities are generally guided by historical assessments, characterization for a specific location often becomes an iterative process of sampling and assessment. This might entail an increase in scope for conducting sampling of an area or simply added sampling for confirmation of results. In some cases, characterization may be preceded by a step called scoping. Scoping is an early, small, targeted characterization effort, intended to supplement site history and help direct characterization planning.

Since the YNPS project goal is to allow release of the plant area for any purpose, a thorough environmental assessment has been implemented. Characterization thus addresses all pertinent media, by areas of the site. The consequences of finding samples above Guidelines triggers re-sampling and analysis. For non-radiological conditions, parameters must comply with applicable regulatory guidance; in this case, that provided by Massachusetts' regulations.

2.0 YNPS Site Environmental Characterization

2.1 Project Documentation

2.1.1 Bases Documents

Environmental characterization of the YNPS plant site began in late 1993, initially focusing on radiological characteristics of the site. Initial investigations were based on a site history provided by Appendix B of the original Decommissioning Plan and general input from Yankee employees. Subsequent rounds of sampling provided further bases for expanded sampling.

The subsequent investigation and remediation, as applicable, of hazardous constituents was based on guidance provided within the Massachusetts Contingency Plan (MCP) regulations under 310 CMR 40.00 for the release of oil or hazardous materials. Activities, which involved remediation, were performed under the guidance of a Licensed Site Professional (LSP) as prescribed within the MCP regulations.

A non-radiological Historic Site Assessment was performed to investigate potential or confirmed areas of environmental concern at YNPS utilizing ASTM Standard E 1527-97 for a Phase I investigation. This was limited to the investigation of oil and hazardous material, thus a radiological investigation was outside of the scope. This non-radiological historical site assessment involved:

- Detailed Records Review - of reasonably attainable records
- Commercial Source - New England Data Maps Environmental First Search Report (To property boundary), DEP records review, and the Town of Rowe municipal records review

- Site Reconnaissance - to identify recognizable environmental conditions (presence of hazardous substance or petroleum products, UST, releases)
- Interviews of site personnel
- Historic chemical use and storage on-site
- RCRA Files, Status and Inspections - from MA DEP files
- Permits (NPDES, Air Permits, RCRA (LQG/SQG), ABC Permit, Recycling Reclamation Permit, Registered Public Water Supply)
- Spill Reports (40 CFR 112)
- UST (four), AST (nine)
- Water treatment operations
- PCB utilization
- Hazardous waste storage

The objective of the ASTM Phase I Report was to identify confirmed or potential areas of environmental concern. These included:

- Discharge areas/septic systems - review for historic discharges
- UST locations - soil borings and monitoring wells down gradient
- Southeast Construction Fill Area (SCFA), outside storage areas - soil and ground water
- Upper parking area - equipment storage, fire training
- Transformer areas - soil and ground water
- Loading areas and subsurface piping
- Above Ground Storage Tanks
- Herbicide and pesticide usage areas

As the site was built during the late 1950s and operated through the early 1990s, the use of asbestos and certain hazardous materials were potential areas of concern. Asbestos containing materials (ACM), presents a significant health hazard during the demolition process, as well as the potential for the release of friable ACM to the environment. PCBs, primarily a component of dielectric fluids, have been linked as a possible carcinogen. Investigations therefore were undertaken to identify these materials onsite in advance of planned demolition activities. In particular, ACM was evaluated in accordance with US EPA Asbestos Hazard Emergency Response Act (AHERA) guidelines (40 CFR Part 763, Subpart E).

The presence of PCB in a number of paints on-site resulted in the development of approval for PCB remediation by the US EPA under Section 6(e)(1) of the Toxic Substances Control Act (TSCA) and the PCB regulations 40 CFR Part 761.

General reference documents were developed to assist with site studies. These include a compilation of historical aerial photographs for the site and a study to assess the history of new construction and soil excavation from the plant property during the years of its operation.

2.1.2 Site Characterization Procedures

In addition to the laboratory analytical procedures that were used during site characterization, several other characterization-specific procedures were developed to implement, to document, and to ensure the completion of an accurate and reliable site characterization survey. All characterization sampling was done in accordance with these procedures. They are as follows:

- "Collection of Site Characterization and FSS Samples"
- "In-Plant Radiological Surveys to Support the Radiological Characterization Program"
- "Subsurface Soil Sampling and Monitoring Well Installation"
- "Sample Security and Chain of Custody"
- "Collection of Pond Sediment Samples for Site Characterization"
- "Characterization of PCB Waste"
- "Yankee Nuclear Station Site Characterization Quality Assurance Program Plan (QAPP) for Non-Radiological Sample Data Quality"
- "Ground Water Level Measurement and Sample Collection in Observation Wells"
- Roof Material sampling was done on a limited basis, so a protocol document was developed instead of a formal procedure.

The basic documentation for samples consists of field sheets from any procedure, chain of custody documentation, and field notebook entries. Lab data sheets and various reports and memos, as well as annual characterization reports were used to issue data summaries.

Sample analyses for non-radiological chemicals was performed by various laboratories based on whether there existed a radiological component in addition to the non-radiological parameter being analyzed. This would determine the analytical lab utilized. For example, sample analyses for radiological investigations were done by the DE&S Environmental Laboratory in Westboro, MA or by the YNPS plant laboratories.

Results of sample analyses were compiled in a database or published in general or media-specific reports. For remediation activities, a Licensed Site Professional (LSP) was consulted to ensure that pertinent information that may be required by MCP regulations was incorporated in the analysis schedule.

2.1.3 Status of Site Characterization Investigations

Site ground surface and subsurface soils have been the focus of investigations to date. Remediation criteria were consistent with the requirements specified by the State of Massachusetts as further described below. In some cases, the quantity of sampling was reduced when higher-than-expected results exceeded Guideline values. In these cases, where the need for remediation was obvious, the remediation process itself was used to pursue the limits of the contamination present.

The State of Massachusetts has developed a vehicle in which to address the release or potential release of oil or hazardous materials. The Massachusetts Contingency Plan (MCP) provides for the protection and health, safety, public welfare and the environment by establishing requirements and procedures for the following:

1. The prevention and control of activities which may cause, contribute to, or exacerbate a release or threat of release of oil and/or hazardous material;

2. Notification to the State in the event of a release or threat of release;

3. The assessment of the nature and extent of contamination and any threat to health, safety, public welfare or the environment caused by a release of oil and/or hazardous material;

4. The evaluation of alternatives for remedial activity to abate, prevent, remedy or otherwise respond to a release or threat of release;

5. Implementation of the appropriate remedial actions if required;

6. Public involvement in decisions regarding the nature of response;

7. The recovery of costs incurred by the Commonwealth in responding to a release or threat of a release.

The MCP identifies those oils and hazardous materials, which are subject to the requirements and procedures. The MCP prescribes the responsive roles and responsibilities of the Department, other government agencies, Responsible Parties, Potentially Responsible Parties, Licensed Site Professionals (LSP), Other Persons, and the public in response actions. The MCP is intended to comport with and complement the national Contingency Plan promulgated by the US EPA under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980.

Separate databases of radiological and non-radiological results of analyses for characterization and related samples were established.

To date a number of areas of the site have been specifically identified based on the status of either remediation or investigation. Many of those areas of the site that have been evaluated for either radiological or non-radiological considerations have been successfully remediated to meet applicable standards. A number of sites have undergone initial characterization and are pending further characterization and planned remediation. The remaining areas that require either additional or initial characterization have been flagged and carry a unique identification number.

In addition to these areas, a significant number of building areas have been characterized to contain particular hazards, i.e., PCB paint, lead, asbestos, radiological. Additional areas may be initiated as characterization activities progress.

2.2 Identification of Materials to be Characterized

A non-radiological history based on plant documents and on interviews with long-time employees and retirees was prepared at the outset of the work. Non-radiological information was also gathered through the Historical Site Assessment discussed above and was used to initiate site characterization activities and provide a framework for proceeding. This also included initial characterization (scoping) data addressing areas that required additional characterization based on their historic use.

Much of this initial environmental characterization data is from "targeted" samples, i.e., samples taken from areas expected to contain levels of analytes above Guidelines. Thus, these preliminary data provide insight into the general status of the site, but not a full or balanced site assessment.

The term environmental characterization is used here to represent investigations for the out-of-doors portion of the site, materials that could be left on the site after decommissioning, as well as for various buildings and structures that would eventually be impacted during plant demolition activities.

Based on-site history and initial scoping surveys, the media (specific materials) tested for YNPS include:

1. Surface soil and asphalt
2. Subsurface soil (in open areas)
3. Subfoundation soil (under structures or their floors)
4. Ground water and surface water
5. River, pond, stream and storm drain sediment
6. Septic leach field soil-fill
7. Circulating Water pipe sediment and bio-encrustation
8. Roofing materials
9. Construction and building materials
10. Building paint

C

SITE CHARACTERIZATION UNDER MULTI-AGENCY RADIATION SURVEY AND SITE INVESTIGATION MANUAL (MARSSIM)

The guidelines in NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual" (MARSSIM) are becoming established as the de facto standard for decommissioning compliance with the radiological site release criteria of 10 CFR 20.1402. As an aid to pre-planning, a detailed outline of the MARSSIM evaluation and review process is provided here. See DTOs 17 and 18.

EXAMPLE OUTLINE FOR PROJECT PLANNING

1) Develop Data Quality Objectives (DQO)

    a) Formal documentation of the DQO process for Site Characterization (SC)
        i) Analyte List
            (1) Process knowledge
            (2) Closure criteria
            (3) Risk levels
            (4) Conceptual model
        ii) Quality Objectives
            (1) Data needs
                (a) Soil
                    (i) Gamma Spec
                    (ii) Analysis for hard to detect radionuclides
                (b) Ground Water
                    (i) Gamma Spec
                    (ii) Tritium
                    (iii) Analysis for hard to detect radionuclides
                (c) Concrete
                    (i) Gamma Spec
                    (ii) Analysis for hard to detect radionuclides
                (d) Other

    b) QA documents
        i) Program Procedure
        ii) Site Procedures

c) Problem Statement
   i) Given site radiological environmental history, characterize the radiological status (nature and extent of contamination and remedial alternatives) of the site environment: soil, ground water, sediment concrete, roofing and other relevant construction materials. Provide Final Status Survey (FSS) with data to allow a decision about whether survey can proceed.

d) Personnel
   i) "Home Office" team:
      (1) Project Scientist
      (2) Project Scientist
      (3) Project Scientist
      (4) Project Scientist
      (5) Project Scientist
      (6) Decision Maker-Client

   ii) On-site characterization team
      (1) Project Scientist
      (2) Project Scientist
      (3) Project Scientist
      (4) Project Scientist
      (5) Project Scientist
      (6) Project Scientist
      (7) Project Data Base Technicians
      (8) Plant Technicians

e) Schedule/Deadlines
   i) SC scoping for PSDAR Submittal
   ii) SC to support LTP submittal
   iii) SC to support FSS planning and scheduling
   iv) SC annual reports
   v) Ties to building demo
   vi) SC completion estimate

2) Establish Release Criteria
   a) Derived Concentration Guideline Limit (DCGL) levels equivalent to NRC risk-based <25 mrem.

      Note: The EPA and some states have or are developing risk-based criteria, less than the NRC regulation, which may supercede the NRC value.

   b) Soil and Ground Water Inputs for Dose Model

3) Identify the decision criteria: radiological environmental character of given site areas are suitable to allow FSS to commence.
    a) Base investigation on Historical Site Assessment for targeted sampling
        i) Surface soil sampling: full coverage of site Radiological Controlled Area (RCA)
        ii) In-situ gamma: full coverage of site RCA
        iii) Subsurface sampling: targeted areas based on-site history and surface sampling
        iv) Subsurface sampling: in all available excavations, e.g., for buried pipe removal
        v) Subfoundation sampling: targeted areas based on-site history

4) Historical Site Assessment
    a) Interviews with site and former site personnel
    b) Analysis of Historical Aerial Photography for the Site
    c) Summary of Excavation Volumes for Construction
    d) Plant Operational Period Construction Excavation History
    e) Verification of Volumetric Solids Released from Site
    f) Site Radiological Environmental History
    g) Annual REMP data reports

5) Evaluation of Scoping and Characterization Data
    a) Characterization Areas
        i) RCA with numerous divisions (list areas from FSS for full listing)
            (1) Outdoor surface soil and asphalt
            (2) Subsurface soil at all suspect locations
            (3) Subsurface soil at locations where buried rad system pipe were removed
            (4) Subfoundation soil at all suspect locations
            (5) Subfoundation soil at locations where buried rad system pipe were removed
            (6) Catch basins
            (7) Concrete in radiological building
        ii) Outside RCA (list areas from FSS for full listing)
        iii) River and pond sediment -- screening only
    b) Use of H-3 as a default tracer in interpreting ground water analytical data

6) Remedial Action and Related Surveys
    a) Determine remediation criteria for surface and subsurface soil
    b) Remediation and Remediation Sampling Procedures

7) DQO Process
   - a) Specify action: decision rule and logic diagrams
     - i) Parameter of interest
     - ii) Action level (max/min/mean)
     - iii) Method of comparison of result vs. action level
   - b) Number of samples, variance and distribution
     - i) Consequences of wrong decisions
     - ii) Evaluate likely result vs. action level
     - iii) Provide probability of wrong decision vs. number of samples and statistic
   - c) Optimize Sampling
     - i) Summarize information
     - ii) Develop alternatives: MARSSIM
       - (1) Determine sample units
       - (2) Estimate bias, precision
       - (3) Calculate number of samples
     - iii) Determine sampling and analytical methods
     - iv) Develop cost estimates
     - v) Compare designs to DQO
     - vi) Selection of design by DQO team
     - vii) Optimize selected design

D
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NP-6931 *1990*	**The Cleanup of Three Mile Island Unit 2, a Technical History: 1979-1990**
TR-106148 *1996*	**Shoreham Decommissioning: Project Summary And Lessons Learned** This report is a summary of utility experience in decommissioning the Shoreham BWR. This report includes experience gained and lessons learned in adapting to the evolving site release criteria.
TR-107916 *1997*	**Trojan PWR Decommissioning: Large Component Removal Project** This report describes the removal and disposal of the steam generators and pressurizer from the Trojan nuclear power plant, carried out in 1996 as the first phase of Trojan decommissioning.
TR-109030 *1998*	**Fort St. Vrain Public Relations and Human Resources Issues** This report details the personnel retention program, the actions taken to mitigate harassment and intimidation issues, and the communications plan in the successful decommissioning of Fort St. Vrain.
TR-107917-V2 *1998*	**Yankee Rowe Decommissioning Experience Record** This report describes the decommissioning of Yankee Rowe. It updates Volume 1 and completes the majority of the experience record, covering all those items that do not have outstanding actions.
TR-112351 *1999*	**Spent Fuel Pool Cooling and Cleanup System During Decommissioning** Operation of original in-plant spent fuel pool facilities is expensive and can interfere with decommissioning. This report describes the approach taken in the Trojan Decommissioning Project to establish independent cooling and cleanup services for the fuel pool until the spent fuel is placed in dry storage.
TR-112143 *1999*	**A Methodology for Decommissioning Project Management** This document provides guidance and utility experience in scheduling and cost control in decommissioning project management, including descriptions of cost control software, based on project management techniques used at Trojan.
TR-1000093 *2000*	**Decommissioning Planning - Oyster Creek Experience** This report chronicles the process of preparing GPU Nuclear's Oyster Creek Nuclear Generating Station for early retirement. This summary of the Oyster Creek experience has great relevance to the nuclear industry, as future decommissioning projects will benefit from the comprehensive pre-planning work performed there.
TR-1000920 *2000*	**Disposal of Pressure Vessels and Internals** This report describes the issues, their resolution, utility experience and lessons learned concerning the PGE project to remove and ship for disposal the Trojan pressure vessel and internals.
TR-1000648 *2000*	**Decontamination, ALARA, Worker Safety Workshop Proceedings** A workshop on ALARA and worker safety. This includes all aspects of controlling radiation doses during the decommissioning process, including the benefits of chemical and mechanical decontamination.
TR-1000908 *2000*	**Remediation of Embedded Piping** Methods of dealing with embedded pipe, including removal and in-situ decontamination will be documented, based on experiences and lessons learned at Trojan plant.

TR-1000951 *2000*	**Embedded Pipe Dose Calculation Method** This report evaluates measurement techniques for determining activities on internal surfaces of embedded pipes, and scaling factors for all nuclide concentrations.
TR-1001238 *2000*	**Plant Engineering Management Workshop Proceedings** A workshop on plant reconfiguration management (drawing control, technical specification changes, reclassification of systems) and the transition from operating plant procedures to decommissioning procedures was held at Millstone in October 2000.
TR-1003029 *2000*	**Reactor Internals Segmentation** This report will document the results obtained to date at Connecticut Yankee, Maine Yankee, San Onofre, Big Rock Point and facilities abroad and will discuss the lessons learned at each site. Recommendations for improving efficiency and reducing personnel exposure levels at future decommissioning sites will be provided.

Regulatory Issues

TR-109032 *1998*	**Guide to Regulatory Process for Decommissioning Power Plants** The decommissioning rule, 10 CFR 50.82, was revised in 1996, with significant changes in the regulatory process for nuclear power plant licensees. This report provides a summary of ongoing Federal agency activities and the regulatory requirements that are applicable, or no longer applicable, to nuclear plants.
TR-109460 *1999*	**Interim Industry Guidance on Decommissioning Standard Review Plans** This document provides interim industry guidance on the preparation of standard review plans (SRPs) for exemptions for key programs not addressed in the NRC Decommissioning Rule, including emergency planning, security plan, technical specifications, operator requalification, and insurance requirements.
TR-1000892 *2000*	**Decommissioning Regulatory Process** This report documents U.S, industry input to NRC on the continuing rulemaking process, covering interactions in 2000.

Radiation and Characterization Issues

TR-107979 *1998*	**Fort St. Vrain Final Site Survey Experience Report** This report describes the final step in the process of decommissioning the Fort St. Vrain nuclear power plant. It formed the legal basis for the termination of the nuclear license, which occurred in August 1997.
TR-109031 *1998*	**Trojan Decommissioning: Site Characterization for Fuel Storage Facility** This report describes the final survey plan and presents the results of the final survey for the area where the Independent Spent Fuel Storage Installation (ISFSI) will be constructed at Trojan nuclear power plant.
TR-109035 *1998*	**A Mobile High Resolution Gamma Ray Spectrometry System for Radiological Surveys** Surveying nuclear power plant sites for radioactive contamination is an expensive part of the overall decommissioning process. This report details a mobile radiological survey system designed to produce a rapid and cost-effective radiological characterization of outdoor land areas.
TR-112874 *1999*	**Comparison of RESRAD with D&D Codes** A detailed comparison of the RESRAD and the Decontamination & Dismantlement (D&D) Codes was conducted to define the benefits of one code over the other for industry use. This analysis includes using actual decommissioning site data for initial testing.
1003030 *2001*	**Guideline for Determination of Background Radiation Levels in Support of Decommissioning Nuclear Facilities** This report will provide recommendations for establishing background radiation levels for soils, surfaces and structures.
To Be Published	**Radiological Guide for Nuclear Power Plant License Termination** This report will address regulatory requirements, site characterization, dose modeling, site remediation and final status survey.

Technology Developments and Demonstrations

TR-109036 *1998*	**Review of Experience with the EPRI DFD Process** This report describes the experiences with the EPRI DFD decontamination system on plant components and reactor coolant systems, including applications at Big Rock Point, Maine Yankee, and Trojan.
TR-112092 *1999*	**Evaluation of Reactor Coolant System Decontaminations at Maine Yankee and Connecticut Yankee** This report is an independent review of the reactor coolant system decontaminations carried out in 1998 at two permanently shutdown PWRs, using the EPRI DFD process and Siemens' CORD.
TR-112877 *1999*	**Upgrading the EPRI DFD Process** This report describes the development of the EPRI DFD Process for new applications, including aluminum and carbon steel systems, and reviews forthcoming applications.
TR-1000884 *2000*	**Technology Demonstration Experience Reports** This document reports on field demonstrations of concrete decontamination technologies, large bore pipe decontamination using grit blasting, GammaCam gamma ray imaging system and large tank and vessel dismantlement.
TR-1003026 *2001*	**Decontamination of Contaminated Components** This report will document activities in US and elsewhere to decontaminate components from nuclear facilities for recycling, reuse or disposal. This will include pumps, steam generators, and contaminated equipment from other nuclear activities.

Radwaste Management

TR-110234 *1999*	**Decommissioning Waste Reduction Guide** This manual describes approaches to reduce the volume and costs of low-level radioactive waste arising from decommissioning activities. The guide spells out the similarities and differences between operating and decommissioned sites, and identifies when specific approaches are more cost-effective .
CM-112872 *2000*	**Waste Logic Software for Decommissioning** The Waste Logic code has been expanded to include a decommissioning module. This module is tailored specifically to deal with the waste streams, processing options, packaging options, disposal options, etc. that are specific to decommissioning.
TR-1000006 *2000*	**Decommissioning Waste Management Workshop Proceedings** A workshop on the management and disposal of low-level radioactive waste at decommissioned plants was held. This workshop addressed all aspects of waste processing. The proceedings are designed to provide a useful reference document on utility experiences.
CM-112872 *2001*	**Waste Logic Software for Decommissioning, Version 2.0** The Waste Logic code has been expanded to include a decommissioning module. This module is tailored specifically to deal with the waste streams, processing options, packaging options, disposal options, etc. that are specific to decommissioning. Version 2.0 includes a number of upgrades and is packaged with Solid Waste Manager Version 2.1.
1003027 2001	**Review of Decommissioning GTCC Radwaste** Describes utility experiences for addressing Greater Than Class C (GTCC) wastes, including lessons learned and challenges dealt with in the storage of GTCC waste.

Workshop Proceedings

TR-110006 *1998*	**Proceedings: First EPRI/NEI Decommissioning Workshop** This workshop, held in San Antonio in December 1997, provided a forum for utility representatives and selected vendors to exchange information related to decommissioning.
TR-111596 *1999*	**Concrete Decontamination Technology Workshop Proceedings** A series of technical workshops is being held to evaluate current utility practices, new techniques and requirements for improved technology. The first workshop, on concrete decontamination, was held in Fall 1998. The proceedings provide a useful reference document on the current status of the technology.

TR-111025 *1999*	**Proceedings: 1998 EPRI/NEI Decommissioning Workshop** This workshop held in December 1998 in Monterey, CA provided a forum for utility representatives and selected vendors to exchange information related to decommissioning of nuclear power plants.
TR-111277 *1999*	**Embedded Pipe, Tank and Fuel Pool Cleaning/Remediation Technology** A workshop on methods of dealing with radioactive pipes embedded in concrete, tank cleaning and fuel pool cleaning was held in February 1999. The proceedings provide a reference document on the current status of the technology.
WM-112876 *1999*	**Site Characterization and Final Site Survey Workshop Proceedings** A workshop on-site characterization techniques and final site surveys held in May, 1999. The proceedings provide a useful reference document on the current status of the technology.
WM-112875 *1999*	**Remediation Technology: Hazardous Waste Workshop Proceedings** Proceedings of a workshop held in August 1999 on the detection, removal and disposal of asbestos, PCBs, lead and mercury from nuclear plants.
WM-114506 *1999*	**Decommissioning Technology Innovations** A compilation of presentations on innovative technologies presented at the NEI/EPRI Decommissioning Planning and Technology Forum in October 1999
TR-1000006 *2000*	**Decommissioning Waste Management Workshop Proceedings** A workshop on the management and disposal of low-level radioactive waste at decommissioned plants was held. This workshop addressed all aspects of waste processing. The proceedings are designed to provide a useful reference document on utility experiences.

NRC DECOMMISSIONING GUIDANCE

Draft Regulatory Guide –1106 *5/01*	“Assuring the Availability of Funds for Decommissioning Nuclear Reactors”
Regulatory Issue Summary 2001-07 *2/23/01*	"10 CFR 50.75 (f)(1) Reports on the Status of Decommissioning Funds (Due March 31, 2001)"
NUREG-1577, Rev. 1 *2/99*	"Standard Review Plan on Power Reactor Licensee Financial Qualifications and Decommissioning Funding Assurance"
NUREG-1567 *3/00*	"Standard Review Plan for Spent Fuel Storage Facilities"
NUREG-1727 *9/00*	"NMSS Decommissioning Standard Review Plan"
Regulatory Guide- 1.185 *7/00*	“Standard Format and Content for Post-shutdown Decommissioning Activities Report”
NUREG-1726 *7/00*	"Predictions of Spent Fuel Heatup After A Complete Loss Of Spent Fuel Pool Coolant"
NUREG-1738 *2/01*	“Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants”
Regulatory Guide – 3.54 Rev. 1 *1/99*	“Spent Fuel Heat Generation in an Independent Spent Fuel Storage Installation”
Draft NUREG-1625 *3/98*	“Proposed Standard Technical Specifications for Permanently Defueled Westinghouse Plants”

NUREG-0586 *8/88*	"Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities"
NUREG-1307, Rev. 9 *9/00*	"Report on Waste Burial Charges: Changes in Decommissioning Waste Disposal Costs at Low-Level Waste Burial Facilities"
Regulatory Guide-1.191 *5/01*	"Fire Protection Program for Nuclear Power Plants During Decommissioning and Permanent Shutdown"
Draft Regulatory Guide- 1075 *3/00*	"Emergency Planning and Preparedness for Nuclear Power Reactors"
Regulatory Guide 1.187 *11/00*	"Guidance for Implementation of 10 CFR 50.59, Changes, Tests, and Experiments"
NUREG-1700 *4/00*	"Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans"
Draft Regulatory Guide-4006 *8/98*	"Demonstrating Compliance with the Radiological Criteria for License Termination"
NUREG-1575 *12/97*	"Multi-Agency Radiation Survey and Site Investigation Manual" (MARSSIM)

NEI DECOMMISSIONING GUIDANCE

NESP-036 2 Vols *5/86*	"Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates"
NEI 98-01, Rev. 04 *5/98*	"Industry Spent Fuel Storage Handbook"
NESP-034 *3/86*	"Intact Decommissioning of Nuclear Power Plants: A Dose Assessment"
NEI 99-01, Rev. 4 *8/00*	"Methodology for Development of Emergency Action"
NEI 96-07, Rev 1 *11/00*	"Guidelines for 10 CFR 50.59 Implementation"
NEI 99-04, Rev 0 *7/99*	"Guidelines for Managing NRC Commitment Changes"
NEI 98-03, Rev. 1 *6/99*	"Guidelines for Updating Final Safety Analysis Reports"

Target:
Nuclear Power

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EPRI • 3412 Hillview Avenue, Palo Alto, California 94304 • PO Box 10412, Palo Alto, California 94303 • USA
800.313.3774 • 650.855.2121 • askepri@epri.com • www.epri.com