

DECOMMISSIONING LESSONS LEARNED AT YANKEE ROWE

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ABSTRACT

The experiences and lessons learned in the decommissioning of Yankee Rowe span almost every aspect of decommissioning. Many of the current regulations and decommissioning techniques used at plants throughout the United States were developed based upon the lessons learned at Yankee Rowe.

These experiences cover a diverse range of topics from shipment of the reactor vessel and other large components to the application of unique decontamination techniques, and to license termination surveys and license termination plans and hearings. Lessons learned at Yankee Rowe have already been deployed at other sites such as Trojan, Maine Yankee, Big Rock Point, and Connecticut Yankee. The Electric Power Research Institute has published a compendium of lessons learned at Yankee Rowe. The document, EPRI TR-107917, "Yankee Rowe Decommissioning Record", is available through the Electric Power Research Institute.

At Yankee Rowe, the majority of decommissioning is complete. Since 1993, more than 21 miles of piping and tubing, 1071 valves, 8,569 pipe hangers, 321 pumps, and 33 miles of conduit and cable tray have been removed. In addition, six large components weighing a total of more than 500 tons were also removed.

Lessons learned in the planning, and execution phases of decommissioning at Yankee Rowe can be employed at other NRC licensed facilities. Scope management and risk management are critical tools that must be utilized to adequately manage the cost of a decommissioning project. This paper deals with specific scope and risk management lessons learned in the Decontamination & Dismantlement, Fuel Storage, Building Demolition & Site Restoration, Waste Disposal and Final Status Survey & License Termination phases at Yankee Rowe.

BACKGROUND

Yankee Nuclear Power Station (YNPS) achieved initial criticality in 1960 and began commercial operations in 1961. The Nuclear Steam Supply System was a four loop pressurized water reactor. The original thermal power design limit of 485 MWt was upgraded to 600 MWt in 1963. The Turbine Generator was rated to produce 185 MWe. Commercial operation ceased in 1992 after about 31 years of operation. During its operation, YNPS achieved an average capacity factor of about 74%.



Fig. 1 - Yankee Rowe Nuclear Power Station

YNPS shut down on October 1, 1991, in response to regulatory uncertainties associated with the integrity of the Reactor Vessel. During the outage and before February 26, 1992, all fuel assemblies, control rods, and neutron sources were removed from the Reactor Vessel and stored in the Spent Fuel Pit. A total of 533 fuel assemblies are stored in the Spent Fuel Pit. Plant systems required to support spent fuel storage and to support permanently defueled operations are in service.

On February 26, 1992, the Yankee Atomic Electric Company (YAEC) Board of Directors decided to cease power operations permanently at YNPS. By letter, dated February 27, 1992, YAEC notified the Nuclear Regulatory Commission (NRC) of the company's decision to permanently cease power operations at the YNPS. Following notification of the NRC, YAEC initiated decommissioning planning and other plant closure activities.

On August 5, 1992, the NRC amended the YNPS Facility Operating License (DPR-3) to a possession only status. This, combined with other amendments and program changes, formed the basis of the Decommissioning Plan. The decommissioning plan was submitted by YAEC in accordance with the U.S. Nuclear Regulatory Commission's requirement, "Domestic Licensing of Production and Utilization Facilities", 10CFR50.82(a). Under this regulation a proposed Decommissioning Plan must be submitted within two years of the permanent cessation of operations. The Decommissioning Plan was submitted to the NRC on December 20, 1993 and subsequently approved on February 14, 1995. A commitment from the approval process required that the Decommissioning Plan be incorporated into the FSAR.

SCOPE MANAGEMENT LESSONS LEARNED

Scope management is critical in any decommissioning project. This is due to the magnitude of the project and the complications associated with changing regulations and the need to shift from an operating plant to a construction site. This shift represents a significant culture change that is often not greeted well by the existing facility workforce. Until the fuel is moved offsite, there will remain a level of plant operations activities that is unavoidable. It is essential to control both the scope of decontaminating the site and the scope of managing the fuel until it leaves the site.

Changing regulations, multiple regulating authorities, the presence of both radioactive and non-radioactive materials, disposal facility availability, and final disposition of spent fuel are just a few of the risk issues associated with managing the scope of a decommissioning project (1). The establishment of a contingency fund to cover these types of project risk items is essential to project success. Another key element in managing the scope is a clearly statement of work in the form of a work breakdown structure.

Contingency

The purpose of contingency is to allow for the costs of high-probability program problems occurring in the field where occurrences, duration, and severity cannot be accurately predicted and have not been included in the basis estimate. The American Association of Cost Engineers ("AACE") defines contingency in their Cost Engineers Handbook as, "specific provision for unforeseeable elements of cost within the defined project scope; particularly important where previous experience relating estimates and actual costs has shown that unforeseeable events which will increase costs are likely to occur."

Based on our experience at YNPS, there are numerous potentials for utilizing contingency in a decommissioning project. Each category of decommissioning has some level of risk that results in changes to the project cost estimate. For example, the plant's 1995 Cost Study (1995 CS) estimated a total cost to decommission the plant in 1999 dollars of \$406.9 million. The net effect of scope, schedule and regulatory assumption changes between the 1995 Cost Study and the current (1999) estimate for completion of decommissioning at YNPS identified approximately \$46.2 million in changes to the cost, resulting in a projection of \$453.1 million, in 1999 dollars.

The amount of contingency dollars set aside for risk mitigation will vary over the project lifecycle and is based on the risk profile of the remaining activities. Based on our decommissioning experience we think it is best to assign contingency factors to each element of the schedule and cost estimate. By doing so, as activities are completed the need for their associated contingency dollars vanishes.

Work Breakdown Structure

The work breakdown structure (WBS) provides the link between the scope of the project and the schedule and cost of the activities in the schedule. There is no industry standard for a decommissioning WBS; however, several including the American Nuclear Society (ANS), American Society of Mechanical Engineers (ASME) the Department of Energy (DOE) and the Environmental Protection Agency (EPA) are developing guidelines. The work breakdown structure is essential to ensuring that all the project scope is identified, estimated and executed. The project manager needs to ensure that a WBS is established early in the project and maintained throughout the project lifecycle.

At YNPS an initial WBS was established as part of the Decommissioning Plan. This WBS has been modified and refined through out the project. One of the valuable lessons learned at YNPS was that the cost estimate should to be integrated with the baseline schedule. An integrated cost estimate and schedule enables the project manager to utilize earned value management

techniques to monitor and control the project performance and provide timely and accurate updates to the cost estimate. The latest WBS was refined to meet the needs of completing the remaining decommissioning activities and reflect the scope of designing and implementing a dry fuel storage facility and to provide cost information for a rate case filing. This WBS can be effectively employed at the onset of the decommissioning project. The highest levels of the WBS are shown below:

- Category 1 – Decontamination & Dismantlement, involves the removal of contaminated systems, structures and components from the plant and the decontamination of building surfaces. Decontamination includes the identification of removal of radioactive and hazardous materials such as PCB based paint, asbestos and lead through site characterization activities.
- Category 2 – Safe Store, involves the continued operation of the spent fuel pool and all ancillary equipment, maintenance and support services.
- Category 3 – ISFSI, involves the design, licensing, construction, loading and long-term operations of a dry fuel storage facility.
- Category 4 – Building Demolition & Site Restoration, involves the demolition of all buildings and structures once they have been decontaminated and the re-establishment of the site grade and placement of topsoil and grass.
- Category 5 – Radwaste Disposal, involves the preparation, packaging, transportation and disposal of all radioactive waste.
- Category 6 – Final Status Survey/License Termination, involves characterizing the radiological and non-radiological hazards on the site, performing the final site survey that verifies that the decommissioning has been accomplished per the applicable regulations and terminating the NRC License.
- Category 7 – Administrative and General, covers the cost of all non-distributed cost and staffing related cost of the Decommissioning Operations Contractor (DOC) that are not readily assigned to Category 1 through 6.
- Category 8 – Yankee Corporate Costs, captures all Yankee payroll related costs, as well as insurance, regulatory fees, and taxes. All DOC costs are captured in Categories 1 – 6, while Yankee personnel costs are captured in this category.

DECONTAMINATION & DISMANTLEMENT LESSONS LEARNED

Every system, structure and component in the decommissioned plant must be disposed of as either radioactive or non-radioactive waste. The strategies associated with decontamination & dismantlement as well as those of radioactive waste disposal and final status survey & license termination must be carefully planned and executed to minimize cost. Disposal options play a large role in determining these strategies; however, other factors such as personnel safety, labor cost and the license termination goals must be factored into the decommissioning equation.

Decontamination & Dismantlement Strategies

There are numerous factors to consider when evaluating decontamination & dismantlement strategies. The primary factor is a clearly defined objective. It is critical to establish the release criteria or Derived Concentration Guideline Level (DCGL) as soon as possible in the process. By understanding the release criteria, an informed decision can be made on a realistic goal for the decontamination effort. If the release criteria is lowered after decontamination efforts have commenced, it may be necessary to change methods later in the project to a more aggressive and usually more expensive method. A major impact of changing release criteria is performing rework on structures or areas that had been previously released. This clearly results in additional costs and schedule impact.

It should be understood that there is a consequence as a result of every method of decontamination. Some methods result in the generation of contaminated water, while others have health and safety concerns. When determining the appropriate method(s) of decontamination the following factors should be considered:

- **Health and Safety Hazards to the workers** –Does the method minimize safe hazards to the workers?
- **The effectiveness of the method** - Does the method have a high success rate in the particular application, i.e., is it proven technology?
- **Waste Minimization** - Does the method generate excessive radioactive and or mixed waste to process or dispose?
- **Impact on Final Survey** - Will the structure/area be left in a condition that can be effectively surveyed?

Processing of contaminated water is a major factor in selecting the best decontamination strategy. Contaminated water is the byproduct of many decontamination methods. Some methods like hydrolasing or concrete cutting can result in large quantities of water that must be processed by ion exchange, evaporation, solidified or other method. The installed liquid radwaste processing systems at decommissioning sites are typically not operational and therefore, reliance on a temporary unit becomes necessary. Liquid radwaste minimization is critical to avoid overloading limited storage and processing capabilities. Failure to do so can result in serious consequences such as schedule impact, need for additional storage tanks, uncontrolled release to the environment.

If there is any doubt about the ability of the selected decontamination process to satisfy the release criteria, the conservative approach is usually the best option. The cost in time spent surveying, decontaminating, resurveying, remediating can easily exceed the cost in simply removing the material and disposing as radwaste. Some of the embedded piping systems Yankee Rowe proved costly in remediating versus removal and disposal. The obvious pitfall to remediating complex components or structures is there is no guarantee that after all reasonable efforts at decontamination have been made that the material will meet release criteria. When making a decision on decontamination or dismantlement versus disposal, consider all of the factors.

Another factor to consider is when to dismantle various systems, structures and components. For example, the decision to remove platforms and stairs in contaminated areas needs to consider issues like accessibility and productivity. At Yankee Rowe we discovered that sometimes it is more effective to remove installed platforms early in the process and use scaffolding so that the installed components did not interfere with concrete wall and floor decontamination efforts.

Site Characterization

Determining the true nature and extent of radiological and non-radiological contamination is the basic element in defining the scope of a decommissioning project. From a Risk Management perspective accurate characterization data does more to fix the scope of a project than any other activity that the project staff can control. Failure to properly characterize a facility can lead to poor decisions on cost and schedule, decontamination strategy and Final Status Survey. The experience at Rowe demonstrated that non-conservative assumptions based on inadequate characterization data leads to the underestimation of the actual quantity of contaminated concrete and soil. As usual, in hindsight it became evident that had the true nature and extent of ALL of the radiological and non-radiological contamination been identified, overall decontamination strategies would have been more aggressive.

For example, there are uncertainties associated with not being able to quantify the amount of radioactive contamination contained in the concrete and surrounding soil of the Spent Fuel Pool (SFP). It is known that the SFP concrete and surrounding soil is contaminated based on past operating information; however until the fuel is removed, it is not possible to quantify how much contamination is present and exactly how much it will cost to decontaminate and dispose of the waste stream. Therefore, it is assumed that 50% of the soil surrounding the SFP is contaminated and 75% of the concrete is contaminated. The picture below shows soil remediation near the plant's waste monitoring tanks. It was initially thought that there were only a couple of inches of soil contamination in this area; however, as can be seen in the photos, significantly more soil had to be removed than anticipated.



Fig. 2 - Soil Removal Near Waste Monitor Tanks at YNPS

The Decommissioning Plan and 1995 Cost Estimate assumed that only 25% of the concrete surfaces in containment would have to be to a depth of ¼ inch, and the remaining surfaces could be wiped clean. Because of the PCB-based paint and greater radiological contamination in the concrete than was previously assumed, 100% of the concrete surfaces inside the Vapor Container had to be remediated to a depth of ¼", and approximately 25% of the concrete surfaces had to be remediated to a depth of approximately 4 inches. The estimated impact of this scope change was approximately \$23.1 MM.



Fig. 3 - Concrete Removal in Reactor Cavity at YNPS

The 1995 cost estimate assumed that only 25% of all concrete surfaces inside buildings other than the Vapor Container and Spent Fuel Pool Building would have to be remediated to a depth of ¼ inch. It was assumed that the rest of the contaminated concrete surfaces could be wiped down to remove the radiological contamination. These techniques proved to be ineffective at removing the contamination and significantly more concrete had to be remediated and disposed of as radioactive waste than was anticipated. The estimated impact of this scope change was approximately \$1.4 MM for additional concrete removal and disposal outside of the Vapor Container and the Spent Fuel Pool.

FUEL STORAGE LESSONS LEARNED

Wet Versus Dry Fuel Storage

To go dry or stay wet is a significant decision that must be faced early in the decommissioning project lifecycle because of its impact on project resources and cost. Regulations require the spent nuclear fuel to remain in the spent fuel pool for an extended period of time to allow for adequate decay heat removal prior to placing the fuel into dry storage. The decay period depends on the particular dry storage system. In Yankee's case, this equated to 5 ½ years following shutdown. This would seem to imply that there is ample time to make this decision. However, lessons learned at Yankee indicate this decision cannot be made too soon. Lessons learned at Trojan show us that the successful movement of fuel to dry storage is a critical success factor in the decommissioning process.

In 1994, an engineering task force was created to develop a plan for the disposition of spent fuel stored on-site. The likelihood of storing fuel on-site during and after plant decommissioning significantly impacts both the decommissioning process and the decommissioning cost. Detailed engineering evaluations were prepared to investigate spent fuel disposition alternatives. Based on the task force review, the following spent fuel management strategy was implemented:

- Continue operation of the Spent Fuel Pit and implement any economically attractive improvements.
- Urge the Department of Energy to accelerate acceptance of spent fuel or to accept financial responsibility for on-site spent fuel storage.
- Continue evaluations of wet and dry storage options to reflect YAEC and industry developments.
- Initiate preliminary design of a dry storage facility.

Additional Years of Wet Fuel Pool Related Operating Cost

The 1995 CS anticipated that fuel would be moved to the ISFSI in 1998; thus terminating fuel pool operational cost at the end of 1998. The current schedule indicates that the fuel will not be moved to the ISFSI until the end of 2001; therefore, three additional years of Wet Spent Fuel Pool operational cost must be accounted for in the current estimate. The estimated impact of this change is approximately \$33.6 MM. The delay in moving fuel to dry storage is related to the extensive time required to obtain approval from the NRC on a Multipurpose Dry Cask Storage and Transportation System. The licensing process has taken over three years. Approval of the multipurpose canister system from the NRC was complete in March 2000. This was the first multipurpose system to be licensed by the NRC. Yankee selected this system because it provided the safest, most economical means for storing and transporting fuel because it eliminates the need to handle the fuel twice, once to put it into dry storage and then again to package it for transportation.

Additional Years of Long-term Dry Fuel Storage Related Cost

The Decommissioning Plan and the subsequent 1995 Cost Study assumed that the spent nuclear fuel would be moved to an Independent Spent Fuel Storage Installation (ISFSI) by the end of 1998. Furthermore, it was assumed that all fuel would be shipped to the Department of Energy (DOE) from the ISFSI between 1998 and 2018. The shipping schedule to the DOE was based on the DOE's published fuel taking schedule at that time. The 1995 CS also assumed that decommissioning of the ISFSI would occur in 2018, thus completing decommissioning in 2018. Based on the most recently published fuel taking schedule published by the DOE, the current cost estimate assumes the spent nuclear fuel will be moved to the ISFSI in 2001 and ship from the ISFSI to the DOE between 2010 and 2020. Decommissioning of the ISFSI and NRC License Termination would take place between 2021 and 2022, as a result, the additional four years of dry storage related costs, not anticipated in the 1995 CS, amount to approximately \$13.7 MM

YNPS began installing a Dry Fuel Storage Facility (ISFSI) in the summer of 2000. Current plans call for fuel to be moved from the Spent Fuel Pool to the ISFSI beginning in the spring of 2001. The fuel will be stored in the ISFSI until the DOE collects the fuel from the site.

BUILDING DEMOLITION & SITE RESTORATION LESSONS LEARNED

Building Demolition & Site Restoration has provided several opportunities for lessons learned at Yankee Rowe. For example, the Environmental Protection Agency (EPA) and Massachusetts Department of Environmental Protection (MADEP) have not determined that it will be acceptable to reuse concrete on the site after it has been decontaminated to reestablish the site grade under a Beneficial Use Determination. The Massachusetts Department of Environmental Protection (MADEP) regulations 10 CMR 19.00 provides a permit mechanism for the beneficial use of demolition debris (BUD Permit) on site. Although, the MADEP had originally agreed to issue Yankee a BUD Permit for concrete re-use, this process was put on hold because of concerns raised by the EPA over the radiological component associated with the concrete rubble. Under the BUD process, the above-ground portion of the buildings would be demolished, and concrete, potentially ranging in size from gravel to large blocks, and possibly rebar would be buried in the below-ground part of the structure and perhaps used for fill to grade portions of the site. If the BUD is not approved and all concrete on site must be disposed of as industrial waste, the potential impact to the current cost estimate could be as high as \$55 million.

Another example of lessons learned in this category involves the demolition of the Diesel Generator/Safety Injection building. In order to demolish the building, the local building inspector had to issue a building demolition permit. Before issuing the permit, the inspector had to have written verification that all hazardous materials had been removed. During the verification process we discovered asbestos in the sub-roofing materials and barium paint on the floor of a battery room. These hazards had to be remediated before the demolition permit could be issued. Since these hazards were not identified during site characterization activities early in the decontamination process, delays and additional costs were incurred.

RADWASTE DISPOSAL LESSONS LEARNED

Low Level Radioactive Waste Disposal Facility Availability

At the time of the development of the Decommissioning Plan, the Low Level Radioactive Waste Disposal Facility (LLRW) at Barnwell, South Carolina was the only disposal facility available to YAEC; however, Barnwell was expected to be closed to YNPS waste January 1, 1993. Therefore, YAEC concluded that the option of complete dismantlement beginning in 1995 was not viable and that YNPS should be placed in a safe storage condition until the year 2003. Under this plan detailed planning and engineering for dismantlement would have begun in 2002, with decontamination and dismantlement activities scheduled to start in 2003 and be completed by 2005.

In late September 1992, YAEC initiated an evaluation of the feasibility of removing and disposing of the four steam generators, the pressurizer and the Reactor Vessel internal components at YNPS. This evaluation was prompted, in part, by an extension of access to the

Barnwell LLRW disposal facility for the period between January 1, 1993 and June 30, 1994. YAEC, with the concurrence of the NRC, initiated a project to remove and dispose of the steam generators, pressurizer, and reactor vessel internals before Barnwell closed. These components were removed from the site with the exception of Greater Than Class-C radioactive material from the reactor vessel internals, which were placed in the spent fuel pool with the fuel. The project was completed before July 1994.

Hazardous Materials

In 1995, PCB based paint was discovered at the plant inside the structure that housed the reactor (Vapor Container). While removing the PCB based paint inside the Vapor Container, asbestos was also discovered under the paint. The original cost estimate included with the Decommissioning Plan and the revised cost estimated, developed in 1995 after the Component Removal Project was completed, did not anticipate the existence of either PCB based paint or asbestos, therefore the cost to remediate these materials was not included.

FINAL STATUS SURVEY & LICENSE TERMINATION LESSONS LEARNED

Final Status Survey

It is very important to have a clear picture of the site's final configuration prior to commencement of Final Status Surveys. Planning the Final Status Survey should include the following:

- **Back-out Plan** - The proper sequencing of decontamination activities for structures/areas will help to avoid or mitigate recontamination of previously released areas and also avoid cross contamination of non-impacted areas. It is equally important to schedule/sequence final surveys to minimize the impact of collateral work activities such as storage, transport of radioactive waste. Environmental conditions such as the weather, dust fallout from demolition can adversely affect final survey efforts.
- **FSS Protocol** - Careful planning and consideration must be made early in the decommissioning process with respect to which structures and areas should be part of the Final Status Survey. Do not include material in the FSS that may require release from the site prior to license termination. Material that the licensee wants to remove from site prior the license termination can not be released via the FSS process. If construction debris, building materials, etc. are to be released from the controlled area, the release criteria will probably be different (lower) from the DCGLs stated in the LTP. For example, it became necessary to remove a storage building at Rowe that had been previously surveyed to the Final Survey release criteria. However, since the material was to be released from site prior to license termination, the structure had to be resurveyed to "no detectable" levels. In retrospect, the better strategy would have been to first decide that structure was not to be included in the Final Survey Plan, then survey the building materials to free release levels, and finally remove the clean material from site.

- **DCGLs** - Changing DCGLs directly impacts the Final Status Survey Plan, procedures and possible even instrument selection. Ensure, if possible, the release criteria are conservative and satisfy all of the regulatory agencies involved. The attached graph illustrates the varying limits that may apply to decommissioning projects (2).

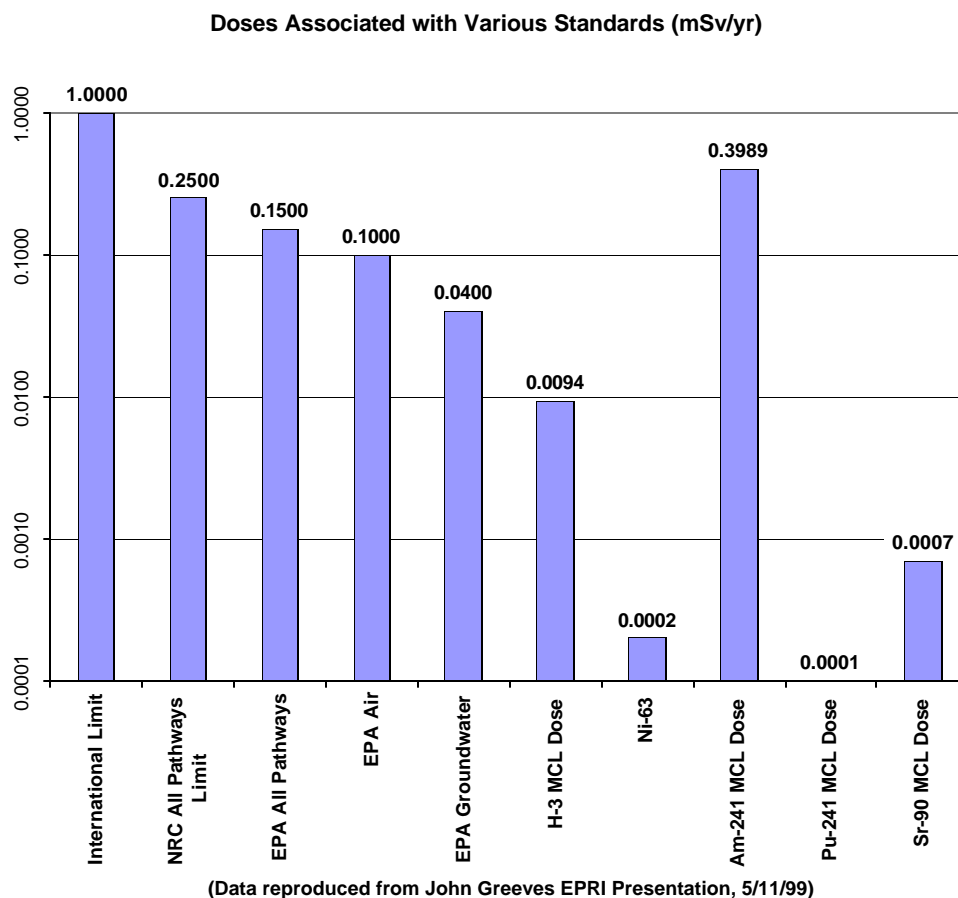


Fig. 4 - Doses Associated with Various Standards (mSv/yr)

Regulatory Requirements

While the NRC still has jurisdiction over the plant's license, other agencies begin to be involved as the project approaches the demolition of buildings and final exit strategies. These agencies can significantly affect the scope and cost of decommissioning.

There are substantive differences between the two primary federal agencies responsible for regulating exposure of the public to radioactive material. Although the USNRC has the primary role as the regulatory agency at facilities that they license, the USEPA also exerts their authority after license termination. It is often times not enough to satisfy the regulatory requirements of the USNRC. Differences in the two agencies in allowable dose to the public can cause a great deal of

conflict and confusion. As if that is not enough to contend with, regulators at the state level may also have their own standards that they apply to a formerly licensed facility. The end result being a "moving target". Meeting the NRC's annual TEDE of 0.25 mSv to the public may not satisfy the EPA required annual TEDE of 0.15 mSv; therefore, an ALARA (as low as reasonably achievable) philosophy should be applied to help ensure compliance with the EPA limit. State agencies may impose an even lower limit.

Given these factors it is critical to define the true limits early on in the decommissioning process. Discussions with all of the potentially involved regulators early in the decommissioning process could mitigate the "moving target" scenario. The additional costs associated with changing the site's DCGLs can be considerable. Revisions to survey plans, re-survey of materials, structures and open land will result in significant impacts on budget and schedule.

License Termination Plan

A License Termination Plan (LTP) is a document that describes how a decommissioned nuclear power plant will meet the Nuclear Regulatory Commission criteria for termination of its license and release of the site for unrestricted use. Yankee submitted a License Termination Plan for the Rowe site in May 1997, but formally withdrew the plan in May 1999 to implement a new radiological survey program called Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM). This new survey program was not available when Yankee's LTP was developed, but is now considered the nationally consistent standard.

Since the permanent shutdown of the Yankee Rowe plant in February 1992, Yankee has been conducting extensive and systematic radiological surveys of the plant site to identify locations and amounts of radioactivity. Yankee expects to gather more than 250,000 readings and test results to demonstrate that the site release criteria have been met and the license can be terminated.

CONCLUSION

The experiences at Yankee Rowe span almost every aspect of decommissioning. Many of the current regulations and decommissioning techniques used at plants throughout the United States were developed based upon the lessons learned at Yankee Rowe. These experiences cover a diverse range of topics from shipment of the reactor vessel and other large components to the application of unique decontamination techniques, and to license termination surveys and license termination plans and hearings.

Scope management is critical in any decommissioning project. This is due to the magnitude of the project and the complications associated with changing regulations and the need to shift from an operating plant to a construction site. The scope must be clearly defined and converted into a statement of work, work breakdown structure, baseline schedule and associated cost estimate.

The strategies associated with decontamination and disposal as well as those of final status survey and license termination must be carefully planned and executed to minimize cost. Disposal options play a large role in determining these strategies; however, other factors such as

safety, labor cost, and the license termination goals must be factored into the decommissioning equation.

To go dry or stay wet is a significant decision that the utility must face early in the decommissioning project lifecycle because of its impact on project resources and cost. Regulations require the spent nuclear fuel to remain in the spent fuel pool for an extended period of time to allow for adequate decay heat removal prior to placing the fuel into dry storage. In Yankee's case, this equated to 5 ½ years following shutdown. This would seem to imply that there is ample time to make this decision. However, lessons learned at Yankee indicate this decision cannot be made too soon.

Determining the true nature and extent of radiological and non-radiological contamination is the basic element in defining the scope of a decommissioning project. From a Risk Management perspective accurate characterization data does more to fix the scope of a project than any other activity that the project staff can control. Failure to properly characterize a facility can lead to poor decisions on cost and schedule, decontamination strategy and Final Status Survey.

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