REACTOR AND FACILITY DECOMMISSIONING AT THE ARMY MATERIALS TECHNOLOGY LABORATORY– A MODEL FOR CONTROLLING DECOMMISSIONING WORK

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ABSTRACT

This paper describes a management and technical methodology to minimize risks by controlling the decontamination and decommissioning efforts at military and industrial facilities. These facilities contain radioactive, hazardous, and mixed wastes. The project discussed can be used as a model for work scope definition and specification of activities necessary to manage carefully this type of large decommissioning effort in a timely and cost-effective manner. By using the Facility and Reactor Decommissioning Plans as a basis and following them with detailed site walkdowns and entries, Stone & Webster Engineering Corporation prepared implementation documents to control the work. In each case, a different decommissioning methodology resulted in better controlled and documented activities with a net savings for the Government. The work was complicated by the necessity to address hazardous waste, mixed waste, low-level radioactive waste, and asbestos removal. Each of these had its own regulations and requirements for processing and handling that required strict attention to detail. Often the handling and processing of the various waste streams were performed simultaneously due to their physical proximity.

INTRODUCTION

The U.S. Army Material Technology Laboratory (MTL) is a major research and development facility located in Watertown, Massachusetts, approximately 5 miles west of metropolitan Boston. The present day MTL facility has evolved out of the former Watertown Arsenal established in 1816. Many of the buildings at the MTL facility date to the nineteenth century. The MTL facility is engaged in research, testing, and evaluations of material for incorporation into various Army systems. A 5 MW research reactor, the first nuclear research reactor designed and built for the U.S. Army Ordnance Corps research program, is located at the MTL facility and was operated from June 1960 to March 1970. The facility also incorporates buildings that once housed depleted uranium melting, fabrication, testing, and analyses operations. The MTL facility, which currently holds U.S. NRC licenses under 10 CFR Part 30, 40, 50 and 70, will be closed September 30, 1995 as part of the Defense Authorization Amendments and Base Realignment and Closure Act. Since the property is to be sold after closure, it must satisfy the clean-up standards for "unrestricted use." To accomplish this, all radioactive materials and residual contamination must be removed from the facility and the NRC licenses terminated prior to the facility's closure.

To terminate the NRC licenses, MTL must decommission the research reactor, discontinue the use of radioactive depleted Uranium, and clean those areas where depleted Uranium was used. The reactor and a total of 10 buildings of various types, sizes, current uses, and degrees of contamination required implementation documents to allow decontamination and decommissioning to proceed.

As Licensee, the U.S. Army Laboratory Command - Materials Technology Laboratory, Watertown, coordinates all NRC submittals and is the primary interface with the NRC. The U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) is the lead Government agency responsible for the preparation of the decommissioning plans which were submitted to the NRC and reviewed for regulatory compliance. The U.S. Army Corps of Engineers - New England Division (NED) is the responsible Government agency for the specification and implementation of the decommissioning plans. Figure 1 shows the general organizational responsibilities.

Stone & Webster Engineering Corporation (S&W), under a contract agreement with ABB-Environmental Services (ABB-ES), has the lead technical responsibility for the development of the decommissioning design packages which include specifications, design drawings, construction cost estimates, and schedules for the decommissioning of the MTL facility. ABB-ES is under contract to NED.

The Government established aggressive schedules to avoid significant disposal surcharges imposed by the disposal facilities effective January 1993. More importantly, the schedule was accelerated by the threat of denied access to Massachusetts low-level radioactive waste generators after January 1, 1993, because of the failure of the Commonwealth to meet specific milestones established in the Low-Level Radioactive Waste Policy Act of 1980 and the 1985 Amendments to the Act. The Army planned to move aggressively to develop the decommissioning design packages plan, which would enable the construction contractor to initiate work and quickly ship for disposal as much of the low-level radioactive waste as possible before January 1993.

S&W received authorization to begin work on the design packages for reactor decommissioning and demolition on April 22, 1992. S&W delivered the completed reactor design package, including all the Government's review comments, in 180 calendar days. Following completion of the reactor design package, S&W received authorization to begin work on the design packages for decontamination and decommissioning of the remaining buildings at the facility. S&W delivered the completed laboratory facility decontamination and decommissioning design package, including all the Government's review comments, in 114 calendar days. The decommissioning contractor began mobilization on July 1, 1992.

The rapid response of the S&W design team provided adequate time for the decommissioning contractor to complete the removal of all radioactive material from the research reactor and a very significant portion of the radioactive

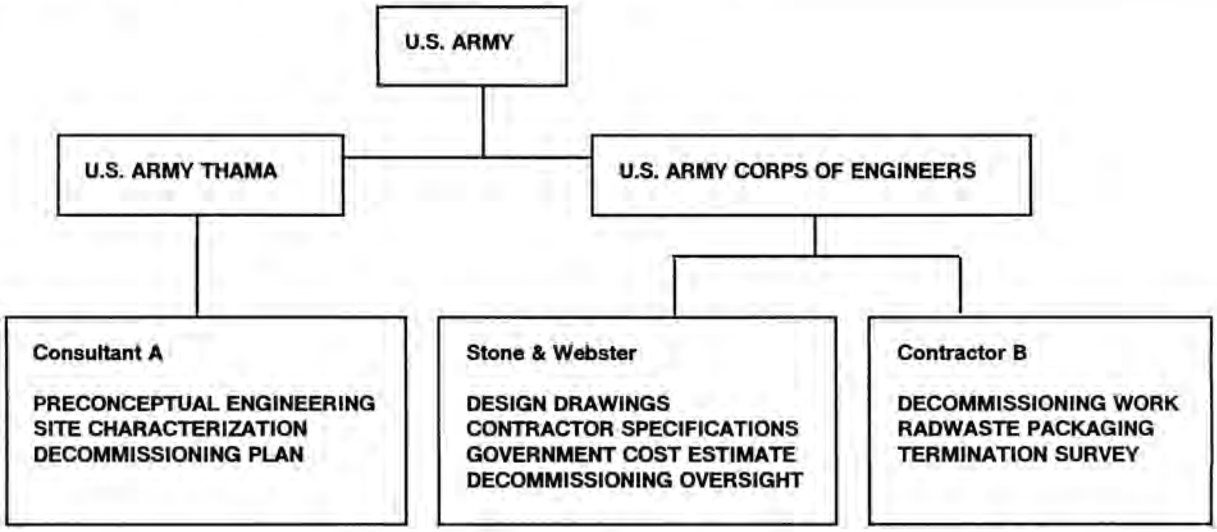

Fig. 1. General responsibilities.

material from the remaining research facilities prior to the initiation of disposal surcharges. Over 1000 cubic meters or 36,000 cubic feet were shipped for disposal. Access to the disposal facility for Massachusetts generators was granted after January 1, 1993, but significant surcharges are being imposed.

Although not closely related in terms of the decommissioning methodology, the reactor and facilities projects had to satisfy the following generic objectives.

1. Personnel performing the work must not be exposed to radiation in excess of the 10CFR20 and applicable Commonwealth limits.
2. The public must not be exposed to radiation in excess of the 10CFR20 and applicable Commonwealth limits during the performance of the work.
3. Material released for disposal in unrestricted landfills must not contain contamination in excess of 10CFR20 and applicable Commonwealth limits.
4. The site shall be released for unrestricted use following completion of a final termination survey and must meet the limits imposed by 10CFR20 and Commonwealth regulations. (The discovery of contamination during the termination survey would have disproportionate cost and external effects as the facility moved toward closing. Therefore, it was deemed essential to have a successful Final Termination survey indicating a clean facility.)

This paper focuses on the activities after the two Decommissioning Plans were prepared (one each for the reactor and the remaining facilities), and prior to the award of work to the decommissioning contractor for performing the physical work activities. Also, it discusses the level of detail required for work initiation to satisfy risk management needs. By identifying preferred decontamination techniques, providing detailed cost and schedules, and preparing scope definition, an appropriate level of risk management was obtained.

SITE WALKDOWNS

Engineers conducted comprehensive field walkdowns, including hazardous waste and/or radiologically controlled area entries. The walkdowns documented the existing conditions of the facilities that had undergone extensive renovation and expansion in the past decades. Many of the facility modifications were not documented in a readily retrievable manner on as-built drawings. These walkdowns proved valuable as a source of information for field conditions, work scope definition, and cost estimate development. Photographs were taken and used as an integral part of the specifications, providing greater task definition and an approved basis for the contractor's cost estimate. In the case of the facilities, the job scope definition was prepared to define a work task. This correlated to an identified area on the design drawing and a specific task identified in the work specification for that building. It was also tied to the cost estimate.

The walkdowns and subsequent comparison to existing drawings helped to define the decommissioning methodology. In the case of the reactor and its building, good as-builts existed. This fact, coupled with the need to maintain an engineered sequence for structural stability during dismantlement, allowed the use of a prescriptive step-by-step set of instructions.

The facility buildings had been modified over decades and good as-builts were not available. This necessitated defining a process where areas of common decommissioning activities were marked out. The specifications then established the acceptance criteria and described allowable methodologies. Types of activities included removing specific contaminated equipment, reperforming characterization, aggressively removing material for decontamination, and cleaning the general area or defining an area as requiring a final survey only. This methodology provided assurances that the entire facility would receive the appropriate attention.

An additional benefit was the development of estimated decommissioning crew sizes and decontamination times as the walkdowns occurred. This provided a more developed basis for the cost estimate than a table and multiplier methodology.

The first walkdown, performed at the beginning of the task, reviewed the areas of proposed decommissioning and decontamination. The areas were photographed for future reference, and the photographs were filed in the job book.

In establishing the Design Basis/Analysis, the following were considered.

- The Impact on Facility Operations - The decommissioning and decontamination activity should be identified and coordinated with ongoing activities at MTL, taking into consideration ALARA requirements.
- The Impact on Engineering and Design - The plans for decommissioning should be prepared in a manner that simplifies the engineering and design process and provides for Contractor flexibility.
- Upon completion of the walkdown, a walkdown report form was completed along with the inspection plan check sheets.

SPECIFICATION DEVELOPMENT

The reactor was removed from service in 1970 and the licensee maintained a "possession only" license since that time. Up until the 1990 timeframe, the decommissioning mode was the SAFSTOR, as the site is controlled by the Army 24 hours a day and access to the reactor building was restricted.

With the reactor in the SAFSTOR mode and with the licensee holding a possession only license, the licensee did not have active procedures for working in a radioactive environment, processing radioactive materials, or dismantling radioactive systems and structures.

The Decommissioning Plans were not intended for use as functional work documents for a decommissioning contractor. Because of this and the lack of existing site procedures to cover all activities, the major focus of specification development was to provide implementation requirements, special requirements of the Decommissioning Plan, project documentation, and the scope of work. In addition, the specifications were used to ensure that the contractor met the general project objectives identified previously.

Quality Assurance (QA) is a Project objective and an important factor in preparing the content of specification documents. Some of the QA considerations are as follows.

- Apply the QA Program to:
  - regulatory requirements identified in the decommissioning plan
  - requirements of technical specifications
  - requirements of the MTL Radiation Protection Program
  - packaging and shipping of radioactive material
  - in-process radiation surveys
- Establish measures for procurement control.
- Establish measures to control the development, revision, and use of documents which define activities that affect quality, including:
  - work instructions and procedures
  - drawings
  - information management
  - radiation survey results
  - field changes
- Establish measures to monitor the adequacy of the decommissioning process in regard to the following:
  - public health and safety
  - security
  - maintenance of ALARA
  - conformance to state and federal regulations
  - document control
  - disposal of radioactive material
  - radiation survey
  - conformance to the QA program
- Establish measures for the control and calibration of measuring and test equipment.
- Establish measures to identify and correct significant conditions adverse to quality, health, and safety.
- Establish measures for the collection, storage, and turnover of decommissioning quality records.
- Establish an audit program.
- Establish measures to control the identification, packaging, shipping, inspection, and storage of radioactive material.

The performance specifications are divided into sections describing acceptable methods of performing tasks. Procedures subject to approval were prepared later by the contractor. Decontamination technologies are specified in a manner to allow the contractor ease in choosing the most effective technique for its task. These specifications for reactor and facility decommissioning and decontamination include the following.

General Project Requirements

- Summary of Work
- Contractor-Required Submittal Descriptions
- Submittal Procedures
- Data Management Specification
- Contractor Quality Control and Quality Assurance
- Worker Health and Safety Requirements
- Environmental Protection and Maintenance of the Site During Construction Operations including Noise Control

Radiological

- Radiation Work Requirements
- Radiation Monitoring Equipment
- Guidelines to Establish a Radiological Control Area Including Radiological Environmental Monitoring
- Protective Clothing Donning and Removal
- Personnel Frisking Instructions
- Quality Maintenance Teams
- Decontamination Techniques — Selection and Precautions
- Decontamination, Dismantling, and Packaging of Radiologically Contaminated Reactor Laboratory Equipment
- Materials for Decontamination
- Decontamination of Steel Structures
- Decontamination of Concrete Surfaces
- Limits and Procedures for Controlling Airborne Radioactivity
- Housekeeping in the Radiological Control Area

- Techniques for Decontamination of Items and Surfaces
- Techniques for Decontamination of Small Tools
- Techniques for Decontamination of Large Components
- Packaging, Handling, On-Site Storage, and Shipping of Radiologically Contaminated Material
- Inspection, Decontamination/Disposal of Radiologically Contaminated Construction Equipment
- Decontamination of Sumps and Tanks
- Wrapping and Identification of Contaminated Material
- Control of Tools and Equipment Used in Radiological Control Areas
- Draining and Cutting of Contaminated Pipe

Site Specific

- Site Preparation
- Preservation of Historic Artifacts
- Ten separate specifications for Buildings 37, 39, 43, 97, 100, 241, 292, 311, 312, and 313 detailing the required individual tasks.
- Structural Demolition
- Surveys for Contamination
- Hazardous Waste Characterization, Decontamination, and Disposal
- Demolition and Removal of Contaminated HVAC Equipment
- Removal and Disposal of Asbestos Materials
- Grading and Site Restoration
- Excavation, Filling and Backfilling for Building
- General Provisions for Electrical Work

These performance-based specifications were the governing documents the decommissioning contractor used to develop its implementing procedures. The intent was to define the work scope and limits carefully, and then provide the contractor flexibility in choosing the final decontamination technique from the several that were allowed.

DESIGN DRAWINGS/SCOPE OF WORK DOCUMENTS

It was recognized early in the project that the Decommissioning Plans should not be used as functional work documents for a decommissioning contractor. S&W developed work specifications, drawings, and a Government cost estimate for negotiation purposes, and carefully defined the actual work. The complexity, uncertainty, or unavailability of detailed information, and the need to satisfy regulatory, ongoing facility missions and quality requirements resulted in a need to develop performance-based specifications. In addition to developing the specifications, S&W prepared specialized decontamination and decommissioning drawings that identified limits of work and defined tasks to be performed. By defining work in this manner, maximum contractor flexibility was maintained without affecting the contract. Because of the accelerated schedule and the need for a high level of confidence to remove all contaminants, the project focused on scope definition for tasks.

S&W prepared the decontamination and decommissioning drawings in two different manners to suit the different requirements of the reactor and facilities decommissioning. The reactor and its structures required close attention to job sequencing and specific work activities. Due to the great differences between the facility buildings, tasks were assigned by localized area to encompass all required tasks including characterization, demolition, decontamination, and final termination surveys. S&W prepared these drawings after careful review of all available original data, the Decommissioning Plan, and field walkdowns. This front- end detailing identified many tasks that likely would have been considered job extras, and because of early identification, improved the Government's cost estimate and better defined the job scope.

COST ESTIMATION

The detailed cost and quantity information was considered commercially confidential due to its application during contract negotiations. The Government's cost estimate was prepared to follow closely the work packages and descriptions identified in the specifications and drawings. This proved to be a successful means of work breakdown, allowing a valid comparison between contractor and Government values. Also, it provided a convenient means to track "in progress" costs to minimize financial risks.

Recently, the Boston Globe quoted Army officials as saying the project was valued at $35 million, including $5.5 million to package, ship, and dispose of the wastes.

SUMMARY AND CONCLUSIONS

In accordance with its policy, S&W developed a "Lessons Learned" summary. Engineering problems were limited and restricted to minor items concerning the methods to be used to characterize the radioactive waste isotopic content. Also the demolition sequence required adjustments to dismantle noncontaminated concrete platforms to ensure the reactor building platforms are properly supported during demolition. Logistical and construction operational problems consisted of establishing the means to allow the following.

- Research operations to continue during decommissioning.
- Use of permits to draw water from public sources and discharge treated effluent into controlled sewers.
- Interface with the responsible Army agency (AMCCOM) for packaging and shipping of contaminated low level wastes.
- Relocation of MTL's research activities requiring coordination with facility management.

It should be noted that the cleanup of hazardous wastes as well as mixed wastes proved to be particularly challenging. These wastes need to be removed before the goal of unrestricted release of the site can be met. An estimated 565 cubic meters or 20,000 cubic feet of mixed waste will be generated that must be sent to authorized disposal areas.

The flexible manner in which the work scope definition documents were prepared provided a means to work systematically with the regulations to ensure a smooth cleanup effort. This methodology should be considered for future cleanups of Government and industrial facilities. The project proved the value of preparing detailed implementation documentation as a follow-up to the Decommissioning Plans. Risks can be better defined and controlled at this level of detail. The project benefitted from exploring the wide range of existing technologies and selecting appropriate ones as it progressed toward the decommissioning of a proven and valued facility.

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