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Lessons Learned in Transitioning to D&D and Demolition of the First Plutonium Facility Within the DOE Complex

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Objective: DOE facilities have been operating in a production mode even as they transition to a Decontamination & Demolition (D&D) mission. The Rocky Flats Environmental Technology Site (RFETS) has successfully completed the first full-scale D&D of a production plutonium building with the recent teardown of Building 779. This paper discusses the transition approach to D&D, lessons learned, and reasons for success that evolved from that project and the potential application to other DOE sites and projects with a similar mission.

Workshop Relationship: Areas addressed by the paper include:

- Authorization Basis – Changes to support D&D mission
- Project Management – Transitioning from operations to project management
- Readiness Assessment – Approach used to support the project and ensure safe implementation
- Accident and Safety Analysis – Identifying and minimizing risk and uncertainty
- Safety Management – ISMS implementation in D&D.

Description: The paper summarizes the two-year timeline in taking Building 779 to the ground, starting with removal of the first glovebox and ending with demolition of the complete structure to ground level in December 1999. Some of the items discussed include:

- Organization structure of the Project
- Project management approach
- Paradigm changes
- Crawl, walk, run strategy used to maximize the learning curve and minimize risk
- Readiness assessment strategy used to validate safety precautions, emergency response, training, and readiness to proceed at each major phase of the project
- Subcontractor participation and incentives
- Project phases and sequencing
- General assessment of what did and did not work
- Summary of overall lessons learned.

Results: The approach used was recognized as highly successful in achieving performance measures with an excellent and constantly improving safety record. Regulatory confidence and support was attained at all stages of the project.

Benefits to Others: The transition to D&D can be an extended process with many options and multiple pathways, many of which add to schedule and cost, and may not lead to success. The results at Rocky Flats indicate a successful approach that has direct application to most DOE sites. This experience and corresponding lessons learned can substantially shorten the learning curve and minimize false starts for similar projects.

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Introduction

In March 1995, DOE planned to close the Rocky Flats Environmental Technology Site (RFETS) by 2060 at a cost of more than $37 billion. The recently negotiated contract with the current operating contractor, Kaiser-Hill, L.L.C., is now looking at a 2006 closure date with a remaining cost of $4 billion, which would reduce the $37 billion to $7 billion. The lessons learned from the successful decontamination and demolition (D&D) of Building 779 at RFETS are a significant contributor to this revision in time and cost. This paper discusses the salient project elements that contributed to this achievement, starting with removal of the first glovebox in February 1998 and ending with structural demolition of the remaining buildings in the Building 779 cluster in January 2000. This is the first major plutonium facility to complete the D&D process within the DOE complex.

Background

The purpose of the Building 779 Closure Project was to decontaminate, decommission, and demolish the entire Building 779 cluster of structures. Building 779 was used as a research and development facility that contained 130 gloveboxes and tons of contaminated ancillary equipment. The cluster also included two four-stage HEPA filter buildings and various smaller support facilities including cooling towers, chillers, a pump house, and an emergency generator building.

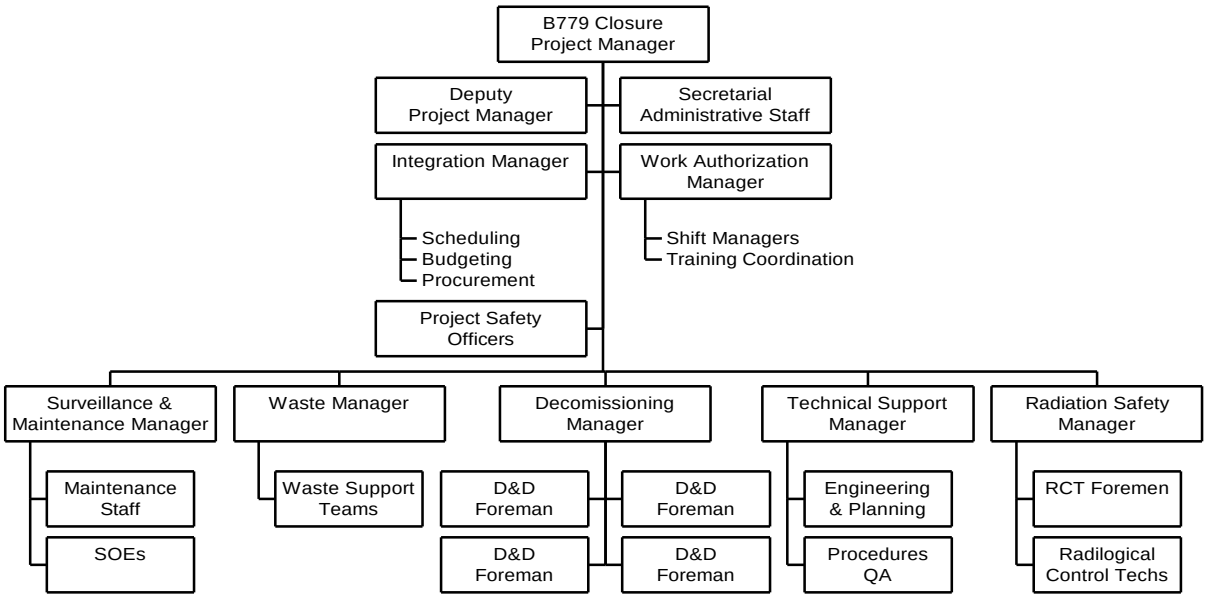
The major contaminant of concern in Building 779 was plutonium in an oxidized state, which was distributed throughout several rooms. Other contaminants of concern included americium, uranium, lead, asbestos, beryllium and polychlorinated biphenyls (PCBs). The original building was constructed in 1965 and was expanded several times, resulting in a single and two-story configuration totaling 65,000 sq. ft. The last upgrade added massive reinforced-concrete abutments around the exterior of the building for seismic reinforcement to the basic concrete block construction of the facility.

The D&D project was initiated with core staffing in October 1998 at the beginning of a new fiscal year. Prior planning included definition of scope, estimation of budget, and development of a Decommissioning Operations Plan (DOP) for stakeholder approval, primarily the Environmental Protection Agency and the State of Colorado. Characterization of the facility was fairly complete and proved sufficient to accurately define the major elements of work and the relative risk to the public and worker. However, many hazardous conditions were difficult to evaluate ahead of time, resulting in varying degrees of uncertainty throughout project execution.

Project Management Approach

Since Building 779 had been in a more or less dormant state for a number of years, staffing was accomplished by assembling a new project team from a multitude of other on-site facilities. The project was assigned to Rocky Mountain Remediation Services (RMRS) for execution, with Kaiser-Hill, L.L.C., as the site operating contractor having oversight responsibilities. The core project organization structure shown in Figure 1 reflects the diversity of skills needed to accomplish D&D.

Figure 1 – Building 779 Closure Project Organization Structure



The entire D&D effort was conceived and executed from a strong project perspective in lieu of a weaker, matrix-supported organization structure. All necessary personnel and resources were assigned directly to the project, with management having full authority over assignments and responsibilities. Many of the functional site organizations, which typically assign personnel on an ad hoc basis to satisfy facility needs, provided full-time personnel to the project, including engineers, planners, D&D work force, Health and Safety personnel, and Radiological Control Technicians (RCT). Limited support functions, mostly involved with activities external to the facility, were available on an as-needed basis. These support groups included central waste verification and shipping, characterization sampling analysis, and full-time emergency response. The Project also directly contracted for specialty needs, such as asbestos abatement and Davis-Bacon construction work.

Paradigm Change

Previous large-scale D&D efforts at RFETS were associated with smaller structures with standard industrial contaminants, such as asbestos and PCBs. The magnitude of this project, in conjunction with a refocus of site priorities and schedules, revealed two major issues:

- The site culture assumed that RFETS would be around for decades, and that worker positions would be secure with a slow transition from a maintenance or standby mode of operations to true D&D. At first there was a reluctance to accept the fast pace of change, with success judged by the speed with which personnel worked themselves out of a job. Workers soon realized that their demonstrated success would be a marketable skill for the expanding D&D tasks on site.
- An aggressive D&D schedule requires more resources than the site's old production role. The number of people supporting D&D was estimated to be over twice the number of people in the building during its peak production period. Due to the constant demolition of previously occupied space, there was a ongoing need to provide logistical support for personnel for office space, showers and lockers, and security access. This was resolved by relocating the support staff to a smaller adjacent building, which was once the site library, and providing supplemental space with trailers for de-construction contractor staff.

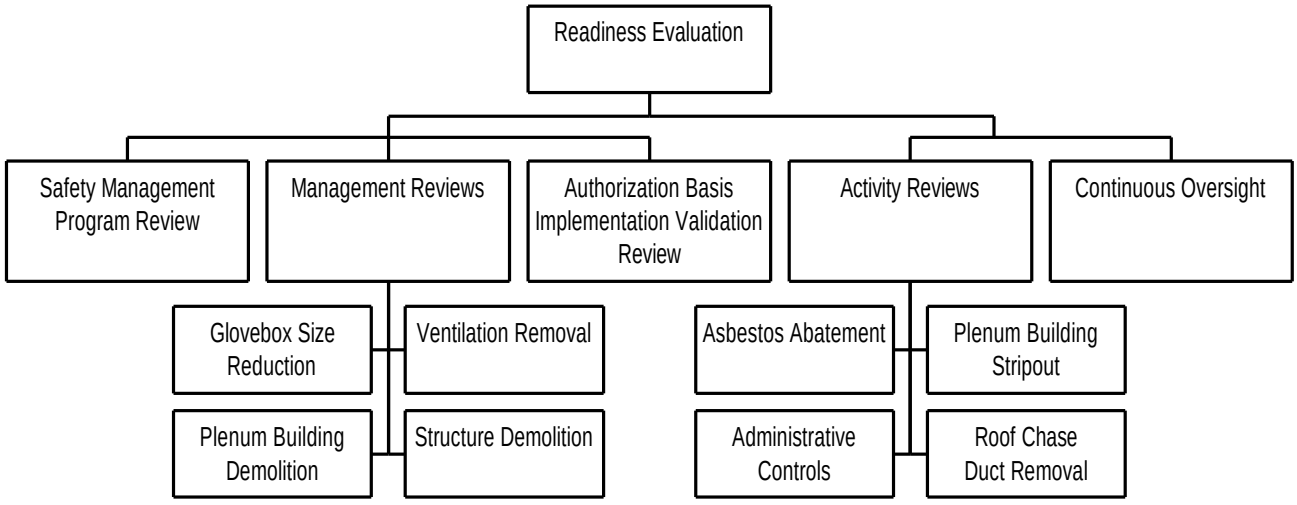
Crawl, Walk, Run Strategy

The project was planned in phases that recognized the need to proceed cautiously, starting with easily definable scope with minimal risk, with each subsequent phase taking on progressively more challenging D&D activities only after skills and capabilities were well proven. This so-called "crawl, walk, run" strategy supported training of workers with no previous D&D experience, and allowed testing of new D&D techniques in circumstances with relatively predictable degrees of risk. Under this strategy, project line management was fully responsible for project execution. Line management was also responsible for implementing the site's Integrated Safety Management System (ISMS). This system requires that hazards associated with planned work be identified; controls to protect workers from these hazards be established; work instructions implementing these controls be prepared; and workers be trained to satisfactory levels of proficiency before beginning each new work activity. Oversight by Kaiser-Hill, management pre-evaluation by line management, and readiness evaluations by an experienced evaluation team were used to validate the growing overall proficiency of the project and to assure that planned work activities could be performed safely and compliantly.

Readiness Assessment Strategy

The readiness demonstration strategy employed by Kaiser-Hill Closure Projects was designed to track the project's approach of gradually tackling more and more challenging D&D activities. A Closure Project Readiness Evaluation Team (CPRT) was established early in the project life cycle to support the project's aggressive schedule. The readiness team was composed of highly experienced and qualified personnel with diverse backgrounds and readiness assessment experience. The CPRT conducted four types of readiness evaluations and provided a continuous oversight function, as shown in Figure 2.

Figure 2 - Readiness Evaluation Structure



The Safety Management Program (SMP) Review was the first major assessment, which evaluated the overall implementation of the ten safety programs in the facility, including Engineering, Emergency Management, Occupational Health and Safety, Environmental Protection and Waste Management, Fire Protection, Management Systems, Nuclear Safety, Operations, Radiation Protection, and Training and Qualification. As the configuration and operations in the facility changed, it was also necessary to implement a new Authorization Basis (AB) that addressed the D&D related hazards, which impacted the technical safety requirements, limiting conditions of operations, and administrative controls within the

facility. The CPRT conducted an Implementation Validation Review (IVR) of the new AB, in this case a Basis for Interim Operations.

Task specific reviews were conducted in accordance with DOE Order 425.1, *Startup and Restart of Nuclear Facilities and Activities,* with particular emphasis on the 20 core requirements listed in the Order. A graded approach was used for all task-oriented reviews dependent on the magnitude and complexity of the task. More formal management reviews were conducted for the complex, first time activities, and less formal activity reviews were conducted for less complex activities. A total of 12 management and activity reviews were conducted by the CPRT over the life of the project, including the IVR and SMP reviews.

The recognized benefits of this assessment approach include:

- DOE and regulator confidence was established at the start of the project and maintained throughout the lifecycle.
- By maintaining a continuous oversight presence, the oversight team was aware of evolving conditions, could focus on safety and compliance issues, and could anticipate and support the project assessment schedule.
- The CPRT acted as the primary interface with regulators and other internal assessment teams to lessen their disruptive impact to the project.
- The graded approach minimized the usual assessment impact to the project. Activity Reviews were typically completed in less than two full days and required minimal preparation by the project. The project was usually able to proceed immediately with the work.

D&D Assignments and Subcontractor Participation

Decisions regarding who would perform the various phases of D&D were made early in the project execution based on the degree of contamination involved in each major element of work scope and Davis-Bacon determination requirements. Basically, the on-site crafts, represented by the Steelworkers Union, were assigned to remove all capital equipment, gloveboxes, and contaminated utility systems above a surface contamination count of 2,000 DPM. The use of specialty and construction subcontractors played a major role in the execution of all other D&D activities. Subcontractors were used for these major areas of work:

- Asbestos Abatement
- Interior strip out and demolition of the separate four-stage plenum buildings
- Building interior strip out of ductwork, piping and miscellaneous utility systems having surface contamination levels below 2,000 DPM
- Surface decontamination of walls, ceilings, and floor surfaces to free-release levels
- Demolition of building structural components.

A definitive statement of work was provided for the procurement process, and the majority of contracts were awarded using fixed-price, competitive subcontracting methods, usually with incentives for early completion. Three major subcontractors were ultimately used, and each subcontractor underwent a readiness assessment before beginning work for each new phase of D&D. This approach ensured that each new subcontractor had appropriate training, was familiar with requirements, and that the D&D methodology proposed was well understood and could be supported by the project's infrastructure.

D&D Technology

Multiple approaches for the actual D&D were applied at various times in the facility. A combination of proven and new technology was successfully employed, particularly in the size reduction arena. The primary D&D strategies involved:

- Prefabricated structures, called soft-side containments (SSC), were erected inside the building for contamination control. The SSCs were individually pre-sized to fit the facility and included separate entry airlocks for equipment and personnel, ventilation connections to maintain negative pressures, and ports for direct disposal of waste into standard waste boxes and drums. At one time four SCCs were in use in the performance of size reduction operations.
- Wherever possible, gloveboxes and equipment were disconnected from local utilities and separated from adjacent equipment, and then moved to dedicated SSCs for size reduction. In-situ size reduction was avoided where feasible.
- Most gloveboxes had sufficiently high levels of contamination to require size reduction by personnel using breathing air suits. Airborne contamination levels inside the SSC were constantly monitored, and action levels were established for evacuation of the SSC and protection of personnel. For lower levels of contamination, personnel used powered air personnel respirators (PAPR). This was the first time PAPRs were used at the site. By using personnel outside the SSCs acting as "spotters" for three workers inside the SSC, the incident rate started out low and continued to improve as the Project progressed. The typical size reduction team consisted of 10 to 12 workers with one supervisor.
- As part of the ISMS process, worker involvement was extensive in the development of the work packages and planning the actual sequence of work. Daily evolution briefings were conducted to walk-through the daily work scope and to obtain final worker input.
- A fixative was applied to all interior surfaces of gloveboxes to congeal loose material and trap contamination during vibration caused by mechanical size reduction activities.
- Disassembly and size reduction were accomplished using mechanical disassembly methods, primarily using Sawzalls and sheet metal nibblers that could cut up to ¼-inch stainless steel. Although labor intensive, workers quickly became proficient and creative in planning and performing size reduction tasks.
- Decontamination of concrete block and concrete surfaces was required to allow the demolition of the buildings for free-release and removal of rubble to a landfill or as scrap metal. A high-pressure water nozzle (25k to 40k psi) with a 6-inch circular head was very effective at reducing contamination below required levels by removing from 1/16-inch to 3/8 of surface material. Water usage rates were a maximum of 6-gallons per minute, and the resultant waste water was stored in tanks and processed through existing site process water systems.
- Demolition of the building structures was almost exclusively accomplished using 50-ton steel-tracked backhoes with combinations of shears, buckets, jaws and impact hammers.

Regulatory Interactions

Because of the shifting priorities as highly contaminated materials and other hazardous materials were progressively removed from the 779 Buildings, the levels of interest by the various regulators also changed. Initially, the Defense Nuclear Facility Safety Board (DNFSB), the State of Colorado and the DOE were focused on nuclear materials like plutonium, americium, and especially hydride materials.

The State and DOE became more concerned about beryllium removal during the D&D process. Later, before demolition, the State and DOE focused on safe removal of asbestos.

Meeting the needs of all regulators (DOE being both the client and a regulator) and responding to their concerns was a top priority of the Project. Key steps to success were:

- No surprises – Met with the regulators prior to all major evaluations and assured that project expectations were well understood.
- Real time communications – Kept regulators informed of progress, issues and incidents in real time.
- Respond appropriately – Identified regulatory concerns and responded reasonably and immediately. This required continuous oversight by the project and balanced responses (not knee jerk reactions) to both regulatory concerns and incidents.
- Closure – Closed issues formally by the project.
- 425 process –Followed the process and requirements in the Site Readiness Manual, which tracks DOE Order 425.1, for all project oversight and readiness assessments, IVRs, etc. Project issues tracking and closure was sensitive to the two DOE rules, Quality Assurance and Radiation Protection.

Summary of Lessons Learned

Project performance was constantly being measured and monitored, both within the context of standard performance parameters and also against the proven successes and issues that developed during the course of project execution. Tracking and sharing of lessons learned was a constant point of emphasis that was acknowledged as a direct benefit in the training and learning process. This listing of the broader lessons learned was selected from the final listing prepared by the project.

Positive Lessons Learned (What the Project did well):

1. It was advantageous to use a combined project and operations organizational structure for D&D. Appointing functional resources within the project (e.g. Health and Safety, Radiological Engineering) also improved the control and usage of resources.
2. Project key personnel were assembled, wherever possible, from a background of applicable experience. This approach proved its effectiveness by demonstrating over the course of a series of management reviews that the team had a high degree of commitment, leadership, and competence.
3. Subcontracted Building Trades Union and the Steel Workers were cross-trained and shared the same lessons learned program.
4. Based on a series of high contamination incidents and the corrective actions that were generated by these incidents, a need was established to conduct activity specific assessments for high risk glovebox work.
5. Many incremental improvements were made over the course of the project for work in the SSCs. These improvements included:
    - Improving use of point source ventilation
    - Adding blowers at certain size reduction tents
    - Establishing a worker lessons learned program

- Investigating fixatives and alternative tools and techniques
- Bracing piping under tension before cutting to control spread of contamination
- Correcting of inconsistencies in crimp-and-cut techniques between different D&D workers
- Increasing expertise in hand off of work between crews
- Enhancing worker walk downs
- Posting worker suggestion boards
- Obtaining worker input at all hands meetings
- Applying fixatives during cutting operations
- Labeling piping to ensure better identification during size reduction
- Making constant improvements in decontaminating tents
- Eliminating of requirements to sort certain waste types
- Sealing pipe ends
- Placing material in waste boxes as soon as practicable to preclude the spread of contamination.

6. Many of the improvements relied primarily on training and worker knowledge. The workforce was acknowledged for their contribution to making their own work safe, performing this work consistently, and exhibiting a high degree of safety consciousness at all times. B779 management and radiological personnel greatly influenced an environment where these types of improvements, over the course of time, were the normal course of business and in the spirit of continuous improvements.
7. Project regulatory needs were met by the project. Continuous oversight provided a constant flow of information to all regulators and helped to set future expectations in a balanced and proactive manner.

Common Issues:

1. Multiple oversight groups were not always carefully aligned with each other. This confused the flow of the traditional project process since it was not clear to all organizations regarding what approvals had been granted on key issues of concern. As a result, these issues were debated over and over again.
2. Key issues of concern were not always well documented once they were understood. As a result, when the same issues were raised by project personnel, DOE, or other site organizations, they were often debated again.
3. The determination of training requirements, required training, and training documentation were not completely defined in a timely manner.
4. The engineering and planning process, as well as the deconstruction sequencing and scheduling efforts, can be complex and must be reviewed based on a the final agreement on scope and methodology.
5. The methodology of size reduction within the SSCs evolved over time and was not well documented and frequently left to the knowledge of the craft. It was, thus, very susceptible to criticism.
6. Although much of the size reduction methodology in Building 779 relied on the skill of the craft, it is important to make engineers and planners joint participants of a continuous improvement process. Ideas for improving the performance of work in size reduction tents will be needed for the more complex work scope in other D&D facilities at RFETS that will require technical innovation to be successful.

7. Combustibles and tripping hazards had a tendency of becoming a concern over time if not constantly watched by building management.