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DEACTIVATION OF TRITIUM CONTAMINATED FACILITIES AT THE DOE'S MOUND PLANT

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ABSTRACT

The DOE Mound Plant in Miamisburg, Ohio is facing a big challenge in the cleanup of its tritium facilities. These laboratory buildings were among the original buildings built at Mound back in late 1940s. Through the years, they were used for a variety of purposes, including tritium recovery, testing, research and development and are heavily contaminated with tritium and other radionuclides. The Mound Plant combined safe shutdown of these facilities into a single project. The first deactivation project of this magnitude in the DOE complex (~$200M), the Mound will need to complete it with full protection of workers and the environment within the next five years.

INTRODUCTION

The DOE Mound Plant in Miamisburg, Ohio is undergoing a significant transition in cleaning up the former weapons facilities for commercial use. In the next five years, Mound will demolish, decontaminate or transfer more than 100 facilities and 100 acres of land to a non-commercial organization, Miamisburg Mound Community Improvement Corporation. (MMCIC), which oversees the site's industrial development for the city. Among these facilities, three buildings present the biggest challenge for this endeavor, namely, Technical (T) Building, Semi-Works (SW) Building and Research (R) Building. These laboratory buildings were among some of the original buildings built at Mound back in late 1940s. Through the years, these buildings were used for a variety of purposes, including tritium recovery, testing, research and development and are heavily contaminated with tritium and other radionuclides.

T Building is a heavily reinforced underground concrete structure with about 173,000 square feet of the floor space. The reinforced concrete exterior shell has a 15-foot thick roof; 16-foot, 7-inch thick walls; and an 8-foot, 3-inch thick floor slab. The primary locations of contamination within T Building are inside of hundreds of linear feet of glovebox lines, fumehoods, their associated equipment and miles of process piping. The SW/R Building is built with concrete block and brick with about 100,000 square feet of the floor space, with several additions to the original structure being added over the years. R Building is adjacent to SW Building, and it too houses tritium operations while sharing a common infrastructure. Together, R and SW Buildings form the Semi-Works and Research (SW/R) Tritium Complex. In addition to hundreds of linear feet of glovebox lines, fumehoods, their associated equipment and miles of process piping, a large area of tritium contamination exists underneath SW Building. Additionally, an entombment of an old process line (so called "Old Cave") present an interesting challenge to an already complex task in tritium facilities deactivation.

The Mound Plant combined safe shutdown of these facilities into a single project, called the "Main Hill Tritium" project. This project includes safe shutdown and decontamination of T Building, and the safe shutdown of SW/R Building Complex. T Building will be decontaminated to standards of the industrial use and transferred to the MMCIC, while SW and R Buildings will be demolished and dispositioned as radiological waste.

APPROACH

The project is the first deactivation project of this magnitude in the DOE complex due to the sizes of the facilities involved, their high degree of contamination, and the fact that the facilities are currently maintained as Category II Nuclear Facilities. The buildings will be maintained as nuclear facilities until deactivation is completed and they are ready for demolition or transition. The Mound will need to complete this enormous project (~$200M) with full protection of workers and the environment within the next five years.

The overall project is broken down into smaller building areas for the purpose of remediation. In general, areas were divided in terms of similarity in types of contamination, previous process uses and difficulties in remediation. This approach allows the project to be managed more easily and provides an opportunity to phase out operations in these buildings in an organized manner. Building T has been grouped into six areas, while Buildings SW and R have been grouped into seven and two areas respectively. The project also includes an unified activity for each building which covers remediation activities performed at a building level and the nuclear facility management activities. The unified activities include such common areas as building ventilation, sewage system, liquid radwaste piping etc. and potential release sites (PRSs), which were stipulated as requiring remediation under the CERCLA program. The buildings will not be available for transfer or demolition until all of these unified activities are completed.

Due to the high degree of interdependencies between the tritium buildings, the technical approach of tackling this project is not straightforward, rather it is very dependent upon work scope scheduling logic ties. All buildings depend upon the tritium emission recovery facility (TERF) to minimize any off-site releases of tritium while conducting building operations and safe shutdown. Due to the various stages of building construction and additions, the buildings often share common utilities between them, which adds considerably to the required coordination efforts. Additionally, there are alpha contamination areas within all three buildings which complicate the planning for safe shutdown activities of tritium contaminated equipment and facilities. Mixed waste scenarios also must be routinely addressed throughout the project's life.

The first part of the SW Building project is very concentrated on the remediation of the highly alpha contaminated "Old Cave" area. This area was used for the separation of actinium from radium using solvent exchange, where the irradiated radium bromide was dissolved in water and the actinium was extracted in a solution of thenoyltrifluoracetone. The process was terminated in 1954 and the area was entombed in 1955 with most of the suspected actinium and equipment buried. In order to remediate the "Old Cave", safe shutdown of several surrounding rooms must be completed first, so that a containment enclosure can be built around the "Old Cave". The surrounding rooms were heavily used and contain heavily contaminated gloveboxes, fumehoods and equipment.

All uranium beds, molecular sieves, carbon traps and other tritium storage equipment from the three buildings must be processed through the solid scrap recovery dry box in room R-108 to remove tritium "heels" from those items. Safe shutdown of this room will be the last step, as work can not begin until all processing activities are completed. Along with the aforementioned SW "Old Cave" area, these areas' activities drive the overall Main Hill Tritium Project, as well as the site's overall critical path. Once these activities are completed, all tritium transfer lines to the TERF will be removed prior to the transfer of the SW/R Complex to its successor project for demolition. Although not on the initial critical path, safe shutdown activities in T Building will starts to escalate as the safe shutdown activities in SW/R Buildings begin to be completed. Figure 1 depicts a schematic flow of the critical activities in the project. With parallel activities competing for limited manpower and funding resources and due to the complexity of each activity, completing the site's overall tritium project in five years will be a great challenge.

TECHNICAL CHALLENGES

The Main Hill Tritium project represents tremendous technical challenges in several ways:

Complexity of the Project Management

As previously discussed, the project is the first tritium deactivation project with this magnitude and complexity in the DOE complex. Although many activities to be performed in the safe shutdown have been done in the past, they were mostly small-scale with less complexity and without any time-constraint. Interdependency between the previously performed activities and other operations was also minimal. The current project is also unlike previous remediation experiences in that many phases of safe shutdown activities will be ongoing in different buildings at the same time. Not only does the project face a strain on resources due to the volume of ongoing different activities, but, as previously noted, many of these activities are highly interdependent upon other activities.

For example, in order to start up the "Old Cave" work, all work in the surrounding areas must be completed first, with each of these areas having their own technical challenges. The project must have scheduling logic ties with reasonable assumptions to integrate all dependent activities together. Task dependency is so delicate that a delay in even one activity can cause significant schedule variance on another activity.

Another example of project interdependency involves the processing of uranium beds and other items in R-108. Those components must be removed from individual areas in a time-phased approach, so that processing efficiency can be maximized. Again, the success of maintaining the overall project schedule relies highly upon careful planning of the entire project. Complexity and interdependency of different tasks make this project a challenge.

Stakeholder Concerns
The Mound Plant is in the City of Miamisburg. The closet neighbors are immediately outside of the fence. In November 1996, there was an off-site release of 63 curies of tritium within a 48 hour period, which caused significant concern in the community, as well as in DOE's upper management. The DOE must be very careful about the level of potential tritium releases during the safe shutdown activities.

Furthermore, portions of the Mound Plant have already been transferred to the Miamisburg Mound Community Improvement Corporation (MMCIC). The MMCIC has been bringing commercial companies on-site since 1994. The proximity of the tritium complex to the buildings occupied by commercial business makes implementation of the project very difficult. Subsequently, a larger degree of environmental release mitigation must be factored into all design decisions at the Mound than what had been traditionally been addressed for the site in the past. This cohabitation of commercial businesses adjacent to the project's facilities is one additional factor making the Mound clean-up effort more unique than those of other DOE past experiences.

Stable Metal Tritides (SMT)
Other than tritium gas and tritium hydroxide (tritiated water), tritium can form metal tritides with many metals. Metal tritides have been produced and researched at Mound, along with other DOE sites and commercial sites for many years. Metal tritides are classified as either stable or unstable depending on the ease with which they release tritium. The unstable metal tritides pose no problems since they dissociate themselves with ease in the environment and biologically form the more conventional water vapor tritium.

Stable metal tritides (SMTs), however maintain their original form with a stable metal-tritium bond. Traditionally, SMTs have not been well understood in terms of characterization and/or identification in the workplace, biokinetics, bioassay and workplace monitoring techniques. Additionally, other unique formations of tritides can be inadvertently formed, such as rust (ferric oxide tritide) and dust (silcon oxide tritide). SMTs have been a Mound issue for 40 years, however, it only recently caught the attention of the Defense Nuclear Facility Safety Board (DNFSB). In two separate letters from the Chairman of the DNFSB, John Conway, to Under Secretary of Energy, E. J. Moniz, Mr. Conway has emphasized a need to address the technical issues associated with the detection, control, bioassay, and internal dosimetry of SMTs. The DNFSB has requested the DOE to develop a radiation protection program to measure for SMTs and develop a technical basis document (TBD) for these radiation protection measures. The Mound Plant is leading the DOE in developing the TBD. During the preparation and reviewing process of the TBD, however, all work associated with SMTs at the Mound has been curtailed. As the result, the MHT project has lost more than six months of valuable time on the baseline's critical path schedule.

Technology Breakthroughs
In the past, basic tritium technology was used in the decontamination of the tritium contaminated facilities. Contaminated gloveboxes were injected with moist air for decontamination purposes, which was then purged through the tritium emission reduction equipment such as TERF. Once

the contamination level was low enough, the gloveboxes were typically size-reduced for waste disposition. During the size reduction phase, workers typically worked in bubblesuits, thus reducing the worker's productivity. The methodology was very time consuming and workers relied upon swipe samples taken from contaminated areas to determine levels of personal protection equipment required. The swipe samples were taken to the laboratories, where the tritium contamination levels were determined using liquid scintillation counters (LSC). Since the turnaround time was often very long, this created much idle time during safe shutdown activities. Due to the time-constraint and volume of swipes generated during the current project's safe shutdown, this basic technological approach is inadequate in meeting the site's needs.

Recognizing the need to replace past technological approaches to increase the workers' safety and productivity, Mound is starting to introduce new innovative technologies in its current project. Recognizing the need for continued improvements, however, Mound continues to solicit technological approaches from others within the DOE and the commercial sector in the following technological areas:

- Tritium Glovebox Decontamination Techniques - Substantial, time-intensive decontamination to reduce outgassing and personnel exposure will be required throughout the project's duration. Mound is interested in pursuing any innovative opportunity which may exist in size reduction and contamination sealant technologies.

- Tritium Characterization Techniques - Because of the anticipated large number of samples to be generated due to the volume of equipment requiring decontamination, improved techniques for characterization are still being pursued. The traditional methods of measuring tritium, including gas proportional counting and liquid scintillation counting, usually have long turn around time. This, along with the very large number of required swipes, will cause significant delays in the project's decontamination efforts. Along with the realized savings in time, radiological waste minimization during decontamination would occur if the amount of tritium remaining on the surface of an object could be more easily determined in a real-time mode.

- Piping System Removal and Disposition - Similar to contaminated gloveboxes, improved technologies which would allow for more expedient disconnection and final disposition of contaminated process piping continues to be pursued at the Mound.

- Mixed and Near-Mixed Waste Treatment and Disposal - Tritiated oils with wide range of chemical and radiological contaminants are pervasive at the Mound site. Tritium contaminated mercury is also present in significant quantities within the facilities. Newer technologies to more effectively deal with these waste streams are still needed.

- Tritiated Water Treatment - Improved means of treatment and or disposal of tritiated water could be of significant benefit.

- Productivity Improvement - Continued improvements in job set-up and type and use of personal protective equipment will also greatly assist Mound in its efforts to reduce the current baseline schedules.

Sponsored by DOE Office of Science and Technology (EM-50), Mound started in FY1998 a Large Scale Demonstration and Deployment Project (LSDDP) with the purpose of identifying, examining and demonstrating innovative technologies feasible for the D&D of tritium facilities. Many innovative technologies in areas of characterization, piping system, mixed waste treatment, contaminated gloveboxes, waste water treatment and productivity improvement have been either demonstrated or considered with promising results being foreseen. At least two of the demonstrated technologies, the Lumi Scint portable LSC technology, a real-time tritium monitor, and the NOCHAR oil solidification technology have already been deployed at the site based upon their successful demonstrations. Two other, the Water Works Crystals wastewater solidification and the gas-tight crimper have shown positive results, but they have not been deployed yet.

CONCLUSIONS

As Mound continues towards its aggressive mission of completing the DOE's largest tritium cleanup to date within the next five years, it is very apparent that much of its future success relies upon overcoming the barriers which have been addressed within this paper. Due to the size and complexity of the mission at hand, good project management, continued emphasis on addressing stakeholders' concerns, a timely resolution of the site's SMT issues, and the continued deployment of new and innovative technologies will be key to ensuring the project's success over the next five years.

To meet this goal, the DOE continues to aggressively work with its on-site contractor in an effort to address each of these barriers. The DOE continues to stress the criticality of improved baseline management, including the ongoing recognition of previously undetected scheduling interdependencies which might have a negative impact on the project's critical path.

The DOE must continue to facilitate the final resolutions of the site's current SMT problems with the site's technical personnel and the DNFSB to derive an approach which is technically reasonable, while meeting all of the concerns associated with this complex problem. As resolution of the current SMT issue is reached, it is paramount that the project baseline be readjusted to more accurately reflect the work scope and the impact of personal protective equipment, which will be required on all future work.

Mound must continue to approach its tritium safe shutdown and remediation efforts in a manner, which assures stakeholder confidence. To this extent, the stakeholders will continue be educated to the technical issues surrounding the site's tritium cleanup efforts through such forums as the Mound Action Committee meetings. Design approaches will continue to reflect the additional challenges provided the site due to its ongoing commercialization efforts in the areas adjacent to the current tritium facilities.

Perhaps the most important emphasis of all, however is the continued pursuit of new and innovative technologies addressing the current mission's challenges, but also those new challenges encountered as work proceeds within the site's facilities. The DOE must continue to facilitate through all available forums the desire for open communications of emerging technologies which could be deployed in support of the site's tritium cleanup mission. The new technologies successfully deployed at the Mound will become the foundation for future DOE tritium cleanup efforts across the country.

REFERENCES

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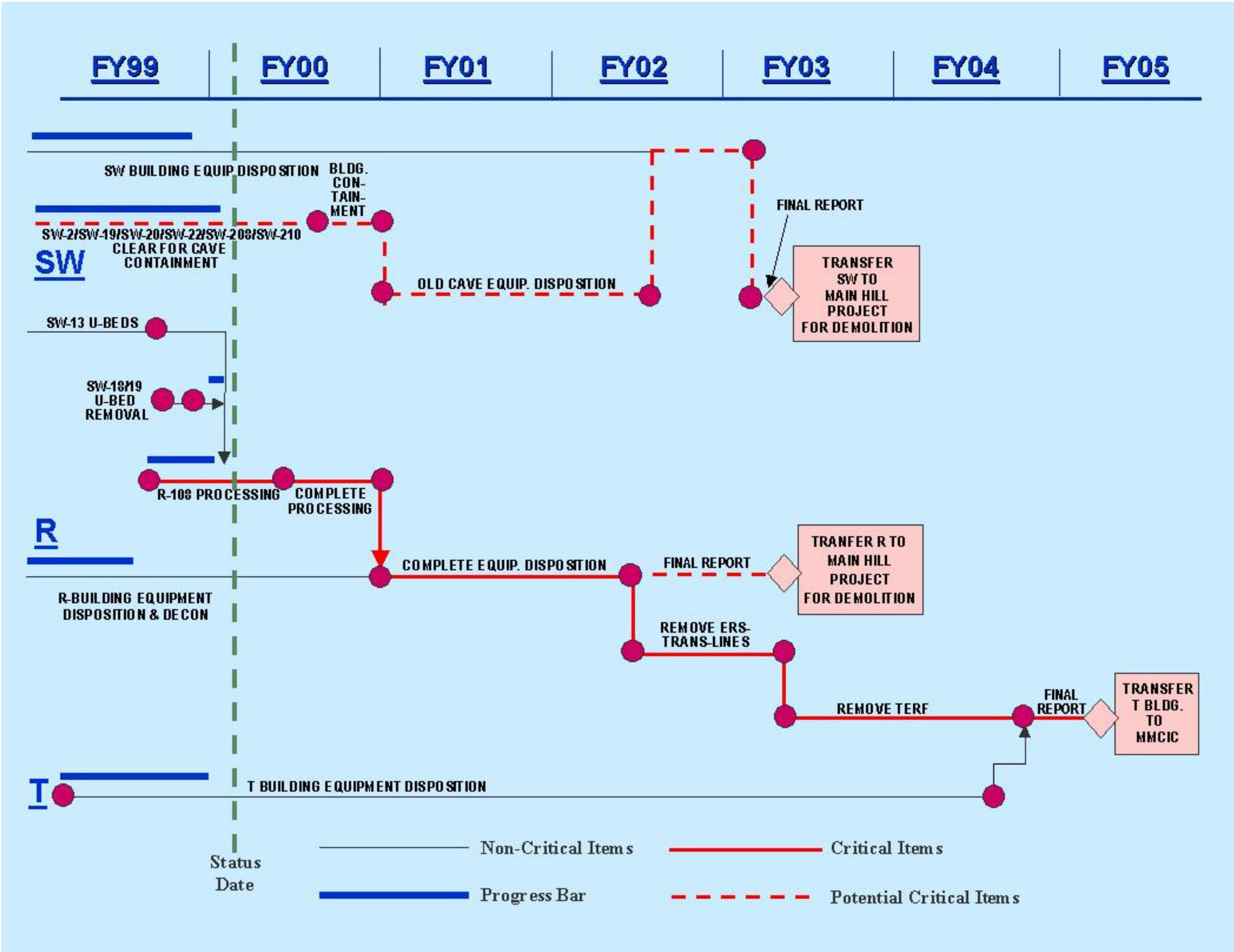

Figure 1 Schematic Flow of the Critical Activities in the Main Hill Tritium Project