Lesson Learned Form

Lesson Learned Title:	Accelerated Demolition of the Reactor Maintenance, Assembly, and Disassembly Facility and the Pluto Disassembly Facility		
DOE Site:	Nevada National Security Site	**Facility Name:**	Reactor Maintenance, Assembly, and Disassembly (R-MAD) Facility and the Pluto Disassembly Facility
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Brief Description of lesson learned: (Provide a short, "abstract-like" description of the lesson learned)

The U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office received funding from the *American Recovery and Reinvestment Act* to demolish two Nevada National Security Site facilities. These facilities were the Reactor Maintenance, Assembly, and Disassembly Facility and the Pluto Disassembly Facility, constructed in the late 1950s and early 1960s to design and test nuclear reactor-powered components.

R-MAD Facility (left) and Pluto Facility (right)

Lessons learned on these projects include:

1. Utilizing the same subcontractor and site workers across several projects led to major efficiencies in operations, shorter schedules, and cost savings. Workers moved from project to project minimizing additional training requirements and transferring more efficient methods for performing work to other projects.

2. An early assessment of the data quality objectives for characterization and sampling needs for BOTH D&D and waste management operations should be done prior to finalizing characterization plans since extra, strategic measurements have often been shown to result in large cost savings. On these projects cost savings arose from:

a) early identification of all asbestos-containing materials (ACM) even in hard to sample locations;

b) characterization of waste using an *Asbestos Hazard Emergency Response Act* (AHERA) survey beyond the required FFACCO regulations;

c) early identification of all waste streams especially those that influence worker safety and disposal options;

d) targeted D&D actions that would allow for using debris as fill material on site;

e) characterization and sampling that would enable disposal of debris in any on-site waste disposal cells;

f) lowering risks to workers of airborne radioactivity or asbestos fibers;

g) lowering of nuclear facility level rating to lower PPE requirements for workers when hazards are eliminated;

h) characterization of physical properties of concrete and rebar that would lend to their separate and lower disposal costs;

i) and minimization of risk from unknown unknowns that often lead to projects coming in over budget and over schedule.

3. Efficiencies in waste packaging, handling and shipment were identified that resulted in the projects being under budget and ahead of schedule:

a) As new conditions were identified, the waste management plan was revised to include the additional waste streams. This effort eliminated the packaging confusion and avoided rework when the waste was generated;

b) Radiological characterization survey performed at the R-MAD and Pluto facilities indicated that only small areas were contaminated with radioactivity. These small areas were decontaminated allowing the building debris to be used as clean fill material at an on-site waste disposal cell resulting in large cost savings;

c) Intermodal containers were lined with heavy duty bags with absorbent pads in the bottom to eliminate the potential for free liquids thereby eliminating the time and effort costs to manage these free liquids;

d) A one-way traffic pattern eliminated congestion and reduced the potential for backing incidents;

e) Permission to ship overweight waste transport vehicles resulted in packaging more waste per container, reducing the number of shipments, the cost of the shipments and the resulting risk to the site worker;

f) Dedicated crews were used to improve efficiency by immediately offloading waste containers that were then staged for disposal as well as dedicated radiological control technicians were used to survey the trucks for a quick release and return to the site. The shorter turn-around time increased the number of shipments per day, also reducing costs.

Summary:

The R-MAD Facility was built to support the nuclear rocket program and was operational from 1959 through 1970. It was used to assemble reactor engines and to disassemble and study reactor parts and fuel elements after reactor tests. The non-radiologically contaminated portions of the facility were demolished in late 2005.

Demolition activities for the radiologically contaminated portions of the R-MAD Facility were initiated in October 2009. Demolition activities included removal, packaging, and disposal of asbestos insulation and roofing material; conventional demolition of the non-high bay structures; explosive demolition of the water tower and large stack; and use of explosives to lower the high bay followed by conventional demolition. Building debris was used to fill the basements, which were then capped with 30 centimeters of grout/concrete. The remainder of the debris was packaged and transported to the Nevada National Security Site (NNSS) Area 5 Radioactive Waste Management Complex (RWMC) for disposal. Demolition of the R-MAD Facility was completed on July 15, 2010, and demobilization activities were completed on August 31, 2010.

The Pluto Facility was used to support design and testing of nuclear reactor-powered missiles and was in use from 1960 until 1964. Preliminary site investigation activities were conducted in May and June 2007, including collecting samples of paint, oil, flooring material, and surface smears as well as conducting radiological swipes and surveys, and collecting swipe samples for beryllium and lead. Closure activities, conducted from May 2008 through March 2009, included tapping and draining fluid systems and equipment reservoirs, characterizing vaults, removing leaded glass shield windows and hazardous material [(such as lead and polychlorinated biphenyls (PCBs)], remediating soil, and placing final postings and markings. The FFACO closure of the Pluto Facility was achieved on July 6, 2009.

The demolition of the Pluto Facility started in October 2009 with preparation activities, including radiological surveys; radiological decontamination; equipment strip out; and removal, packaging, and disposal of radioactive items, and asbestos-containing material. Explosive demolition of the water tower was completed in February 2010, and demolition of the facility using traditional methods began in September 2010. Radiological decontamination activities and extensive radiological surveys performed during demolition preparation allowed the building rubble to be used as fill material. This resulted in cost savings by reducing the cost for importing fill material required at the disposal location, and avoiding the cost of packaging the waste. Shipping of the building rubble to the NNSS Area 5 RWMC for use as fill began in September 2010. Demolition of the Pluto Facility was completed on January 11, 2011, and demobilization activities were completed on March 24, 2011.

Why the lesson learned was developed: (Briefly describe the issue/improvement encountered and why lesson learned was developed. Also, describe how this lesson learned addresses problem encountered)

The selection of a single D&D Team for multiple D&D projects led to great efficiencies, improved planning and major cost savings. While this was a result of streamlined procurement, DOE should, when funding allows, procure D&D projects in similar hazardous operation areas and for multiple facilities to take advantage of many synergies, expected improved performance and anticipated lower costs.

An early assessment of the data quality objectives for characterization and sampling needs for BOTH D&D and waste management operations should be done prior to finalizing characterization plans since extra, strategic measurements have often been shown to result in large cost savings. On these projects cost savings arose from: targeted removal of limited contamination allowed for some debris to be used as fill material; other debris was allowed to be disposed of in an onsite waste disposal cell; concrete was separated from rebar; and radiological surveys were utilized regularly to release materials. The late identification of ACM added significant costs beyond that planned for ACM.

A flexible waste management plan was developed for each of the facilities to identify the type of waste generated and how to package and manage the waste. As conditions changed, the waste management plan was revised to include additional, unplanned waste streams and to take actions to lower the volumes generated of more costly waste streams. This flexible waste management planning eliminated the confusion of how to package all wastes and avoided waiting until waste was generated to change planning. Huge savings were realized due to some debris being used as fill material; some debris being disposed of onsite; and being given permission to ship overweight waste transport vehicles.

What problems/issues were associated with the lesson learned: (Briefly describe the problems/issues experienced/encountered & type of lesson learned. Would this lesson be implemented in future projects?)

Multiple D&D Projects to Leverage Cost Savings: The selection of a single D&D team for multiple D&D projects requires additional upfront coordination. This extra effort leads to great efficiencies, improved planning and major cost savings. While this was a result of streamlined procurement, DOE should, when funding allows, procure D&D projects in similar hazardous operation areas and for multiple facilities to take advantage of many synergies, expected improved performance and anticipated lower costs.

Early Characterization Planning: To establish the extent and confidence level of existing characterization, planning involves review and documentation of existing historical documents, closure plans, drawings, sample results, and other pertinent information. For regulatory (FFACO) closure of a facility, the facility is characterized in enough detail in its existing physical state to determine whether further action is required to protect the environment, site workers, and the public from the hazards contained in the facility. This type of characterization does not always provide the level of information required to protect demolition workers and to lower the costs by determining the optimal waste disposal options. Therefore, additional characterization is often required.

Asbestos: In particular, facilities constructed in the 1960s and earlier should be evaluated for the presence of asbestos-containing materials (ACM). Asbestos was not only used as insulation and construction materials, but also added to paint and skim coat for walls, floors, and ceilings. The presence of ACM may not be obvious during early characterization activities, yet significant funds may be required for sampling and abatement activities prior to demolition or other dismantlement operations. In addition, for facilities with multiple paint types and surfaces, an *Asbestos Hazard Emergency Response Act* (AHERA) survey or a similar assessment should be considered to evaluate and identify potential ACM. Careful examination of facility surfaces is required to identify ACM. At the Pluto Facility, asbestos tiles were found beneath equipment in one room, and wall and ceiling surfacing materials in some areas contained asbestos while the surrounding materials did not. Late identification of ACM led to cost overruns for operations to remove and dispose of this material.

Waste Management: A huge challenge on D&D projects is to weigh the cost for detailed characterization and extra planning against more expedited D&D operations with less planning. There is a cost associated with taking more time to collect sufficient information to analyze life cycle costs of the entire project under various possible scenarios. This life cycle cost analysis can be re-analyzed throughout the project, especially after facility characterization is complete. In this project, the targeted removal of limited contamination may have delayed the initial demolition and D&D schedule but analysis showed that based upon the limited radiological contamination, the overall cost savings would be very large in disposal of debris. A detailed life cycle cost analysis also allows managers to analyze other scenarios that would minimize waste volumes to ascertain if these alternative plans might generate additional cost savings. Minimizing waste volumes, such as radiological waste that needs to be shipped offsite, involves higher initial planning and characterization costs, and should be pursued only when cost savings can be expected. A radiological characterization survey was performed at both the R-MAD and Pluto Facilities. Based on the results, building debris from the R-MAD Facility was disposed as low-level waste. However, the survey of the Pluto Facility indicated that only small areas were radiologically contaminated. Therefore, these small areas were decontaminated and a final release survey was performed. Upon the successful conclusion of this survey, the building debris was determined to meet the waste acceptance criteria for the on-site sanitary landfill. The building debris from the Pluto Facility was used as clean fill material at another on-site waste disposal cell. This resulted in significant cost savings over the planned disposal as low-level waste.

At both facilities, the age of the concrete and exposure to harsh conditions, combined with the large size of the rebar, resulted in the rebar readily separating from the concrete during demolition. The remaining concrete was then packaged with a much lower potential for damaging liners and waste containers. The rebar was handled separately. At the R-MAD Facility, the rebar was coated with a fixative and sent to the on-site LLW landfill. At the Pluto Facility, the rebar was loaded into end dumps and disposed as sanitary waste or fill material.

At the R-MAD Facility, the waste containers utilized were intermodals lined with heavy duty bags that included absorbent pads in the bottom to eliminate the potential for free liquids. The process for loading and shipping these containers was extensively evaluated to streamline the process and eliminate project delays. A one-way traffic pattern was established to eliminate congestion and reduce the potential for backing incidents.

Permission was received to ship overweight vehicles which resulted in packaging more waste per container, reducing the number of shipments, the cost of the shipments and the resulting risk to the site worker. The roadway was routinely inspected to verify that damage was not occurring. A dedicated crew at the Area 5 RWMC was utilized to immediately offload waste containers that were then staged for disposal. Dedicated radiological control technicians surveyed the trucks for a quick release and return to the site. The shorter turn-around time at the RWMC increased the number of shipments per day, also reducing costs.

If implemented in subsequence projects/tasks, how the success of the lesson learned was measured: (What data/operating experience is available to document how successful the lesson learned has been?) (Any improvements on safety or minimization of risk?)

Lessons learned and best practices were documented and transferred to subsequent projects but no performance metrics were created to measure improvements to lower risk and costs and shorten schedules.

What are the benefits of the lesson learned: (Briefly describe the benefits derived from implementing the lesson learned.)

Both R-MAD and Pluto projects were completed under budget and ahead of schedule. The R-MAD Project was completed almost 5 months ahead of schedule and about $500K under cost. The Pluto project was completed approximately 3 months ahead of schedule and under budget by approximately $1.5M, including the additional costs and impact of a 4-week delay to characterize the Pluto facility for disposal as sanitary fill material.

Utilizing these Lessons Learned and Best Practices has allowed for more effective and efficient planning for other Nevada site demolition activities, including the Engine Maintenance, Assembly and Disassembly compound (EMAD) and Test Cell C.

Alternative solutions considered: (any additional lessons learned associated with the issue/improvement opportunity?)
EPA enforcement discretion varies regionally. Direct contact with the regional regulators regarding the applicability of certain flexibilities for managing asbestos during D&D activities is critical. In the case of leaving asbestos on the structure during demolition, it is highly recommended that an agreement is reached with the NESHAPs regulators prior to start of D&D in order to set the parameters and conditions under which such a provision can be utilized. Earlier work with the local regulators via other pro-technology state regulators (e.g., the Interstate Regulatory Cooperative (ITRC)). The ITRC is led by state regulators promoting the use of technology and improved processes to improve the quality and lower costs of remediation programs.

Additional Information	
Technology Links:	
Vendor Links:	
Videos Pictures:	 **Before and after photos of the R-MAD Facility**  **Before and after photos of the Pluto Facility**
Comments:	