IMPROVED TECHNOLOGIES FOR DECONTAMINATION OF CRATED LARGE METAL OBJECTS
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ABSTRACT

The Los Alamos Large Scale Demonstration and Deployment Project (LSDDP) in support of the US Department of Energy (DOE) Deactivation and Decommissioning Focus Area (DDFA) is identifying and demonstrating technologies to reduce the cost and risk of management of transuranic element contaminated large metal objects, i.e. gloveboxes. The previously conducted demonstrations supported characterization and "front end" aspects of the Los Alamos Decontamination and Volume Reduction System (DVRS) project. The first demonstration was shown to save the DVRS project approximately $200,000 per year and characterization technologies have been estimated to save DVRS a month of DVRS operation per year.

In FY01 demonstrations for decontamination technologies, communication systems, and waste data collection systems have provided additional savings equivalent to another $200K per year of operation. The Los Alamos Large Scale demonstration and Deployment Project continues to provide substantial cost savings to the DVRS process in this second round of demonstrations. DVRS cost savings of $400K per year can now be counted, with additional efficiency savings of up to 30% on many tasks.

INTRODUCTION

The Los Alamos Large Scale Demonstration and Deployment Project (LSDDP) in support of the US Department of Energy (DOE) Deactivation and Decommissioning Focus Area (DDFA) is identifying and demonstrating technologies to reduce the cost and risk of management of transuranic element contaminated large metal objects, i.e. gloveboxes. DOE must dispose of hundreds of gloveboxes from Rocky Flats, Los Alamos and other DOE sites. Current practices for removal, decontamination and size reduction of large metal objects translates to a DOE system-wide cost in excess of $800 million, without disposal costs.

Several demonstrations conducted by the Los Alamos LSDDP demonstrated technologies that improved the cost and risk associated with decontamination of crated large metal objects. The objects were crated for storage in the early 1970s and activities have begun on the uncrating and volume reduction of these objects in the LANL Decontamination and Volume Reduction System (DVRS). The problem of crated large metal objects is not unique to Los Alamos, but it is one to be addressed in the future by other DOE sites including Hanford, Savannah River and INEEL.

The previously conducted demonstrations supported characterization and "front end" aspects of the Los Alamos DVRS project. The first demonstration was shown to save the DVRS project approximately $200,000 per year by using air pallets to move the large crates through the characterization system. Two follow-on demonstrations compared two very different technologies for radiography of the crate contents. The cost avoidance of dealing with unexpected items in the crates justified LANL deployment of one of the technologies equivalent to a month of DVRS operation per year. A small cost savings, but a potential large risk reduction was estimated from the demonstration of an hydraulic cutter for glovebox legs and appurtenances. The last FY00 demonstration showed the benefits of a digital recording technology for monitoring the filling of waste crates.

In FY01 several demonstrations were conducted to further support the DVRS intent of reducing the large metal objects to Low-Level Waste for burial in the LANL Solid Waste Disposal Area.

Fog & Strip Demonstration

The use of Fogging to reduce airborne contamination followed by application of conventional strippable coatings has been successfully used several times at the Rocky Flats Environmental Technology Site (RFETS) and Hanford. Based on the Rocky Flats success, a demonstration was conducted at a plutonium contaminated commercial facility for the purpose of collecting baseline and innovative technology data applicable to the LANL DVRS position. A PermaCon at the Nuclear Fuel Services facility in Erwin TN, contaminated with plutonium, was used as the demonstration location (1). The fogging technology, as developed by Encapsulation Technologies, was followed by application of a stripping technology, in this case Instacote, for decontamination. This combination of technologies was recommended by the service supplier for this application.

Initially, smears were taken over numerous locations in the PermaCon. The baseline technology, Bartlett Stripcoat TLC, was applied and subsequently removed from selected areas of the PermaCon by NFS technicians. Data were collected on the decontamination effectiveness over aluminum, plexiglass, and stainless steel surfaces. Subsequently, the Fog and Strip combined technologies were applied to the entire PermaCon using a commercial service, Master-Lee Decontamination Services, and data were collected on the decontamination factors for the same three types of surfaces.

The initial particulate contamination levels in the PermaCon were measured at 443 dac-hours. After an air stream containing a glycerin/ saccharide fog was injected for 8 hours, the particulate levels were reduced to 0.5 dac-hours. Instacote was applied over the entire PermaCon, including the remaining equipment. Figure 1 shows the technicians applying the Instacote, and Table I provides the average decontamination factor for three sample smears on each of the surfaces for both baseline and Fog & Strip technologies.

Fig. 1. Instacote installation in PermaCon

Table I. Percent Reduction in Surface Activity for Fog and Strip Technology Demonstration

Surface	Bartlett Stripcote TLC	Capture Cote Fogging and Instacote
Aluminum	90	91
Plexiglass	48	55
Stainless Steel	88	94

Data was taken on the cost of application and secondary waste volumes. Although the Capture Cote/ Instacote combination was more effective, the cost impact of the combined technologies is being reviewed to determine if the improved decontamination is beneficial.

Race Scan Communications Systems Demonstration

The Race Scan Ear Mic System was developed for use in the NASCAR racing for communication between drivers in the loud environment of a racing car and a pit crew. The system is applicable to Decontamination and Decommissioning (D&D) work since noise levels are high, respiratory protection is worn, and workers must communicate with outside supervision without interference from background noise. Figure 2 shows the Ear Mic System components.

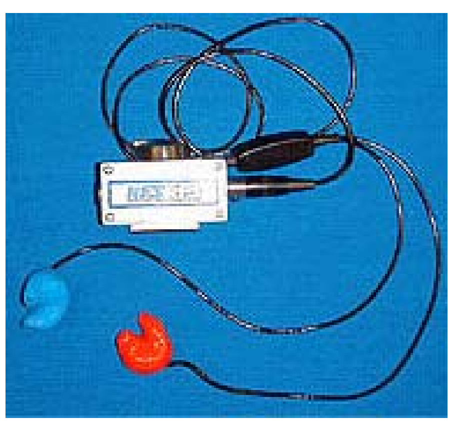

Fig. 2. Race Scan Ear Mic System Components

The system includes two earpieces, a push to talk switch, and associated wiring. Separate earpieces are designed for the right and left ears. The right earpiece contains a speaker, and the left contains a microphone. The ear microphone works by receiving voice sonics inside the ear canal. Race Scan Communications offers standard or custom molded earpieces. The custom earpieces provide noise reduction to 40 dBA while allowing clear communication without interference from background noise. All Ear Mic System equipment is worn under PPE, minimizing worker interference and preventing equipment contamination.

In this demonstration, the Ear Mic System was used during two ongoing D&D operations at LANL (2). These operations were waste drum retrieval from an above ground berm, and a waste box venting operation carried out within a PermaCon structure. In both operations, communication between the technicians within the work zone was limited by loud noise produced by equipment. In the PermaCon structure, the walls of the structure limited communication between workers and outside supervision.

Both phases of the demonstration involved monitoring the operation in the baseline condition (marker board or shouting through the respirator) followed by monitoring productivity with the Ear Mics. The data collected included both productivity information and technician impressions. In both phases of the demonstration, the technicians were impressed with the transmission clarity, ease of use, and comfort of the Ear Mic System. All workers thought safety was enhanced by use of the system since direct communication with supervisors and safety services is possible.

In both phases of the demonstration, productivity was increased by the reduction of effort and time spent by the technicians communicating with each other and supervision. In the drum retrieval operation, a 21% reduction in the time to retrieve the specified number of drums was observed. In the drum venting operations productivity was almost doubled (45% reduction in time) during the demonstration data phase. In both phases of the demonstration it was possible for workers to speak to each other and to supervision outside the work zone without exiting the workstation. Transmission clarity was not limited by the walls of the PermaCon.

The combined annual cost savings for Ear Mic application in these two applications is estimated to be over $30,000.

Crate Cutting Tool Evaluation

In preliminary crate opening operations at DVRS, the physical difficulty of sawing open the fiberglass reinforced plywood crates was shown to be both time consuming and hazardous. The LSDDP and D&D Focus Area have supported two different activities to enhance the DVRS crate opening (3). The baseline technology, a reciprocating saw and four circular saws were selected by the Technology Selection Committee and evaluated in a non-radioactive mock-up. The evaluation was conducted at the Florida International University Hemispheric Center for Environmental Technologies facility using LANL technicians in a fully mocked-up radioactive application. They worked in a PermaCon using PPE planned for DVRS and dismantled FRP crate mockups. The safest and most cost effective tools were quickly identified.

The Porter-Cable circular saw, although not an innovative tool, was shown most effective and the preferred tool for this application by virtue of the light weight and cutting speed. It is a double-insulated circular saw with a power tool-triggered wet/dry vacuum for vacuuming sawdust generated during cutting. Figure 3 shows the technicians using this tool.

Fig. 3. LANL Technicians opening a Fiberglass Reinforced Plywood Crate

The saw efficiently performed horizontal and vertical cuts on the FRP crate. LANL technicians found this tool very light and fast. It efficiently size-reduced the FRP crate including nails and a 1/16" stainless steel metal piece inserted in the crate. However, the saw could not cut through the stainless steel plate purposely fastened to the crate mockup. Even though the saw has a vacuum cleaner hose as an attachment, LANL technicians worked with it smoothly. The vacuum system collected up to 87% of the sawdust generated during the demonstration. Table II summarizes the cutting data generated in the tool evaluation.

Table II. Crate Cutting Tool Evaluation Results

Cutting Tool	Cutting rate (ft/min)	Time to Size Reduce Crate (Hrs.)	Comments
DeWalt Reciprocating Saw (Baseline)	2.2	2.7	Vibration caused technician discomfort
Porter Cable Circular saw with vacuum	4.14	2.0	Lightest and easiest to use
Milwaukee Worm Drive Circular Saw	4.35	2.0	Most powerful, but heavy
Evolution 180 Circular Saw	1.53	0.7 (did not complete crate dismantlement)	Improper application (see text below)
Adamant Twin Blade Circular Saw	4.37	0.1 (did not complete crate dismantlement)	Most efficient, but needs safety guards for continuous use.

Two additional points are made on Table II. The Adamant saw, one of the innovative tool options, was briefly evaluated, but not fully demonstrated. It was found to be a very effective tool, but improved blade guard features would be necessary for routine use at LANL. The second important point on Table II relates to the Evolution 180 saw, another innovative tool. It is specifically designed for stainless steel cutting. The Evolution 180 saw did not perform satisfactorily on crate cutting, but was tried on a flat plate of stainless steel and found to work extremely well. The cutting rate of over one foot per minute on ¼" stainless steel plate with no heat generation and almost no sparking makes this tool valuable for future DVRS operations.

The second crate cutting support activity for DVRS involves the development of a saw support frame to ease technician strain and improves safety. The LSDDP has supported development of the design and design review activities.

Ntvision Demonstration

The LSDDP demonstrated NTvision at the LANL's TA-54, Area G, within a PermaCon® structure inside of Dome 231 (4). NTvision was developed as a security camera system with features that are particularly interesting to the DVRS operations. For the demonstration, LLW items were removed from two damaged FRP crates and placed in new B-25 waste storage containers as a repackaging effort. The items consisted of dirt, boards, sawdust, personal protective equipment, cellulose material and other objects of variable size. TRU waste items (gloveboxes and ductwork) were repackaged in one large transport container for safe storage at LANL, TA-54, Area G. The repackaging effort took place in a PermaCon® structure where personnel were dressed in Anti-C personal protective equipment (PPE).

The NTvision system consisted of one camera mounted on the roof of the PermaCon®, and a desktop computer system located outside the wall of the PermaCon®. The camera was aimed through a window-covered viewport on the ceiling of the PermaCon® and directly above the B-25 loading area. NTvision recorded each waste item as it was added to a new B-25 container. The baseline technology for this demonstration consisted of manual entry of waste descriptions in paper or electronic media by a dedicated worker inside the PermaCon® structure. In the baseline case, one data recorder must be present during the entire loading process.

The use of NTvision met or exceeded expectations in that the system ran unattended and produced high quality electronic files documenting each item as it was placed in a new B-25. The video recordings and still images produced during the demonstration were of high resolution, layered objects were easily distinguishable, and light color and opaque objects were easily seen. Figures 4 provides images produced by NTvision during the demonstration. NTvision software proved that it would enhance the review process of the waste management paperwork and improve quality assurance that the waste has been properly characterized and disposed.

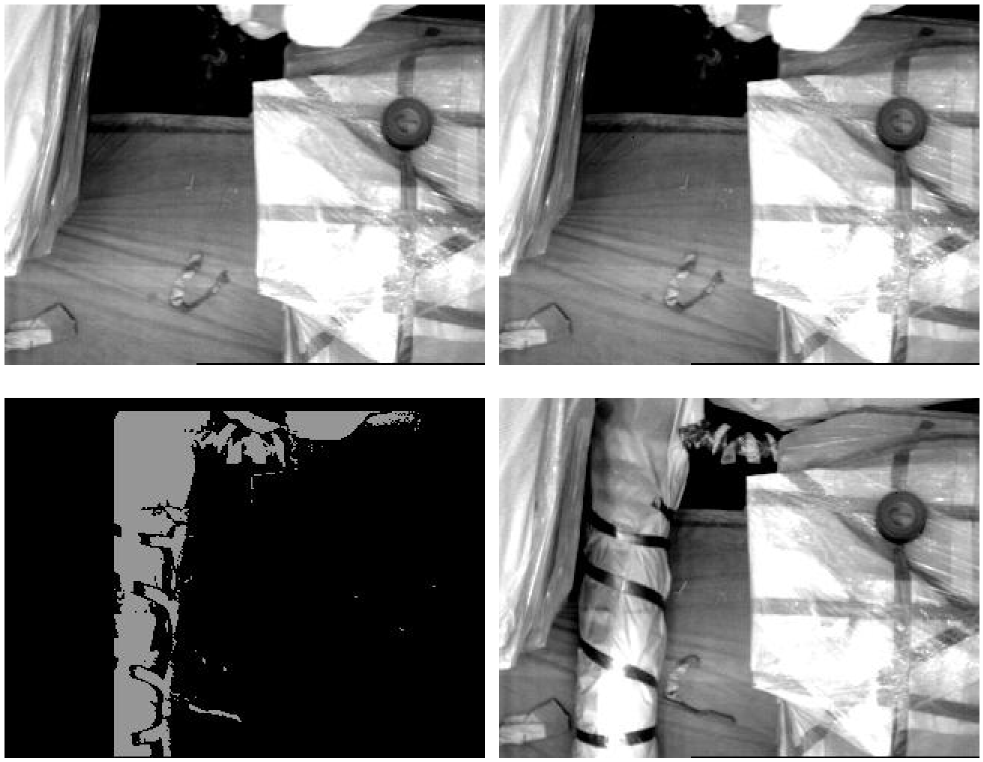

Fig.4. NTvision image of the addition of a plastic wrapped bundle.

The image in the upper left shows the reference frame prior to detection of movement. The frame that triggered the event is shown in the upper right, and the ending reference image is shown in the lower right. The object key, shown in the lower left, shows the difference between the first reference image, and ending reference frame which in this case is the added bundle.

The ability of NTvision to operate unattended results in a cost savings as a dedicated waste inspector is not required to record each item as it is repackaged. Schedule impact from data recording and associated paperwork will also be minimized, since all files are stored and readily accessible from any computer via the Internet. Worker safety was enhanced since one less person will be present in the controlled work area.

Based on this successful demonstration of NTvision, LANL plans to use an NTvision system with multiple cameras for recording the packaging of all TRU containers prior to shipment to WIPP. The demonstration data was used to develop a cost savings estimate for use of the NTVision system. In DVRS a waste data recorder is replaced by the NTvision system. Thereby the $6,692 investment in the Ntvision purchase and installation is off-set by the cost of the waste data recorder, a savings of $98,100 per yr. The demonstration data did not identify savings in the area of waste data certification, but it is expected.

Additional Decontamination Activities

Electrochemical decontamination of hot spots in plutonium contaminated gloveboxes has been utilized at LANL in production operations. The primary conclusion is that it is a very effective decontamination technology and capable of much higher decontamination factors than simple acid wipe-down, but secondary waste features make deployment at DVRS difficult. Electrochemical decontamination is judged a technology to be better applied while the glovebox is still in place where hydrogen emissions and secondary liquid wastes are more easily treatable. Data is under review.

Two Russian developed decontamination technologies will be monitored by the Los Alamos LSDDP for potential application at Los Alamos. Under DOE sponsorship, Russian investigators have developed a specialized electrochemical decontamination technology and have identified a foam decontamination technology that may be of interest. Although these decontamination activities will not be official LSDDP "demonstrations" they will be planned, monitored and reported on using LSDDP methodologies.

CONCLUSION

The Los Alamos Large Scale demonstration and Deployment Project continues to provide substantial cost savings to the DVRS process in this second round of demonstrations. Currently the anticipated DVRS cost savings are a combination of cost avoidance associated with the use of advanced crate characterization and an estimated 30% reduction in labor requirements for crate processing.

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