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Title: THE MOBILE VISUAL EXAMINATION AND REPACKAGING (MOVER) SYSTEM

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The Mobile Visual Examination and Repackaging (MOVER) System

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ABSTACT

Process engineering and waste technology teams at Los Alamos National Laboratory delivered a prototype Mobile Visual Examination and Repackaging (MOVER) system to the Waste Isolation Pilot Plant (WIPP) outside of Carlsbad, NM in October, 2000. This system was developed in response to compliance issues with legacy waste that was packaged in 55 gallons drums prior to release of WIPP's waste acceptance criteria (WAC). A statistical percentage of these 55 gallon drums will be opened and visually examined (VE) as part of re-characterization using Non-destructive examination (NDE) procedures. VE is an intrusive technique since the drum is opened, and as a result, there are more risks in spreading contamination. Hence, VE is performed in a glovebox to protect the workers and the environment. During VE, waste is pulled out of one drum, visually examined, the amount of plutonium measured if necessary, and the waste repackaged into one or more drums. MOVER can perform all these operations, along with having the capability to house the glovebox operations and all support equipment in a 40-foot-long container that can be transported to a site on a semi-trailer. This container is divided into three rooms, providing the level of safety and containment of a fixed facility. A key asset of mobile systems is the inherent need for modular design that reduces infrastructure costs and overhead. A mobile system like MOVER represents a technology base aimed at meeting DOE schedules to accelerate decommissioning of many sites.

BACKGROUND

For more than 50 years, quantities of transuranic (TRU) radioactive waste have been generated and stored at 18 Department of Energy (DOE) sites nationwide. The bulk of this waste is categorized as contact-handled (CH) TRU waste, and approximately 97% of all CH-TRU is at five DOE sites. On March 26, 1999, the Waste Isolation Pilot Plant (WIPP) opened for the permanent disposal of TRU waste resulting from weapons research and production.

For disposal at WIPP, waste criteria are based on Environmental Protection Agency (EPA) and New Mexico Environmental Division (NMED) permit requirements. Hence, for both transport and waste disposal, a suite of certification requirements based on analysis and certification methods has been established. These include Non Destructive Assay (NDA) to measure the type and amount of radioactive material in a drum without opening it; Nondestructive Examination (NDE) based on Real Time Radiography (RTR) using X-rays to examine objects inside a drum without opening it; Headspace Gas Sampling and Analysis used to test the gas, and associated generation rate, in the drum's headspace by sampling through a filter; Visual Examination (VE) as discussed below; Acceptable Knowledge (AK) based on process documentation describing the pedigree of the waste; and H_2 Generation Testing for mixed wastes.

Prior to the opening of WIPP, many of the DOE sites CH-TRU waste packaging operations were completed prior to the implementation of the WIPP waste acceptance criteria (WAC). In order to dispose of CH-TRU at WIPP, characterization and certification of the waste is required. To insure that NDE identifies all incompatible materials in the waste, a percentage of the drums are opened and visually examined (VE). Criteria established for VE is linked with additional NDE including RTR. Hence, VE is used to verify RTR validity. The percentage of drums requiring VE can vary depending on the size of the waste stream. For waste streams of less than 50 drums, 100% VE is required. For waste streams with a larger number of 55 gallon drums, between 2% and 20% VE is required.

Additional issues drive the need for VE certification. Materials may be incompatible because of transportation or WIPP regulations, especially liquids, which are not accepted at WIPP. Some materials may be transportable or disposable at WIPP, but may be difficult to assay by NDA when mixed and, thus, need to be separated. Some waste classifications, like paper, need to contain a low quantity of transuranics (plutonium) to prevent excessive generation of gas. Finally, NDA may measure too high a quantity of TRU per weight of container, and the contents must be re-distributed into two or more drums to meet the wattage limit.

VE is an intrusive technique since the drum is opened and this introduces a increased level of risk to the workers. In contrast, all other NDE and NDA methodologies address issues with drum content, levels of contamination, and presence of flammable gas without opening the drums. With the risk of spreading contamination, VE is performed in a glovebox to protect the workers and the environment. The air circulating through the glovebox exits through a series of high-efficiency particulate (HEPA) filters before being exhausted to the atmosphere. Handling of the waste is done through the glovebox gloves. During VE, waste is pulled out of one drum, visually examined, the amount of plutonium measured if necessary (NDA), and the waste repackaged into one or more drums. There are well-defined ways to package waste to protect workers and the environment. Along with paper records, MOVER provides the ability to video tape the contents of each drum as it is unpacked (see Table 1).

MOVER was developed as a means to address all aspects of VE, along with providing a mobile capability by housing the glovebox in a 40-feet-long container that can be transported to any site. This container is divided into three rooms, providing the level of safety and containment of a building. In comparison to the option of erecting a fixed facility, it is more economical to use a mobile system at the sites that need VE. This technology base also offers the means to meet DOE schedules aimed at accelerating decommissioning of many sites at the same time.

SYSTEM DESIGN FEATURES OF MOVER

Process engineering and waste technology teams at Los Alamos National Laboratory delivered a prototype MOVER system to the Waste Isolation Pilot Plant (WIPP) outside of Carlsbad, NM in October, 2000. The system includes a series of gloveboxes linked together in a "glovebox line." Within the glovebox line, 55-gal. containers of waste are unloaded, visually sorted, and then analyzed to determine the level of radioactivity. The waste is then repackaged in new acceptance barrels in preparation for disposal at the WIPP site.

MOVER is classified as a low-level radiation facility that meets authorization basis guidelines. The MOVER project involved design and modification to many of the engineering systems within an existing Type 1 transportainer (45 feet length, 7 feet width, 8 feet heigth).

The team found that manipulating the 55-gal. containers within the transportainerfacility so that the barrels could be safely and accurately connected to the internal glovebox line was a significant challenge. As well, facilitating manual waste sorting and upgrading the control and design of an inadequate ventilation system were challenging. Some of the modifications made to this system include the addition of ventilation air flow and pressure change sensors, continuous air monitors (CAMs), door position indicators, a small crane within the glovebox, and a non-destructive analysis (NDA) system based on passive neutron assay technology (see Figure 1 below).

Mechanical Design

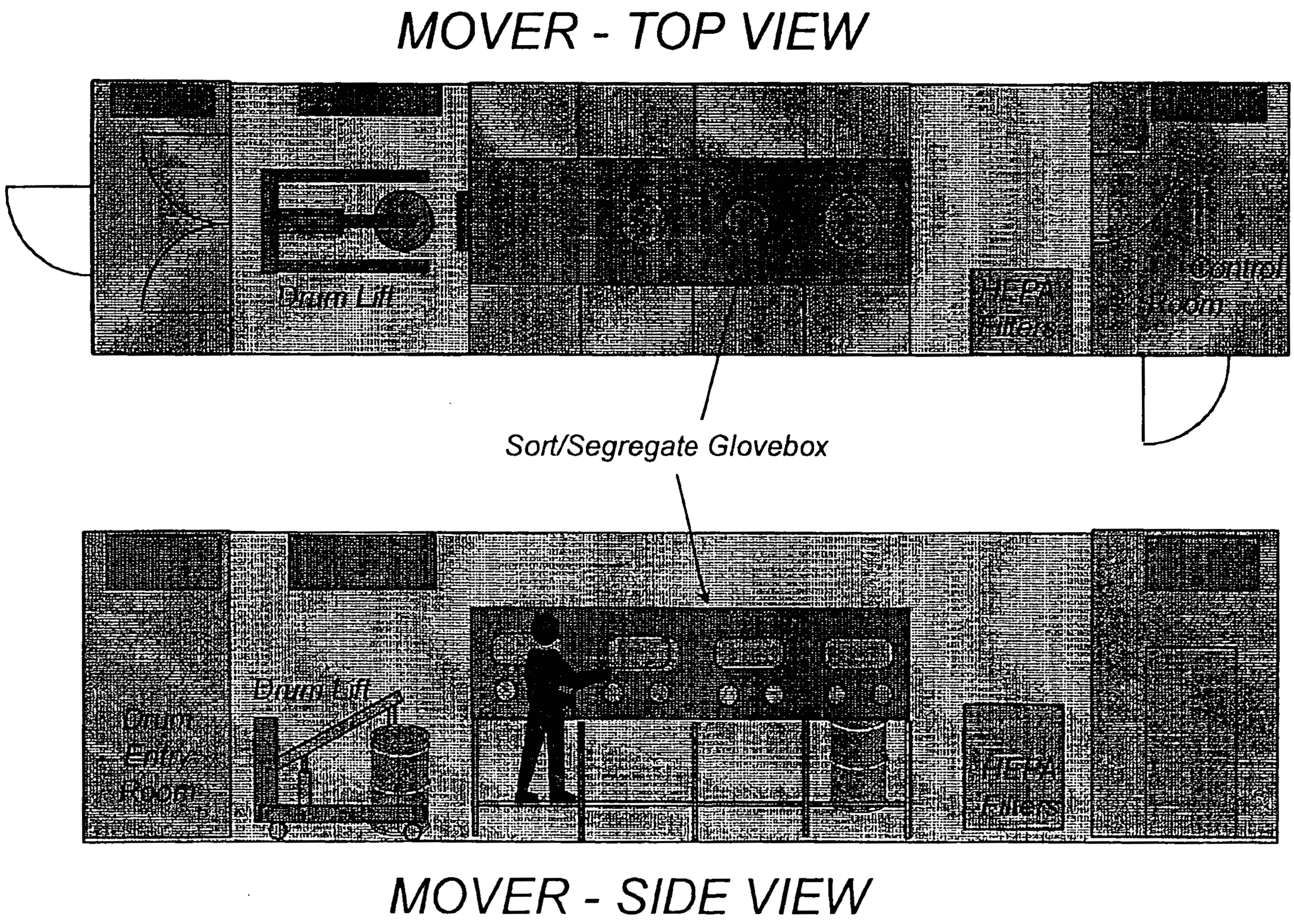
The MOVER design uses a modular approach for glovebox operations within the transportainer (see Figure 1). The equipment and its use includes:

Drum loader: this piece of equipment is used to bring a drum full of waste to the horizontal position in front of the bag-in port of the glovebox. Typically, these drums range in weight from 450 to 600 pounds each. A cradel on the lift connects to the drum as the drum sits on the floor. Then the drum is hoisted, via an electric winch and cable, as the carriage rolls on rails to the horizontal position in front of the glovebox approximately five feet off the floor.

Glovebox: The glovebox is used as a containment system during all VE operations. These include attaching the waste drum to the glovebox via a plastic bag, attaching empty drums, opening the waste drum, extracting the waste from the drum and the packaging bags, characterizing the waste through visual examination and documenting through audio and videotaping, segregating the waste when needed and permitted, repackaging to meet TRU wattage limits—which involves analyzing the amount of transuranic, repackaging the waste in the empty drum, and bagging out each drum. The glovebox has one bag-on port for a 55-gallon drum, and two bag-out ports in the floor for a 55-gallon drum and a 30-gallon drum.

Exhaust HEPA filters: Each of the three ventilation zones in MOVER is protected by HEPA filters. HEPAs have two goals: filter fine radioactive particulate with over 99.9% efficiency, and prevent the return of contamination from a potentially more contaminated zone to a less contaminated when the exhaust blower is shut off. As described below, each zone air flow and pressure differential is monitored automatically with sensors, and this data is collected by a computer.

Figure 1 MOVER Floor Plan and Side View



Exhaust blower: The blower uses negative pressure to draw fresh air from the outside, through HEPA filters, into the ante rooms located at each end of MOVER (zone 3), the area surrounding the glovebox (zone 2), and also the air supplied to the inside of the glovebox (zone 1). Pressure differentials are maintained to ensure that airflow is from the lowest contamination level (zones 2&3) to higher levels of contamination (zone 1) . The blower is designed with a system of valves to maintain a graded negative pressure in each zone. Hence, zone 1 is a higher negative pressure than zone 2, and zone 2 is a higher negative pressure than zone 3.

Neutron counter, canister, and canister lift: The counter is based on passive neutron assay, and it is located underneath the glovebox. This NDA system will be used to assay waste when the initial amount of transuranic material, like plutonium, exceeds the value for a given waste matrix in the drum undergoing VE (see Table 2). For example, the maximum may be 200 grams of plutonium equivalent for a waste stream classified as a metal matrix, but only 10 grams plutonium equivalent for paper. Therefore, a drum of waste may be separated into two or more different drums to meet the plutonium equivalent criteria for a given waste stream. If a waste drum contents are separated during VE, then the waste requires NDA certificatin prior to repackaging. This is done by inserting the waste into the neutron counter sample canister, the canister is lowered in the well inside the counter with a small electric winch, and the amount of plutonium measured in the neutron counter. This operation is repeated until the repackaged drum contains the appropriate level of plutonium. The interior well of the neutron counter remains uncontaminated with the use of a sealed well attached to the glovebox and inserted into the neutron instrument. Samples are then placed inside this well from the interior of the glovebox.

Control System Design

The MOVER design includes a sensor system, linked to a computer, to monitor airflow within the three separate air zones maintained the transportainer and glovebox (see Figure 1). The equipment and its use includes:

Airflow meters.: MOVER is designed to use five flow sensors in concert with nine differential pressure meters (desribed below). These flow sensors are located in front of HEPA filters and inside ducting to measure air velocity via electrical connections to meters and a computer. Knowing the surface area of the HEPA or the pipe, the volume of airflow per can be calculated. Airflow is not uniform across a HEPA filter surface, and as a result the measurement is not as accurate as an anemometer. Therefore, the airflow meter is calibrated with an anemometer on a regular basis. However, the meters are used to assess whether the flow is sufficient, and as such can be used to remotely monitor the condition of the filters over time if particulate is accumulating and restricting airflow. The airflow indicator is designed to be visible from most control valves, and the sensors are linked to a control panel that will alarm if flow rates drop below a control point. In addition, the signal is recorded by the computer in the control room and the long-term trend can be displayed. LabView software provides the data interface with the sensors.

Differential pressure sensors: MOVER is designed to use nine differential pressure meters in concert with the five flow meters. Photohelic meters provide an electrical signal based on control points manually set by the operator. Photohelic meters are used to monitor the pressure differential between each of the three zones (1, 2, and 3). A minimum vacuum of 0.5 inches of water is set between each zone using mechanical valves controlled manually by the operators. The photohelic sensors are used to transmit pressure readings to indicators visible from most of the control valves. Some photohelic gauges were selected to provide an alarm signal when the pressure becomes too high or too low. Pressures are also logged into the computer to identify long-term trends and records.

STATUS

The MOVER system was completed and tested for operational readiness at Los Alamos prior to transfer to WIPP in Carlsbad, New Mexico. A key component in MOVER is the air handling system due to the need to protect the workers and environment during the VE process. Thus, balancing the airflow in the three separate zones was a critical step in assuring MOVER compliance with worker safety in a low radiation environment within the confines of the transportainer.

The MOVER prototype will be installed for operation at WIPP within the next year. The performance of this first prototype is expected to confirm the fact that mobile VE capability will be less expensive than fixed facilities. The addition of computer monitoring and sensor feedback proves that a small, portable, low radiation glovebox operation can be transportable.

Table 1. List of Materials and Tools for VE

INSIDE GLOVEBOX	OUTSIDE GLOVEBOX
• Fixed volume weighing tray • Knives • Tape • Certified weights • Markers • Calibrated balance • Drum lid removal tool • Clamp ring removal tool • Inert mineral absorbent like vermiculite • Plastic or metal inner containers for holding absorbed liquids • Fire suppressing graphite powder • Tamping tool	• Video camera, spare tapes and batteries, markers, blank paper • Calibrated balance for drums • Westinghouse replacement form for LANL's Form 2A/B • Controlled or current version copies of the VE procedure, and other pertinent procedures. (Minimize the number of procedures kept in a controlled area to minimize radioactive waste.) • Bagout supplies

Table 2. WIPP Waste Material Parameters

Waste Material Parameter	Description
Iron-based Metals/Alloys (IM)	Iron and steel alloys in the waste; does not include the waste container materials
Aluminum-based Metals/Alloys (AM)	Aluminum or aluminum-based alloys in the waste materials
Other Metals (OM)	All other metals found in the waste materials
Other Inorganic Materials (OI)	Nonmetallic inorganic waste, including concrete, glass, firebrick, ceramics, sand, and inorganic sorbents
Cellulosics (C)	Materials generally derived from high polymer plant carbohydrates (e.g., paper, cardboard, wood, cloth)
Rubber (R)	Natural or man-made elastic Latex materials (e.g., surgeons' gloves, leaded rubber gloves)
Plastics (waste materials) (PW)	Generally man-made materials, often derived from petroleum feedstock (e.g., polyethylene, polyvinylchloride)
Organic Matrix (OR)	Cemented organic resins, solidified organic liquids, and sludges
Inorganic Matrix (IN)	Any homogeneous materials consisting of sludge, or aqueous-based liquids which are solidified with cement, calcium silicate, or other solidification agents (e.g., waste water treatment sludge, cemented aqueous liquids, and inorganic particulates)
Soils (S)	Generally consists of naturally occurring soils which have been contaminated with inorganic waste materials
Steel (packaging materials) (ST)	208-liter (55-gal.) drums
Plastics (packaging materials) (PP)	90-mil polyethylene drum liner and plastic bags

SOURCE: *DOE Treatability Group Guidance.*