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Title: "On the Road to WIPP": or Remote Packaging of Transuranic Waste

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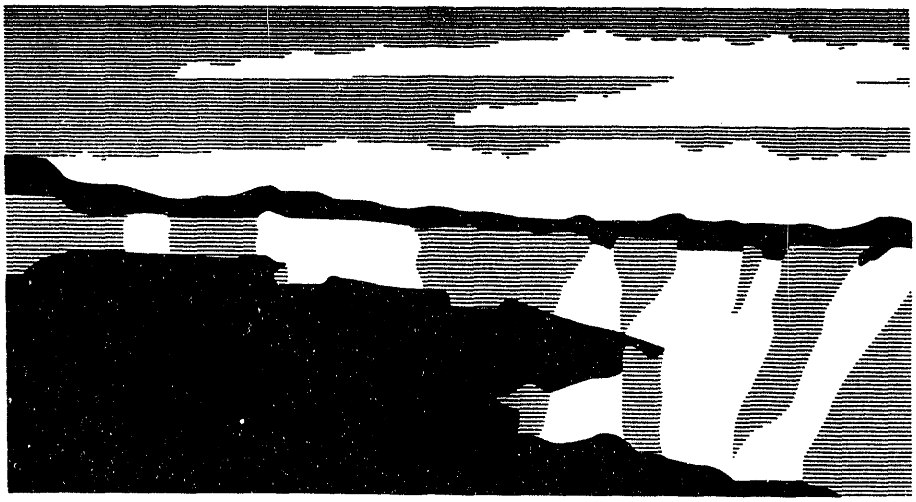

Los Alamos
NATIONAL LABORATORY

ON THE ROAD TO WIPP: OR
REMOTE PACKAGING OF TRANSURANIC WASTE

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ABSTRACT

At the Los Alamos National Laboratory (LANL) Hot Cell facility, highly productive programs in reactor research spanning three decades have generated appreciable quantities of legacy waste. Hot cell capability had become virtually useless due to the storage of this waste. As a result of concentrated efforts by LANL staff, in cooperation with Westinghouse Waste Isolation Pilot Plant (WIPP), a solution was arrived at that allowed the facility to become productive once again. Equipment has been designed and fabricated to remotely handle 55-gal. waste drums[1], load waste canisters, perform canister weld closure, leak test welds, grapple the waste canister and transport the canister to an interim storage site. It is our contention that the technology and acquired equipment produced from this effort should be used to further benefit other DOE sites.

INTRODUCTION

Over the past one and a half years we have been using our unique loading and transportation system (developed and tested and operated at LANL) for packaging, loading, and transporting high activity Remote Handled Tranuranic (RH-TRU) waste in WIPP Approved Canisters[2] to our Nuclear Waste Storage Facility at Technical Area 54 (TA-54). Once there, these Canisters are remotely lowered into underground storage shafts and capped, where they will remain in interim storage until the opening of the WIPP repository. This system also provides the unique capability of being able to retrieve the Canister from the storage shaft directly into the transportation shield without any exposure. This is significant step in implementing ALARA considerations in the handling of high activity radioactive waste.

The development and operation of this unique system has been a very successful project for LANL. It has enabled us to totally remove waste from our Hot Cells and allowed the introduction of productive new programs into the facility. To our knowledge, there are no existing technologies that provides the capabilities that we are presenting here. This system was developed as a demonstration project for the Department of Energy (DOE) to show feasibility and to provide WIPP certified packages of remote handled waste. These packages meet waste acceptance criteria[2] for repository disposal. Los Alamos was the first to Canisterize and store this type of waste in shielded underground shafts for interim storage while awaiting final disposition at WIPP.

The requirements for this project were to characterize, package, certify, and put into canisters all the RH TRU waste generated from the Wing 9 Hot Cell Facility. The waste stream includes all RH waste generated during the phase-out operation as well as all waste previously generated during the examination of irradiated reactor fuels and components. After all the RH TRU waste is packaged and certified, the loaded canisters are then transported, using a canister shield and special purpose trailer to an on-site disposal area 6.4 km (4 mi.) away for interim storage in underground shafts. Once an approved shipping cask is available, the loaded canisters will be retrieved from the shafts and shipped to WIPP.

New developments in remote handling equipment were required to insert loaded 55-gal. waste drums into the WIPP canister, perform a weld closure and leak test all while the canister is in a horizontal position. Following the loading sequence, the canister is hydrolyically elevevated to the vertical position for insertion into the transport shield. A specially designed grapple is attached to the canister lifting pintle, and the canister is transferred from the welding and positioning fixture to the transport shield located outside the containment area. The transport shield is placed on a modified "low-boy" trailer for transportation to an on-site storage area.

DESCRIPTION OF REMOTE HANDLING OPERATIONS

Since its commissioning in 1960, the Wing 9 Hot Cell Facility has been used for the destructive and nondestructive examination of irradiated reactor fuels and components from several research reactors. The facility has two banks of eight hot cells, each 1.8 m wide by 1.8 m long by 3.4 m high (6 ft wide by 6 ft long by 11 ft high). Each bank of hot cells has two rows of four cells separated by a corridor 2.4 m wide by 9.4 m long by 4.3 m high (8 ft wide by 31 ft long by 14 ft high) where canister loading operations are carried out.

The RH-TRU waste was placed into 0.18 m (7 in. dia.) plastic disposal cans and transported into the Hot Cells using an in-cell transfer system. The plastic cans were next inserted into a vented steel can, a lid installed, and a weld closure made.

REMOTE HANDLING OF WIPP CANISTERS

The welded steel cans were transferred to adjacent hot cells for assay of nuclear materials using non-destructive neutron assay equipment. The assayed containers were next loaded into vented DOT/17A 55-gal. drums. These drums were then weighed and stored to await being put in canisters.

The remote handling (addressed in this paper) occurs when the drums are put into the RH-TRU canister. The canister is fabricated from carbon steel (length of 3.07 m (121 in.) and a nominal dia. of 0.66 m (26 in.)). The maximum design weight of a loaded canister is limited to 3,630 kg (8000 pounds). The certified Type "A" drop test weight is 6500 pounds.

Once the canister is in the loading fixture, it rests on a set of turning rollers (load capacity of 9,072 kg (10-ton)) with its bottom end centered on a rotateable thrust-bearing and locator block. The rollers and thrust bearing provide secure centering of the canister during payload insertion and lid positioning. At a later time during the operation, the rollers provide rotation of the canister necessary for the remote welding and leak detection.

Additional fixtures are provided to support the loading and welding operations. For example, support fixtures are used to position the payload, insert the closure lid, and provide for unloading of the Canister if a weld fails.

To develop our remote handling techniques, we determined that all remote operations involving the large canister had to be performed in the 2.4 m wide by 9.4 m long (8 ft wide by 31 in. long) shielded corridor with a usable ceiling height of 3.1 m (10 ft). Available viewing and remote-handling equipment in the corridor is limited to two shielded windows, one 2,722 kg (3-ton) bridge crane, one 150 lb. capacity rectilinear manipulator, and two (2) light-duty master-slave manipulators. Facility limitations determined that all loading, welding, leak checking, and other associated tasks needed to be performed with the canister in a horizontal position, while the loaded canister has to be removed from the shielded corridor in a vertical mode.

We designed and fabricated a canister handling fixture that can horizontally insert the payload, position a 227 kg (500 pound) lid, provide an end closure weld, and then elevate the container to the vertical position for exit from the shielded area into the transporter shield.

The 4.6 m long (15 ft long) canister manipulating fixture was designed to fit on an 18,144 kg (20-ton) remotely operable cart that runs on standard railroad gauge track. This was done so it could be moved in and out of the shielded area on the facilities railroad track system. After the handling fixture is positioned within the shielded corridor and connected to the operating consoles by umbilical cables that pass through the shielded hot cell walls, it is ready for operation. The functions of payload insertion, lid positioning, and elevation of the canister were carried out by an on-board electrohydraulic positioning system. This system is controlled and safety interlocked by a series of electric valves and switches. Activation and movement of the hydraulic cylinders are controlled by the valving system and the hydraulic pump pressure is regulated from the operation control console.

Two (2) hydraulic cylinders provide the movement necessary for insertion of the payload and placement of the closure lid. Two (2) more hydraulic cylinders provide the necessary power to elevate the canister into the vertical position.

Welding of the closure lid is accomplished by a welding system mounted on a retractable gantry arm. A Gas Metal Arc pulse spray process welds the lid to the canister body. The arc position is held constant by a seam tracker system that senses in the horizontal and vertical modes. The electrode position is simplified by the auto search feature and visually verified by strategically positioned closed circuit television (CCTV). The canister rotation speed is manually adjusted to a predetermined rate by observing a digital readout coupled to the turning rolls. The combination of wire feed, seam tracking, and stable rotation have provided consistently good welds on the canister.

The electropneumatically operated gantry arm also incorporates the devices for leak checking the weld on the canister. The canister is purged with helium through the HEPA filtered vent located in the center of the lifting pintle. A leak-sensing shoe, coupled to a leak detector in the operating area, is positioned with a pneumatic cylinder to straddle the closure weld. The turning rolls are activated at a low speed to allow the detector shoe to "sniff" the entire circumferential weld. Following the welding operation and leak detection (leak test sensitivity is 10^{-7} cc/sec.), the gantry arm is retracted to its parked position against the wall.

Following the packaging operations and inspections, the loaded canister is raised to the vertical position to be introduced into the transporter system. The transporter system consists of a canister grapple, a 17,236 kg (38000 pound) radiation shield, and a specially modified "low-boy" trailer.

The grapple is an intregal part of the transporter shield in that it is attached to the shield winching system. It is a self-contained electropneumatic device that is activated by an on-board air supply and battery pack. All the electrical and pneumatic systems of the grapple are redundant in case a component fails. A manually operated backup system has been provided in the event that the grapple fails to uncouple.

The shield is capable of attenuating a 1000 R/hr payload to acceptable levels at its exterior surface. Design features of the shield coupled with a portable power generator enable it to be equally versatile while in use at the Hot Cell Facility or in the remote area of the temporary storage shafts on site. The shield is to be used not only for the transport and insertion of the waste container into the storage shafts but also for retrieval later when an approved shipping cask has been approved for shipping to WIPP.

We modified a 22,580 kg (25-ton) capacity low-boy trailer to transport the canister shield. Trunion type tie-downs were designed and approved; they are welded onto the framework of the trailer. Trunion positioning allows the shield to be secured at a 8° elevation toward the top end. The top end elevation is vital to maintain tension of the internal grapple and winching system. The angled configuration also promotes simpler loading and off loading.

WASTE STORAGE AND RETRIEVAL

Twenty underground storage shafts were constructed at TA-54 to receive the retrievable storage canisters used in this effort. These shafts are fifteen feet deep and 30 inches in diameter. The bottom contains adequate gravel media to provide necessary drainage. The shafts are lined with corrugated galvanized steel culverts. The shafts are positioned on 6 foot centers and are aligned in a two abreast formation. The top pad that surrounds the shafts is constructed of 2 feet thick reinforced concrete. After the storage canisters have been placed in the underground shafts a "Stepped"-plug constructed of 2 feet thick concrete is lowered into the open shaft hole. A 30 inch diameter Butyl O-ring (1 inch in diameter) is used between the sealing plug and the top to the shaft concrete pad to provide a water tight seal.

FUTURE EQUIPMENT USES

Our future desires are to modify our successful stationary system to the point where it would be a mobile unit that could be used across the DOE Complex as a viable means of providing some resolution to a long standing waste removal problem at our national laboratories. Presently, our system is configured in such away that it relies on equipment contained in the facility to perform its function e.g., a wall mounted remote welding head, in cell video equipment, ceiling mounted cranes and rectilinear manipulators. We are proposing to modify the existing design and operational technology to a universal system that would adapt to the unique requirements of a number of DOE facilities.

We are also proposing to uses this system to remotely package and transport spent reactor fuel elements to an interim storage facility. This would provide us with the capability to study the viability of long term "DRY" storage of spent reactor fuel.

CONCLUSION

New developments in all nuclear facilities are usually unique to specific needs and building configurations. This uniqueness characterizes the equipment designed for the Hot Cell Facility at Los Alamos. However, we hope that some of the new techniques and equipment concepts for remote handling that have been developed to satisfy our requirements will provide some insight into RH-TRU waste handling-problems at other facilities.

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[1] ANS Proceedings, 37th Conference 1989, Ledbetter & Dowler, "Remote handling equipment for WIPP canisters"

[2] Waste Isolation Pilot Plant Waste Acceptance Criteria, "Attachment 7", 1989.