OPTIMIZATION OF WASTE OPERATIONS AT WIPP

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ABSTRACT

The Waste Isolation Pilot Plant (WIPP) will receive nuclear waste in late 1988. The unique material-handling aspects of contact- and remote-handled transuranic waste containers has resulted in handling systems with unique features and complications. Optimum waste handling at WIPP requires cooperation and design considerations at the waste generator site, the transportation system, and at WIPP. This cooperation reduces costs for all three parties. Best WIPP handling considerations require (1) maximizing transuranic package transporter (TRUPACT) payload, (2) minimizing operational steps, (3) minimizing lifting operations (slide loads instead of lifting), and (4) automating processes where practical. Conclusions and recommendations reached for WIPP operations are presented.

INTRODUCTION

The Waste Isolation Pilot Plant (WIPP) will be operational and receiving waste in late 1988. Work continues to improve the waste-handling operations. Operational review committees have been established to review and make recommendations to improve existing waste-handling operations. Considerable changes have been made to the initial baseline handling scheme for receiving and handling contact-handled transuranic (CH TRU) waste. Methodology changes to handle remote-handled transuranic (RH TRU) waste are also being considered. Some of the changes and lessons learned are presented in this paper.

The waste-handling operations at WIPP are unique to the nuclear industry. The operation is basically to receive large amounts of defense-generated transuranic waste in sealed containers. The operation becomes a classical material-handling problem with unusual design considerations and changing environments. Waste is received into a typical warehouse-type facility with specialized ventilation controls, off-loaded, and transported to an underground mine. The mine represents a limited space and ventilation environment which is most conducive to simple, straight-forward handling operations with minimal equipment size and complexity. The waste handled is relatively bulky and heavy and, in the case of RH TRU, requires large, heavy shielded casks to minimize personnel radiation exposures during handling.

The basic lessons learned for CH TRU and RH TRU handling are to (1) maximize shipment payload in ways that will decrease handling time per waste container, (2) minimize the number of handling operations, (3) minimize lifting operations (slide loads instead of lifting), and (4) automate processes where possible. The basis for these conclusions is given below.

CH TRU WASTE HANDLING OPTIMIZATION

An operational review committee was formed at WIPP to review existing baseline waste-handling operations in terms of adequacy, efficiency, and cost effectiveness. Radiological considerations, application of human factors engineering, use of automation and/or robotics, ease of maintenance, and functional operability were included in the evaluation. Some design options were closed since the WIPP surface facilities are nearing completion.

Original plans called for removal of the transuranic waste transporter (TRUPACT) from its travel trailer using a straddle carrier when unloading at WIPP. This proved to be a labor-intensive task and also involved more equipment and the potential to drop a TRUPACT. Current plans leave the TRUPACT on the dedicated over-the-road trailer. The TRUPACT and trailer will be backed to a specially designed unloading dock as shown in Fig. 1.

Once at the dock, the first task is to open the two TRUPACT doors. The inner door has 36 bolts, each torqued to 34.6 kg-m. The decision was made to use an automated door bolter to open and close this door. The following benefits are realized:

1. Labor cost is reduced
2. Cycle time is reduced, increasing facility throughput capacity
3. Risk of damage to the TRUPACT inner door, bolts, and bolt hole threads is reduced by eliminating operator error.

Similar advantages could be obtained if the waste could be loaded onto the hoist cage using automated equipment. However, the fact that the facility was not designed for straight-through access with one vehicle precludes automating this operation or makes it very difficult. Future facilities should be designed with simple travel routes conducive to automated equipment carrying heavy loads.

Engineers soon found that handling considerations extend beyond WIPP and include the waste-handling transportation system. Plans exist to receive waste at WIPP in the TRUPACT shipping container. A value analysis team[1] determined that the TRUPACT payload could be increased from 6340 to 9470 kg by implementing design changes. This 49 percent payload increase impacts WIPP significantly. It allows WIPP to handle fewer TRUPACTs to receive its required inventory. Four improved TRUPACT loads are the equivalent to six original loads. WIPP handling efficiency is improved since it takes the same amount of time and handling to receive, dock, and open the more efficient, improved TRUPACT.

The first slip-plate is indexed laterally so the second slip-plate can be skidded onto the pallet. The second slip-plate is pulled onto the facility pallet, and then the entire load is secured to the pallet.

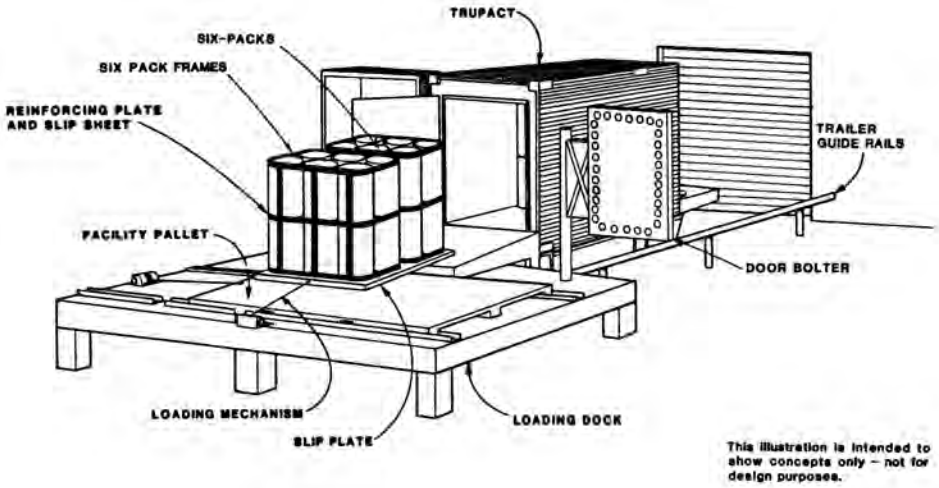

Fig. 1. Slip Handling Concept.

The means to maximize the TRUPACT payload includes eliminating the TRUPACT roller floor (783 kg) with a slip-plate system (187 kg, shown in Fig. 1) and eliminating the use of heavy-angle iron six-pack frames (187 kg each, eight required per TRUPACT load). The six-pack frame can be eliminated by going to a platen and slip-sheet handling method (shown in Fig. 2), which is a material-handling system that uses a thin polyethylene or polypropylene sheet (approximately 0.20 cm thick) under the load and a lift truck attachment that grips the slip-sheet to pull the load into a steel platen. Both slip-handling methods utilize the concept of skidding loads rather than lifting them.

The use of a platen-handling device and slip-sheet allows drums to be banded into six-pack arrangements using conventional steel banding material or plastic stretch-wrap material. Spacers placed between the drums keep the six-pack in proper configuration. Six-pack framing costs are reduced approximately 99 percent, and TRUPACT payload is increased, thus benefiting both WIPP and the waste generator.

The use of a slip-plate allows multiple six-packs to be skidded from the TRUPACT at one time as shown in Fig. 1. The slip-plate is a structural metal plate with a bottom surface fabricated of a high-density, polyethylene-type material with a low coefficient of friction to allow the loaded plate to be skidded easily. One-half of the TRUPACT load (four six-packs or one 1.22 x 1.22 x 2.13-m box) is skidded onto the awaiting facility pallet as shown in Fig. 1.

The loaded facility pallet is moved by a forklift to a specially designed transfer car. This car transfers the pallet onto the hoist cage and then retreats from the cage to remain on the surface. The loaded cage descends to the underground storage horizon. At the underground station, a truck is backed up to the cage, and the loaded facility pallet is winched onto the bed and secured. A similar winching operation for loading the cage on the surface is precluded by the WIPP facility design which was implemented before slip-handling concepts were proposed.

The waste is transferred by the truck to the emplacement site. The waste is off-loaded and stacked using the platen handling device mounted on a forklift. This technology is new to many people but is well proven in applications like the Denver, Colorado Coors Brewery, and the California vegetable industry.

Dunnage used in the TRUPACT also is important to both WIPP's and the generators' waste-handling considerations. Dunnage represents non-productive payload for the generator and a handling and disposal problem for WIPP. Efforts are being made to minimize or totally eliminate dunnage in the TRUPACT. The entire waste program benefits if dunnage is minimized or eliminated.

Maximum CH TRU handling efficiency at WIPP requires cooperation among the waste generator, transportation system, and WIPP. All parties benefit by considering the waste material handling problem on a total system scale rather than as independent facility or system requirements. The generator can package the waste to facilitate handling at WIPP and to maximize productive payload efficiency. The transportation system can maximize payload to minimize transportation costs and also minimize WIPP handling.

long, large diameter holes in TUFF, capable of drilling ±2.5 cm of a true horizontal centerline. Other companies are also developing horizontal drilling technology. Drilling in salt requires different cutting bits, but salt is deemed an easier cutting medium. Thus, drilling technology for horizontal holes is no longer a limiting factor.

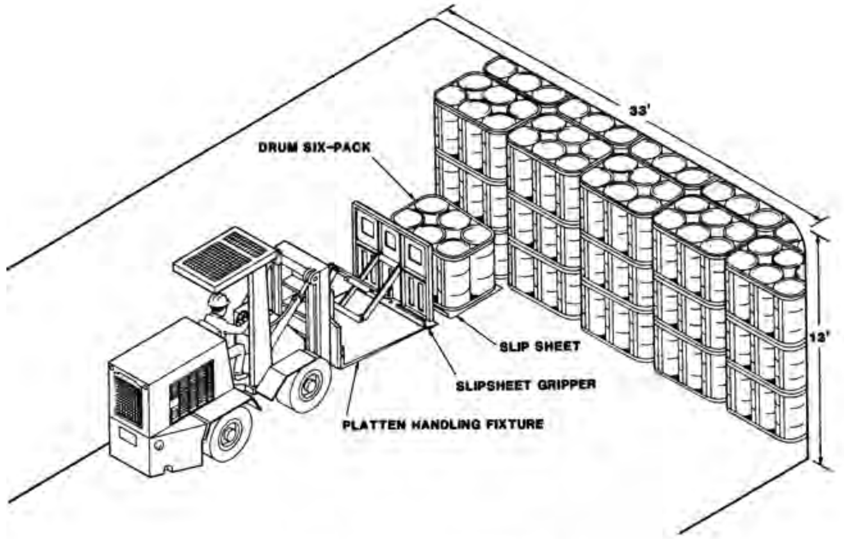

Fig. 2. Drum Handling.

RH TRU WASTE HANDLING OPTIMIZATION

A review, similar to that held for CH TRU, was held for RH TRU handling operations and revealed that beneficial changes could be made to the baseline concept. The baseline concept calls for:

1. Receiving and unloading a transportation cask
2. Passing the cask through an inspection station in a hot cell
3. Transferring the waste canister to a facility cask
4. Transferring the facility cask underground and then to a predrilled emplacement hole
5. Emplacing the canister in a horizontal emplacement hole (one canister per hole)
6. Emplacing a shield plug in front of the canister for permanent hole shielding

The operational review revealed that much time, money, and labor can be saved by placing multiple canisters in a long, horizontal hole. This requires less equipment set-up time for hole drilling and waste-emplacement operations. The need for a costly shield plug for each canister is eliminated. It is also very conducive to the use of the automated or robotic emplacement equipment, since the transport and final emplacement operations are done numerous times at the same location.

In the past, some have dismissed the concept of horizontal long boreholes due to lack of drilling technology. However, Robbins Drill Corporation[2] is now in final design of drill for 183 m

Personnel radiation dose limits will require the use of automated or robotic handling equipment in a high throughput facility. For instance, an operator receiving 0.5 sieverts/day while handling waste will exceed the WIPP goal of 100 sieverts/year maximum dose, during 250 work days per year. This operational radiation dose limit may be lowered in the future. In any case, allowable operator doses should be minimized during routine, waste handling to allow for off-normal event recovery and facility decontamination without exceeding the as-low-as-reasonably-achievable (ALARA) goal.

Robotic handling poses advantages in that the shielding cask handling can be eliminated, and thus the handling payload is 10 percent or less of a shielded payload. Equipment can be smaller, more maneuverable, and requires less ventilation and power. Disadvantages posed are that careful engineering must be done to ensure that equipment failures can be corrected and the waste form recovered safely.

WIPP has design limitations for use of unshielded robotic handling. The mine was designed for shielded handling. The best production solution, for WIPP, seems to be limited application of robotics and unshielded, automated handling. Future facilities should give strong consideration to unmanned, unshielded handling to allow personnel radiation doses to be minimized and to reduce design problems with equipment maneuverability.

GENERAL CONSIDERATIONS

A TRUPACT driver bringing a load to WIPP will disengage the loaded TRUPACT/trailer and pick up an empty TRUPACT/trailer. After completing necessary radiological surveying, the empty TRUPACT will be on the road, minimizing driver hold-up time.

WIPP has considered the provisions for sampling the inner air cavity of the TRUPACT and proposed defense high-level waste (DHLW) road cask. The operational review committee advised that these cavities not be sampled at WIPP. The sampling involves taking a very limited air sample of a stagnant air space without sufficient velocity to re-entrain any contamination present. This sample showing clean does not give a high confidence that no contamination exists in the cask or TRUPACT. In fact, it may give a false sense of security that the enclosure is not contaminated when it is contaminated.

WIPP plans to install a TRUPACT/cask washdown station. This washdown station has the following operational benefits:

1. Minimizes road dirt in the Waste Handling Building
2. Minimizes the potential for seal damage
3. Enhances public image by having clean equipment
4. Decreases time to perform preventive maintenance.

WIPP plans to use conventional bar-code systems to inventory incoming waste. The bar-code reader will be interfaced with a computer to do a records check to ensure that the six-pack and box identification numbers received agree with those in the data package transmitted for that shipment. The reader is capable of reading bar-codes up to 1.83 to 2.13 m away from the waste package. This minimizes operator exposure associated with shipment inventory requirements.

SUMMARY

The unique and prototypic nature of the WIPP repository and its waste disposal mission creates some unusual material-handling considerations. Handling processes are being designed and developed to optimize waste-handling operations and minimize personnel radiation doses. Basic steps to accomplishing this are:

1. Maximize shipment payload in ways that will minimize handling time per canister
2. Minimize the number of handling operations
3. Minimize lifting operations (slide loads instead of lifting)
4. Automate processes where possible

For CH TRU, specific recommendations are:

1. Leave TRUPACT on the over-the-road trailer when unloading
2. Use an automated door bolter to open and close the inner TRUPACT door
3. Minimize or eliminate TRUPACT dunnage
4. Maximize the TRUPACT payload in ways that will minimize waste-handling time
5. Utilize slip-handling technology to off-load and handle CH TRU waste
6. Eliminate heavy, metal six-pack drum frames and replace them with drum spacers and conventional banding or shrink wrap (less substantial six-pack frame is possible due to use of slip-handling)
7. Skid the facility pallet, with a full TRUPACT load, directly from the hoist cage to the underground transporter bed
8. Off-load the underground transporter using a platen handling device mounted on a forklift.

Maximum CH TRU handling efficiency at WIPP requires cooperation among the waste generator, transportation system, and WIPP. All parties benefit by considering the waste handling on a total system scale. The generator can package the waste to the system's best advantage, and the transportation system can maximize payload to reduce WIPP handling requirements and reduce shipping costs.

Specific recommendations for RH TRU are:

1. Place multiple canisters in a long horizontal borehole
2. Automate the canister handling, as practical, to reduce personnel exposure

RH TRU handling involves either large, heavy shielding casks or remote, robotic unshielded handling. Many advantages can be obtained by robotic handling, but the design of the WIPP facility limits the extent of its use.

Waste handling operations at the WIPP are evolving. Unique material-handling considerations are present in this first-of-a-kind repository. Radiation dose limits and operational efficiency considerations cause handling to lean towards minimized handling steps and use of automation or robotics, as existing facilities allow.

REFERENCES

1. "Final Report of the TRUPACT Value Analysis Task Force," report submitted to the U.S. Department of Energy, Albuquerque Operations Office, May 15, 1985.

2. "Final Report for Repository Drilled Hole Methods Study," The Robbins Company for Sandia National Laboratories, SAND83-7085, July 1984.