USING THE ISMS PROCESS TO QUALITATIVELY EVALUATE RISKS AND CONSEQUENCES FROM RELOCATING MONOLITH CASKS AND VAULTS TO A DESIGNATED STORAGE FACILITY

T. T. Potts, S. A. Guy
WESKEM, LLC
105 Mitchell Road, Suite 100, Oak Ridge, TN 37830

J. M. Hylko
WESKEM, LLC
297 Kentucky Avenue, Kevil, KY 42053

T. D. Moore
Engineering Construction Services
7031 Knoxville Highway, Oliver Springs, TN 37840

ABSTRACT

This paper summarizes how the Integrated Safety Management System (ISMS) process was used to qualitatively evaluate the risks and potential consequences from relocating empty monolith concrete casks and concrete vaults at Oak Ridge National Laboratory (ORNL) in Oak Ridge, Tennessee. The work release (WR) included a thorough engineering and safety review of performing the relocation activities using a forklift. However, the WR also allowed for alternate methods to be proposed as necessary. Even though a properly rated forklift could be procured, the ISMS evaluation provided numerous justifications that a forklift was not the preferred option. For example, a forklift operator’s forward view was restricted due to the height of the monolith cask and side view was restricted due to the width of the double vault container. Also, this type of forklift was neither suited for driving or maneuvering on the low-density gravel-like soil pads nor graveled roadways. The potential for degrading road conditions because of heavy traffic and considering previous lessons learned led WESKEM, LLC to conclude that a properly rated crane, tandem flatbed trailers, and hoisting-and-rigging equipment to relocate the casks and vaults were safer alternatives. Additional benefits included using this process to relocate other nonaffiliated cask molds, several smaller casks/boxes, lid retention devices, and various material handling equipment.

INTRODUCTION

The U.S. Department of Energy (DOE) requires that activities be performed in a manner that protects DOE, contractor personnel and the general public against all environmental, health, and safety hazards. Therefore, it is DOE’s expectation that the principles of the Integrated Safety Management System (ISMS) are incorporated into existing and future work activities. WESKEM, LLC’s programmatic ISMS infrastructure uses a graded approach that takes into account the nature and hazards of the work to be performed (1). Furthermore, WESKEM, LLC’s Activity Hazards Analysis database, work control processes, and employee feedback, for example, ensure the ISMS functions are fully implemented and that hazards associated with the WR are identified and controlled to ensure work is performed safely (2).

In this particular ISMS application, WESKEM, LLC was assigned a work release (WR) to relocate empty monolith concrete casks and concrete vaults from their current storage locations within Solid Waste Storage Area (SWSA) 6 to the Interim Waste Management Facility (IWMF) located at Oak Ridge National Laboratory (ORNL) in Oak Ridge, Tennessee. Table I summarizes the specifications of the concrete casks and vaults.

Table I. Monolith Cask, Double Vault and Regular Vault Specifications

SPECIFICATIONS	**MONOLITH CASK**	**DOUBLE VAULT**	**REGULAR VAULT**
Quantity	89±10	5	49±10
Length	N/A – cylindrical	4.78 m (188" or 15.67')	2.39 m (94" or 7.83')
Width or Diameter	2.64 m (104" or 8.67')	1.75 m (69" or 5.75')	1.70 m (67" or 5.58')
Height	2.67 m (105" or 8.75')	1.93 m (76" or 6.33')	1.83 m (72" or 6.00')
Empty Weight (w/lid)	21.7 tonnes (24.1 tons)	~14.4 tonnes (~ 16.0 tons)	<9.0 tonnes (<10 tons)
Lid Weight	4.1 tonnes (4.6 tons)	~3.8 tonnes (~ 4.2 tons)	~1.78 tonnes (~ 1.98 tons)
Full Weight (w/lid)	<35.6 tonnes (< 39.6 tons)	<32.0 tonnes (< 35.6 tons)	<17.62 tonnes (< 19.58 tons)

The WR required the strategic placement of these casks and vaults with other existing IWMF casks and vaults in preparation for final disposal (Figure 1), ultimately resulting in burial under an engineered earthen cap.

Fig. 1. Overview of the IWMF illustrating full pads containing regular vaults and a nearby empty pad with a crane readied for adding more casks and vaults.

As part of the preparation process, void spaces were filled with rock to eliminate potential subsidence issues. Because of the added weight issue associated with filled casks and vaults, potentially increasing a handling weight to approximately 36 tonnes (40 tons), it was decided to fill the larger casks and vaults with rock after they had been relocated to their final disposal location.

The WR included a thorough engineering and safety review of performing the relocation activities using a forklift. However, the WR also allowed for alternate methods to be proposed if the cask and vault movements could not be performed safely using a forklift. This paper summarizes how the ISMS process was used to qualitatively evaluate the risks and potential consequences from relocating monolith casks and vaults to the IWMF.

ISMS Process Results

Using a 22.5-Tonne (25-Ton) Rated Forklift to Relocate Monolith Casks and Double Vaults with Lids

On April 1, 2004, a work-planning ISMS session was conducted with stakeholders involved in executing the WR. The location of the monolith casks (Figure 2) and size of the double vaults (Figure 3) presented several challenges.

Fig. 2. Monolith casks with lids before relocation to the IWMF pad in SWSA 6.

Fig. 3. A double regular vault after relocation to IWMF pad. The lid is being removed to facilitate rock-filling operations.

Recalling that a typical monolith cask with lid weighed 21.7 tonnes (24.1 tons) empty, executing this WR would require a minimum 22.5-tonne (25-ton) capacity forklift. Even though a properly rated forklift could eventually be procured, the ISMS evaluation provided numerous justifications that using a forklift of this capacity was still not the preferred option for this relocation activity:

- A forklift operator's forward view was restricted due to the height of the monolith cask and side view was restricted due to the width of the double vault container.
- This type of forklift was neither suited for driving or maneuvering on the low-density gravel-like soil pads nor graveled roadways. In addition, the maneuverability of this type of forklift would be constrained because of the limited space in certain receiving and storage areas.
- The initial positioning of the casks presented problems in accessing the lifting-strap pockets (i.e., the pockets faced opposite and away from the roadway).
- The small size of the pockets would not have accommodated the width of the 22.5-tonne (25-ton) rated forklift tines. These pockets were for placement of rigging equipment (e.g., slings) and were not intended for forklift tines.
- The uphill road grade would be difficult to climb, along with a high potential for damage to the roadway, equipment, and/or storage area. Past experience and lessons learned from similar activities (3) demonstrated rapid deterioration to roadways and storage areas could occur when much lighter items, compared to the items in this WR, were moved.
- Rapid damage and deterioration to the SWSA 6 ground surface from repetitive forklift turning and maneuvering in this limited area would create stability and safety issues (e.g., formation of ruts).
- Climatic conditions such as heavy summer rains and high winds would have contributed to deterioration of the SWSA 6 ground surface (e.g., puddling, erosion).
- A slower-traveling forklift could induce traffic jams, creating new hazards to the area.

Relocating Empty Regular Concrete Vaults

Another set of 49 empty regular concrete vaults, weighing <9.0 tonnes (<10 tons) empty, were located in SWSA 6 on a solid-packed gravel lot (Figure 4).

Fig. 4. Regular concrete vaults.

Although it was anticipated that the 22.5-tonne (25-ton) rated forklift would cause damage to the ground surface, these vaults could be lifted with a lighter [e.g., 9.0-tonne (10-ton) capacity] forklift and placed on a flatbed truck for transport to the IWMF. They could then be unloaded with a forklift and positioned for rock-filling operations.

Lessons Learned on Accelerated Cleanup

Taking Other Non-Associated, Yet Adjacent Work Into Consideration

Accelerated cleanup is a process that involves earlier-than-originally-planned closure activities across numerous projects on the Oak Ridge reservation. This has caused heavier-than-normal traffic conditions with numerous subcontractors often crossing paths during day-to-day operations. These conditions prompted additional reviews to strengthen the hazard evaluations associated with heavy traffic volumes and road conditions:

- Temporarily suspending all hauling operations.
- Walking down the entire haul road to identify any additional spots where two-way traffic created a hazard and to ensure the traffic pattern was consistent with the design drawings.
- Conducting post-incident reviews and critiques with all project staff, union craft and subcontractors.
- Protective controls, such as installing jersey barriers along the White Oak Creek portion of the haul road, and posting signs indicating single-lane-only traffic

subject to yielding a right of way in areas where roadways have inclines, ditches, as well as soft, little or no shoulders.
- Incorporating reminders regarding traffic safety into plan-of-the-day discussions. Formal “Rules of the Road” were issued to all operators to carry on their person. Heavy equipment operators needed to understand that they have the right of way when being approached by other vehicles.
- The project instituted the practice of posting flaggers at the ends of the haul road with radios to assist with traffic control during periods of heavy usage.
- Acknowledging a blind spot created on the right side of the forklift when the boom is in the down position.
- Determining actual clearance distances relative to movement of equipment on one-lane roads that have essentially no shoulder.
- Refer to drawings that reveal special conditions, such as stating “Two lane to existing single lane - reduce speed.”
- Initiating the additional clearing of vegetation to provide a clear line of sight to aid traffic safety.
- Reviewing other areas along the haul road and placing additional barriers, traffic cones, flagging, and signage in similar safety-affected traffic areas.

Heavy Equipment, Relocating Heavy Objects and Changing Road Conditions

Since WESKEM, LLC’s WR involved heavy equipment (e.g., forklift) coinciding with relocating heavy objects (e.g., casks and vaults) and the potential for changing road conditions, a previous lessons learned (3) reemphasized the need to evaluate and mitigate these existing hazards. Although the IWMF drive route is approximately 0.4 km (0.25 miles), changing road conditions were addressed as part of WESKEM, LLC’s ISMS review.

At the time of this evaluation, the original design and engineering drawings of the roads expected to be used for relocating the casks and vaults could not be located. Nevertheless, the roads were in fair condition, built on uphill and downhill rolling grades to and from the IWMF, and had historically handled thousands of loads of dirt, rock, and concrete associated with various construction operations. Washout areas from recent rains had already been identified. Furthermore, accelerated cleanup activities from new and other unassociated construction activities were expediting the relocation of these casks and vaults because of their current storage locations. Also, road sharing from heavy equipment movement supporting the earthen capping operation was expected to degrade road conditions indirectly.

Given the newly-induced high traffic areas, the number of casks and vaults that must be relocated, the short wheelbase and limited weight distribution of a properly rated forklift, and the average annual rainfall for the region being >1.3 m (>50 inches) per year, the road to the IWMF was expected to deteriorate rapidly. The road would require frequent maintenance for suitable forklift travel. This required maintenance would be difficult to implement since the road is slated to be covered by several meters (feet) of fill material.

Another concern along this route was a concrete box culvert that traverses underneath the roadway (Figure 5).

Fig. 5. Rectangular concrete culvert under IWMF Drive.

The short wheelbase of a loaded forklift would have distributed a concentrated load on the culvert compared to a tractor-trailer that spreads the load. Despite the fact that other contractors had used this route in the past to construct and place vaults on the IWMF pad, the load-bearing capacity of the culvert had not been rated. Historic engineering drawings could not be located on this culvert so it was difficult to properly evaluate the exact rating capacity for this structure. Since the shortened wheelbase of the forklift could concentrate the gross load directly over the culvert, it was determined that the loads needed to be transferred using a flatbed trailer where only a fraction of the load was ever directly over the box culvert during transport. Such practices reduced the chances of harmful failure, which could have resulted in personnel injury and/or costly project delays if corrective measures were necessary.

CONCLUSION

The ISMS process was used to qualitatively evaluate the risks and potential consequences from relocating monolith casks and vaults to a designated storage facility. As a result of this evaluation, using a properly rated forklift to complete this WR would prove to be an inefficient and possibly hazardous approach. The type of forklift required to move either the monolith casks or vaults would have been: 1) difficult to operate within the confined areas where the casks and vaults are located; 2) would induce a visual restriction hazard; 3) could generate a concentrated traffic condition resulting in increased hazards; and 4) would damage the ground surfaces resulting in subsequent hazards associated with ruts.

The aforementioned considerations combined with less-than-ideal road and culvert conditions covering a distance of approximately 0.4 km (0.25 miles) led WESKEM, LLC to conclude that a properly rated crane, tandem flatbed trailers, and hoisting-and-rigging equipment (e.g., hoist rings, slings, spreader devices, etc. compatible with these containers) to relocate the containers were safer alternatives to accomplish this WR successfully. Since the container lids were not designed to be lifted using a forklift, a crane was already slated for project use. Additional benefits included using this process to relocate other nonaffiliated cask molds, several smaller casks/boxes, lid retention devices, and various material handling equipment from SWSA 6 to other ORNL storage locations.

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