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Project Report: Tritiated Oil Repackaging Highlighting the ISMS Process

Historical Radioactive and Mixed Waste Disposal Request Validation and Waste Disposal Project (HDRV)

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Sandia Contract No. SA-0005

Abstract

The Integrated Safety Management System (ISMS) was established to define a framework for the essential functions of managing work safely. There are Five Safety Management Functions in the model of the ISMS process: (1) work planning, (2) hazards analysis, (3) hazards control, (4) work performance, and (5) feedback and improve. Recent activities at the Radioactive and Mixed Waste Management Facility underscored the importance and effectiveness of integrating the ISMS process to safely manage high-hazard work with a minimum of personnel in a timely and efficient manner. This report describes how project personnel followed the framework of the ISMS process to successfully repackage tritium-contaminated oils.

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Acronyms

ALARA	As Low As Reasonably Achievable
DAC	Derived Air Concentration
HEPA	High-Efficiency Particulate Air (filters)
HDRV	Historical Radioactive and Mixed Waste Disposal Request Validation and Waste Disposal Project
ISMS	Integrated Safety Management System
PPE	Personal Protective Equipment
PVC	Polyvinyl Chloride
RMWMF	Radioactive and Mixed Waste Management Facility
RTR	Real-Time Radiography
RWP	Radiological Work Permit
TID	Tamper Indicating Device

Project Report: Tritiated Oil Repackaging Highlighting the ISMS Process

Historical Radioactive and Mixed Waste Disposal Request Validation and Waste Disposal Project (HDRV)

Purpose of Report

The purpose of this report is to describe the Historical Radioactive and Mixed Waste Disposal Request Validation and Waste Disposal (HDRV) Project's process for safely and efficiently handling waste with a significant tritium oxide hazard. This report will demonstrate how HDRV's continued commitment to safety is reflected in the recently implemented Integrated Safety Management System (Figure 1).

Figure 1. Integrated Safety Management System

Background

Tritium-contaminated waste oil with RCRA metals was accepted from Sandia National Laboratories, California (SNL/CA) in 1994. This mixed waste was predominantly packaged in 15-gallon carboys and paint cans, with possible debris (Personal Protective Equipment (PPE), pipettes, etc.) located inside the carboys. In 1996, HDRV removed the containers of oil from SNL/CA's shipping containers to inventory and sort the contents, check for leaks in the oil packaging, and prepare the waste for sampling and analysis. The carboys were stored in 4' x 4' x 7' boxes for easy access in sampling and repackaging for eventual treatment and disposal. The boxes were then placed in the tritium storage room at the Radioactive and Mixed Waste Management Facility (RMWMF) until sampling could occur.

Problem

The tritium storage room at the RMWMF was scheduled to be used as a second sorting room; therefore, the boxes containing the tritiated oils were moved into the RMWMF north bay. The tritiated oil was off-gassing tritium oxide, which was slowly being released into the RMWMF work areas. Tritium contamination levels in the general work areas were reaching 300 dpm per swipe—significantly higher levels than were reached with previous swipes. Continued tritium oxide release from the boxes also posed an ALARA (As Low As Reasonably Achievable) concern. In June 1997, HDRV personnel decided to repack and seal the carboys into 30-gallon drums.

Objective/Task

The main objective was to open the boxes without allowing the gaseous tritium oxide, which had built up inside the boxes, to release into the sorting room. The boxes would be vented out the building stack until tritium concentration levels were acceptable. The carboys would be repackaged into 30-gallon drums and caulked shut. Sealing the drums would decrease the tritium off-gassing into the RMWMF.

Integrated Safety Management System (ISMS)¹

Sandia National Laboratories, New Mexico, established the Integrated Safety Management System (ISMS) to provide a structure for evaluating the development of activities that could affect the safety of the public, workers, or the environment. There are Five Safety Management Functions in the model of the ISMS process: (1) Plan work; (2) Analyze hazards, (3) Control hazards, (4) Perform work, and (5) Feedback and Improve. The elements within each of the functions are derived from DOE (e.g., the DOE Seven Guiding Principles) and from Sandia National Laboratories (e.g., the Ten Management Standards). The Guiding Principles form the foundation of safety management:

1. Line ownership and accountability for safety
2. Clear roles and responsibilities
3. Competence commensurate with responsibilities
4. Balanced priorities
5. Identification of safety standards and requirements
6. Hazard controls tailored to work being performed
7. Operations authorization

The tritiated oil repackaging task incorporated each of these Safety Management Functions and Guiding Principles into the planning and perform-work stages.

1. J. R. Guth and C. J. Madigan, *Sandia National Laboratories' Integrated Safety Management System Implementation Plan*, PN471010, Issue A, Sandia National Laboratories, Albuquerque, NM, March 31, 1997.

I. Plan Work

Brainstorming

Previous activities at the RMWMF included the use of a plastic tent to control gas releases. Essentially, a PVC pipe frame covered with a plastic tent would be connected to the RMWMF's HEPA filter system. The box of tritiated oil could be placed inside the tent, opened, and allowed to vent. This would keep the tritium oxide gas confined to the tent area.

The tent design was discussed and determined to be unacceptable. To remove the box clamps and move the lid for ventilation, the technicians would have to be inside the tent. This would defeat the purpose of building a containment.

The next idea was to drill holes into the lid and vent through the holes. While this concept reduced exposure to the workers, it would require two drills and bits. Once exposed to the tritium, the drills would be contaminated and it was unlikely that the drills could be decontaminated to free-release levels—the drills would essentially become waste. Also, the box lids with drilled ventilation holes could no longer be used, thereby violating waste-minimization principles. The HDRV Team assumed responsibility for balancing all the priorities of this task and was committed to finding the best alternative.

During further HDRV round-table discussion of the problem, the idea was presented of isolating the top portion of the box to allow ease in handling the lid. Further refinement resulted in a "shower-cap" design that would allow the lid to be easily handled, while maintaining a sealed barrier between the technicians and the tritium (Figure 2). It was decided to test the theory in a full-scale mock-up at the RWMWF.

Figure 2. The RMWMF HEPA system (elephant trunk upper left) provides negative pressure in the shower-cap design, ensuring that the tritium oxide does not escape the system.

Mock-Up

A clean 4' x 4' x 7' box, a roll of clear plastic sheeting, duct tape, and an elephant trunk ventilation duct were gathered in the high bay at the RMWMF. Considering conditions that would be encountered in the sorting room, a step-by-step process for venting the boxes was developed.

One problem identified during the mock-up was the removal of the box pins with the shower cap in place. Because the pins must be removed with a pry bar and hammer, there was a concern that the seal might be breached. If the pins were removed prior to placing the cap on the box, the lid could potentially "burp" a large amount of tritium oxide. Further discussion identified the possibility of using strapping bands to hold the lid in place while the pins were removed. The mock-up continued and the box was banded with metal strapping bands to ensure a tight seal of the lid on the box.

The HDRV Team attached the shower cap to the box and after experimenting with the ventilation rate and devising an inlet system, the team successfully moved the lid to allow ventilation with the shower cap in place. The mock-up proved that the shower-cap method was valid and the HDRV Team and Radiation Protection Personnel agreed that this procedure was the best alternative.

The Radiological Work Permit (RWP) was initiated, step-by-step instructions were written, and the ALARA coordinator reviewed and approved the planned work. The Radiation Protection Team Supervisor and the 7577 Department Manager provided operational authority to begin work.

By doing the mock-up and relying on the experience of the HDRV Team, all the required materials, from Personal Protective Equipment (PPE) to 30-gallon drums, were gathered prior to performing any field work with radioactive mixed waste.

II. Analyze Hazards

The major concern for the HDRV Team members was the possibility of high air concentrations of tritium oxide in the sorting room. SNL/NM does not own bubble suits, which provide personnel protection from tritium oxide air concentrations for a specific period of time. The shower-cap design for the venting activity would prevent significant air concentrations of tritium oxide inside the sorting room.

Review of Container Contents

Because the HDRV Project had placed the oil into the boxes and maintained the Tamper Indicating Devices (TIDs) on the containers, project personnel were confident as to the contents of the boxes. Box inventory information was gathered from the HDRV Database and previous RWP to determine if any of the contents posed a particular hazard. The expected tritium activity for each box was 52.5 Ci and 27.2 Ci total. In addition, Real-Time-Radiography (RTR) was performed on both boxes to determine the status of the containers and to see if the containers held debris in addition to the oil (Figure 3). The video of the RTR was reviewed for any potential problems.

The HDRV Preliminary Hazard Screening, Hazard Analysis, Health and Safety Plan, and procedures were reviewed and determined to be adequate for the planned venting/repackaging activity. The RWP identified any additional safety concerns and requirements.

Figure 3. Two carboy containers and the liquid level in each.

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III. Control Hazards

Tritium Presentation

To better educate the workers about the hazards they may encounter during the box venting and repackaging activities, Anne Hallman gave a presentation and conducted a round-table discussion on tritium. Anne's tritium background provided an excellent foundation for this presentation, which focused on tritium's chemistry and hazards, as well as safe work practices. HDRV Project technicians and radiation protection support personnel attended the presentation.

Pre-Job Briefing

As with all waste handling activities conducted under the HDRV Project, the day of the drum venting began with a pre-job briefing. The roles and responsibilities of each person were emphasized and a step-by-step review of the job was performed. In addition to the verbal refresher, the steps were written down on a white board for quick reference.

Tritium Sniffers

To monitor the levels of tritium in the box, sorting room, and the high bay, it was necessary to obtain three tritium monitors (Figure 4). Using the three monitors ensured that no accidental release of tritium would go undetected. The readouts were continuously monitored and recorded. At no time did the levels exceed allowable limits set in the RWP.

Figure 4. Tritium monitors.

Shower-Cap Design

Once in place, the shower-cap design allowed the flexibility needed by the technicians to handle the box lid, yet provided the protection required to keep the tritium oxide away from personnel (Figure 5). This control was tailored to the work being performed and (as will be discussed in the next section) the design worked perfectly.

Figure 5. Off-gassed tritium oxide is allowed to vent. The air inlet can be seen in the back right side of the box.

IV. Perform Work

As the technicians performed the work, the three tritium sniffers monitored the air concentrations inside the box and ambient air concentrations inside the sorting room. Using the mock-up design and lessons learned during the mock-up, the actual work went quickly and without incident. The ambient tritium oxide levels inside the sorting room during the lid removal, when the puff of tritium would be the highest, reached approximately $10 \mu\text{Ci}/\text{m}^3$ ($< 1 \text{ DAC}$) for the first box and $< 1 \mu\text{Ci}/\text{m}^3$ for the second box. Levels of tritium inside the box pegged the tritium sniffer at over $70,000 \mu\text{Ci}/\text{m}^3$ ($\sim 3,500 \text{ DAC}$). Once the lid was removed from the box, the technicians exited the area and the box was allowed to vent.

By the time the technicians started handling the waste three hours later, the tritium levels inside the box were reading around $10 \mu\text{Ci}/\text{m}^3$ ($\sim 0.5 \text{ DAC}$). The waste was removed and repackaged in thirty gallon drums.

To further reduce the waste associated with the tritium repackaging, the HDRV Project repacked the carboys and paint cans in 30-gallon drums using a cellulose-based packing/spill control material instead of the traditional kitty-litter. The cellulose-based material is incinerable, unlike kitty litter, and will not have to be returned to SNL/NM for disposal after the oil is treated.

The only issue that arose during the process was worker fatigue experienced by workers wearing the Saranex suit. Saranex suits are hot and uncomfortable to work in but provide an additional factor of protection against tritium contamination. As HDRV Procedures, and Health and Safety Plan dictate, the workers were provided with ample periods of rest and were continuously monitored for fatigue.

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V. Feedback and Improve

Through every step in the task development and execution, project staff feedback improved the safety and efficiency of the work. By developing a sense of ownership and accountability, the skills and experiences of every team member were utilized.

Conclusion

From its inception in 1995, the HDRV Project has maintained safety as the number one priority. This tritium-venting task is just one example of the high-hazard work HDRV has completed. By following a framework of project and task development, the HDRV Project has been able to safely and efficiently manage high-hazard work with a minimum of personnel.

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