DISPOSITION PATHS FOR ROCKY FLATS GLOVEBOXES: EVALUATING OPTIONS

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ABSTRACT

The Kaiser-Hill Company, LLC has the responsibility for closure activities at the Rocky Flats Environmental Technology Site (RFETS). One of the challenges faced for closure is the disposition of radiologically contaminated gloveboxes. Evaluation of the disposition options for gloveboxes included a detailed analysis of available treatment capabilities, disposal facilities, and lifecycle costs. The Kaiser-Hill Company, LLC followed several processes in determining how the gloveboxes would be managed for disposition. Currently, multiple disposition paths have been chosen to accommodate the needs of the varying styles and conditions of the gloveboxes, meet the needs of the decommissioning team, and to best manage lifecycle costs.

Several challenges associated with developing a disposition path that addresses both the radiological and RCRA concerns as well as offering the most cost-effective solution were encountered. These challenges included meeting the radiological waste acceptance criteria of available disposal facilities, making a RCRA determination, evaluating treatment options and costs, addressing void requirements associated with disposal, and identifying packaging and transportation options.

The varying disposal facility requirements affected disposition choices. Facility conditions that impacted decisions included radiological and chemical waste acceptance criteria, physical requirements, and measurement for payment options. The facility requirements also impacted onsite activities including management strategies, decontamination activities, and life-cycle cost.

INTRODUCTION

Kaiser-Hill Company LLC (KH) is the integrating management contractor for the U.S. Department of Energy (DOE) Rocky Flats Field Office at the Rocky Flats Environmental Technology Site (RFETS) located in Golden, Colorado. RFETS is the home of facilities formerly used to conduct nuclear production activities, including the handling of plutonium-contaminated materials in gloveboxes. KH has responsibility for DOE mandated site closure of RFETS by 2006.

Envirocare of Utah, Inc. (Envirocare) operates a low-level radioactive waste disposal facility 80 miles west of Salt Lake City in South Clive, Utah. The Envirocare facility serves government and commercial customers for the treatment, storage and disposal of radioactive waste.

KH and Envirocare have jointly pursued opportunities to expedite the closure of the RFETS prior to the 2006 closure deadline. In pursuit of this goal, one obstacle – the disposition of radiologically contaminated gloveboxes - offered opportunities for both companies to identify new disposition options, create new processes, reduce costs, and achieve project success on or ahead of schedule. Efficient and cost-effective glovebox disposition at RFETS is a "critical path" activity associated with achieving successful and timely closure in 2006.

KH evaluated disposition options at two facilities: Nevada Test Site (NTS) and Envirocare. Radiological waste acceptance criteria, hazardous constituent waste acceptance criteria, and cost were all factors that were considered in the evaluation. The varying styles of gloveboxes at RFETS influenced the results and the comparison of the two disposal facilities since the origin and design of the glovebox dictated available disposition options and the ease with which options could be exercised.

After this evaluation process, it was concluded that both NTS and Envirocare would be used to disposition gloveboxes from various buildings. However, the path toward shipment to each of the respective facilities and the actions taken after receipt at the facilities is different, requiring separate handling and management procedures at RFETS as well as at the facilities. Today, a clear disposition path utilizing best practices and lowest lifecycle cost options is identified and utilized in RFETS closure activities and glovebox disposition.

PROJECT HISTORY

Gloveboxes were historically used for workers to safely handle radioactive materials during the weapons production phase of the site's mission. However, not all gloveboxes were designed similarly.

> "There are many types, styles, and shapes of GloveBoxes. They were all designed to contain and shield radioactive material while allowing workers to perform various nuclear operations within GloveBoxes. Lead was incorporated into the GloveBox design in the form of sheeting, windows, and gloves to protect workers from gamma radiation and alpha contamination. Lead sheeting on the exterior of GloveBoxes continues to provide the intended purpose of shielding. Additionally, the sheeting and windows continue to provide another originally intended purpose, namely, containment of alpha contamination."
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> "¼" lead sheeting has been installed over the exterior surfaces of GloveBoxes. The sheeting is bolted or glued to the stainless steel shell of the GloveBox. If glued, removal of the sheeting is done by D&D workers using hammer and chisel.
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> "The GloveBoxes are equipped with two types of windows: Rocky Flats Windows and Los Alamos Windows. The Rocky Flats window is nonleaded glass, which has an externally attached leaded glass overlay. The leaded overlay can be removed without breach of the GB's containment. Los Alamos Windows, which are attached from the interior, cannot be removed without breach of containment. These contain lead in

> a glass matrix that is inseparable from the nonleaded portion. The leaded glass matrix is fused between two layers of nonleaded glass, forming a single piece of manufactured glass to serve as the window."[1]

The gloveboxes are currently contained in Buildings 371/374 and 707. Originally, it was anticipated that almost all RFETS gloveboxes would have to be size-reduced and sent to Waste Isolation Pilot Plant (WIPP) as transuranic (TRU) waste. Through characterization and decontamination techniques developed by KH more than two years ago, it was determined that gloveboxes could potentially qualify for disposal at NTS. However, the leaded glass, gloves, and other lead shielding prevented the gloveboxes acceptability for direct disposal at the NTS facility without stripping all lead items. This was because the lead items are currently considered a radioactive lead solid and subsequently a hazardous waste requiring treatment prior to disposal.

In efforts to continue process improvements, KH continued to seek less expensive, safer, and more expeditious options for disposition of the gloveboxes to support closure of RFETS before 2006.

IDENTIFIED OPTIONS

In seeking additional options for disposition of the gloveboxes, consideration had to be made for the two primary types of gloveboxes, each presenting differing challenges. First, the older category gloveboxes typically had the lead glued or bolted onto the exterior of the glovebox. Newer gloveboxes were designed with the lead integrated into the construction between sheets of stainless steel, consequently making removal inherently more difficult.

After review of this design, two basic options were identified for disposition of the gloveboxes.

> Option One (status quo): the removal of all lead portions from the glovebox resulting in the remaining glovebox "carcass" being characterized as low level waste acceptable for direct disposal at NTS. A part of this option includes the fact that the removed lead must be packaged, treated and disposed as low level mixed waste at Envirocare.
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> Option Two (new alternative): leave the glovebox essentially intact and characterize the entire glovebox as low level mixed waste requiring treatment and disposal at Envirocare.

Evaluation of Option One (Status Quo)

Option One, requiring removal of all leaded glass, shielding, and gloves prior to disposal, escalates operational costs for glovebox management because of the time and effort required to remove the lead. However, this option offers lower potential disposal costs at NTS versus Envirocare. And, depending on whether the glovebox lead was easily removed, some gloveboxes resulted in greater costs than others. For example, to prevent releasing radiological contaminates to workers and the environment while managing gloveboxes with interior lead shielding, extraordinary and necessary worker precautions are required to maintain appropriate worker safety, thus increasing decommissioning time and costs.

[1] *Regulatory Analysis: Disposition of GloveBoxes as Low Level Waste*, by Jacqueline H. Berardini, Kaiser-Hill Company LLC

Evaluation of Option Two (New Alternative)

Option Two, which allows all existing lead items to remain intact to the glovebox, lowers operational costs for glovebox management because the costs of lead removal are eliminated. But, utilization of this option requires treatment prior to disposal, thus increasing potential management costs at the disposal facility. Additionally, potential physical and radiological risks to workers are reduced because less intensive physical handling of the glovebox is required.

Treatment of the waste includes placing the waste item(s) in a mold and then pouring molten low-density polyethylene around the waste item(s), thus encasing the waste item with low-density polyethylene and meeting treatment standards for radioactively contaminated lead. This treatment process is categorized as macroencapsulation.

DISPOSAL FACILITY WASTE ACCEPTANCE CRITERIA AND COST DRIVERS

Nevada Test Site (NTS)

NTS accepts radioactive waste less than 100 nanocuries per gram total activity. As a result, many gloveboxes require limited decontamination to meet this requirement, although all loose contamination is typically removed during the glovebox preparation process. From a RCRA standpoint, gloveboxes prepared under the Option One scenario are acceptable at NTS as low-level waste, since all radioactive lead is removed. The NTS waste acceptance criteria excludes the disposal of RCRA hazardous waste. Therefore, direct disposal of the gloveboxes managed under Option Two is not acceptable.

Under either option, KH prepares gloveboxes for shipment and packages the waste into cargo containers with dimensions of eight-foot by eight-foot by twenty-foot. The entire cargo container is disposed on arrival and payment for disposal is made on the volume of the shipping package, i.e. the cargo containers exterior volume.

Envirocare of Utah

Envirocare is limited to receiving low-level radioactive waste less than 10 nanocuries per gram total activity. Consequently, decontamination procedures can be more intensive for glovebox waste destined for Envirocare. From a RCRA standpoint, gloveboxes are acceptable as prepared under Options One or Two, since Envirocare has the capability to treat waste prior to disposal through macroencapsulation technology.

Like NTS, cargo containers are utilized to ship glovebox waste to Envirocare. However, measurement for payment is based on the exterior dimensions of the glovebox, not the exterior dimensions of the shipping container. KH also has the option of having the emptied cargo container returned for reuse since the shipping container is not required for disposal at Envirocare.

Two additional considerations were evaluated prior to sending the glovebox waste to Envirocare. First, Envirocare's disposal facility plan requires that void spaces be filled to the maximum extent practicable. To that end, the void space in the glovebox interior must be filled to minimize disposal embankment settlement after disposal. Because of the significantly high alpha contamination inside the glovebox, appropriate containment facilities are required to be in place

while filling the glovebox interior to prevent worker and environmental contamination. As a result, Envirocare designed a containment tent with HEPA exhaust systems to be used during the glovebox filling process to reduce risk of exposure and loss of contamination control due to alpha particulates.

Second, at the time Option Two was developed, Envirocare had only accepted waste for macroencapsulation that could fit inside a standard B-25 waste box. Reducing the glovebox pieces to this size would be costly and time consuming. Resultantly, Envirocare developed a macroencapsulation treatment method that allowed treatment of waste materials with dimensions up to nine-foot by nine-foot by fifteen-foot, thus enabling KH to continue to ship glovebox pieces that would fit inside a standard cargo container. This treatment method included building an adjustable mold/form where the sidewalls could be adjusted to the dimension of the incoming glovebox.

CONCLUSION: CHOSEN DISPOSITION PATHWAYS AND LIFECYCLE COSTS

In evaluating Option One and Option Two, and taking into consideration the differences in the disposal facility waste acceptance criteria requirements and limitations, the following disposition pathways were chosen.

First, lifecycle costs associated with removing the lead items from the older category gloveboxes and shipping the glovebox "carcass" to NTS are still less than the costs of treatment and disposal as mixed waste at the Envirocare facility. This is because the older gloveboxes typically have lead glued or bolted to the outside of the box rather than integrated between stainless steel sheets, making it easier to remove the lead. As a result, all gloveboxes in this category are currently decontaminated, stripped of lead, and shipped to NTS. The resulting lead from the stripping process is accumulated and shipped to Envirocare for treatment by macroencapsulation and low level mixed waste disposal. Eighty percent (80%) of the gloveboxes continue to be shipped under the status quo Option One.

Second, lifecycle cost reductions can be achieved for the newer category gloveboxes through utilization of the newly developed Option Two. Several factors contribute to this fact. First, costs associated with the more difficult lead removal for the newer gloveboxes are greater than the total treatment and disposal price at the Envirocare facility. This includes accounting for schedule reduction and the associated savings achieved through reduced work scope. Second, cost savings occur as a result of measurement for payment terms being applied to the volume of waste rather than the volume of the shipping container. Third, cost savings can occur if KH chooses to have the shipping container/cargo returned for reuse, thus eliminating the cost of procuring a new shipping container.

As a result, all gloveboxes less than 10 nanocuries per gram activity after decontamination and in the newer glovebox category are currently shipped to Envirocare. Approximately 20% of the RFETS gloveboxes remaining onsite will be shipped using this new option. Although only 20% of the remaining glovebox waste will be managed in this manner, selection of the alternative Option Two results in a $5 million cost savings.

LESSONS LEARNED

The lifecycle cost evaluation of the project resulted in several lessons learned. First, lifecycle evaluation of total costs is necessary to identify potential savings. Because the disposal cost of low level waste at NTS is less expensive than treatment and disposal of waste as mixed waste at Envirocare, generators may choose to make the waste conform as low level waste at the generating site rather than ship the waste offsite for treatment and disposal. In the case outlined above regarding gloveboxes, the total project cost is actually less expensive for some of the gloveboxes if management and handling at the generating site is reduced to the extent possible and the waste is sent offsite for treatment at a higher treatment and disposal rate. Onsite handling in this case is labor intensive and time consuming, thus expensive.

Second, the lowest project lifecycle cost may include multiple disposition paths for a single waste stream. In this case, some gloveboxes were managed at NTS, while others were managed at Envirocare.

REFERENCES

[1] *Regulatory Analysis: Disposition of GloveBoxes as Low Level Waste*, by Jacqueline H. Berardini, Kaiser-Hill Company LLC