TECHNOLOGY @ ROCKY FLATS

DEMONSTRATION & DEPLOYMENT SUMMARY

Chemical decontamination of gloveboxes and tanks improves safety, reduces TRU waste

Summary

Using Office of Science & Technology (OST) funding, the Rocky Flats team has developed methods to successfully decontaminate waste to Surface Contaminated Objects (SCOs) hundreds of contaminated gloveboxes and tanks destined for more hazardous and costly size reduction. The single most significant decommissioning innovation, chemical decontamination has slashed months from the site's already accelerated closur

A scrub brush is used during the second step of the decontamination process.

The Need

More than 900 gloveboxes at RFETS were used to protect workers from the hazards of processing plutonium, americium, uranium and other radioactive isotopes. Hundreds of tanks stored plutonium and actinide liquids used for recovery processes. The majority of gloveboxes and tanks were contaminated to Transuranic (TRU) levels and without decontamination would have to be disposed according to the acceptance criteria.

Per acceptance criteria of the Waste Isolation Pilot Plant (WIPP), TRU waste must either be packaged in a Standard Waste Box (SWB), a small metal container that accommodates just 1.9 cubic meters of waste or a 55-gallon drum. Additionally, WIPP requires TRU waste to be counted in an approved assay system and undergo visual examination to verify packaging contents. To meet these requirements, after field characterization, RFETS TRU waste is transferred to buildings 440, 559 or 664 where counters confirm a container's gram loading. Then, before it can be shipped, TRU waste is stored at RFETS for up to 144 days and tested for gas generation. This repeated handling of TRU waste is both costly and poses hazards to workers.

Even more hazardous are activities required to size-reduce tanks and gloveboxes for packaging into the small SWBs. The largest of RFETS gloveboxes was 64-feet long and the largest of tanks had a capacity of more than 20,000 gallons. For equipment that could be moved, a central size-reduction containment enclosure with extensive air handling equipment was utilized. Size-reduction involved using cutting tools like Sawzalls, nibblers and plasma-arc torches to cut through quarter-inch thick stainless steel. Workers in some cases reached through glove ports and exerted great effort in supporting cutting tools. Waste was repeatedly handled en route to the SWB. For gloveboxes too large to be relocated, custom tents were built around them to contain high airborne radioactivity released by cutting contaminated steel. In situ size-reduction evolutions were costly and time consuming because workers must don supplied air suits which requires a series of lengthy entry and exit steps.

Precursors to Chemical Decon Success

In 1996, waste managers began studying alternatives for disposing of large process equipment. They concluded that decontamination would generate excessive secondary waste, be too labor intensive and expose workers to unknown hazards.

After the Department of Transportation (DOT) in 1997 released exceptions to regulations that would allow transporting low-level waste in certain conveyances, decontamination was again studied at RFETS. The DOT exceptions stipulated limits for a waste's removable and total contamination in Disintegrations Per Minute (DPM) averaged over 100 square centimeters. Waste that meets these criteria are called Surface Contaminated Objects (SCOs).

Because waste's contamination had to be characterized in terms of surface area, the ratio of surface area to mass for a variety of materials had to be established. Detailed procedures for characterization were developed that, in part, established surface area to mass ratios for a variety of surfaces so that surface area could easily be established when waste was weighed.

Per DOT guidelines, waste that meets SCO criteria can be packaged in a variety of conveyances. The most accommodating is a cargo container, which has a capacity of 38 cubic meters. Packaging waste as SCO avoids all of the costly and stringent criteria for packaging TRU waste. More importantly, it avoided hazardous and risky size-reduction evolutions for thousands of cubic meters of waste.

The use of chemical to decontaminate gloveboxes is performed manually using existing glove ports

OST funded modifications to the Alpha 12-1A detector so that it could detect higher limits of activity needed to characterize SCO waste. The 12-1A air-proportional ion chamber could previously detect just 2M DPM. With the addition of an attenuator screen to the front of the chamber, its limit of detection was increased to 200M DPM. Also, with OST support, the Ludlum 195 high-range alpha chamber, which can detect up to 1B DPM, was deployed. The Ludlum 195 can be performance tested in the field, an important advantage over the 12-1A since survey equipment frequently becomes too contaminated for release from a contamination area.

The Technology

The first successful decontamination process was developed by Environmental Alternatives, Inc. This process used a complex blend of acids and other chemicals which are applied to equipment's surfaces in a three-step process. This extraction solution used micro-emulsification and chemical ion exchange to bind itself to contaminants. After a 24-hour waiting period, surfaces were surveyed to determine if SCO criteria were achieved.

Another method funded and developed with OST support used Cerium Nitrate (CN) to decontaminate surfaces. During the site's production era, CN was used in Building 771 as a plutonium recovery surrogate in process experiments. For decontamination, CN was first injected with steam into tanks and other equipment. Later methods simply applied diluted solutions of CN to interior surfaces, which were then wiped and rinsed with a neutralizer. Following a 20-30 minute waiting period, surfaces were surveyed to determine if SCO criteria were met.

Case Study: Size-reduction vs. chemical decontamination

This section will compare packaging of two B771 gloveboxes of similar size. One was decontaminated and packaged as SCO. The other one, too highly contaminated to achieve SCO criteria and too large to be re-located to a central size-reduction enclosure, was size-reduced in-place after a containment tent was constructed.

- Line 15 was 14-feet long about 6-feet high and had about 300 square feet of surface area. Line 15 used hydrogen peroxide to convert plutonium nitrate solution into plutonium peroxide cake. A highly volatile process, precipitation created the solid for further processing into metal. After all internal equipment was removed, Line 15 was decontaminated in just over a day and packaged whole in a single cargo container.

- Line SR12 employed a process for converting plutonium oxide into plutonium tetrafluoride using fluorine gas. An 11-foot section of the 25-foot glovebox was decontaminated to SCO and packaged in a cargo container. The interior surfaces of the remaining 14 feet were too highly contaminated to achieve SCO criteria. At over 10-feet high, the remaining sections encompassed about 430-square feet of surface area. To construct the tent and conduct size-reduction operations required 25 working days and more than 1,500 hours. Nine SWBs were required to correctly package SR12's glovebox surfaces.

Although SR12 was slightly larger in this comparison, the advantages of decontamination are evident. Had all 240 gloveboxes in B771 undergone size-reduction, the project would not be ahead of schedule for demolition and would probably be behind schedule.

Summary

Due to the success of chemical decontamination technology, the Rocky Flats Closure Project life-cycle estimates for TRU waste were reduced by nearly 30 percent – from an estimated 17,500 cubic meters to 12,500 cubic meters.

The most significant benefit of chemical decontamination has been thousands of hours of avoided worker exposure to high airborne radioactivity, exertion and several industrial hazards that result from size-reduction evolutions.

After the decontamination process a glovebox is weighted, packaged and loaded into a cargo container.

Technology Supporting the Path to Closure

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