

Gas Generation Testing Technology



Workers lower the bell jar over a waste drum to get a readout on the instruments (shown in inset) of hydrogen gas generation in drums.

Introduction

The production of nuclear weapons components at Rocky Flats supported America's nuclear arsenal for 40 years. It also generated large volumes of residual radioactive waste materials. These materials are either transuranic (TRU) or low-level waste, depending on the type and concentration level of the radioactive material they contain. Transuranic wastes are contaminated with radioactive elements at a concentration level above about one-tenth of that of an average household smoke detector and with a greater atomic mass than uranium, thus are termed "trans" or beyond uranium. Transuranic waste remains radioactive for thousands of years, which puts the waste in a special category and is a primary consideration in determining safe methods for transporting, storing, and disposing of these materials.

Most TRU waste from the Site's former production mission consists of everyday items used by workers, such as rubber gloves, shoe covers, cloth lab coats, plastic bags, and laboratory glass. Larger items, such as pumps, valves, motors, hand tools, and some machining tools, had to be scrapped if they were contaminated during routine operations. When these items were discarded, they became TRU waste.

The Rocky Flats Environmental Technology Site (Site) safely stores approximately 21,000 drum equivalents of TRU and TRU-mixed waste. (TRU-mixed wastes also con-

tain chemical contamination.) The waste generated during cleanup and closure of the Site is expected to bring that number to a total of 100,000 drums. Before the Site can be closed, these drums must be shipped to their final destination, the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico.

Challenge

Rocky Flats was faced with a dilemma: To meet the 2006 closure date, the Site had too many drums and not enough time or resources to transport them to WIPP. The challenge then was to minimize the number of waste drums by maximizing the amount of material placed in each drum and to reduce the number of shipments required to transport the drums to WIPP. The challenge was complicated by the potential buildup of hydrogen gas during transit, which placed significant limitations on the amount of radioactive material in each drum. Reducing radioactive material content to safe levels would mean repackaging a significant number of drums. One drum of organic waste containing 135 grams of plutonium would have to be repackaged into 15 daughter drums of 9 grams each of plutonium to meet conservative, theoretical safeguard limits.

Solution

Rocky Flats engineers set out to find an accurate method of measuring hydrogen gas generation in plutonium-containing

drums. They developed the Gas Generation Testing Canister (GGTC), a mobile unit that can be plugged into a 120 V outlet and allows use of remote analysis instrumentation. The unit consists of an insulated 300-liter bell-jar equipped with a pressure gauge and pressure relief valve.

How it Works

The top of the GGTC is raised so workers can insert the test drums inside the canister and onto a base plate that is sealed with an O-ring. Two gas samples are drawn, a day apart, through a sample connection at the top of the bell jar and analyzed for gas content to calculate the hydrogen gas generation rate. Because of the presence of volatile organic compounds in some drums, special ventilation equipment is used in the testing area during drum change-out.

Results

By adopting this real-time testing method rather than using computer models for predicting gas generation, Rocky Flats engineers learned that organic wastes actually generate 10 percent, and inorganic wastes 2 percent, of the predicted amount of gas. WIPP has approved the GGTC as the preferred method over computer modeling.

The successful deployment of the GGTC was followed by the development of a second promising technology, a small-scale testing platform that can be inserted into a glovebox. This unit measures gas generation in individual cans of waste before they are bagged out. Test results are not only more accurate, but also available in much less time. Because small cans attain equilibrium in a very short time, the six-month waiting period for drums to reach that state can be avoided.

Benefits

The waste reduction resulting from the GGTC has exceeded the expectations of its design engineers. Nearly all of Rocky Flats' dry residue drums and almost 90 percent of wet combustible drums tested to date did not need repackaging to guarantee safe shipment. So far, close to 700 drums have been certified for safe shipment in their original configurations. As a result of this innovative technology, Rocky Flats will end up shipping 17,000 fewer drums of repackaged material by the time all wet and dry residues are packaged.

Since far fewer drums have to be repackaged, the technology provides great savings in time and cost as well as a significant safety benefit. Workers spend far less time handling contaminated materials, which dramatically reduces their risk of exposure.

Based on the success of this project, Rocky Flats engineers have gone one step further by overpacking drums into standard waste boxes. As long as gas generation limits are met, drums can contain up to 325 fissile gram equivalents. After various audits, this method was also approved by WIPP.

Conclusion

Rocky Flats is not the only Department of Energy Site to benefit from the GGTC technology. Both Los Alamos National Laboratory and Idaho National Engineering and Environmental Lab now use gas generation testing. Since DOE's total waste inventory is 25 times greater than that of Rocky Flats, the ultimate benefits of this testing method could be enormous. At Rocky Flats alone, savings from cost avoidance are estimated to reach \$55 to \$60 million.



U.S. Department of Energy

Make It Safe. Clean It Up. Close It Down.



For further information about Rocky Flats

Contact DOE Communication at (303) 966-6088, or Kaiser-Hill Communication at (303) 966-2882, or toll free at (800) 269-0157
(press *82882# when you hear the automated attendant)

Also, additional information about Rocky Flats is available on the internet at: <http://www.rf.doe.gov>