TECHNOLOGY @ ROCKY FLATS

Demonstration & Deployment Summary

Raschig Ring Vacuum System

Summary

Raschig rings are Borosilicate (Pyrex ®) glass rings approximately 1.5 in. long by 1.5 in. wide and look something like napkin holders. The rings are named after a German physicist involved in their development. The Pyrex ® glass contains Boron which absorbs neutrons and prevents the occurrence of a criticality (nuclear fission) chain reaction. Raschig rings were first used in the late 1950s to stabilize fissile uranium solutions contained in tanks. Their use was extended to plutonium processing in the early 1960s. A Rocky Flats Plant Standard for Raschig ring use as a nuclear poison was established in 1969. That was followed by ANSI/ANS standards in 1979.

On June 16, 2003, the "Ring Crew" finished extracting the contaminated Raschig rings from the last of 75 tanks in B371. This project developed an innovative version of a "vacuum cleaner" technology to remove more than 600,000 lbs. of rings in approximately two years. The work was conducted in a high hazard environment with no injuries or personnel contamination events.

Until the introduction of vacuuming in November of 2001, tank cleaning consisted of a manual raking process. This exposed the workers to significantly higher levels of radiation and contamination and took much more time. Without the use of this pioneering technology, tank cleanup would have been significantly more hazardous, labor-intensive and much slower.

The Need

Removal of Raschig rings and commingled residue was considered to be one of the significant hazards in the cleanup of Rocky Flats. Use of the traditional raking process held the promise of a lengthy and hazardous ordeal that would have increased the time involved for completion of the cleanup of the tanks in 371 and other buildings. The traditional method of ring removal involves the fabrication of two tools that closely resemble a garden rake and hoe. They are sized small enough so that they can fit through the ports on the tanks. They are made of stainless steel and constructed so that different lengths of pipe can be attached as handles. There are elbows in the middle of the handles so that the tools can be configured to reach all of the areas and surfaces in the tanks. In an effort to reduce the hazard, workers tried using the glycerin aerosol technology called "Fog-N-Fix." However, it proved ineffective for Raschig ring tanks. Problems with the baseline technology put the building D&D on the site closure critical path.

The Technology Solution

Raschig Ring Vacuum System

A closed loop vacuum system was developed for Raschig ring removal. The system consists of a wand assembly to extract the material from inside the tanks, an intake hose to transport the material from the wand to a 55-gallon receiver drum, a suction unit to create a vacuum condition in the wand assembly and intake hose, and an exhaust hose to return the vacuum system exhaust flow to the tank. The exhaust hose is routed through HEPA filters to remove contamination from the exhaust flow. The wand assembly slides and rotates in a ball

joint assembly so that the operator can move it to reach all of the surfaces in the tank. The ports in the tank through which the intake wand and exhaust hose pass are sealed so that closed loop integrity can be maintained. The rings and any accompanying residue are deposited directly into the receiver drums. This saves time and contributes to safety by eliminating the requirement for secondary handling and/or containment of the material.

Early attempts at a Raschig ring "Shop Vac" failed, due to excess glass breakage and process control problems. With OST support, a workable system of equipment and configuration was finally developed and demonstrated.

Worker extracting rings

The Project

The largest Raschig ring tanks on site were in B371. Some of these were as large as 7 feet in diameter and 19 feet in height. As noted above, the tanks in 371 contained more than 600,000 pounds of contaminated rings. The project required over 1,500 drums to hold the material. Most of the drums have been shipped to the Nevada Test Site as low-level radioactive waste. The crew also removed almost 800 liters of residues and over 10 kilograms of SNM holdup that was dried and commingled with the rings on the tank bottoms. Holdup of more than 3.5 kilograms was removed from one of the tanks.

The Benefits and Results

Raschig Ring receiver drum

Ring removal from the tanks in 371 and other buildings used for work with Plutonium could have been considerably more hazardous and labor intensive if the traditional manual system had been used. Instead, use of the vacuuming system allowed the crew to remove the rings in a fraction of the time while reducing exposure to many of the hazards associated with the traditional system. The vacuum system also improved packaging efficiency by eliminating the requirement for secondary containment. This allowed the safe packaging of a greater number of rings in a drum and reduced the number of drums used by more than 50 percent. Only one tank had to have the rings removed manually. It had high gram values and criticality safety controls stipulated the use of the traditional removal methods. Two tanks that were part of the facility's filter plenum deluge system did not require removal of the rings. Their contamination levels were measured and found to be low enough that they could be shipped as is.

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