AN UPCOMING ROBOTICS SUCCESS: Remote Sampling of Residual Tank Waste at WVDP

The Problem: In 1980, the West Valley Demonstration Project (WVDP) Act directed the U. S. Department of Energy (DOE) to develop and demonstrate technology for the safe retrieval and solidification of alkaline PUREX and acidic THOREX high-level radioactive waste contained in two large underground waste storage tanks. Processing of the waste started in 1988. By the end of FY 2000, nearly all the supernate and sludge waste in these two tanks had been removed and processed into glass using a series of low-pressure, high-flow, long-shafted centrifugal pumps. Visual inspection revealed that many of the metal surfaces of the tanks and tank internals were covered with thin layers of material that might be either residual waste or rust and peeled paint. In order to ascertain the radioactive content of the surface materials, it is necessary to obtain samples of the material. The sample analysis would also help determine whether additional waste retrieval would be required to meet tank closure requirements.

Because of the many dome-support columns and steel beams on the tank floor, it is not practical to deploy a vehicle for sampling. The radioactive shine and distances to be reached preclude use of long-handled tools for sampling. Fortunately, WVDP had previously built a vertical trolley system for tool deployment in tank 8D-2 that could be used for deploying an end effector.

The Technology: The Robotics Crosscutting Program (Rbx) is working with the Tanks Focus Area and WVDP to develop a remotely operated sampling end-effector tool that can be deployed with the WVDP tool deployment system. This end effector is primarily designed for obtaining small amounts of residual waste, rust, and surface corrosion from flat or nearly flat metal surfaces. Oak Ridge National Laboratory (ORNL) and WVDP staff collaborated on design of the system. Fabrication and testing were performed at ORNL. The sampler can be configured with different sized sampling heads depending on the size of area to be sampled (less than 1-in. diam) and the volume of sample anticipated. The sampler uses an end-mill bit to dislodge material from the surface down to a shallow depth below the sampled surface. A vacuum is applied to the chamber surrounding the drill bit to suction all the loose material onto a paper filter. The sampling head can then be detached and taken to a hot cell or glove box for recovery.

Cold testing of the sampling end effector was performed in FY 2000. A variety of tests were performed. It was demonstrated in controlled tests that approximately 95% of the surface material would be retained when milling 0.020 in. into steel walls that had a 0.007-in. uniform layer of paint. Other tests using a 0.25-in. soap layer to simulate alkaline scales have achieved 85% retention; however, the performance is actually better than measured because of evaporation of the soap components. Tests are also under way to measure performance under wet conditions.

ORNL and WVDP will collaborate further with the sampler to design versions that can take floor samples that are under water. A patent application is being considered for the design.