PROGRESS IN HIGH-LEVEL WASTE TANK CLEANING AT THE IDAHO NATIONAL ENGINEERING AND ENVIRONMENTAL LABORATORY

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ABSTRACT

The Department of Energy Idaho Operations Office (DOE-ID) is making preparations to close two underground high-level waste (HLW) storage tanks at the Idaho National Engineering and Environmental Laboratory (INEEL) to meet Resource Conservation and Recovery Act (RCRA) regulations and Department of Energy (DOE) orders. Closure of these two tanks is scheduled for 2004 as the first phase in closure of the eleven 300,000 gallon tanks currently in service at the Idaho Nuclear Technology and Engineering Center (INTEC).

Design, development, and deployment of a remotely operated tank cleaning system were completed in August 2001. The system incorporates many commercially available components, which have been adapted for application in cleaning high-level waste tanks. The system also uses existing waste transfer technology (steam-jets) to remove tank heel solids from the tank bottoms during the cleaning operations. By using this existing transfer system and commercially available equipment, the cost of developing custom designed cleaning equipment can be avoided. Remotely operated directional spray nozzles, automatic rotating wash balls, video monitoring equipment, decontamination spray-rings, and tank-specific access interface devices have been integrated to provide a system that efficiently cleans tank walls and heel solids in an acidic, radioactive environment. This system is also compliant with operational and safety performance requirements at INTEC. Through the deployment of the tank cleaning system, the INEEL High Level Waste Program has demonstrated the capability to clean tanks to meet RCRA clean closure standards and DOE closure performance measures.

The tank cleaning system deployed at the INTEC offers unique advantages over other approaches evaluated at the INEEL and throughout the DOE Complex. The system's ability to agitate and homogenize the tank heel sludge will simplify verification-sampling techniques and reduce the total quantity of samples required to demonstrate compliance with the performance standards. This will reduce tank closure budget requirements and improve closure-planning schedules.

INTRODUCTION

Cleaning the HLW storage tanks in the INTEC Tank Farm Facility will allow DOE to meet its long-term objective to close HLW facilities and meet applicable RCRA regulations and DOE orders. The tank cleaning approach is simple and uses commercially available equipment, modified to meet the specific needs of the INTEC tanks. Since the tank access points are limited and the tank interiors are obstructed with cooling coils, many of the robotic cleaning devices in use at other DOE sites were not suitable for the INEEL tanks. The selected system directs high-pressure water throughout the tank interior to remove contaminants from the tank wall and floor. The contaminants are then removed from the tank by means of steam-jet transfer technology, which has been used for many years in the tanks at INTEC.

The tank cleaning approach and design features were selected after reviewing available systems throughout the DOE complex, as well as the commercial industry. Because of the unique configuration of the INTEC tanks and nature of the tank heel waste, many of the available technologies were not suitable or necessary. To ensure success, the selected components were simulated in a full-scale mockup test facility using simulated waste, which provided proof of principle demonstrations.

The lessons learned from mock-up testing were applied to the final design of the cleaning system and the components were fabricated and installed at the Tank Farm Facility. Tank WM-182 was selected for the first deployment, and initial testing was completed on August 29, 2001. An additional test of the Washball was completed on October 18, 2001, and the system was shutdown for the winter.

Results of the cleaning system deployment compared favorably to the mock-up test results. The Washball was effective in removing contaminants from the tank wall surface and was successful in suspending the solids within the liquid heel. The steam-jet flow rate was monitored and maintained flow rates within normal parameters while transferring the tank heel to an adjacent tank.

TANK CLEANING DRIVERS AND REQUIREMENTS

In 1992, DOE-ID was party to a Consent Order in response to a Notice of Noncompliance (1) issued by the Idaho Department of Health and Welfare, Division of Environmental Quality. In the Consent Order, DOE-ID agreed to interim status for the INTEC Tank Farm Facility until the unit could be made to meet RCRA standards or emptied of waste by the year 2012. In 1998 a modification to the Consent Order (2) was issued and DOE-ID further agreed to submit by December 31, 2000, a RCRA closure plan for at least one tank. The plan was submitted as required, and the document continues to be reviewed and revised as the State of Idaho considers approval.

The Tank Farm Facility, along with hazardous materials, also contains significant quantities of radioactive waste. The tanks were formerly used to store wastes generated during spent nuclear fuel reprocessing campaigns. Since the Tank Farm Facility stored high-level waste (HLW), as a deactivated HLW unit it must comply with closure requirements defined in DOE Order 435.1 (3) and associated guidance.

DOE-ID, therefore, is proceeding with tank closure planning and implementation at the INTEC Tank Farm Facility. Prior to closure, the tanks must be cleaned to meet RCRA performance objectives for hazardous constituents and DOE Order requirements for the radioactive constituents. While both sets of requirements require removal of waste prior to closure, compliance is measured in terms of risk to the public and environment. Since complete removal of "all" waste is not technically or economically feasible the goal is to provide the regulators with objective evidence that the waste has been successfully removed to the extent that is economically and technically practical to meet performance objectives. Any doses from potential exposure pathways to tank residuals must be within the limits of acceptable risk.

Meeting RCRA Cleaning Requirements

The RCRA regulations govern hazardous (non-radioactive) contaminants. The Code of Federal Regulations (CFR) Title 40, Part 265.197, *Closure and post-closure care*, for clean closure of tank systems, requires "removal or decontamination of all waste residues." Removal of all residues would certainly leave no risk to the public or environment. However, when dealing with mixed waste (hazardous and radioactive) removal of "all" waste, while technically achievable (given enough time and money), is not always practical. The safety of the workers involved in removal operations and the expenditure of funds, which could be used for other important cleanup activities, must be balanced against the incremental reduction in risk to the environment that might be achieved. Therefore, the closure approach includes an element of risk analysis to determine the overall best configuration at closure.

Risk-based closure is, therefore, being pursued for the INTEC tanks. This will require development of action-levels for each contaminant. These action levels will pre-determine the waste removal and decontamination efforts necessary to meet performance objectives for clean closure. Waste residues may still remain in the tanks, but exposures to the public from any credible pathway will be within acceptable limits.

Development of Action Levels for RCRA Closure

Action levels required to meet RCRA closure standards were developed to ensure that the tank configuration at closure is protective of human health. Action levels define the acceptable level for concentration of hazardous materials remaining in the tank after closure. Compliance with these levels is determined from analysis of samples of the waste residuals after tank cleaning. The action levels were developed by defining the acceptable excess cancer risk and hazard quotient thresholds and then using those thresholds to calculate corresponding concentrations for the contaminants of concern. The contaminants were defined based on the detections that were noted during tank sampling and characterization efforts. The selected pathways for exposure were soil inhalation and soil ingestion to an occupational receptor. Groundwater pathways to all potential receptors were also modeled and considered.

While the EPA guidance (4) states that inhalation and ingestion pathways are appropriate for near surface soil (less than 10 feet in depth), these pathways were used to ensure the protectiveness of action level development methodology. Thus the modeling of potential pathways is conservative, since the residual waste will be approximately 40 feet below grade and covered with grout. The concrete vault, stainless steel tank, and grout fill within the tank will impede infiltration and limit releases of any contaminants to the adjacent soils.

A list of contaminants of concern was developed from sampling in the tank farm. All contaminants for which true detections were noted during waste characteristic sampling activities were included in the list. Action levels for the contaminants of concern were based on EPA guidance (5), using the suggested slope factors and referenced doses. These action levels are documented in the RCRA closure plan, which was submitted to the State of Idaho for approval (6)

Meeting DOE Cleaning Requirements

DOE Order 435.1, “Radioactive Waste Management,” governs the closure of high-level waste facilities. The order requires that radioactive wastes be removed from tanks and any remaining residues be stabilized to protect public health and the environment. Performance objectives in terms of dose limits are provided for all potential pathways. Compliance with these objectives is determined by computer modeling using the various pathway dose scenarios.

The source term modeling of release rates from the closed tank farm was conducted using the Disposal Unit Source Term—Multiple Species (DUST-MS) computer code (7). The code uses material and contaminant specific bulk densities and specific coefficients for distribution, diffusion, and dispersion to model releases from the tanks. The model conservatively assumes surface rinsing to transport contaminants from the tank after tank degradation. The concrete tank vaults are assumed to remain intact for 100 years and the stainless steel tanks for 500 years. Once the contaminants are released from the closed tank system, the PORFLOW computer code is used to model subsequent transport through the underlying geological media (8). PORFLOW is well suited for modeling at the INEEL since it has direct application to multi-phase contaminant transport problems. It has also been through extensive validation review by independent researchers and verified using tritium data from disposal sites at the INEEL.

Because the INTEC tanks previously held high-level waste, an evaluation must be completed to determine if the residual contamination may remain in the tanks after closure and be disposed as low-level waste. Compliance with this determination depends on meeting several criteria. In terms of tank cleaning, removal of as much waste as is technically and economically practical will be necessary to comply with low-level waste disposal criteria.

A performance assessment was completed to determine the impacts to public health and safety from the remaining waste residuals in the closed tanks using the computer models described above (9). The assessment investigated groundwater transport mechanisms and inadvertent intruder scenarios using conservative assumptions to demonstrate compliance with regulatory dose limits. The conservatism was factored into several elements including; the amount of residual waste remaining in the tank; the degradation periods for the grouted tank and vault; the nature of contaminant transport into the groundwater; and the ability of intruders to penetrate the closed tank. All of these assumptions enhance the credibility of the modeling and assessments of potential doses to the public and environment.

The performance assessment used a bounding tank residual waste inventory to calculate potential doses to the public. The source term inventory was developed from historical process records of tank farm operations along with heel samples taken from Tanks WM-182, -183 and -188. The highest concentration of each contaminant (based on sample results) was used to develop the source term for the bounding tank. Each tank was then assumed to contain that bounding inventory. The performance assessment also assumed a residual waste heel volume of 1 inch in the bottom of each tank.

During tank cleaning operations, removal of waste will continue as long as the cleaning process is effective (below the 1 inch level if achievable). Prior to sampling, the remaining volume will be measured by comparing residual waste levels against the known height of existing features of the tank bottom (cooling coil supports). Sampling and analyzing the contaminant concentrations against the performance assessment assumptions will then ensure compliance with performance objectives.

TANK CLEANING APPROACH

Compliance with the cleaning requirements necessary to meet RCRA and DOE closure performance objectives is the driving force behind the tank cleaning approach. The closure approach for the HLW tanks at INTEC consists of two basic steps: (1) tank cleaning to remove contaminants, and (2) addition of cement grout to solidify and stabilize any remaining residuals. This section describes the cleaning approach.

The tank cleaning system consists of a Washball, two directional spray nozzles, and a steam operated transfer jet (see Fig. 1). The Washball and directional nozzles are remotely operated and powered by high-pressure water. Both the Washball and the directional nozzles are equipped with individual cameras and lighting. Using existing tank access points, the Washball and directional nozzles are lowered into a tank and deployed in unison to remove contaminants from the walls and floor with high-pressure water. The removed waste will be consolidated into other existing waste storage tanks until it can be processed for permanent disposal in an off-site geological repository. The wash water will also be collected in other tanks and processed through existing evaporation systems at the INEEL.

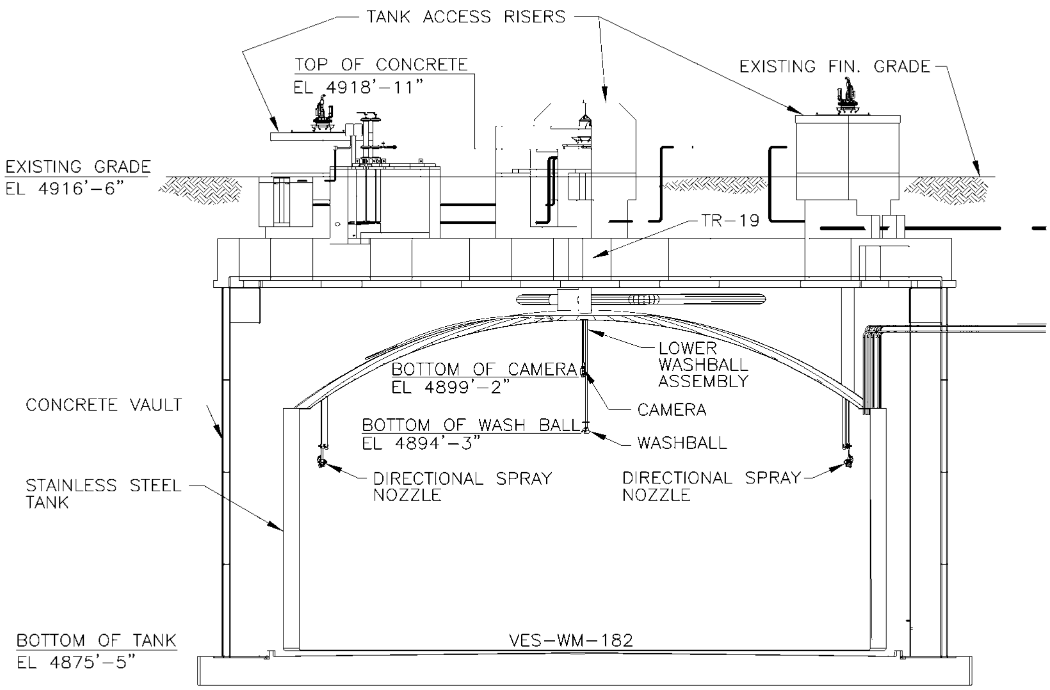

Fig. 1. Cross-section of Tank WM-182 and Tank Cleaning System.

WASHBALL DESCRIPTION

The Washball is a stainless steel rotating cleaning system typically used in cleaning petroleum tanks (see Fig. 2). The Washball has two rotating nozzles, which are gear driven as pressurized water is applied to the unit. The nozzles rotate in a vertical plane as the Washball gradually rotates in a horizontal plane - creating a systematic pattern to clean the entire interior surface of the tank. The spray pattern moves approximately 1.5 to 2.0 feet for every revolution. The Washball completes a cycle (complete coverage of the interior surface of the tank) in approximately 14 minutes.

The Washball is attached to a 1.5-inch-diameter ridged pipe, approximately 25 feet long. The upper end of the pipe is attached to a flange, which bolts to the tank access riser near the ground surface after the Washball is lowered into the tank. Water is supplied to the unit through a 1.5 inch diameter pipe by a pump, which is designed to produce a flow rate of up to 100 gallons per minute. The water supply is staged in four 5,000-gallon plastic storage tanks located just outside the tank farm fence next to the supply pump. The Washball is connected to the pump by approximately 225 feet of 2.5-inch-diameter flexible hose.

Lechler Tank Cleaning System

- Model No. M20.210
- 10 mm Nozzle Orifice
- Stainless steel construction
- Cycle time:14 minutes
- Flow Rate: 75 GPM
- Impact Diameter: 72 feet (max.)

Fig. 2. Washball assembly with 2-nozzle attachment (optional 4-nozzle attachment below).

A remote camera is also attached to the Washball assembly and is protected from the spray nozzle by a splashguard. The camera lens is also protected with a continuous air lance to prevent accumulation of water droplets that could obstruct the view. The camera is fitted with high-intensity lighting and has a full range of pan and tilt functions to allow complete inspection of the tank interior during cleaning operations. A camera monitor, video recording unit, and the camera remote controls are located in the control trailer just outside the tank farm fence next to the water supply tanks and pump.

During the summer of 2000, a mock-up tank was used to test a proto-type Washball system. This test helped establish the operating parameters and equipment designs necessary to ensure optimum use of added water to achieve performance objectives.

There are several crucial aspects for achieving maximum waste removal with the minimum amount of added water. Optimum pressure at the spray nozzles ensures adequate force at the end of the spray pattern without breaking up the water stream. Excessive pressure tends to atomize the spray pattern and reduce the water forces at the tank wall. Maintaining the water level in the bottom of the tank within a certain range, by transferring the heel during Washball operation, affects the rate of solids removal. A minimum depth of liquid is needed to suspend the solids and facilitate transport toward the jet, however, if the depth is too high, the Washball loses its effectiveness in agitating the solids. As washing proceeds and the quantity of solids is significantly reduced, the heavier solids tend to accumulate around the perimeter of the tank. The mock-up tests demonstrated the need for remotely controlled directional nozzles that can be focused at these accumulated solids and force them into suspension and toward the steam-jet for removal.

The Washball is designed to operate at the following specifications:

- Supply water flow rate 70 to 80 gpm
- Water temperature Ambient (55 to 75°F)
- Water source De-mineralized
- Nozzle orifice 10 mm
- Nozzle pressure 80 to 100 psi
- Cycles per hour 4 to 5
- Gallons to clean tank (average) 77,000 gallons

DIRECTIONAL NOZZLE DESCRIPTION

The directional nozzle is similar to the Washball and uses high-pressure water (120 psi. max.) through a 10 mm orifice (see Fig. 3). The nozzle assembly, however, is not automated, but is controlled remotely by an operator. The operator's station and associated video monitor are located in the control trailer. The nozzle has a full range of motion (both pan and tilt) and is fitted with a camera and high-intensity light that follows the direction of spray. The operator directs the unit using a joystick-type controller.

Like the Washball, the directional nozzle is connected to a 1.5-inch-diameter ridge pipe (supply water), which is connected at the upper end to a flange and bolted to the tank access riser. Mock-up testing during the summer of 2000 revealed the need for capabilities to focus cleaning water at stubborn contaminants. The use of the directional nozzle also allows for displacement of sludge on the tank bottom toward the steam-jet for removal.

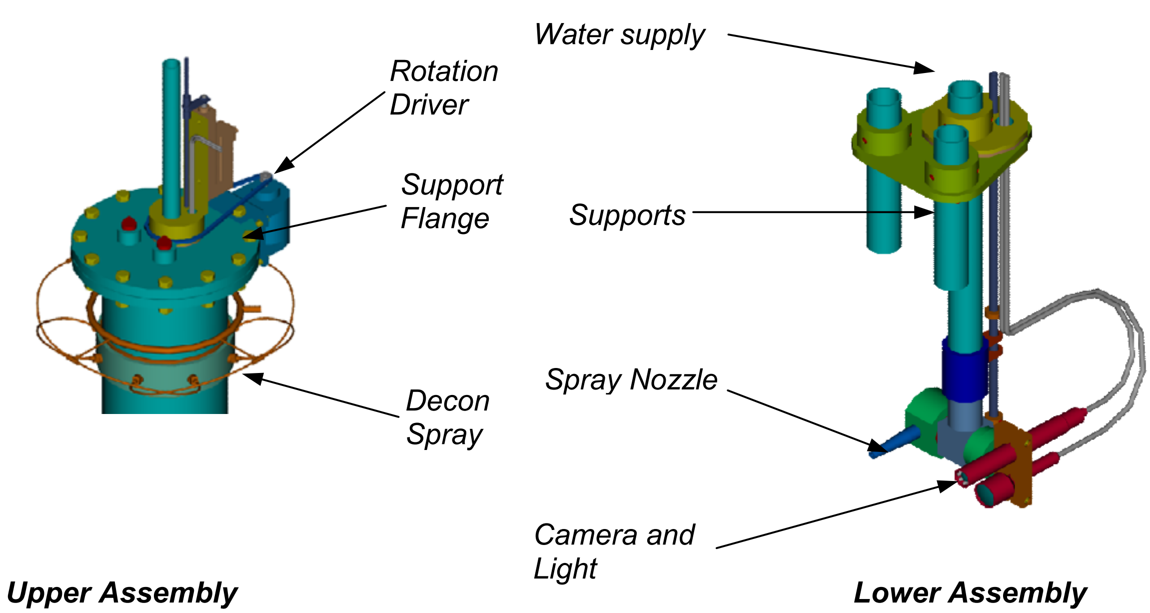

Fig. 3. Directional Nozzle Assembly.

STEAM-JET DESCRIPTION

Steam-jets were previously installed in the tanks to allow vertical pumping of tank contents. Steam-jet technology was selected over conventional pump technology since there are no moving parts. This means virtually no maintenance over the life of the tank. The steam-jets were not installed at the time of tank construction, but were added later during spent fuel reprocessing campaigns when it was decided to remove the tank contents for treatment. Adding the jets as a retrofit project resulted in the jet intake nozzles being located approximately 4 to 8 inches from the tank bottoms. Mock-up testing indicated that the optimum height of the jet inlet, to achieve maximum removal of solids, is approximately 0.5 inch above the tank bottom. Therefore, the existing jets will be removed and new jets will be installed to this optimum height. This will improve solids removal during the tank cleaning operations.

WASHBALL INSTALLATION IN TANK WM-182

After completion of mock-up testing and detailed design, the project commenced with fabrication and installation of the tank cleaning system in Tank WM-182 at the INTEC Tank Farm Facility. The Washball assembly was the first unit to be fabricated, installed, and tested. Fabrication and installation of the directional nozzles and modified stream-jet will be conducted in 2002 and are not addressed in this report.

The Washball assembly was placed in Tank WM-182 through tank riser TR-19. Before the assembly could be installed, the existing steam-jet located in that riser was removed. A stacked series of concrete shielding hatch covers, which protect the opening to the tank, were removed to allow access for demolition of the steam-jet. Removal of these hatches presented some challenges. Hatch covers to the center tank risers have not been removed from Tank WM-182 since they were originally installed (in the 1950s). The hatch cover lifting eyes are made from reinforcing steel, which by today's standards is not considered acceptable. Special considerations were made to allow removal of this upper hatch cover. When the upper hatch cover was removed it revealed that the middle hatch cover lifting eyes were rusted beyond use. Special lifting fixtures were designed and installed using drop-in epoxy anchors to allow the middle hatch cover to be removed. The weight of the hatch cover also presented challenges. The available 65-ton crane had to be moved to the edge of the tank vault to meet the lifting and boom limits of the crane. Additional analysis of the lifting loads on the tank farm vaults were performed to allow closer staging of the crane.

After the middle hatch cover was removed, demolition and removal of the existing steam-jet began. The interior surfaces of the steam-jet were triple rinsed with water to remove any residual contamination in the piping. The entire steam-jet assembly, which is approximately 40 feet long, was removed as a single unit using a crane. The exterior surfaces of the assembly were rinsed with water as it was lifted from the riser. After removal, the assembly was cut into 3-foot sections and boxed for removal from the tank farm. The piping sections will be analyzed for remaining residual contamination on the interior surfaces to demonstrate the effectiveness of the triple rinse. The radiation levels on the removed steam-jet assembly averaged 50 mR/hr with one hot spot at 150 mR/hr.

Before the Washball assembly was installed in the tank and exposed to the contaminated environment of the tank interior, it was tested to ensure proper operation. The assembly was connected to a temporary water supply and suspended from a crane in the lay-down yard. No operational deficiencies were noted. The camera system had been previously tested in the fabrication shop. After final system checkout was completed, the assembly was lowered into the open tank riser and the supply water and camera leads were connected. Prior to operation, the entire installation was reviewed in accordance with operating procedures and the system was certified as ready for operations.

DEPLOYMENT OF THE WASHBALL IN TANK WM-182

The Washball was initially deployed in Tank WM-182 on August 28, 2001, and again on October 18, 2001, after some minor modifications. The Washball functioned as designed, providing adequate coverage to the interior surfaces of the tank while completing the desired revolutions of the assembly. The force of the spray was adequate to agitate the tank heel and suspended solids within the liquid to the extent that the cooling coils were no longer visible beneath the surface of the liquid. The Washball was also effective in removing contaminants from the tank wall and cooling coils on the walls. Some areas of the wall showed an “X” pattern where the spray nozzles had removed contaminants as the Washball moved through its cycle exposing the stainless steel surface of the tank wall. The results compared favorably to those of the mock-up test indicating that the Washball will provide cleaning capabilities to meet performance goals.

The pump provided the necessary flow rate to power the Washball and produced adequate pressure at the nozzles. The control value downstream from the pump discharge was opened approximately 25% and the flow rate at the Washball (>220 feet away) was over 80 gallons per minute. Head loss in the length of flexible hose from the pump to the tank access riser did not affect performance of the Washball. During pre-operational testing, several of the hose connections required rework to fix leaks at the fittings. Some of the fittings continued to leak during operations, however, none were considered serious enough to stop work.

The camera and lighting system attached to the Washball also functioned as intended. The spray guard did not, however, completely protect the lens from over spray and water droplets. The air lance system was able to remove any accumulation of drops on the lens and visual capabilities were adequate to inspect the tank interior during and after deployment. The camera was in the tank for more than two months and there was no evidence of any degradation due to the radiation background. The radiation field, measured at the tank riser near ground level, was approximately 90 mR/hr. The field at the camera was estimated to be approximately 300 mR/hr. No degradation of the camera optics and transmission quality was noted during the operational period.

The remote control system on the camera was also effective and provided for complete inspection of the tank interior. During the second deployment (October 18, 2001), the camera operator was able to focus on specific areas and record the removal of contaminants from the tank wall during actual washing operations. More than two hours of video footage was recorded during both deployments.

CONSIDERATIONS FOR IMPROVED WASHBALL DEPLOYMENT

The project is proceeding with design and fabrication of the remaining components of the tank cleaning system. The Washball was removed from Tank WM-182 (for winter shutdown) and can be modified as desired to achieve improved performance during the next deployment (planned for the spring of 2002). The following items will be considered for improved operation of the cleaning system.

Installation and Operation of the Washball

Lifting of hatch covers to obtain access to tank risers presented the greatest challenge for installation of the Washball in the tank. Future installations will plan on attachment of new lifting devices to allow safe removal of the hatch covers. Placement locations of the crane due to load restrictions on the tank farm must also be considered. The use of a larger crane, staged outside the boundaries of the tank farm will be considered, although cost and availability may be an issue.

The approximate 225 feet of flexible hosing used to supply water from the pump to the Washball was also the cause of considerable rework to repair leaking fittings. Planning for the next deployment will consider the use of 2.5-inch-diameter PVC piping. The potential for leakage is greatly reduced and the cost of material and labor for installation is low. Rework of piping is also cost-effective, as the Washball and directional nozzles are moved from tank to tank.

Camera System

The splashguard above the Washball was not completely effective in protecting the camera from over-spray, however, the air lance was able to remove the water droplets. Between the first and second deployment, the wetted lens dried out which caused a slight film that reduced the clarity of view. This was noticed during inspection of the tank (with the camera) prior to commencing the second deployment. Within a few minutes of starting the Washball, however, the lens became wetted again and the clarity was immediately improved. Considerations will be given to adjusting the spray guard prior to the next deployment in an effort to avoid over spray on the camera lens. Also, installation of a lens cleaning system that will allow for removal of any film build-up during operation will be investigated. This would ensure clear inspection capabilities throughout the closure process.

PLANS FOR CONFIRMATORY SAMPLING AFTER TANK CLEANING

Following tank cleaning operations and prior to grouting the tanks for final closure, the remaining residuals in each tank will be sampled and analyzed to verify compliance with performance objectives. A sampling and analysis plan has been developed to ensure that adequate data, of known quality, are obtained to support compliance with regulatory drivers and requirements. The plan provides the necessary sampling procedures and processes for compliance with Environmental Protection Agency (EPA) guidance.

Sample Collection

Sample collection planning is based on the use of the Light-Duty Utility Arm (LDUA). The LDUA was successfully used in 1999 and 2000 to obtain baseline samples of the heels in Tanks WM-182,WM-183, and WM-188. The data obtained were used in planning the cleaning and closure approach for these tanks. The LDUA can be lowered through existing tank risers and has the ability to obtain samples from the tank bottom within a 13.5-ft radius under the point of insertion. Because the Washball action will homogenize the tank heel (based on the results of testing in a mock-up tank) and utilizing the reach capabilities of the LDUA, only five random sample locations are required to obtain representative data to characterize the tank residual. This number was derived from the Data Quality Objective process following EPA guidance. While the number of required sample locations is relatively small, obtaining the necessary sample volumes is somewhat challenging. Modifications to the LDUA will be required to ensure success in obtaining adequate sample volumes to demonstrate compliance with regulatory requirements.

LDUA Upgrades

During previous sampling campaigns the ability of the LDUA sample chamber to collect adequate sample volumes was not always reliable. Because Tanks WM-182 and WM-183 contained large quantities of solids, the suction tube design was inadequate for obtaining the necessary volumes for analysis. The LDUA sampling chamber was, therefore, redesigned to use a modified suction tube to handle the heavier solids encountered in the tanks. A proto-type was fabricated, and testing with solid simulates provided proof of the new design. New sampling chambers for the LDUA are being fabricated for use in sampling Tank WM-182 residuals, planned for the summer of 2002.

Simple Sampler

While the LDUA will be very successful in obtaining the necessary samples to confirm tank cleanliness and compliance with performance objectives, it is also costly to deploy. Prior to commencing a full sampling campaign it is desirable to obtain preliminary samples for analysis of key contaminants of concern as an indication of the effectiveness of the cleaning operations. If these contaminants are outside the bounding performance objectives, additional cleaning may resume to ensure successful confirmatory sampling when the LDUA is deployed.

The INEEL is developing and testing a simplified tank sampling device that can be deployed for a significantly lower cost than the LDUA. It does not have the latitude of the LDUA for reaching multiple random locations, however, it can be lowered manually below each tank riser (access point) to obtain samples at four separate locations. The simple sampler uses a manually operated suction piston attached to a sample chamber with plastic tubing. The plastic tubing can be designed to the desired length for lowering the sample chamber into the bottom of the tank. The design utilizes off-the-shelf components and assembly of the unit will be performed on-site. The sample chamber is lowered into the tank through a glove bag located at ground level over the tank riser. The simple set-up and operating procedures make deployment extremely cost-effective to meet initial sampling needs.

CONCLUSION

Based on the deployment of the Washball in Tank WM-182, the proposed cleaning system will provide the necessary capabilities to remove contaminants from the tanks to achieve closure performance measures for both DOE and RCRA requirements. The system is primarily developed from commercially available components and the operational approach is simple. The components can be reused for subsequent cleaning of other tanks, which will reduce the overall cost and schedule for closure of the tank farm. The system requires very little preventive maintenance and any repairs or replacements are readily available. Operating procedures are simple and allow for many decisions concerning operating parameters to be made in the field by project personnel responsible for meeting closure objectives. The project is continuing with full development and deployment of the tank cleaning system.

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