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River Corridor
Closure Contract

618-10 Burial Ground Trench Remediation and 618-10 and 618-11 Burial Ground Nonintrusive Characterization of Vertical Pipe Units Lessons Learned

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Washington Closure Hanford

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1.0 LESSONS LEARNED INTRODUCTION

A "lessons learned" is a noteworthy practice or innovative approach that is captured and shared to promote repeat application, or an adverse work practice/experience that is captured and shared to avoid reoccurrence. This document provides the lessons learned identified by the 618-10 Burial Ground trench remediation and the 618-10 and 618-11 Burial Ground nonintrusive characterization of the vertical pipe units (VPUs).

2.0 TRENCH REMEDIATION PROJECT

2.1 ANOMALY (BOTTLE) PROCESSING

An Explanation of Significant Differences (ESD) to the Record of Decision for the 300 Area Remedial Action was approved on August 3, 2011 (EPA 2011), which authorized a modified approach for managing liquids in bottles at 618-10. The ESD modified the remedy for 618-10 to allow for necessary treatment of liquid waste in bottles, up to one gallon per bottle, to occur in a tray or box within the excavation area. Because of the unknown integrity of bottles, removing each bottle from the excavation for individual handling poses a safety challenge. Safety for both workers and the environment is greatly improved if the bottles are placed into a tray or box in the excavation for treatment within the remediation area. The approach allows treatment of liquid waste in bottles, up to one gallon per bottle. The process involves covering a batch of bottles with soil and then crushing them and stabilizing with a Portland cement grout mixture. Post-treatment verification sampling is performed to demonstrate compliance with land disposal restrictions and disposal facility acceptance criteria. The requirements are met by mixing the liquid into grout which immobilizes metals and radioactive metals expected in the waste and neutralizes the acids.

2.2 URANIUM OXIDE DRUM PROCESSING

Uranium oxide drums represent a pyrophoric waste stream that have generated fires during transportation and remediation at several locations across the country over the years. A "Lesson Learned" identified during the remediation of this waste stream at the Idaho National Laboratory Site was to open the drums with the excavators to allow a slower "controlled burn" of the material.

A variation of the process is being developed for the 618-10 project. The project worked with a vendor to investigate the ability to open the drums using an excavator with a shear. They determined that the operation could be readily performed by an experienced operator. This is being incorporated into a process similar to the bottle processing noted above to minimize the risk from exposed material. The drum would be breached under cement grout inside a bedding box. The drum could be emptied under grout, the drum carcass removed, and the grout mixture poured into a depression in the excavation and allowed to harden. The intent is to minimize the amount of material exposed to oxygen and thus minimize or eliminate any potential for fire.

2.3 DRUM PROCESSING IMPROVEMENTS

An evaluation performed by the project identified opportunities to improve the drum processing to address inefficiencies in the operation and delays due to equipment failures.

The effect of failures of support equipment was compounded because some of the failing equipment is located in a radiological/beryllium zone. The solutions included accumulating a supply of critical spare parts, setting up a corridor to allow more efficient access to the radiological/beryllium zone equipment, replacing some older equipment, and having redundant instruments in some cases.

Modifying methods of work can have a big impact on the day-to-day production rate. The biggest improvement was gained by staggering personnel in order to work though lunch, thus eliminating having to shut down the operation in a safe configuration, doffing and donning, and the downtime during lunch. Another improvement involved the Resident Engineers' documentation of data collected for each drum anomaly. The data is collected on an Anomaly Tracking Form (ATF) that was hand written with a clerk later transcribing the information into electronic forms. The improvement has the Resident Engineers entering the ATF information into the Anomaly Tracking System in real time, thus allowing current information to all that need it. Also co-location of the Resident Engineers and Field Work Supervisors added to communication efficiencies. Another efficiency was to eliminate sending concreted drums to the drum penetration facility by performing all of the needed monitoring activities at an earlier step in the process, which was achieved by the addition of monitoring equipment at the station for the neutron slab counter.

2.4 ELEVATED AIRBORNE RADIOACTIVITY

The 618-10 site contains a broad spectrum of low- to high-level dry wastes, primarily fission products and some transuranic (TRU) isotopes from the 300 Area. Low-level wastes were generally buried in trenches; however, some higher activity wastes placed in concrete-shielded drums were also disposed in the trenches.

Elevated airborne radioactivity concentrations were produced during the Friday, July 7, 2011 trench excavation activities. Although air sampling analysis procedures were followed, the elevated air sample results were not identified until the start of work activities on the following Monday. Upon the Monday morning review of the air sample analysis results, it became clear that opportunities for earlier identification of potential elevated airborne radioactivity had been missed. Additional measures were instituted to gain an earlier understanding of more current airborne radioactivity concentrations and thereby reducing the potential for worker exposure. These measures included the following:

- Increasing air sample analysis to twice per day (before lunch and end of day), allowing the project to isolate a "problem" to morning OR afternoon.
- Timely review of beta-to-alpha ratios to identity outlying/uncommon ratios
- Field checking of air sample media (when background levels permit) for uncharacteristic alpha to beta ratios.

Additional enhancements to mitigate the airborne radioactivity hazard included the following:

- Increased pre-watering and additional water cannons for fugitive dust control
- Revised the work packages to include wording to prevent bringing anomalous materials right up to the trench/radiological boundaries, and to ensure sorting is performed below grade

2.5 REDUCTION IN PREPARATION TIMES

Several improvements were identified to reduce the amount of time it takes to prepare the craft and begin remediation activities within the exclusion zone.

- The IH team was co-located in one office in order to improve communications and reduce the amount of time required to collect the items needed to supply the craft for their entry.
- A list was posted in the plan-of-the-day (POD) trailer at the end of each day that identifies the work assignment and location for each of the craft for the following shift. Based on this list the IH team prepares a package the night before for each craft member that was entering the zone. A “Tote” system is used with each craft member’s name to hold all the material in a convenient package for that worker that can be distributed quickly and easily carried to the change trailer.
- The change trailer arrangement was modified to provide more area for the workers. Also, support personnel were available to pre-cut tape (used in taping personal protective equipment [PPE]), hanging the tape at change locations, and assisting the craft in donning PPE.
- This greatly decreased the amount of time needed to prepare for entry and workers frustration with waiting was eliminated.

2.6 INITIAL VIDEO MONITORING OF ANOMALIES

The Resident Engineering Team has a video system that is used to view anomalies as they are exposed – this capability is especially important for capturing motion video to provide the means to recognize pyrophoric or chemical reactions, or general observations while keeping personnel positioned safely away from the anomalies. Visual images are recorded and included in the record of each anomaly. During the project, the system has evolved to a third generation of equipment to better meet their needs. In many ways it has replaced the logistics and other problems/limitations with handheld cameras.

The latest video system has the following:

- HD 1080p resolution
- Wireless antenna connection so that videos and still images can be saved electronically without physically removing files from camera
- Remote control pan and tilt 360 degrees
- Zoom is 20x optical and 12x digital. This means that sand grains can “optically” be distinguished at ~30 yards. Also, digital zoom provides for saved images to be zoomed without apparent pixelation.
- Up to 30-ft telescoping mast adjustment on a trailer platform for mobility
- Solar power battery charger with a timer for minimal time to set up and maintain.

The team has found that it improves safety, enhances quality, and is overall more efficient means of visual monitoring. They have two wireless systems now, and two more are on order that incorporate the lessons learned from the first two incremental trial systems.

2.7 TRACKING PHYSICAL LOCATION OF DRUMS

Currently the project tracks the location of more than 300 drums recovered from the 618-10 Burial Ground remediation as they move from the excavation through an interim storage area, material release area, and then to a long-term storage area. The number of drums is expected to increase to over 1,000 as the remediation progresses. The current method uses a tracking board in which the location of each drum is manually moved each time the drum is moved along the surface of the site through two remote-read instrument stations, into a remote-operated drum opening enclosure, to a sampling station, through the Beryllium survey station, and finally into longer term storage before shipment off-site. An electronic backup copy of the board is also maintained and must be updated daily. Maintenance of the electronic board is time consuming and does not provide real-time tracking of the drum locations.

The manual poster board is being replaced by an electronic large screen monitor. The location of the drums will be tracked on the monitor in real-time. The monitor has touch-screen capabilities that allow drum locations to easily be moved without the need of a keyboard entry. Using the monitor will eliminate the need to maintain a poster board that has to be updated daily. It will also allow multiple people access at remote locations to see real-time drum locations.

3.0 618-10 AND 618-11 BURIAL GROUND NONINTRUSIVE CHARACTERIZATION

3.1 618-10 BURIAL GROUND NONINTRUSIVE CHARACTERIZATION

- **Maintain due diligence regarding the establishment of radiological controls even though radiological contamination is not expected**: Radiological surveys were being conducted using a test gauge lowered into the cone penetrometers, to determine if any contamination was present within the recently installed cone penetrometers. The surveys were being conducted as part of the cone penetrometer installation activities adjacent to the vertical pipe units (VPUs) in support of nonintrusive characterization activities. Each VPU had four cone penetrometers installed to test depth in support of future radiological characterization of each VPU. Upon discovery of contamination during the survey of the test gauge, all work activities were stopped at the 618-10 work site. No contamination source could be determined. As a result, the work process was revised to control all cone penetrometers as High Contamination Areas (HCA) with PPE required for placing and removing items from inside the cone penetrometers. This work process was successfully implemented for the remaining 618-10 characterization and employed at 618-11.

- **Review characterization processes and data to ensure future applications or deployments are consistent with expectations and capabilities**: During the nonintrusive characterization (NIC) activities conducted at 618-10, concerns were raised related to the usefulness of the characterization equipment deployed. The characterization system was developed by North Wind Incorporated (NWI), in conjunction with the U.S. Development and Deployment Program in FY 2003. The objective of the program was to identify, develop, and demonstrate technologies to support accelerated remediation of radioactive and hazardous wastes at the Hanford Site. The system was specifically developed for characterization of the VPUs at the 618-10 and 618-11 Burial Grounds, with potential application for other buried wastes elsewhere. Following the design completed by NWI, in conjunction with Idaho National Laboratory (INL) a field demonstration of the technology development effort was conducted in FY 2007 for the trench I silos at the 118-K-1 Burial Grounds. Although the silos were much larger than the VPUs for which the system was designed, data from the system provided useful information on the probable locations and ranges of activity of radioactive wastes within the silos. Based upon the demonstration at 118-K-1, the 618-10 project decided that similar data for the VPUs could supplement process and records information for planning future remediation strategies at 618-10. As a result, the NIC system was deployed to conduct the characterization activities at 618-10 in FY 2009/2010 in accordance with the requirements of the *Sampling and Analysis Plan for 618-10 and 618-11 Nonintrusive Sampling* (SAP) (DOE/RL-2008-27).

  A U.S. Department of Energy (DOE), Richland Operations Office (RL) surveillance (S-10-SED-WCH-026; DOE-RL 2010) was conducted to investigate the design, operation, and performance of the characterization equipment. A corrective action plan (WCH 2010) was prepared to address the findings of the surveillance regarding the adequacy of instrument capabilities, data collection, reporting, and documentation. A workshop was conducted in December 2010 (WCH-434, *618-10 Burial Ground VPU Nonintrusive Characterization Process and Data Collection Work Shop*) with RL and the EPA to review the results of the characterization effort and determine the path forward. The results are documented in the 618-10 NIC report dated December 9, 2010. The workshop determined that based on the inherent uncertainties associated with the soil and debris density effects, scaling factor and system uncertainties, a Data Quality Objective session would be conducted with RL and the EPA to evaluate the results and determine the changes to be made to the SAP prior to future deployment at 618-11. In addition to the above, DOE performed an independent assessment of the NIC process to validate results obtained and recommend improvements. The assessment was performed in January 2011 by Dr. Phil Loscoe of Quadrant One Technical Services, LLC. The assessment concluded the following:

– The rationale for the selection and use of the associated detectors was sound and based on extensive review of existing records.

– The lack of detailed knowledge of the density of the surrounding soil and debris in the VPU (even when assumed to be different low densities) introduces systematic errors that have a significant impact on the uncertainty in the measurement results. Approximately 85% of all Cs-137 activities assigned to a measurement location were based on dose rate measured by the gross gamma dose rate meter. Further, the calibration of the scintillation detectors appears to be conservatively biased high, and the scaling factors used to infer transuranic activities from the measured Cs-137 activity differ by about a factor of five or more, depending on the type and irradiation history of the spent fuel residues presumed to be present. As a result, although not part of the NIC objectives, no firm conclusions can be drawn as to waste classification.

– The measurement and location of hot spots in many of the VPUs will aid in ALARA planning of the future remediation activities. In addition, to reduce costs, fewer penetrometer tubes, two or three versus four, might be considered for assay of the 618-11 VPUs.

– The information obtained from the 618-10 NIC effort will be useful to support future VPU characterization activities required to determine their waste classifications. Depending on the remediation method that is adopted, the dose rate maps could prove to be very useful. The location of the few extreme hot spots noted might affect the retrieval method selected.

The above conclusions were considered in development of the SAP that was revised in support of the 618-11 NIC activities, as addressed in the following section.

Figure 1. Insertion of the Multi-Detector Probe at the 618-10 Burial Ground.

3.2 618-11 BURIAL GROUND NONINTRUSIVE CHARACTERIZATION

- **Characterization equipment improvements were made to the system based on lessons learned from the 618-10 characterization activities:** The robustness and reliability of the system was improved including upgraded umbilical connectors, field hardening of the detectors, and improved hardware for conducting daily source checks and documenting system operation. Implementation of these system improvements resulted in greatly improved reliability of the characterization system, and as a result there was no downtime or delays associated with the system operation during the 618-11 characterization activities.

- **Based on operational lessons learned from characterization activities previously conducted at the 118-K-1 and 618-10 Burial Grounds, the 618-11 Sampling and Analysis Plan was revised to include the following**:

  - The elimination of caisson characterization at 618-11. The caissons are constructed of 8-ft-diameter corrugated metal pipe approximately 10 ft in length with the top approximately 15 ft below grade. During 118-K-1 characterization activities of large-diameter silos it was learned that the cone penetrometers installed at the external boundary of the silos did not provide any meaningful data regarding their contents. Therefore, the caissons were eliminated from the 618-11 characterization work scope.

- The elimination of trench characterization at 618-11. During characterization activities conducted at 618-10 cone penetrometers were driven to a depth of approximately 30 ft at 25-ft intervals. Based on the results obtained, no significant contamination was detected; it was decided to eliminate trench characterization from the 618-11 work scope.

- Because it was learned from the results obtained during the 618-10 characterization effort that meaningful data could be obtained using only two cone penetrometers versus four (as used at 618-10), the 618-11 VPU characterization effort was revised to collect data using two cone penetrometers adjacent to each VPU.

- During review of the 618-10 characterization data it was recognized that only the gross gamma dose rate instrument would be utilized to collect data from each cone penetrometer location using an energy-compensated Geiger-Mueller detector with a sensitivity range from a few mR/hr to about 500 R/hr.

- During characterization activities at 618-10, soil samples were collected adjacent to and below each VPU. The results concluded that no contamination was detected and soil sampling was eliminated from the characterization work scope. As a result, the cone penetrometers were driven to approximately 6 ft below the believed bottom of each to determine if significant levels of contamination were present. The results concluded no significant levels of contamination beneath the VPUs.

The characterization data were collected in accordance with the revised sampling and analysis plan and provided the information needed in support of planning future VPU remediation activities at 618-11. The results are documented in the 618-11 NIC Report dated August 24, 2011.

Figure 2. Installation of the Cone Penetrometers at the 618-11 Burial Ground.

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