Remediation of the Melton Valley Watershed at Oak Ridge National Lab: An Accelerated Closure Success Story - 8449

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ABSTRACT

The Melton Valley (MV) Watershed at the U. S. Department of Energy's (DOE's) Oak Ridge National Laboratory (ORNL) encompasses approximately 430 hectares (1062 acres). Historic operations at ORNL produced a diverse legacy of contaminated facilities and waste disposal areas in the valley. In addition, from 1955 to 1963, ORNL served as a major disposal site for wastes from over 50 off-site government-sponsored installations, research institutions, and other isotope users. Contaminated areas in the watershed included burial grounds, landfills, underground tanks, surface impoundments, liquid disposal pits/trenches, hydrofracture wells, leak and spill sites, inactive surface structures, and contaminated soil and sediment. Remediation of the watershed in accordance with the requirements specified in the Melton Valley Record of Decision (ROD) for Interim Actions in Melton Valley, which estimated that remedial actions specified in the ROD would occur over a period of 14 years, with completion by FY 2014. Under the terms of the Accelerated Closure Contract between DOE and its contractor, Bechtel Jacobs Company, LLC, the work was subdivided into 14 separate subprojects which were completed between August 2001 and September 2006, 8 years ahead of the original schedule.

INTRODUCTION

The U. S. Department of Energy's (DOE's) Oak Ridge Reservation (ORR) consistes of 13,970-hectares within and adjacent to the city limits of Oak Ridge, Tennessee, in Roane and Anderson counties. ORR hosts three major industrial research and production facilities originally constructed as part of the World War II (WWII)-era Manhattan Project: East Tennessee Technology Park (formerly the K-25 Site), Oak Ridge National Laboratory (ORNL), and the Oak Ridge Y-12 National Security Complex Plant. The Melton Valley (MV) watershed is immediately south of the ORNL main campus.

Remediation activities in the watershed were completed in accordance with requirements and performance objectives specified in the Melton Valley Record of Decision (ROD) for Interim Actions in Melton Valley signed in September 2000 by the Federal Facilities Agreement (FFA) parties (DOE, the State of Tennessee, and U.S. Environmental Protection Agency [EPA]). The ROD and its subsequent changes (ROD amendment and four Explanations of Significant Differences) addressed contaminant releases and potential risks or hazards associated with 175 contaminated units scattered across an area of 430 hectares (1,062 acres) within the watershed. The remedial action project also addressed inactive liquid low level waste tanks slated for closure under a separate ROD at ORNL and the retrieval of buried transuranic (TRU) waste from trenches in one of the burial grounds in the valley as stipulated in a Dispute Resolution Agreement with the State of Tennessee.

The focus of the MV ROD was on 1) principal threat wastes; 2) contaminant source and release areas; 3) contaminated structures; and 4) contaminated media, primarily soils associated with these wastes, sources, and release areas. The ROD specifically excluded secondary media, including sediment, groundwater, and floodplain soils exhibiting dose levels less than 2500 µR/hr; these secondary media will be addressed by the final ROD for the watershed. The ROD acknowledged that Melton Valley would remain a controlled area with restricted access. Future land use was among the principal factors in determining the scope of the final remedies. The eastern portion of the valley was remediated to a condition that allows future industrial use with limited restrictions while the western portion, occupied by waste disposal sites, would remain a waste management area with closed-in-place wastes. Surface waters were to be remediated consistent with the State of Tennessee's stream use classification.

The completed remedy was designed to protect surface water in the MV Watershed by attaining surface water remediation levels, including ambient water quality criteria (AWQC), in the major tributaries inside the valley within 2 years and risk-based limits for residential exposures at the confluence of White Oak Creek and the Clinch River in approximately 10 years. The MV ROD required the development of a monitoring program for surface water, groundwater, and biota within MV. Results from the monitoring activities are presented and evaluated on an annual basis in the Remediation Effectiveness Report (RER), a document that is used by stakeholders (i.e., State of Tennessee, U.S. EPA, and the general public) to assess the performance of completed Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) response actions on the ORR relative to the requirements of the decision documents directing the actions.

The MV remedial action entailed the construction of engineered cover systems and groundwater diversion/collection systems that require ongoing Surveillance and Maintenance (S&M) programs. S&M activities are integral components of the remedy that were initiated immediately following completion of the remedial action.

The MV remedial actions left hazardous substances in-place (e.g., buried wastes beneath hydraulic isolation caps) that could pose a future potential risk if exhumed. In addition, institutional controls were selected as the remedial response action for certain units within the valley. Consequently, the ROD required DOE to develop and implement a Land Use Controls Implementation Plan (LUCIP) that addresses the units covered by the ROD to identify specific LUCs that will be implemented and maintained to ensure protection of human health and the environment. The status of the LUCs is reviewed on an annual basis and documented in the RER.

Another consequence of leaving hazardous substances in-place (at levels that do not allow for unrestricted access and unlimited exposure) is that the MV remedial action will be subject to CERCLA 5-Year Reviews (FYRs). The FYRs will document the results of monitoring, S&M, and LUCs and provide an assessment as to whether the remedy remains protective of human health and environment.

Results from the monitoring, S&M, and LUC activities in Melton Valley will provide data needed to support any future remedial decisions for the MV Watershed. As stated above, remedy selections for sediment, groundwater, and floodplain soils exhibiting dose levels less than 2500 µR/hr were deferred until the effectiveness of the interim remedial actions could be evaluated. This future remedial decision will also specify the selected remedy for those units or areas that were deferred from the interim ROD. Future decision documents will address any additional remedial actions that may be required, including long-term institutional controls for MV.

OVERVIEW OF MELTON VALLEY REMEDIAL ACTION

DOE and its contractor, Bechtel Jacobs Company, LLC, subdivided the remediation work into 14 separate subprojects. Table I lists each of the subprojects along with a general description of scope. Remediation sites are shown in Figure 1. Highlights of the remedial action are presented below.

Table I. Scope of the Melton Valley Remedial Action

No.	Subproject	Remedy	General scope description
1	Pits and Trenches	Hydrologic isolation	Capping of Pits 2, 3 and 4 and capping of Trenches 5, 6, and 7.
2	SWSA 4	Hydrologic isolation	Excavation of IHP, capping of SWSA 4, D&D of related structures, and P&A of unneeded wells.
3	SWSA 5	Hydrologic isolation	Capping of SWSA 5 South, four trenches in SWSA 5 North, and the former OHF facility; D&D of related structures; and P&A of unneeded monitoring wells.
4	SWSA 6	Hydrologic isolation	Capping of SWSA 6, D&D of related structures, and P&A of unneeded monitoring wells.
5	ISG for Trench 5, Trench 7, and HRE fuel wells	ISG	ISG of Trench 5, Trench 7 and the 7 HRE fuel wells adjacent to Trench 5.
6	Soils and Sediments	Excavation/Removal	Removal of HFIR Impoundments, HRE Pond, ETF, EPICOR-II Lysimeters, 6 contaminated soil sites, and 25 hot spots; and final verification surveys.
7	NHF	D&D	D&D of NHF surface facilities, storage tower, and waste slotting tank.
8	HRE Ancillary Facilities	D&D	D&D of 11 facilities at HRE, 2 pump stations, and 1 waste repackaging facility.
9	7841 Equipment Storage area	Disposition of contaminated tanks, carriers, equipment, etc.	857 items characterized and dispositioned at EMWMF, NTS, and Envirocare.
10	Hydrofracture Well P&A	Grouting of hydrofracture injection/monitoring wells	4 injection wells & 107 monitoring wells grouted/abandoned.
11	Tanks T-1 and T-2 and the HFIR Tank	Removal of sludges and grouting of tank shells	~11,000 liters of sludge transferred from Tanks T1 and T2 to the ORNL LLW evaporator and grouting of Tanks T1 and T2 and the HFIR tanks
12	TRU Trenches	Removal of buried casks of RH-TRU waste	204 casks, 12 steel drums, 18 boxes, and 15 m^3 waste removed from 22 trenches.
13	OHF Surface Facilities D&D	Demolish to slab; coincidentally capped	D&D of Bldg 7852, Waste pit T-4, pump house, and related structures, equipment and debris
14	SWSA 4 Small Facilities D&D	Demolish to slab; some sites coincidentally capped	D&D of the Pilot Pits, Alpha Greenhouse, 7819 Decon Facility, and ISV hood and support structures

D&D = decontamination and decommissioning.
EMWMF = Environmental Management and Waste Management Facility.
ETF = Engineering Test Facility.
HFIR = High-Flux Isotope Reactor.
HRE = Homogenous Reactor Experiment.
IHP = Intermediate Holding Pond.
ISG = in-situ grouting.
LLW = low-level (radioactive) waste.
NHF = New Hydrofracture Facility.
NTS = Nevada Test Site.
OHF = Old Hydrofracture Facility.
ORNL = Oak Ridge National Laboratory.
P&A = plugging and abandonment.
RH = remote-handled.
SWSA = solid waste storage area.
TRU = transuranic.

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Fig. 1. Location of principal sites addressed by the Melton Valley remedial action project.

HYDROLOGIC ISOLATION

The remedial action selected for many of the waste areas in MV was hydrologic isolation, which involved placing RCRA-type multi-layered caps over the buried waste. The areas selected for hydrologic isolation included areas in the Pits and Trenches area, SWSA 4, SWSA 5, and SWSA 6. A total of 58 hectares was capped as part of the hydrologic isolation project. Final capping configurations are shown in Figure II.

Hydrologic isolation was achieved by covering the waste areas with both RCRA-type and isolation caps. These provide hydrologic isolation by reducing infiltration through the waste disposal areas. The RCRA-type cap contains, in ascending order, a geotextile subsidence geogrid over waste trench areas (not shown), a gas vent layer, contouring fill, a geosynthetic clay liner (GCL), a geomembrane, a geocomposite drainage layer, 30 cm of frost protection soil, and a 15-cm. vegetative layer. The isolation cap does not contain a GCL.

Major activities that supported cap construction involved the development and operation of a borrow area and the construction and maintenance of more than 3 miles of haul road to connect the sites. The 11 hectare Copper Ridge Borrow area was cleared, grubbed, and developed to provide fill material for the hydrologic isolation caps. More than 645,000 m^3 of soil were removed from the borrow area.

The capped areas are divided into four separate groups: Pits and Trenches, SWSA 4, SWSA 5, and SWSA 6; each is described below.

Pits 2, 3, and 4 were used for disposal of LLLW between 1952 and 1962. Disposal of sludges from the Process Waste Treatment Plant continued (in Pit 4 only) until 1976. **Trenches 5, 6, and 7** were constructed in 1960, 1961, and 1962, respectively, and used for the disposal of LLLW between 1960 and 1966. During the operational history of the three seepage pits, together they received approximately 80 million liters of liquid waste containing $1.6x10^{15}$ Bq of Sr-90; $6.8x10^{15}$ Bq of Cs-137; $8.5x10^{15}$ Bq of Ru-106; and more than $2.6x10^{15}$ Bq of trivalent rare earths. Trenches 5, 6, and 7 received nearly 76 million liters of waste containing several hundred thousand curies of activity from Sr-90, Cs-137, and Co-60.

The **SWSA 4** Burial Ground covered an area of 23 acres, including trenches and auger holes used for disposal. Shallow land burial was conducted routinely at the SWSA 4 Burial Ground for the disposal of waste materials, including off-site sources, when ORNL was designated the Southeast Regional Burial Ground (1955 – 1963). Unlined trenches and auger holes (with contained and uncontained wastes) were covered by soil from trench excavation or by concrete caps and soil. Trenches that contained TRU waste were specifically capped with concrete. The total volume of waste buried at SWSA 4 between 1951 and 1959 is estimated at 57,000 m^3, with a total radioactivity of $4.1x10^{15}$ Bq. Radionuclides included Sr-90, Cs-137, Co-60, H-3 (tritium) and others. Much of the waste at SWSA 4 was located in or very near the water table

SWSA 5 South is a waste disposal area (burial ground) that contains over 220 unlined waste trenches and nearly 1000 unlined auger holes. Waste disposal activities occurred between 1959 and 1973, involving a variety of solid and liquid radioactive wastes from ORNL facilities. In addition, waste was received from other agencies prior to 1963 when ORNL was designated the Southeast Regional Burial Ground by the AEC. Records indicate a total of approximately 85,000 m^3 of wastes containing $7.8x10^{15}$ Bq of radioactivity were placed in the disposal facility. Primary contaminants include Sr-90, Cs-137, Co-60, and tritium, with lesser quantities of uranium-thorium isotopes and transuranics.

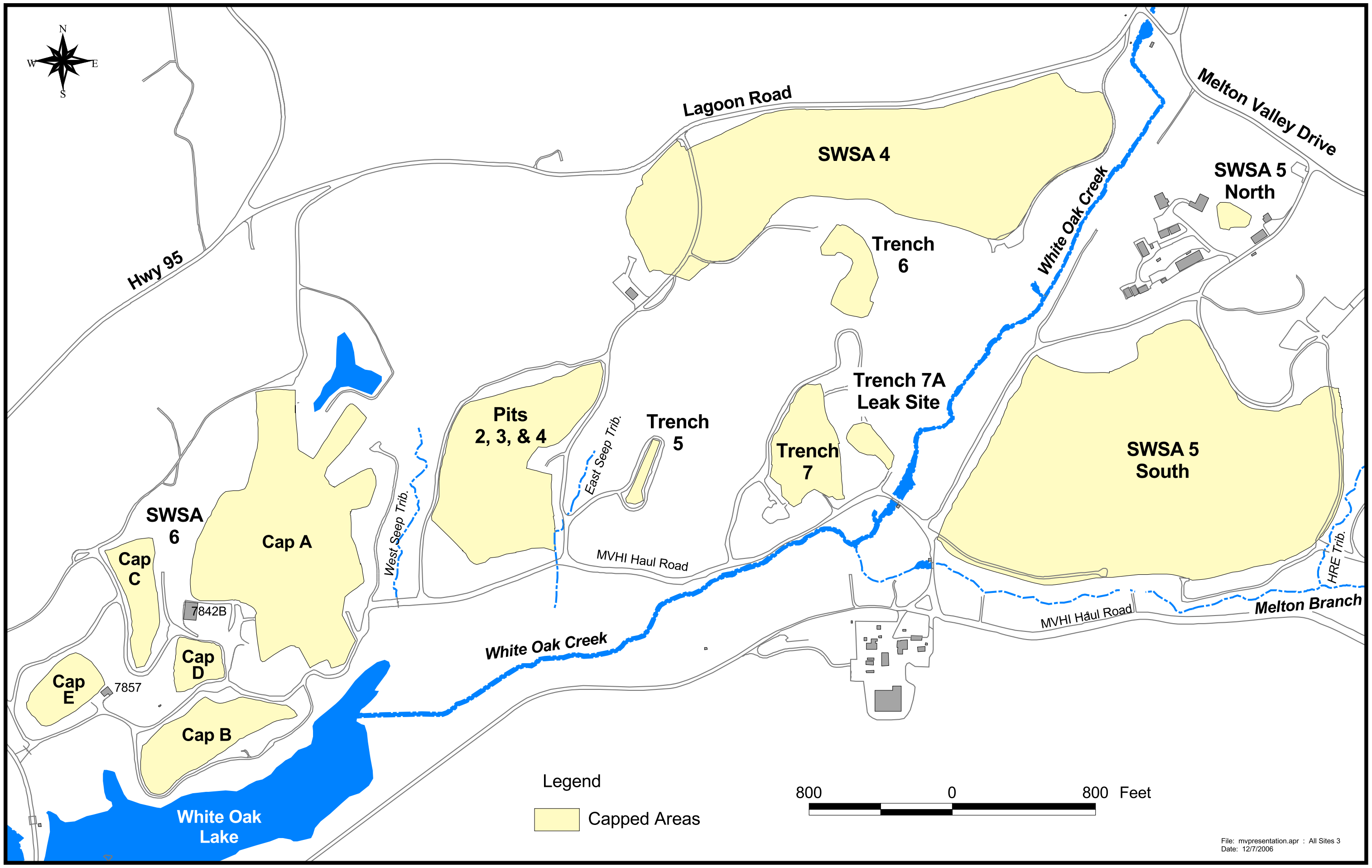

Figure II. Final Configuration of Capped Areas in Melton Valley.

IN SITU GROUTING

The ISG project was conducted to decrease hydraulic conductivity and thereby decrease water flow and contaminant migration from the area of Seepage Trenches 5 and 7 (described above) and the Homogeneous Reactor Experiment (HRE) fuel wells adjacent to Trench 5. The HRE fuel wells consisted of 7 auger holes used in 1964 for the disposal of residual HRE test fuel (a sulfuric acid solution containing about 4 kg of irradiated uranium sulfate and about 7.4×10^{11} Bq of fission products).

The primary design criterion was a reduction in hydraulic conductivity of the trenches, HRE fuel wells, and surrounding soil to at least 1×10^{-5} cm/sec. The design life of the stabilized contact zone is estimated to exceed 200 years. The work was accomplished by filling the void space within the crushed stone section of each trench with cementitious grout. The contaminated soil surrounding the trenches (1 meter perimeter) was then grouted with acrylamide grout. A summary of the quantities used is shown in Table II.

Table II. Summary of grouting quantities at Trenches 5 and 7 and HRE fuel wells

Location	No. grout injection pipes	Cement grout injected	Acrylamide grout injected
Trench 5	287	264 m^3	157 m^3
Trench 7	224	153 m^3	157 m^3
HRE fuel wells	44	--	39 m^3

After completion of grouting, in-situ hydraulic conductivities of the grouted materials were measured to verify attainment of the design objective. The areas were then covered with multi-layer caps as part of the MV hydrologic isolation project.

D&D OF HYDROFRACTURE FACILITIES AND WELLS

Liquid radioactive wastes generated at ORNL were disposed of through underground injection between 1966 and 1984. The so-called hydrofracture waste disposal process involved pumping a radioactive waste/grout slurry into the hydraulically fractured Pumpkin Valley Shale at depths of 320 meters below ground surface (bgs). Radioactive waste disposal injections were performed initially at the Old Hydrofracture Facility (OHF) and later New Hydrofracture Facility (NHF). Prior to construction of OHF, field experiments were used to develop the injection technology. Most of the approximately 5.6×10^{16} Bq of radioactive waste consisted of fission products such as Cs-137 and Sr-90. Approximately 7.4×10^{13} Bq of long-lived radionuclides in TRU waste sludges were disposed of during the NHF (i.e., HF-4) grout injection process.

Dozens of wells ranging in depth from approximately 60 to 320 meters bgs were installed at these injection sites to monitor the performance of the hydrofracture process. These wells provided potential pathways for contaminated fluids to migrate from the injection zones to shallower groundwater zones and the surface environment

The NHF D&D project entailed removal of the surface facilities associated with the hydrofracture injection waste disposal activities and cutting of the actual injection well (the well was plugged as part of the Hydrofracture Well P&A project described below). The initial phase of work entailed the demolition and removal of above-ground piping, tanks, equipment, and support facilities at the site, including injection pump rooms, equipment room, the control room and offices. The final phase of work involved the remotely-operated demolition of the highly contaminated NHF pump cell within a HEPA-ventilated containment structure. The injection wellhead was cut approximately 4 ft below grade using a guillotine saw attachment following excavation of the cell floor.

Figure III. Demolition of the Old Hydrofracture Facility.

Demolition and removal of the OHF surface facilities were conducted as a prerequisite to the SWSA 5 capping activities. The facilities were coated with a fixative solution prior to demolition, which was accomplished using both manual techniques and an excavator with a shear attachment. Following demolition, the site was regraded and eventually included beneath the SWSA 5 South hydrologic isolation cap. The resulting debris from both the OHF and NHF demolition was size-reduced and transported to the EMWMF for disposal.

The remedial objective for the Hydrofracture Well P&A project was to plug the injection and monitoring wells in a manner consistent with the technical intent of TDEC underground injection control (UIC) well P&A standards [1200-4-6-.09(6)]. The scope of the project consisted of the P&A of 111 wells and the clean-out of 9 monitoring wells for future monitoring use.

The basic approach for plugging and abandoning the 111 monitoring and injection wells was to fill the open hole, casing, and potential flow area outside the casing (well annulus) with cement grout from the bottom up. Wells generally underwent P&A or clean-out from least contaminated and difficult to most contaminated and difficult to minimize the risk of cross contamination. All P&A work was performed in accordance with the intent of the state of Tennessee UIC regulations.

MV SOILS AND SEDIMENTS

The scope and method of accomplishment for the MVSS project were designed to meet RAOs and performance objectives specified in the MV ROD that apply to soil and sediment remediation. Fieldwork for the MVSS project began in June 2004 and was completed in September 2006. Major scope elements of the MVSS project included the following:

- Removal of the HFIR Impoundments (four).

- Removal of the HRE Pond (cryogenic pond).
- Remediation of contaminated soil at sites associated with historical releases of contamination related to the LLLW system and hydrofracture injection experiments.
- Remediation of the Inactive Waste Pipeline System in MV.
- Removal of buried wastes and soil from the ETF.
- Removal of the EPICOR-II Lysimeters and related structures.
- Final verification surveys and sampling across all of the uncapped areas in MV.

Soil remediation activities were conducted by loading the excavated materials into lined trucks and transported to EMWMF or to one of the MV hydrologic isolation capping sites for use as contour fill. Once the excavation reached the design limits, verification surveys were conducted to determine whether additional excavation was needed to meet the soil remediation levels established in the ROD. Following the completion of soil removal activities, the sites were backfilled with clean fill and otherwise restored. Figure IV shows remediation in progress at the HFIR Impoundments.

Figure III. Remediation of the HFIR Impoundments.

Pipeline remediation entailed the careful excavation of soils to expose the buried pipelines. The pipelines were then tapped, and any liquids therein were drained or pumped into collection tanks for subsequent treatment at an ORNL wastewater/liquids treatment facility. The pipelines were cut and fittings were attached to allow the injection of grout at certain points and the venting or draining of liquids displaced by the grout. Pipelines that could not be grouted or otherwise did not require grouting were isolated through plugging and capping. Pipeline remediation included the grouting of void spaces associated with valve boxes, manholes, pump pits, and other appurtenances. In addition, seepage barriers, as required by the ROD, were installed at the edge of the MV hydraulic isolation caps where the pipelines intersect the caps.

Final verification activities entailed walkover surveys and soil sampling in all uncapped areas of MV to evaluate compliance with the soil remediation levels in the ROD, as well as dose measurements in the floodplain for comparison to ROD dose-based exposure criteria. The results from the final verification field measurements and analytical data were used to confirm that all areas in the watershed potentially requiring remediation had been identified and addressed as appropriate. In addition, the final verification surveys and sampling have yielded data to support the calculation of post-remediation risk levels for future workers and other receptors.

Table III. Summary of Quantities for the Melton Valley Soils and Sediment Project

Item	Quantity
Number of excavation sites	10 primary sites plus 25 hot spots
Quantity of soil excavated	23,416 m^3
Soil sent to EMWMF	9,464 m^3
Soil reused as contour fill (Melton Valley hydraulic isolation capping site)	13,952 m^3
Number of waste shipments	3,258 truckloads
Total quantity of pipelines remediated	12,026 meters (linear distance)
Quantity of pipelines grouted	8,453 meters (linear distance)
Quantity of pipelines isolated	3,573 meters (linear distance)
Void spaces (valve boxes, etc.) grouted	142 m^3
Seepage barriers installed at the edge of the Melton Valley hydraulic isolation caps	12
Survey units evaluated for final verification	68
Total surface area covered by walkover surveys	237 hectares
Number of survey measurements	>4,800,000 beta/gamma measurements
Floodplain dose rate measurements	4,350
Soil samples collected and analyzed	1,717

SMALL FACILITIES D&D

A total of 34 facilities underwent D&D as part of the Melton Valley remedial action project. Facilities were demolished and size reduced to facilitate disposal at the EMWMF. Below-ground structures were drained and stabilized by grouting in place. The bulk of the work was conducted at the HRE site, where a number of facilities including the HRE stack, theHRE Waste Evaporator, the Evaporator Loading Pit, the Waste Tank Valve Pit, and 7557 Charcoal Adsorber Valve Pit were demolished to approximately 2 ft below existing grade and disposed at EMWMF.

The project included remediation of the 7841 Equipment Storage area (7841 Scrapyard) containing over 850 containers that had to be characterized and processed as needed prior to packaging for disposal. Items containing lead that required treatment to meet RCRA land disposal restrictions were transported to Envirocare of Utah for treatment and disposal. The remaining items were disposed at EMWMF. Relatively small items were filled with grout prior to shipping to EMWMF to meet acceptance criteria. Several larger items were size-reduced and shipped to EMWMF.

GROUTING OF LLW TANKS

Three underground tanks formerly used for the storage of liquid low level waste were remediated as part of the MV remedial action. All 3 were single-shell, direct-buried tanks without leak detection or cathodic protection. The LLW tank at the HFIR facility contained only negligible quantities of residual LLW waste (sludge and supernatant) and was simply filled with grout. Two other tanks, designated T-1 and T-2, contained several thousand liters each of liquid low level waste that had to be removed prior to grouting. Because the existing pumps associated with the two tanks was inoperable, the existing waste transfer line had to be tapped and a temporary pump, suction leg and hosing was used to transfer the material to the ORNL LLW treatment plant. A summary of tank remediation efforts is shown in Table IV.

Table IV. Summary of sludge transfer and grouting details for Tanks T-1, T-2, and HFIR

Tank	Tank capacity (liters)	Sludge volume (liters)		Radioactivity in tank (Bq)		Slurry transfer dates (2004)	Date tank grouted
		Initial	Final	Initial	Final		
T-1	56,781	7,579	1,143	4.2×10^{12}	1.9×10^{12}	2/24[a], 3/1[a], 9/23[a], 9/28, 9/29, 10/4, 10/5, 10/6	12/31/04
T-2	56,781	4,920	148	1.7×10^{13}	5.0×10^{11}	5/26[b]	12/31/04
HFIR	11,356	8,700	8,700	8.1×10^{11}	8.1×10^{11}	N/A[c]	11/24/04

[a] Approximately 45,000 liters of supernatant were transferred from Tanks T-1 and T-2 to Bethel Valley Evaporator Complex Tank W-22 on December 30, 2003, prior to installation of the pulse-jet mixing system. The 2/24, 3/1, and 9/23 transfers from Tank T-1 to Bethel Valley Evaporator Complex Tank W-22 were completed after installation of the pulse-jet mixing system using above-ground Moyno pump and existing pipeline.

[b] Final transfer of material from Tank T-2 to Tank T-1 using the pulse-jet mixing system.

[c] Material was left in the HFIR Tank.

The residual sludges in the T-1/T-2 tanks contained wastes from the regeneration of ion exchange columns in the High Flux Isotope Reactor (HFIR) facility, which resulted in the the presence of ion exchange resin beads in the sludges. During the design phase, it was determined that the resins were incompatible with the waste acceptance criteria (WAC) for the ORNL LLW treatment system. An oxidation treatment train was mobilized to the site for destruction of the resins prior to transfer to the ORNL treatment plant but was not used. Further evaluation of sludge characteristics during implementation of the remedial action determined that chemical destruction of the resins was not required to meet the WAC prior to transfer of the waste to the LLLW system.

The primary technology deployed to remediate Tanks T-1 and T-2 was a pulse-jet mixing system that mixed the settled solids. After the contents of Tank T-2 were fully mobilized, the pulse-jet mixing system was used to transfer the contents of Tank T-2 into Tank T-1. The pulse-jet mixing system was then used to mix the contents of Tank T-1. Following the complete mixing of the contents of Tank T-1, the mobilized waste was transferred out of the tank using an auxiliary suction leg and hose connected to an above-ground progressive cavity (Moyno) pump and into the pipeline for conveyance to the LLW waste treatment system. After cleanout, the tanks were video inspected and filled with grout. The waste, consisting of approximately 11,400 liters of sludge containing nearly 500 Ci of activity, will be stored in the Bethel Valley Evaporator Complex tanks for future transfer, treatment, and disposal by the TRU Waste Processing Facility as part of a separate action.

TRU TRENCHES WASTE RETRIEVAL

The SWSA 5 North area in Melton Valley contained 22 earthen trenches in which RH-TRU wastes were retrievably stored between. The 22-trench area includes trenches 1 through 7, 9, 10, 12, 13, 15, and 18 through 27, where wastes were emplaced between 1972 and 1981. Wastes consisting of 204 large concrete casks, 18 steel and/or wooden boxes, and 12 steel drums were stored in the 22-trench area. In addition, approximately 15 m^3 of miscellaneous loose waste was placed in the 22-trench area. Most of the containers came from ORNL's Radiochemical Engineering Development Center.

The trenches in were typically 3 to 5 meters deep, 2 to 3 meters wide, of variable length, and intended primarily for the interim storage of concrete casks. There was very little spacing between casks in the trenches and excavated soil was used as backfill. Trenches were excavated to a depth at least 0.75 meters above the known groundwater elevation.. The tops of the waste containers were typically between 1 and 5 meters below ground level.

Retrieval of these wastes was conducted in accordance with requirements in the September 2000 Dispute Resolution Agreement between DOE and TDEC. Excavation and retrieval operations began at Trench 1 and continued trench-by-trench until all 22 trenches, with the exception of Trench 13, had been excavated and the waste casks retrieved and overpacked. The waste found and retrieved matched quite well with the waste reported to have been buried in the 22-Trench area based on historical records. A total of 204 casks were indicated by historical records to have been buried in the 22-Trench area, and 204 casks were found and overpacked during the retrieval operations.

The historical records also indicated that some 18 steel or wood boxes, 12 steel drums, and approximately 15 m^3 of loose waste were buried in the trenches. These packages had mostly deteriorated due to their lengthy burial period, but the contents of approximately 12 boxes, 3 drums, and approximately the expected 15 m^3 quantity of loose waste were retrieved and overpacked. Most of the discrepancy is accounted for by the nine drums that were left in-place in Trench 13 (see below) and the containers that were not found in Trench 27. Extensive excavation until undisturbed native soil was encountered in the area around each trench demonstrated that all waste buried in the 22-Trench area has been retrieved (except the material left in Trench 13 discussed below).

Excavations were performed under a movable enclosure. The enclosure provided protection from the weather and stormwater run-on into the excavation area, and helped control the spread of contamination during excavation. Excavated waste containers were placed into an overpack container suitable for the size of the waste container (e.g., cask, drum, or box). Once the external surface of the overpack was verified free of contamination, the overpacked waste was removed from the enclosure and transported to one of the temporary structures in SWSA 5 North for storage pending disposition at the TRU Waste Processing Facility.

One significant deviation from the actions described in the Dispute Resolution Agreement and the remedial design occurred during the excavation of Trench 13. Pyrophoric material that historical records indicated may have been buried in the trench was encountered and a reaction occurred, causing a brief flame in the excavator bucket. No personnel contamination or radioactive material release occurred. Work was suspended until the event could be critiqued and it was assured that adequate procedures were in place in the event of a similar reaction. When work resumed, the waste buried in Trench 13, consisting of approximately eight 208-liter (55-gallon) and one 114-liter (30-gallon) drums, was stabilized in-place due to risks associated with the retrieval and handling of this pyrophoric material. The Dispute Resolution Agreement completion date was revised to allow this material to remain stabilized in-place as interim storage until a disposition path is established. TDEC expects disposition of this material by September 30, 2009.

COMPLETION

A detailed evaluation of the ROD-specified performance metrics assigned to each of the major components of the MV remedial action project was completed. Attainment was demonstrated by a summary of the accomplishments of the remedial action and references to the supporting specific documentation (e.g., as-built drawings). As stated earlier, the attainment of certain measures will be demonstrated on the basis of future monitoring and maintenance data or continued implementation of LUCs. These on-going activities will provide the confirmatory data needed to show that remaining performance measures have been met and establish the framework for continued upkeep of the engineered systems and administrative controls necessary to keep the remedy functioning as designed.

DOE prepared and implemented an independent verification assessment plan to determine if all of the work was completed in compliance with the specific regulatory and contractual requirements. The assessment was conducted in multiple phases, including document review and physical walk down of completed field work. The results of the independent assessment were documented in a verification report, confirming that all requirements were successfully achieved in accordance with the regulatory and contractual specifications.