DOE Oak Ridge Environmental Management Program

Melton Valley Remediation Completed

Milestone Completed

The U.S. Department of Energy (DOE) and its contractor, Bechtel Jacobs Company LLC, have completed a major cleanup milestone in Melton Valley under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Federal Facility Agreement for the Oak Ridge Reservation. Remediation of the area was performed on an accelerated schedule with activities described in the Melton Valley Interim Record of Decision (ROD). The remedial actions were completed in September 2006.

Background

More than 50 years of operation, production, and research activities at Oak Ridge National Laboratory (ORNL) have produced a legacy of contaminated inactive facilities and waste disposal areas. Many of these wastes and facilities are located in Melton Valley, which occupies approximately 1,000 acres in the southern portion of ORNL. Two burial grounds in Melton Valley were also used in the 1950s and 1960s as the Atomic Energy Commission's Southeastern Regional Burial Ground for radioactive wastes from more than 50 other facilities.

The Melton Valley Watershed occupies approximately 1,000 acres in the southern portion of ORNL.

Wastes in Melton Valley reside at a variety of locations, including solid waste landfills, trenches, liquid waste tanks and pipelines, surface structures, and impoundments. Contamination at some locations had leached into surrounding soil and groundwater, where it migrated to nearby streams. Leaks and spills from some historic sites also contaminated soil and sediment. Contaminants included metals and radionuclides.

Project Accomplishments

Intermediate Holding Pond Remediation

The Intermediate Holding Pond, located immediately east of the Solid Waste Storage Area (SWSA) 4, was one of the more highly contaminated floodplain soil areas in Melton Valley. The remedial action was performed from June through October 2002 and consisted of removing the floodplain soil that was contaminated above remedial action levels. Approximately 24,300 tons of contaminated soil from the pond were excavated and disposed at the DOE's CERCLA waste facility near the Y-12 National Security Complex in Bear Creek Valley.

Well plugging activities

Hydrofracture Well Plugging/Abandonment

More than 100 wells associated with the hydrofracture process of deep waste injection at ORNL have been plugged and abandoned to prevent the migration of contaminated fluids to more shallow groundwater zones.

Between the 1960s and mid-1980s, the hydrofracture process was used at ORNL to dispose of radioactive liquids and sludge waste mixed with cement-based grout and various additives in deep injection wells. Two test injection wells were initially constructed, and then an additional well was constructed at the Old Hydrofracture Facility (OHF) and New Hydrofracture Facility (NHF) for large-scale waste disposal. Other wells were installed for monitoring purposes. Approximately 3.2 million gallons of the liquid and sludge waste were injected into artificially induced fractures in a shale formation at depths of 700 to 1,000 feet.

As part of the remediation process, wells were flushed, and then a coil tubing unit was employed to fill each well with a grout mixture from the bottom up.

A total of 112 wells, including the four injection wells, have been plugged and abandoned, and all waste generated by these remediation activities has been disposed. This work took place from May 2001 through June 2005. The final well, the HF-4 injection well, located in a contaminated cell of the NHF, was plugged in 2005, and capped in May 2006 as part of the NHF demolition.

Melton Valley (continued)

Remediation Completed

Spent Nuclear Fuel Removal at ORNL

The last remnant of legacy spent nuclear fuel at ORNL was shipped to the Idaho National Engineering and Environmental Laboratory, where it will be stored until a method of final disposal becomes available. The shipments were made in support of efforts to consolidate all the spent fuel from across the DOE complex in Idaho and South Carolina.

Research and development programs related to nuclear reactor fuel historically have been a part of the ORNL mission. Many of these programs involved research on spent fuels from various types of reactors. After these programs were completed, the remaining spent fuels were collected and placed into on-site storage facilities, primarily during the 1960s and 1970s.

In 1995, DOE issued a Programmatic Environmental Impact Statement ROD for spent nuclear fuel. The ROD directed DOE sites with smaller inventories of the material, like Oak Ridge, to prepare and ship specific spent fuels to the Savannah River Site in South Carolina and the Idaho laboratory. Those two sites serve as the regional storage and interim management locations for DOE spent nuclear fuel.

An important reason for the shipments is the enhanced security from consolidating material at two facilities rather than a variety of facilities scattered around the country. Three shipments were sent from Oak Ridge to Savannah River in 1998. Five shipments were made from Oak Ridge to Idaho in 2003, completing the transfer of more than 100,000 curies of radionuclides from Oak Ridge storage facilities.

During 2006, secondary waste generated from the repackaging activities was segregated, removed from the hot cell facilities, and placed into appropriate storage until it can be processed for final disposal.

T-1, T-2, and HFIR Tanks Remediation

The High Flux Isotope Reactor (HFIR) Tank was installed during the construction of the HFIR reactor complex and received radioactive waste from drains throughout the reactor facility. Tanks T-1 and T-2 were constructed at the same time as the HFIR Tank. Two pumping stations were constructed along with the tanks to provide transfer capabilities to the ORNL Liquid Low-Level Radioactive Waste (LLLW) Evaporator Complex. These tanks did not meet the Oak Ridge Federal Facility Agreement requirements for secondary containment of LLLW tanks and were removed from service and declared inactive in 1997.

The HFIR tank was closed in place by removing the liquid contents and stabilizing the tank and residual sludge in place using grout. Tanks T-1 and T-2 were closed by removing approximately 3,000 gallons of transuranic sludge from the tanks using pulse jet mixing equipment and transferring the sludge to the LLLW system. The empty tank shells were stabilized in place by filling them with grout. Secondary waste and equipment that could not be reused on other planned projects were disposed at the EMWMF, and the project completion report has been approved by the regulatory agencies.

Hydrologic Isolation

Shallow land burial was used routinely at ORNL for solid low-level waste disposal from 1943 until 1986, when improved disposal technologies were implemented. The principal waste burial sites in Melton Valley are SWSAs 4, 5, and 6.

Early burial procedures used unlined trenches and auger holes covered by either soil from the trench excavation or a combination of concrete caps and soil. The concrete caps were used for disposal of high-activity wastes or wastes with transuranic elements. More than 850 trenches and 1,500 auger holes are located in the three main Melton Valley burial grounds.

Hydrologic isolation is being used to prevent the migration of contamination from the burial grounds (SWSAs 4, 5, and 6). Hydrologic isolation is also being used on Seepage Pits 1, 2, 3, and 4, and on Seepage Trench 6. The hydrologic isolation actions consisted of a combination of the following:

- multilayer caps over the waste units to minimize rainfall infiltration and to lower the water table,
- stormflow diversion trenches located along the uphill edge of the waste units to intercept and divert shallow groundwater before it flows into the waste units, and
- groundwater collection trenches located along the downhill side of the waste units to collect groundwater contaminated by leachate before the groundwater discharges to nearby streams. Contaminated groundwater collected by the drains is treated before it is released.

The total cap area is 145 acres. To facilitate cap installation, the project included the plugging and abandonment of approximately 1,000 unneeded, shallow non-hydrofracture wells, the development of a 33-acre soil borrow area, relocation of approximately 1,200 feet of Melton Branch at SWSA 5, relocation of Lagoon Road, construction of haul roads, demolition of any structures situated within the cap boundaries, and rerouting of

Liner placement over a Solid Waste Storage Area

several power lines. Hydrologic isolation of all units is complete.

Since the MV ROD was signed, the following three additional units in Melton Valley were transferred from "active' to "inactive" status and therefore were eligible for remediation: the Tumulus I, Tumulus II, and the Interim Waste Management Facility. These three waste units were added to the Melton Valley ROD via an Explanation of Significant Differences in March 2003 and capped as well. All completion reports for Hydrologic Isolation have been approved by the regulatory agencies.

As documented in the completion report and as agreed by Tennessee Department of Environment and Conservation (TDEC) Division of Solid Waste Management (DSWM), the approval of the completion report by Environmental Protection Agency (EPA) and TDEC/DOE constituted approval of the SWSA 6 RCRA closure once copies of the final approved completion document and EPA and TDEC/DOE approval letters were sent to TDEC/DSWM in November 2006.

NHF dismantlement

Small Facilities D&D

The remediation of several inactive facilities, buildings, and structures in Melton Valley was addressed under the Melton Valley Decontamination and Decommissioning (D&D) Project. The D&D project involved demolishing surface structures to slab or below grade; decontamination; removal and/or stabilizing subsurface structures in place; waste characterization, transportation and disposal; and site restoration. Stabilization of subsurface structures was typically preceded by removal or fixation of transferable contamination.

Following are the buildings and structures addressed by the project.

New Hydrofracture Facility

The NHF was the last of two facilities built during the 1970s to perform hydrofracture operations in Melton Valley. The NHF operated from 1982 to 1984 and was designed to facilitate the injection of wastes mixed with grout into underground shale formation. The majority of the NHF was demolished in previous years. Demolition of the three reinforced concrete rooms, or cells, of the main NHF structure was completed in 2006. Final site work, including demolition of the cells, grouting below-grade tanks and structures in place, disposal of the waste, and demobilization and site restoration, were completed in July 2006.

Homogenous Reactor Experiment Ancillary Facilities

The HRE ancillary facilities consist of 11 separate structures, external of the main HRE reactor building, which provided support capabilities (e.g., waste management, storage, etc.) during reactor operation. The ancillary facilities include a liquid waste evaporator, a charcoal absorber that cleaned up gaseous effluents prior to discharge to the atmosphere, a decontamination pad and storage shed, an office building, and miscellaneous structures.

D&D of 11 HRE ancillary facilities was completed in August 2006. Final waste disposal, demobilization, and site restoration was completed in FY 2006. D&D of the HRE facility will be accomplished following a future CERCLA decision.

Shielded Transfer Tanks

The shielded transfer tanks (STTs) are five shipping casks that were originally used during the 1950s and 1960s to transport high specific activity radionuclide solutions by rail from Hanford to ORNL for further processing. Planning for the characterization and disposal of the STTs and their residual contents was performed during FY 2005. Based on that effort, it was determined that additional evaluation of the options available for final disposal of the STTs and their contents will be required. The STTs have been removed from the Melton Valley Accelerated Closure Scope and are being addressed under another program.

Liquid Low-Level Liquid Waste (LLLW) Pumping Stations

Two separate LLLW pumping stations, Buildings 7567 and 7952, were constructed during the 1960s to support the collection and transfer of LLLW from the High Flux Isotope Reactor (HFIR)

facility, Radiochemical Engineering Development Center, HRE, and the Molten Salt Reactor Experiment. D&D and waste disposal of Building 7952 was completed during FY 2005, and D&D of Building 7567, including decontamination and stabilization of the below-grade pump vault, was completed early in FY 2006.

Equipment Storage Yard

The 7841 Equipment Storage Yard is a fenced facility with an area of less than 1 acre used to store a wide variety of surplus items, including shielded carriers, drums, high-integrity containers, shields, tanks, and nearly 200 pieces of specialized equipment ranging from fuel casks and storage cabinets to tanker trailers and other vehicles.

Waste characterization, processing, and disposal activities were completed in FY 2006.

Miscellaneous Storage Buildings

Two miscellaneous facilities, Buildings 7802F and 7831A, have been used for the storage of well drilling cores and other sampling related materials, and as a waste repack facility, respectively. The D&D of both facilities, including waste disposal and site restoration, was completed in FY 2006.

Trenches 5 and 7 Remediation

Seven seepage pits and trenches (Pits 1, 2, 3, and 4; Trenches 5, 6, and 7) were used for the disposal of LLLW from 1951 to 1966. As intended, LLLW seeped into the surrounding clay soil. The seepage pits and trenches were excavated in clayey soils to take advantage of the clay's low permeability and high sorption capacity for some radionuclides in the LLLW.

Although hydrologic isolation is the designated remedial action for most units in Melton Valley, Seepage Trenches 5 and 7 were grouted in place.

Trenches 5 and 7 are 300 and 200 feet long, respectively. The trenches were excavated to a nominal depth of 15 to 16 feet. An approximate 10-ft-thick layer of crushed limestone was placed in the trenches to allow for percolation. Horizontal LLLW distribution lines were installed along the center lines of the trench and buried beneath the top surface of the crushed limestone. The remainder of the trench was backfilled to the surface with soil.

The waste within the trenches was grouted with Portland-cement-based grout injected under low pressure. The grouted crushed limestone material (waste matrix) formed a solid mass that greatly reduced the hydraulic conductivity of the trench materials. The perimeter area adjacent to the trenches (3-ft-wide area covering the entire depth of the trench walls) was grouted with a grout solution.

In situ grouting of the trenches and adjacent perimeter areas, and hydraulic conductivity tests were successfully completed. By June 2006, all equipment from grouting and support operations was demobilized following the completion of the field grouting operations.

All residual waste generated from the in situ grouting operations were packaged, transported, and disposed at the EMWMF or the Y-12 Landfill.

22-Trench Area Waste Retrieval

During the 1970s, packages of transuranic (TRU) waste were retrievably stored in the 22-Trench Area. Since the 1980s, packages of newly generated TRU waste have been stored in constructed facilities. Radionuclides in the TRU waste containers represent some of the most toxic and longest-lived radioisotopes stored on the Oak Ridge Reservation.

TRU wastes that have been stored in the 22-Trench Area in SWSA 5 North, including 204 concrete casks and miscellaneous other wastes, were retrieved from the trenches in 2006.

After retrieval, the waste packages were placed in overpack containers and staged in appropriate areas pending transfer to the TRU Waste Processing Facility. At that facility, the wastes will be segregated, characterized, and repackaged to meet the acceptance criteria for off-site disposal and then shipped for final disposal. Secondary waste (e.g., wastes generated during the TRU retrieval and overpacking activities) was disposed from the SWSA 5 North site.

A significant pyrophoric reaction occurred on August 8, 2005, as DOE's contractors were attempting to retrieve the containers in Trench 13. The containers in Trench 13 included carbon steel and stainless steel drums. Several of the drums were damaged and the carbon steel drum had deteriorated, revealing inner contents of glass mason jars. Based on historical records, the jars contain metallic carbides of uranium and plutonium that are pyrophoric. The excavation activity apparently broke a jar from a damaged or deteriorated drum, exposing some material to air. Methane is

TRU waste retrieval

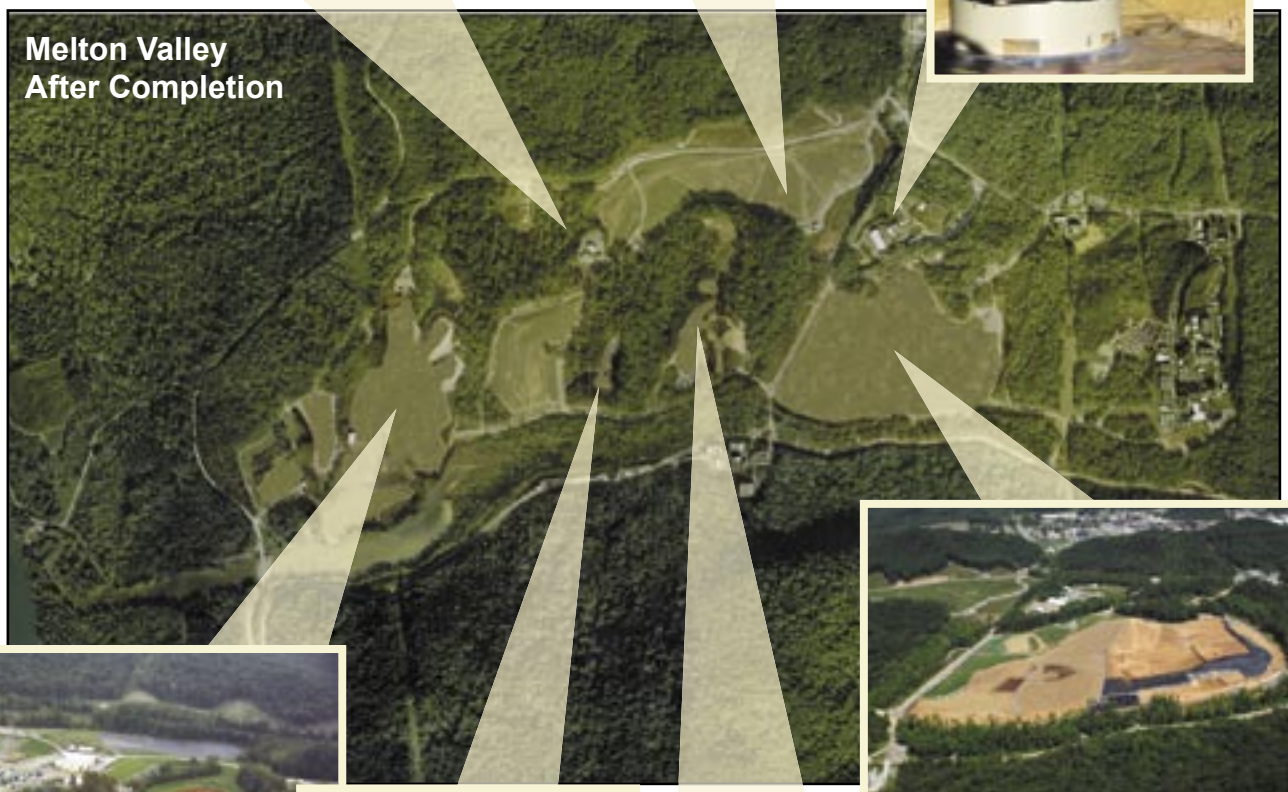
Melton Valley (continued)

Remediation Completed

7841 Scrapyard

Solid Waste Storage Area 4

Transuranic Waste Retrieval



Solid Waste Storage Area 5

Solid Waste Storage Area 6

Trench 5

Trench 7

A total area of 1,000 acres was remediated in Melton Valley

believed to have accumulated in the headspace of the jar and was ignited when the pyrophoric material reacted. On July 28, 2006, DOE proposed to the regulators to maintain Trench 13 in interim in situ storage, pending further efforts to identify treatment and disposition pathways in the future.

DOE proposed that final disposition of the Trench 13 pyrophoric material be addressed in the future, prior to September 30, 2009. DOE also proposed to modify the Dispute Resolution Agreement, which had a termination date of September 30, 2006, to show the changed completion date. On August 11, 2006, TDEC acknowledged DOE's effort to retrieve drums containing jars of pyrophoric metallic carbides of uranium and plutonium with methane, and agreed to the temporary storage approach as proposed by DOE.

Soils and Sediments Remediation

Field work has been completed on the Melton Valley Closure Soils and Sediments Project. Notable accomplishments include the following:

Excavation of the HFIR Impoundments. These four unlined impoundments, located at the HFIR facility, received liquid process waste streams mostly from floor and laboratory drains, steam condensates, and pressure vessel cooling waters. Remediation of the surface impoundments has been completed and the site restored. Remediation consisted of removing standing water and excavating and disposing the contaminated sediment at the EMWMF.

Remediation of the HRE Cryogenic Pond. This pond received contaminated condensate from the HRE waste evaporator and from discarded shielding water. The pond was taken out of service and backfilled. This backfilled pond later served as a demonstration for cryogenic stabilization in which soil around the pond was frozen to form a barrier to groundwater for several years. The cryogenics system was shut down in February 2004 in preparation for system dismantling and pond excavation. Excavation of the pond, backfill, and cryogenics material has been completed and the site restored.

Removal of contaminated soil. Six sites contaminated as a result of pipeline leaks or hydrofracture experiments have been excavated and restored. As a result of verification walkover surveys and sampling, an additional 24 localized "hot spots" containing soil contamination areas were identified and excavated.

Engineered Test Facility. Nine trenches filled with compactible, low-level waste that were constructed for a technology demonstration by ORNL were successfully remediated through the removal of buried wastes and soil. The site, located in the northwest corner of SWSA 6, was restored after remediation.

EPICOR-II Lysimeters and Building 7848. Five stainless steel lysimeters used for a 10-year leaching experiment involving highly radioactive waste forms were excavated, size reduced, and transported to EMWMF for disposal. Building 7848, used in support of the lysimeter experiment, was also demolished and the debris taken to EMWMF. The site, located in the northwest corner of SWSA 6, was restored after remediation.

Final Verification. The project includes a final verification activity designed to confirm that all of Melton Valley has been cleaned up sufficiently to meet the remediation levels. Walkover surveys and sampling have been conducted on more than 500 acres of the watershed that lie outside the footprint of the hydrologic isolation caps. Data collected from the Final Verification activities were used to confirm that the post-remediation conditions in Melton Valley are compatible with anticipated future land uses. These land uses are a waste management area for the western two-thirds of the watershed and a controlled industrial area in the eastern third.

Sediment and soils from the HFIR surface impoundments and HRE Cryogenic Pond were disposed in the EMWMF. Material excavated from the Melton Valley Pumping Station, Engineering Test Facility, Lysimeters, Facility 7848 were also disposed at EMWMF. Selected soils from the remaining sites—generally

HFIR Impoundments during and after remediation

containing only minor amounts of contamination—were used as contour fill beneath one of the hydrologic isolation caps.

Pipeline Grouting

In addition to the remediation of contaminated soils, the Melton Valley Soils and Sediment Project has stabilized and isolated inactive liquid waste transfer pipelines throughout Melton Valley. The inactive waste pipeline system consists of a complex series of buried waste pipelines and appurtenances (e.g., vents, valve pits, pump vaults, etc.) historically used to transport liquid process waste and low-level waste between generator facilities in Melton Valley, storage and disposal sites in Melton Valley, and storage/treatment facilities in Bethel Valley. Almost 40,000 linear feet of pipeline were addressed through the remediation; more than 27,000 ft were grouted and the balance was isolated through plugging and capping. In addition, about 5,000 ft^2 of void space associated with valve boxes, pump pits, manholes, and vaults was also grouted. The wastes from this activity (contaminated equipment and tools, personal protective equipment, etc.) were taken to EMWMF. A completion report for soils and sediments remediation has been approved by the regulatory agencies.

Future Melton Valley Activities

A Remedial Action Report (RAR), which provides an overview of Melton Valley remedial actions, has been completed and approved. The RAR includes as appendices the Melton Valley Monitoring and S&M Plans. The Monitoring Plan has a primary goal to collect data necessary to determine the effectiveness of the remedial actions. The S&M Plan will identify regulatory requirements and means to verify compliance with remedial action objectives as well as specify S&M requirements for engineered components of the remediation and identify reporting requirements. ORNL S&M and Water Resources will be responsible for the implementation of the S&M Plan and Monitoring Plan, respectively.

DOE published a Land Use Controls Implementation Plan for Melton Valley (DOE/OR/01-1977&D6) that establishes enforceable requirements for implementation of the land use controls described in the ROD and updated in the RAR.

With the concurrence of the EPA and TDEC, and consistent with the public End Use Working Group, remedial actions and cleanup goals were based on the assumptions that future land uses would be limited and that the property would remain in federal ownership.

Based on the Melton Valley ROD, the property is divided into three zones, each with different limitations for future use. These zones are:

- **Waste Management Areas:** prevent unauthorized access/use of groundwater and any use other than waste management;
- **Controlled Industrial Area:** prevent unauthorized access/use of groundwater and control excavations or penetrations below 2 feet; and
- **Surface Water and Floodplain:** protect hypothetical recreational uses and prevent unauthorized access/use of groundwater.

Because land use on Melton Valley is restricted due to the continuing presence of hazardous substances at levels that do not allow for unrestricted use, the ROD requires production of Notations on Ownership Record (Deed Restrictions). These restrictions delineate the boundaries of the surveyed areas in which high concentrations of hazardous substances, low-level radioactive waste, and/or Resource Conservation and Recovery Act of 1976 hazardous waste remain beneath engineered covers.

The future use limitations of areas within Melton Valley are depicted in the figure on the next page. DOE maintains other land use controls, as specified in the ROD, including signs, surveillance patrols, and the Oak Ridge Reservation excavation/penetration administrative permit program.

The predominant contaminants of concern in Melton Valley that could potentially cause a threat are:

- *in soil: cesium-137, strontium-90, cobalt-60, curium-244*
- *in surface water: tritium, strontium-90*
- *in sediment: cesium-137, strontium-90, cobalt-60, curium-244, PCBs*
- *in groundwater: tritium, strontium-90*

Melton Valley (continued)

Remediation Completed

Future Use Limitations in Melton Valley