GUNITE AND ASSOCIATED TANKS REMEDIATION PROJECT
RECYCLING AND WASTE MINIMIZATION EFFORT

By S. D. Van Hoesen and A. D. Saunders

Abstract: The Department of Energy's (DOE) Environmental Management Program at Oak Ridge National Laboratory has initiated clean up of legacy waste resulting from the Manhattan Project. The Gunite and Associated Tanks Project has taken an active pollution prevention role by successfully recycling eight tons of scrap metal, reusing contaminated soil in the Area of Contamination, using existing water (supernate) to aid in sludge transfer, and by minimizing and reusing personal protective equipment (PPE) and on-site equipment as much as possible. Total cost savings for Fiscal Year 1997 activities from these efforts are estimated at $4.2 million dollars.

Keywords:
- Environmental Restoration
- Gunite
- Liquid Low-Level Waste
- Personal Protective Equipment
- Regulator
- Soil
- Tank
- Waste Minimization

Introduction
Since its inception in 1942, the Oak Ridge National Laboratory (ORNL) of DOE Oak Ridge Operations has been an international center for research and development involving the use of a wide array of radioactive and hazardous materials. In support of this work, the collection, transfer, and storage of the resulting liquid radioactive waste included an extensive liquid low-level waste (LLLW) collection and transfer system; the Gunite and.
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Associated Tanks (GAAT) are part of that system. The LLLW system is an assembly of tanks and pipelines designed to collect, neutralize, concentrate, and store the waste prior to final treatment and disposal.

The GAAT was constructed in 1943 by spraying wire mesh and reinforcing rod frames with layers of gunite, a Portland cement and sand mixture. The GAAT consists of six large tanks of 170,000-gal capacity each and two smaller tanks of 42,500-gal capacity each containing residual quantities of mixed waste [radioactive and Resource Conservation and Recovery Act (RCRA) characteristic sludges]. Some tanks contain transuranic (TRU) mixed waste. Most of the liquid and solid waste was removed in the 1980s, but a heel of sludge and other debris remains in the tanks. Additional radiological contamination is also present in the tank walls and floors. These aging underground storage tanks are estimated to contain approximately 40 percent of ORNL’s transuranic sludge inventory.¹ This waste, as well as the equipment, structures, soil, and groundwater in the tank farms area, represents a potential risk to human health and the environment.

**Project Description**

The GAAT Project is an interim remedial action (IRA) being performed under a Federal Facility Agreement (FFA) among the Department of Energy (DOE), the Environmental Protection Agency (EPA), and the Tennessee Department of Environment and Conservation (TDEC). The FFA integrates all regulatory requirements applied to the legacy waste cleanup efforts conducted on the Oak Ridge Reservation. To resolve uncertainties regarding the best way to clean out the GAAT, DOE, EPA, and TDEC agreed to perform a Treatability Study (TS) under the provisions of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA). The TS addressed the development of waste removal technologies to the successful waste removal operations from the two smaller, lower risk tanks. Concurrently, site preparation for the IRA was underway on the site where the six remaining larger tanks are located. The amount of waste removed from the tanks during the interim action will be determined based on the information gained from the treatability study and on the conditions experienced in each tank. Waste generated will be temporarily stored in one or more of the large gunite tanks and then transferred to the existing permitted Melton Valley Storage Tanks. A contractor selected through a separate ongoing DOE action will eventually treat the waste. Once the
IRA is considered complete, a final remedy, which is currently being established in the Bethel Valley Record of Decision (ROD), will address the remaining tank shells.

The GAAT Project has taken an active role toward pollution prevention, source reduction, and reuse or recycling of materials as an alternative to disposal during both the planning and execution phase of each of the subtasks necessary to complete the overall objectives of the project. Pollution prevention is an integral part of the project. The activities described herein represent the pollution prevention efforts taken during the waste removal phase of the TS and site preparation activities in fiscal year 1997 (see Figure 1).

Table 1

<table>
<thead>
<tr>
<th>Category</th>
<th>Quantity</th>
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<tbody>
<tr>
<td>Metal</td>
<td>33 ft³</td>
</tr>
<tr>
<td>PPE</td>
<td>385 ft³</td>
</tr>
<tr>
<td>Metal</td>
<td>1,200 ft³</td>
</tr>
<tr>
<td>Liquid</td>
<td>300,000 gal</td>
</tr>
<tr>
<td>Soil</td>
<td>6,480 ft³</td>
</tr>
<tr>
<td>TOTAL</td>
<td>8,098 cu ft solid/300,000 gal liquid</td>
</tr>
</tbody>
</table>

Through a proactive approach to project planning and execution, the GAAT project team and support personnel have recycled approximately 33 cubic feet of scrap metal and 700 cubic feet of radiologically contaminated scrap metal. In the process, it has been possible to avoid generating 385 cubic feet of secondary waste resulting from personal protective equipment; 500 cubic feet of contaminated equipment and scrap by innovative management practices; and approximately 6480 cubic feet (240 cubic yards) of solid low-level waste (LLW). This has been done by applying engineering and construction techniques to minimize excavation and by obtaining an internal waiver to use contaminated soil as fill material. By achieving consensus with DOE and the regulatory agencies, two of the inactive gunite tanks are being used to consolidate excess supernate and liquid from
waste removal activities. This provides a portion of the liquid necessary to effect slurry transfers to the Melton Valley Storage Tanks, resulting in reduced LLLW generation by approximately 300,000 gallons, thereby allowing onsite beneficial reuse of the waste stream.

Extensive site preparation was required prior to initiation of tank remediation. Initial construction activities involved the removal of several large steel structures (bentonite mixing facility, video tower, structural platform, etc.) and associated equipment (aboveground conduits, junction boxes, utility piping, etc.). Because the equipment was located in a radiological area and had been associated with handling of radioactive waste, all pieces were declared suspect for radiological contamination. In order to relocate the metal to an area with a lower radiological background, an initial screening was conducted to rule out the presence of transferable surface contamination. Once relocated, a complete radiological survey was performed. Metal meeting the criteria for unrestricted release was sold to a scrap metal vendor for recycling. The metal was ultimately sent to a foundry that manufactures automobile parts. The parts can be found in greater than 50% of U.S. made cars and greater than 70% of the country’s light-duty trucks. Metal that did not satisfy unrestricted release criteria was appropriately packaged, characterized, labeled, and sent to a Nuclear Regulatory Commission licensed commercial company for metal recycle processing. The metal processing unit consists of an electric-induction furnace that operates exclusively for melting and recycling of radioactively-contaminated metals. All metal is recycled into shield blocks for use by various high-energy physics organizations throughout the United States and Canada.

Site preparation also involved the removal of several pieces of process equipment located in and around the tanks. Cameras, piping, and other waste handling and processing hardware were among the items removed. It was determined that the equipment had been in contact with the sludge and was therefore classified as a mixed waste. In order to reduce radiological exposure to employees, DOE and regulator approval was obtained to manage these contaminated items in below-grade concrete pump pits within the area of contamination (AOC). This storage option minimized the need for extensive waste sizing and packaging and reduced radiation exposure consistent with the “As-Low-As-Reasonably-Achievable” (ALARA) principle. The disposition of this equipment will be addressed along with the tank shells in the Bethel Valley ROD.
Due to the nature of the activities and the presence of radiological and chemical contamination, PPE is required for a majority of site preparation, waste removal operations, and maintenance activities. The project duration, compounded by the large number of workers, provided an opportunity for the team to develop waste minimization options. Reusable PPE for field activities has proven to be economical while minimizing waste. The team is utilizing coveralls and reusable shoe covers that can be laundered. The use of disposable PPE would have accounted for a significant volume of secondary waste and also would not have been cost effective considering the potential purchase and disposal costs. This initiative has translated into an estimated waste reduction of approximately 385 cubic feet of LLW.

Site preparation and related construction activities required significant soil excavation in the radiologically contaminated areas. While shoring and other engineering controls were applied, where appropriate, to reduce the amount of excavation and associated contaminated soils generated, the excavation of a portion of the contaminated soils was unavoidable. An internal ORNL procedure for the management of radiologically contaminated soils limits the use of contaminated soil as backfill. Because soil remediation is not within the scope of the GAAT Project and will be addressed in a later action, a waiver of the procedural requirements to remove contaminated soils was requested and granted. The excavated soil was allowed to be returned to its point of generation if it did not increase contamination levels previously noted in the area. All of the excavated soil met this criterion. Contamination control was implemented by placing a minimum of one foot of uncontaminated gravel over the backfilled areas. Leaving the soil in the AOC resulted in a significant waste minimization, reduced impacts from an environmental and safety standpoint, and cost savings to the project.

Remediation of the first TS tank was initiated with the transfer of supernate to the active LLLW system for treatment. Since a large volume of liquid is necessary to help adjust waste slurry solid/liquid content to meet the interconnecting pipeline acceptance criteria, storage of existing supernate and water added for waste removal is desirable. Removal, rather than storage, of supernate with the addition of process water for dilution of slurry for transfer is inconsistent with the waste minimization philosophy adopted by the project. This alternative is also in conflict with the FFA which designates the GAAT Tanks as inactive and, unavailable to intentionally receive and store waste. Construction of new tanks to
store supernate is not a practical alternative due to location, cost, and schedule constraints. The project team requested and was successful in obtaining a waiver from this FFA requirement. The project has been granted approval to consolidate liquid in two of the inactive Gunite Tanks until slurry transfers are made beginning in fiscal year 1999. This waiver allowed approximately 300,000 gallons of liquid to remain in the tanks until needed for transfers or for radiological shielding facilitating onsite reuse of the waste stream within cleanup operations.

Conclusion
The activities described in this paper have resulted in estimated cost savings of approximately $4.2M for fiscal year 1997 (see Table 2). This is based on a total solid low-level and mixed waste reduction of approximately 3.6 million lbs or 8,100 cubic feet. Based on past experience, the packaging, shipping, and disposal cost for solid LLW and mixed waste is approximately $144 per cubic foot. This represents an estimated savings of $1.2M. The estimated cost for treating liquid LLW at ORNL is approximately $10 per gallon. By eliminating 300,000 gallons of liquid waste, approximately $3M is saved. Waste removal and reduction activities conducted as part of the TS, and site preparation for the remediation of the higher risk tanks proved to be extremely successful. The basis of this success was due largely to the incorporation of waste minimization and dose reduction considerations in the very earliest stages of the work planning process. The project continues to explore new and innovative waste reduction techniques.
REFERENCES


4Margaret Wilson, correspondence, Anthony Abel and Doug McCoy, A Transmittal of the Feasibility Study/Proposed Plan (FS/PP) for Sludge Removal from the Gunite and Associated Tanks Operable Unit, Waste Area Grouping 1, Oak Ridge National Laboratory, Oak Ridge, Tennessee, DOE/OR/D2-1509/V1&D2 and V2&D2, and Additional Documentation Concurrence, March 13, 1997.


7Margaret Wilson, correspondence, Anthony Abel and Doug McCoy, A Transmittal of the Feasibility Study/Proposed Plan (FS/PP) for Sludge Removal from the Gunite and Associated Tanks Operable Unit, Waste Area Grouping 1, Oak Ridge National Laboratory, Oak Ridge, Tennessee, DOE/OR/D2-1509/V1&D2 and V2&D2, and Additional Documentation Concurrence, March 13, 1997.
Table 2. Waste Reduction and Cost Savings Summary

<table>
<thead>
<tr>
<th>Material</th>
<th>Amount</th>
<th>Disposal Cost</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scrap Metal</td>
<td>33 ft³</td>
<td>$144/ft³*</td>
<td>$4,752</td>
</tr>
<tr>
<td>Scrap Metal</td>
<td>500 ft³</td>
<td>$144/ft³*</td>
<td>$72,000</td>
</tr>
<tr>
<td>Scrap Metal</td>
<td>700 ft³</td>
<td>$144/ft³*</td>
<td>$100,800</td>
</tr>
<tr>
<td>PPE</td>
<td>385 ft³</td>
<td>$144/ft³*</td>
<td>$55,400</td>
</tr>
<tr>
<td>Soil</td>
<td>6480 ft³</td>
<td>$144/ft³*</td>
<td>$933,120</td>
</tr>
<tr>
<td>Liquid</td>
<td>8,098 ft³</td>
<td></td>
<td>$1,166,112</td>
</tr>
<tr>
<td>Liquid</td>
<td>300,000 gal</td>
<td>$10/gal**</td>
<td>$3,000,000</td>
</tr>
</tbody>
</table>

*Estimated LLW disposal cost = $144/ft³

**Estimated LLLW disposal cost = $10/gal

Waste Reduced: ~3,621,484 lbs (1,646 metric tons)

Cost Savings: ~$4,166,112 (one-time)