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| | | Design Agent | | | | 1 | 1 | EA Pacquet | <i>[Signature]</i> | 8/31/99 | R3-47 |
| 1 | 1 | Cog. Eng. JP Sederburg | <i>[Signature]</i> | 8/31/99 | R3-73 | | | | | | |
| 1 | 1 | Cog. Mgr. PJ Certa | <i>[Signature]</i> | 8/31/00 | R3-73 | | | | | | |
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| | | Safety | | | | | | | | | |
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Hanford Tank Initiative/Acquire Commercial Technology for Retrieval Report and Database

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U.S. Department of Energy Contract DE-AC06-99RL14047

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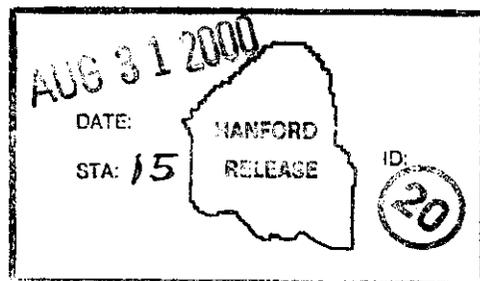
Hanford Tank Initiative, HTI, Acquire Commercial Technology for Retrieval, ACTR, bibliography, database

Abstract: The database is an annotated bibliography of technology evaluations and demonstrations conducted in previous years by the Hanford Tank Initiative (HTI) and the Acquire Commercial Technology for Retrieval (ACTR) programs.

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HANFORD TANK INITIATIVE/ ACQUIRE COMMERCIAL TECHNOLOGY FOR RETRIEVAL REPORT AND DATABASE

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

CH2MHILL

Hanford Group, Inc.

Richland, Washington

Contractor for the U.S. Department of Energy
Office of River Protection under Contract DE-AC06-99RL14047

Approved for Public Release; Further Dissemination Unlimited

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Date Published
August 2000

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(HTI/ACTR) Database

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Information System (RMIS)

TABLE

Table 1. Hanford Tank Initiative/Acquire Commercial Technology for Retrieval
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TERMS

ACTR
DOE
HTI
RMIS
SST

Acquire Commercial Technology for Retrieval
U.S. Department of Energy
Hanford Tank Initiative
Records Management Information System
single-shell tank

1.0 INTRODUCTION

The Hanford Tank Initiative (HTI)/Acquire Commercial Technology for Retrieval (ACTR) Database was developed to provide a convenient method of obtaining document information pertinent to the ACTR and subsequent HTI programs. This database is an annotated bibliography of technology evaluations and demonstrations conducted in previous years by the HTI and ACTR programs.

This work was performed in support of Tank Focus Area fiscal year 2000 Milestone RL09WT22A.1-2 "Assemble HTI and ACTR Retrieval Data," in collaboration with the Hanford RPP Single-Shell Tank Retrieval Program.

The ACTR program began in June 1995 to research the technologies and contracting methods industrial firms would use to retrieve waste from the single-shell tanks (SST) at the Hanford Site. The ACTR program was established by the U.S. Department of Energy (DOE), Richland Operations Office, under the Office of Waste Management (EM-30). The ACTR effort was designed to identify and test innovative, commercially available, or adaptable retrieval technologies and equipment that would significantly reduce cost and/or risk associated with the baseline retrieval approach of sluicing (hydraulic mining) in SSTs. The primary reasons for seeking an alternative to sluicing included the following:

1. The potential exists that the SSTs may leak liquids bearing radionuclides and hazardous constituents into the environment during sluicing operations.
2. Some of the waste forms may be "hard" and, therefore, may not be mobilized sufficiently by sluicing.
3. Special challenges exist due to discrete radioactive sources present during sluicing operations (e.g., filter loading due to generation of aerosols).

A portion of the ACTR effort included baseline knowledge, which consisted of gathering information from the past and present technology development areas at the various DOE sites. ACTR nonproprietary test results and studies were made available to all firms that had an interest in performing remediation work.

ACTR also established a dialog with firms in the United States and Europe, receiving and reviewing information regarding technologies and waste retrieval solutions. The purpose of this was two-fold. First, it allowed the Hanford Site to understand the capabilities of industry and its technologies and approaches to remediation of the underground storage tanks. Second, it allowed industry to understand the technical and business issues associated with tank cleanup.

The ACTR program evolved and was transitioned into another program called the HTI in 1996. The scope of activities of the HTI over an approximate five-year period was to demonstrate alternate retrieval technologies, retrieve hard heel wastes from Tank 241-C-106 and assess compliance with retrieval performance evaluation criteria, develop retrieval performance evaluation criteria supporting readiness to close SSTs, and characterize residual waste to assess

compliance with retrieval performance criteria associated with Tank 241-AX-104. The objective of HTI was to minimize technical and program risks and uncertainties by removing and characterizing waste with technologies and methods needed to support future tank waste remediation and tank farm closure activities at the Hanford Site. The HTI program was terminated in 1999.

2.0 DATABASE DESCRIPTION

A report printed out from the HTI/ACTR Database is provided in Appendix A. The HTI/ACTR Database is the result of researching documentation that could possibly be applicable to the retrieval of waste from Hanford Site tanks. A listing of the documents considered during the compilation of the HTI/ACTR Database is provided in Appendix B.

The report provided in Appendix A is structured in ten self-explanatory fields. Use of key words establishes a topical classification of the references and, hence, allows for multiple and assorted searches. The Category field was established to structure the database into three easily identifiable groups described hereafter. Within each of these three categories, the various documents are presented in chronological order.

2.1 HANFORD TANK INITIATIVE/ACQUIRE COMMERCIAL TECHNOLOGY FOR RETRIEVAL

Documents presented in this category are those documents that resulted directly from the specific HTI and ACTR efforts at the Hanford Site.

2.2 PRIOR TO HANFORD TANK INITIATIVE/ACQUIRE COMMERCIAL TECHNOLOGY FOR RETRIEVAL

Documents presented in this category were published before HTI and ACTR efforts began. Two reports of specific interest in this category summarize the work completed before the beginning of the HTI and ACTR efforts.

2.2.1 WHC-EP-0352, *Single-Shell Tank Retrieval Study*

WHC-EP-0352, *Single-Shell Tank Waste Retrieval Study*, is a study completed in the early 1990s to satisfy a Tri-Party Agreement milestone (number M-06-01). WHC-EP-0352 identifies waste retrieval technologies that should be tested in a scale-model tank.

2.2.2 SD-WM-ES-334, *Bibliography of Documents Pertaining to Retrieval of Waste from Hanford Single-Shell Tanks*

SD-WM-ES-334, Revision 0, *Bibliography of Documents Pertaining to Retrieval of Waste From Hanford Single-Shell Tanks*, is a bibliography of documents pertaining to retrieval of waste from Hanford SSTs and was published in March 1995. SD-WM-ES-334, Revision 0 is considered to be a predecessor to this HTI/ACTR bibliography.

2.3 MISCELLANEOUS REFERENCES

Documents in this category include:

1. Documents from other DOE sites that are considered relevant to retrieval of waste at the Hanford Site.
2. Miscellaneous programmatic and nontechnical documents associated with HTI/ACTR.
3. Reference sources other than those in the HTI/ACTR and prior to HTI/ACTR categories.

3.0 SUMMARY AND RECOMMENDATIONS

During development of the HTI/ACTR Database, multiple searches were conducted throughout the Internet and other reference sources, interviews were conducted with cognizant personnel, and potentially applicable documents were submitted for review and consideration by senior technical customers. Of the various media considered (see Appendix B for examples), 71 documents were selected for inclusion in this HTI/ACTR Database. The six major types of technologies considered by the HTI and ACTR programs and described in these documents are listed in Table 1. It should be noted that some documents contain information in multiple areas (e.g., some reports provide information on both waterjet technology and crawlers).

The full database (i.e., a Microsoft¹ Access file that includes more data than are included in the printout provided in Appendix A) is available under electronic form, allowing for searches, updates, and future expansion.

¹ Microsoft is a trademark of the Microsoft Corporation, Redmond, Washington.

Based on the work conducted to develop this database, the following recommendations are suggested:

1. The reports identified in Appendix C are not presently available on the Hanford Site Records Management Information System (RMIS). It is suggested that these reports be made available and accessible through RMIS. This effort may include further document clearance activities and/or the removal of specific proprietary status from selected equipment and/or reports.
2. Only one report was identified on salt dissolution. The report focuses on the process, and further work needs to be identified toward the enhancement of a saltcake dissolution technology.
3. The database could be enriched by the addition of photographs of specific equipment representing these technologies. Unfortunately these photographs were not readily available during finalization of this report.

Table 1. Hanford Tank Initiative/Acquire Commercial Technology for Retrieval Database Technologies Summary.

| Technology | Number of Documents Included in Appendix A | Technology Principle Description |
|-------------------|---|--|
| Salt Dissolution | 1 | Retrieval by Mass Transfer of solids contained primarily as soluble sodium salts into a liquid suspension using water as diluent. Dissolution based on low volume density gradient method is recommended. |
| Crawler/Vehicle | 13 | Retrieval by introduction of a small (sometimes collapsable/foldout) vehicle into the tank environment. Most common use of the vehicle is to mount other tools to the vehicle. |
| Manipulator/Arm | 11 | Introduction of a device that is fixed at one end (often from and/or above the tank risers). As with the crawler/vehicle, various tools often are mounted to the opposite (i.e., nonriser) end of the arm. |
| Sluicing/Waterjet | 11 | Introduction of a liquid (typically water), often at high pressures and/or volumes, into the waste matrix to break apart and/or suspend the solids materials into the sluicing fluid for subsequent transport out of the tank. |
| Camera/Viewing | 3 | Machinery that assists and aids in the visual imaging of the equipment and waste contained in the tanks. |
| Miscellaneous | 32 | Documentation not fitting readily into one of the above categories. |

APPENDIX A

**HANFORD TANK INITIATIVE/ACQUIRE COMMERCIAL
TECHNOLOGY FOR RETRIEVAL (HTI/ACTR) DATABASE**

Document Log Report

| Category | Keyword | Document Date | Document Number | Title | Author(s) | Source | Comments |
|------------------|--|---------------|-----------------|---|-----------|---|----------|
| <u>HTI/ACTR</u> | feasibility study technology. high performance pulsed power, test results, long reach arms. deployment of end effectors, hydraulically adapted snakes manipulator | 5/29/97 | HNF-MR-0538 | Results of the SNAKES Manipulator & ARD Sluicer Testing as part of Hanford Single Shell Tanks Waste Retrieval - Phase 1 - ACTR Integrated Testing Company-Authored: Magnox Electric Team | | Hanford Web Site HTML / PDF / WP / Native http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=243 | |
| Abstract: | | | | <i>Long reach arms represent one of the options available for deployment of end effectors which can be used in the retrieval of radioactive waste, from the Hanford single shell tanks. The versatility of an arm based deployment system is such that it has the potential to improve the performance of a wide range of end effectors compared with stand-alone or other deployment methods.</i> | | | |
| | | | | <i>The long term reliability and availability of the deployment system is central to the timely completion of a waste retrieval program. However, concerns have been expressed over the dynamic performance of long reach arms and it is essential that an arm based system can cope with operational dynamic loads generated by end effectors.</i> | | | |
| | | | | <i>The test program conducted set out to measure static and dynamic loads and responses from a representative arm and sluicer, with the objective of extrapolating the data to a long reach arm system, that can be used for in-tank waste retrieval.</i> | | | |
| | | | | <i>As an arm with an appropriate reach was not available, the test program was undertaken to measure dynamic characteristics of a Magnox Electric 18 ft multi-link, hydraulically actuated SNAKES manipulator. This is the longest reach unit in service, albeit only one third of the 50 ft length required for in-tank waste retrieval. In addition operational performance and loading measurements were obtained from a low pressure confined system sluicer under development by ARD Environmental, to add to the end effector data base.</i> | | | |
| | | | | <i>When subject to impulse loading, the arm was found to behave in a repeatable manner having fundamental natural frequencies in the vertical and transverse directions of 1 Hz. There were also a large number of higher natural frequencies measured up to 100 Hz.</i> | | | |
| | | | | <i>The mode shapes for these natural frequencies appear to follow classical shapes as would be expected for a continuous beam. Hence, it should be possible to calculate natural frequencies for an arm for retrieval of waste from a Hanford tank based on mass and stiffness distributions. Indeed, in developing a long reach arm for Hanford tanks, fundamental natural frequencies have been calculated at between 1.1 Hz to 1.3 Hz. Hence the dynamic response could be expected to be similar to the shorter arm. The responses at the lower natural frequencies were shown to be relatively highly damped. Whilst this could be expected to be applicable to a scaled-up system, damping could be dependent on the detail joint design of the long reach arm.</i> | | | |
| | | | | <i>A study was undertaken to determine the sensitivity of response to variations in payload, stiffness, geometry, reach and force level, the parametric changes that would be encountered in operational duty. Variations were detected and these were broadly in line with expectations.</i> | | | |
| | | | | <i>The low pressure confined sluicer has been developed to improve upon the performance of other sluicing systems. The sluicer spray nozzle system has been shown to be effective in breaking up saltcake and hardpan materials. However, the prototype had only limited success in containing water.</i> | | | |
| | | | | <i>The sluicer was primarily designed for deployment with a remote vehicle and there is clearly a mis-match in the 200 lbf payload for an arm deployment system and the 400 lb. weight of the sluicer. The sluicer produces relatively large, broadband dynamic forces which will inevitably excite some of the natural frequencies in the long reach arm. However in view of the high damping, it is not expected that the resulting vibration would be detrimental to the integrity of the arm system. To realize the potential benefits of the low pressure confined sluicer, a design optimization and development program would need to be undertaken.</i> | | | |
| | | | | <i>The test program has provided data that goes some way to allaying concerns on the issue of dynamic response of a long reach arm affecting long term endurance capabilities for waste retrieval. Since the SNAKES system is considerably shorter than a system for in-tank waste retrieval it is recommended that an integrated development program for the sluicer and deployment arm should be undertaken that includes rigorous combined testing, prior to "hot waste retrieval".</i> | | | |
| | advanced sluicing system, test report, ARD Environmental, Inc., LATA, simulants, sluice testing | 4/23/97 | HNF-MR-0539 | Advanced Sluicing System Test Report for Single Shell Tank Waste Retrieval Integrated Testing Berglin, E.J. | | Hanford Web Site HTML / PDF / WP http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=240 | |
| Abstract: | | | | <i>This document describes the testing performed by ARD Environmental, Inc., and Los Alamos Technical Associates of the LATA/ARD Advanced Sluicing System, in support of ACTR Phase 1 activities. Testing was to measure the impact force and pressures of sluicing streams at three different distances, as measured by the Government supplied load cell. Simulated sluicing of large simulated salt cake and hard pan waste coupons was also performed.</i> | | | |
| | | | | <i>Due to operational difficulties experienced with the Government supplied load cell, no meaningful results with respect to sluice stream impact pressure distribution or stream coherence were obtained. Sluice testing using 3000 psi salt cake simulants measured waste retrieval rates of approximately 12 m³/day (17.6 ft³/hr. Rates as high as 314 m³/day (463 ft³/hr) were measured against the lower strength salt cake simulants.</i> | | | |

Document Log Report

| Category | KeyWord | Document Date | Document Number | Title | Author(s) | Source | Comments |
|------------------|---|---------------|-----------------|--|---|---|----------|
| HTI/ACTR | test, ARD Environmental, Inc., feasibility, vehicle based | 7/31/97 | HNF-MR-0542 | Alternate Retrieval Technology Demonstrations Program - Test Report by ARD Environmental, Inc. | Company-Authored: ARD Environmental, Inc. released by Berglin, E.J. | Hanford Web Site HTML / PDF / WP / Native http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=508 | |
| Abstract: | A simulated cleaning demonstration of radioactive waste from a Hanford tank using a robotic crawler vehicle system from ARD Environmental Inc. was funded by the Hanford Tanks Initiative's Alternative Retrieval Technology Demonstrations to address issues relating to deployment, removal, mobility, waste removal rate, minimization of liquid, mining strategy, prototype vehicle, control system, and waste and water scavenging system were designed and fabricated with essentially the full capabilities of the vehicle system proposed by ARD Environmental. A test tank mockup, including riser and decontamination chamber were designed and fabricated, and approximately 830 cubic feet of six varieties of waste simulants poured. The tests were performed by ARD Environmental personnel at its site in Laurel, Maryland, from 4/22/97 through 5/2/97. The capabilities tested were deployment and retrieval, extended mobility and productivity, the ability to operate the system using video viewing only, retrieval after simulated failure, and retrieval and decontamination. Testing commenced with deployment of the vehicle into the tank. Deployment was accomplished using a crane and auxiliary winch to position the vehicle and lower it through the decontamination chamber, into the 36" diameter x 6' high riser, and touch down on the waste field in the tank. The initial mobility tests were conducted immediately after deployment, prior to sluicing, as the waste field exhibited the greatest amount of variation at this time. This test demonstrated the ability of the vehicle to maneuver over the simulated waste field, and the ability of the operator to work with only video viewing available. In addition, the ability of the vehicle to right itself after being turned on its side was demonstrated. The production rate was evaluated daily through the testing period by measuring the surface and estimating the amount of material removed. The test demonstrated the ability of the vehicle to reduce the waste surface using 400 psi (nominal) water jets, scavenge water and material from the work area, and move to any location, even in the relatively confined space of the 20' diameter test tank. In addition, the ability to sluice to a remote scavenging module was demonstrated. The failure mode test demonstrated the ability to retrieve a stuck vehicle by pulling on the tether, even if the vehicle heels were locked or the vehicle was on its side. Line pull required to retrieve the vehicle was measured, and side load on the riser calculated from the line pull and line angles. Finally, the decontamination test demonstrated the ability to effectively clean the umbilical and vehicle. The issues addressed and resolved during the testing were: Feasibility of deploying a vehicle-based system, mobility, production rate and limitation of water in the tank during sluicing, mining strategy, operator efficiency, vehicle recovery, and decontamination. Water usage and waste removal rates were used to estimate the time and water usage requirements for cleaning a Hanford SST. | | | | | | |
| | track 3 system, test demonstration | 7/24/97 | HNF-MR-0543 | Final Test Report - Demonstration Testing in Support of the Track 3 System Waste Dislodging, Retrieval, and Conveyance Concepts by Delphinus Engineering | Company-Authored, released by Berglin, E.J. | Hanford Web Site HTML / PDF / Native http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=509 | |
| Abstract: | This report contains the quantitative and qualitative data and information collected during performance of the Track 3 System testing protocol. Information contained herein focuses on the data collected during performance of the following Tests Procedures. *Test Procedure-1, Position Management Test Procedure-2, Waste Dislodging, Retrieval, and Conveyance and Decontamination *Test Procedure-3, Dynamic Response Test procedures, Safety Demonstration | | | | | | |
| | vehicle-based, demonstration, simulated cleaning, robotic crawler, ESG, LLC, water jets | 7/15/97 | HNF-MR-0544 | Hanford Tanks Initiative Vehicle-Based Waste Retrieval Demonstration Report Phase II, Track 2 by Environmental Specialties Group LLC | Company-Authored; Environmental Specialties Group LLC | Hanford Web Site HTML / PDF http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=284 | |
| Abstract: | A simulated cleaning demonstration of radioactive waste from a Hanford tank using a robotic crawler vehicle system from Environmental Specialties Group (ESG), LLC was funded by the Hanford Tanks Initiative's Alternative Retrieval Technology Demonstrations to address issues relating to waste removal rate, imbibical design and control, mobility, decontamination, remote operations, recovery from failure of plugged line, deployment, removal, waste conveyance rate, and maintenance. The waste retrieval system included a robotic crawler track vehicle with medium-pressure water jets (approximately 10,000-15,000 psi at 28 - 65 gpm), control system, and waste and water pumping system with the size and many of the capabilities required for an actual retrieval operation in a Hanford tank. The demonstrations were done at ESG's plant in Holden, LA during April, 1997 using four simulated waste test beds filled to a depth of eight to ten inches of three simulants mimicking sludges, saltcake, and hardpan and one test bed with a mixture of all three simulants. | | | | | | |
| | EMMA Robotic manipulator, lightweight scarifier (by Waterjet Technology, Inc.), test performance, demonstrations | 7/24/97 | HNF-MR-0545 | Hanford Tanks Initiative Alternate Retrieval Demonstrations - Final Report of Testing Performed by GreyPilgrim LLC | Company-Authored; Grey Pilgrim LLC | Hanford Web Site HTML / PDF http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=287 | |
| Abstract: | A waste retrieval system has been defined to provide a safe and cost-effective solution to the Hanford Tanks Initiative. This system consists of the EMMA robotic manipulator (by GreyPilgrim LLC) and the lightweight Scarifier (by Waterjet Technology, Inc.) powered by a 36-kpsi Jet-Edge diesel powered high pressure pumping system. For demonstration and testing purposes, an air conveyance system was utilized to remove the waste from the simulated tank floor. | | | | | | |

Document Log Report

| Category | KeyWord | Document Date | | Document Number | Title Author(s) | Source Web Address | Comments |
|------------------|---|---------------|--|----------------------------|---|--|----------|
| | | Release Date | | | | | |
| <u>HTI/ACTR</u> | stabilization, waste tanks, soils, evaluation, end-state options | 10/9/97 | | HNF-SD-HTI-ES-004 | Stabilization of in-tank residuals and external-tank soil contamination: FY 1997 interim report Becker, D.L. | Hanford Web Site PDF http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=1869 | |
| Abstract: | <i>This interim report evaluates various ways to stabilize decommissioned waste tanks and contaminated soils at the AX Tank Farm as part of a preliminary evaluation of end-state options for the Hanford tanks. Five technical areas were considered: (1) emplacement of smart grouts and/or other materials, (2) injection of chemical-getters into contaminated soils surrounding tanks (soil mixing), (3) emplacement of grout barriers under and around the tanks, (4) the use of engineered barriers over the tanks, and (5) the explicit recognition that natural attenuation processes do occur. Research topics are identified in support of key areas of technical uncertainty, in each of the five technical areas. Detailed cost/benefit analyses of the recommended technologies are not provided in this evaluation, performed by Sandia National Laboratories, Albuquerque, New Mexico.</i> | | | | | | |
| | mission analysis review, development of performance measures, end-state criteria, closure scenarios | 10/22/97 | | HNF-SD-HTI-TX-001 | Hanford tanks initiative alternatives generation and analysis plan for AX tank farm closure basis Schaus, P.S., Westinghouse Hanford, Richland, WA | Hanford Web Site PDF http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=2090 | |
| Abstract: | <i>The purpose of this document is: (1) to review the HTI Mission Analysis and related documents to determine their suitability for use in developing performance measures for AX Tank Farm closure, (2) to determine the completeness and representativeness of selected alternative closure scenarios, (3) to determine the completeness of current plans for development of tank end-state criteria, and (4) to analyze the activities that are necessary and sufficient to recommend the end-state criteria and performance measures for the AX Tank Farm and recommend activities not currently planned to support establishment of its end-state criteria.</i> | | | | | | |
| | Progress report, simulant testing, wet sludge, hard pad/dried sludge, hard saltcake, soft saltcake | 4/1/96 | | PNNL-11021 / ACTR File #33 | Initial ACTR Retrieval Technology Evaluation Test Material Recommendations Powell, M.R. | Hanford Web Site HTML / PDF / Native http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=312 | |
| Abstract: | <i>Millions of gallons of radioactive waste are contained in underground storage tanks at Hanford (SE Washington). Techniques for retrieving much of this waste from the storage tanks have been developed. Current baseline approach is to use sluice jets for single-shell tanks and mixer pumps for double-shell tanks. The Acquire Commercial Technology for Retrieval (ACTR) effort was initiated to identify potential improvements in or alternatives to the baseline waste retrieval methods. Communications with a variety of vendors are underway to identify improved methods that can be implemented at Hanford with little or no additional development. Commercially available retrieval methods will be evaluated by a combination of testing and system-level cost estimation. Current progress toward developing waste simulants for testing ACTR candidate methods is reported; the simulants are designed to model 4 different types of tank waste. Simulant recipes are given for wet sludge, hardpan/dried sludge, hard saltcake, and soft saltcake.</i> <i>Comparisons of the relevant waste and simulant properties are documented in this report. These comparisons provide the justification for the properties of the specified simulants. In most cases, the simulants re shown to be reasonably similar to the known and estimated waste properties in the relevant respects. The specified simulants, however, cannot be considered validated based on the information presently available. More waste characterization data and retrieval process test data are needed to improve the confidence in these simulants.</i> | | | | | | |

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| Category | KeyWord | Document Date | Document Number | Title | Source | Comments |
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| HTI/ACTR | request for proposal (RFP), statement of work (SOW), complete retrieval solution | 11/26/96 | RFP W-A15120-SH | Single Shell Tank Waste Retrieval Alternative Technology Demonstrations SOW in support of the Hanford Tanks Initiative (HTI) <i>Company-Authored</i> | Hanford Web Site Native http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=2218 | |
| Abstract: | <i>Requisition W-A15120-SH dated November 26, 1996</i> | | | <i>Lockheed Martin Hanford Company (LMHC) has released a Request for Proposal for the following work on Tuesday, November 26, 1996, with responses due December 30, 1996. Please notify those listed below if you have difficulty downloading the information. The attached information includes background, proposal format, statement of work, evaluation criteria and references supporting information. Please read the information carefully, since changes from the previous comment cycle have been incorporated into the attached Statement of Work.</i> | | |
| | | | | <i>In this request, LMHC is seeking commercial firms wishing to demonstrate complete tank waste retrieval solutions, supporting alternate retrieval technology demonstrations for the Hanford Tanks Initiative. The scope of work includes:</i> | | |
| | | | | <i>Description of a complete retrieval solution, Identification of the primary technical, safety, regulatory, institutional and contractual issues associated its implementation, Preparation of a test plan to resolve those issues, Performance of the tests, simulations and analyses, and Creation of a report that resolves the key issues</i> | | |
| | | | | <i>The complete solicitation package contains the following:</i> | | |
| | | | | <i>The Request for Proposal (this file) with Cover Letter, Statement of Work, and Evaluation Criteria.</i> | | |
| | | | | <i>Additional Background Information - Appendix A</i> | | |
| | | | | <i>Contractual Terms and Conditions, Representations and Certifications, and Pricing Instructions</i> | | |
| | simulants, high volume water sluicing, hard wastes | 10/1/96 | WHC-MR-0526 | Demonstration of Retrieval Methods for Westinghouse Hanford Corp. <i>Company-Authored;</i> | Hanford Web Site HTML / PDF / WP / Native http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=540 | |
| Abstract: | <i>Westinghouse Hanford Corporation has been pursuing strategies to break up and retrieve the radioactive waste material in single shell storage tanks at the Hanford Nuclear Reservation, by working with non-radioactive "saltcake" and sludge material that simulate the actual waste. It has been suggested that the use of higher volumes of water than used in the past (10 gpm nozzles at 10,000 psi) might be successful in breaking down the hard waste simulants. Additionally, the application of these higher volumes of water might successfully be applied through commercially available tooling similar to those used in the deslagging of large utility boilers. NMW Industrial Services, Inc., has proposed a trial consisting of three approaches each to dislodging both the solid (saltcake) simulant and the sludge simulant.</i> | | | | | |
| | high pressure waterjet, simulants | 10/1/96 | WHC-MR-0527 | Demonstration of Retrieval Methods for Westinghouse Hanford Corp. by MPW Industrial Services Trial #2 <i>Company-Authored; MPW Industrial Services, Inc.</i> | Hanford Web Site HTML / PDF / Native http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=541 | |
| Abstract: | <i>Dislodging of Hanford tank waste simulants of sludge and soft/hard saltcake using a 10,000 psi pressure waterjet stream was demonstrated by MPW Industrial Services, Inc. to support the testing of retrieval technologies through Hanford Tanks Initiative (HTI) and Acquire Commercial Technology for Retrieval (ACTR) projects. Two dislodging devices were tested, a rotary water jet and a water cannon, with flow rates around 25 gpm.</i> | | | | | |
| | | | | <i>Westinghouse Hanford Company has been pursuing strategies to break up and retrieve the radioactive waste material in single shell storage tanks at the Hanford Nuclear Reservation by working with non-radioactive "saltcake" and sludge material that simulate the actual waste. Previous trials run by MPW for Westinghouse Hanford Company (report dated October 20, 1995) resulted in difficulty breaking up the simulant using three approaches, with pressures to 10,000 psi and flow rates to 56 gpm. The saltcake simulant was extremely hard, with a tensile strength similar to concrete. Westinghouse Hanford proposed a second set of trials utilizing a range of four simulants to attempt to bracket the capability of the 10,000 psi waterblast stream. This set of trials had one simulant similar to the soft sludge previously trialed, two similar to the hard saltcake but with a lower strength, and one with a coarse rock-salt in a saltcake matrix, which is quite low in strength. Under this proposal, MPW would attempt to dislodge the four different simulants using two methods, for a total of eight pans. Each pan would be 4-foot square x 1-1/2-foot deep. The approaches would be as follows: A. Rotary tooling approaching straight down, with two triangle nozzles, each at a nominal 12.5 gpm at 10,000 psi, at a 45-degree angle. B. Straight in to the exposed edge of the material with an articulated "water cannon" -with a triangle nozzle rated at approximately 25 gpm.</i> | | |

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|------------------|--|---------------|--------------|------------------------------|---|--|--|----------|--|
| <u>HTI/ACTR</u> | No Keywords Available... | 3/29/96 | 3/29/96 | WHC-MR-0528 | Feasibility Study of High Performance Pulsed Power Technology for Supporting Hanford Site Single-Shell Tank Waste Retrieval | Brian Peters | Hanford Web Site HTML / PDF / Word Perfect http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=542 | | |
| Abstract: | | | | | The U.S. Department of Energy (DOE) has established the Tank Waste Remediation System (TWRS) to safely manage and dispose of the wastes in single-shell tanks (SSTs) and double-shell tanks (DSTs) at the Hanford Site. The TWRS program has begun to assemble information on potentially applicable methods of retrieving wastes from SSTs in support of milestones under the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement). | | | | |
| | | | | | Westinghouse Hanford Company (WHC) has developed databases on retrieval methods that include more than 155 companies that have technologies potentially applicable to DSST waste retrieval, including the High Performance Pulsed Power Technology (HPT). This report summarizes the feasibility of the technology for supporting retrieval of SST waste. Other potential applications such as unblocking plugs in waste transfer pipelines are described in Appendix C. The feasibility study addresses issues of implementation, operation, and safety with a focus on strengths, weaknesses, and potential pitfalls of the technology. The feasibility study was based on information acquired from TZN GmbH, a German company that developed and manufactures HPT systems for a wide-range of applications. Marketing partners of TZN for this technology are the German company Telerob and R.J. International, the U.S. representative of both companies. | | | | |
| | | | | | An HPT system is capable of fracturing brittle materials into 100-microm particles using electrothermally-generated shock waves. Until now, the technology has been used only to separate glass, metal, ceramic, and plastic components. One primary application of the technology has been in foundries for removing ceramic molds from metal castings. Metals, except for those that are very brittle, are not impacted by the shock wave. The HPT system is highly effective in fracturing and mobilizing ceramic mold materials contained in the crevices of castings that are normally difficult to remove. The HPT system has also been shown to be effective in separating glass in windshields from their protective layers of plastic; concrete from reinforcing rods; ceramic, plastic, and metal materials in computer chips; and ceramic insulation from spark plugs and high-voltage insulators. The HPT system has been used successfully to bore a 7-in. diameter hole into hard rock at a rate of 33 ft/hr. The HPT system has also been demonstrated successfully in mining applications. | | | | |
| | ACTR fiscal year (FY) summary | 10/31/96 | 10/31/96 | WHC-SD-WM-RPT-269, Rev. 1 | Acquire Commercial Technology for Retrieval Fiscal Year 1996 Summary and Highlights | EJ Berglin, LB McDaniel, DC Ramsower, JA Yount | Hanford Web Site HTML / PDF / WP http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=71 | | |
| Abstract: | | | | | The Acquire Commercial Technology for Retrieval (ACTR) program element began June 1995 to learn about the technologies and contracting methods industrial firms would use to retrieve waste from the Hanford Site's single-shell tanks. This information will guide the Retrieval Program office as approaches are defined for future projects and Phase II Privatization of the Hanford Site. | | | | |
| | heel retrieval | 10/31/96 | 10/31/96 | WHC-SD-WM-TA-180, Rev. 0, 0A | Residual Waste Volume Measurement for Hanford Underground Storage Tanks, Rev. 0, 0A | MS Evans | Hanford Web Site HTML / PDF / WP http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=70 | | |
| Abstract: | | | | | The Acquire Commercial Technology for Retrieval program seeks commercial solutions to measure any waste residual (i.e., heel) left after waste retrieval operations of underground radioactive storage tanks. The technology identified should operate in a range of waste depth thickness of 0-6 inches. This report provides a description of the need, requirements, and constraints for the residual waste volume measurement system; describes a logical approach to measuring waste volume; provides a brief review and assessment of available technologies; and outlines a set of integrated tests that will evaluate the performance of candidate technologies. | | | | |
| | manipulators, test development, candidate assessment | 9/17/96 | 9/17/96 | WHC-SD-WM-TA-181, Rev. 0, 0A | Issues Associated with Manipulator-Based Waste Retrieval from Hanford Underground Storage Tanks with a Preliminary Review of Commercial Concepts | MS Evans, Berglin, E.J. | Hanford Web Site HTML / PDF / WP / Native http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=546 | | |
| Abstract: | | | | | Westinghouse Hanford Company (WHC) is exploring commercial methods for retrieving waste from the underground storage tanks at the Hanford site in south central Washington state. WHC needs data on commercial retrieval systems equipment in order to make programmatic decisions for waste retrieval. Full system testing of retrieval processes is to be demonstrated in phases through September 1997 in support of programs aimed to Acquire Commercial Technology for Retrieval (ACTR) and at the Hanford Tanks Initiative (HTI). One of the important parts of the integrated testing will be the deployment of retrieval tools using manipulator-based systems. WHC requires an assessment of a number of commercial deployment systems that have been identified by the ACTR program as good candidates to be included in an integrated testing effort. Included in this assessment should be an independent evaluation of manipulator tests performed to date, so that WHC can construct an integrated test based on these systems. The objectives of this document are to provide a description of the need, requirements, and constraints for a manipulator-based retrieval system, to evaluate manipulator-based concepts and testing performed to date by a number of commercial organizations; and to identify issues to be resolved through testing and/or analysis for each concept. Five commercial companies manipulator concepts were reviewed based on existing technology and scaled up for use in tanks 75-ft in diameter by 54-ft high. | | | | |
| | NIST testing, camera development | 7/30/96 | 7/30/96 | WHC-SD-WM-TD-012, Rev. 0, 0A | Test Results for Robotic Manipulator EMMA | Ramsower, D.C. | Hanford Web Site PDF http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=548 | | |
| Abstract: | | | | | Testing was performed at the National Institute of Standards and Technology (NIST) headquarters in Gaithersburg, Maryland, where Grey Pilgrim has experimental space available under a Cooperative R & D Agreement (CRADA) with NIST. Under the CRADA, Grey Pilgrim is tasked with developing a version of EMMA suitable for deployment of a stereo camera on a NIST RoboCrane, a mobile platform with applications to several industrial environments (including hazardous materials) based on the concept of the Steward Platform, a structure with great strength and a minimum of material. | | | | |
| | sluicing nozzle, test report | 8/8/96 | 8/8/96 | WHC-SD-WM-TD-013, Rev. 0, 0A | Sluicing Nozzle Test Report Volume 1 | Ramsower, D.C., Westinghouse Hanford | Hanford Web Site HTML / PDF / WP / Native http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=549 | | |
| Abstract: | | | | | The Westinghouse Hanford Company is exploring various options for retrieving waste materials from the underground storage tanks at the Hanford Site in Richland, Washington. One option under investigation is the use of a commercially available sluicing nozzle manufactured by Bristol Equipment Company. | | | | |

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| | | Release Date | | | | | Web Address | | |
| HTI/ACTR | review, EMMA™ manipulator | 2/7/97 | | WhitePaper ACTR File #168 | A Review of the EMMA Manipulator System With Regard to Waste Retrieval from Hanford Underground Storage Tanks - An Independent Report | | Hanford Web Site HTML / PDF / WP http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=2217 | | |
| Abstract: | | | | | <i>The U.S. Department of Energy (DOE) is exploring commercial methods for retrieving waste from the underground storage tanks at the Hanford site in south central Washington state. GreyPilgrim, LLC, has developed a unique manipulator concept which may be applicable to tank waste retrieval. GreyPilgrim refers to this robotic manipulator as EMMA(tm). In an earlier report written for the Westinghouse Hanford Co. (WHC) [ref. 1], the issues associated with manipulator-based waste retrieval from the single-shelled underground storage tanks at Hanford were discussed along with a preliminary review of several commercially produced concept manipulators, including EMMA(tm). This earlier review of the EMMA(tm) manipulator system was based on a study produced by GreyPilgrim [ref.2] addressing the feasibility of scaling-up an early proof-of-concept EMMA(tm) manipulator prototype. Significant engineering development work has been performed by GreyPilgrim on EMMA(tm) since completion of the early scale-up study and resulting review for WHC.</i> | | | | |
| | | | | | <i>The objective of this document is to update the review of the EMMA(tm) manipulator in light of the recent engineering development work performed by GreyPilgrim. This document will review the manipulator with regard to its applicability for retrieval of waste from the Hanford single-shelled underground storage tanks. This review will not specifically compare the EMMA(tm) manipulator system with the other commercial manipulator concepts reviewed in the earlier WHC review [ref. 1], as any results of further engineering studies have not been received from the other commercial entities by the author.</i> | | | | |
| Miscellaneous | No Keywords Available... | | | | Single Shell Tank Waste Retrieval: Integrated Testing in Support of the Acquire Commercial Technology for Retrieval (ACTR) Program | | | | Request for Proposal (RFP) Document [Partial] -- APPENDIX A - Westinghouse Hanford Company's Request for Proposal WA15104-SJ, July 25, 1996 |
| References | | | | | No Author Information Available... | | http://www.hanford.gov/tanks/hti/docume/ntstest/intstspk.htm | | Request for Proposal (RFP) Document Number -- PMM-JRO-808 |
| Abstract: | No Abstract Information Available... | | 11/12/98 | | Waste Retrieval Demonstration Briefing - Task 1 - System Definition | | Contact Vince Fitzpatrick | | Competition Sensitive |
| | | | | | <i>Los Alamos Technical Associates, Inc.; Environmental Specialties Group, LLC; and NUMANCO</i> | | | | |
| Abstract: | No Abstract Information Available... | | | | Water Jet Technology Association - Recommended Practices | | Hanford Web Site No Electronic Copies Available... | | |
| | High pressure water jets, recommended practices, OSHA, ASTM, ANSI | | 1/1/94 | (No #11) | No Author Information Available... | | http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=261 | | |
| Abstract: | <i>These Recommended Practices apply to the operation of all types of high pressure water jets as normally used in construction, maintenance, repair, cleaning, cutting and demolition work. Types of water jetting equipment are described, and recommendations are made about how to run the equipment and how to train equipment operators. Reference should also be made to present or proposed industry standards, including those of the U.S. Occupational Safety and Health Administration (OSHA), the American Society of Testing Materials (ASTM), the American National Standards Institute (ANSI), and to equipment manufacturers recommendations, where they are appropriate.</i> | | | | Initial Failure Mode and Effects Analysis of the Tank-241-C-106 Waste Retrieval Demonstration | | Contact Vince Fitzpatrick | | Competition Sensitive |
| | No Keywords Available... | | 8/25/98 | 10245-CD-003, Rev. A | <i>Los Alamos Technical Associates, Inc.</i> | | | | |
| Abstract: | No Abstract Information Available... | | | | Waste Retrieval Demonstration System Preliminary Design | | Contact Vince Fitzpatrick | | Competition Sensitive |
| | | | 11/30/98 | 10245-CD-005, Rev. 1 | <i>Los Alamos Technical Associates, Inc.; Environmental Specialties Group, LLC; and Cox-Walker & Associates, Inc.</i> | | | | |
| Abstract: | No Abstract Information Available... | | | | Tank 241-C-106 Baseline Dome Load Reevaluation | | Hanford Web Site No electronic Copies Available | | |
| | Dome loading estimates | | 12/13/96 | 74740-96-LJJ-017 | LJ Judyk | | http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=264 | | |
| Abstract: | <i>This report reevaluates current baseline dome loading estimates for tank 241-C-106 to determine how much additional loading is available in support of the Hanford Tanks Initiative (HTI).</i> | | | | | | | | |

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| <u>Miscellaneous References</u> | scumbuster, pump performance characteristics, simulated saltcake, testing report | 5/27/77 | 5/27/77 | ARH-CD-935 | Scumbuster Pump Test Series Analysis NM Arnold | Hanford Web Site No electronic Copies Available http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=218 | |
| Abstract: | | | | | <i>This report describes the testing of a Vaughn Model 300 Scumbuster centrifugal pump, conducted from October 26, 1975, to March 25, 1977, to determine pump performance characteristics using slurries of simulated saltcake. The test site was the 406 Tank located in the 222-S (REDOX) Building.</i> | | |
| | | | | | <i>Test results indicate that the Scumbuster is capable of pumping a slurry containing 68.3 wt % solid sodium nitrate beads at a rate of 190 gpm (719 L/min). The recirculation of large volumes of slurry at relatively low pressures yields insufficient agitation to retain in suspension all of the solid material present in the 8-ft-dia test tank. Once the solids have settled for several months, less than 50% can be resuspended by recirculation. Increasing the slurry temperature improves fluidity by placing more solid material into solution. A simulated saltcake waste form could not be slurried with the Scumbuster as insufficient interstitial liquid drains to the pump bowl from the saltcake. Addition of a small volume of liquid helps initiate pumping action, but the low pressure, high volume characteristics of the Scumbuster are not suitable to create a slurry pool without additional agitation (mechanical or hydraulic) from another source. When thoroughly drained and air-dried, the simulated saltcake was sufficiently hard to prevent startup of the Scumbuster pump. Large quantities of water had to be added to the 406 Tank partially dissolve the saltcake before the Scumbuster pump could break free from the surrounding solidified mass and begin the recirculation process.</i> | | |
| | fluidic pulse jet mixing, demonstration for mobilization of RH-TRU for retrieval, ORNL, demonstration results | 8/1/98 | 8/1/98 | BIC/OR-82 | Deployment of a fluidic pulse jet mixing system for horizontal waste storage tanks at Oak Ridge National Laboratory, Oak Ridge, Tennessee Kent, T.E.; Hylton, T.D. [Lockheed Martin Energy Research Corp., Oak Ridge, TN (United States), Chemical Technology Div.]; Taylor, S.A. [AEA Technology, Cheshire (United Kingdom)]; Moore, J.W. [Bechtel Jacobs Co. LLC, Oak Ridge, TN (United States)] | Hanford Web Site PDF http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=1820 | |
| Abstract: | | | | | <i>A fluidic pulse jet mixing system, designed and fabricated by AEA Technology, was successfully demonstrated for mobilization of remote-handled transuranic (RH-TRU) sludge for retrieval from three 50,000-gal horizontal waste storage tanks (W-21, W-22, and W-23) at Oak Ridge National Laboratory (ORNL). The pulse jet system is unique because it does not contain any moving parts except for some solenoid valves which can be easily replaced if necessary. The pulse jet system consisted of seven modular equipment skids and was installed and commissioned in about 7 weeks. The system used specially designed fluidic jet pumps and charge vessels, along with existing submerged nozzles for mixing the settled sludges with existing supernate in the tank. The operation also used existing piping and progressive cavity pumps for retrieval and transfer of the waste mixtures. The pulse jet system operated well and experienced no major equipment malfunctions. The modular design, use of quick-connect couplings, and low-maintenance aspects of the system minimized radiation exposure during installation and operation of the system. The extent of sludge removal from the tanks was limited by the constraints of using the existing tank nozzles and the physical characteristics of the sludge. Removing greater than 98% of this sludge would require aggressive use of the manual sluicer (and associated water additions), a shielded sluicer system that utilizes supernate from existing inventory, or a more costly and elaborate robotic retrieval system. The results of this operation indicate that the pulse jet system should be considered for mixing and bulk retrieval of sludges in other horizontal waste tanks at ORNL and US Department of Energy sites.</i> | | |
| | ORNL, compacted clay, broth, gunite (shotcrete) tanks, telerobotic arm-based, hydrofracture facility tanks, vehicle based remediation | | | CONF-951006-33 | Remote systems for waste retrieval from the Oak Ridge National Laboratory gunite tanks Faltier, D.D.; Babcock, S.M.; Burks, B.L.; Lloyd, P.D.; Randolph, J.D.; Rutenber, J.E. [Oak Ridge National Lab., TN (United States), Robotics and Process Systems Div.]; Van Hoesen, S.D. [Lockheed Martin Energy Systems, Oak Ridge, TN (United States), Central Engineering Services] | Hanford Web Site PDF http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=2049 | |
| Abstract: | | | | | <i>As part of a Comprehensive Environmental Response, Compensation, and Liability Act Treatability Study funded by the Department of Energy, the Oak Ridge National Laboratory (ORNL) is preparing to demonstrate and evaluate two approaches for the remote retrieval of wastes in underground storage tanks. This work is being performed to identify the most cost-effective and efficient method of waste removal before full-scale remediation efforts begin in 1998. System requirements are based on the need to dislodge and remove sludge wastes ranging in consistency from broth to compacted clay from Gunite (Shotcrete) tanks that are approaching fifty years in age. Systems to be deployed must enter and exit through the existing 0.6 m (23.5 in.) risers and conduct retrieval operations without damaging the layered concrete walls of the tanks. Goals of this project include evaluation of confined sluicing techniques and successful demonstration of a telerobotic arm-based system for deployment of the sluicing system. As part of a sister project formed on the Old Hydrofracture Facility tanks at ORNL, vehicle-based tank remediation will also be evaluated.</i> | | |

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| Category | Keyword | Document Date | Document Number | Title | Author(s) | Source | Comments |
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| Miscellaneous References | GAAT, treatability study, ORNL, WD&C based, vehicle-based, confined sluicing end-effector | Release Date | CONF-970464-14 | Development of a waste dislodging and retrieval system for use in the Oak Ridge National Laboratory gunite tank | Randolph, J.D.; Lloyd, P.D.; Burks, B.L. [and others] | Hanford Web Site PDF http://www.tanks.org/documentsearchresu/issingle.asp?documentid=2054 | |
| Abstract: | | | | As part of the Gunite And Associated Tanks (GAAT) Treatability Study, the Oak Ridge National Laboratory (ORNL) has developed a tank waste retrieval system capable of removing wastes varying from liquids to thick sludges. This system is also capable of scarifying concrete walls and floors. The GAAT Treatability Study is being conducted by the Department of Energy Oak Ridge Environmental Restoration Program. Much of the technology developed for this project was cosponsored by the DOE Office of Science and Technology through the Tanks Focus Area (TF-A) and the Robotics Technology Development Program. The waste dislodging and conveyance (WD&C) system was developed jointly by ORNL and participants from the TFA. The WD&C system is comprised of a four degree-of-freedom arm with back driveable motorized joints, a cutting and dislodging tool, a jet pump and hose management system for conveyance of wastes, confined sluicing end-effector, and a control system, and must be used in conjunction with a robotic arm or vehicle. Other papers have been submitted to this conference describing the development and operation of the arm and vehicle positioning systems. This paper will describe the development of ORNL sludges from the GAAT tanks. The confined sluicing end-effector relies on medium pressure water jets to dislodge waste that is then pumped by the jet pump through the conveyance system out of the tank. This paper will describe the results of cold testing of the integrated system. At the conference presentation there will also be results from the field deployment. ORNL has completed fabrication of the WD&C system for waste removal and is full-scale testing, including testing of the confined sluicing end-effector. | | | |
| | TFA, annual report, program | | DOE/EM-0360 | Tanks focus area. Annual report | Frey, J. | Hanford Web Site PDF http://www.tanks.org/documentsearchresu/issingle.asp?documentid=1844 | |
| Abstract: | | | | The U.S. Department of Energy Office of Environmental Management is tasked with a major remediation project to treat and dispose of radioactive waste in hundreds of underground storage tanks. These tanks contain about 90,000,000 gallons of high-level and transuranic wastes. We have 68 known or assumed leaking tanks that have allowed waste to migrate into the soil surrounding the tank. In some cases, the tank contents have reacted to form flammable gases, introducing additional safety risks. These tanks must be maintained in the safest possible condition until their eventual remediation to reduce the risk of waste migration and exposure to workers, the public, and the environment. Science and technology development for safer, more efficient, and cost-effective waste treatment methods will speed up progress toward the final remediation of these tanks. The DOE Office of Environmental Management established the Tanks Focus Area to serve as the DOE-EM's technology development program for radioactive waste tank remediation in partnership with the Offices of Waste Management and Environmental Restoration. The Tanks Focus Area is responsible for leading, coordinating, and facilitating science and technology development to support remediation at DOE's four major tank sites: the Hanford Site in Washington State, Idaho National Engineering and Environmental Laboratory in Idaho, Oak Ridge Reservation in Tennessee, and the Savannah River Site in South Carolina. The technical scope covers the major functions that comprise a complete tank remediation system: waste retrieval, waste pretreatment, waste immobilization, tank closure, and characterization of both the waste and tank. Safety is integrated across all the functions and is a key component of the Tanks Focus Area program. | | | |
| | technology summary report, Houdini™ I and II, remote vehicle, test results | 7/1/98 | DOE/EM-0368 | Innovative technology summary report: Houdini (trademark) I and II remotely operated vehicle | | Hanford Web Site; All published Innovative Technology Summary Reports are available on the OST Web Site at: http://em-50.em.doe.gov/underpublications/ PDF http://www.tanks.org/documentsearchresu/issingle.asp?documentid=1815 | |
| Abstract: | | | | The US Department of Energy (DOE) is responsible for cleaning up and closing 273 large, aging, underground tanks the department has used for storing approximately 1 million gal of high- and low-level radioactive and mixed waste. The Houdini robot addresses the need for vehicle-based, rugged, remote manipulation systems that can perform waste retrieval, characterization, and inspection tasks. Houdini-I was delivered to ORNL in September 1996, deployed in a cold test facility in November, and first deployed in the gunite tanks in June 1997. Since then, it has seen continuous (still on-going) service at ORNL, providing a critical role in the cleanup of two gunite tanks, W-3 and W-4, in the GAAT NTF. Houdini-I has proven rugged, capable of waste retrieval, and able to withstand high reaction force operations such as wall core sampling. It's even able to operate while hanging, which was the case when Houdini was used to cut and remove cables and steel pipes hanging below manways in Tank W-3. Based upon the lessons learned at ORNL, Houdini's design has been completely overhauled. A second generation system, Houdini-II, is now being built. | | | |

Document Log Report

| Category | KeyWord | Document Date | Document Number | Title | Source | Comments |
|---------------------------------|--|---------------|---------------------------------------|---|---|----------|
| Miscellaneous References | Listing, Directory, Products, Services, Treatment, Characterization, n, Extraction, Delivery, Materials Handling, Commercially Available Technologies | 11/1/95 | DOE/TD/12584-230;GJPO-120 | Commercial Environmental Cleanup -- The products and services directory. Treatment, characterization and extraction/delivery/materials handling technologies Prepared by Rust Geotech | Hanford Web Site PDF http://www.tanks.org/documentsearchresuIssingle.asp?documentid=2060 | |
| Abstract: | | | | This directory is patterned after the telephone Yellow Pages and is designed as a reference tool to those who may seek commercial remedies for their environmental cleanup problems. It offers the user the opportunity to survey 325 environmental cleanup businesses that currently market their products and services through 1,134 applications of commercially available technologies. Like the Yellow Pages, the Directory furnishes the user with points-of-contact to investigate the capabilities of the listed companies to perform within acceptable standards, practices, and costs and to meet a user's specific needs. The three major sections of the Directory are organized under the broad headings of Treatment, Characterization, and Extraction/Delivery/Materials Handling. Within each section, information is grouped according to the applicable contaminant medium and companies are listed alphabetically under each medium heading. Not all vendors in the environmental cleanup business are included in this first edition of the Directory. Future editions will more completely reflect the status of the industry. The database of the commercial cleanup products and services Directory will be offered on the Internet in the future and will be available on the Homepage www.doe.gjpo.com . | | |
| | gunite tanks, houdini™, vehicle based, ORNL, Fernald | | DOE/MC/32092-5630 | Houdini (trademark); Reconfigurable in-tank mobile robot. Final report, June 1995--January 1997 Thompson, B.; Slifko, A. | Hanford Web Site PDF http://www.tanks.org/documentsearchresuIssingle.asp?documentid=2064 | |
| Abstract: | This report details the development of a reconfigurable in-tank robotic cleanup system called Houdini (trademark). Driven by the general need to develop equipment for the removal of radioactive waste from hundreds of DOE sites such as Oak Ridge National Laboratory and Fernald, Houdini (trademark) represents one of the possible tools that can be used to mobilize and retrieve this waste material for complete remediation. Houdini (trademark) is a hydraulically powered, track driven, mobile work vehicle with a collapsible frame designed to enter underground or above ground waste tanks through existing 24 inch riser openings. After the vehicle has entered the waste tank, it unfolds and lands on the waste surface or tank floor to become a remotely operated mini-bulldozer. Houdini (trademark) utilizes a vehicle mounted plow blade and 6-DOF manipulator to mobilize waste and carry other tooling such as slushing pumps, excavation buckets, and hydraulic shears. The complete Houdini (trademark) system consists of the tracked vehicle and other support equipment (e.g., control console, deployment system, hydraulic power supply, and controller) necessary to deploy and remotely operate this system at any DOE site. Inside the storage tanks, the system is capable of performing heel removal, waste mobilization, waste size reduction, and other tank waste retrieval and decommissioning tasks. The first Houdini (trademark) system was delivered on September 24, 1996 to Oak Ridge National Laboratory (ORNL). The system acceptance test was successfully performed at a cold test facility at ORNL. After completion of the cold test program and the training of site personnel, ORNL will deploy the system for clean-up and remediation of the Gunite storage tanks. | | | | | |
| | Houdini™, folding frame vehicle, confined access | | DOE/MC/32092-97/C0795;CONF-9610231-35 | Houdini: a remote mobile platform for tank waste retrieval tasks Denmeade, T.J.; Slifko, A.D.; Thompson, B.R.; White, D.W. | Hanford Web Site PDF http://www.tanks.org/documentsearchresuIssingle.asp?documentid=2065 | |
| Abstract: | RedZone has developed Houdini (trademark), a folding frame vehicle for work in waste storage tanks and other confined-access areas. Houdini is a tethered, hydraulically-powered platform that folds to fit through small openings. Once deployed, the vehicle unfolds to provide a substantial work platform for the deployment of a wide variety of tools. The Houdini system will perform heel removal, waste retrieval, waste mobilization, waste size reduction, and other tank waste retrieval and decommissioning tasks. Within the DOE Complex, 332 underground storage tanks have been used to process and store radioactive and chemical mixed waste generated from weapon materials production. The ultimate goal of the program is to develop and commercialize the Houdini system for broad application throughout the DOE Complex. | | | | | |
| | Attributes and maintainability requirements, TWRS, TPA, tank remediation, conceptual design, performance specifications | 5/1/94 | EGG-WTD-11310 | Maintenance Study for W-340 Waste Retrieval System C Christensen; CC Conner; JP Sekot | Hanford Web Site No electronic Copies Available http://www.tanks.org/documentsearchresuIssingle.asp?documentid=197 | |
| Abstract: | This study was performed to identify attributes and maintainability requirements for the Tank Waste Retrieval System (TWRS). The system will be developed for Westinghouse Hanford Company in Richland, Washington, as an integrated system to perform waste removal in Tank C-106 and, thus, demonstrate technologies for tank remediation that will satisfy requirements of the Tri-Party Agreement. The study examines attributes of the TWRS, scope of maintenance operations required for the TWRS, maintenance requirements, and potential methods of performing maintenance functions. Recommendations are provided for consideration in the development of both the conceptual design and performance specification, which will be used in procuring the W-340 Waste Retrieval System. | | | | | |

Document Log Report

| Category | KeyWord | Release Date | Document Number | Title | Author(s) | Web Address | Comments |
|----------------------|---|--------------|--------------------|---|---------------------------------------|---|----------|
| Miscellaneous | high volume , low pressure confined sluicing system, vehicle based, test report, issues resolution, key issues, vehicle based | 3/1/97 | HNF-MR-0534 | Task 5 Test Report: Demonstration of Low Pressure Confined Sluicer and Vehicles for SST Tank Waste Retrieval at Hanford | Berglin, E.J. | Hanford Web Site HTML / PDF / WP http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=50 | |
| References | | | | | | | |
| Abstract: | | | | The purpose of this test program was to evaluate the proposed high-volume low-pressure confined sluicing system as a vehicle-based means of dislodging and conveying the waste in the Hanford tanks; to resolve as many of the technical and safety issues as possible, and to identify those key issues which would have to be resolved by future effort. | | | |
| | retrieval analysis tool, technical work plan, validation | 9/1/97 | HNF-MR-0549 | Retrieval Analysis Tool (RAT) Validation | J.A. Yount, E.J. Berglin, J.Y. Dobson | Hanford Web Site No electronic Copies Available http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=301 | |
| Abstract: | | | | The beta version of the Retrieval Analysis Tool (RAT) has been reviewed and validated and meets the Retrieval Analysis Tool Technical Work Plan milestone IE3 due August 29, 1997. | | | |
| | The RAT has been validated by successfully answering three questions: Does it work? Is it complete? Has it been accepted by users? The validation process consisted of three steps: First, a structured review was conducted of the RAT's functions, including a systematic review of the various features of the RAT website to assure that each feature was working properly and correct data was being returned and to document the capability of the RAT in this report. Second, to judge completeness, a series of keyword queries, believed to be typical of a RAT user, were performed to evaluate the responses (see Section 2.0) and to recommend enhancements (see Section 5.0). The third part of the validation process involved user acceptance and consisted of documenting the RAT's performance in support of its first client, the Hanford Tanks Initiative (HTI) project (see Section 3.0) in HTI's "C-106 Waste Retrieval Demonstration REQUEST FOR PROPOSAL (RFP)" (see Section 4.0). While the initial focus of the work has been mostly HTI, the broader scope is clearly to serve the entire DOE complex. HTI assistance has encouraged other sites to openly contribute their technologies, tank data, and lessons learned; more of other sites' data will be included in fiscal year (FY) 1998. The history of the RAT project and information on its configuration is given in Section 1.0. | | | | | | |
| | permitting actions, cost and schedule | 2/10/97 | HNF-SD-HTI-EV-001 | Permitting Plan for Hanford Tanks Initiative | Bloom, J.W., Fluor Daniel Hanford | Hanford Web Site PDF http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=529 | |
| Abstract: | | | | This plan describes all the possible permitting actions that could be required to implement the Hanford Tanks Initiative Project (HTI). Since the HTI Project Plan has several decision points where possible future activities could be eliminated, not all permitting actions described will be implemented. The cost and schedule for the permitting actions are included. | | | |
| | F&RS, test facility, workshop | 3/1/97 | HNF-SD-HTI-FRD-001 | Hanford tanks initiative test facility functions and requirements | Krieg, S.A., Fluor Daniel Hanford | Hanford Web Site PDF http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=2088 | |
| Abstract: | | | | This document presents the functions and requirements for a test facility for testing single-shell tank waste retrieval equipment and systems for the Hanford Tanks Initiative (HTI) project. This effort includes review of previous test facility functions and requirements and conducting a workshop to develop specific functions and requirements for HTI testing needs. Functions and requirements for testing future retrieval systems that follow HTI are also identified. | | | |
| | project execution plan (PEP), retrieval of difficult Hanford waste | 2/9/98 | HNF-SD-HTI-PEP-001 | HTI retrieval demonstration project execution plan | Ellingson, D.R. | Hanford Web Site PDF http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=2089 | |
| Abstract: | | | | This plan describes the process for demonstrating the retrieval of difficult Hanford tank waste forms utilizing commercial technologies and the private sector to conduct the operations. The demonstration is to be conducted in Tank 241-C-106. | | | |

Document Log Report

| Category | KeyWord | Document Date | Release Date | Document Number | Title | Author(s) | Web Address | Comments |
|----------------------|---|---------------|----------------------------|-----------------|---|--|---|----------|
| Miscellaneous | ORNL, GAAT, radioactive tank cleaning, field-scale cleaning, robotic system | 5/1/98 | ORNL/CP-98309;CONF-980905- | | Large underground radioactive waste storage tanks successfully cleaned at Oak Ridge National Laboratory | Billingsley, K. [Solutions to Environmental Problems, Inc., Oak Ridge, TN (United States)]; Burks, B.L. [Providence Group, Knoxville, TN (United States)]; Johnson, M. [Lockheed Martin Energy Systems, Oak Ridge, TN (United States)]; Mims, C.; Powell, J. [Dept. of Energy, Oak Ridge, TN (United States)]; Hoesen, D. van [Lockheed Martin Energy Research, Oak Ridge, TN (United States)] | Hanford Web Site PDF http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=2099 | |
| References | | | | | | | | |
| Abstract: | | | | | <i>Waste retrieval operations were successfully completed in two large underground radioactive waste storage tanks in 1997. The US Department of Energy (DOE) and the Gunite Tanks Team worked cooperatively during two 10-week waste removal campaigns and removed approximately 58,300 gallons of waste from the tanks. About 100 gallons of a sludge and liquid wheel remain in each of the 42,500 gallon tanks. These tanks are 25 ft. in diameter and 11 ft. deep, and are located in the North Tank Farm in the center of Oak Ridge National Laboratory. Less than 2% of the radioactive contaminants remain in the tanks, proving the effectiveness of the Radioactive Tank Cleaning System, and accomplishing the first field-scale cleaning of contaminated underground storage tanks with a robotic system in the DOE complex.</i> | | | |
| | project management plan (PMP), GAAT, treatability study, performance criteria, organizational roles and responsibilities, work breakdown structure (WBS), schedule, milestones, cost estimate | 12/1/95 | ORNL/ER-254 | | Project management plan for the gunite and associated tanks treatability studies project at Oak Ridge National Laboratory, Oak Ridge, Tennessee | Lockheed Martin Energy Systems, Inc. and Jacobs Engineering Group Inc. | Hanford Web Site PDF http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=2101 | |
| Abstract: | | | | | <i>This plan for the Gunite and Associated Tanks (GAAT) Treatability Studies Project satisfies the requirements of the program management plan for the Oak Ridge National Laboratory (ORNL) Environmental Restoration (ER) Program as established in the Program Management Plan for the Martin Marietta Energy Systems, Inc., Oak Ridge National Laboratory Site Environmental Restoration Program. This plan is a subiter of several other ER documents designed to satisfy the US Department of Energy (DOE) Order 4700.1 requirement for major systems acquisitions. This project management plan identifies the major activities of the GAAT Treatability Studies Project; establishes performance criteria; discusses the roles and responsibilities of the organizations that will perform the work; and summarizes the work, breakdown structure, schedule, milestones, and cost estimate for the project.</i> | | | |
| | fluidic pulse jet mixing, RH-TRU sludge mobilization and retrieval, ORNL | 1/1/98 | ORNL/TM-13578 | | Demonstration of fluidic pulse jet mixing for a horizontal waste storage tank | Kent, T.E.; Taylor, S.A.; Moore, J.W.; Steller, J.L.; Billingsley, K.M | Hanford Web Site PDF http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=1921 | |
| Abstract: | | | | | <i>A fluidic pulse jet mixing system, designed and fabricated by AEA Technology of the United Kingdom, was successfully demonstrated for mobilization and retrieval of remote handled transuranic (RH-TRU) sludge from a 50,000-gal horizontal waste storage tank at Oak Ridge National Laboratory (ORNL). The pulse jet system, consisting of seven modular equipment skids, was installed and commissioned in about 7 weeks and operated remotely for 52 days to remove about 88% of the sludge in the tank. The system used specially designed fluidic jet pumps and pulse vessels, along with existing submerged nozzles for mixing the settled sludges with existing supernate in the tank. The operation also used existing piping and progressive cavity pumps for retrieval and transfer of the mixture. A total of 64,000 gal of liquid was required to transfer 6300 gal of sludge to the Melton Valley Storage Tanks (MVSTs) designated for consolidation of all ORNL RH-TRU sludges. Of the liquid used for the retrieval, 88% was existing or recycled tank supernate and only 7770 gal of additional process water was added to the system. Minimizing the addition of process water is extremely important at ORNL, where tank system storage capacity is limited. A simple manual sluicer was used periodically to wash down and aid the removal of localized sludge heels.</i> | | | |

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| Category | KeyWord | Document Date | | Title | Source | Comments |
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| | | Release Date | Document Number | | | |
| <u>Miscellaneous</u> | Request for proposal (RFP), waste retrieval demonstration, capabilities, statement of work (SOW) | 8/6/97 | PMM-JRO-808 | Lockheed Martin Hanford Corporation C-106 Waste Retrieval Demonstration Request for Proposal (RFP), Solicitation #WA31512 | This RFP can be downloaded from the internet at http://www.hanford.gov/tanks/html/business/c106rfp/index.htm . | |
| <u>References</u> | | | | No Author Information Available ... | http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=313 | |
| Abstract: | | | | <p>The purpose of the Tank 241-C-106, Waste Retrieval Demonstration is the removal of the waste in single-shell tank (SST) 241-C-106 using a performance based service contract. In performing this work, the project will demonstrate retrieval systems capable of removing stubborn (heel) wastes from potentially leaking tanks. The waste retrieval mission must be accomplished without adverse affects on the environment or the health and safety of the workers or public. This work will be completed in a series of tasks that will first demonstrate and qualify the retrieval system at the Seller's facilities. The system will be moved to Hanford for further testing and training, culminating with installation of the system on C-106 and retrieving the waste heel from the tank. The major tasks and the responsibilities for all work are delineated in Scope of Work referenced below.</p> <p>Three critical response dates are:</p> <p>August 18, 1997 - Notify the Buyer of intent to propose, anticipated team members and primary contact.</p> <p>September 24, 1997 - Notify the buyer of intent to propose, all teaming members and corporate affiliates.</p> <p>October 8, 1997 - Proposals due.</p> <p>Refer to section 1.2 Critical Dates for detailed information.</p> <p>All portions of the RFP are identified in the Index below. Offerors are instructed to delete all drafts from their systems and down load the final edition. Please read the information carefully, since changes from the previous comment cycle have been incorporated into all portions of the RFP. Only proposals to the final RFP will be accepted.</p> | | |
| | fiscal year (FY) technology testing report, retrieval process development and enhancements | 9/1/96 | PNNL-11349 | Tanks Focus Area Retrieval Process Development and Enhancements FY96 Technology Development Summary Report | Hanford Web Site HTML / PDF / WP / Native http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=514 | |
| Abstract: | | | | <p>The purpose of this report is to describe and summarize the Retrieval Process Development and Enhancements technology testing activities in FY96. The detailed final FY96 testing reports from the various Retrieval Process Development and Enhancements technology development subtasks are listed in the appendix of this document.</p> <p>The Retrieval Process Development and Enhancements (RPD&E) activities are part of the Retrieval and Closure Program of the U.S. Department of Energy (DOE) EM-50 Tanks Focus Area. The purposes of RPD&E are to understand retrieval processes, including emerging and existing technologies, and to gather data on those processes, so that end users have the requisite technical basis to make retrieval decisions. Work has been initiated to support the need for multiple retrieval technologies across the DOE complex. Technologies addressed during FY96 focused on enhancements to sluicing, borehole mining, confined sluicing retrieval end effectors, the lightweight scarifier, and pulsed air mixing. Furthermore, a decision tool and database have been initiated to link retrieval processes with tank closure to assist end users in making retrieval decisions.</p> | | |

Document Log Report

| Category | KeyWord | Release Date | Document Number | Title | Author(s) | Field Performance of the Waste Retrieval End Effectors in the Oak Ridge Gunitite Tanks | Source | Web Address | Comments |
|---------------------------------|--|--------------|-----------------|--|------------------------------|--|---|-------------|----------|
| Miscellaneous References | waterjet-based tank waste retrieval end effectors testing, robotic arm, simulants, ORNL, modified LDVA, houdini remotely operated vehicle, GAAAT-TS, RPD&E | 9/1/97 | PNNL-11688 | | Mullen, O.D. | | Hanford Web Site HTML / PDF http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=520 | | |
| Abstract: | | | | Waterjet-based tank waste retrieval end effectors have been developed by Retrieval Process Development and Enhancements through several generations of test articles targeted at deployment in Hanford underground storage tanks with a large robotic arm. The basic technology has demonstrated effectiveness for retrieval of simulants bounding a wide range of waste properties and compatibility with foreseen deployment systems. The Oak Ridge National Laboratory (ORNL) selected the waterjet scarifying end effector, the jet pump conveyance system, and the Modified Light Duty Unity Arm and Houdini Remotely Operated Vehicle deployment and manipulator systems for evaluation in the Gunitite and Associated Tanks Treatability Study (GAAAT-TS). The Retrieval Process Development and Enhancements (RPD&E) team was tasked with developing a version of the retrieval end effector tailored to the Oak Ridge tanks, waste, and deployment platforms. | | | | | |
| | | | | The conceptual design was done by the University of Missouri-Rolla in FY 1995-96. The university researchers conducted separate effects tests of the component concepts, scaled the basic design features, and constructed a full-scale test article incorporating their findings in early FY 1996. The test article was extensively evaluated in the Hanford Hydraulic Testbed and the design features were further refined. Detail design of the prototype item was started at Waterjet Technology, Inc. before the development testing was finished, and two of the three main subassemblies were substantially complete before final design of the waterjet manifold was determined from the Hanford hydraulic testbed (HTB) testing. The manifold on the first prototype was optimized for sludge retrieval; assembled with that manifold, the end effector is termed the Sludge Retrieval End Effector (SREE). | | | | | |
| | F&R, GAAAT, ORNL, CERCLA, RI/FS, TDEC | 11/5/98 | PNNL-11876 | Functions and Requirements for a Waste Conveyance Jet Pump for the Gunitite and Associated Tanks at Oak Ridge National Laboratory | OD Mullen | | Hanford Web Site No electronic Copies Available http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=526 | | |
| Abstract: | | | | Since the mid 1940's, the U.S. Department of Defense (DOD) and the U.S. Department of Energy (DOE) have conducted research and development activities at the Oak Ridge National Laboratory (ORNL) in support of urgent national interests in the fields of nuclear weaponry and nuclear energy. Some of these activities resulted in radiologically hazardous waste being temporarily deposited at ORNL in Waste Area Grouping 1. At this location, waste is stored in several underground storage tanks, awaiting ultimate final disposal. There are tanks of two basic categories; one category is referred to as the "gunitite" tanks, and the other category is "associated" tanks. The ORNL Gunitite and Associated Tanks Treatability Study (GMT-TS) project was initiated in fiscal year (FY) 1994 to support a record of decision in selecting from seven different options of technologies for retrieval and remediation of these tanks. This decision process is part of a Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), Remedial Investigation and Feasibility Study (RI/FS) presented to DOE and the Tennessee Department of Environment and Conservation (TDEC). As part of this decision process, new waste retrieval technologies were evaluated at the 25-ft diameter gunitite tanks in the North Tank Farm. | | | | | |
| | fiscal year (FY) midyear report, technology review | 6/1/98 | PNNL-11906 | Tanks Focus Area FY98 midyear technical review | Schlahta, S.N.; Browns, T.M. | | Hanford Web Site PDF http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=1970 | | |
| Abstract: | | | | The Tanks Focus Area (TFA) serves as the DOE's Office of Environmental Management's national technology and solution development program for radioactive waste tank remediation. Its technical scope covers the major functions that comprise a complete tank remediation system: waste retrieval, waste pretreatment, waste immobilization, tank closure, and characterization of both the waste and tank with safety integrated into all the functions. In total, 17 technologies and technical solutions were selected for review. The purpose of each review was to understand the state of development of each technology selected for review and to identify issues to be resolved before the technology or technical solution progressed to the next level of maturity. The reviewers provided detailed technical and programmatic recommendations and comments. The disposition of these recommendations and comments and their impact on the program is documented in this report. | | | | | |
| | performance evaluation, rotation pump jet mixing, adequacy study, TEMPEST computer code modeling | 7/1/98 | PNNL-11920 | Performance evaluation of rotating pump jet mixing of radioactive wastes in Hanford Tanks 241-AP-102 and -104 | Omishi, Y.; Recknagle, K.P. | | Hanford Web Site PDF http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=2148 | | |
| Abstract: | | | | The purpose of this study was to confirm the adequacy of a single mixer pump to fully mix the wastes that will be stored in Tanks 241-AP-102 and -104. These Hanford double-shell tanks (DSTs) will be used as staging tanks to receive low-activity wastes from other Hanford storage tanks and, in turn, will supply the wastes to private waste vitrification facilities for eventual solidification. The TEMPEST computer code was applied to Tanks AP-102 and -104 to simulate waste mixing generated by the 60-ft/s rotating jets and to determine the effectiveness of the single rotating pump to mix the waste. TEMPEST simulates flow and mass/heat transport and chemical reactions (equilibrium and kinetic reactions) coupled together. Section 2 describes the pump jet mixing conditions the authors evaluated, the modeling cases, and their parameters. Section 3 reports model applications and assessment results. The summary and conclusions are presented in Section 4, and cited references are listed in Section 5. | | | | | |

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| Category | KeyWord | Document Date | | Document Number | Title | Author(s) | Source | | Comments |
|---------------------------------|--|---------------|---|-----------------|--|------------|--|--|--|
| | | Release Date | | | | | Web Address | | |
| Miscellaneous References | PITBULL™, performance evaluation, Savannah River, test results, conclusions and recommendations | 9/1/98 | PNNL-11968 | | Performance evaluation of the PITBULL {trademark} pump for the removal of hazardous waste | | Hanford Web Site PDF http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=1974 | | |
| Abstract: | | | | | <i>Kent, T.E.; Hylton, T.D. [Lockheed Martin Energy Research Corp., Oak Ridge, TN (United States), Chemical Technology Div.]; Taylor, S.A. [AEA Technology, Cheshire (United Kingdom)]; Moore, J.W. [Bechtel Jacobs Co. LLC, Oak Ridge, TN (United States)]; Hatchell, B.K.; Combs, W.H.; Hymas, C.R.; Powell, M.R.; Rinker, M.W.; White, M.</i> | | | | <i>One objective of the Waste Removal Project at the Department of Energy's Savannah River Site (SRS) is to explore methods to successfully remove waste heels that will remain in the high-level waste tanks after bulk waste removal has been completed. Tank closure is not possible unless this residue is removed. As much as 151,000 liters of residue can remain after a conventional waste removal campaign. The waste heels can be comprised of sludge, zeolite, and silica. The heels are generally hardened or compacted insoluble particulate with relatively rapid settling velocities. A PITBULL {trademark} pump is being considered by SRS to retrieve sludge-type waste from Tank 19. Sections 1 through 4 of this report present the scope and objectives of the test program, describe the principles of operation of the PITBULL, and present the test approach, set-up, and instrumentation. Test results, including pumping rates with water and slurry, are provided in Section 5, along with considerations for remote operation. Conclusions and recommendations are provided in Section 6.</i> |
| | technology review, requirements verification, thickness technologies | 9/1/94 | SAND94-1235 / ACTR File #20 | | A Review of Technology for Verification of Waste Removal from Hanford Underground Storage Tanks (WHC Issue 30) | S Thunborg | Hanford Web Site No Electronic Copies Available... http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=145 | | |
| Abstract: | | | | | <i>Remediation of waste from Underground Storage Tanks (UST) at the Hanford Waste storage sites will require removal of all waste to a nearly clean condition. Current requirements are 99% clean. In order to meet remediation legal requirements, a means to remotely verify that the waste has been removed to sufficient level is needed. This report discusses the requirements for verification and reviews major technologies available for inclusion in a verification system. The report presents two operational scenarios for verification of residual waste volume. Thickness verification technologies reviewed are Ultrasonic Sensors, Capacitance Type Sensors, Inductive Sensors, Ground Penetrating Radar, and magnetometers. Of these technologies Inductive (Metal Detectors) and Ground Penetrating Radar appear to be the most suitable for use as waste thickness sensors.</i> | | | | |
| | No Keywords Available... | 3/1/98 | TPG-0398-01 | | Houdini Remotely Operated Vehicle System Performance Assessment for Tank W-3 Waste Removal Operations | | Hanford Web Site PDF http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=324 | | |
| Abstract: | <i>No Abstract Information Available...</i> | | | | <i>The Providence Group</i> | | | | |
| | high pressure scarifier/pneumatic conveyance testing, parametric performance data development, arm based manipulator | 9/1/94 | TR-631/09-94 / ACTR File #25 and ACTR File #58 / QUEST-631 / PNL-8901 | | Development of a Multi-Functional Scarifier Disloderger with an Integral Pneumatic Conveyance Retrieval System for Single-Shell Tank Remediation - Summary Report <i>DG Alberts; DO Monserud</i> | | Hanford Web Site No Electronic Copies Available... http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=127 | | 2 Records in RMIS (See alternate Document Numbers) |
| Abstract: | | | | | <i>The objective of this investigation is to develop parametric performance data and develop a high-pressure scarifier/pneumatic conveyance test platform to simulate retrieval salt cakes, sludge, and viscous fluids from single-shell tanks. The initial application of this approach is planned for tank C-106 through EM30 Project W-340. The current retrieval strategy proposes the use of an arm-based system to remove the waste remaining in the tank after past-practice sluicing has reduced the waste volume to an impenetrable heel and residual sludge. A key variable in the design and procurement of this manipulator is the payload of the proposed waste retrieval system. This research supports the development of the high-pressure scarifier and conveyance system and the definition of the performance and system payload.</i> | | | | |

Document Log Report

| Category | Keyword | Release Date | Document Number | Title Author(s) | Source Web Address | Comments |
|-------------------------------------|--|--------------|---------------------------------|--|---|---|
| <u>Miscellaneous References</u> | Results and test, mechanical, hydraulic, pneumatic | 12/1/75 | VITRO-R-375 / ACTR File #138 | Evaluation and Adaptation of Standard Mechanical, Hydraulic, and Pneumatic Devices for Saltcake and Sludge Retrieval at Hanford Hanford J Buldrige | Hanford Web Site No electronic Copies Available http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=122 | |
| Abstract: | | | | | | <i>This study provides results and tests commercially available equipment for mechanical, hydraulic and pneumatic retrieval of waste. Jack hammers, a mechanical arm with bucket, a bucket elevator, pumps, and pneumatic suction equipment are evaluated. Recommendation for in-tank testing are also included.</i> |
| | | | | | | <i>The mechanical equipment evaluated could be used to maneuver pneumatic and hydraulic retrieval systems within the tank. Most of the mechanical retrieval discussion pertained to concepts for installation of the equipment into the tank rather than retrieval of waste.</i> |
| | | | | | | <i>Breakup Equipment</i> |
| | | | | | | <i>An equipment search for standard, commercially available breakup devices was limited to demolition (Jack) hammers due to availability of equipment. Different hammers were tested on concrete. Breakup rates ranged up to 26 barrels/hr. The results of demolition hammer tests, and 12-in. trench bucket tests are summarized in this report.</i> |
| | | | | | | <i>Mechanical Retrieval Equipment</i> |
| | | | | | | <i>A Gradall 660 (a trademark of _____) hydraulically actuated, boom-mounted excavator was selected as suitable for in-tank mining. A Gradall 660 upper structure consisting of a hydraulic system control cab, stripped-boom assembly, and bucket was purchased for testing. The Gradall 660 with bucket during tests loaded broken concrete at a rate of at least 40 barrels/hr. A 12-in-wide trenching bucket mined soft sludge, jelly-type saltcake, and reacted diatomaceous earth caustic liquid at about 15 barrels/hr in a simulation of near-bottom mining.</i> |
| | | | | | | <i>Adaptation of the Gradall 660 to tank waste retrieval would require a mounting column with trunnions to attach the boom to the column, a column rotation system, and an aboveground support structure. Concepts to adapt the Gradall to a tank include a rotatable, pivotable anchor supported above the tank by an L-beam bridging structure. Fifty feet of overhead clearance would allow for installation and removal of the boom and the addition of vertical sections. Preliminary calculations indicate the aboveground support structure and containment enclosure would weigh over 100 tons.</i> |
| | | | | | | <i>With boom extensions, all waste could be mined from a central location. An additional 42-in riser ideally would be installed 30 ft from the center so the excavator could release the load directly into a hopper. Otherwise a two step operation may be required to bring material inward from outer tank edge.</i> |
| | | | | | | <i>Bucket/Hopper Elevator</i> |
| | | | | | | <i>An equipment search identified the hopper elevator as the preferred mechanical conveyance to be used in conjunction with the Gradall miner. A hopper can raise at least 30 barrels/hr of saltcake while operating at a conventional hoist rate of about .33 ft/sec. The hopper can also handle material up to 30-in. long.</i> |
| | | | | | | <i>A vendor built several hopper elevators for charging catalytic reactors by remote control. The vendor's concept is a rail-guided, 150-gal container raised and lowered by a conventional air-driven hoist at the rate of about .33 ft/sec; a 35-ft-long unit is suitable for tank use.</i> |
| | | | | | | <i>Vitro also developed hopper elevator concepts. The drawings are included in the report. A list of companies invited to bid on a barrel/hopper elevator is also included.</i> |
| | | | | | | <i>Hydraulic Retrieval Equipment</i> |
| | | | | | | <i>Two high-density solid pumps along with a special hydraulic power system were purchased for testing. Bench-scale testing of the pumps defined operability ranges and moisture/mother liquor profiles to determine if liquid waste is hydraulically retrievable.</i> |
| | | | | | | <i>The pump would be maneuvered in the tank by some mechanical system such as the Gradall 660 described in the mechanical retrieval equipment section.</i> |
| | | | | | | <i>No testing was done to test pumping of saltcake and sludges.</i> |
| | | | | | | <i>Pneumatic Retrieval Equipment</i> |
| | | | | | | <i>A search for standard off-the-shelf equipment found readily adaptable pneumatic equipment for retrieving saltcake and sludge from underground tanks.</i> |
| | | | | | | <i>Twelve retrieval tests were conducted with a vacuum truck with a nominal 2,700 cfm triple stage suction fan. Sticky saltcake was mined pneumatically at the reduced rate of about five barrels/hr. Detailed results are summarized in the report.</i> |
| | | | | | | <i>Previous testing has shown that typical forces (air erosion) at a pneumatic suction nozzle are not sufficient to break up damp saltcake (jellylike). The feasibility test clearly showed that hydraulic and mechanical breakup devices are needed.</i> |
| | | | | | | <i>Bidders on a pneumatic retrieval system are listed in the report.</i> |
| | | | | | | <i>General Information</i> |
| | | | | | | <i>The following information addresses some requirements and pertinent information covered in this report:</i> |
| | | | | | | <i>Uncontrolled liquid addition to a tank to produce a pumpable slurry was considered unacceptable.</i> |
| | | | | | | <i>Mining rate requirements were based on the capacity of the waste treatment facility.</i> |
| | | | | | | <i>Laboratory agitation viscosity tests conducted by ARH personnel substantiate that some saltcakes and most wet sludges are thixotropic (become fluid when agitated and set again when left at rest).</i> |
| | | | | | | <i>A floating 10-ft layer of digester scum, appearing to be similar to Hanford's jelly-type saltcake, was emulsified by a 300 Scumbuster pump (a trademark of Vaughn Pump Company).</i> |

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| | | | | <i>The barrel/hopper elevator structure will be supported above-ground so that no forces are applied to the riser.</i> | | | | |
| | | | | <i>The pneumatic system must be able to retrieve all liquids and soft materials such as sludge and granular saltcake at a depth of 60-ft. Other retrieval schemes are unable to remove near-bottom sludge that contains the bulk of the actinide and fission product inventory.</i> | | | | |
| | alternatives study, single shell tank (SST) retrieval, retrieval technologies identification, USTID Program | 11/24/92 | WHC-SD-TD-ER-002 | Alternatives Methods Study for the Retrieval of Single-Shell Tanks | BC Cornwell | Hanford Web Site No electronic Copies Available http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=104 | | |
| Abstract: | | | | <i>This report documents an effort made as part of the Underground Storage Tank Integration Demonstration program in fiscal year 1992. The report identified retrieval technologies for single-shell tanks at the Hanford Site.</i> | | | | |
| | USTIC Program, technology development, robotics technology, critical technical issues investigation, long-reach manipulators | 10/4/93 | WHC-SD-TD-TRP-001 | Underground Storage Tank Waste Retrieval Technology Demonstration Test Report | WR Jaquish, YR Enderlin | Hanford Web Site No electronic Copies Available http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=141 | | |
| Abstract: | | | | <i>This report documents the technology development activities for underground storage tank (UST) retrieval conducted in the Hanford Site 337 High-Bay in fiscal year (FY) 1991 and FY 1992. These development activities were funded by the U.S. Department of Energy (DOE), Office of Technology Development, Robotics Technology Development Program (RTDP), and the Underground Storage Tank Integrated Demonstration (USTID) program. The purpose of these programs was to investigate critical technical issues regarding the application of long-reach manipulators to the problem of retrieving waste from USTs.</i> | | | | |
| | cost justification, advanced design mixer pump program, LLC, computer modeling | 7/23/96 | WHC-SD-WM-CBA-001, Rev. 0 | Life-cycle cost analysis of advanced design mixer pump | Hall, M.N., Westinghouse Hanford | Hanford Web Site PDF http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=2171 | | |
| Abstract: | | | | <i>This analysis provides cost justification for the Advanced Design Mixer Pump program based on the cost benefit to the Hanford Site of 4 mixer pump systems defined in terms of the life-cycle cost. A computer model is used to estimate the total number of service hours necessary for each mixer pump to operate over the 20-year retrieval sequence period for single-shell tank waste. This study also considered the double-shell tank waste retrieved prior to the single-shell tank waste which is considered the initial retrieval.</i> | | | | |
| | GAAT treatability study, ORNL, F&OR for waste dislodging and conveyance | 9/1/95 | WHC-SD-WM-FRD-024, Rev. 0 | Functions and requirements for a waste dislodging and conveyance system for the Gunite and Associated Tanks Treatability Study at Oak Ridge National Laboratory | Potter, J.D., Mullen, O.D. | Hanford Web Site PDF http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=1862 | | |
| Abstract: | | | | <i>Functions and requirements for the Waste Dislodging and Conveyance System to be deployed in Gunite and Associated Tanks (GAAT) and tested and evaluated as a candidate tank waste retrieval technology by the GAAT Treatability Study (GAAT TS).</i> | | | | |

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| <u>Miscellaneous</u> <u>References</u> | ARD Environmental' s self-propelled robotic crawler vehicles, equipment capability, test performance | 7/11/96 | 7/11/96 | WHC-SD-WM-TD-011, Rev. 0, 0A | Testing of Scavenger Systems Dislodging & Conveyance Devices | Ramsower, D.C., Westinghouse Hanford | Hanford Web Site HTML / PDF / WP / Native http://www.tanks.org/documentsearchresuIssingle.asp?documentid=547 | |
| Abstract: | | | | | <i>Testing of ARD Environmental's self-propelled robotic crawler vehicles using various mechanical dislodging devices (rotary cutter, scabbler, jackhammer) and conveyance pumps (air and hydraulic/water) on Hanford Site single-shell tank (SST) waste simulants. The scope of this work was to evaluate ARD's equipment capability to break up and convey the waste simulants. Tests were performed, documented, analyzed, reported, and follow-on testing efforts were recommended. The focus was testing existing technologies against materials likely to be encountered during actual tank cleaning and no optimization of system was performed under this test plan.</i> | | | |
| | alternative technology acquisition, waste retrieval acquisition strategy | 10/14/96 | 10/14/96 | WHC-SD-WM-TD-016, Rev. 0 | Hanford tanks initiative technology demonstration and waste retrieval acquisition strategy | Ramsower, D.C. | Hanford Web Site PDF http://www.tanks.org/documentsearchresuIssingle.asp?documentid=2186 | |
| Abstract: | | | | | <i>This document describes the alternative technology acquisition and waste retrieval acquisition strategy for the Hanford Tanks Initiative (HTI).</i> | | | |
| | Viewing, Video, Camera, Savannah River, Hanford Development, Deployment | | | WSRC-MS-96-0719, CONF-970464- | Viewing Systems for Large Underground Storage Tanks | Heckendorn, F.M., Robinson, C.W., Anderson, E.K. [Westinghouse Savannah River Co., Aiken, SC (United States)], Pardini, A.F. [Westinghouse Hanford Co., Richland, WA (United States)] | Hanford Web Site PDF http://www.tanks.org/documentsearchresuIssingle.asp?documentid=2201 | |
| Abstract: | | | | | <i>Specialized remote video systems have been successfully developed and deployed in a number of large radiological Underground Storage Tanks (USTs) that tolerate the hostile tank interior, while providing high resolution video to a remotely located operator. The deployment is through 100 mm (4 in) tank openings, while incorporating full video functions of the camera, lights, and zoom lens. The usage of remote video minimizes the potential for personnel exposure to radiological and hazardous conditions, and maximizes the quality of the visual data used to assess the interior conditions of both tank and contents. The robustness of this type of remote system has a direct effect on the potential for radiological exposure that personnel may encounter. The USTs typical of the Savannah River and Hanford Department Of Energy - (DOE) sites are typically 4.5 million liter (1.2 million gal) units under earth, or concrete overburden with limited openings to the surface. The interior is both highly contaminated and radioactive with a wide variety of nuclear processing waste material. Some of the tanks are flammable rated -to Class I, Division 1, and personnel presence at or near the openings should be minimized. The interior of these USTs must be assessed periodically as part of the ongoing management of the tanks and as a step towards tank remediation. The systems are unique in their deployment technology, which virtually eliminates the potential for entrapment in a tank, and their ability to withstand flammable environments. A multiplicity of components used within a common packaging allow for cost effective and appropriate levels of technology, with radiation hardened components on some units and lesser requirements on other units. All units are completely self contained for video, zoom lens, lighting, deployment, as well as being self purging, and modular in construction.</i> | | | |
| | Savannah River, Hanford, video, photography, robotics development groups, OST Program | 11/4/96 | 11/4/96 | WSRC-MS-96-0720;CONF-970462-5 | Remote Viewing End Effectors for Light Duty Utility Arm Robot (U) | Heckendorn, F.M [Westinghouse Savannah River Company, AIKEN, SC (United States)], Robinson, C.W.; Haynes, H.B.; Anderson, E.K.; Pardini, A.F. [Westinghouse Hanford Co., Richland, WA (United States)] | Hanford Web Site PDF http://www.tanks.org/documentsearchresuIssingle.asp?documentid=2202 | |
| Abstract: | | | | | <i>The Robotics Development Groups at the Savannah River Site (SRS) and at the Hanford site have developed remote video and photography systems for deployment in underground radioactive-waste storage tanks at the Department of Energy (DOE) sites as a part of the Office of Science and Technology (OST) program within DOE. Viewing and documenting the tank interiors and their associated annular spaces is an extremely valuable tool in characterizing their condition and contents and in controlling their remediation. Several specialized video/photography systems and Robotic End Effectors have been fabricated that provide remote viewing and lighting. All are remotely deployable into and out of the tank, with all viewing functions remotely operated. Positioning all control components away from the facility prevents the potential for personnel exposure to radiation and contamination. Only the remote video systems are discussed in this paper.</i> | | | |
| | Savannah River, density driver salt dissolution, laboratory experiments, tank 41H | | | WSRC-TR-96-0160 Conf-980368 | An Investigation of Density Driven Salt Dissolution Techniques | B. J. Wiersma, Westinghouse Savannah River Company | Hanford Web Site PDF http://www.tanks.org/DocumentSearchResuIssingle.asp?DocumentID=2207 | |
| Abstract: | | | | | <i>Laboratory experiments were performed to support the salt dissolution demonstration in Tank 41H. The desire was to improve upon past salt dissolution operations and develop a safe, efficient and cost effective means for future operations.</i> | | | |

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| <u>Prior to ACTR/HTI</u> | Mechanical, Mining, ARM, Tools, conceptual design | 9/13/77 | ARH-C-20 | Prototype Waste Retrieval System - Conceptual Design Final Report | Hanford Web Site No electronic Copies Available http://www.tanks.org/documentsearchresu/Issingle.asp?documentid=219 | |
| Abstract: | | | | <i>This is the second study in the series of four reports, starting with ARH-LD-144, that lead to the completion of the design of a prototype mechanical mining retrieval system. This study is essentially a conceptual design report for a system consisting of an arm with interchangeable tools.</i> | | |
| | | | | <i>This report covers the conceptual design of a prototype waste retrieval system to remove defense wastes from underground storage tanks. This report presents the specifications and design considerations and a complete discussion of the prototype design. The basic concept of an articulated mining boom capable of entering a 42-in-diam. tank riser was developed during the initial study effort, which ran from April 1975 to November 1975. Work resumed in July 1976.</i> | | |
| | | | | <i>The retrieval system elements include the following:</i> | | |
| | | | | <i>Mining equipment to remove waste material from the tank and move it to the surface</i> | | |
| | | | | <i>Surface loading facility to package or prepare the retrieved waste for transport to an onsite processing facility or storage area</i> | | |
| | | | | <i>A means of transporting the waste to the processing facility or storage site</i> | | |
| | | | | <i>Equipment to allow movement of the retrieval system from one tank to another</i> | | |
| | | | | <i>A facility for the decontamination and maintenance of the retrieval equipment</i> | | |
| | | | | <i>A remote controlled video system with suitable lighting to enable the equipment operator to see the retrieval equipment operating in the tank</i> | | |
| | | | | <i>A control center from which all operations can be controlled and monitored.</i> | | |
| | | | | <i>The mining equipment includes: a remote-controlled boom entering remotely interchangeable mining tools and an elevator to move the waste to the surface. The mining tools include: breaking up hard layers of waste, removing in-tank obstructions, moving material to the elevator, and performing final tank cleanup.</i> | | |
| | | | | <i>these tools and their predicted weights include the following:</i> | | |
| | | | | <i>Clamshell bucket, 850 lb.</i> | | |
| | | | | <i>Hydraulic impact hammer, 1,460 lb. complete assembly</i> | | |
| | | | | <i>Backhoe, 725 lb.</i> | | |
| | | | | <i>External pipe cut-off tool (torch, abrasive cutting saw, band saw, or arc saw) 1,000 lb.</i> | | |
| | | | | <i>Rod/cable cutting tool (hydraulic shear) cutter - 240 lb., overall assembly 900 lb.</i> | | |
| | | | | <i>Object handling tool (similar to clamshell bucket), 850 lb.</i> | | |
| | | | | <i>Wall cleaner, (two hydraulically driven heads, one a brush), 1,150 lb.</i> | | |
| | | | | <i>Internal pipe cutoff tool (torch) 800 lb.</i> | | |
| | | | | <i>The retrieval equipment is housed in a T-shaped structure, which spans a tank, to avoid putting loads on the tank dome. The structure is supported at three points, which allows movement over uneven terrain without warping like four point support structures.</i> | | |
| | | | | <i>Waste material is removed by an articulated, hydraulically actuated mining boom, which operates through a 42-in riser in the center of the tank dome. The boom is mounted on the end of a telescoping hoist that draws the boom into a support facility above the tank for tool changing, maintenance, and moving between tanks.</i> | | |
| | | | | <i>A variety of remotely interchangeable tools would be available to the boom for removing pipes and other tank obstacles: breaking up hard waste material, moving waste material to an elevator, and performing final tank cleanup. The waste elevator operates through a 42-in riser located 20 ft 9 in. from the tank centerline.</i> | | |
| | | | | <i>The major item in the conceptual design is the waste retriever. The equipment is capable of the following eight processes: (1) entering the tank through a 42-in riser, (2) picking up waste material, (3) moving waste into an elevator, (4) raising the elevator through a second 42-in riser, (5) dumping the material into a shipping container, (7) placing the shipping container into a sealing container, and (8) loading the containers onto a special tractor/trailer for transport to the processing facility.</i> | | |
| | | | | <i>The mining boom has 8-ft 7-in-long sections with 1000 of rotation (in-line to right angle). The end section of the boom has an additional motion of 1000 for positioning mining tools.</i> | | |
| | | | | <i>Material Elevator</i> | | |
| | | | | <i>The conceptual design uses an elevator bucket that is pivoted from a vertical position to a position over a shipping container and the bucket-bottom door opens-to discharge the material. A waste-water spray, mounted over the elevator bucket, washes the material out during each discharge. An alternate method of emptying</i> | | |

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| | | | | | | <i>the elevator bucket uses a hydraulic rotary actuator to dump the bucket, so that the material is discharged through the open top of the bucket. This method presents a problem of containing the spillage of material during dumping and requires the use of movable baffles. This alternative method also requires considerably more headroom in the filling room, resulting in an increase in shielding weight.</i> |
| | | | | | | <i>The conceptual design uses a telescoping tube to provide vertical travel. An alternative consideration is to have fixed guide rails extending into the tank. The alternative consideration has several disadvantages:</i> |
| | | | | | | <i>The guide rails are an obstruction around which the boom must work</i> |
| | | | | | | <i>The elevator cannot enter a filled tank, nor follow the changing waste material level</i> |
| | | | | | | <i>The elevator needs to be assembled and disassembled each time the system is moved from tank to tank.</i> |
| | | | | | | <i>Main Structure</i> |
| | | | | | | <i>Nonmobile structure, cross-shaped, and H-shaped are several options considered for the main support structure for the system.</i> |
| | | | | | | <i>The nonmobile structure involves moving the system between tank and entails partial disassembly, moving subsections by a truck-mounted crane and reassembling the system.</i> |
| | | | | | | <i>The cross-shaped structure consists of four structural sections that extend from the tank center to points beyond the tank perimeter. A tracked transporter would be located at each of the four ends of the cross. The problem with this arrangement is that transporters must pass over the tank in moving the system, from one tank to another, unless a complicated moving pattern involving rotating the structure while it is translated is used. Extending the four legs on a diagonal so that the transporters clear the tank involves an excessively long structure. Large torsional loads can be imposed on the structure if the four points are not kept level at all times. Extensive grading and leveling would be needed in the waste tank area.</i> |
| | | | | | | <i>The H-shaped structure consists of transporters at each end, which would not impose loads on the dome during movement between tanks. The H-shaped structure involves a large structure and bears the problem of excessive loads imposed by four support points.</i> |
| | | | | | | <i>General Information</i> |
| | | | | | | <i>The following assumptions and requirements were used for the development of the prototype system:</i> |
| | | | | | | <i>The retrieval equipment will be remotely controlled with no personnel access allowed inside the tank at any time</i> |
| | | | | | | <i>Access to tank interior will be through a 42-in riser penetrating the tank dome. For the prototype design, the tank consists of two 42-in. risers: one on tank centerline, and one located 20 ft 9 in. from the center. Smaller risers will be available for video equipment and lighting for remote observation</i> |
| | | | | | | <i>The retrieval equipment will not be mounted directly to any riser or impose any direct loads on any riser</i> |
| | | | | | | <i>The retrieval system will be movable from tank-to-tank.</i> |
| | | | | | | <i>The retrieval equipment will be capable of removing waste from any point inside a waste tank below the liquid level line</i> |
| | | | | | | <i>The retrieval system will be capable of monitoring the radiation level, and measuring and recording on a continuous basis the amount of waste material being shipped</i> |
| | | | | | | <i>Minimum waste retrieval rate is 500 gal/hr before compensation for operator efficiency, downtime for maintenance, etc.</i> |
| | | | | | | <i>Equipment used in contaminated or potentially contaminated areas will be designed for maximum reliability, maintenance, and ease of decontamination</i> |
| | | | | | | <i>The retrieval system will minimize the amount of radioactive material discharged to the environment from the retrieval operations. This requirement applies to the shipping containers and the system structure</i> |
| | | | | | | <i>The main structure of the retrieval system will be made in sections that can be readily hauled to the site and bolted together using conventional field erection techniques</i> |
| | | | | | | <i>The retrieval system will be designed with adequate safety features to protect operating personnel from injury and exposure to hazardous radiation. The air circulation and filtering unit will be provided as an item not incorporated in the main system structure. This ventilation unit will connect to a tank riser not dedicated to the waste retrieval process</i> |
| | | | | | | <i>An average density of 1.7 per gm/cc for waste material will be used for design purposes. The hard saltcake is equivalent to poor quality concrete</i> |
| | | | | | | <i>Radioactivity is higher in sludge than saltcake. When loading shipping containers, the material loaded will be reduced to maintain an acceptable level of radioactivity</i> |
| | | | | | | <i>Retrieval equipment will be capable of mining around in-tank obstructions, or cutting them into manageable pieces and removing them. The central 42-in risers in "A" tanks extend down 25 ft below the dome. If the waste is at or near the riser bottom, the retrieval system must be capable of removing enough riser to allow the mining boom to gain entrance and be deployed in the normal operating position. Three other in-tank obstructions are as follows:</i> |
| | | | | | | <i>1. Airlift circulators - vertical standpipes 2 to 2.5-ft-dia, 10 to 22-ft long, mounted on floor or suspended from the tank dome.</i> |
| | | | | | | <i>2. Piping ranges in diam. from .075 to 6 in.</i> |
| | | | | | | <i>3. Miscellaneous rocks, bottles, pipe sections, sludge weights, small tools, section of riser covers, construction materials, gloves, plastic bags, etc.</i> |

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| Category | KeyWord | Document Date | Document Number | Title | Source | Comments |
|--------------------------|--|---------------|-----------------|---|---|----------|
| <u>Prior to ACTR/HTI</u> | feasibility study, testing and development recommendations | 6/1/90 | WHC-EP-0352 | Single-Shell Tank Waste Retrieval Study (AR File) S.A. Krieg; W.W. Jenkins; K.J. Leisi; K.G. Squires; J.F. Thompson | Hanford Web Site No electronic Copies Available http://www.tanks.org/DocumentSearchResultsSingle.asp?DocumentID=118 | |
| Abstract: | | | | <i>This study was done to satisfy the Hanford Federal Facility Agreement and Consent Order (Ecology et al. 1989) milestone M-06-01 "Identify Waste Retrieval Technologies to be Tested in Scale-Model Tank." October 1990.</i> | | |
| | | | | <i>Descriptions of the SSTs and the wastes they contain are summarized in this study.</i> | | |
| | | | | <i>The overall conclusion of this study states that waste retrieval from the SSTs is feasible based on currently available and foreseeable developments in the state-of-the-art technologies for positioning systems, end-effectors, conveyance systems, and control systems.</i> | | |
| | | | | <i>Recommendations are presented for testing and developing equipment for pumping, sluicing, conveying, and mechanical mining of the waste in the SSTs. Three types of positive displacement pumps, air jets, and water jets are recommended for development. One air conveyance system and one mechanical conveyor system are also recommended for development. Development of a mechanical arm and related mining and general use tools are recommended for breakup and removal of saltcake, riser pipes, and miscellaneous debris. The mechanical arm will also be used to position pumps or other equipment within the SST.</i> | | |
| | | | | <i>Table 1 identifies the technologies recommended for further development and the ones that are not recommended. The summaries for the identified technologies are listed below.</i> | | |
| | | | | <i>Unlimited and Limited Sluicing--Unlimited and limited sluicing are ruled-out based on the current water addition restrictions. Revisiting the water addition limits was recommended. Using an encapsulation barrier (such as a grout curtain and/or Bentonite clay leak shield) is discussed, if sluicing is used. Concerns are that a leak detection system would be needed, a leak recovery system would be needed, and the new facilities would become additional waste.</i> | | |
| | | | | <i>Boring Vehicle--Use of a boring vehicle was not recommended.</i> | | |
| | | | | <i>Carbon Dioxide Blast--It was recommended that carbon dioxide blasting not be tested or further developed at this time because requirements for the extent of the wall and floor cleanup and allowable temperature variations are not defined. Circular Rail System--Manipulators mounted on a circular rail system are rejected due to loads on tank components and the difficulty of deployment with obstructing risers.</i> | | |
| | | | | <i>Commercial Mining Equipment--Commercial mining equipment is not recommended due to the size and weight of the equipment. Downsized equipment will not work. The equipment is only good for brittle material. Damage to the liner and inability of the systems to remove in-tank obstructions are also reasons listed for not recommending this concept.</i> | | |
| | | | | <i>Confined Sluicing--Confined (contained) sluicing is recommended.</i> | | |
| | | | | <i>Electric Probes--Use of electric probes to melt the sludge before pumping was not recommended due to the excessive temperature required.</i> | | |
| | | | | <i>Focused Ultrasonics--Using focused ultrasonics to breakup solids was rejected because the technology is not available on the scale required.</i> | | |
| | | | | <i>Large Opening--Three tank penetration options are reviewed, which included: retrieval through existing penetrations, retrieval through new or existing center penetrations, and retrieval through a large opening. The use of existing penetrations was not recommended because the waste would be removed through the same penetration that the retrieval equipment is operating through and the horizontal arm reach is excessive. Further evaluation of the center penetration and large opening were recommended.</i> | | |
| | | | | <i>Laser/Inductive Heating--Using lasers or inductive heating to prepare the waste before removal was not recommended because excessive temperature was required.</i> | | |
| | | | | <i>Melt Saltcake--Melting the saltcake and sludge (i.e., with electric probes, laser, or inductive heating) to pump in the melted form was rejected due to the excessive temperature required.</i> | | |
| | | | | <i>Microwaves--Using microwaves to dry the sludge into a powder form in preparation for vacuuming was rejected because the technology is not sufficiently developed and sludge is not expected to form powder.</i> | | |
| | | | | <i>Rapid Temperature Drops--Using rapid temperature drops to break up solids was rejected because practical means to drop temperature is not available and there is no indication that temperature drop will fracture saltcake.</i> | | |
| | | | | <i>Self-Propelled Vehicle--Self-Propelled vehicles are not recommended because the vehicles would not operate on uneven waste surfaces or are not sufficiently developed. Some wastes lack strength to support the vehicles and possess ""sticky"" properties that render these vehicles useless.</i> | | |
| | | | | <i>Shaped Charges--Using small-shaped charges to break up solids was not recommended because the charges may damage the tank and other means are simpler and safer.</i> | | |
| | | | | <i>Side Entry--Side entry is not recommended because of excessive cost and no apparent advantage over cutting a hole in the top of the tank.</i> | | |
| | | | | <i>Solvents or Acids--Dissolving the waste with solvents or acids were rejected because acids damage the tank and solvents (other than water) react with the waste.</i> | | |
| | | | | <i>Mechanical Arm--Development of a light payload arm and light payload end-effectors were recommended. If this proved ineffective, heavier equipment would be developed.</i> | | |
| | | | | <i>Abrasive Cutoff Saw--The abrasive cutoff saw is recommended as a backup to the abrasive water jet.</i> | | |
| | | | | <i>Abrasive Water Jet--The abrasive water jet system is recommended as an in-tank hardware removal tool. The potential for damage to tank and liner from the jet should be addressed.</i> | | |
| | | | | <i>Air Jet--The air jet is recommended.</i> | | |
| | | | | <i>Arc Saw--The arc saw for cutting in-tank hardware is not recommended because of the difficulty of maintaining the arc and the excessive temperatures involved. The simpler abrasive cutoff saw is preferred over this option.</i> | | |

Document Log Report

| Category | KeyWord | Document Date | Document Number | Title | Author(s) | Source | Web Address | Comments |
|----------|---------|---------------|-----------------|--|-----------|--------|-------------|----------|
| | | | | Clamshell Bucket--The clamshell bucket is recommended. | | | | |
| | | | | Gas Cutting Torch--The gas cutting torch is not recommended because of potential problems with establishing and maintaining a flame in waste-encrusted material and the presence of the high-temperature flame. | | | | |
| | | | | Grabber--The grabber is recommended. | | | | |
| | | | | Impact Hammer--The commercially available impact hammer is recommended as a means of breaking up hard saltcake. | | | | |
| | | | | Impact Reduction Equipment--Impact reduction equipment is not recommended because this process is not applicable to ductile material (stainless- and carbon-steel), which comprises the bulk of the in-tank hardware. | | | | |
| | | | | Laser--Using lasers for in-tank hardware size reduction and cutup is not recommended because of system cost, operational complexity, and the potential to damage the tank wall. The excessive temperatures involved also exclude this option. | | | | |
| | | | | Plasma Arc Cutter--The plasma arc cutting system is not recommended because of the difficulty in maintaining the arc, the tendency of the airborne particles to plug and/or penetrate the absolute filters, and the excessive temperatures. | | | | |
| | | | | Pulverizer--The pulverizer is recommended for saltcake retrieval. | | | | |
| | | | | Rotary Saw--The rotary saw for cutting of in-tank hardware is not recommended because the operations performed by this saw can be performed quicker by the abrasive cutoff saw, which is less sensitive to binding and breakage. | | | | |
| | | | | Saltcake Grinder--The grinder is recommended. | | | | |
| | | | | Scarifier--The scarifying system is recommended. | | | | |
| | | | | Shear--The shearing unit is recommended as a backup to the abrasive water jet. | | | | |
| | | | | Steam Jet--The steam jet end-effector is recommended. | | | | |
| | | | | Water Jet--Both high pressure/low volume and low pressure/high volume water jet end-effectors are recommended, while development of this equipment is dependent on water addition limitations. The jets are recommended for sludge and saltcake retrieval and size reduction operations on saltcake. | | | | |
| | | | | Air Conveyor--The air conveyance system for sludge and saltcake retrieval is recommended. | | | | |
| | | | | Batch Conveyor--While not the preferred system for sludge and saltcake retrieval, the batch conveyor is recommended for development as a fall-back system. It is recommended for development for tank hardware and solid waste retrieval. | | | | |
| | | | | Belt Conveyor--The belt conveyor for sludge transport is not recommended due to the tendency of sticky material to adhere to the belt and to the high-maintenance mechanical components that would be operated in-tank. Also listed as a reason for not recommending this option was the lack of features that aid in decontamination. | | | | |
| | | | | Bucket Elevator--The bucket elevator is not recommended for sludge removal due to its inability to handle sticky material and lack of features that aid in decontamination. | | | | |
| | | | | Screw Conveyor--Developing screw elevators and conveyors are not recommended because of the inability to handle sticky materials. The problem with recovery from a breakdown with the conveyor full of waste results in an unacceptable operating system. Also listed as a reason for not recommending this option was the lack of features that aid in decontamination. | | | | |
| | | | | Centrifugal Pump--Three types of centrifugal pumps are considered: the chopper pump, centrifugal slurry pump, and multiple disc pump. Centrifugal pumps are not recommended because they normally have small or non-existent suction lifts and do not efficiently pump viscous materials such as sludge. Needed production rates are not supported. | | | | |
| | | | | Positive Displacement Pumps--Eight types of positive displacement pumps are as follows: diaphragm pump, hose pump, membrane pump, piston pump, progressive cavity pump, rotary pump, screw pump, and sine pump. The progressive cavity pump, the sine pump, and the rotary pump are recommended for testing because these pumps pump high-viscosity, abrasive fluids and slurries with relatively large particles. The piston pump and screw are not recommended due to their poor performance with abrasive, non-self lubricating fluids and inability to support the needed production rate. The membrane, hose and diaphragm pumps are not recommended due to potential chemical and radiation damage to the elastomers and tendency to plug the check valves. Also listed as a reason for not recommending the diaphragm pump is that diaphragm pumps do not support the needed production rate. | | | | |
| | | | | Jet Pump--Jet pumps are not recommended because they will not provide the necessary lift at the flowrates and densities required without excessively large quantities of air, steam, or water. Jet pumps do not support the needed production rate. | | | | |

Document Log Report

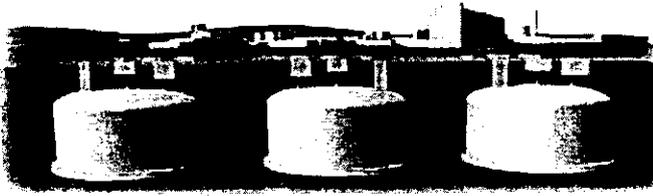
| Category | KeyWord | Document Date | | Title | Source | Comments |
|-------------------------|--|---------------|---------------------------|--|---|----------|
| | | Release Date | Document Number | | | |
| Prior to ACTR/HI | ARM, long-reach, manipulator, Tank C-106 | 1/1/94 | WHC-SD-W340-ES-00, Rev. 1 | Project W-340 Manipulator Retrieval System Tank 241-C-106 DA Wallace | Hanford Web Site No electronic Copies Available http://www.tanks.org/documentsearchresu/itsingle.asp?documentid=92 | |
| Abstract: | <p>The U.S. Department of Energy (DOE), Richland Operations Office (RO), has established the tank waste remediation system (TWRS) to resolve environmental and safety issues related to underground waste storage tanks.</p> <p>Retrieval of waste from single- and double-shell tanks is a key part of the TWRS strategy for resolving underground storage tank issues. Waste retrieval supports resolution of tank safety issues by transferring waste from aging SST into the double-shell tank (DST) system for subsequent transfer to other facilities for treatment and disposal. The retrieval process must account for wide variations in waste composition and physical properties, limited tank access, foreign objects dropped into the tanks, and in-tank equipment.</p> <p>Several technologies have been identified to retrieve waste from the SSTs. These different technologies accommodate the wide range of waste tank access. Sluicing technology was adapted from the mining industry and has been used to retrieve waste from a total of 43 SSTs between 1952 and 1978. This technology is capable of removing most of the soft waste from the tanks but is not expected to remove hard wastes. The technique would not be used on tanks that are known or suspected to leak.</p> <p>An advanced technology using long-reach manipulators to deploy waste retrieval tools inside the tank has been identified as an alternative to sluicing. This technology allows deployment of retrieval tools (end effectors) capable of retrieving wastes with a wide range of properties, including hard wastes.</p> <p>The waste retrieval program within TWRS includes a series of retrieval demonstrations in both SSTs and DSTs to validate the retrieval technologies. Demonstration of SST waste retrieval technology is required by milestone M-07-00 of the Hanford Federal Facility agreement and Consent Order (Tri-Party Agreement [TPA]). This milestone also requires removal of at least 95% of the radioactive and chemical waste inventory to demonstrate milestone completion. Tank 241-C-106 (C-106) has been selected by the DOE for this demonstration.</p> <p>Tank C-106 is a 75-ft diameter SST located in the 200 East Area of the Hanford Reservation. The tank is reinforced concrete with a carbon-steel liner on the tank bottom and sides. The tank has a useable waste depth of approximately 16 ft at the sidewalls. The top of the tank is dome shaped and is constructed of 1.5-in.-thick reinforced concrete.</p> <p>Retrieval of most of the high-heat sludge from C-106 will be accomplished by sluicing (Project W-320, "Tank 241-C-106 Sluicing"). Sluicing will leave the hardened 1- to 2-ft-thick sludge "heel" on the bottom of the tank. The long-reach manipulator retrieval system (Project W-340, "Tank 241-C-106 Manipulator Retrieval System") will remove this heel. Both of these technologies will be deployed in other SSTs to complete the waste retrieval mission. The manipulator retrieval system used on C-106 is expected to support retrieval from additional SSTs. Before conceptual design begins, a sensitivity analysis will determine the expected decay heat-generation rate, waste volume and radiation, and the effect of these on system cost.</p> | | | | | |
| | bibliography of documents | 3/1/95 | WHC-SD-WM-ES-334, Rev. 0 | Bibliography of Documents Pertaining to Retrieval of Waste from Hanford Single-Shell Tanks PW Gibbons | Hanford Web Site No electronic Copies Available http://www.tanks.org/DocumentSearchResultsSingle.asp?DocumentID=85 | |
| Abstract: | <p>This document is a listing of several studies, reports, papers, testing programs, and other pertinent data associated with single-shell tank (SST) waste retrieval methods. The documents were reviewed and divided into seven groups.</p> <ol style="list-style-type: none"> 1. Arm-Based Retrieval Demonstration 2. Tank Waste Characterization for Retrieval 3. Light-Duty Utility Arm 4. National Robotics Program 5. Underground Storage Tank Integrated Demonstration Management Documents 6. Waste Dislodging and Conveyance Program 7. Miscellaneous <p>Letter reports are attached in the Appendix to assure availability.</p> | | | | | |

APPENDIX B

**HANFORD TANK INITIATIVE/ACQUIRE COMMERCIAL
TECHNOLOGY FOR RETRIEVAL (HTI/ACTR) DATABASE**

EXAMPLE DOCUMENTS SEARCH RESULTS

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[PMM-JRO-808, Request for Proposal, WA15104-SJ, Single Shell Tank Waste Retrieval: Integrated Testing in Support of the Acquire Commercial Technology for Retrieval \(ACTR\) Program, July 25, 1996](#)

<http://www.hanford.gov/tanks/hti/documents/inttest/inttstpk.htm>

Description: *Request for Proposal (RFP) Document [Partial] -- APPENDIX A - Westinghouse Hanford Company's Request for Proposal WA15104-SJ, July 25, 1996 Request for Proposal (RFP) Document Number -- PMM-JRO-808*

[The Acquire Commercial Technology for Retrieval \(ACTR\) Program - Home Page](#)

<http://www.hanford.gov/tanks/hti/info/actr/actr.htm>

Description: *The Acquire Commercial Technology for Retrieval (ACTR) program began in 1995 to seek and evaluate commercial technologies that could be used for radioactive waste retrieval, including the retrieval of stubborn wastes from leaking single-shell tanks on the*

[The Acquire Commercial Technology for Retrieval \(ACTR\) Program - Index](#)

<http://www.hanford.gov/tanks/hti/info/actr/actrindx.htm>

Description: *ACTR quick reference index*

[The Acquire Commercial Technology for Retrieval \(ACTR\) Program - Documents](#)

<http://www.hanford.gov/tanks/hti/info/actr/docinfo.htm>

Description: *ACTR Documents - LINKS DO NOT WORK*

[Retrieval Process Development & Enhancements \(RPD&E\)](#)

<http://www.pnl.gov/rpde/tfa.html#top>

Description: *Mission, Challenges, and and Program activities.*

Updated: 10/04/99

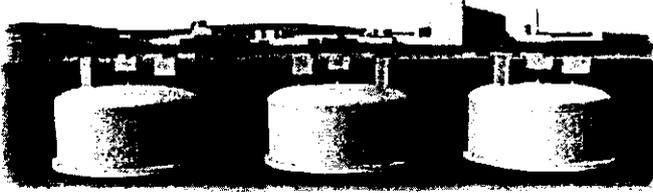
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ORP - Privatization

<http://www.hanford.gov/orp/privatization.html>

Description: *DOE and BNFL Inc. Sign Contract for Hanford Tank Waste Treatment Hanford Tanks Initiative*

Privatization

TWRS Privatization Contract (DE-AC06-96RL13308)

Report to Congress--Treatment & Immobilization of Hanford Radioactive Tank Waste

Energy Department and BNFL, Inc. Reach Agreement for Tank Waste Treatment at Hanford Site

Links include:

Leak Detection Monitoring and Mitigation

Regulatory Unit for Tank Waste Remediation System Privatization (RU)

TWRS Technology Database

Hanford's Tank C-106 Waste Removal System

Estimate Revised for Waste Volume in Tank AX-104

<http://www.hanford.gov/tanks/hti/articles/in-tank.htm>

Description: *In August, the Hanford Tanks Initiative team completed an in-tank campaign in Tank AX-104 to estimate the volume of high-level waste that remains. Researchers need to know the amount of residual waste to determine the most efficient retrieval requirements*

Magnetometer Probe Testing and Calibration Completed

<http://www.hanford.gov/tanks/hti/articles/probe.htm>

Description: *The Hanford Tanks Initiative team recently completed testing and calibration of the magnetometer waste thickness probe for deployment in Tank AX-104. Waste thickness information is needed to assess waste volume, which is part of the technical basis for th*

The Hanford Tanks Initiative (HTI)

<http://www.hanford.gov/tanks/hti/hti.htm>

Description: *Mission, Related Informaiton, News, Regulatory Events & Schedule, Stakeholder Involvement Events and Schedule, Current and Completed Activities. The Hanford Tanks Initiative (HTI) is demonstrating technologies and costs for characterizing and removing hig*

A Guide to Web Based Information Relevant to the Hanford Tanks Initiative's (HTI) C-106 Waste Retrieval Demonstration

<http://www.hanford.gov/tanks/hti/info/gfiinfo.htm>

Description: *This site guides users through available information regarding waste retrieval technologies and waste tanks as collected from existing documents, ongoing DOE programs, and work with industry. Many links may no longer work*

TFA Technical Highlights August 15, 1997

<http://www.pnl.gov/tfa/hiligh/back/15aug97.htm>

Description: *Radioactive Crystalline Silicotitanate (CST) Vitrification Started
Hanford Tanks Initiative (HTI) Leads to Possible Multiple Site Benefit
Waste Retrieval Two-Thirds Completed at Oak Ridge Tank W-3
Extendible Nozzle Delivered to Oak Ridge Reservation
Tank 106-C Request for Proposal Released*

TFA Technical Highlights May 16, 1997

<http://www.pnl.gov/tfa/hiligh/back/16may97.htm>

Description: *Fourth Cesium Removal Demonstration Completed
Topographical Mapping System Data Analysis Completed
Tether Handling System Successfully Tested
Tanks 20 and 17 Approaching Completion
FY98 to FY00 Multiyear Technical Responses Are Now Online
Product Acceptance Testing Meeting
Development of Retrieval Performance Evaluation Criteria Support
Hanford Tanks Initiative Meets with Indian Nations
Meeting with Community Leaders Network Discusses Involvement in Program Planning
TFA Technologies Discussed at American Nuclear Society Meeting
Western Governor's Association Meets to Discuss Clean-up Technologies*

TFA Technical Highlights February 28, 1997

<http://www.pnl.gov/tfa/hiligh/back/28feb97.htm>

Description: *Cesium Removal Technology Processes Over 4,500 Gallons of Radioactive Waste
Countercurrent Demonstration of Strontium Extraction Done on Actual Waste
Preliminary Results from Caustic Recycle and Recovery Work
LDUA Can be Deployed in Flammable Gas Tanks
Nondestructive Examination End Effector for the LDUA Demonstrated
Waste Dislodging Hose Management System Demonstrated with LDUA
Hanford Tanks Initiative Technical Peer Review on Characterizing Residual Tank Waste Conducted
Hanford and Idaho National Engineering and Environmental Laboratory Deployment Needs Reviewed*

TFA Technical Highlights April 30, 1997

<http://www.pnl.gov/tfa/hiligh/back/30apr97.htm>

Description: *Vitrification of Ion Exchange Material From Oak Ridge Reservation
Plans for Closing Tank 20 Are Progressing
Borehole Miner Undergoes 90% Design Review
Hanford Tanks Initiative Vadose Zone Characterization Task Begins
FY97 Needs Assessment Now On-line
Laser Ablation/Mass Spectrometer Presented at International Conference*

Characterization, Monitor, and Sensor Technology Review

TFA Technical Highlights May 30, 1997

<http://www.pnl.gov/tfa/hiligh/back/30may97.htm>

Description: *Cooling Coil Cleaning and Retrieval End Effector Demonstrated*

Melter Spout Working Well

The First Pilot-Scale Test for Caustic Recovery Was Initiated

Hanford Tanks Initiative In-Tank Volume Estimate Planning Completed

Technical Exchange with Waste Isolation Pilot Plant Staff

Hanford Tanks Initiative Retrieval and Closure Peer Review Held

TFA Technical Highlights November 30, 1997

<http://www.pnl.gov/tfa/hiligh/back/30nov97.htm>

Description: *Preventing Phosphate Compounds from Plugging Waste Lines Part of Sludge Treatment Studies*

Idaho Arm Undergoing Systems Checkout

Hanford Tanks Initiative (HTI) Team Visits Waterways Experimental Station (WES)

Retrieval Begins in Oak Ridge Tank W-4

Tank 17: Controlled Low Strength Material Pour Completed

Analysis of Russian Cross-Flow Filter Testing Results

TFA Technical Highlights December 31, 1996

<http://www.pnl.gov/tfa/hiligh/back/31dec96.htm>

Description: *Retrieval Systems Demonstrated at Oak Ridge National Laboratory*

Pulsed Air Mixer Successfully Demonstrated

Meeting on Extendible Nozzle Demonstration

Hanford Tanks Initiative Technical Exchange with Idaho National Engineering Laboratory

TFA Technical Highlights May 3, 1996

<http://www.pnl.gov/tfa/hiligh/back/3may96.txt>

Description: *Light-Duty Utility Arm Testing Begins*

Hanford Tanks Initiative Plans to Use LDUA

LDUA Technology Transferred to Fuel Pin Investigation

LDUA Data Acquisition System Testing Done

LDUA High Resolution Stereoscopic Video System Post-delivery Test Report Issued

Detailed Design of Fume Hood for Laser Ablation/Mass Spectrometer Begins

Simulant Preparation and Sampling Plan Issued

Salt Dissolution and Corrosion Studied

Sensitivity Analysis Completed for "Base Case" Tank Closure

PNNL-SA-29368 - TFA Presentation - Implementation of New Technologies for Tank Closure and the Role of the Tanks Focus Area

<http://www.pnl.gov/tfa/lib/pres/homepage1/sld001.htm>

Description: *Implementation of New Technologies for Tank Closure and the Role of the Tanks Focus Area (PNNL-SA-29368) Table of Contents: TFA Roles, The Program, Why Tank Closure Is Important, Answering The Tough Questions, Hanford Tanks Initiative (HTI), Technology T*

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Database Contact: Kevin Selby

Document Contact: Eric Berglin

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Hanford Tank Farm Vadose Zone

<http://www.doegjpo.com/programs/hanf/HTFVZ.html>

Description: *The DOE-GJO manages a project to assess the radioactive contamination that leaked from high-level nuclear waste storage tanks at the DOE Hanford Site near Richland, Washington.*

Single- and double-shell, steel-lined concrete tanks were constructed at Hanford for underground storage of this liquid waste that resulted from the processing of plutonium. The term "tank farm" refers to the areas on the Hanford Site where groups of these subsurface tanks are located. Sixty-seven single-shell tanks have been identified as leaking and have released an estimated 1 million gallons of high-level mixed waste into the vadose (unsaturated) zone sediments surrounding the tanks.

DOE-GJO is collecting a baseline log of each of 760 existing dry wells, or boreholes, located around the single-shell tanks using two truck-mounted passive spectral gamma-ray logging systems.

ORP - Tank Farm Operations

<http://www.hanford.gov/orp/operations.html>

Description: *The Waste Storage Division is responsible for safe operation of the tank farms, interim stabilization, waste transfers from single-shell tanks to double-shell tanks, facility upgrades to support safe operations and waste retrieval, treatment and disposal, and vadose zone characterization.*

Tank Farm Upgrades

Vadose Zone Characterization

Analysis of SX Farm Leak Histories--Historical Leak Model (HLM) (HNF-3233)

Groundwater/Vadose Zone Integration Project

Results of Phase I Groundwater Quality Assessment for Single-Shell Tank Waste Management Areas T and TX-TY at the Hanford Site

Results of Phase I Groundwater Quality Assessment for Single-Shell Tank Waste Management Area S-SX at the Hanford Site

*DOE Reconvenes Expert Panel at Hanford to Review Vadose Zone Data
Radioactive Waste Tank Expert Panel To Meet Late June Hanford Site Panel Will Review and
Analyze Draft Contamination Report
Statement of John D. Wagoner, Hanford Site Manager, Regarding State of Washington Notice of
Intent to Sue
National Laboratories Meet to Address Hanford VADOSE Zone and Groundwater Issues*

The Acquire Commercial Technology for Retrieval (ACTR) Program - Home Page

<http://www.hanford.gov/tanks/hti/info/actr/actr.htm>

Description: *The Acquire Commercial Technology for Retrieval (ACTR) program began in 1995 to seek and evaluate commercial technologies that could be used for radioactive waste retrieval, including the retrieval of stubborn wastes from leaking single-shell tanks on the*

Historical Tank Content Estimate For The Northeast Quadrant of the Hanford 200 East Area

http://www.hanford.gov/twrs/char.pub/docs/htce/ne/htce_ne.htm

Description: *Document #: WHC-SD-WM-ER-349, Rev 1, June 1996, S. D. Consort, K. L. Ewer, J. W. Funk, R. G. Hale, G. A. Lisle, C. V. Salois, ICF Kaiser Hanford Company, Richland, Washington. Abstract: Purpose - The purpose of this historical characterization document is to present the synthesized summaries of the historical records concerning the physical, radiological, and chemical composition of mixed wastes stored in underground single-shell tanks and the physical conditions of these tanks. The single-shell tanks are located on the Department of Energy Hanford Site, approximately 25 miles northwest of Richland, Washington. The document will be used to assist in characterizing the waste in the tanks in conjunction with the current program of sampling and analyzing the tank wastes. Los Alamos National Laboratory (LANL) developed computer models that used the historical data to attempt to characterize the wastes and to generate estimates of each tank's inventory. A historical review of the tanks may reveal anomalies or unusual contents that could be critical to characterization and post characterization activities. This report was developed by reviewing the operating plant process histories, waste transfer data, and available physical and chemical data from numerous resources. These resources were generated by numerous contractors from 1945 to the present. Waste characterization, the process of describing the character or quality of a waste, is required by Federal law (Resource Conservation and Recovery Act) and state law (Washington Administrative Code (WAC) 173-303, Dangerous Waste Regulations). Characterizing the waste is necessary to determine methods to safely retrieve, transport, and/or treat the wastes. This document is not intended for use as a total design basis document. Further investigations of the information may be required before using this data for design purposes or safety analysis. Scope - The scope of this document is to provide a summary of the supporting documents (Brevick et al., 1996a, b, c, d, e, f) for the NE Quadrant. The Northeast Quadrant covers six single-shell tank farms. These six tank farms, A, AX, B, BX, BY, and C, are located in the 200-East Area and are shown on the map in Figure 1. This summary includes waste transfer and level data, tank physical information, and surveillance data of the tanks and wastes for the NE Quadrant. The inventory estimates of waste types and volumes generated by the computer modeling programs developed by LANL are also included. A flow diagram showing the relationships between the sources of data, the HTCE, and the supporting documents is in Figure 2. This HTCE document also includes information on the safety issues affecting the tanks and the plants and processes that produced the waste in the underground waste storage tanks. For further explanation and development of the information, see the supporting documents. Approach - This report was compiled from work performed by ICF Kaiser Hanford Company (ICF KH), LANL, and Westinghouse Hanford Company (WHC). ICF KH reviewed the historical records of the tanks and incorporated the inventory estimates and models of waste layers in the tanks being developed by LANL into the report.*

Tank Waste Remediation Systems (TWRS) Waste Storage and Operations

<http://www.hanford.gov/twrs/storage.htm>

Description: *The Waste Storage Division is responsible for safe operation of the tank farms, interim stabilization, waste transfers from single-shell tanks to double -shell tanks, facility upgrades to support safe operations and waste retrieval, treatment and disposal*



Updated: 10/04/99

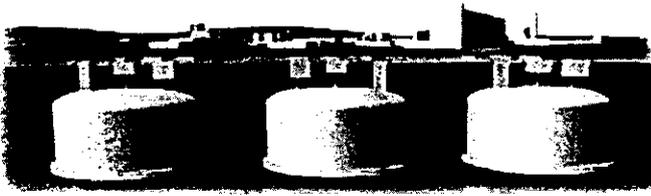
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Light Duty Utility Arm Readied to Sample Residual Waste in Tank AX-104

<http://www.hanford.gov/tanks/hti/articles/ldua.htm>

Description: *An operational readiness review and training to approved operating procedures are currently under way to support the deployment of the Light-Duty Utility Arm (LDUA) in June. The LDUA, developed by the Office of Science and Technology and the Tanks Focus A*

ACTIVITIES: C-106 Heel Retrieval Demonstration

<http://www.hanford.gov/tanks/hti/activities/c-106.htm>

Description: *On August 6, 1997, work started with Lockheed Martin Hanford Company (LMHC) releasing a Request for Proposal titled "C-106 Waste Retrieval Demonstration, Solicitation #WA31512" This work uses information collected in the Alternative Retrieval Technology D*

Auger Sampling Completed Ahead of Schedule

<http://www.hanford.gov/tanks/hti/articles/auger.htm>

Description: *With the dedicated support of Lockheed Martin Hanford Characterization Project Operations, the HTI team completed auger sampling in Tank AX-104 in late November, meeting this project milestone two weeks ahead of schedule. Analyses of the retrieved hard he*

Estimate Revised for Waste Volume in Tank AX-104

<http://www.hanford.gov/tanks/hti/articles/in-tank.htm>

Description: *In August, the Hanford Tanks Initiative team completed an in-tank campaign in Tank AX-104 to estimate the volume of high-level waste that remains. Researchers need to know the amount of residual waste to determine the most efficient retrieval requirements*

Initial Screening Analysis of Tank AX-104 Auger Samples Completed

<http://www.hanford.gov/tanks/hti/articles/labresults.htm>

Description: *The HTI team has characterized auger samples (two each from risers 3A and 9G) taken by laser sampling from Tank AX-104 in late November 1997 using the recently installed Laser Ablation Inductively Coupled Plasma Mass Spectrometry system (LA/MS) at the 222*

Magnetometer Probe Testing and Calibration Completed

<http://www.hanford.gov/tanks/hti/articles/probe.htm>

Description: *The Hanford Tanks Initiative team recently completed testing and calibration of the magnetometer waste thickness probe for deployment in Tank AX-104. Waste thickness information is needed to assess waste volume, which is part of the technical basis for th*

AX-104 Auger Sample Analysis Results Provide Insight to Waste Composition

<http://www.hanford.gov/tanks/hti/augersamp.htm>

Description: *Four hard heel auger samples retrieved from the floor of Tank 241-AX-104 last fall have now been analyzed. The samples recovered from under riser R-3A appeared to be lightly contaminated rust from the degradation of the tank interior and thus are not cons*

HTI - Project Highlites, Back Issues

<http://www.hanford.gov/tanks/hti/backs.htm>

Description: *HTI Highlites newsletter from Novemeber 1996 to August 1998.*

C-106 Waste Retrieval Demonstration, REQUEST FOR PROPOSAL (RFP), Solicitation #WA31512

<http://www.hanford.gov/tanks/hti/business/c106rfp/index.htm>

Description: *The C-106 Waste Retrieval Demonstration - Request for Proposal has been finalized and released on August 6, 1997. Any modifications to the RFP will be announced at the Updates link located at <http://www.hanford.gov/tanks/hti/business/c106rfp/updates.htm>.*

HTI - Current and Completed Activities

<http://www.hanford.gov/tanks/hti/cca.htm>

Description: *Activities include: Activities in Progress - Tank C-106 Heel Removal, AX-104 Characterization, Retrieval Performance Evaluation Criteria Analysis, Vadose Zone Characterization Technology Development, Tank Removal and Remediation Analysis. Completed Acti*

PMM-JRO-808, Request for Proposal, WA15104-SJ, Single Shell Tank Waste Retrieval: Integrated Testing in Support of the Acquire Commercial Technology for Retrieval (ACTR) Program, July 25, 1996

<http://www.hanford.gov/tanks/hti/documents/inttest/inttstp.htm>

Description: *Request for Proposal (RFP) Document [Partial] -- APPENDIX A - Westinghouse Hanford Company's Request for Proposal WA15104-SJ, July 25, 1996 Request for Proposal (RFP) Document Number -- PMM-JRO-808*

The Hanford Tanks Initiative (HTI)

<http://www.hanford.gov/tanks/hti/hti.htm>

Description: *Mission, Related Informaiton, News, Regulatory Events & Schedule, Stakeholder Involvement Events and Schedule, Current and Completed Activities. The Hanford Tanks Initiative (HTI) is demonstrating technologies and costs for characterizing and removing hig*

The Acquire Commercial Technology for Retrieval (ACTR) Program - Home Page

<http://www.hanford.gov/tanks/hti/info/actr/actr.htm>

Description: *The Acquire Commercial Technology for Retrieval (ACTR) program began in 1995 to seek and evaluate commercial technologies that could be used for radioactive waste retrieval, including the retrieval of stubborn wastes from leaking single-shell tanks on the*

The Acquire Commercial Technology for Retrieval (ACTR) Program - Index

<http://www.hanford.gov/tanks/hti/info/actr/actrindx.htm>

Description: *ACTR quick reference index*

The Acquire Commercial Technology for Retrieval (ACTR) Program - Documents

<http://www.hanford.gov/tanks/hti/info/actr/docinfo.htm>

Description: *ACTR Documents - LINKS DO NOT WORK*

A Guide to Web Based Information Relevant to the Hanford Tanks Initiative's (HTI) C-106 Waste Retrieval Demonstration

<http://www.hanford.gov/tanks/hti/info/gfiinfo.htm>

Description: *This site guides users through available information regarding waste retrieval technologies and waste tanks as collected from existing documents, ongoing DOE programs, and work with industry. Many links may no longer work*

HTI - Mission

<http://www.hanford.gov/tanks/hti/mission.htm>

Description: *The mission of HTI is explained including Background, Who Makes Up the Team?, Overview of HTI, What are HTI's expected results?, Who to contact for more information.*

HTI - Project Highlites, Latest Issue September/October 1998

<http://www.hanford.gov/tanks/hti/news.htm>

Description: *The HTI bimonthly newsletter. The current addition is on this page but bask issues are also available by link from here.*

HTI Highlites - April 1997

<http://www.hanford.gov/tanks/hti/news/hilites/htiapr97.htm>

Description: *Articles include: HTI: Moving Toward Defining the TWRS End-State, The Hidden Challenge!, HTI Vadose Zone Characterization Task Initiated!, Technology Demonstration Contractors Issue Invitations*

HTI Highlites - July/August 1997

<http://www.hanford.gov/tanks/hti/news/hilites/htiaug97.htm>

Description: *Articles include: Demonstrations Pave Way for Hot Retrieval of Wastes from Tank 241-C-106, Peer Reviews Contribute New Ideas, Solutions, Work Begins on Probes that Will Map Soil Contamination, Robotic Arm Grows, Assessment Shows Systems Engineering on Cou*

HTI Highlites - July/August 1998

<http://www.hanford.gov/tanks/hti/news/hilites/htiaug98.htm>

Description: *Articles include: Light Duty Utility Arm Readied for Deployment, AX-104 Auger Sample Analysis Results Provide Insight to Waste Composition, Retrieval Performance Evaluation Nears Completion, Tank C-106 Waste Retrieval Demonstration on Track*

HTI Highlites - December 1996

<http://www.hanford.gov/tanks/hti/news/hilites/htidec96.htm>

Description: *Article titles include: Inside the Tank, LDUA Readied for AX-104 Deployment, RFP Issued for Additional Integrated System Demonstrations, Alternative Sampling Plans Proposed, Progress Made as Retrieval Testing Continues, Tribal Involvement Essential for Su*

HTI Highlites - February 1997

<http://www.hanford.gov/tanks/hti/news/hilites/htifeb97.htm>

Description: *Articles include: HTI: Integrating Tank Retrieval Objectives With Risk Definition, Four Vendors Selected for \$1.8 Million in Retrieval Demonstration Contracts, Solicitation for Crawler Design, Fabrication and Deployment, Alternatives Evaluated Via DQO Pro*

HTI Highlites - January 1997

<http://www.hanford.gov/tanks/hti/news/hilites/htijan97.htm>

Description: *Articles include: HTI: Solving the Tank Waste Retrieval Riddle, Integrated System Component Demos Completed, Proposals Received for Alternative Retrieval System Demos, Laser System Tested to Improve Estimate of Residual Waste Volume, Probe Selected to Det*

HTI Highlites - January/February 1998

<http://www.hanford.gov/tanks/hti/news/hilites/htijan98.htm>

Description: *Articles include: Stakeholder Input Vital in Determining Retrieval Performance Criteria, Retrieval Performance Evaluation of Tank AX-104 Nearing Completion, Initial Screening Analysis of Tank AX-104 Auger Samples Completed, Contracts Awarded for Tank C-10*

HTI Highlites - June/July 1998

<http://www.hanford.gov/tanks/hti/news/hilites/htijul98.htm>

Description: *Articles include: Field Exercise Prepares for Vadose Zone Sensor Deployment, Lasentec Particle Size Analyzer to be Installed at Oak Ridge, Draft Retrieval Performance Evaluation Uncertainty and Sensitivity Analysis Plan Completed, Sandia National Laborato*

HTI Highlites - March 1997

<http://www.hanford.gov/tanks/hti/news/hilites/htimar97.htm>

Description: *Articles include: HTI - Focusing on Technical Quality, Technical Peer Review of Plan to Characterize Waste Now Complete, Regulators, Tribes and Stakeholders to Assist in Retrieval Performance Criteria Development, Teams Selected for Retrieval Demonstratio*

HTI Highlites - March/April 1998

<http://www.hanford.gov/tanks/hti/news/hilites/htimar98.htm>

Description: *Articles include: Vadose Zone Sensor Technologies Tested at Hanford, HTI Issues AX-104 Vadose Zone Data Quality Objectives, HTI to Deploy New Slurry Monitors, Retrieval Performance Evaluation Completes Regulatory Requirements Report, Sandia National Labor*

HTI Highlites - May/June 1997

<http://www.hanford.gov/tanks/hti/news/hilites/htimay97.htm>

Description: *Articles include: HTI: Seeking the Best Solutions from Industry and the National Laboratories, Safety Recognized as Core Value, High-Tech Assessment of AX Farm to be Revealing, Specs for AX-104 Released for Vendor Comment*

HTI Highlites - November 1996

<http://www.hanford.gov/tanks/hti/news/hilites/htinov96.htm>

Description: *Articles include: Waste Characterization Approach Employs LDUA and Tracked Vehicle, Retrieval Testing 'Very Encouraging', HTI Plan Truly A Joint Effort, Statistical Approach Initiated to Sample Residual Waste, HTI Accomplishments:*

HTI Highlites - November/December 1997

<http://www.hanford.gov/tanks/hti/news/hilites/htinov97.htm>

Description: *Articles include: Auger Sampling Completed Ahead of Schedule, Safety and Licensing Strategy Integral to HTI, Magnetometer Probe Testing and Calibration Completed, Proposals*

Received for C-106 Waste Retrieval Demonstration, Requirements Drafted for Pit Cle

HTI Highlites - September/October 1997

<http://www.hanford.gov/tanks/hti/news/hilites/htisep97.htm>

Description: *Articles include: Estimate Revised for Waste Volume in Tank AX-104, Risk Management Process Sets Stage for Upcoming Work, Targeted Data Collection Design Saves Time, Money, Completed Studies Will Support Retrieval Decision Making, Paperless Procurement Li*

Retrieval Process Development & Enhancements (RPD&E)

<http://www.pnl.gov/rpde/tfa.html#top>

Description: *Mission, Challenges, and and Program activities.*

TFA Technical Highlights August 15, 1997

<http://www.pnl.gov/tfa/hilight/back/15aug97.htm>

Description: *Radioactive Crystalline Silicotitanate (CST) Vitrification Started
Hanford Tanks Initiative (HTI) Leads to Possible Multiple Site Benefit
Waste Retrieval Two-Thirds Completed at Oak Ridge Tank W-3
Extendible Nozzle Delivered to Oak Ridge Reservation
Tank 106-C Request for Proposal Released*

TFA Technical Highlights November 30, 1997

<http://www.pnl.gov/tfa/hilight/back/30nov97.htm>

Description: *Preventing Phosphate Compounds from Plugging Waste Lines Part of Sludge Treatment Studies
Idaho Arm Undergoing Systems Checkout
Hanford Tanks Initiative (HTI) Team Visits Waterways Experimental Station (WES)
Retrieval Begins in Oak Ridge Tank W-4
Tank 17: Controlled Low Strength Material Pour Completed
Analysis of Russian Cross-Flow Filter Testing Results*

PNNL-SA-29368 - TFA Presentation - Implementation of New Technologies for Tank Closure and the Role of the Tanks Focus Area

<http://www.pnl.gov/tfa/lib/pres/homepage1/sld001.htm>

Description: *Implementation of New Technologies for Tank Closure and the Role of the Tanks Focus Area (PNNL-SA-29368) Table of Contents: TFA Roles, The Program, Why Tank Closure Is Important, Answering The Tough Questions, Hanford Tanks Initiative (HTI), Technology T*

Updated: 10/04/99

Contact: Eric Berglin (509) 372-1824

Database Contact: Kevin Selby

Document Contact: Eric Berglin

Disclaimer

ACTR

COMPONENT TESTING SUMMARIES

Last Updated: 02/19/1999 14:32:20

This phase of the ACTR program was intended to test some selected retrieval equipment components to determine the feasibility of the technology against a wide range of Hanford waste tank simulants and in some areas to establish a technology baseline. In all cases where hardware was tested, commercial off-the-shelf equipment was configured near a scale that may be used in a Hanford tank. Scale-up feasibility studies were completed for manipulators in a Hanford tank with computer animation because off-the-shelf equipment was not available and large-scale testing was cost prohibitive.

Testing Summary List

Sluicing Nozzle
Medium Pressure Water Jet
Crawler with Various Dislodging Devices
Manipulator Scale-up Feasibility
Residual Waste Volume Measurement

Sluicing Nozzle

Packer Engineering / Bristol

Document Title -- Sluicing Nozzle Test Report, Volume I

Document Number -- WHC-SD-WM-TD-013

A BEC tank cleaning system using a hydraulic sluicing nozzle was tested against Hanford waste simulants at pressures ranging from 20 - 300 psi, nozzle diameter ranging from 0.5 - 0.75 in., and standoff distance varying from approximately 1 - 63 ft. All simulants were successfully sluiced but the higher strength salt cake simulants removal rate was slow. A test report was written supported by photos and videos.

Medium Pressure Water Jet

MPW Industrial Services Inc.

Document Title--Demonstration of Retrieval Methods for Westinghouse Hanford Corp.

Document Number--WHC-MR-0526

Document Title--Demonstration of Retrieval Methods for Westinghouse Hanford Corp. TRIAL No. 2

Document Number--WHC-MR-0527

APPENDIX C

**HANFORD TANK INITIATIVE/ACQUIRE COMMERCIAL
TECHNOLOGY FOR RETRIEVAL (HTI/ACTR) DATABASE**

**DOCUMENTS NOT CURRENTLY IN RECORDS
MANAGEMENT INFORMATION SYSTEM (RMIS)**

**HTI/ACTR Database
Documents Not Currently in RMIS**

Appendix C

RPP-6947 REV 0

| Document No | Title Authors | Date | Source | Web Address |
|----------------------|---|-------------|---|---|
| (No #11) | Single Shell Tank Waste Retrieval: Integrated Testing in Support of the Acquire Commercial Technology for Retrieval (ACTR) Program No Author Information Available... Waste Retrieval Demonstration Briefing - Task 1 - System Definition Los Alamos Technical Associates, Inc.; Environmental Specialties Group, LLC; and NUMANCO Water Jet Technology Association - Recommended Practices | 11/12/98 | Contact Vince Fitzpatrick | http://www.hanford.gov/tanks/hti/documents/inttest/inttstpk.htm |
| 10245-CD-003, Rev. A | No Author Information Available... Initial Failure Mode and Effects Analysis of the Tank-241-C-106 Waste Retrieval Demonstration Los Alamos Technical Associates, Inc. | 1/1/94 | Hanford Web Site No Electronic Copies Available... | http://www.tanks.org/documentssearchre/sultssingle.asp?documentid=261 |
| 10245-CD-005, Rev. 1 | Waste Retrieval Demonstration System Preliminary Design Los Alamos Technical Associates, Inc.; Environmental Specialties Group, LLC; and Cox-Walker & Associates, Inc. | 8/25/98 | Contact Vince Fitzpatrick | |
| BJC/OR-82 | Deployment of a fluidic pulse jet mixing system for horizontal waste storage tanks at Oak Ridge National Laboratory, Oak Ridge, Tennessee Kent, T.E.; Hylton, T.D. [Lockheed Martin Energy Research Corp., Oak Ridge, TN (United States). Chemical Technology Div.]; Taylor, S.A. [AEA Technology, Cheshire (United Kingdom)]; Moore, J.W. [Bechtel Jacobs Co. LLC, Oak Ridge, TN (United States)] | 11/30/98 | Contact Vince Fitzpatrick | http://www.tanks.org/documentssearchre/sultssingle.asp?documentid=1820 |
| CONF-951006-33 | Remote systems for waste retrieval from the Oak Ridge National Laboratory gunite tanks Falter, D.D.; Babcock, S.M.; Burks, B.L.; Lloyd, P.D.; Randolph, J.D.; Rutenber, J.E. [Oak Ridge National Lab., TN (United States). Robotics and Process Systems Div.]; Van Hoesen, S.D. [Lockheed Martin Energy Systems, Oak Ridge, TN (United States). Central Engineering Services] | | Hanford Web Site PDF | http://www.tanks.org/documentssearchre/sultssingle.asp?documentid=2049 |
| CONF-970464-14 | Development of a waste dislodging and retrieval system for use in the Oak Ridge National Laboratory gunite tank Randolph, J.D.; Lloyd, P.D.; Burks, B.L. [and others] | | Hanford Web Site PDF | http://www.tanks.org/documentssearchre/sultssingle.asp?documentid=2054 |

| <i>Document No</i> | <i>Title</i> <i>Authors</i> | <i>Date</i> | <i>Source</i> | <i>Web Address</i> |
|---|--|-------------|--|---|
| DOE/EM-0360 | Tanks focus area. Annual report Frey, J. | | Hanford Web Site PDF | http://www.tanks.org/documentsearchre/sultssingle.asp?documentid=1844 |
| DOE/EM-0368 | Innovative technology summary report: Houdini(trademark) I and II remotely operated vehicle | 7/1/98 | Hanford Web Site; All published Innovative Technology Summary Reports are available on the OST Web Site at: http://em-50.em.doe.gov under "Publications" PDF | http://www.tanks.org/documentsearchre/sultssingle.asp?documentid=1815 |
| DOE/ID/12584- 230;GJPO-120 | No Author Information Available... Commercial Environmental Cleanup -- The products and services directory. Treatment, characterization and extraction/delivery/materials handling technologies Prepared by Rust Geotech | 11/1/95 | Hanford Web Site PDF | http://www.tanks.org/documentsearchre/sultssingle.asp?documentid=2060 |
| DOE/MC/32092-5630 | Houdini(trademark): Reconfigurable in-tank mobile robot. Final report, June 1995--January 1997 Thompson, B.; Sliifko, A. | | Hanford Web Site PDF | http://www.tanks.org/documentsearchre/sultssingle.asp?documentid=2064 |
| DOE/MC/32092- 97/C0795;CONF- 9610231-35 | Houdini: a remote mobile platform for tank waste retrieval tasks Denmeade, T.J.; Sliifko, A.D.; Thompson, B.R.; White, D.W. | | Hanford Web Site PDF | http://www.tanks.org/documentsearchre/sultssingle.asp?documentid=2065 |
| EGG-WTD-11310 | Maintenance Study for W-340 Waste Retrieval System C Christensen; CC Conner; JP Sekot | 5/1/94 | Hanford Web Site No electronic Copies Available | http://www.tanks.org/documentsearchre/sultssingle.asp?documentid=197 |
| ORN/CP-95937;CONF- 970469- | Simulation tools for robotic and teleoperated hazardous waste removal Love, L.J. [Oak Ridge Inst. for Science and Education, TN (United States)]; Kress, R.L.; Bills, K.C. [Oak Ridge National Lab., TN (United States)]. Robotics and Process Systems Div.] | 2/1/97 | Hanford Web Site PDF | http://www.tanks.org/documentsearchre/sultssingle.asp?documentid=2097 |

| Document No | Title Authors | Date | Source | Web Address |
|----------------------------|---|---------|--|---|
| ORNL/CP-98309;CONF-980905- | Large underground radioactive waste storage tanks successfully cleaned at Oak Ridge National Laboratory Billingsley, K. [Solutions to Environmental Problems, Inc., Oak Ridge, TN (United States)]; Burks, B.L. [Providence Group, Knoxville, TN (United States)]; Johnson, M. [Lockheed Martin Energy Systems, Oak Ridge, TN (United States)]; Mims, C.; Powell, J. [Dept. of Energy, Oak Ridge, TN (United States)]; Hoesen, D. van [Lockheed Martin Energy Research, Oak Ridge, TN (United States)] | 5/1/98 | Hanford Web Site PDF | http://www.tanks.org/documentsearchreultssingle.asp?documentid=2099 |
| ORNL/ER-254 | Project management plan for the gunite and associated tanks treatability studies project at Oak Ridge National Laboratory, Oak Ridge, Tennessee Lockheed Martin Energy Systems, Inc. and Jacobs Engineering Group Inc. | 12/1/95 | Hanford Web Site PDF | http://www.tanks.org/documentsearchreultssingle.asp?documentid=2101 |
| ORNL/TM-13578 | Demonstration of fluidic pulse jet mixing for a horizontal waste storage tank Kent, T.E.; Taylor, S.A.; Moore, J.W.; Steller, J.L.; Billingsley, K.M | 1/1/98 | Hanford Web Site PDF | http://www.tanks.org/documentsearchreultssingle.asp?documentid=1921 |
| PNNL-11688 | Field Performance of the Waste Retrieval End Effectors in the Oak Ridge Gunite Tanks Mullen, O.D. | 9/1/97 | Hanford Web Site HTML / PDF | http://www.tanks.org/documentsearchreultssingle.asp?documentid=520 |
| PNNL-11876 | Functions and Requirements for a Waste Conveyance Jet Pump for the Gunite and Associated Tanks at Oak Ridge National Laboratory OD Mullen | 11/5/98 | Hanford Web Site No electronic Copies Available | http://www.tanks.org/documentsearchreultssingle.asp?documentid=526 |
| PNNL-11920 | Performance evaluation of rotating pump jet mixing of radioactive wastes in Hanford Tanks 241-AP-102 and -104 Onishi, Y.; Recknagle, K.P. | 7/1/98 | Hanford Web Site PDF | http://www.tanks.org/documentsearchreultssingle.asp?documentid=2148 |
| PNNL-11968 | Performance evaluation of the PITBULL(trademark) pump for the removal of hazardous waste Kent, T.E.; Hylton, T.D. [Lockheed Martin Energy Research Corp., Oak Ridge, TN (United States). Chemical Technology Div.]; Taylor, S.A. [AEA Technology, Cheshire (United Kingdom)]; Moore, J.W. [Bechtel Jacobs Co. LLC, Oak Ridge, TN (United States)]; Hatchell, B.K.; Combs, W.H.; Hymas, C.R.; Powell, M.R.; Rinker, M.W.; White, M. | 9/1/98 | Hanford Web Site PDF | http://www.tanks.org/documentsearchreultssingle.asp?documentid=1974 |
| TPG-0398-01 | Houdini Remotely Operated Vehicle System Performance Assessment for Tank W-3 Waste Removal Operations The Providence Group | 3/1/98 | Hanford Web Site PDF | http://www.tanks.org/documentsearchreultssingle.asp?documentid=324 |

| <i>Document No</i> | <i>Title</i> <i>Authors</i> | <i>Date</i> | <i>Source</i> | <i>Web Address</i> |
|----------------------------------|---|-------------|-------------------------|---|
| WSRC-MS-96-0719; CONF-970464- | Viewing Systems for Large Underground Storage Tanks Heckendorn, F.M., Robinson, C.W., Anderson, E.K. [Westinghouse Savannah River Co., Aiken, SC (United States)]; Pardini, A.F. [Westinghouse Hanford Co., Richland, WA (United States)] | | Hanford Web Site PDF | http://www.tanks.org/documentsearchresultsSingle.asp?documentid=2201 |
| WSRC-MS-96-0720;CONF-970462-5 | Remote Viewing End Effectors for Light Duty Utility Arm Robot (U) | 11/4/96 | Hanford Web Site PDF | http://www.tanks.org/documentsearchresultsSingle.asp?documentid=2202 |
| WSRC-TR-96-0160 Conf-980368 | An Investigation of Density Driven Salt Dissolution Techniques B. J. Wiersma, Westinghouse Savannah River Company | | Hanford Web Site PDF | http://www.tanks.org/DocumentSearchResultsSingle.asp?DocumentID=2207 |