

# Cold Demonstration of the MPI™ Process and Plans for Closure of the Old Hydrofracture Facility Tanks at Oak Ridge

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# Tank Closure Objectives

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- Immobilize residual wastes
- Uniformly mix the waste with grout
- Fill and structurally stabilize tanks with low strength grout
- Demonstrate the use of Ground Environmental Services Multi-Point-Injection (MPI<sup>®</sup>) technology for horizontal tank closure applications

# Technical Approach

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- Disposable grout injection tools.
- High cost capital equipment located in a support zone away from contamination areas.
- High speed grout delivery system using Ground Environmental Services patented MPI™ technology.
  - Multiple grout injection tools
  - High speed - high volume grout delivery system for waste mixing and immobilization

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# Cold Demonstration Goals

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- Duncan, Oklahoma vertical tank demonstration was conducted in December 1997.
  - Grout pumpability
  - Mixing effectiveness in vertical tanks
- Odessa, Texas horizontal tank demonstration was conducted in July 1999.
  - Tool insertion in limited access tanks – 4-in. diam riser
  - Mixing effectiveness in horizontal tanks
  - Overview camera test
  - Drum wall penetration test

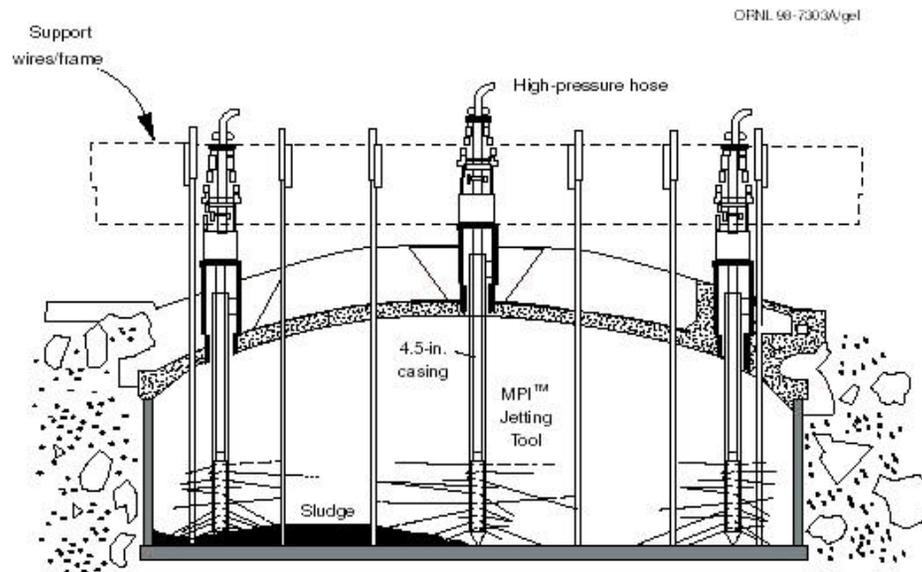
# Duncan OK Cold Demonstration Summary

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- ~15 ft diameter 8 ft tall test tank
- 8 injection lances with a total of 64 nozzles
- Halliburton Special Services
- Oil field pumping equipment and work crews

# MPI Tool Insertion



- The initial concept for MPI tool deployment was to use multiple small diameter holes in the roof of the tank.
- The improved tooling used during the Odessa TX demonstration can be deployed through a single large diameter riser.
  - Multiple injection tools can be deployed along the floor of a tank through 4-in.-diam holders.
  - Two tool strings over a 20 ft length were used in Odessa

# Grout Formulation Used in Duncan OK Demonstration

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- Oak Ridge reducing grout formulation dry blend (wt %)
  - 40 Granulated blast furnace slag
  - 40 Class F fly ash
  - 7 Indian red pottery clay
  - 10 Portland type 1 cement
  - 3 Bentonite (prehydrated with grout water)
- Water to dry blend solids ratio - 0.48:1
- Shown to be effective in retention of RCRA (Hg, Pb, Cr) and radioactive constituents (Sr and Cs) for waste loadings up to 35 wt%.
- Dispersant - 0.4 wt %

# Observations from Duncan OK Demonstration

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- Successfully pumped ORNL grout formulation and formed 32 ton monolith in ~8 min.
- Excavation and sample analysis showed near uniform mixing of grout and surrogate over a 40-in. thick monolith.
- High density (~14.5 lb/gal) grout mixed and pumped using a high efficiency grout plant.

# Observations from Duncan OK Demonstration

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- No free water following injection.
- ~40 % of jet nozzles plugged from debris in old rubber hydraulic hoses that were used in the cold test.
- Maximum set temperature of ~100°F.

# Odessa TX Cold Demonstration Summary

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- 8 ft diameter and 21 ft long tanks
- Two test tanks
  - ORNL OHF tanks
  - SRS OBG tanks
- Two tool deployment techniques
  - Vertical lances same as used in Duncan OK demonstration - OHF
  - Flexible lances for horizontal deployment through 4-in. diameter opening - OBG
- In-tank camera

# MPI Flexible Lance Insertion

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- Coal chute-type mechanism is used to guide the flexible lance into test tank.
  - 4-ft radius of curvature
- Small diameter vertical lance is used in same deployment port to inject grout into end of tank.
  - 1.75-in.-diam. lance

# Grout Formulation Used in Odessa TX Demonstration

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- Modified Oak Ridge grout formulation dry blend (wt%)
  - 38 Granulated blast furnace slag
  - 38 Class F fly ash
  - 7 Indian red pottery clay
  - 14 Portland type I cement
  - 3 Bentonite prehydrated with grout water
- Water to solids ratio – 1.3:1
- No dispersant

# Surrogates

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- ORNL Test Tank
  - 4-in. water
  - Six batches of 90-lb clay, 65-lb water, 10-lb stone in four corners of tank for a total of ~1,000 lb
  - Test tubes of red dye in clay mounds
  - 4-in. layer of sand
  - Two 5-gal pails of sand
  - Two 6-in.-diam pipes
- SRS Test Tank
  - 5.5-in. water
  - Six batches of 145-lb clay, 70-lb water, 10-lb stone against end walls of tank for a total of ~1,350 lb
  - 4-in. layer of sand
  - Small bundle of loose steel pipes
  - Loose 25-ft steel tape

# Equipment - Odessa TX

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- 50-ton field bin for the ORNL dry blend (not shown)
- 5000-gal water storage tank, containing a 6% bentonite gel
- Main grout plant - batch mixer capable of bulk blending ~75 bbl (3,000 gal) of grout at a single time
- Three triplex oil-field cementing pumps for a total of ~1,800 hp

# Observations from Odessa TX Demonstration

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- Successfully deployed flexible grout injection tooling through 4-in. diameter access port.
  - Tooling design can be applied in horizontal and vertical waste tanks.
- Grout density of ~11 lb/gal was possible with conventional mixing system.
- MPI system exhibited robust in-tank mixing action.

# Observations from Odessa TX Demonstration

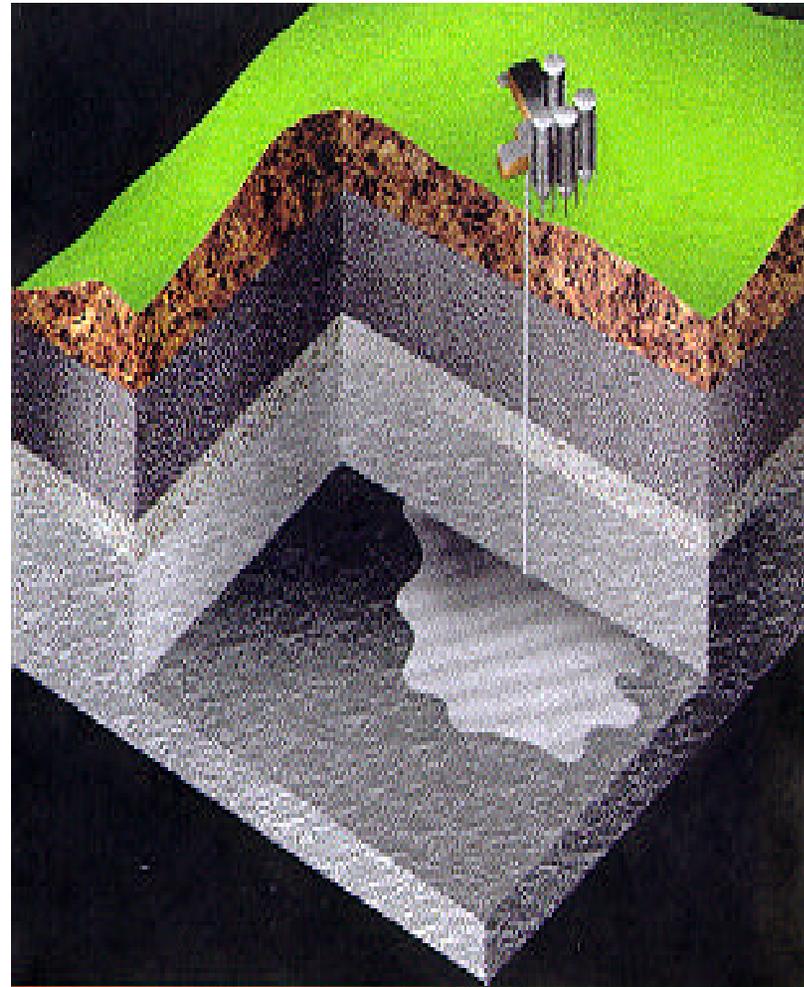
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- No damage to standard steel 55-gal drum during preliminary checkout of system.
- Grout set too rapidly to extract samples to quantitatively assess mixing effectiveness.
- No free water.
- In-tank camera requires more rigid mount and flush system to keep viewing window clear.

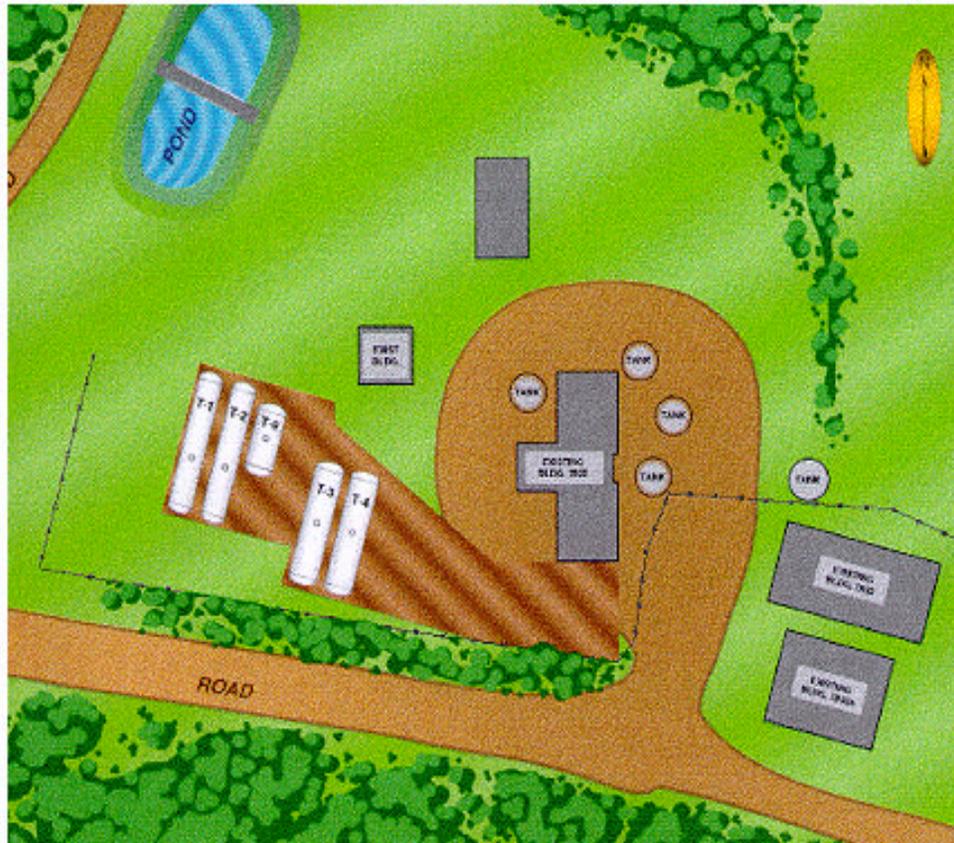
# OHF Facility Description

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- The OHF site at the Oak Ridge National Laboratory was used for the disposal of radioactive waste by grout injection into a shale formation ~1,000 ft below ground.
- Operations at the site were conducted from 1963 through 1980 leaving over 40,000 gal of sludge and supernatant in five underground storage tanks.



# OHF Site Layout



- Tank sizes
  - T-1
    - 15,000 – 8 × 44
  - T-2
    - 15,000 – 8 × 44
  - T-3
    - 25,000 – 10.5 × 42.5
    - Rubber lined
  - T-4
    - 25,000 – 10.5 × 42.5
    - Rubber lined
  - T-9
    - 13,000 – 10 × 23

# OHF Tank Description

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Tank	Nominal Capacity (gal)	Diameter (ft)	Approximate Length (ft)	Material	Residual Inventory (gal)	Internal Components
T-1	15,000	8.0	44.0	Carbon Steel	111	Multiple Air Spargers
T-2	15,000	8.0	44.0	Carbon Steel	222	Multiple Air Spargers
T-3	25,000	10.5	42.5	Carbon Steel; Rubber Lined	40	Multiple Air Spargers and internal connections
T-4	25,000	10.5	42.5	Carbon Steel; Rubber Lined	373	Multiple Air Spargers and internal connections
T-9	13,000	10.0	23.0	Carbon Steel	228	Multiple Air Spargers and Submersible Pumps

# OHF Tank Closure Plan Summary

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- Tank riser interface covers will be fabricated and installed on each riser. The interface covers will accommodate installation of MPI tools, an overview camera, sample port, and HEPA filter connections.
- Two MPI vertical injection tools will be installed in each tank riser. Each tank has three risers.
- A central overview camera will be used to view the in-tank process operation.
- An on-site grout plant will be used to supply the process with the ORNL grout formulation.
- A high-pressure pumping services supplier will be used to feed grout to the MPI system.
- Samples will be withdrawn from one or more of the tanks, as funding permits.

# OHF Tank Closure Task Organization

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- LMER to manage initial design and provide tooling, long lead materials, tank riser interfaces, camera system, and piping.
- BJC to manage on-site tasks for actual deployment of MPI technology, including site preparation, labor support during tank closure, and regulatory compliance documentation.
- LMER will be responsible for performance report.

# Status of OHF Tank Closure

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- LMER completed a contract extension for Ground Environmental Services (GES) to design the injection tooling, tank riser interfaces, and participate in planning meetings.
- Statement of Work for fabrication of tooling and tank riser interfaces, procurement of long lead materials, delivery of piping and storage containers, and preparation of a summary report released to GES by LMER January 2000.

# Status of OHF Tank Closure

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- BJC subcontract for site preparation support has been issued for vendor comment. Site preparation support is part of a larger contract for closure of two waste ponds.
- Camera system design is underway. Low cost disposable board cameras will be used.
- Statement of work for post closure sampling of the OHF tanks will be prepared in near future.
- Closure of OHF tanks is planned to begin in May 2000.

# Contacts

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- Department of Energy
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  - Joe Kauschinger, Ground Environmental Services (678) 778-5858

# Reports - Read More About It

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- J. L. Kauschinger, B. E. Lewis, and R. D. Spence, *Fiscal Year 1999 Cold Demonstration of the Multi-Point Injection (MPI™) Process for Stabilizing Contaminated Sludge in Buried Horizontal Tanks with Limited Access at the Oak Ridge National Laboratory and Savannah River Site Fiscal Year 1999 Cold Demonstration of the Multi-Point Injection (MPI™) Process for Stabilizing Contaminated Sludge in Buried Horizontal Tanks with Limited Access at the Oak Ridge National Laboratory and Savannah River Site*, ORNL/TM-1999/330, Oak Ridge National Laboratory, Oak Ridge, Tennessee, (in prep).
- J. L. Kauschinger and B. E. Lewis, *Utilization of the MPI™ Process for In-Tank Solidification of Heel Material in Large-Diameter Cylindrical Tanks*, ORNL/TM-2000/8, Lockheed Martin Energy Research Corp., Oak Ridge National Laboratory, Oak Ridge, Tennessee, (in prep).
- J. L. Kauschinger, R. D. Spence, and B. E. Lewis, *In-situ Grouting Technology Demonstration and Field Specifications Overview for Hot Deployment of the Multi-Point Injection System in Gunitite and Associated Tank TH-4*, ORNL/TM-13710, Lockheed Martin Energy Research Corporation, Oak Ridge National Laboratory, Oak Ridge, Tennessee, October 1998.
- B. E. Lewis, R. D. Spence, J. V. Draper, R. E. Norman, and J. L. Kauschinger, *Oak Ridge National Laboratory Old Hydrofracture Facility Tank Closure Plan and Grout Development Status Report for FY 1999*, ORNL/TM-2000/7, Oak Ridge National Laboratory, Oak Ridge, Tennessee, (in prep).