High Resolution Resistivity – Leak Detection and Monitoring (HRR-LDM)

The Hanford Tri-Party Agreement requires that waste retrieval operations within the underground nuclear waste storage tanks use the best available leak detection technology as well as provide cost and time savings. Electrical resistivity methods can detect and quantify leakage in the vadose zone immediately surrounding underground nuclear waste tanks. Electrical resistivity methods have been used for leak detection in a variety of applications for over 15 years.

In July 2002, High Resolution Resistivity – Leak Detection and Monitoring (HRR-LDM), a new methodology developed by hydroGEOPHYSICS, Inc. (HGI), was performance evaluated during a three-month EPA-guided test at a mock tank site in the Hanford 200E Area, Richland, WA.

Results demonstrated that HRR-LDM can provide the following:

1. Much more timely early warning leak detection than current ex-tank technology.
2. Detection sensitivity at least an order of magnitude more sensitive than baseline technologies.
3. A probability of a false alarm less than 5% for tested leak volumes of 1,500 gallons* and greater
4. A probability of detection greater than 95% for tested leak volumes of 1,500 gallons* and greater
5. A predicted leak volume estimate within 30% of the actual volume released.
6. An autonomous and remotely accessible monitoring system.

(*RPP-14606 Performance Test Assessment of HRR-HRR-LDM, ERT-PET, and ERT-LET Ex-Tank Resistivity Leak Detection Methods – Fiscal Year 2002 & 2003 - March 20, 2003)

Benefits and Features

- Fewer false alarms than baseline technology
- Provides early detection of relatively small leaks due to high sensitivity
- Detects and quantifies waste leakage in the vadose zone immediately surrounding the tanks

Deployment of HRR-LDM at Hanford

Traditional Approach

Waste sluiced from underground waste tanks uses a powerful water jet to mobilize sludge and other material in the tanks. The waste is pumped to a double-shell tank prior to treatment. Due to the large water quantities, it is difficult to determine when a leak has occurred using dynamic waste inventory balance information, which monitor changes in tank liquid levels. False alarms can occur and inappropriately stop waste transfers. Baseline ex-situ leak detection obtained from drywell logging is performed in the vadose zone surrounding the tanks. Neutron probes and spectral gamma-detectors are used. Drywell logging may detect leaks as small as 4,000 gallons while leaks as large as 100,000 gallons may go undetected, depending on the location of the leak and available drywells for monitoring. With drywell monitoring, operators are able to detect a leak only when the plume has migrated to the drywell. *HRR-LDM can overcome these limitations.*

hydroGEOPHYSICS, Inc. – Arizona & Washington
www.hgiworld.com

HRR-LDM Versatility

Quite possibly the single greatest strength of HRR-LDM is the versatility and adaptability of the method. HRR-LDM may be thought of as an analysis algorithm that can receive, process, and produce near real-time, leak detection results from almost any grounded sensor network. The goal of the system is to make use of existing infrastructure as sensors, eliminating the expense and risk that invasive technologies create. As a result, HRR-LDM can and has been deployed in variety of specialized and difficult environments that include tank farms, well fields, landfills, leach ponds, and leaking buried pipeline sites. *An important safety aspect is that all sensor connections are to electrically grounded structures.*

Non-intrusive Deployment

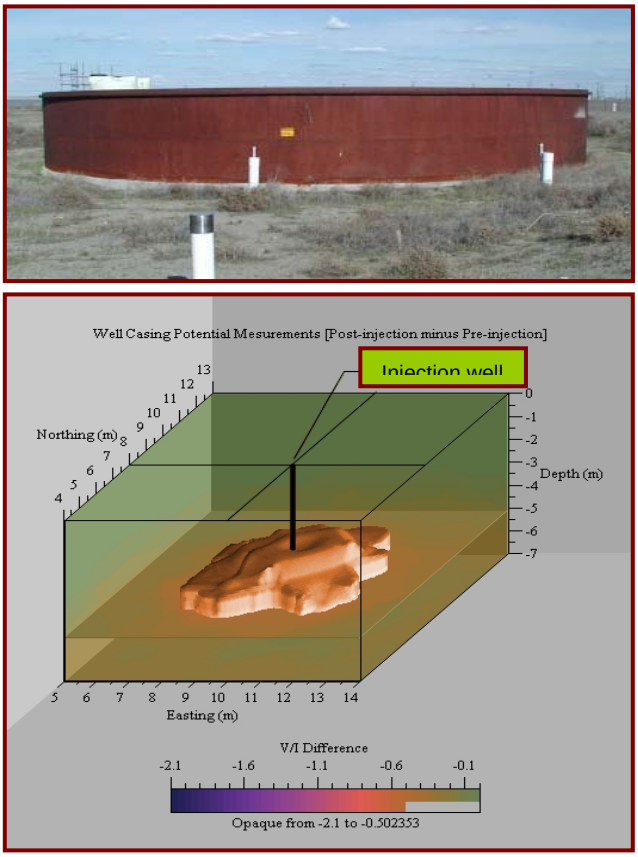
HRR-LDM makes use of potential measurements between steel-cased monitoring wells or surface-deployed electrodes that surround the storage tanks. Temporary connections are made to the well casings/surface electrodes and interconnecting cable is routed along existing infrastructure pathways. A recent deployment was successfully installed at the S and C tank farms at Hanford.

Continuous Monitoring

Unlike electrical resistance tomography (ERT), HRR-LDM does <u>not</u> require complex and time consuming data processing. The method also uses fewer sensors which reduces the time to acquire a complete dataset. The HRR-LDM system is easily automated which can provide continuous leak detection. By contrast, drywell logging is time and labor intensive, limiting the method to only sporadic monitoring.

Remote Operation

State-of-the-art remote-access technology allows the HRR-LDM system to be operated, monitored and updated from almost any location around the world. The system makes use of digitally encrypted Virtual Private Networking (VPN) which uses the internet as a pathway between the project site and any desired monitoring location. This feature removes the system operator from a possibly hazardous site and allows simultaneous monitoring of multiple sites from any location.



Testing of HRR-LDM in a nuclear storage tank at Hanford. Top) Picture of Mock Waste Tank. Bottom) 3D Interpretation of HRR-LDM Data

Multiple Tank Monitoring

HRR-LDM has the ability to use one set of equipment to monitor multiple simultaneous retrievals without increasing onsite personnel. In fact, it is possible to monitor an entire tank-farm at one time by installing connections to all dry-wells within the tank-farm. Such an installation is capable of providing state-of-the-environment data on a continuous basis regardless of surface activities.

Deployment

HRR-LDM can be deployed for daily monitoring of solution recovery within remediation sites. The system is typically integrated into existing or planned infrastructure. Onsite implementation can be performed by HGI or the onsite environmental contractor. Incorporation of a geophysical system at the design stage would:

- allow seamless integration of the geophysical infrastructure with the planned remediation systems
- prevent any inadvertent problems to the remediation systems that could be caused by geophysical monitoring systems
- substantially reduce the cost by using planned remediation systems infrastructure (such as trenches) for sensor and cabling installation

Installation of sensors and-or connection to existing infrastructure can be performed by HGI or existing site personnel. HGI can provide detailed procedures and training of personnel performing the installation in order to ensure safe and successful installation.

Benefits

HRR-LDM is the most affordable, long-term monitoring solution currently available. In comparison to conventional nuclear geophysical logging as is presently performed at the tank farms, HRR-LDM provides vastly superior accuracy and sensitivity.

HGI's approach for a typical tank monitoring project would be to:

- Design a monitoring program specific to the onsite infrastructure.
- Assist in onsite sensor installation or connection.
- Train onsite project personnel to provide periodic maintenance.
- Provide daily, weekly, or monthly monitoring from our home office.
- Submit a final digital report summarizing the monitoring program.
- Provide certification of leak/non-leak status and tank tightness.

Company Profile

hydroGEOPHYSICS, Inc. (HGI) has over twenty years experience in the application of geophysical methods towards solving complex hydrogeologic, environmental, and geotechnical investigations.

HGI has become a recognized leader in the application of geophysical methods to the characterization of environmental waste sites that include solid waste landfills, contaminated disposal areas, and subsurface contaminant plumes. Our flagship method, HRR-LDM has been tailored to use on existing tank farm infrastructure for the non-invasive mapping of leaks and leak volumes. Sensors have included steel-cased monitoring wells, tank risers, shallow buried electrodes, and the tank itself. This technology has been so successful that DOE project personnel ranked our method the number one technology for use in ex-tank leak detection.

To date, we have implemented HRR-LDM on projects for Los Alamos National Laboratory (LANL), Pacific Northwest National Laboratory (PNNL), Environmental Protection Agency (EPA), Arizona Department of Environmental Equality (ADEQ) and other government agencies.

Contact Us:
Tel: 520-647-3315 Fax: 520-647-3428
Email: questions@hgiworld.com

Funding for technology deployment was provided by the U.S. Department of Energy.

CH2M HILL Hanford Group, Inc.
River Protection Project
Tank Farm Contractor for the Office of River Protection