COMPARATIVE TESTING OF PIPELINE SLURRY MONITORS

TECHNOLOGY NEED

The DOE has millions of gallons of radioactive liquid and sludge wastes stored in underground tanks at sites such as Hanford, Savannah River, and Oak Ridge. These wastes must be retrieved from the tanks and processed to a final waste form. For removal from the tanks, the sludge wastes will typically be mixed with the liquid wastes to create a slurry, which will then be transferred to a treatment facility through pipelines. Depending on the site, the slurries may have to be transported several miles. Since the wastes are radioactive, it is critical that the slurries be transferred without plugging the pipeline. If a pipeline is plugged with radioactive waste and the plug is not removable by conventional methods (e.g., back-flushing the pipeline with water), the site must exercise one of two options: (1) locating, excising, and replacing the plugged section or (2) abandoning the pipeline and building a new one. Both of these options are expensive, cause delays in schedule, and pose significant radiation exposure to workers. To prevent plugging, the slurry transport properties (e.g., density, percent solids, particle size, and viscosity) should be determined and adjusted as needed prior to transport. These properties should also be monitored during transport to determine if they are changing. Such monitoring is especially important for heterogeneous wastes, such as those that have been stored. This project evaluates various types of instrumentation for on-line, real-time monitoring of slurry properties.

The conventional technology for determining the transport properties of the slurries is sampling and analysis. The table below compares sampling and analysis with on-line slurry monitoring. The conclusion is that the latter is the more cost-effective method.

Comparison of Methods for Determining Slurry Transport Properties

Sampling and Analysis	On-line Slurry Monitoring
Sample results represent the slurry transport properties at the time of sampling.	Slurry transport properties are provided continuously.
Sample results are not immediately available.	Results are available in real time.
Changes in the slurry transport properties are detected only when additional samples are collected.	Operators continuously monitor the slurry transport properties and respond with corrective actions as required.
Sampling and analytical personnel are exposed to radiation.	Radiation exposures to personnel are reduced.

TECHNOLOGY DESCRIPTION

The goal of this project is to assess the ability of various types of instrumentation to monitor slurry transport properties on-line and in real time. In FY 1997, nine pipeline and three in-tank instruments were evaluated with non-radioactive slurries for monitoring density, percent solids concentrations, viscosity, and particle size. In addition, the electric current and power requirements of the transfer pump were evaluated to determine whether these criteria could be used to provide an early indication of a potential problem with a plugged pipeline. Activities for FY 1998 include selecting the most promising technologies from the FY 1997 testing and evaluation, incorporating the selected instruments in a test system and evaluating the instruments with radioactive slurries under actual operating conditions. Based on the results of the FY 1997 testing and evaluation, an instrument for monitoring density and an instrument for monitoring the suspended solids concentrations were selected. In addition, an instrument that measures particle size distribution were included in the FY 1998 testing and evaluation. This instrument, which was previously tested using non-radioactive slurries and evaluated by the Pacific Northwest National

Laboratory (PNNL), is being included under the sponsorship of the Accelerated Site Technology Deployment Program. The current and/or power requirements for the transfer pump will also be monitored.

In FY 1998, the instruments will be installed in a recirculation loop that is part of the Gunite and Associated Tank (GAAT) project at the Oak Ridge National Laboratory (ORNL). The objective of the GAAT project is to remediate and permanently close several inactive storage tanks that were constructed in the 1940s. The GAAT project will remove the sludges from the various tanks by creating slurries and consolidating them into a single tank. Once the slurries are in the consolidation tank, they will be mixed to homogenize and suspend them in the liquid phase (i.e., in the form of slurries). A pipeline loop will be used to circulate the slurries out of and back into the consolidation tank. The slurry monitoring test system will be installed in the circulation loop. While the slurries are being circulated, the various monitoring instruments will determine their transport properties. Samples will be collected and analyzed to verify the accuracy and precision of the data reported by the instruments. After the completion of a successful demonstration, the slurry monitoring instruments will be used to determine if and when the transport properties are acceptable. When the transport properties are deemed acceptable, the slurry flow will be diverted and transferred to the Melton Valley Storage Tanks (MVSTs) for processing.

BENEFITS

Prevent the plugging of pipelines with high-level waste slurries and thereby:

- Avoid major expenses.
- Eliminate radiation exposure of personnel caused by working on plugged lines.
- Avoid schedule delays.

On-line and real-time monitoring of the slurry transport properties provides site operators with the data they need to make decisions regarding the transfer of slurries through pipelines. By continuously monitoring the slurry transport properties, the operators are provided data in real time. They can then determine if the transport properties are steady and acceptable for transport and reduce radiation exposure to personnel. The slurry monitoring instruments can also be used while transferring the slurries to determine if the transport properties remain steady during transport. In addition, operators can respond quickly to prevent plugs in pipelines as the situation requires.

CAPABILITIES/LIMITATIONS

The Slurry Monitoring Test System was designed for use with the ORNL cross-site transfer pipeline, which is limited to 300 psig. It is conceivable that a monitoring system could be designed for higher pressures.

COLLABORATION/TECHNOLOGY TRANSFER

In this project, ORNL has collaborated with Argonne National Laboratory (ANL), PNNL, and Sandia National Laboratories (SNL). During FY 1997, these laboratories provided prototype instruments to ORNL for evaluation with non-radioactive surrogate slurries. PNNL also provided viscosity analyses (at a high shear rate) for the non-radioactive slurries, and ANL is providing an instrument for evaluation with radioactive slurries in FY 1998.

ACCOMPLISHMENTS

- Designed and conducted a test program to simultaneously test and evaluate twelve slurry monitoring instruments with non-radioactive slurries.
- Prepared and published a technical report that documented the testing and results from the evaluation of the various slurry monitoring instruments using non-radioactive slurries (T. D. Hylton, M. S. Anderson, D. C. Van Essen, and C. K. Bayne, *Comparative Testing of Slurry Monitors*, ORNL/TM-13587, Oak Ridge National Laboratory, Oak Ridge, TN, May 1998).

- Designed and fabricated a test system for evaluating slurry monitoring instruments using radioactive slurries.
- Prepared a test program for testing and evaluating the selected slurry monitoring instruments under radioactive conditions.
- In late FY 1998, the slurry monitoring system will be installed, tested, and evaluated with radioactive slurries.

TECHNICAL TASK PLAN (TTP) INFORMATION

The evaluation of slurry monitoring instrumentation is being funded by:

TTP No./Title: OR17C231 - Comparative Testing of Pipeline Slurry Monitors
TTP No./Title: OR16WT51 - LMES Retrieval and Closure (Subtask D)

ANL is developing an ultrasonic instrument for determining suspended solids concentrations that will be evaluated by ORNL. ANL activities are funded in FY 1998 under the following TTP:

TTP No./Title: CH26C217 - Ultrasonic Sensors for *In Situ* Monitoring of Physical Properties

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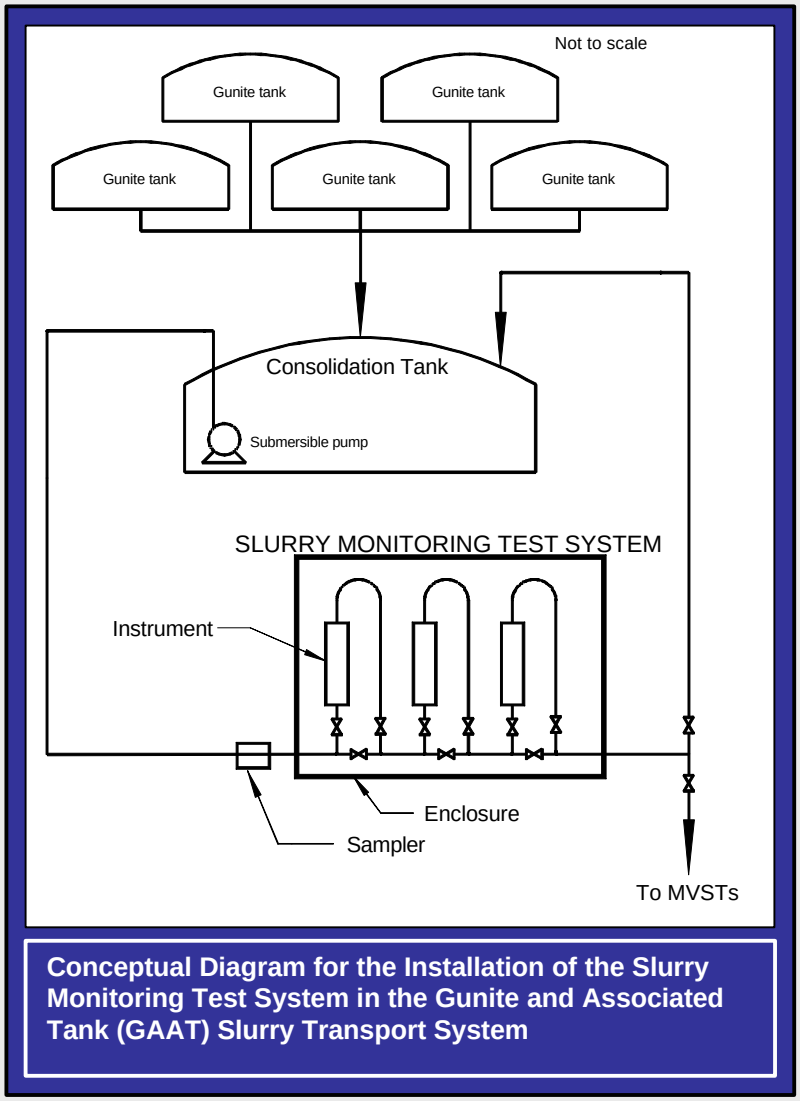

Conceptual Diagram for the Installation of the Slurry Monitoring Test System in the Gunite and Associated Tank (GAAT) Slurry Transport System