

DOE LOST CIRCULATION TECHNOLOGY DEVELOPMENT

by

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ABSTRACT

Lost circulation is a problem common in both the geothermal and the solution mining industries. In both cases, drilling is on a relatively large scale (geothermal holes can be as large as 26 inches). Lost circulation technology development for geothermal drilling has been in progress at Sandia National Laboratories for more than 15 years. The initial work centered on lost circulation materials, but testing and modeling indicated that if the aperture of a loss zone is very large (larger than the drill bit nozzles) it cannot be plugged by simply adding materials to the drilling fluid. Thus, the lost circulation work evolved to include:

- Construction of a laboratory facility for testing drillable straddle packers (to improve the plugging efficiency of cementing operations) and the actual testing of components of the straddle packer.
- Construction of a laboratory facility for the testing of candidate porous fabrics as a part of a program to develop a porous packer that places polyurethane foam into a loss zone.
- Implementing (with Halliburton and CalEnergy Company), a program to test cementitious lost circulation material as an alternative to Portland cement.
- Development of metering techniques that accurately measure and characterize drilling fluid inflow and outflow for rapid diagnosis of lost circulation and/or fluid balance while drilling.

The drillable straddle packer is designed to maximize the volume of cement that flows into the loss zone, to minimize the volume of cement remaining in the borehole, and to reduce dilution of cement from other wellbore fluids flowing into the formation. Its development is essentially complete. A prototype has been tested with cement in the Engineered Lithology Test Facility (ELTF). The ELTF test chamber was loaded with alternating layers of gravel and clay to simulate impermeable rock and loss zones respectively. Facility piping was used to flow water into and out of the gravel beds to model loss and production zones.

Testing of candidate porous fabrics for the wireline porous packer has been completed. While development of the porous packer follows that of the straddle packer, much of the

packer technology (bag fabrication, shroud development and deployment, decoupling from a wireline or drill string) will have applicability to the porous packer concept.

The cementitious lost circulation material hardens faster than conventional cement, drills faster, and is more compatible with the drilling fluid, thereby potentially reducing loss-zone, cementing, and mud conditioning costs. The first field trial showed promise and in certain instances saved several hours of rig time compared to conventional methods. The material was reformulated and will be tested this fall.

Rapid and accurate diagnosis of lost circulation while drilling is necessary to minimize fluid loss, reduce treatment costs, and save rig time. A rolling float meter was built, tested, and is being transferred to industry for use in monitoring fluid outflow in partially filled return line pipes. A new generation of commercial Doppler flow meters have been purchased and tested in monitoring drilling inflow rates. Together these flow meters have been used in the laboratory and field to accurately monitor fluid balance and detect lost circulation while drilling. An expert system also is being developed to detect lost circulation.

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