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HARD ROCK PENETRATION RESEARCH

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The DOE program in hard rock penetration is directed at reducing costs associated with drilling and completing geothermal wells. The project, in existence since 1974, currently consists of research and development in three areas: Borehole Mechanics, Rock Penetration Mechanics, and Wellbore Diagnostics.

The borehole mechanics task addresses problems in lost circulation control, drilling fluids, and fracture stimulation of wells. We have developed and used improved versions of the API standard slot tester to evaluate lost circulation materials. In addition, a large high temperature lost circulation test facility has been constructed at Sandia and extensive comparative data on materials performance have been generated. We worked with Texas Tech University to evaluate bentonite and bentonite/-saponite mixtures for use as geothermal drilling fluids. In the area of well stimulation, we investigated high energy gas fracturing as a technique for creating multiple fractures in a geothermal well. Underground tests (with mineback) at the Nevada Test Site demonstrated the validity of the technique and analytical models have been developed to predict productivity increases for typical geothermal reservoirs.

Rock penetration mechanics includes extensive R & D that resulted in the introduction and acceptance of PDC bits. Recent results in the PDC field are design criteria for full-face bits and quantification of the performance of PDC cutter/water jet combinations. A joint Sandia/-industry development of a computer code for analysis of drill string dynamics has recently been completed. In addition, drill strings for operation in very high temperature formations are being designed. A new effort is evaluating continuous coring systems for sample recovery in deep, high temperature regimes.

Developments in wellbore diagnostics have included high temperature electronic components, a high temperature borehole acoustic televiewer, a wellbore navigator, and cement bond log tools. Recently, dewared "slickline" tools with downhole memory were developed for pressure, temperature, and flow measurement. A prototype borehole radar tool with directional capability has been designed and assembled. The instrument is designed to locate producing fractures up to 100 m from the wellbore. The prototype is being evaluated and upgraded in a series of laboratory and field tests.

A project publication list is available.

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