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A PROPOSAL FOR AN ADVANCED DRILLING SYSTEM WITH REAL-TIME DIAGNOSTICS
(Diagnostics-While-Drilling)

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ABSTRACT

In this paper, we summarize the rationale for an advanced system called Diagnostics-While-Drilling (DWD) and describe its benefits, preliminary configuration, and essential characteristics. The central concept is a closed data circuit in which downhole sensors collect information and send it to the surface via a high-speed data link, where it is combined with surface measurements and processed through drilling advisory software. The driller then uses this information to adjust the drilling process, sending control signals back downhole with real-time knowledge of their effects on performance. We outline a Program Plan for DOE, university, and industry to cooperate in the development of DWD technology.

OVERVIEW

Drilling is an essential, ubiquitous, and expensive part of the oil, gas, geothermal, water-well, and mining industries. Improving the drilling process carries great interest, but research targets are not obvious because the technology is very mature. Drilling technology improvements can fall in one of two categories: reducing the cost of conventional drilling, where "conventional" includes even high-risk, high-cost operations such as off-shore horizontal drilling; or providing a beneficial new capability that did not exist before, regardless of cost.

Consequences of reducing cost can be impressive. U. S. oil and gas drilling expenditures exceed $10 billion per year (Oil & Gas Journal, 1/98), while drilling and well completion can account for up to 50% of the capital cost for a geothermal power project. Because of the industry's size, reducing total drilling expenditure by a small fraction pays off with a large amount of dollars. Cost reduction can take many forms – faster drilling rates, increased bit or tool life, less trouble (twist-offs, stuck pipe, etc.), lower completion cost through multi-laterals, and others – but the key to any of these improvements is better knowledge at the surface, in real time, of what is happening downhole.

In this proposal, we describe a new technology called **Diagnostics-While-Drilling** (DWD) that will address both kinds of drilling improvement. The central concept of DWD is a closed information loop, carrying data up and control signals down, between the driller and tools at the bottom of the hole. Up-coming data will give a real-time report on drilling conditions, bit and tool performance, and imminent problems. The driller can use this information to either change surface parameters (e.g. weight-on-bit, rotary speed, mud flow rate) with immediate knowledge of their effect, or to return control signals to active downhole components. DWD will reduce costs, even in the short-term, by improving drilling performance, increasing tool life, and avoiding trouble. Its longer-term potential includes variable-damping shock subs for smoother drilling, self-steering directional drilling, and autonomous "smart" drilling systems that analyze data and make drilling decisions downhole, without the driller's direct control.