Exceptional service in the national interest









Geothermal: Advanced Well Construction Technologies

and construction.

ammering action similar to that of a jackhammer. Downhole hammers are not new — the oil and gas and mining industries have used them since the 1950s but the older design, with its reliance on oil-based ubricants, plastic and rubber O-rings, isn't suited for the hotter temperatures of geothermal drilling.

"The technology behind the new hammer is undamentally the same, but Sandia worked with Sweden-based Atlas Copco in material selection and dry lubricant technology that will work in the hightemperature environment," said mechanical engineer Jiann Su, Sandia's principal investigator on the project with Atlas Copco, which operates worldwide and makes specialized equipment and systems for drilling, mining

The Department of Energy (DOE) Geothermal Technologies Office funded Atlas Copco as prime contractor on the project, and the company partnered with Sandia as the subcontractor.

'Part of what the DOE's Geothermal Program is looking to do is help lower the cost of getting geothermal energy out to customers," said Su, a researcher in Sandia's geothermal research department. "Some of reducing the cost is lowering exploration and development costs, and that's one of the areas we're helping to tackle."

he Geothermal Energy Association's 2016 annual U.S. had about 2.7 gigawatts





TECHNICAL BENEFITS:

 Reliable access to deep, hot geothermal resources Cost-efficient, durable Directional control during drilling Sandia's downhole motor works by converting Geothermal wells with multilateral longitudinal oscillatory motion of a piston into uniform completions rotational motion, in turn powering the attached drill Decreased environmental impact bit. High pressure fluid (gas or liquid) is pumped

Reduced lateral vibrations

please conta

Refer to SD#129

Or to learn mo

motors, such as Positive Displacement Motors (PDM), rely on elastomeric material, limiting operations to approximately 350°F or less, making them unreliable for extended use in geothermal wells. Sandia's downhole motor is designed using proprietary advanced materials to withstand prolonged exposure to high temperature and pressure. Unlike conventional drilling motors, this motor allows for downhole directional control when drilling high temperature formations, resulting in preferential targeting of geothermal resources.



	production report said the U.S. had about 2.7 gigawatts	
andia Labs News Releases	of net geothermal capacity at the end of 2015. Ir addition, the U.S. market was developing about 1.25	
Designing a Geothermal Drilling Tool That Can Take the Heat	gigawatts of geothermal power, and new renewable portfolio standards in states such as California and Hawaii could create opportunities for geothermal energy, the report said.	
andia National Laboratories and a commercial firm	Su said the high temperature hammer could help reach those development goals.	
ave designed a drilling tool that will withstand the eat of geothermal drilling.	New downhole hammer will be plus for drillers	

was developing about 1.25 power, and new renewable ates such as California and portunities for geothermal re hammer could help reach

er will be plus for drillers Su considers the three-year project a success, and said The downhole hammer attaches to the end of a the team and Atlas Copco are looking for opportunities column of drill pipe and cuts through rock with a rapid to deploy the tool.

12 Innovation Marketplace

piston to cycle. The axial motion of the piston is then ADDITIONAL APPLICATIONS converted into rotational motion in a rotor. All rotor components remain on the centerline, ensuring no . Mobile hydraulics (construction equipment dvsfunctional lateral vibrations are introduced into the Oil & Gas Auto Industry CONTACT US drillstring. Aerospace This novel downhole motor has the ability to produce wells with multilateral completions resulting in improved geothermal resource recovery and well construction economics, thus making geothermal a more affordable alternative energy source. Additional applications for high-torque linear motors have also ase visit our website a been conceived.

from the surface downhole to the piston, causing the

TECH TO MARKET SHOWCASE

Frank Maldonado, Sandia National Laboratories

PURPOSE & OBJECTIVE

- IDENTIFY LAB GEOTHERMAL IP & TECHNOLOGIES \bullet
- DEVELOP TOOLS TO DEMONSTRATE TECHNOLOGY TO MARKET •
- **BUILD RELATIONSHIPS IN NEW MARKETS**

SANDIA GEOTHERMIAL DRILLING TECHNOLOGT IP			
TITLE	PATEN NUMBE	FILING DAT	
Drilling Fluid Compatible High Temperature Downhole Motor	Application Filed	4/4/2016	
Active Cancellation of Drill String Vibrations Using Inertial Exciters	Application Filed	9/16/2015	
High Temperature Charge Amplifier for Geothermal Applications	9,209,766		
Methods for detecting and locating electrically conductive proppant	8,931,553		
Tagged Nanoparticles for Fluid Flow Monitoring	Application Filed	9/17/2014	
Downhole Tool for the Measurement of Tracer Concentration and Ph	Application Filed	4/28/2015	
High-Temperature Brushless DC Motor Controller	Application Filed	9/30/2014	
Deployable Powered Centralizers	Application Filed	3/4/2014	
Characterization of Stimulated Fractures Using Natural Tracers	Application Filed	8/30/2013	
Single well injection-withdrawal tracer tests for proppant detection	Application Filed	8/11/2011	
Simulating Current Flow through a Well Casing and an Induced Fracture	Application Filed	8/9/2011	
Self Consuming Structural Materials and Composites	Application Filed	7/17/2013	
Air Driven Downhole Drilling Motor	Application Filed	2/27/2014	
Reduced-Impact Sliding Pressure Control Valve for Pneumatic Hammer Drill	8,176,995		
Sliding Pressure Control Valve for Pneumatic Hammer Drill	8,006,776		
Self-Assembling Segmented Coiled Tubing	Application Filed	2/16/2009	
Downhole Geothermal Well Sensors Comprising a Hydrogen-Resistant Optical Fiber	6,853,798		

NDIA GEOTHERMAL DRILLING TECHNOLOGY IR

Aethod of Reducing Injection Loss in Drill Strings	6,791,470
Controllable Magneto-Rheological Fluid-Based Dampers for Drilling	7,036,612
npedance-Matched Drilling Telemetry System	7,362,235
n Improved Acoustic Transducer	6,147,932
Fill Bit Assembly for Releasably Retaining a Drill Bit Cutter	6,427,791

METHODS

- DEVELOP TOOLS FOR MARKETS MAGAZINE, MARKET SHEETS, CONFERENCE SHOWCASE \mathbf{O}
- ATTEND CONFERENCES IN POTENTIAL MARKETS \mathbf{O}
- IDENTIFY AREAS OF INTEREST WITH NEW PARTNERS
- SEEK TO ESTABLISH AGREEMENTS LICENSING, COLLABORATION/PARTNERING





- DEVELOPED SNL GEOTHERMAL IP PORTFOLIO
- PUBLISHED MATERIALS FOR DISTRIBUTION IP WEBSITE, MARKETPLACE MAGAZINE \mathbf{O}
- OIL & GAS CONFERENCE
- ESTABLISHED RELATIONSHIPS WITH SEVERAL POTENTIAL NEW PARTNERS
- FOLLOW ON MEETINGS AT SNL TO IDENTIFY POTENTIAL FOR COLLABORATION AND LICENSING





- MARKETING MATERIALS ARE DEVELOPED NEW IP CAN EASILY BE INCORPORATED
- IN NEGOTIATIONS WITH POTENTIAL PARTNERS TO DEVELOP COLLABORATIVE WORK AGREEMENTS THAT LEVERAGE OUR **TECHNOLOGY & EXPERTISE**
- FUTURE WORK WILL CONTINUE REACHING OUT TO NEW PARTNERS & SETTING UP COLLABORATIVE AGREEMENTS





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