Microhole Arrays Drilled with Advanced Abrasive Slurry Jet Technology to Efficiently Exploit Enhanced Geothermal Systems

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EGS Component R&D › Drilling Systems

Overview Slide

- Timeline
  - Project start date: February 1, 2010
  - Project end date: February 1, 2013
  - Percent Complete: 1%
- Budget
  - Total project funding: $2,999,999; DOE share: $2,399,999; Awardee share: $600,000
  - DOE Funding received: $0 in 2009, $0 in 2010 to date
  - DOE $ Budgeted : $741,016 in 2010 (projected)
- Barriers
  - Temperature 300^{o}C; Depth limiting hydraulics; High Pressure
- Partners
  - Lawrence Berkeley National Laboratory (LBNL)

Relevance / Impact of Research

- Innovative Aspects of Project:
  - FLASH ASJ™ drilling system
  - Microhole arrays
  - Coiled Tubing Drilling (CTD)
- Impact on DOE GTP program goals:
  - Reduces exploration risks and up-front costs
  - Increases overall volume of useful, productive reservoir rock
  - Increases well connectivity between multiple microholes and fractures in an optimized array
  - Creates a step change improvement in EGS reservoir heat exchange efficiency
  - Multiple side benefits of related technologies (sealing, seismic)
  - Drives market development of EGS

Scientific/Technical Approach

- Scientific/Technical Approach:
  - Advance & adapt microhole & ASJ/FLASH ASJ™ drilling for EGS
  - Optimize microhole array configurations to maximize heat removal from expanded volume of reservoir rock
- Highlights:
  - LBNL: geothermal simulation & optimization expertise
  - 3-year timeline, potential barriers and workarounds identified
  - Task structure designed for interactions, feed points, & overlaps
  - Methods field tested decades ago by Gulf Oil and others
  - Commercial ASJ cutting/drilling (DrillStream, Hydroslotters, Blast, DiaJet)
  - Impact's FLASH ASJ™ system bench tested at 4,000-15,000 psi
  - Current SBIR Phase II project for 2,000 ft microseismic wells

Planned milestones for FY10:

- Phase I – Feasibility study report to be submitted in Y1Q3
  - Selection of drilling fluids and abrasives
  - Selection and sizing of potential piping, tools and equipment
  - Identify the potential array configurations and operation scenarios for a range of EGS characteristics
- Phase II- Testing phase (On-going)
  - Begin work in any section as soon as Phase I identification work done
  - Testing erosion characteristics of 300^{o}C reservoir rocks
  - Simulation flow and heat transfer of multi-phase fluids and abrasives within the microhole
  - Develop evolution of directional drilling capabilities
  - Development of safety and environment procedures, and
  - Development of a reservoir model for fluid flow and heat transfer

Accomplishments, Expected Outcomes and Progress

- Progress to date- Project just beginning. Evaluating commercial drilling hydraulics models and potential piping and fluids
- Planned accomplishments/outcomes
- Relevant data- None to date in project
- Team & Facilities
  - Ken Oglesby/Impact – inventor, patents, drilling expertise
  - LBNL – geothermal simulation & optimization
  - Dr. Felber – recognized expert in Enhanced Oil Recovery techniques & FLASH fluids
  - Dr. Rychel –CTD researcher
  - State-of-the-art required equipment is available

Project Management/Coordination

- Project management plans
  - Microsoft Project software
  - Quarterly teleconference calls & written reports
  - Onsite meetings by PI
- Schedule
  - April 2010: Begin Phase I- Feasibility Study
  - July 2010: Finish Phase I Feasibility Study
  - August 2010: Phase I Report and continue Phase II work
  - Y3Q3: Finish Phase II Microhole Technology Development
  - Y3Q3: Go / No-Go Decision Point
  - Y3Q3: Begin Phase III – Final Design & Optimization of Microhole Deployment for EGS
  - Y3Q4: Complete project and submit Final Report

Future Directions

- In FY10 we will identify
  - required drilling system (fluids, abrasives, pipe configurations, pressures);
  - drilling barriers (generating FLASH conditions, scale formation, erosion, hole cleaning, etc);
  - favorable array configurations by flow and heat transfer models;
  - tools required to install the desired array configurations;
  - specific safety and environmental issues requiring further investigation; and
  - test FLASH fluids, abrasive and pipe materials.
- In FY11 we will continue testing and refining the array configuration and building appropriate models of the desired system.
- First milestone will be the Phase I report in Y1Q3

Summary Slide

- Project just started
- Testing of a new FLASH ASJ™ drilling system for EGS
  - Faster and lower cost drilling
  - Capable of drilling microholes (less than 4” diameter)
  - Capable with coiled continuous tubing
  - Capable of directional drilling
  - New SPI sealing gels
  - Multiple other applications
- Modeling of microhole arrays
  - Improved reservoir contact
  - Improved heat transfer
- Potentially shallower and cooler EGS targets may be economic