4.4.4 High-temperature Pump Monitoring - High-temperature ESP Monitoring

Presentation Number: 018
Investigator: Dhruva, Brindesh (Schlumberger Technology Corp.)
Objectives: To develop a down-hole monitoring system to be used in wells with bottom hole temperature up to 300 °C for measuring motor temperature, pump discharge pressure, and formation temperature and pressure.
Average Overall Score: 3.0/4.0

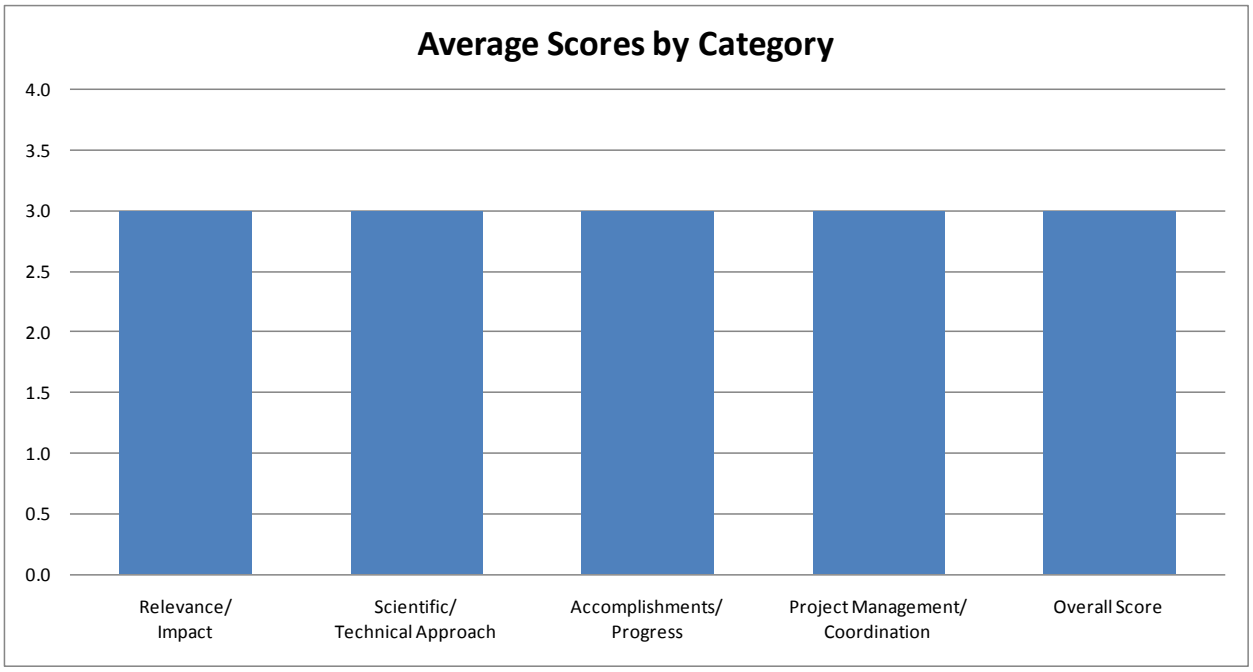

Figure 25: High-temperature Pump Monitoring - High-temperature ESP Monitoring

4.4.4.1 Relevance/Impact of the Research

Ratings of Three-member Peer Review Panel: Good (3), Good (3), Good (3)

Supporting comments:

- Making temperature and pressure measurements under deep geothermal well conditions is valuable both for monitoring pump function (motor temperature and discharge pressure) and for determining reservoir properties (temperature and pressure).

  Two approaches are being followed, each of which should provide a robust and long-lived sensor. It is not clear if the two sensors are alternatives, each capable of doing two jobs, or whether each is destined for a particular application.

- This project builds on previous research and experience. It is trying to improve the equipment in addition to having it operate under a higher temperature requirement. They are having some issues with drift, which is slowing down the research, until they can solve this problem. It

appears they have a solution. I would note that in research especially, one cannot anticipate all issues.

- For the extraction of hot water from a deep EGS, down-hole pumps will be necessary. They will have to have pumping capability an order of magnitude greater than the present generation of electric submersible pumps, which are designed primarily for the petroleum industry, and which are not designed to work at temperatures of 300 °C. Consequently, relatively large pumps that can operate at those temperatures are essential to the success of EGS power production. Furthermore, measurements of the operating pump motor temperature and output pressure will be needed for the proper operation of this equipment.

4.4.4.2 Scientific/Technical Approach

Ratings of Three-member Peer Review Panel: Good (3), Good (3), Good (3)

Supporting comments:

- It is not entirely clear whether two sensor styles are needed - the fiber optic sensor for pump discharge pressure and another pressure sensor for the formation pressure, and then other sensors for motor and formation temperature, or whether e.g. the fiber optic pressure sensor is capable of making both pressure measurements. Apparently development of two styles of pressure sensor is going on, but whether they are equivalent or destined for different applications is unclear.

  Abandoning the Free Piston Stirling Cooler was a good strategic move, as maintaining moving machinery in the down-hole environment is always difficult. Having different sensors that can survive uncooled in the environment is much to be preferred.

- The approach of extending the range of current instruments seems very logical. I would add that this approach does, at least at the outset, exclude new ideas. The drift issue appears to have brought a new search for materials into this research.

- Objectives: Develop temperature and pressure sensors that can measure both characteristics in the down-hole fluid and in the electric submersible pump in a geothermal well. A temperature limit of 300 °C is specified as the ultimate goal, but current testing is performed at somewhat lower temperatures to determine characteristics of materials and components at intermediate levels.

4.4.4.3 Accomplishments, Expected Outcomes and Progress

Ratings of Three-member Peer Review Panel: Good (3), Good (3), Good (3)

Supporting comments:

- Good progress has been obtained so far. However, field testing will eventually be required and additional funding will be required for that work to be done

- They have some promising results for monitoring temperature and pressure at 290 °C. They still have to package and prepare for a well test.

- The project is approaching the 300 degree limit with appropriate designs. Lab equipment and the capabilities of researchers seem adequate for the task.

4.4.4.4 Project Management/Coordination

Ratings of Three-member Peer Review Panel: Good (3), Fair (2), Outstanding (4)

Supporting comments:

- Project management appears to be good, and is internal to the Schlumberger group, so that should minimize difficulties in communication.

- This project is running about 6 months behind schedule and they anticipate completion in fourth quarter 2010.

- An initial approach, a down-hole Stirling cooler proved to be impractical and at a decision point was dropped from further consideration, and an alternative approach was adopted. The new approach is tailored to remaining time and resources, and is on track to achieve the project objective. This necessary midstream change of approach is indicative of heads-up research management.

4.4.4.5 Overall

Ratings of Three-member Peer Review Panel: Good (3), Good (3), Good (3)

Supporting comments:

- Overall, it is somewhat confusing to disentangle the different threads in the work as it is progressing. However, steady progress is apparently being made. Attention should be given to planning the next steps, viz. towards a field test, that will involve finding a suitable collaborating company and test location.

- This project is running behind schedule and over budget. The researchers expect to spend more of their own money to complete the research.

- This project, although with revised objectives, appears to be leading to the development of down-hole systems that will provide the desired temperature and pressure data in the well and in the pump to the operators of an EGS well.

4.4.4.6 PI Response

No response.