4.4.6 Fielding of HT-seismic Tools and Evaluation of HT-FPGA Module - Development of a HT-seismic Tool

Presentation Number: 020
Investigator: Henfling, John (Sandia National Laboratories)
Objectives: To design, fabricate and field test two high-temperature seismic tools in an EGS application; to work with commercial partners in the development of the tool; and to develop two electronic designs.
Average Overall Score: 2.7/4.0

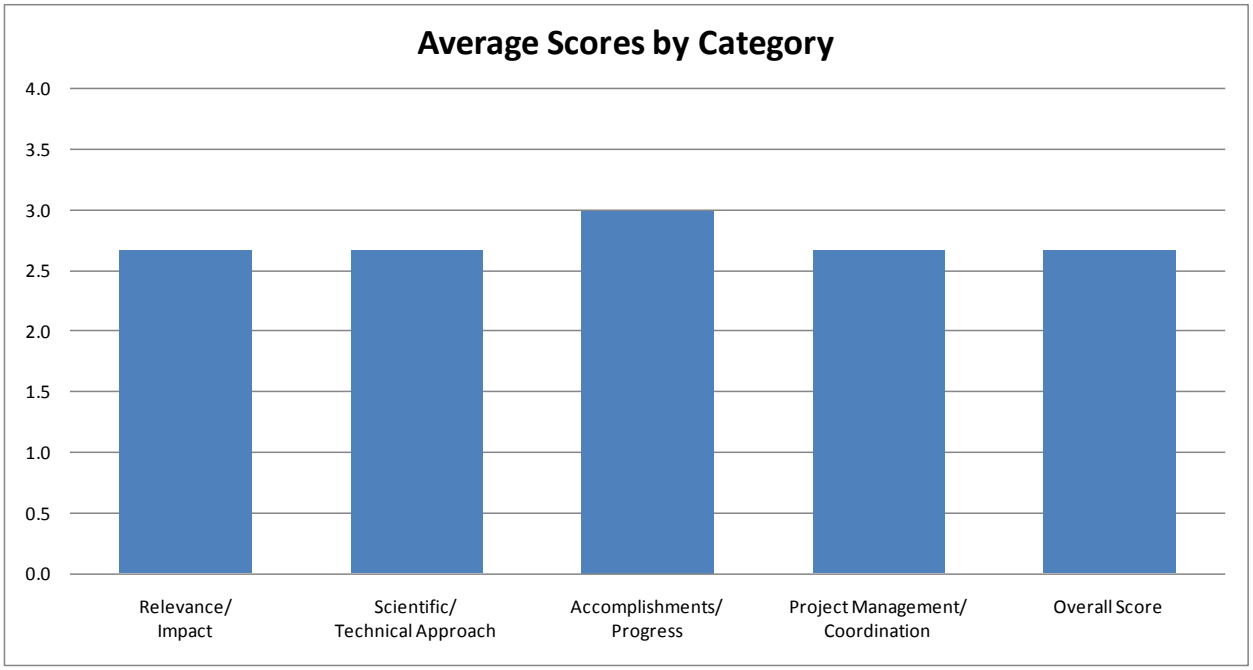

Figure 27: Fielding of HT-seismic Tools and Evaluation of HT-FPGA Module - Development of a HT-seismic Tool

4.4.6.1 Relevance/Impact of the Research

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

Supporting comments:

- Collection of seismic data from geothermal wells are of importance in several areas. Probably most important is in the detection and location of rock fracture events while the well is being stimulated (hydrofractured). This is required in a large number of geothermal wells. Subsequent operation of the well results in pressure changes that in turn create rock fracture events that then can be interpreted to give information on reservoir behavior. Generating seismic information of this type is thus of broad value in almost all geothermal wells.
- The goals of this project could be a stepping stone to higher temperatures. Current goal is 200 °C seismic tools.

- A viable Enhanced Geothermal Systems technology will require down-hole seismic monitoring systems to evaluate the characteristics of the accessible reservoir created by fracturing between wells. Such seismic tools must survive the rigors of the down-hole temperature environment, and other EGS related research and development programs have 300 °C as a goal.

  This project's stated objective mentions "HT" but does not specify a value. Later within the report the figure of greater than 240 °C is mentioned as "desired." The temperature limitation of existing seismic equipment is identified as 125 °C.

  The work reported by this project will advance the temperature resistance of a down-hole seismic tool by a significant amount (to about 200 °C). However, the ultimate achievement of suitable performance at 300 °C may lag other EGS program achievements.

4.4.6.2 Scientific/Technical Approach

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

Supporting comments:

- The scientific and technical approach is based on making improvements to an existing seismic tool that was developed previously by Sandia. Improvements included increasing the thermal resistance of the tool (obviously) but also improving the clamping mechanism, shock resistance etc.

  Considerable effort is going into the selection and integration of the electronic components, with the requirement to balance signal-processing capability against resistance to high temperatures. This appears to be well thought out and correctly executed.

- Approach is to start with known tools/packing and modify the tools for a higher temperature environment. Appears to be making progress and the breakaway portion of the tool will provide an option that reduces the cost of failure.

- The approach is to begin with existing equipment, evaluate the performance of subsystems, seek improvements in each, and then apply the improved components to an improved system assembly. This strategy seems logical and straightforward, but when the technical barriers are considered, may not be the most effective approach.

  Progress is good in some areas; however, some of the subsystems are available only from outside commercial sources and the limitations of these components inhibit progress toward EGS goals. Thus, the rate of progress toward program goals is to some extent beyond the control of the researchers. Consequently, the scope of the research effort is inadequate to fully support progress toward the EGS program goals.

4.4.6.3 Accomplishments, Expected Outcomes and Progress

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

Supporting comments:

- Progress has been good (allowing for interruption of funding in 2008) and expected targets are being achieved. Field tests remain to be done.
- The project appears to be on track.
- The overall quality of what has been accomplished is good. The mechanical issues for the down-hole tool have been addressed. Temperature resistance of the motor that drives the clamping mechanism is a weakness, but similar issues are being addressed on other EGS research projects, and those results should eventually be applicable to this problem. The stepper motor as a "place-holder" is a good way to move forward to testing the hardware. The lack of sensor technology that will meet the project specifications has slowed progress. In-house development of a suitable sensor is not in the project scope, and since this is a critical component, its lack is a weakness in the development of the desired tool, and EGS program management may wish to address this shortcoming.

  The quality of research personnel and the available facilities appear adequate for the present project scope and objectives.

4.4.6.4 Project Management/Coordination

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

Supporting comments:

- The project is largely complete. Interruption of funding in September 2008 delayed work. The project is being supported by collaborative work in Halliburton and Harvey Mudd College. This appears to be working well.
- Working with industry for a real world test (Raft River).
- Firm decision points appear to be lacking. Coordination with project partners and suppliers of commercially available components is good. The selected technical approach is being followed correctly. This work has identified barriers to development of a seismic tool that will satisfy EGS program needs. The researchers also have made progress toward a system that is a substantial improvement over current technology. But the project seems nowhere close to developing a system that will satisfy EGS program requirements. Plans to take the development of an EGS seismic system to the next level are a bit fuzzy.

4.4.6.5 Overall

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

Supporting comments:

- A well run project overall. There is a need for high-temperature seismic logging capability in geothermal wells, and this project is moving steadily forward in that direction. Much of the required progress is in the area of complicated signal-processing capacity. COTS equipment is being used, with alternative approaches that balance processing capability against thermal resistance.

- The project is producing solid basic advancement.

- The project objectives appear to be inadequate to support the broad overall goals of the EGS program on an acceptable schedule. It appears that this project is under-planned and underfunded. Other EGS program funded R&D projects on high-temperature electronic circuits, components and cables for transmitting data from down-hole equipment to the wellhead may be applicable to the seismic detection problem. Some critical issues are being worked on by other groups at Sandia. However, coordination with other research projects performed by industrial groups may be problematical due to proprietary issues. But waiting for appropriate electronic components to appear as off-the-shelf items may not be the optimum strategy.

  Perhaps this research group should first focus on development of a seismic sensor that will operate up to 300 ^{o}C, and in the later stages of the EGS program, coordinate with other groups that are developing electronic components, circuits, signal cables, seals and packaging suitable for high-temperature, down-hole conditions.

4.4.6.6 PI Response

No response.