4.3.4 Systems Engineering

Presentation Number: 004
Investigator: Lowry, Thomas (Sandia National Laboratories)
Objectives: To develop a physics based systems level simulation and analysis tool for geothermal energy development.
Average Overall Score: 2.7/4.0

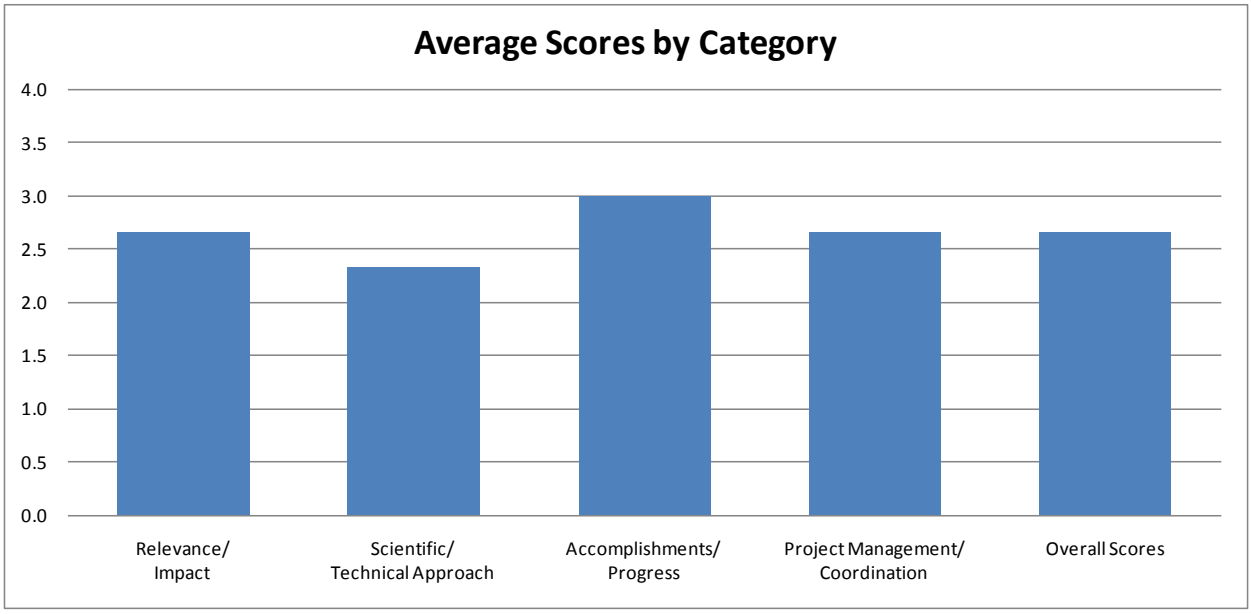

Figure 19: Systems Engineering

4.3.4.1 Relevance/Impact of the Research

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

Supporting comments:

- The systems dynamics approach may prove to be a valuable analysis tool.
- This is a high-level model that simulates GT electric systems including EGS, and that addresses barriers W,X, and Y. The only rationale for not giving this project a "good" rating is lack of definition of scope and potential duplication with GETEM, along with use of a proprietary platform. Use of the completed model should allow DOE and others to conduct orderly analyses - a function now performed with GETEM. One can argue that the PI's claimed result of "Identify points to maximize efforts....." is already known and that this model will not provide additional depth of knowledge. DOE and SNL must better define the purpose and scope of this project.
- The project addresses an EGS goal that would help DOE and the industry analyze potential EGS projects. The model could also be extended to other geothermal development options. The promise is for a new tool to help design and manage EGS projects.

4.3.4.2 Scientific/Technical Approach

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

Supporting comments:

- While the overall project seems well founded, I do not see documentation that the extensive efforts of DOE in the 70s, 80s, and 90s have been incorporated. I am concerned that while the physics is soundly based on early papers (e.g. Snow 1968), work in the last 40 years, especially DOE-funded drilling and reservoir engineering efforts, might have refined some of the assumptions used. I note that this project has been presented at a Stanford workshop, which is good. But what has been incorporated or changed as a result of feedback from the presentation?

- Again, this should be a "good" rating if DOE and SNL would decide on the desired level of detail that this model will address. The resulting model can range from essentially a "macro" wherein major components such as conversion can continue to be treated as a "black-box" with parametric input by the user; to the other extreme of a "micro" wherein there are routines to do detailed component calculations. In the latter case there may be duplicative efforts, e.g. with GETEM and the CO_2 efforts at LBNL. The latter approach will be very costly - present funding is just the "tip of the iceberg". This is not necessarily bad if it is what the GTP decides it needs as efforts such as GETEM have been sort of ad-hoc in definition and this approach is much more systematic. Again, "What's it gonna be when it grows up?".

  A much more accessible computer programming platform than Pro-Sim should be used. The current platform costs about $300 or more per user with a bulk purchase - this will somewhat limit the use of the resulting program.

- The technical approach appears to be sound and the project well executed.

4.3.4.3 Accomplishments, Expected Outcomes and Progress

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

Supporting comments:

- The presenter seemed to understand the nuances of this effort, and explained them well. Some of his slides, however, were dense and illegible. The tiered approach to the program will allow good flexibility. I do not recall the status of the beta version being clarified. The presentation calls for a May to June delivery, and we are there. Has it been delivered?

- Very competent PI, with a good approach on an ill-defined project plan. There appears to be significant progress. This reviewer questions whether both the deterministic (essentially rating a specified system) and the stochastic (essentially designing a system to meet specified goals) are needed. It is hard to imagine a casual user being able to input a meaningful probability density function for the stochastic applications. As stated above, this project needs to have close collaboration with some other GTP efforts such as GETEM, as acknowledged by the PI.

- Sandia's team has the capability of doing this project well, and can draw on a large pool of talent if needed.

4.3.4.4 Project Management/Coordination

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

Supporting comments:

- It was noted during the presentation that coordination with industry is at the stage of "silently developing a list of targets," and that coordination with other lab modeling efforts is still in the planning stage. It seems to me that both industrial input and coordination with other national lab modeling efforts should be increased. Coordination among labs is critical, but it is not sufficient to produce a successful end product. Modular development of the program will allow multiple decision points for further directions or termination.

- Reasonably good project management with an ill-defined project plan as discussed previously. However, this project should be better defined in scope with development of a long-range plan giving costs including maintenance and technical-assistance (to users) costs - with agreement by DOE.

- There is no explicit mention of decision points in this project. The project seems to be well managed.

4.3.4.5 Overall

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

Supporting comments:

- Great idea to base a systems analysis on good physics. But I fear that the goal of providing" a platform for public education and interaction" will be lost through use of terms such as "points of attack" and "parameter space." The presentation did not identify how the general public will be reached by this project. I would like to see very close coordination among model developers. Is there any chance that all the models funded by DOE could be based on one front end, so users will not have to learn separate models and programs to answer questions, but instead could learn one program and have multiple options in how they run it?

- Potentially a "good" or "outstanding" rating with better definition of the project scope and plan. Platform should be public domain, or common and easily accessible. Relationship of this project to other GTP projects must be better defined, as must the ultimate use and costs.

- The model being developed in this project has some overlap in its goals with the GETEM model, which has been under development for several years. As a predictive tool for EGS reservoir performance, the model seems to also overlap the capabilities of several widely available reservoir simulators. This is not necessarily a bad thing since a new approach will afford the opportunity to compare model results for vetting purposes. With the amount of funding available ($625,000), however, it seems unlikely that the model will reach the state of capability that either GETEM or simulators such as the various TOUGH incarnations has. This type of

model-development project often never reaches a stage where it is “finished”, and it appears that the total amount of funding may not be enough to yield a truly useful model. The project staff should interact with other modelers in geothermal energy to take advantage of their expertise and help vet the model. DOE should consider how much more money they are willing to commit to make this new model most useful.

4.3.4.6 PI Response

No response.