

LOUISIANA TANK, INC.

FINAL TECHNICAL REPORT

U.S. Department of Energy: Award No. DE-EE0002855

“Demonstrating the Commercial Feasibility of Geopressured-Geothermal Power Development at Sweet Lake Field – Cameron Parish, Louisiana”

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The goal of the project was to demonstrate the commercial feasibility of geopressured-geothermal power development by exploiting the extraordinarily high pressured hot brines know to exist at depth near the Sweet Lake oil and gas field in Cameron Parish, Louisiana. The existence of a geopressured-geothermal system at Sweet Lake was confirmed in the 1970’s and 1980’s as part of DOE’s Geopressured-Geothermal Program. That program showed that the energy prices at the time could not support commercial production of the resource. Increased electricity prices and technological advancements over the last two decades, combined with the current national support for developing clean, renewable energy and the job creation it would entail, provided the justification necessary to reevaluate the commercial feasibility of power generation from this vast resource.

The specific objectives of this project were:

- To use a well design specific to the conditions anticipated for a geopressured-geothermal reservoir at the site, and then to drill and test a production well to a depth of 16,000 feet and an injection well to a depth of 7,400 feet, without any matching funds from the DOE.
- To develop conceptual and numerical models of the reservoir and quantify the reservoir characteristics, using log, core, PVT and flow test data from the well.
- Based on the above steps, to design the most appropriate surface technology and power plant to optimize production of electricity from heat, kinetic energy and dissolved methane gas in the brine.
- To conduct a long-term test of the production well, construct all surface facilities and power plants, and start power generation.
- To assess the technical and economic aspects of performance of the constructed system, and direct and indirect job creation from the project.

Project Summary

Well Testing & Reservoir Assessment

Louisiana Tank, Inc. examined an extensive database of information available from the multiple wells that have been drilled in and around the Sweet Lake field at a depth to sufficiently analyze the targeted geopressured sand formation. This process increased the understanding of the Sweet Lake geopressured reservoir. Analysis of this information enabled the development of conceptual and numerical modeling of the targeted reservoir and the quantification of the reservoir characteristics. Well log correlations, as well as core, PVT (pressure, volume, temperature) and flow test data were employed to forecast well performance and reservoir performance. In addition, Louisiana Tank obtained the rights to map a proprietary 3-D seismic data survey covering the project site location to further analyze the targeted geopressured sand structures. The results of these analyses indicated very positive results for the anticipated reservoir and fluid characteristics.

Louisiana Tank, Inc. also completed extensive financial analyses and modeling of production scenarios for the Sweet Lake power plant in order to determine the commercial viability of the project. Results of these analyses indicated the necessary electricity and commodity prices required for commercial success of the project are higher than current market rates.

Technical Effectiveness & Economic Feasibility

Louisiana Tank, Inc. completed preliminary front end engineering and design work for the power plant and associated surface facilities. An EPC contractor was selected and the process of power cycle optimization and selection of equipment was begun. Louisiana Tank solicited bids from potential vendors and was in the process of negotiation and selection when the project was terminated.

Louisiana Tank, Inc. engaged M&H Energy Services to perform preliminary design work and cost estimates for the proposed geopressured-geothermal production facilities. M&H Energy Services is a leading independent design and engineering company that is focused on the delivery of high quality, innovative solutions to meet the engineering, operations and maintenance challenges of its clients. M&H Energy Services' professionals and technical staff are highly qualified and experienced and remain client focused, working to understand the unique challenges each is facing and implementing solutions that will drive value, enhance operational efficiencies and reduce costs.

The completed preliminary design work included the following:

- Developing the Process design
- Sizing Equipment
- Selecting equipment vendors
- Obtaining equipment pricing
- Developing a plant layout
- Developing a capital cost estimate
- Developing a project schedule through start-up
- Developing a project cash flow analysis

Louisiana Tank's plan was to employ M&H to perform the detailed design work for the geothermal production facilities and construction management services, which would have included the following:

- Finalizing the Process design
- Finalizing Equipment sizing
- Finalizing the equipment vendors, pricing, and issuing purchase orders for the equipment
- Finalizing the plant layout
- Finalizing the detail design of foundations, piping, electrical, and system controls
- Preparing construction drawings for the plant installation
- Issuing a construction installation bid package
- Evaluating the construction bids and recommending the successful construction contractor
- Issue the purchase order for plant construction
- Provide construction inspectors to oversee the plant construction
- Provide plant startup assistance

Power Purchase Agreement

Louisiana Tank, Inc. attempted to negotiate a power purchase agreement contract with several different utility companies to purchase all electricity generated by the power plant as well as all associated geothermally derived methane gas (natural gas). Upon consummation of this agreement, Louisiana Tank's plan was to proceed with a complete set of stamped project engineering plans to be used for power plant construction in Phase 2 of this project.

Conclusion

In summary, the three keys elements of a successful geopressured-geothermal power generation project are (1) drilling a geothermal production well that is specifically designed to handle the extremely high flow rates required for commercial production (20,000-40,000 barrels per day) while also being designed to combat production problems such as scaling and corrosion; (2) drilling a saltwater disposal well or a series of saltwater disposal wells into reservoirs that are capable of handling the massive amounts of spent brine associated with commercial geothermal production; and (3) having a power purchase agreement (PPA) with a utility company that is willing to pay a premium price for “green” energy vs. the normal market rate for traditional sources of power as well as allowing access to electric power transmission infrastructure.

In States, such as Louisiana, that do not have any formal “Renewable Portfolio Standard” (RPS), the utility companies have no incentive to pay greater than market prices for power; especially for a smaller scale project, such as the Sweet Lake project, which would have only produced less than 8 megawatts of electricity.

The original DOE studies conducted in the 1970’s and 1980’s determined that re-entering existing oil and gas wells was not a viable option. However, this current grant award prohibited the use of any government funding dollars being used towards drilling costs associated with a new geothermal production well which would be specifically designed to produce geothermal brines at optimal flow rates. The greatest risk associated with a geopressured-geothermal project is in the drilling of the production well, which Louisiana Tank estimated would cost between \$8 and \$10 million. Each disposal well was estimated to cost \$2 million. After making this initial investment, the production well would be subjected to a 30-day flow test in order to estimate and model its production capacity, quantify the reservoir characteristics and assess the power generation potential from the geothermal heat, kinetic energy and methane gas in the brine.

Only after securing favorable results from the flow test of the production well could one justify the additional \$12 million investment necessary to construct the geothermal power generation facility. However, with no guarantee that commercial level flow rates could be sustained for a length of time necessary to justify the total project cost of over \$22 million and no current incentive for utility companies to pay above-market rates for geothermal power, it is the opinion of Louisiana Tank that commercial production from a geopressured-geothermal resource in Southwest Louisiana is not a commercially viable power generation option at this point in time.

As a result of this conclusion, the project was terminated on May 26, 2011 based on mutual agreement between Louisiana Tank and DOE officials that it would be the most prudent decision at this point. Total Federal cash expenditures for the project were \$867,850.84 out of a total original award amount of \$5,000,000 while Louisiana Tank contributed a total cost share amount of \$951,924.47.

At the termination of the project, an unobligated balance of Federal funds existed in the amount of \$4,132,149.16.