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GEOLOGY • HYDROLOGY • PETROLEUM ENGINEERING • ENVIRONMENTAL & RESOURCE EVALUATION

Info on Pressure Assessment & Commercialization

July 27, 1979

To: Participants - DOE/Industry Geopressured Geothermal Energy Forum

Subject: Status Report

Attached is the June Status Report. It includes direct quotes from the University of Texas' Geothermal report and information from the General Crude daily drilling reports.

Remember the meeting next Tuesday, August 1st in Houston. It will include a full discussion of the Gruy Federal tests on Fairfax Foster Sutter #1 and the current test data on Pleasant Bayou Well #2.

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STATUS REPORT

June 1979

DOE/INDUSTRY GEOPRESSURED GEOTHERMAL
ENERGY DEVELOPMENT PROGRAM

Pleasant Bayou Well # 2 - General Crude/DOE
Brazoria County, Texas

The GCO-DOE test well was drilled and tested in two intervals below the main zone of interest as follows: DST #1- 15,992-16,010 at 16,042-16,050 four holes per foot - packer at 15,943. At full cushioned fresh water, no bottom hole choke. Opened on 20/64" choke has 200 psi, bled to 0 psi immediately. Closed in at surface, pressure built to 500 psi in one hour. Opened to flow, pressure bled to 0 psi in two minutes. No flow. Calculated recovery 3 barrels water cushioned. Initial SIBHP 11,032 psi, final SIBHP 9,735 psi. Dry test. DST#2- 15,580-15,590, four holes per foot. Packer set at 15,512. At full cushioned fresh water, no bottom hole choke. Opened to with 12/64" surface choke. Initial flowing pressure 4,500 psi, flowed for eight minutes, shut in pressure 3,000 psi, shut in for one hour. Opened tool, initial flowing pressure 2,000 psi. Flowed three hours with average 370 psi, rate 13.3 barrels per hour, chlorides 65,000 ppm with trace of gas. Initial SIBHP 9,759 psi, final SIBHP 9,686 psi.

Made block cement squeeze at 14,714 and 14,600 feet. Drilled out cement and cleaned out 7" liner to 15,475. Set 4 ½" FJ Hydril tail pipe and placed sealed nipple in polished floor receptical at top of 7" liner, but packer failed. Ran and set 5½" by 9 5/8" Otis type WD packer above the liner at 13,967. Ran 5½" tubing with 20 foot Otis sealed nipple, stabbed into packer and spaced out to put locater sub 16 feet above WD packer. Circulated tubing leaving 10 ppg brine inside and 12 ppg $CaCl_2$ in the annulus. Nippled up 5 1/16", 15,000 psi WP tubing head. Perforated 14,644 to 14,704 using four jet shots per foot while holding 2500 psi at the surface. Pressure immediately increased to 3,750 psi. Flowed well at rate of 60 barrels per hour for 8 hours and 100 barrels per hour for 12 hours with 4,464 psi tubing pressure. Shut in tubing pressure stabilized at 4,539 psi; indicated SIBHP approximately 11,400 psi. Estimated bottom hole temperature 280°F. Salinity of formation water 85,000 ppm. Gas and water ratio appears to be 20 cu feet per barrel. Released Welsh Drilling Co. rig June 11th. General Crude expects to start work to complete the #1 Well as a disposal well in about a month and they have surface facilities ready for production tests of the #2 Well by October.

Wells of Opportunity Program

During the month of June 1979, Gruy Federal has carried out extensive flow tests on the first well of opportunity, the Fairfax Foster Sutter #1. Flow rate at the beginning of the month was 6100 BWPD through a 24/64" choke with tubing surface pressure of approximately 2200 psi. The well was shut in on June 4 and allowed to build up until June 9. At that point the surface pressure was 4457 psi and the bottom hole pressure (at 13,840 feet) was 11,063. This compares to the original BHP of 11,272 and 4469 surface pressure.

On June 9, the well was opened on a 30/64" choke and flowed at a rate of 6561 BWPD with 22 cu ft gas/BW. Chloride content was 96,000 ppm. From June 10 to June 20 the well continued to flow with rates decreasing from 6245 BWPD on the 10th to 4838 BWPD on June 20th. During that time the surface flowing pressure decreased from 1192 psi to 940 psi with a gradual build up in gas/water ratio to 23.1 cu ft gas per barrel of water.

On June 21, the well was shut in for a long term pressure build up test. By July 2nd the surface pressure had built up to 4236 psi compared to the 4469 psi original surface pressure. A complete analysis of the results of the Fairfax Sutter well test will be given at the Drilling and Testing meeting in Houston on August 1st.

By passing the coolers, the hot brine was injected directly into the disposal well to study effects on the disposal system. High volumes of brine at over 4000 barrels/day were injected at 240°F with no apparent problems.

Gruy Federal continues to monitor all other deep Gulf Coast wells for potential wells of opportunity. They have located a good candidate with Tenneco and are making arrangements for a test to be made on the well. A prime candidate well from Superior was recently scratched when the well found gas production at 21,000 feet.

University of Texas

Corrosion Research: In this period, electrical chemical corrosion measurements were made for: (1) AISI 1018 carbon steel, (2) AISI 304, 316,410,430 stainless steel, (3) two high corrosion resistant sand vik alloys, (4) inconel 600, nickle based alloy. The brines employed were: 10,000 ppm nacl, 30,000 ppm nacl (with and without air in solution), and brine from the Pleasant Bayou #2 at room temperature and ambient pressure.

University of Texas continued

The results showed that the uniform corrosion rate for all the materials tested were lower than 5 mpy, with the possible exception of the 1018 carbon steel, which exhibited somewhat higher corrosion rates. All the stainless steels and inconel 600 showed high pitting and crevice tendencies. Excellent behavior was exhibited by the sand vik alloys in all the tests conducted.

Some experiments were also undertaken to assess the applicability of our corrosion equipment to determination of sensitization in welded stainless steel pipes and rods.

Effects of Gas Saturation: The effect of gas saturation on well deliverability are being studied. As the flow rate increases, more gas should evolve and have a more pronounced effect on deliverability.

Louisiana State University

Major effort for the month was in preparing the proposal for drilling a well in the La Fourche Crossing prospect. The technical work has been completed and the proposal to DOE has been reviewed and approved by the Department of Natural Resources of Louisiana. The proposal will be submitted to DOE this week.

EPRI (Electric Power Research Institute)

EPRI held their annual review of geothermal and geopressured geothermal developments. Included in the meeting were two papers on geopressured geothermal.

One paper, by J. Parker Lamb of the University of Texas gave an overview of the geopressured geothermal concept and highlighted the work being carried out by the University of Texas. It presents an excellent up to date discussion of the scope of the research program in geological assessment, entrained methane, environmental impacts, sandstone diagenesis, elastic rock properties, resource engineering, resource utilization, legal and institutional studies, and operational research. It also announced the next geopressured geothermal conference is to be held in Austin from October 29-31, 1979.

The second paper, by R. K. Swanson, was titled Production Behavior and Economic Assessment of Geopressured Reservoirs in the Texas and Louisiana Gulf Coast. It presents a summary of the work being carried out for EPRI by Southwest Research Institute.

EPRI (Electric Power Research Institute) continued

The paper gives an analysis of the resource potential based on the best available information and relates details concerning production. The conclusions from the paper are provided. Values of the parameters used in making the analysis are available from Southwest Research Institute. If you would like a complete copy of the paper, please let us know and we will send you one.

> "CONCLUSIONS. Gulf Coast geopressured zones show promise of yielding moderately large quantities of hot water and methane. Based on the sand volume contained within the twenty prospective geopressured areas so-far defined, the total energy recoverable by primary pressure depletion is in the range of 7 trillion cu.ft. of methane and 13 Quads of thermal energy, assuming all these areas prove productive.
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> Wells drilled to exploit these reservoirs will probably be capable of flowing at rates from 10,000 to 40,000 bbl/day for periods of from ten to twenty years. Reservoir modelling and economic analysis of the Brazoria, TX prospect, site of a currently drilling DOE test well, indicates a well will produce a total of 71 million barrels of 300°F water in twenty years, based on optimistic reservoir parameters. On this basis, the well will show a small net return on investment if the gas can be sold for $7.50/mcf, if the water can be sold for 5¢/bbl, and if the spent fluid can be disposed of for 5¢/bbl."

Oak Ridge National Laboratory

A excellent study of geopressured geothermal energy was published by the Oak Ridge National Laboratory in May 1979. It is available from the National Technical Information Service, U. S. Department of Commerce, Royal Road, Springfield, Virginia 22161 for $6.00. Author of the publication "Geopressured Energy Resource Evaluation" is Garland Samuels.

The study presents a discussion of the potential value of the geopressured geothermal resource for methane production and generation of electricity. Conclusions from the report are provided below:

"CONCLUSIONS

> The geopressured aquifers of the northern Gulf of Mexico undoubtedly contain an enormous quantity of thermal and chemical energy. However, the physical characteristics of the reservoirs and the cost of recovery will probably severely limit the percentage of the energy that can be recovered. As indicated by the results of recent studies of these aquifers, some of the initial projections of both the extent and recoverability of the resource were far too optimistic. Much more information is needed to make reasonable projections of the contribution these aquifers will make to national energy requirements; it will, however, probably be relatively small, at least in the foreseeable future.

Although it is possible to recover thermal, chemical, and hydraulic energy from these formations, exploitation of the chemical energy, the methane, is of most importance. Unless the methane content and market value are sufficient to offset the cost of the production and reinjection wells, there is currently little incentive to develop this resource.

Even if thermal energy is available at no cost as a by-product of methane production, its use in electrical power production appears to be marginal at best. A small power plant (25 MW) with 325°F brine and a production rate of 40,000 bbl/day would require about ten wells. Unless the reservoirs supplying the plant exhibited an unusually high compressibility or were driven by shale water influx, the distance between wells and thus the cost of the fluid transmission system would probably be prohibitive.

Although the energy potential of these formations now appears to be less than some of the projections that created the initial interest, it is too large to be ignored, and certainly a program aimed at providing a better understanding of the extent and characteristics of the resource is warranted. Ideally, the geopressured zone should be mapped so that reliable projections can be made of the quantity of energy recoverable as a function of cost. This parallels DOE's position on these aquifers, which is "that fundamental data are needed to characterize the average geopressured reservoir and that developing technology for energy utilization or seriously adding geopressure to the Nation's stockpile must await the answer to those entry questions of technical and economic feasibility."