ANCR-1247
4/1 to 6/30/75 mRD

2.2 Deep Drilling Program

2.2.1 Raft River Geothermal Exploratory Well No. 1, RRGE-1

Drilling in RRGE-1 was completed on April 1, 1975, at a total depth of 4989 feet. Several flow tests and wellbore temperature profiles were conducted during the early part of April using a clock driven temperature recording tool. Average flow without back pressure was 650 gpm with a maximum bottom hole temperature of 146°C (294°F). Production is coming from the
1326 4350 ft to 5000 ft interval located in and above a fractured zone. This interval
1524 consists predominently of tuffaceous sandstone.

Well logging was again conducted in the bottom portion of the hole to complete the logging profile. A packer was then set and the permanent well head was installed. The 14 in. master gate valve was closed on April 9, 1975.

2.2.2 Rigging Down and Site Preparation

The next 10 days were spent in partial disassembly of the drilling rig and preparation of the new drilling site. Rig maintenance, casing and drill pipe inspection was also accomplished during this period.

2.2.3 Raft River Geothermal Exploratory Well No. 2, RRGE-2

The drilling site for RRGE-2 was selected in the extreme northeast corner of Section 23, T15S, R26E. (See Figures 1 and 2.) The drilling rig was reassembled over the new location and the hole was spudded in on April 26, 1975. Surface casing was set at 904 feet and eventually cemented to the surface after experiencing premature setting of the cement, allowing for displacement only to the 225 ft level. The cementing of the surface casing was completed by emplacing cement through 1.9 in. tubing that was run down the annulus to the 216 ft depth.

The cement inside the 20 in. casing was subsequently drilled out from the 460 ft level (where it had been left after prematurely hardening) to the bottom of the casing. Drilling proceeded from that point to a depth of 3054 ft at which point a 16 foot core was recovered. Drilling continued to 4229 ft and cores were taken at 3702 ft and 4199 ft.

Flow tests showed zero flow. Drill stem tests taken at the 4229 ft level with an open drill stem indicated flows in the 5 gpm range and a bottom hole temperature (non-equilibrium because of short time involved) of 245°F. Also occurring at the 4223 ft level is a very impermeable dark gray siltstone with 4 microdarcies in-situ porosity. However, despite these indications of no resource at that depth, a number of concerns existed. Drilling returns subject to microscopic examinations, had given indication of the presence of fracturing. Furthermore, the general lithological pattern in this well showed nominal similarity with RRGE No. 1, except for a 500 ft deeper location. Production in the other well presumably began at the 3700 ft level. Based on these facts, the decision was made to completely log the hole to this depth. The logs gave no further information on which to base a conclusion. The decision was made to case to this depth and switch to water as the drilling fluid, giving more control on identification of a potential resource.

The production casing (13-3/8 in. O.D.) was set at 4227 ft and the cementing operation initiated in two stages. The first stage cemented the annulus to the 2420 ft level. The second stage resulted in no cement returns at the surface. Cement was later measured with a sonic tool, to the 1532 ft level inside the annulus. It was decided to continue drilling. The cement job would be completed at a time when other cementing (such as a liner casing to greater depth) was required or upon completion of the well (in either case, packers would need to be set).

Shortly after drilling out of the casing shoe, the drilling fluid began to be augmented. Artesian flow with the mud pumps stopped was approximately 270 gpm, with well depth drilled to 4358 ft. Bottom hole temperature was 284°F. Drilling continued to 4788 ft at which point flow tests indicated a no-back-pressure flow rate of at least 550 gpm and a bottom hole temperature still only 280°F measured under non-equilibrium conditions.

At that time, some problems were experienced at the Braden head with a cracked weld. Since the well was now a producer approximately equivalent to the first well, it was felt that casing would not be desirable to a lower depth and that it would be prudent to attempt to complete the cementing of the production casing in order to assure isolation of the geothermal fluid from the near surface aquifer in case of a break in the production casing or leaking of the slips and pack-off material at the Braden head.

Nine separate casing perforations and cement operations followed in order to complete the cement job on the production casing above 1532 ft. In no case was cement circulation established back to the surface. Rather, each squeeze inserted about 100 ft of cement into the annulus. These operations finally resulted in a good cement bond up to the 852 ft level. The 13-3/8 in. production casing cementing job thus overlaps the 20 in. surface casing by 52 ft. Later pressure tests on the perforations confirmed that none of the perforations were leaking.

Drilling continued routinely until a depth of 4907 ft was reached at which point a failure occurred in the drill stem Monel collar. The Monel collar broke off at the box end and resulted in the bit plus approximately 30 ft of drill stem being left in the hole. The fishing operation proved successful using a 10-5/8 in. Bowen overshot.

Drilling was resumed and continued through very hard quartzite and quartz monzonite to the current total depth of 5988 ft. Total depth was reached on June 27, 1975. Electric logs were run and brief flow testing was then conducted. Artesian flow with no back pressure exceeded 600 gallons/minute (38 liters/sec). Temperatures from the 4450 ft depth to total depth at 5988 ft were 295° to 297°F, respectively (146 to 147 °C). On June 30, the drilling rig was placed in standby while more thorough review was given to the data and additional well testing was conducted. Appendix A is a tabulated chronology of the history of drilling on both wells. Appendix B is a tabulation of the chemical content of both wells as measured to date, plus that of other nearby wells.

2.3 Electrical Power Plant and Associated Studies

The primary work associated with electric power production studies was the design of the binary plant and the component test systems. The progress in each of these areas is reported below.

2.4 Geology and Geophysics

2.4.1 RRGE-1 and RRGE-2

The geological sequence of RRGE-1 is depicted in Figure 4 and that of RRGE-2 in Figure 5. The Raft River and Salt Lake Formations are apparently offset as much as 500 feet between wells around the 4500 ft level. Figure 6 illustrates the lithological sequence through both wells. The Precambrian sequence (metamorphic transition zone, quartzite and quartz monzonite) does not exhibit any significant offset. The apparent offset in the younger beds above the Precambrian is due to fault influence in the vicinity of RRGE-1 and more normal basin sedimentation around RRGE-2. The lack of offset observed in the Precambrian sequence would suggest a dying out of the fault zone with depth or a steeping of the fault in the harder Precambrian sequence with very little vertical displacement.

The data acquired from RRGE-2 substantiates the occurrence of a major nonconformity between the Tentiary and Precambrian sequences. This fact not only eliminates any Mesozoic rock sequence in the area but also eliminates the Paleozoic rock sequence, at least in this immediate vicinity.

An evaluation of the available geologic data from RRGE-1 and RRGE-2 indicates that the major portion of the geothermal resource may occur directly above the Precambrian quartz monzonite (above 5000 feet). The water migrates into the valley basin from a considerable distance away and from higher elevations than the surrounding mountains. It percolates downward until it encounters the quartz monzonite and then moves along the top of this rock member. The quartz monzonite acts like a "hot plate," transmitting the heat from depth to the water. The faulting in the system encourages upward migration of the hot water wherever it occurs.

2.4.2 Surface Measurement Program (U.S. Geological Survey)

All initial field data has been collected, open-filed, and evaluated. Additional resistivity data is being gathered this summer by a U.S. Geological Survey crew, to enlarge the existing net. Also samples for dating and correlating waters in the area have been gathered and are undergoing analysis at the present time.

2.4.3 Intermediate Depth Test Wells

There has been no further activity since completion of the five wells reported in the previous quarterly reports.

2.5 Hydrology

During the entire period since the first well developed Artesian flow, the nearby shallow geothermal wells were routinely monitored for flow rate and shut-in pressure changes. These data are summarized in Figure 7. No explanation for the major trends is available. The steady increase in shut-in pressure of the test well labelled USGS No. 3 (depth of 1300 ft) may be due to a natural spring time recharge of the aquifer. Minor changes noted in the other wells can be nominally correlated either with "reinjection" (high drilling fluid pressure during drilling operations) or with climactic changes (heavy rains). In any case, it appears that drilling and well testing activities have had effects not exceeding 10% on the nearby geothermal wells, all of which are to relatively shallow depths.

2.6 Environmental and Area Impact Considerations

An environmental program for the test loop and power plant has been outlined and should be instituted in full by September. The first phase of this program will detail baseline air and water quality, land use, meteorology, soil conditions, flora and fauna, and cultural resources in the Raft River Valley. Contracts were issued to Idaho State University for the biological and cultural resource studies. The Soils Conservation Service has agreed to fit the proposed power plant site into their program to profile the soils of the valley. A meteorological station has been established at the site by the National Oceanic and Atmospheric Administration for use in routine monitoring of weather conditions, feeding into the Idaho National Engineering Laboratory computerized network.

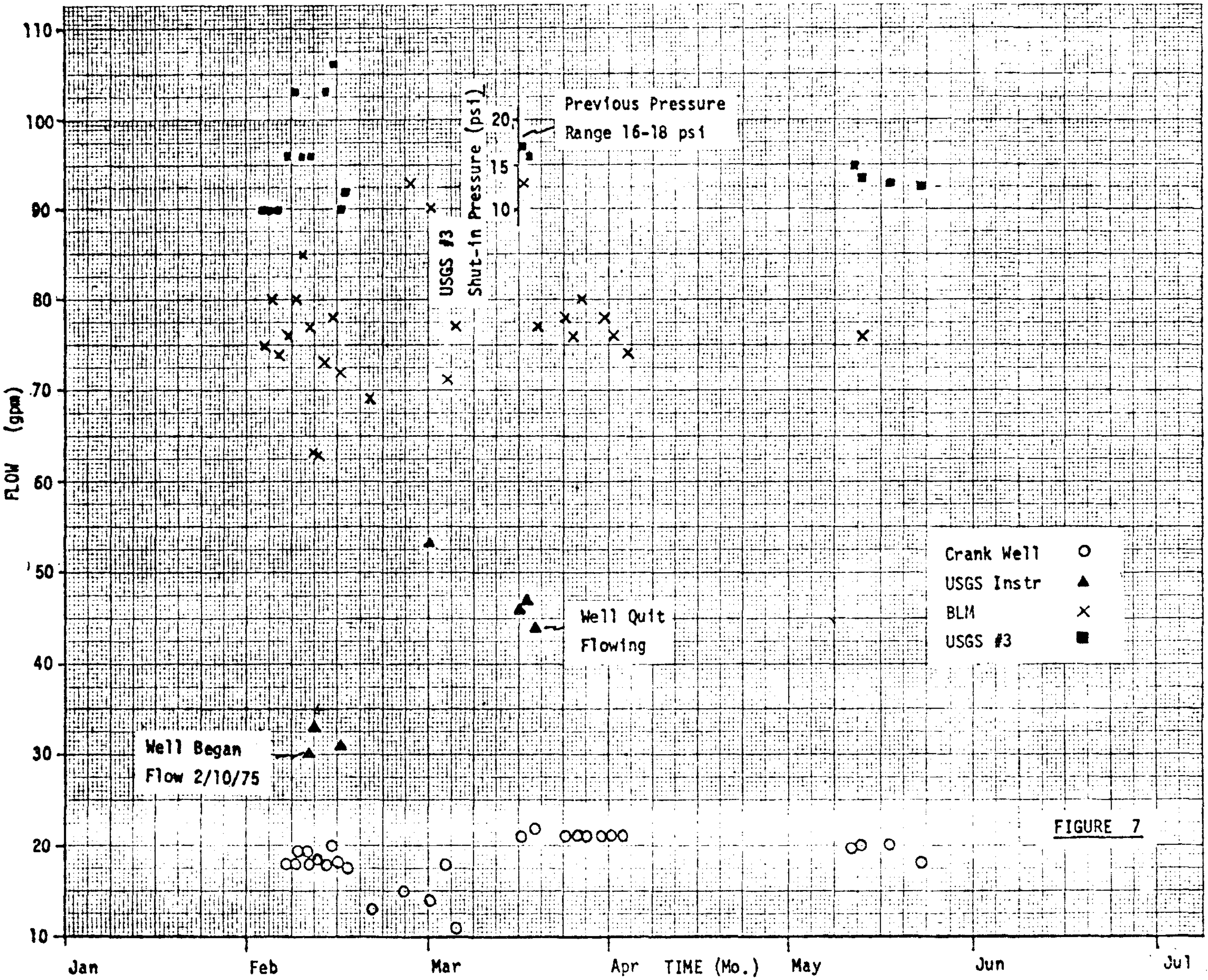

Fig. 7 Shallow Geothermal Well Data

As part of the impact evaluation phase of the program, a quarter-mile elevation grid has been established on nine sections of land surrounding the two exploratory wells. Periodically, the grid will be resurveyed to determine if any subsidence has occurred due to fluid withdrawal. Also to be periodically monitored will be water quality and flow characteristics and flora and fauna patterns. A permanent system will be set up to monitor microseismic activity, hydrogen sulfide, radon, particulates, carbon dioxide and sulfur compounds. The monitoring equipment presently in hand or on order and the systems should be complete and operational by the time the test loop is operational.

That part of the RRGE-1 site not to be used for the test loop has been graded and reseeded with Russian Wild Rye in an attempt to resotre the disturbed area to near the natural condition.