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MRD

2.0 RESOURCE DEVELOPMENT AND ENERGY SUPPLY SYSTEMS

2.1 Raft River Wells

2.1.1 RRGE-1

The first well, RRGE-1,[3] has been pumped several weeks in various pump tests to determine formation characteristics replacement pump and reservoir testing. For a 450 ft drawdown, the well will produce 900 gpm. Replacement pump design is completed and will be ordered next quarter. In addition to pumping, the well free flows thru the pipeline to No. 2 reserve pit at greater than 400 gpm were delivered for several months this winter. Over 10 million gallons have been delivered from No. 1 well to No. 2 reserve pit, with 8-1/3 million gallons reinjected into RRGE-2 over the four winter months.

2.1.2 RRGE-2

During March, RRGE-2 was deepened from its original 5988 ft depth to a 6543 ft depth and followed by nearly a week of flow testing. Well temperature was considerably lower due to the 8-1/3 million gallons of reinjection water previously put into the well, but temperature plots each day indicated a general temperature and flow increase approaching the previously measured production well value. Although the deepening operation was expected to find further faulting, nothing but relatively impermeable quartz monzonite was found in the bottom of RRGE-2. One region near 6200 ft accepted considerable cool drilling fluid, but did not seem to discharge it rapidly, implying it was not an outstanding production zone.

1850 m

2.1.3 Geology and Geophysics of RRGE-1 and RRGE-2

The lithological sequence of RRGE-1 is depicted in Figure 1 and that of RRGE-2 in Figure 2. Figure 3 illustrates the geological cross section through both wells. There was some uncertainty as to whether or not RRGE-2 had penetrated the Bridge Fault Zone as shown in Figure 3. The deepening of RRGE-2 from 5988 to 6543 feet was completed in late March.

The additional 555 ft of drilling was accomplished entirely in the basement rock, quartz monzonite. The drill cuttings and core samples failed to show any indication of significant faulting in this interval. There has been no indication of any significant additional geothermal production but full confirmation must await later testing under full heated conditions. The Bridge Fault Zone was believed to have, in fact previously been penetrated around the 5,000 ft depth but was less extensive and distinctive than anticipated. The extensive evidence of faulting that occurred between 3750 and 4500 ft in RRGE-1 is believed to be a result of the Narrows Structure and to a lesser degree, the Bridge Fault Zone.

Soon after the additional drilling was completed in RRGE-2, the drilling rig facilities were used to complete the well and install wellhead equipment. The rig was then moved to the RRGE-3 drilling site.

2.1.4 Well Logging of RRGE-2

The bottom of RRGE-2 was logged by both the USGS and INEL. The INEL logging was confined to detailed temperature scans as the reinjected water and drilling fluid came out of formation and the well continued on its long, slow process of being returned to production status. Neither the INEL nor USGS flow-meter tools worked satisfactorily on the deepened hole.

The USGS flow meter data (run in RRGE-2 during prior quarter, before deepening) was partially evaluated, but was not suitable for release. The identified production zones correlate closely with those identified previously from the examination of drill cuttings, core samples and electric logs. However, the calibration of the flow meter has not been satisfactory and consequently relative quantities of flow are still unknown. The apparent bottom hole production that was indicated (then from 5988 ft) of RRGE-2 has been re-evaluated and does not now appear to consist of more than minor production. The bulk of the production is from 5200 ft and above.

The temperature logging conducted by the INEL equipment gave the most revealing information to date on the production zone regions of the well. This occurred because the well head received 8.5 million gallons of cool reinjection water over the prior three months, plus 3.1 million gallons of cool drilling fluid circulated during the deepening operation. A week of unstimulated flow testing followed, during which 2.5 million gallons were flowed out of the well. The progress on recovering of the well can be seen in Figure 4.

2.1.5 Component Test Facility Provisions

Design was completed and bids were submitted for general construction work at sites 1 and 2. When completed, the system will allow the testing of the component test trailer and other loop tests at operating temperatures, pressure and chemistry. All weather design will allow year around operation of the test facility.

2.1.6 RRGE-3

Selection of RRGE-3 was made on the basis of several criteria. A major critera was the need for a triangulation of three wells for basic reservoir analysis data. To develop the triangulation in relation to RRGE-1 and RRGE-2, an area of resistivity low based on resistivity work by the USGS which lay to the southwest was chosen. This area is farther out in the sedimentary basin away from the major fault structures, which should be at least 200 ft structurally lower than the two existing deep wells. Another criteria was to determine the extent of the geothermal reservoir, if in fact it is covering a large aerial extent as data now shows or more fault controlled. There could be reservoir barriers which are not defined in the basin which could significantly change the lithology and characteristics of the reservoir. Also lithologies compatible for large scale reinjection need to be determined for reinjection wells to support the power plant.

The design and drilling plan for RRGE-3 has been completed. The well has been designed with smaller and less casing to reduce costs. Several side track holes dyna drilled below the casing should increase production.

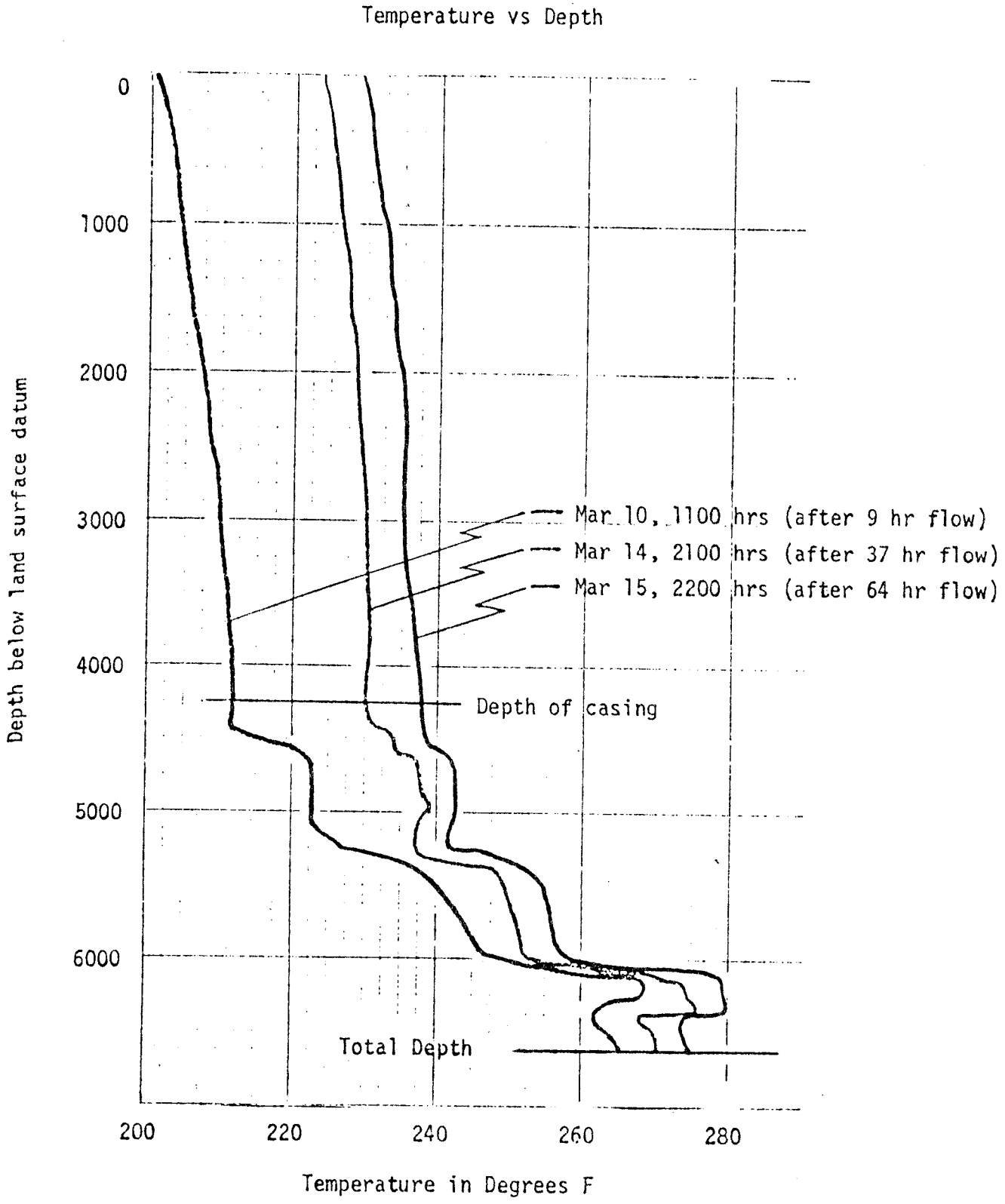

Fig. 4 Raft River Geothermal Exploratory Well No. 2

Upon completion of the deepening of RRGE-2, the rig was moved to RRGE-3 location in the SW 1/4, NW 1/4, Sec 25, T15S., R26E. RRGE-3 was spudded March 28, 1976. The rat and mouse holes and 120 ft of 20 in. conductor pipe were completed in late February. A 17-1/2 in. hole was drilled with mud to a depth of 1386 ft for the 13-3/8 in. surface casing. No lost circulation was incurred during the drilling. Sediments drilled were alluvium valley fill comprised of unconsolidated small gravel and sand. No significant clay or shale was encountered in the lower section. Temperature caliper and dual induction logs were run. Bottom hole (1386 ft) temperature at 1386 ft was 158°F showing a temperature gradient of 6°/100 ft.

A domestic well was drilled at the SW corner of RRGE-3 location to a depth of 200 ft for the purpose of locating water supply. The drilled section consisted of unconsolidated sand and gravel and sandy clay. It was set with 10-3/4 in. stolled casing. The well produces 80 gpm water at approximately 76°F.

2.2 Boise Exploratory Wells and Holes

2.2.1 Boise Slim Hole - 3 (BSH-3)

The site for BSH-3 (2-7/8 in. diameter, wire-line core retreival) was selected on the basis of the area geology and geophysical data. It was completed at 550 ft with broken drill rod and core barrel in the hole. Several attempts were made at hooking onto the "fish," but all proved unsuccessful as the drill rod has leaned over to the extreme side of the enlarged hole. The BSH-3 drill site is shown in Figure 5.

Drilling operations progressed smoothly during the early portion except for wet cold weather. Toward the bottom of the hole however, unconsolidated sandstone and clay were encountered which caused considerable drilling difficulties. Coring operations are best conducted in consolidated formations with this particular drilling rig. Core retrieval was very poor and the sandstone and clay tended to wash out below 450 ft where it occurs at this location.

Much valuable core was retrieval however and evaluation is continuing at present. The basalt and cemented sandstone show a particularly high degree of alteration in the upper reaches of the hole.

2.2.2 Boise Exploratory Hole-1 (BEH-1)

BEH-1 was drilled on the same location as the slim hole BSH-2. See Figure 5. An attempt to set 8-in. casing to 610 ft failed when the casing became stuck at 340 ft. The 7-in. casing was then run inside the larger casing and successfully set at 610 ft. The 8 in. casing was then removed and the 7-in. casing cemented in place. See Figure 6 for the stratigraphic section of this well.

BEH-1 was then drilled to a total depth of 1222 ft and terminated as the drill rig was approaching an overload condition due to the weight of the drill rod. The rig was then moved off site and the well was closed in. No attempt was made to flow the well, however indications are that the well will