1-2

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subject INJECTION CAPACITY FOR RAFT RIVER FIRST 5 MW(e) PILOT PLANT - CJB-1-78

Ref: (a) T. W. Lawford ltr to J. H. Ramsthaler, TWL-19-78, Analyses Pertaining to the Question of Triple Legging RRGP #5, August 4, 1978.

(b) EDF File #GE 84032.4, Serial #64, Parasitic Power For 5 MW(e) Power Plant, May 18, 1978.

(c) R. C. Stoker ltr to J. H. Ramsthaler, RCST-45-78, RRGE-1 Production Estimation, July 27, 1978.

The following study considers the capacity of the present Raft River injection system and its relation to the requirements of the First Raft River 5 MW(e) Pilot Plant. The most recent information about the injectibility of wells RRGE #3, RRGI #6 and RRGI #7 was used in the study along with the power plant characteristics. The results indicate that, if an injection pressure of 700 psia can be achieved, no additional injection wells will be needed to handle the geothermal fluid flow from the power plant. If an injection pressure of 500 psia is used; one additional well similar in injectivity to well #6 will be needed but the plant net power output will increase by 0.27 MW. If the injection pressure is limited to 300 psia, four additional wells like well #6 will be needed; but the net power output will increase 0.52 MW over the case where no additional wells were required (injection pressure of 700 psia).

Data for wells RRGE #3, RRGI #6 and RRGI #7 was obtained from D. W. Allman on August 15 and is shown in Appendix A. These results shown in Figure 1 are for the injection capacities of combinations of the existing wells after 5 years of operation. The data for well #3 was given for injected water and reservoir at both 290°F and 150°F. The results of the 150°F case were used for this study because it was felt that this more closely approximated the real case of injecting 150°F water into a reservoir which was initially at 290°F, but will be cooled near the injection well. This result is more conservative then the 290°F injection result. The more optimistic estimate (290°F water) is shown on the figure by the dashed line. The nominal plant outlet flow rate is 2120 gpm and is also shown on Figure 1. Note that this is a lower volumetric flow rate than the nominal 2240 gpm entering the plant from the production wells. This is a result of the increase in density of the fluid caused by the cooling from 280°F at the plant inlet to 150°F at the plant outlet. This is slightly greater than the injection rate because the difference between cooling tower make up and blowdown is removed before injection. Using the conservative assumption for Well #3, and injection pressure of 700 psia is required for the combination of wells #3, #6 and #7.

Increasing the injection pressure causes more injection pumping power to be needed and, thereby, decreases the plant net output. Figure 2 shows the net power plant output operating in the floating power mode for both Summer and Winter conditions for different injection pressures. The plant gross output was taken from Reference a. The plant was assumed to be using the output of Wells #1, #4, and #5 as producton wells (as recommended in Reference a), but with the flow throttled to give the nominal design flow. This results in a temperature at the plant of 270°F. The power plant parasitic losses were taken from Reference b which uses the actual plant data. The production well pumping power was calculated assuming a pump depth in Well #1 of 750 feet as recommended in Reference c. Using the same methods, the pumps in wells #4 and #5 were located at 1000 feet and 440 feet respectively. For injection pumping power calculation, it was assumed that the pressure at the injection well-heads were each 100 psia (120 psia leaving the plant with a 20 psi drop in the distribuiton lines). Both injection and production pumps were assumed to have pump efficiencies of 75 percent and motor efficiencies of 95 percent.

More wells will be needed to attain injection pressures less than 700 psia. The number of additional injection wells like Well #6 (the well with the best performance) and like Well #7 (a well with lesser performance) are shown on Figure 2. Note that the greatest decrease in injection pressure and increase in net output result from the addition of the first few wells.

ajw

Attachments:
Five Graphs

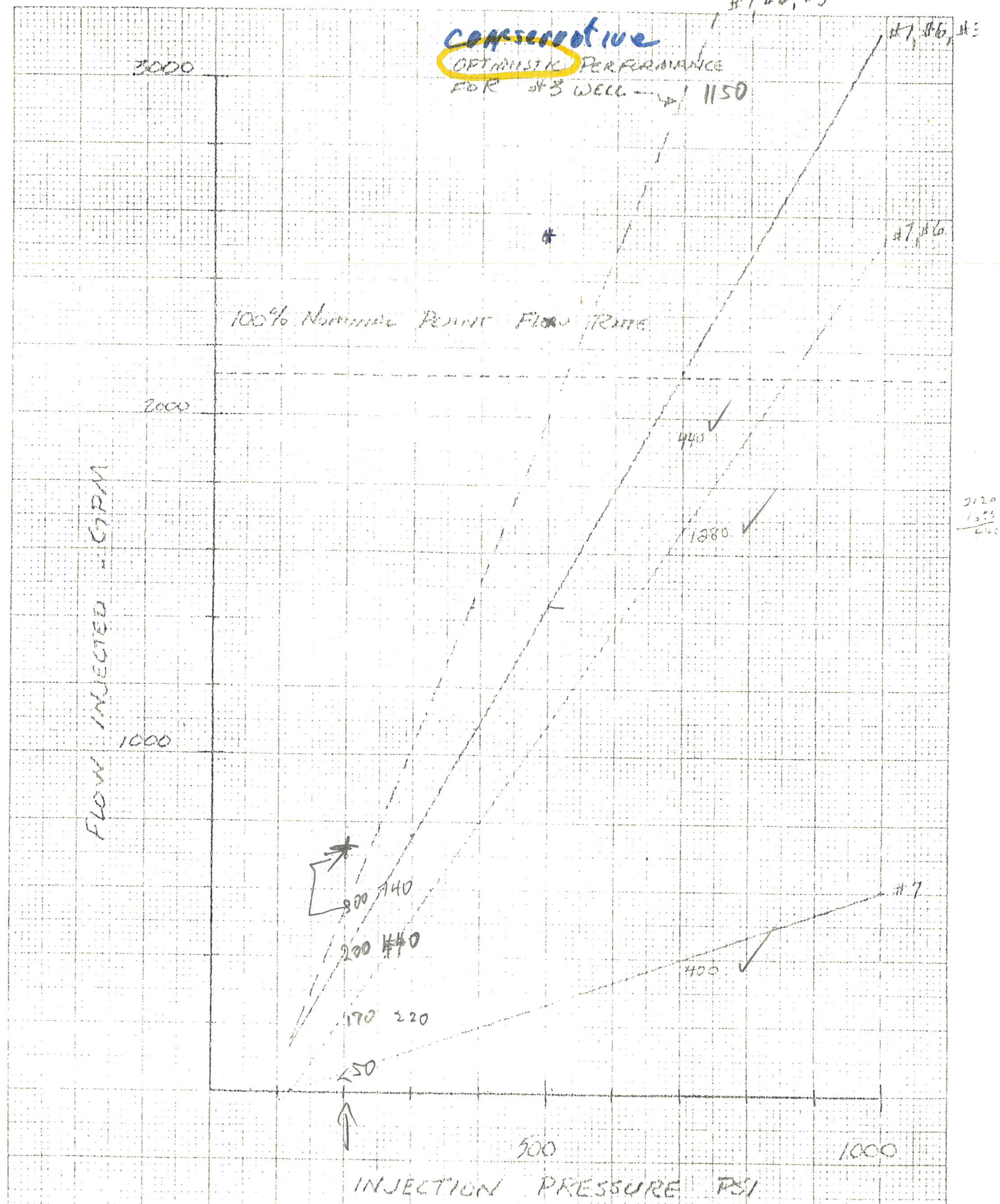
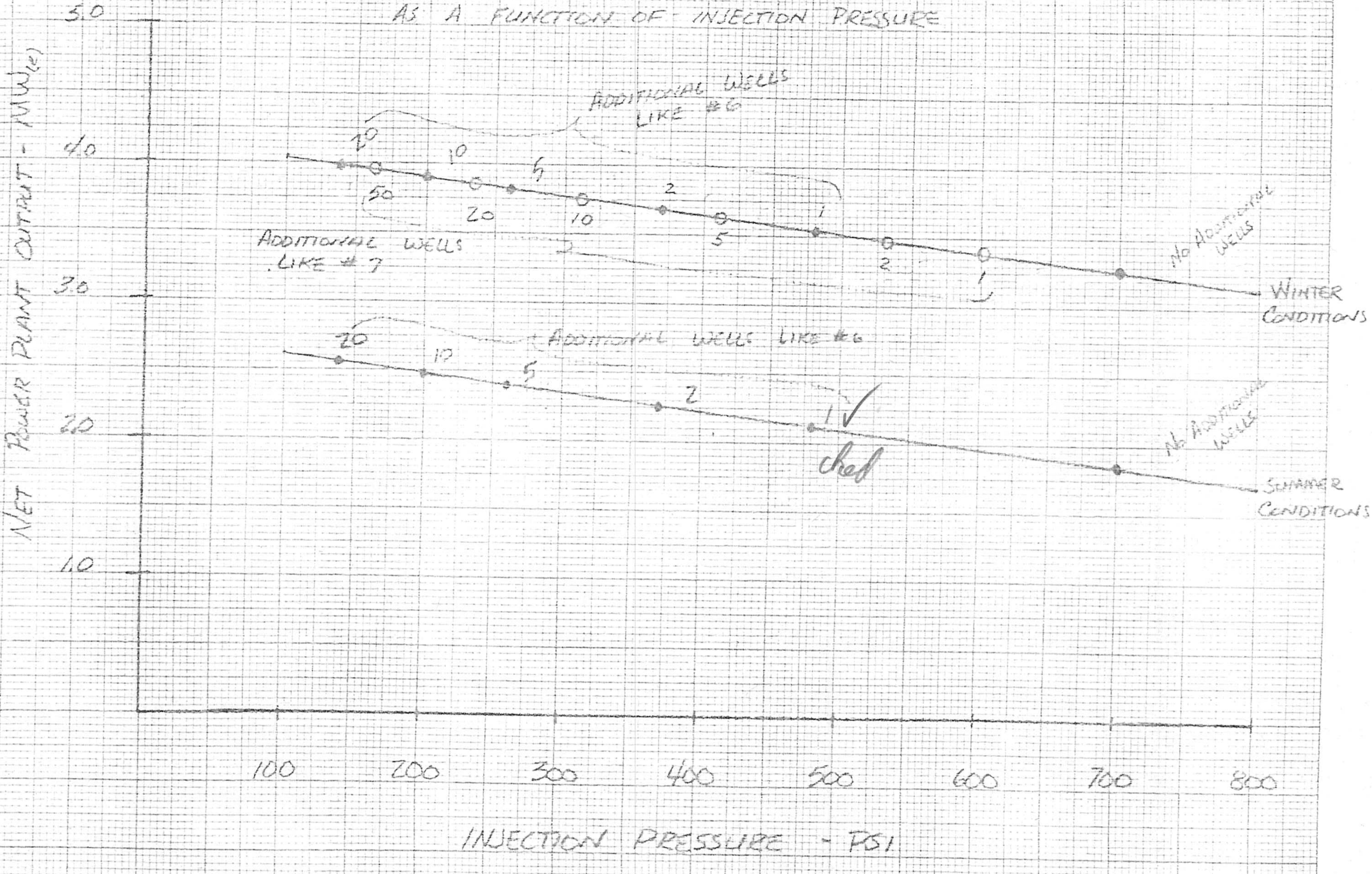


FIGURE 1. INJECTION RATE (GPM) V.S. INJECTION PRESSURE (AFTER 5 YRS)

FIGURE 2. RAFT RIVER POWER PLANT NET POWER OUTPUT AS A FUNCTION OF INJECTION PRESSURE

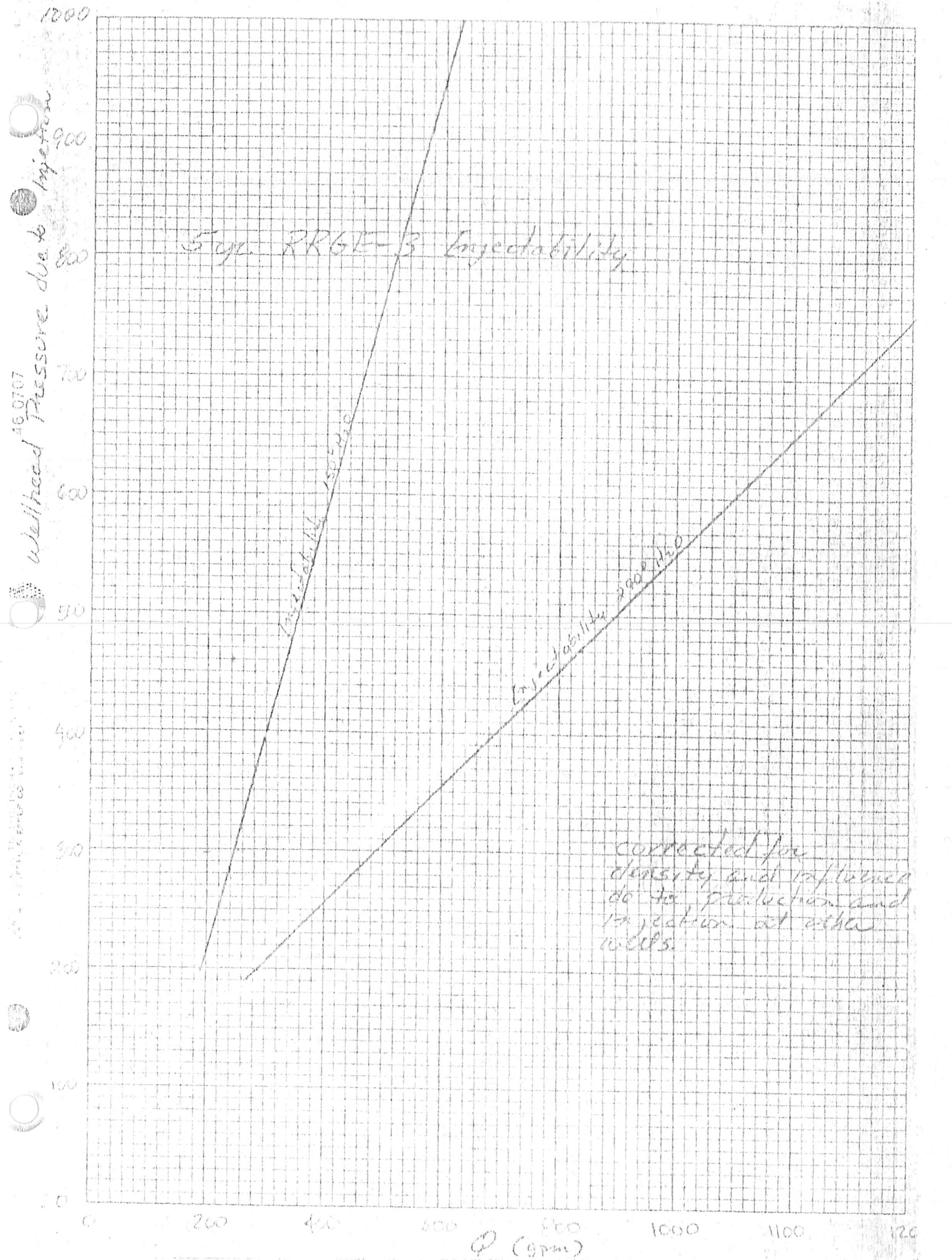


APPENDIX A

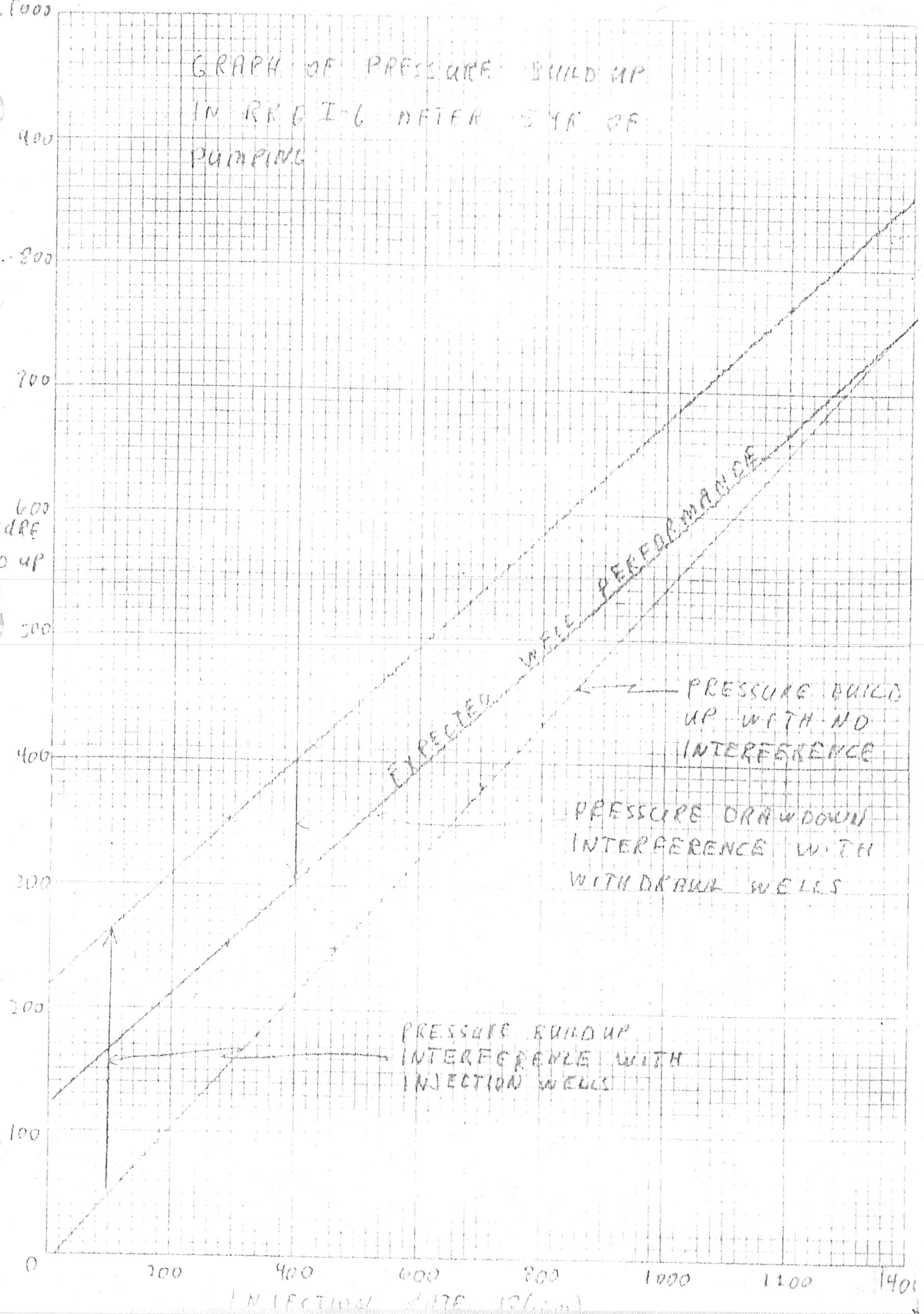
Injection Well Data

Used in

Present Analysis



Wellhead Pressure due to Injection
Fig. RRGE-3 Injectability
Injectability 500 F 1120
Injectability 2900 F 1120
corrected for density and influence do to production and injection at other wells.
0
100
200
300
400
500
600
700
800
900
1000
0
200
400
600
800
1000
1100
Q (gpm)


GRAPH OF PRESSURE BUILD UP
IN RKGI-6 AFTER 5 YR OF
PUMPING
EXPECTED WELL PERFORMANCE
PRESSURE BUILD UP WITH NO INTERFERENCE
PRESSURE DRAWDOWN INTERFERENCE WITH WITHDRAWL WELLS
PRESSURE BUILDUP INTERFERENCE WITH INJECTION WELLS
1000
900
800
700
600
500
400
300
200
100
0
200
400
600
800
1000
1200
1400