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date August 28, 1978

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subject ECONOMIC EVALUATION OF RAFT RIVER INJECTOR SYSTEM TO SUPPORT FIRST 5 MW(e) PILOT PLANT - CJB-2-78

Ref: C. J. Bliem ltr to T. W. Lawford, CJB-1-78, Injection Capacity for Raft River First 5 MW(e) Pilot Plant, August 18, 1978.

The capacity of the Raft River injection system was studied in the referenced letter in relation to the demands of the First 5 MW(e) Pilot Plant. The conclusion reached was that, if a well-head injection pressure of 700 psig can be achieved economically, wells RRGE #3, RRGI #6, and RRGI #7 would be sufficient to service the plant. If only wells RRGI #6 and RRGI #7 were used, the injection pressure needed would be 830 psia. The following study continues the above mentioned effort with emphasis on the economic aspects of the problem. The additional cost of going to these higher injection pressures will be primarily the pumps because the pipe and well-head equipment should be within the design range. Economically, the capital cost savings in pumps will not offset the cost of a new injection well. However, if the economics associated with the increase in plant net power output are considered (as would be the case for a utility building a plant) one or two additional injection wells may be justified related to their projected performance.

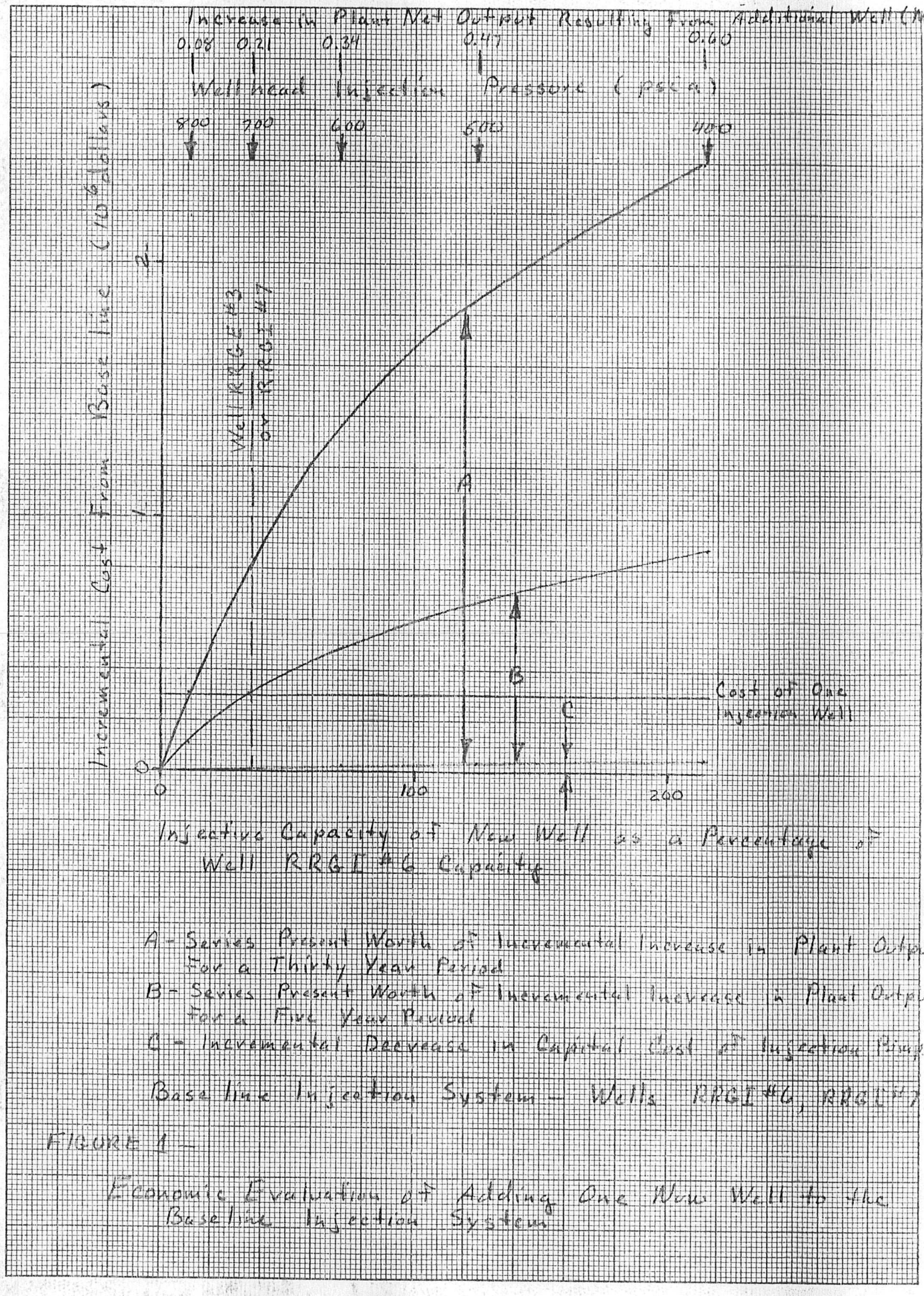
Figures 1 through 4 show the results of the economic study with different baseline assumptions for both one and two additional wells. Figure 1 considers wells RRGI #6 and RRGI #7 and the possibility of one additional new well. Figure 2 considers the same two existing wells and the possible addition of two new wells. Figures 3 and 4 are for the possible addition of one and two new wells to the initial system of RRGE #3, RRGI #6 and RRGI #7. For these projections the capital cost of pumps was assumed to be solely a function of the total flow and head pumped and not the number of pumps. Data used was obtained from Ray Sanders for two pumps with a total flow of 2500 gpm. (Note that the total cost of the pumps to supply the flow at 830 psia would be approximately $104,000 contrasted with the cost of an additional injection well of $300,000.)

The other effect of an additonal injection well which will lower the injection pressure is that the net plant output will be increased because the injection pumping power will decrease. Expressing this gain in output as an equivalent initial capital cost involved first determining the annual increase in income assuming that the electricity produced could be sold at 50 mills per kW hr and that the plant operating factor was 80 percent. Then this annual profit increase was referred to an equivalent initial cost by using the amount of initial capital invested at 8 percent which would allow equal annual withdrawals equal to the profit increment for a fixed number of years. The figures show this both for 30 years (a typical time for a utility to justify such a power plant) and also for 5 years.

Figure 1 shows the case of adding one new well to RRGI #6 and RRGI #7 to form the injection system for the plant. Incremental cost changes from the baseline of the two existing wells only are shown as they are related to the performance of the new well expressed as a percentage of the capacity (flowrate) of RRGI #6 at the same pressure. The performance of wells RRGE #3 and RRGI #7 are shown on the figure as reference points. The relative well performance is influenced by the wellhead pressure so the points are slightly different on the subsequent figures. System wellhead injection pressure for this new well performance is shown across the top of the curve. Increment C is the capital cost savings for the pumps in having the additional well and lowering the pumping head requirement. Increments A & B are measured from this line and are respectively the present worth of the increase in net power (resulting from the decrease in injection pressure). The cost of drilling and outfitting an injection well is shown on the figure also. It was taken as $300,000; an estimate by Susan Prestwich based on the costs of RRGI #6 and RRGI #7. It is seen that on the basis of increased net power output for 5 years, if the well has a capacity larger than 34 percent of well RRGI #6 (approximately equal to the performance of wells RRGE #3 and RRGI #7), it is advantageous to drill the new well. If the worth of power for 30 years is considered, the breakeven point would be a well with 12 percent of the RRGI #6 capacity. For the case of drilling two wells, considering the 5 year power worth; the wells must average 52 percent of well RRGI #6 performance (approximately one-third more than the capacity of RRGE #3 or RRGI #7). Similar results are indicated if the combination of RRGE #3, RRGI #6 and RRGI #7 are considered with one or two additional wells (see Figures 3 and 4).

ajw

Attachments:
Figures 1-4



A - Series Present Worth of Incremental Increase in Plant Output For a Thirty Year Period

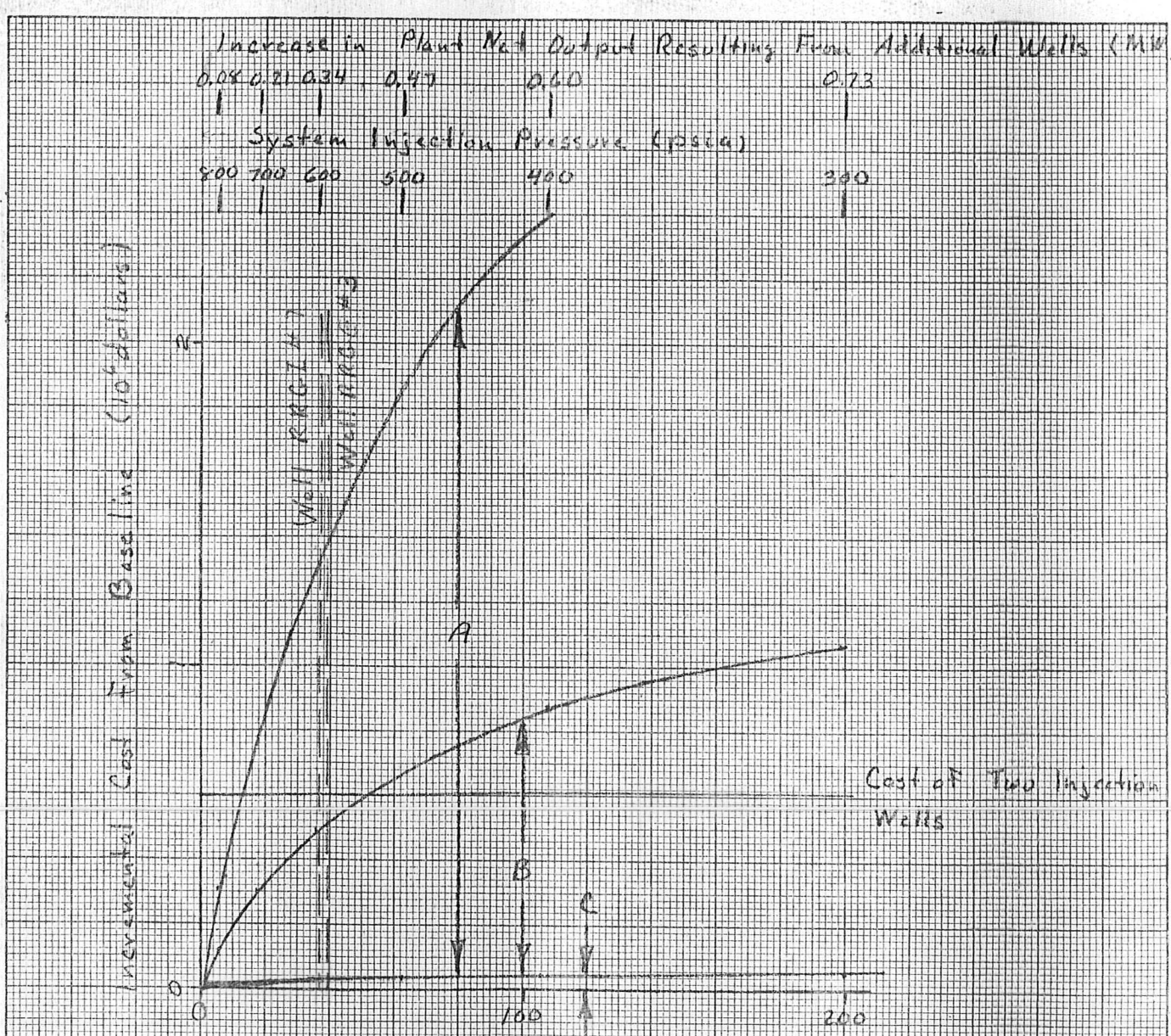
B - Series Present Worth of Incremental Increase in Plant Output For a Five Year Period

C - Incremental Decrease in Capital Cost of Injection Pumps

Base line Injection System — Wells RRGI #6, RRGI #7

FIGURE 1 —

Economic Evaluation of Adding One New Well to the Base line Injection System



Average Injectivity Capacity of the New Wells as a Percentage of RRGI #6 Capacity

A - Series Present Worth of Incremental Increase in Plant Output for a Thirty Year Period

B - Series Present Worth of Incremental Increase in Plant Output for a Five Year Period

C - Incremental Decrease in Capital Cost of Injection Pumps

Baseline Injection System — RRGI #6, RRGI #7.

FIGURE - 2

Economic Evaluation of Adding Two New Wells to The Baseline Injection System

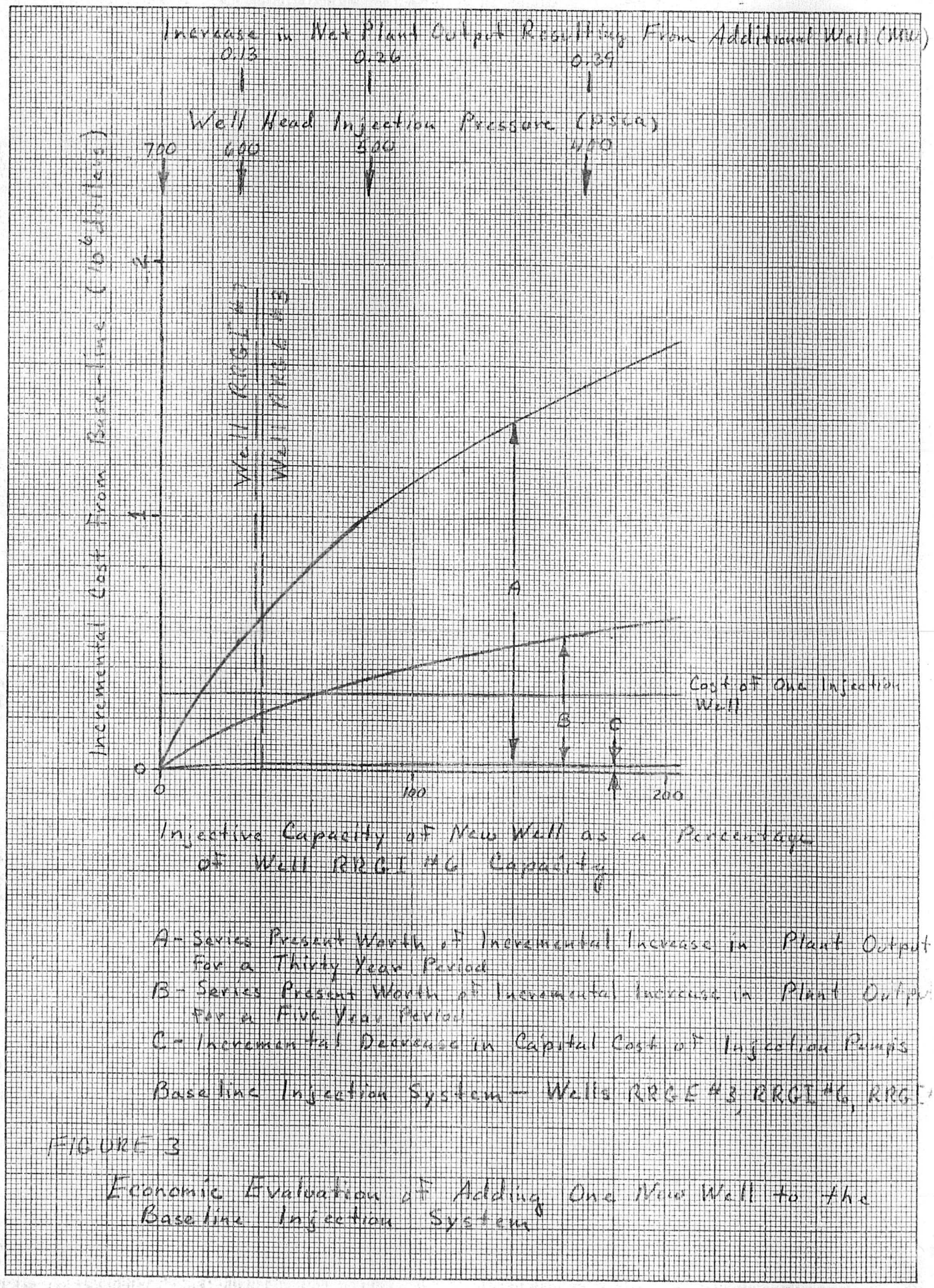
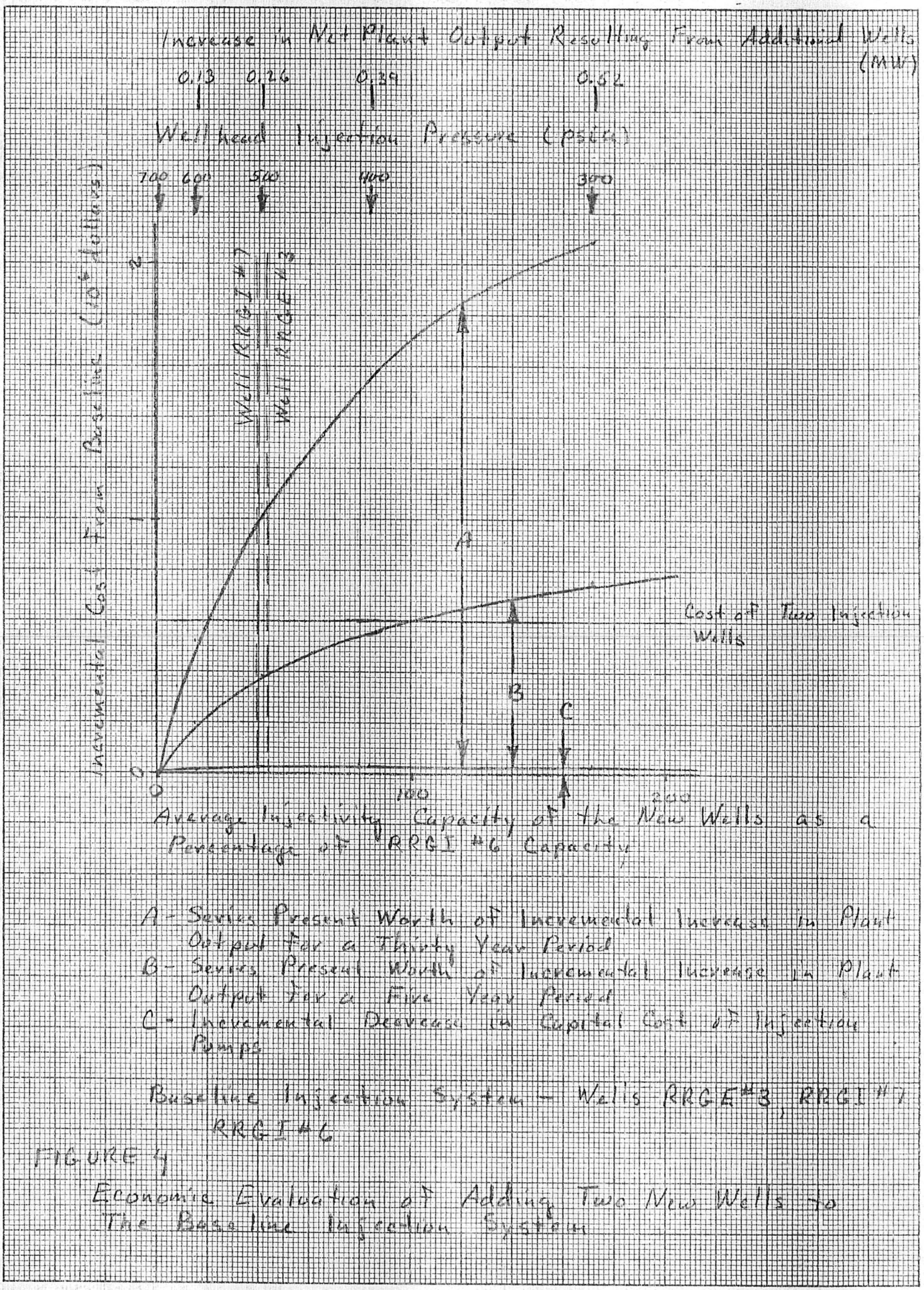


FIGURE 3

Economic Evaluation of Adding One New Well to the Baseline Injection System



A - Series Present Worth of Incremental Increase in Plant Output For a Thirty Year Period

B - Series Present Worth of Incremental Increase in Plant Output For a Five Year Period

C - Incremental Decrease in Capital Cost of Injection Pumps

Baseline Injection System — Wells RRGE #3, RRGI #1 RRGI #6

FIGURE 4

Economic Evaluation of Adding Two New Wells to The Baseline Injection System