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EG&G Idaho

INTEROFFICE CORRESPONDENCE

date April 2, 1980

to Dennis Goldman

from Susan Petty

subject PRESSURE BUILD-UP DURING COLD WATER INJECTION - SP-7-80

In order to predict the pressure build-up for long term cold-water injection, a linear regression of the semi-log pressure build-up curve for hot water injection was first performed. The slope of this line, Q/S_{10} was then used to calculate a value for kh, which is a term independent of the viscosity. The calculated value of kh was then used to find a new Q/S_{10} value for the desired flow rate and temperature.

$$\frac{Q}{S_{10}} = \frac{\mu Q\ 5567}{kh}$$

70 = .5 × 1200 × 5567   kh = .5 × 1200 × 5567 / 70   93717

The y-intercept value on the semi-log plot of pressure build-up, where t = 1 min., includes pressure build-up due to injection for 1 minute, density effects, well losses and wellbore storage due to compressability of the water. These are all dependent on temperature dependent fluid properties. It was therefore necessary to calculate a new y-intercept value for the pressure build-up. The largest influence on this early time pressure build-up is the change in pressure due to density differences between the injected fluid and the fluid stored in the aquifer. The shut-in wellhead pressure is due to the pressure of the fluid in the aquifer at approximately 220°F and the density of the cooled fluid standing in the wellbore at about 140°F. Replacing the fluid in the wellbore with higher temperature fluid of a lower density increases the pressure at the wellhead while lower temperature water decreases wellhead pressure. The equation:

$$P_{shut\text{-}in} - (\gamma_1 - \gamma_2)\left(\frac{D}{144}\right) = P_{initial}$$

1.98   12.5   =   18 psi

65 —   29.75   = 40 psi   at 120°

FORM EG&G-954
(Rev. 05-79)

γ_1 = Density of aquifer water

γ_2 = Density of injected water

D = Depth of receiving zone

$P_{shut\text{-}in}$ = Measure shut-in wellhead pressure

$P_{initial}$ = Initial pressure using lower temperature injected water

is used to calculate the change in pressure due only to density changes between the water in the wellbore and the injected water. The remaining effects are grouped together as skin effects and a one minute pressure build-up is calculated using the calculated skin factor, the value of the viscosity of the injected water and the calculated kh value:

$$P_i = P_{shut\text{-}in} + P_{skin}$$

$$P_{skin} = S\left(\frac{Q\ \gamma}{2\pi \frac{kh}{\mu}}\right)$$

The larger the viscosity (i.e. colder water) the larger the P_{skin}.

To project the pressure build-up, the calculated 1 minute pressure build-up is used in conjunction with an assumed linear pressure build-up with the long of the time of injection. No boundary effects have been positively observed in either wells RRGI-6 or RRGI-7 beyond early injection where thermal effects still dominate the flow.

$$P_{(t)} = P_{initial} + P_{skin} + \frac{\mu\ Q\ 5567}{kh}$$

Values for pressure build-up over various times for wells RRGI-6 and RRGI-7 are shown below. High and low observed values of kh were used to bracket the prediction. Predictions were made for injection of water at the summer power plant effluent temperature of 150^{O}F and winter effluent temperature of 125^{O}F.

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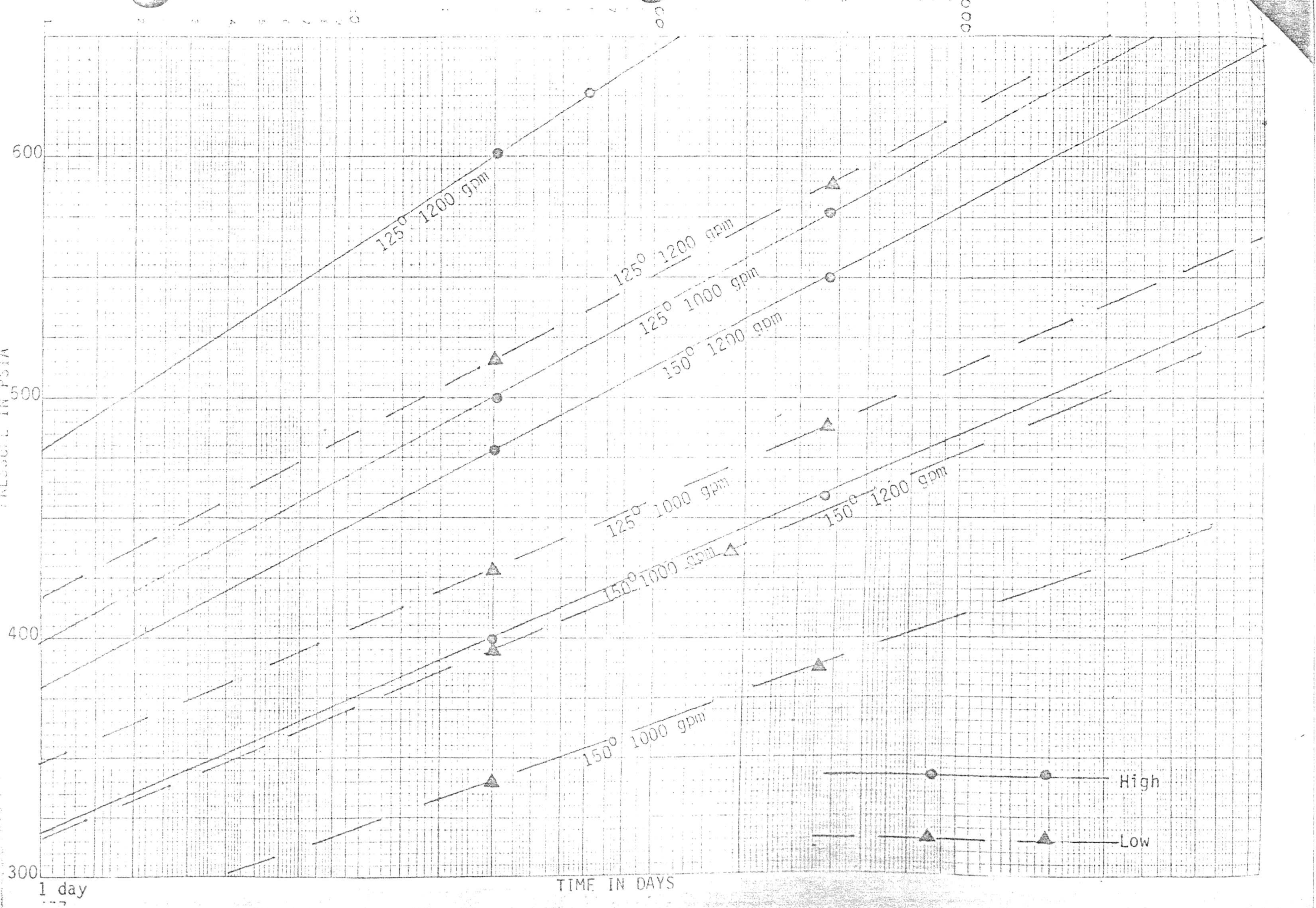
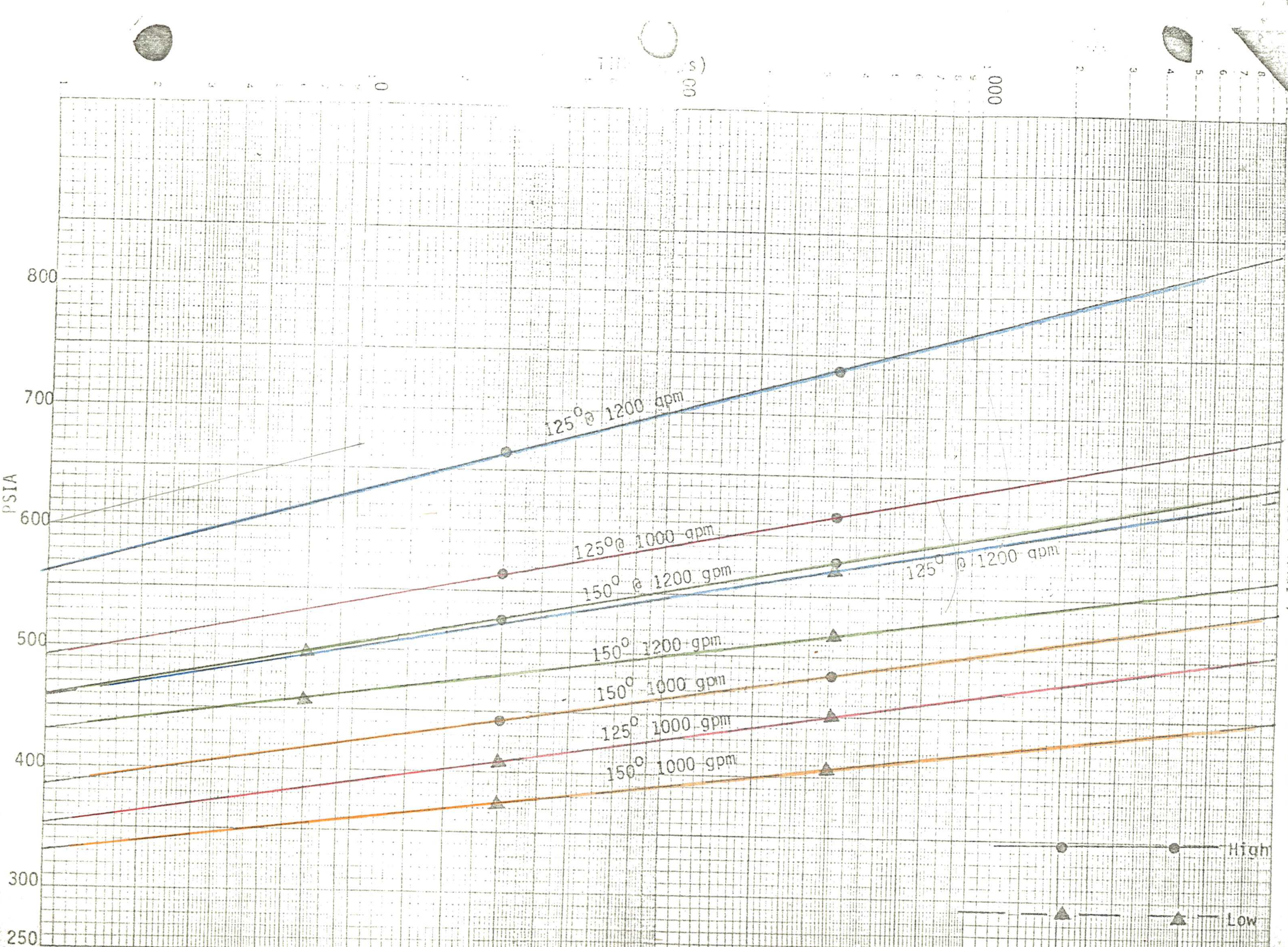
Attachments:

1. Figure 1. Wellhead Pressure vs Time for Different Flow Rates at RRGI-6
2. Figure 2. Wellhead Pressure vs Time for Different Flow Rates at RRGI-7

cc: C. A. Allen
Don Callen
Central Files
Letter File

PRESSURE BUILD-UP AT RRGI-6





PSIA
800
700
600
500
400
300
250
125° @ 1200 gpm
125° @ 1000 gpm
150° @ 1200 gpm
125° @ 1200 gpm
150° 1200 gpm
150° 1000 gpm
125° 1000 gpm
150° 1000 gpm
High
Low

RRGI-7