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MASSIVE HYDRAULIC FRACTURE MAPPING
AND CHARACTERIZATION PROGRAM
SURFACE POTENTIAL DATA FOR WATTENBERG
'75 - '76 EXPERIMENTS

MASTER

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Surface Potential Data for Wattenberg '75-'76 Experiments

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Abstract

Three massive hydraulic fracture operations for natural gas stimulation were conducted in November and December 1975 and January 1976. The fractures were performed by Halliburton for AMOCO in the Wattenberg field northeast of Denver, Colorado. A surface electrical potential technique was used by Sandia Laboratories in cooperation with AMOCO to obtain diagnostic information that would characterize the fractures. Comparison of field data with model calculations indicates that the electrical potential gradients produced by the direct electrical excitation of the fracture well and fracture fluid can be used to map and characterize the fracture. The surface electrical potential techniques utilized and mathematical modeling is described and the data obtained are presented. Fracture orientations apparently lay in a SE to NW direction and analysis indicates the creation of asymmetrical fractures.

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SUMMARY

Three massive hydraulic fracture experiments for natural gas stimulation were conducted by Halliburton for AMOCO in the Wattenberg field northeast of Denver, Colorado. The experiments were conducted on three wells -- Martin Hart "E" No. 1, Salazar G.U. No. 1, and UPRR-22P. All three wells were open hole and the fracture zone was located at a depth of approximately 8000 feet. All were treated with approximately 300,000 gallons of fluid and 600,000 pounds of proppant.

The surface electrical potential technique was used to attempt characterization and mapping of the fracture. The casing of the well which was to be fractured in one experiment and a downhole sinker bar in others were used as the probe for inducing current into the earth. A remote well casing was used as the probe for the current return. Data were taken by recording the potential differences between 24 pairs of probes placed circumferentially around the well with an inner probe radius of 1800 feet and an outer probe radius varying from 2800 feet to 4000 feet. The induced current was essentially DC and was obtained from a series of batteries.

Three second current pulses of both polarities were used for the induced current. After a one-second delay each of the 24 data channels was sampled 20 times at 25 millisecond intervals. The potential of each location was normalized with respect to the current used to induce the field. A comparison of the data for the "before fracture" to "after fracture" was made to obtain the characterization of the fracture.

The noise perturbing the system consists of telluric currents, currents from industrial sources, and natural local currents. It is difficult to determine the exact signal-to-noise ratio or the exact origin of the noise without exhaustive field measurements and data analysis. However, improvements have been made in the surface potential gradient technique since the early developmental stage of the diagnostic program.

To aid in the interpretation of the field data, mathematical modeling efforts have been undertaken. The model utilizes the Green's function integral equation approach where the so-called half-space

Green's function is used. The model calculates the potential difference ($\Delta\phi$) that exists at the surface as a function of fracturing conditions.

Data analysis indicates that the fracture orientation for all three wells lies in a SE to NW direction and that the fractures are asymmetric.

I. INTRODUCTION

In April 1973, a special Natural Gas Technology Task Force issued a report on major gas deposits in the United States which cannot be exploited with current extraction techniques.¹ The low permeability of the gas-bearing sands in these regions dictates that extremely large fractures are required to provide adequate productivity. The report indicates that the gas deposits could be stimulated by massive hydraulic fracturing (MHF). Massive hydraulic fracturing stimulation consists of multi-stage sand and fluid injections that would potentially create long fractures (~ 5000 ft) over a large gross pay interval. To assess the efficiency of the MHF process, characterization information is needed on the azimuthal direction, length, and height of the permeable portion of the hydraulic fractures.^{2,3} In addition, for production application of MHF, similar information is needed to affect optimum well placement to achieve overall efficient drainage.

Sandia Laboratories is currently working on a Massive Hydraulic Fracture Mapping and Characterization Program funded by the Division of Oil, Gas and Shale Technology of the Energy Research and Development Administration (ERDA). The geophysical diagnostic techniques include the use of passive seismic signals created by the fracturing and surface electrical potentials induced by injecting current into the fracture well casing and subsequently influenced by the electrically-conducting fracturing fluid.⁴ This report concerns only the surface potential method. The instrumentation used and mathematical modeling are described, and the field results and data obtained from three MHF's are presented.

Surface electrical potential data have been obtained during three fracturing tests. The MHF's were performed by Halliburton Services for AMOCO in the Wattenberg field northeast of Denver, Colorado.

Data was collected for the first (Martin Hart "E" No. 1) in November of 1975, for the second (Salazar G.U. No. 1) in December of 1975, and for the third (UPRR-22P) in January of 1976. All three wells were open hole and the fracture zone was located at a depth of approximately 8000 feet. All were treated with approximately 300,000 gallons of fluid and 600,000 pounds of sand for proppant. Access to a downhole current probe was provided by AMOCO on all three wells. The Wellex probe provided through AMOCO allowed the electrical current to be induced at the fracture depth. A sinker bar was electrically connected to the center conductor of a standard wire line which was then connected to the current pulser. Breakdown on all three wells occurred weeks before the main fracture.

The electrical MHF mapping technique is associated with the science (or art) of electrical prospecting used in the investigation of geological structures. In the technique used here, potential gradients created at the surface of the earth are the result of using the fracture well casing along with the associated fracture filled with a conducting fluid as the induced current electrode and a remote well casing as the return current electrode. As the fracture progresses the potential gradient changes at the surface are due to the change in electrode geometry. If the potential gradients before, during, and after the fracture are compared, diagnostic information about the fracture is obtained.

To aid in the interpretation of the field results, a mathematical modeling effort was undertaken. An initial approach treated the well casings and fracture fluid as perfectly conducting electrical line sources in an infinite isotropic and homogeneous medium. For a non-homogeneous medium, a resistance ladder network, chosen to represent the well casing, fracture fluid, and the resistivity of the formation, was used to apportion the current densities on the fracture well casing and the fluid-filled fracture.⁵

A second method utilizes the Green's function integral equation approach where the so-called half-space Green's function is used. The well casing and fracture fluid are assumed to have a finite resistivity, and the voltage distribution along the well casing and fluid-filled fracture is taken into account. It is assumed that the well casings and the fluid-filled fracture can be treated as line electrodes with a finite cross-sectional area; the earth is treated as a half-space

with a uniform resistivity; and the current leaving or entering the line electrodes per unit length are constant. With these assumptions, the new calculations are similar in some respects to the earlier results.⁶

II. MODEL CALCULATIONS

Electrical prospecting is a well-known technique that is used in the investigation of geological structures beneath the surface of the earth. The approach taken is to determine the variation of the electrical constants of the earth's crust and to make the proper interpretation of these variations. Of the electrical constants associated with the earth's crust, the variation in the resistivity is by far the greatest and the theory used is based entirely upon electrical potential theory. Most of the problems that exist in electrical prospecting are not new, however, there are applications of these theories to specific situations that have not been considered in the past. The situation considered here is the application of these theories to determine diagnostic information of an underground hydrofracture.

A vast amount of the work that has been done in electrical prospecting has been applied to the problem of the potential distribution about a point electrode placed on the earth's surface. In the application of potential theory considered here, the fracture well casing serves as one current electrode; the fracture fluid is conductive and after fracturing the fluid-filled fracture acts as a horizontal conductor within the fracture zone; and the current return path is provided by another well casing located some distance from the source. Thus, the electrode spacing is not large compared to the dimensions of the electrode and the source must be considered a line and not a point source.

A rigorous analysis of potential distributions resulting from a penetrating electrode has been presented by Muskat.⁷ The formulae developed by Muskat cover both point electrodes at the surface of the earth and penetrating electrodes. Also the formulae are applicable for the potential distribution at all distances from the current source. However, the analysis is overly complicated and for present purposes a simpler analysis can be applied to the hydrofracture problem. Sunde⁸ in his treatment of buried metallic structures used for both power and

communications system describes a simpler analysis. In this analysis, mathematical approximations not affecting the fundamental aspects of the problem are used in order to obtain engineering equations. Simplifying assumptions made in the development of the equations are that the earth is homogeneous and isotropic and the current flux density along the penetrating electrode is uniform. In the application here, the spirit of Sunde's assumptions is employed which results in a simplified model to describe the potentials. The results are believed to give a fairly accurate description of the behavior of the potentials during fracturing.

The use of the Green's function technique for solving partial differential equations in electrostatic problems is quite common.⁹ This technique is used here to solve for the electrical potentials in the MHF mapping problem.

Consider a volume V bounded by a surface S . Green's second identity given by Van Bladel⁹ is

$$\int_V dV \left\{ G(\underline{x}, \underline{x}') \nabla'^2 \phi(\underline{x}') - \phi(\underline{x}') \nabla'^2 G(\underline{x}, \underline{x}') \right\} \\ = \int_S dS' \Gamma(\underline{x}, \underline{x}') \quad , \quad (1)$$

where

$$\Gamma(\underline{x}, \underline{x}') = G(\underline{x}, \underline{x}') \frac{\partial \phi(\underline{x}')}{\partial n'} - \phi(\underline{x}') \frac{\partial G(\underline{x}, \underline{x}')}{\partial n'} \quad . \quad (2)$$

Here $G(\underline{x}, \underline{x}')$ is the Green's function, $\phi(\underline{x}')$ is the sought after solution for the potential, $\partial/\partial n'$ is the normal derivative to the surface, and $\underline{x}'$ is on the surface S . The appropriate Green's function to use here is

$$G(\underline{x}, \underline{x}') = \frac{1}{4\pi} \left\{ \frac{1}{\left[(x-x')^2 + (y-y')^2 + (z-z')^2 \right]^{1/2}} \right. \\ \left. + \frac{1}{\left[(x-x')^2 + (y-y')^2 + (z+z')^2 \right]^{1/2}} \right\} \quad , \quad (3)$$

where $G(\underline{x}, \underline{x}')$ satisfies the equation

$$\nabla^2 G(\underline{x}, \underline{x}') = \delta(x-x') \delta(y-y') \left\{ \delta(z-z') + \delta(z+z') \right\} , \quad (4)$$

and $\delta(x-x')$, etc. are Dirac delta functions. $G(\underline{x}, \underline{x}')$ has the property that the normal derivative of $G(\underline{x}, \underline{x}')$ in equation (2) will vanish at the surface of the earth.

For a volume which does not contain any charges or currents such that $\nabla^2 \phi = 0$, then from equation (1), $\phi(\underline{x})$ is given by

$$\phi(\underline{x}) = \int_S dS' \Gamma(\underline{x}, \underline{x}') \quad . \quad (5)$$

It remains now to solve equation (5) for the potential $\phi(\underline{x})$ with a specified current distribution, $\partial\phi(\underline{x}')/\partial n'$, on S . Since there is a current leakage from the electrodes, the potential distribution on S , $\phi(\underline{x}')$ in equation (2), is determined by the specified $\partial\phi(\underline{x}')/\partial n'$ as will be shown.

The surface S consists of the surface of the earth ($z' = 0$), the fracture well casing (S_+) along with the associated conducting fracture fluid (S_f), and the current sink well (S_-) as shown in Figure 1. No current lines flow through the surface of the earth such that $\partial\phi/\partial n' = 0$ at $z' = 0$; also at $z' = 0$, $\partial G/\partial n' = 0$ where $\partial/\partial n' = -\partial/\partial n'$. In addition, $\partial\phi/\partial n'$ and $\partial G/\partial n'$ vanish at ∞ . Thus equation (5) becomes

$$\begin{aligned} \phi(\underline{x}) = & \int_{S_+} dS' \Gamma(\underline{x}, \underline{x}') + \int_{S_-} dS' \Gamma(\underline{x}, \underline{x}') \\ & + \int_{S_f} dS' \Gamma(\underline{x}, \underline{x}') \quad , \end{aligned} \quad (6)$$

where $\Gamma(\underline{x}, \underline{x}')$ is given by equation (2) and the surface is shown in Figure 1. The normals to the surface are outward normals.

The integral equation, equation (6), is in general difficult to solve. However, to illustrate the potentials for the MHF mapping problem some simplifying assumptions are made. With these assumptions the solution reduces to some simple integrals which can be evaluated in closed form. However, the Green's function technique is general enough to handle more complicated cases which would require solutions to an integral equation.

Fig. 1 - Schematic Layout of the Model Calculations.

In this report the following assumptions are made. The resistivity of the earth is assumed to be uniform with a value of ρ . Since the earth is assumed to have uniform resistivity, it is reasonable to assume that the current leaving or entering an electrode per unit area is constant.⁸ The well casings and the fluid-filled fracture are treated as line sources with a finite cross-sectional area and circumference. The current leaving the (+) electrode (+ well casing and conducting fracture fluid) per unit area is taken to be

$$j_+ = I/(S_+ + S_f) \quad (7)$$

while the current entering the (-) electrode (- well casing) per unit area is taken to be

$$j_- = I/S_- \quad (8)$$

where I is the current injected into the (+) electrode. As long as the measurements are made far away from the fracture, the (-) electrode is sufficiently far away from the (+) electrode, and the half-space has a uniform resistivity, the above assumptions are reasonable.

The area integrals in equation (6) are approximated by replacing them by the appropriate line integral times a circumferential factor or area factor. For an electrode, $\partial\phi/\partial n$ in equation (2) is proportional to the current leaving or entering the electrode per unit area. (Current leaving is positive and current entering is negative.) Thus,

$$\frac{\partial\phi(\mathbf{x}')}{\partial n} = \begin{cases} j_+ \rho, & \text{on } S_+ \text{ and } S_f \\ -j_- \rho, & \text{on } S_- \end{cases} \quad (9)$$

To finalize the development, the potential distribution, $\phi(\mathbf{x}')$ in equation (2), needs to be determined. Briefly, the potential distributions on the electrodes are determined by the current distribution; a more detailed account is given elsewhere.¹⁰ The potential distributions on each conductor are given by

$$\begin{aligned} \phi_+(z) &= V_O^+ - (\rho_p j_+ / A_p) \left[(S_+ + S_f)z - \pi a z^2 \right], \text{ on } S_+, \\ \phi_f(x) &= \begin{cases} \phi_+(l_+) - (\rho_f j_+ / A_f) \left[S_f' x - (h+t)x^2 \right], & \text{on } S_f, x > 0, \\ \phi_+(l_+) + (\rho_f j_+ / A_f) \left[S_f' x + (h+t)x^2 \right], & \text{on } S_f, x < 0, \end{cases} \\ \phi_-(z) &= V_O^- + (\rho_p j_- / A_p) \left[S_- z - \pi a z^2 \right], \text{ on } S_-, \end{aligned} \quad (10)$$

where the subscript p and f on ρ denote the resistivities for the well casing and fracture fluid, respectively. Here a is the well casing

radius and h and t are the fracture height and thickness, respectively. The surface areas S_+ , S_f , and S_- in Figure 1 are: $S_+ = 2\pi a l_+$, $S_f \approx S'_f + S''_f = 2(h+t)l' + 2(h+t)l''$, and $S_- = 2\pi a l_-$. The cross-sectional area A_p and A_f are given by $A_p = \pi[a^2 - (a-t')^2]$, t' is the well casing thickness, and $A_f = ht$.

Approximating the area integrals by a line integral times the appropriate circumferential factor or area factor, from equations (2), (3), (6-9), and (10) the potential $\phi(x)$ can be determined. It is convenient to express the results in terms of normalized variables where variables are normalized by l_+ , ρ , $I\rho/l_+$ for the length, resistivity, and potential, respectively. The variables in the following equation are the reduced variables where in the previous equations

$$x \rightarrow x/l_+, \text{ etc.,}$$

$$\rho_i \rightarrow \rho_i/\rho,$$

$$\phi \rightarrow \phi(l_+/I\rho).$$

In terms of the normalized variables the potential $\phi(x)$ becomes

$$\begin{aligned} \phi(x) = & (a/2)\lambda \int_0^1 dz' (g_+ + g_-) |_{x' = x_+, y' = y_+} \\ & - (a^2/2) \int_0^1 dz' \phi_+(z') (g_+^3 + g_-^3) |_{x' = x_+, y' = y_+} \\ & + \left[(h+t)/2\pi \right] \lambda \int_{-\ell}^{\ell} dx' (g_+ + g_-) |_{y' = y_+, z' = \ell_+ - h/2} \\ & - (ht/2\pi) \int_{-\ell}^{\ell} dx' \phi_f(x') (g_+^3 + g_-^3) |_{y' = y_+, z' = \ell_+ - h/2} \\ & - (1/4\pi\ell_-) \int_0^{\ell} dz (g_+ + g_-) |_{x' = x_-, y' = y_-} \\ & - (a^2/2) \int_0^{\ell} dz' \phi_-(z') [g_+^3 + g_-^3] |_{x' = x_-, y' = y_-}, \quad (11) \end{aligned}$$

where

$$g_{\pm} = \left[(x-x')^2 + (y-y')^2 + (z+z')^2 \right]^{-1/2} \quad (12)$$

and

$$\lambda = \left[2\pi a + 2(h+t)(\ell' + \ell'') \right]^{-1} \quad (13)$$

The line integrals in equation (10) can be evaluated in closed form or numerically on a computer. For brevity, the closed form of equation (10) will be omitted here.

The potentials V_O^+ and V_O^- in equation (10) are determined self-consistently by solving equation (11) for points on the well casings at x_+ , y_+ (+ well) and at x_- , y_- (- well) both at $z = 0$. It is noteworthy that for the current injected at any other place than on (+) well casing at $z = 0$, the expressions for the potential distributions on the electrodes, equation (10), will be altered.

The experimental procedure used by Bartel, McCann, and Keck⁶ was to compare potential gradients prior to and after the fracturing. To model the experiment, the potential gradient calculated at the surface ($z = 0$) at radii R_1 and R_2 along the same radial is defined by

$$\Delta\phi(\theta) = \phi(R_1, \theta) - \phi(R_2, \theta) , \quad (14)$$

where $R_1 < R_2$ as shown in Figure 1. The comparison of potential gradients before and after the fracturing is

$$V(\theta) = \Delta\phi(\theta)_{\text{after}} - \Delta\phi(\theta)_{\text{before}} \quad (15)$$

A plot of $V(\theta)$ for selected R_1 and R_2 and fracture length $\ell' + \ell''$ are shown in Figure 2. For the calculations here the fracture is oriented in the 90° to 270° direction. The various curves in the figure represent the degree of asymmetry of the fracture. For the 0.50 curve, the fracture is symmetric and there are two cycles within the 360° . The 1.00 curve denotes the total fracture in the 90° direction. Note that the asymmetric curves (.667, .75, 1.0) show a change in potential gradient to be one cycle for 360° . For an asymmetric fracture, the largest negative value of the cycle occurs in the direction of the major part of the fracture while the smallest negative value of the cycle is in

Fig. 2 - Difference in potential gradient $\bar{V}(\theta)$ (after fracture minus before fracture) as function of angle around fracture well; fracture is along line from 90° to 270° with major portion in 90° direction for the asymmetrical fractures; R_1 and R_2 are radii at which the potentials are calculated; normalization length is fracture well depth $l+$ and normalization potential is $\rho l/l+ V(\theta)$ defined by Eq. (15).

the direction of the minor part. For these conditions, the induced current was injected at the fracture well casing at the surface of the earth. Calculations have been made for the current injected directly into the fracture zone. The results for a downhole current source are similar to those for the current injected at the surface.

III. INSTRUMENTATION

The surface electrical potential data were taken by recording the potential differences between 24 pairs of probes around the wellhead (Figure 3). The 24 probes were placed circumferentially around the well with an inner probe radius of 1800 feet and an outer probe radius of 2800 feet for the Martin Hart and Salazar fractures and 4000 feet for the UPRR fracture. Each probe consisted of a stainless steel rod measuring 18 inches in length and $1/2$ " in diameter.

The induced current and the data collection was controlled from an instrumentation van. A mini-computer initiated the entire sequence

Fig. - Layout of the Surface Potential Instrumentation.

of one complete set of data measurements. The potential at each stake-pair location was transmitted to the van where it was measured and recorded. Figure 4 is a block diagram of the instrumentation at each stake-pair location. The output for 12 locations were frequency multiplexed onto one coax cable, and two coax cables carried data from the 24 stake-pair locations into the instrumentation van. For record keeping purposes, these were referred to as A-string and B-string. Each location was identified as A1 through A12 and B1 through B12.

The instrumentation van contained 12 subcarrier discriminators, monitoring equipment, power supplies, and a mini-computer. The peripherals for the mini-computer included an analog multiplexer, an A/D converter, a storage disk, and a teletype terminal. Figure 5 shows a block diagram of this system.

Fig. 4 - Stake-Pair Instrumentation.

Fig. 5 - Instrumentation Van Configuration.

The potential field was created by inducing electrical current flow through the earth. Pulsed DC current from a series of batteries was used. The direction of current flow was reversed during each measurement to eliminate polarization effects. A three-second current pulse was initiated, and after a one-second delay, each data channel was sampled 20 times at 25 millisecond intervals. This procedure was repeated for the reversed current flow. A large number of potential measurements were made before, during, and after the fractures to obtain good averages. The potential for each position was taken as the difference between the sampled positive pulse and the negative pulse. The voltage and current used to create the potential field were measured in the same manner. The output data are the normalized potentials which are the potential differences divided by the current.

IV. EXPERIMENTAL RESULTS

A. Martin Hart "E" No. 1 Fracture -- The massive fracture occurred on November 18, 1975. Electrical potential measurements were made for background and the main fracture.

The electrical potential probes were placed around the wellhead with an inner probe radius of 1800 feet and an outer probe radius of 2800 feet. Although the downhole current probe was available for use, an electrical connection failure at the sinker bar required that the current be induced directly into the wellhead at the surface of the earth. The return line was attached to another well casing located approximately one mile to the east.

A total of 29,400 gallons of pad fluid were pumped between 0750 hours and 0825 hours. Pumping for the main fracture began at 0830 hours and continued to 1430 hours. A total of 317,000 gallons of fluid were pumped and 600,000 pounds of proppant used. A mixture of condensate and water was used for the main fracture. Potassium chloride (KCl) was added which placed the resistivity of the water in the range of .1 to .2 ohm-meter.

Field data have been obtained for background on November 17, 1975, and for the main fracture on November 18, 1975. The induced current used for creating the electric field was produced from a series of nickel-cadmium batteries and was approximately 12 amperes. Electrical potential data for the main fracture was taken at approximately five minute intervals

beginning at 0530 hours and continuing through 1640 hours. Only measurements taken on the day of the main fracture have been analyzed. Approximately 35 data points taken prior to the fracture were averaged and used as the before-fracture measurement. Approximately the same number taken at the end of the fracture were averaged and used as the after-fracture measurement. For convenience, a multiplying factor of 100 was used. The potential comparison, $V(\theta)$, is shown in Figure 6.

Fig. 6 - Potential Comparison as a Function of Direction for the Wattenberg Martin Hart E No. 1 Fracture, Nov. 18, 1975.

The data are examined after reduction and tabulation. A burst of noise or a malfunction in the electrical potential system at the time of making a measurement can cause noisy output. Because the mini-computer is used in the field, malfunctions that occur in the potential measurement system is readily detected and repairs made immediately. The noise which perturbates the system can vary over a large range of both frequency and amplitude. Noise is defined as any unwanted signal in the system. The noise produced by natural and man-made currents that occur in the earth are the more serious to cope with. Extraneous earth currents that degrade the data consist of telluric currents, currents that originate from industrial sources, and natural local currents.

Telluric currents flow in uniform sheets and cover large areas of the earth. Their period can vary from less than a second to many days. Industrial source currents are unpredictable in both amplitude and frequency; however, the currents are associated mainly with power lines with a predominate frequency of 60 hertz and its harmonics. Natural local currents are produced by electrochemical reaction in the earth. From this source DC electrical potential differences of 100 millivolts to 750 millivolts have been observed in the field. The geographical location of the fracturing operation will dictate to what degree the noise will interfere with the signal. Examination of the data is necessary to eliminate those data points which are greatly effected by noise.

In the case of the Martin Hart fracture, the southern side of the recording array was compromised by a high voltage power line that created excessive noise in the electronics and is, therefore, excluded from the plot.

The data appear to provide a one-cycle change in potential gradient, thus indicating an asymmetrical fracture was created. When compared with the model calculations and treated as a homogeneous and isotropic medium, the cycle minima appears to lie in the northwest quadrant indicating that this is the direction of the major wing of the fracture. The limited data does not allow for a precise specification of fracture orientation, other than in the general direction of NW to SE.

The data for the Martin Hart operation are presented in Table I and Table II, Appendix A.

B. Salazar, G.U. No. 1 Fracture -- The massive fracture occurred on December 16, 1975. Electrical potential measurements were made on the day of the main fracture only.

The electronics system and the placement of the electrical potential probes were the same as that used for the Martin Hart operation. However, the data collected are the first obtained with the downhole current probe. Because of the added resistance of the 12,000 foot line, the induced current at the fracture zone for this operation was approximately five amperes. The return current line was attached to another well casing located approximately two miles to the west.

A total of 29,400 gallons of pad fluid were pumped between 0900 hours and 0930 hours. Pumping for the main fracture started at 0935 hours and ended at 1440 hours. A total of 312,000 gallons of fluid were pumped. The fluid mixture was similar to that used for the Martin Hart fracture.

The data for the December 16, 1975, fracture are presented in Table I, Appendix B. Electrical potential measurements were made on the day of the massive fracture only.

The data analysis was similar to the Martin Hart analysis and a plot of the results are shown in Figure 7.

Fig. 7 - Potential Comparison as a Function of Direction for the Wattenberg Salazar, G.U. No. 1 Fracture, Dec. 12, 1975.

The fluctuations in the data result from the reduction in induced current by use of the downhole current probe, producing a low signal-to-noise ratio. However, the data indicate that the fracture is asymmetric and the azimuthal direction is from NW to SE with the major portion extending to the SE.

C. UPRR-22P Fracture -- The massive fracture occurred on January 27, 1976. Electrical potential measurements were made for background and for the main fracture.

The test configuration and the electronics used were the same as that used for the previous fractures with the exception that the potential probes were placed with the inner probe radius at 1800 feet and the outer probe radius at 4000 feet. The downhole current probe was used where a current pulse of 6.5 amperes was induced directly into the fracture zone. The return current line was attached at two wells -- one located approximately 1.5 miles to the northwest and the second located approximately 1.5 miles to the southeast.

Pumping for the main fracture started at 0840 hours and continued to 1700 hours. The pumping fluid was consistent with the previous two fracture operations where the resistivity of the water was in the range of .1 to .2 ohm-meter.

The data for the UPRR-22P are presented in Table I and Table II, Appendix C. Field data were taken on January 26 and 27 of 1976.

Again, data were taken in approximately five-minute intervals in order to obtain good averages. The data analysis was similar to the previous tests and a "before" to "after" comparison made. A plot of the results is shown in Figure 8. The data clearly shows a one-cycle change, indicating an asymmetrical fracture was formed, and indicates orientation in a NW to SE direction with the major extension of the fracture to the NW.

A map showing the relative locations of the three test wells and the orientation of the fractures is presented in Figure 9. The arrow drawn through the well location indicates the direction of the major portion of the fracture.

A further analysis of the UPRR data was made in order to determine the progressive growth of the fracture as a function of the quantity of pumping fluid. A plot of the fracture fluid volume versus time of day is shown in Figure 10. The result of the potential comparison is presented in Figure 11, where each curve represents an increment of approximately 75,000 gallons of fluid. The growth away from the southeast quadrant is clearly shown and represents the major fracture

Fig. 8 - Potential Comparison as a Function of Direction for the Wattenberg UPRR-22P Fracture, January 27, 1976.

length being in the northwest direction. The reversal in the northwest quadrant, between 150,000 and 225,000 gallons, is not clearly understood but could be caused by the total fracture length being increased while the degree of asymmetry varies.

CONCLUSIONS

Although the model calculation used for comparison with the Wattenberg field data are for an isotropic and homogeneous earth, the results are believed to be adequate in describing the behavior of the surface potentials to the extent of determining azimuthal direction, any asymmetry, and the direction of the major part of the fracture.

The model calculations shown that for a homogeneous earth, the behavior and magnitude of the surface potentials when the current is injected into the fracture zone are similar to when the current is injected into the fracture well casing at the surface.

Fig. 9 - Location Map of the AMOCO Wattenberg Field. Arrow direction indicates the orientation of the fracture and direction of the major wing.

Fig. 10 - Fluid Volume vs. Time of Day for the Wattenberg UPRR-22P Fracture, January 27, 1976.

Fig. 11 - Progressive Growth of Fracture as a Function of Direction for the Wattenberg UPRR-22P Fracture, January 27, 1976.

The results of the field tests indicate that the effect of the fracture can be observed. The surface potential gradient technique further indicates the capability to determine the orientation of the fractures as well as the ability to determine asymmetrical features of the fracture.

Comparison of the field data with the model calculations indicates that the fractures are asymmetric, when treated as a homogeneous and isotropic medium, and are oriented in the NW to SE direction with the major part oriented NW for both the Martin Hart and the UPRR, and to the SE for the Salazar.

Further improvements in the diagnostic system, numerical model studies and field instrumentation, should allow the surface potential technique to characterize the dimensions of the fracture.

REFERENCES

1. United States Federal Power Commission: "Natural Gas Survey, Vol. II, Survey, Task Force Reports," Washington, DC (1973).
2. Randolph, P. L.: "Massive Stimulation Effort May Double US Gas Supply - Part 3," World Oil (October 1974) p. 131-134.
3. Randolph, P. L.: "Massive Stimulation Effort May Double US Gas Supply - Part 4," World Oil (November 1974) p. 81-84.
4. Power, D. V., Schuster, C. L., Hay, R. G., and Twombly, J.: "Detection of Hydraulic Fracture Orientation and Dimensions in Cased Wells," SPE 5626, presented at SPE 50th Annual Fall Meeting, Dallas, Texas, September 28-October 1, 1975, to be published in the J. Petroleum Technology.
5. McCann, R. P., and Keck, L. J.: "Massive Hydraulic Fracture Mapping and Characterization Program: Surface Potential Data for Pinedale '75 Experiments," SAND-76-0379, Sandia Laboratories, August 1976.
6. Bartel, L. C., McCann, R. P., and Keck, L. J.: "Use of Potential Gradients in Massive Hydraulic Fracture Mapping and Characterization," SPE 6090, presented at the SPE 51st Annual Fall Meeting in New Orleans, Louisiana, October 4-6, 1976.
7. Musket, M: "Potential Distribution in Large Cylindrical Disks with Partially Penetrating Electrodes," Physics, Vol. II (1932).
8. Sunde, E. D.: Earth Conduction Effects in Transmission Systems, Dover Publ. Inc., New York (1968) p. 1-94.
9. Van Bladel, J.: Electromagnetics Fields, McGraw-Hill Book Co., Inc., New York (1964) p. 7-16, 59, 73.
10. Bartel, L. C.: "Model Calculations of the Potential Gradients Used in Massive Hydraulic Fracture Mapping and Characterization," presented at the 46th Annual International Meeting of the Society of Exploration Geophysicists, Houston, Texas, October 24-28, 1976 (submitted for publication).

APPENDIX A

TABLE 1

WATTENBERG - MARTIN HART HYDROFRACTURE

BACKGROUND-NOVEMBER 17, 1975

TIME	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°
16:20	1.9997	2.2956	2.1695	2.4884	2.9222	3.1371	3.2100	2.8897	2.5693	2.2672	1.9457	1.9464
16:23	2.0244	2.3183	2.1597	2.4901	2.9352	3.1341	3.2416	2.8750	2.5684	2.3224	2.1917	2.0050
16:26	1.9796	2.3068	2.1743	2.4913	2.9363	3.1376	3.2418	2.8803	2.5825	2.2698	1.9986	2.0189
16:27	1.9962	2.3075	2.1542	2.4941	2.9285	3.1369	3.2603	2.8782	2.6004	2.2515	2.2106	1.9985
16:31	1.9997	2.3101	2.1587	2.4788	2.9338	3.1353	3.2562	2.8828	2.5666	2.2804	2.0532	2.1082
16:33	2.0013	2.3091	2.1454	2.4712	2.9270	3.1385	3.2632	2.8803	2.5400	2.2872	2.2011	1.9529
16:35	2.0027	2.3051	2.1432	2.4796	2.9286	3.1350	3.2596	2.8925	2.5875	2.3552	2.0611	1.9980
17:17	2.0146	2.3225	2.1756	2.4891	2.9374	3.1432	3.2675	2.7752	2.5801	2.3100	2.2276	2.0570
16:40	2.0049	2.3197	2.2147	2.4923	2.9317	3.1316	3.2556	2.8847	2.5174	2.2824	1.8879	2.0034
16:42	2.0280	2.3078	2.1602	2.4842	2.9326	3.1406	3.2623	2.8875	2.6321	2.3388	2.1555	2.0416
16:55	2.0188	2.3288	2.1393	2.4725	2.9242	3.1345	3.2579	2.7773	2.6016	2.3755	2.3426	2.0567
17:20	2.0178	2.3182	2.1860	2.4852	2.9345	3.1397	3.2575	2.7751	2.5658	2.2967	2.0733	2.0280
17:53	2.0054	2.3357	2.2200	2.4898	2.9393	3.1462	3.2631	2.9323	2.5727	2.2660	2.1476	1.9813
17:48	2.0220	2.3434	2.1581	2.4888	2.9351	3.1456	3.2668	2.9368	2.5808	2.3665	2.0953	1.9481
17:53	2.0099	2.3196	2.1518	2.4896	2.9352	3.1461	3.2647	2.9304	2.5844	2.4144	2.2168	1.9456
17:58	2.0058	2.3366	2.1847	2.4869	2.9367	3.1457	3.2657	2.9367	2.5811	2.3027	2.2882	2.0800
18:00	1.9988	2.3136	2.1842	2.5052	2.9533	3.1483	3.2678	2.9349	2.5723	2.1279	2.0533	2.0728
18:02	1.9897	2.3263	2.1228	2.4706	2.9293	3.1387	3.2626	2.9321	2.6116	2.4496	2.4092	2.0866
18:05	2.0073	2.3037	2.2026	2.5003	2.9547	3.1464	3.2655	2.9338	2.5667	2.3143	2.2070	2.1475
18:08	2.0228	2.3189	2.1493	2.4775	2.9263	3.1457	3.2665	2.9342	2.6106	2.2508	2.1055	1.9818
18:09	1.9341	2.2961	2.2673	2.5104	2.9481	3.1434	3.2637	2.9290	2.5103	2.2366	1.9488	2.0305
17:48	2.0281	2.3368	2.1866	2.4897	2.9330	3.1422	3.2668	2.9281	2.5738	2.3026	2.2425	2.0260
17:43	2.0031	2.3195	2.1824	2.4793	2.9348	3.1426	3.2636	2.9359	2.5737	2.3603	2.1473	2.0909
17:45	1.9916	2.3116	2.1756	2.4891	2.9402	3.1434	3.2657	2.9341	2.5304	2.3858	2.1707	2.0217
17:47	2.0041	2.3272	2.1631	2.4814	2.9342	3.1468	3.2113	2.9394	2.5963	2.2761	2.1635	2.0848

TABLE 1 (continued)

WATTENBERG - MARTIN HART HYDROFRACTURE												
BACKGROUND-NOVEMBER 17, 1975												
TIME	180°	195°	210°	225°	240°	255°	270°	285°	300°	315°	330°	345°
16:23	2.0395	1.9709	1.9181	1.7960	2.0704	2.0330	1.9769	1.9903	1.8765	1.9104	1.9451	1.9877
16:23	2.0395	1.9589	1.9584	1.8072	2.0632	2.0987	1.9302	1.9960	1.8698	1.8924	1.9524	1.9941
16:24	2.1528	2.1261	2.0936	1.8866	2.0843	2.1004	1.9589	2.0411	1.9327	1.8737	1.9377	1.9812
16:27	1.9420	1.9378	2.0061	1.8014	2.0994	2.0997	1.9798	1.9568	1.8392	1.8585	1.9425	1.9818
16:31	2.1920	2.0470	2.0220	1.8212	2.0679	2.1037	1.9804	2.0657	1.8709	1.9109	1.9423	1.9821
16:33	2.1527	1.9094	1.9352	1.7716	2.0333	2.0960	1.9305	2.0157	1.8933	1.8901	1.9429	1.9864
16:35	2.0694	2.1135	1.9088	1.8251	2.0721	2.0939	1.9658	2.0309	1.9127	1.8890	1.9436	1.9818
17:17	2.0295	2.0422	1.9796	1.8057	2.0793	2.0921	1.9709	2.0120	1.8777	1.8656	1.9451	1.9346
16:40	1.9405	1.8922	2.0598	1.8340	2.0849	2.1946	1.9785	1.9674	1.8599	1.8925	1.9433	1.9866
16:42	2.0130	2.1520	2.0734	1.7892	2.0709	2.0962	1.9763	2.0233	1.9280	1.8850	1.9472	1.9879
16:55	2.0776	2.0534	2.0352	1.7403	2.0668	2.0945	1.9723	2.0117	1.8928	1.9047	1.9429	1.9769
17:20	2.1150	2.0074	1.9333	1.8140	2.0890	2.0869	1.9703	2.0106	1.8974	1.8915	1.9455	1.9834
17:53	2.0432	2.0164	2.0412	1.8306	2.0640	2.0914	1.9754	2.0155	1.9264	1.8801	1.9486	1.9876
17:48	2.0137	2.0083	2.0525	1.8401	2.0939	2.0951	1.9759	2.0131	1.9109	1.8845	1.9466	1.9895
17:55	2.1952	2.0805	2.0642	1.8107	2.0933	2.0978	1.9777	2.0123	1.9216	1.8900	1.9448	1.9822
17:58	2.0482	2.0295	2.1265	1.8797	2.0787	2.0943	1.9765	2.0102	1.9184	1.8938	1.9453	1.9855
18:00	2.1535	2.1821	2.1138	1.8839	2.0894	2.0950	1.9693	2.0131	1.9132	1.8773	1.9465	1.9855
18:02	2.3492	2.2445	2.0279	1.7590	2.0766	2.0968	1.9719	2.0146	1.9225	1.8710	1.9447	1.9866
18:05	2.1921	2.2812	1.8976	1.7810	2.0759	2.0913	1.9739	2.0116	1.9109	1.8907	1.9432	1.9853
18:08	2.0602	1.9594	2.0248	1.8503	2.0962	2.0953	1.9775	2.0143	1.9279	1.8796	1.9478	1.9849
18:09	1.9481	1.9229	2.1079	1.8767	2.1050	2.0943	1.9802	2.0107	1.9197	1.8733	1.9413	1.9805
17:48	2.0078	2.0280	1.9592	1.8091	2.0932	2.0967	1.9754	2.0132	1.8955	1.8769	1.9471	1.9957
17:43	1.9823	2.0035	2.0336	1.8456	2.0817	2.0946	1.9770	2.0150	1.9363	1.8965	1.9474	1.9846
17:45	2.1679	2.0823	2.0054	1.8100	2.0809	2.0952	1.9765	2.0171	1.9282	1.8943	1.9478	1.9879
17:47	2.0955	2.0641	1.9463	1.8252	2.0778	2.0921	1.9733	2.0113	1.9137	1.8851	1.9430	1.9875

TABLE II

WATTENBERG - MARTIN HART HYDROFRACTURE

FRACTURE-NOVEMBER 18, 1975

TIME	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°
5:31	2.8348	2.3365	2.2682	2.5111	2.9382	3.1535	3.2640	2.9285	2.5122	2.1488	1.8677	1.9348
5:35	1.9824	2.3382	2.1531	2.4663	2.8954	3.1595	3.2685	2.9346	2.5653	2.3803	2.0862	2.0479
5:40	2.8394	2.3215	2.1690	2.4685	2.9152	3.1487	3.2635	2.9301	2.5737	2.3213	2.2564	2.1546
5:45	1.9838	2.3328	2.1713	2.4887	2.9378	3.1433	3.2598	2.9219	2.5629	2.3506	2.1813	2.0092
5:50	1.9648	2.3315	2.1481	2.4737	2.9147	3.1496	3.2662	2.9329	2.6006	2.3423	2.0245	1.9509
5:55	1.9890	2.3460	2.1943	2.4771	2.9333	3.1565	3.2704	2.9378	2.5938	2.2872	2.1784	2.0136
6:00	1.9901	2.3446	2.1976	2.4894	2.9345	3.1509	3.2697	2.9315	2.5760	2.3793	2.1434	1.9486
6:05	1.9983	2.3245	2.1826	2.4901	2.9350	3.1439	3.2646	2.9255	2.5334	2.4810	2.0148	2.0296
6:10	1.9526	2.3066	2.1907	2.4844	2.9390	3.1492	3.2668	2.9318	2.5762	2.1923	2.1364	2.0831
6:15	1.9803	2.3255	2.1555	2.4507	2.9292	3.1521	3.2729	2.9379	2.5775	2.3425	2.1368	2.1875
6:20	1.9551	2.3225	2.1739	2.4811	2.9435	3.1524	3.2707	2.9339	2.6045	2.3798	2.2952	2.0853
6:25	2.0228	2.3817	2.1865	2.5008	2.9606	3.1709	3.2885	2.9520	2.5977	2.3157	2.1140	1.7790
6:30	2.0779	2.3749	2.1791	2.5394	2.9646	3.1815	3.2996	2.9646	2.6178	2.3163	2.2841	2.0836
6:35	2.1129	2.3574	2.1923	2.5086	2.9559	3.1763	3.2931	2.9548	2.6260	2.3036	2.2300	2.0327
6:40	2.0388	2.3606	2.2198	2.5221	2.9565	3.1665	3.2853	2.9481	2.5507	2.3110	1.9666	1.9893
6:45	1.9979	2.3123	2.1638	2.4828	2.9333	3.1471	3.2657	2.9292	2.5699	2.4105	2.3283	2.1088
6:50	2.0137	2.3317	2.1616	2.4917	2.9287	3.1501	3.2677	2.9313	2.5687	2.2948	2.3609	2.0124
6:55	1.9886	2.3179	2.1779	2.4923	2.9420	3.1537	3.2699	2.9330	2.5704	2.3720	2.1281	2.0411
7:00	2.0868	2.3330	2.1608	2.4646	2.9260	3.1495	3.2692	2.9310	2.5908	2.2809	2.0766	2.0837
7:10	2.0331	2.3278	2.1646	2.4896	2.9381	3.1508	3.2689	2.9288	2.5910	2.2238	2.1736	2.0917
7:15	2.0071	2.3278	2.1692	2.4846	2.9358	3.1495	3.2699	2.9454	2.6040	2.2504	1.9528	2.0314
7:20	2.0224	2.3216	2.1569	2.4935	2.9333	3.1484	3.2672	2.9307	2.5860	2.4648	2.1746	1.9969
7:25	2.0419	2.3052	2.1789	2.4815	2.9351	3.1527	3.2683	2.9257	2.5746	2.3879	2.0846	2.1080
7:30	1.9947	2.3056	2.1705	2.4648	2.9326	3.1450	3.2642	2.9273	2.5571	2.3000	2.2887	2.0374
7:35	1.9790	2.3137	2.1751	2.4789	2.9334	3.1483	3.2698	2.9338	2.5669	2.3719	2.1731	2.0814
7:45	2.0039	2.3206	2.2018	2.5049	2.9390	3.1516	3.2656	2.9220	2.5525	2.4187	2.3949	2.0672
7:50	2.0029	2.3271	2.3074	2.0688	1.9863	1.9420	1.8779	1.9451	2.0199	1.9722	2.0850	2.0800
7:55 Start pumping	1.9927	2.3139	2.1904	2.4780	2.9299	3.1442	3.2460	2.9247	2.5812	2.2882	2.0980	1.9701
8:00	2.0026	2.3130	2.1501	2.4723	2.9226	3.1386	3.1999	2.9266	2.5767	2.2306	2.1137	2.0772
8:05	1.9749	2.2952	2.1869	2.4730	2.9185	3.1269	3.2122	2.8987	2.5319	2.2997	2.1723	1.9825
8:10	1.9774	2.3077	2.1994	2.4766	2.9169	3.1269	3.2219	2.9243	2.5627	2.2129	2.2149	1.9835
8:15	1.9809	2.3115	2.1605	2.4730	2.9163	3.1300	3.2207	2.9159	2.5592	2.2700	2.1170	2.0187
8:20	1.9967	2.3035	2.1463	2.4636	2.9230	3.1286	3.1182	2.7075	2.5581	2.3020	1.9690	2.0004
8:30	2.0170	2.3174	2.1180	2.4924	2.9326	3.1453	3.2362	2.8597	2.5749	2.2939	2.1306	1.9987
8:40	1.9955	2.3156	2.0581	2.4726	2.9260	3.1389	3.2429	2.8713	2.5730	2.2441	2.1108	2.0445
8:45	2.0045	2.3202	2.2111	2.4783	2.9354	3.1470	3.2422	2.8576	2.5329	2.4492	2.0905	2.0184
8:50	2.0095	2.3344	2.1744	2.4765	2.9207	3.1379	3.2366	2.8644	2.6043	2.3325	2.0943	1.8671
8:55 54,600 gal.	2.0091	2.3346	2.2056	2.4819	2.9290	3.1412	3.2394	2.8598	2.5544	2.3518	2.1471	2.0331
9:00	2.0116	2.3269	2.1427	2.4855	2.9252	3.1431	3.2430	2.8690	2.6003	2.1967	2.1917	2.0666
9:05	1.9869	2.3159	2.1972	2.4173	2.9349	3.1431	3.2428	2.8644	2.5633	2.2725	1.9764	1.9968
9:10	2.0148	2.3207	2.2036	2.4766	2.9374	3.1471	3.2436	2.8689	2.5676	2.1802	2.1471	2.1208
9:15	1.9986	2.3189	2.1432	2.4851	2.9248	3.1436	3.2408	2.8683	2.6025	2.1790	2.1189	1.9878
9:20	1.9676	2.3130	2.1942	2.4737	2.9284	3.1434	3.2393	2.8574	2.5733	2.3553	2.1043	1.9332

TABLE II (continued)

WATTENBERG - MARTIN HART HYDROFRACTURE

FRACTURE-NOVEMBER 18, 1975

TIME		0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°
9:25		2.6212	2.3310	2.2142	2.4537	2.9349	3.1437	3.2468	2.8565	2.5497	2.5557	2.1600	2.3653
9:30		2.6102	2.3322	2.1791	2.4312	2.9267	3.1436	3.2453	2.8749	2.6223	2.0818	1.9012	2.3427
9:40		2.6023	2.3185	2.1746	2.4930	2.9337	3.1432	3.2391	2.8539	2.5307	2.2884	2.0669	1.9666
9:45		2.6098	2.3211	2.1713	2.4974	2.9282	3.1382	3.2392	2.8591	2.5748	2.3315	2.0065	2.0705
9:50		2.6035	2.3247	2.2322	2.4943	2.9367	3.1414	3.2313	2.8445	2.5475	2.2159	2.2374	1.9587
9:55	96,600 gal.	2.6130	2.3298	2.2435	2.4792	2.9450	3.1364	3.2408	2.8543	2.5543	2.2122	1.6826	2.0693
10:00		2.6035	2.3316	2.1653	2.5125	2.9264	3.1438	3.2429	2.8657	2.6033	2.1433	2.3737	2.0301
10:05		2.6027	2.3254	2.1676	2.4996	2.9310	3.1408	3.2432	2.8640	2.5831	2.3268	2.7357	2.0784
10:15		1.9960	2.3224	2.1412	2.4943	2.9156	3.1366	3.2374	2.8533	2.5933	2.0812	2.1044	1.9433
10:20		2.6194	2.3342	2.1595	2.4816	2.9206	3.1386	3.2391	2.8566	2.4904	2.3565	2.1402	2.0154
10:25		2.6182	2.3318	2.2051	2.4639	2.9364	3.1376	3.2375	2.8591	2.5683	2.1324	2.3284	2.0381
10:30		2.6013	2.3135	2.2019	2.4895	2.9314	3.1375	3.2392	2.8586	2.5642	2.2133	2.1589	1.8977
10:35		2.6007	2.3203	2.1224	2.4732	2.9246	3.1376	3.2435	2.8703	2.6024	2.1908	2.3325	2.1555
10:40		2.6115	2.3305	2.1948	2.4707	2.9246	3.1351	3.2375	2.8628	2.5641	2.1525	1.9222	1.9254
10:45		2.6036	2.3327	2.2045	2.4787	2.9278	3.1364	3.2363	2.8562	2.5421	2.0455	2.1873	1.9547
10:50		1.9980	2.3273	2.2336	2.4974	2.9453	3.1384	3.2436	2.8675	2.5265	2.2190	2.1762	2.0645
10:55		1.9989	2.2657	2.1575	2.4726	2.9391	3.1343	3.2342	2.8552	2.5702	2.1688	2.2963	2.1912
11:00	153,300 gal.	2.6273	2.3348	2.2118	2.4815	2.9247	3.1307	3.2324	2.8539	2.5697	2.0923	2.3188	1.8835
11:05		1.9743	2.3305	2.2097	2.4843	2.9112	3.1249	3.2261	2.8500	2.5531	2.1095	2.0979	1.9134
11:10		2.6111	2.3458	2.1497	2.4914	2.9334	3.1337	3.2481	2.8747	2.5968	1.8791	2.0876	2.1731
11:15		1.9908	2.3215	2.2241	2.4769	2.9416	3.1356	3.2395	2.8621	2.5042	1.8592	2.0969	1.9952
11:50		2.6313	2.3412	2.1907	2.5117	2.9231	3.1370	3.2391	2.8693	2.5791	2.2873	1.9212	1.9783
11:55		2.6292	2.3475	2.1738	2.4759	2.9273	3.1365	3.2411	2.8641	2.5323	2.3462	2.1355	2.0685
12:03		2.6174	2.3213	2.2501	2.4863	2.9377	3.1350	3.2369	2.8659	2.5555	2.0230	2.1923	2.0691
12:05	200,000 gal.	2.6127	2.3317	2.2123	2.4739	2.9289	3.1390	3.2424	2.8711	2.6016	2.4011	2.3182	2.0313
12:10		2.6015	2.3305	2.1847	2.5111	2.9442	3.1430	3.2460	2.8686	2.5980	2.3215	2.2845	2.0643
12:15		2.6037	2.3344	2.1492	2.4704	2.9215	3.1380	3.2419	2.8645	2.6023	2.4188	2.1834	2.0739
12:23		1.9910	2.2384	2.1619	2.4750	2.9213	3.1356	3.2373	2.8572	2.5674	2.4639	2.1511	2.0041
12:30		2.6148	2.2433	2.1839	2.4763	2.9327	3.1392	3.2395	2.8551	2.5643	2.3377	1.8279	2.0877
12:35		1.9930	2.2881	2.2076	2.4676	2.9236	3.1316	3.2334	2.8515	2.5258	2.4136	1.7533	2.0709
12:40		2.6030	2.3447	2.1656	2.4768	2.9227	3.1352	3.2388	2.8635	2.5791	2.4735	2.2854	2.0905
12:45		2.6035	2.3224	2.1756	2.4837	2.9303	3.1407	3.2442	2.8642	2.5725	2.4651	2.0607	1.7814
13:00		2.6219	2.3196	2.1374	2.4862	2.9310	3.1331	3.2397	2.8620	2.6103	2.3767	2.3612	2.1927
13:05	252,000 gal.	2.6002	2.3455	2.1953	2.4853	2.9390	3.1331	3.2412	2.8620	2.5477	2.3435	2.3069	2.1405
13:10		2.6190	2.3225	2.1553	2.4637	2.9235	3.1356	3.2386	2.8596	2.5836	2.2910	2.2413	1.9050
13:18		1.9998	2.2988	2.2344	2.4889	2.9283	3.1374	3.2379	2.8547	2.5455	2.2961	2.0560	1.9408
13:25		2.6158	2.3175	2.2541	2.5250	2.9519	3.1471	3.2521	2.8770	2.5540	2.2908	2.0999	2.1406
13:30		2.6262	2.2832	2.2055	2.4783	2.9289	3.1380	3.2422	2.8641	2.5670	2.3668	2.1961	2.1547
13:38		2.4726	2.1896	2.1976	2.5145	2.9377	3.1455	3.2538	2.8733	2.5608	2.4037	2.0822	2.0225
13:45		2.6194	2.3234	2.2311	2.4858	2.9317	3.1335	3.2373	2.8523	2.5116	2.3627	2.0268	2.0301
13:55		2.6001	2.3525	2.1518	2.4854	2.9172	3.1324	3.2351	2.8572	2.5871	2.5466	2.2996	1.9045
14:05	305,000 gal.	2.6004	2.2995	2.1638	2.4793	2.9239	3.1322	3.2330	2.8590	2.5797	2.4624	2.0457	2.0131
14:10		2.6153	2.3124	2.2078	2.4732	2.9334	3.1423	3.2450	2.8609	2.5772	2.4712	2.0862	2.0961

TABLE II (continued)

WATTENDERS - MARTIN HART HYDROFRACTURE

FRACTURE-NOVEMBER 18, 1975

TIME	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°
14:15	2.0104	2.3140	2.1552	2.4898	2.9384	3.1327	3.2370	2.8590	2.6074	2.3533	2.3673	1.9952
14:20	2.0192	2.3079	2.1339	2.4587	2.9172	3.1288	3.2282	2.8477	2.5659	2.4190	1.9758	1.9610
14:25	1.9817	2.2865	2.2538	2.4785	2.9290	3.1264	3.2230	2.8416	2.4973	2.3947	2.2850	2.3203
14:30	2.0040	2.3206	2.1776	2.4669	2.9257	3.1364	3.2445	2.8719	2.5452	2.3795	2.2641	2.3125
14:35	1.9853	2.2806	2.1333	2.4512	2.9192	3.1296	3.2331	2.8530	2.5791	2.3085	1.9929	2.2422
14:40 Stop pumping	1.9694	2.2932	2.1530	2.4642	2.9211	3.1274	3.2315	2.8568	2.5382	2.3130	1.7795	2.0588
14:45	1.9848	2.2809	2.1838	2.4606	2.9297	3.1276	3.2339	2.8539	2.5651	2.2938	2.1079	2.1991
14:50 Total Volume - 37,000 gal.	1.9736	2.3055	2.1829	2.4557	2.9069	3.1156	3.2214	2.8375	2.5750	2.3043	2.2122	1.9020
14:55	1.9623	2.2761	2.1537	2.4556	2.9116	3.1147	3.2173	2.8306	2.5536	2.3275	2.4348	2.3414
15:00	1.9974	2.2771	2.1736	2.4555	2.9117	3.1179	3.2231	2.8424	2.5476	2.4277	2.3341	2.0695
15:05	1.9810	2.2625	2.1613	2.4862	2.9146	3.1199	3.2248	2.8532	2.5611	2.3564	1.9995	1.9043
15:10	1.9758	2.3440	2.1662	2.4496	2.9170	3.1254	3.2258	2.8482	2.5737	2.3804	2.0127	1.9404
15:15	1.9681	2.3233	2.2033	2.4702	2.9188	3.1204	3.2274	2.8488	2.5493	2.3221	1.8174	2.0371
15:20	1.9958	2.2882	2.1403	2.4424	2.9014	3.1174	3.2278	2.8477	2.5719	2.3802	1.8246	1.9676
15:30	1.9772	2.2616	2.1115	2.4432	2.9375	3.1187	3.2242	2.8443	2.5393	2.5143	1.7751	1.7961
15:40	1.9852	2.3084	2.1628	2.4492	2.9183	3.1241	3.2229	2.8471	2.5205	2.3499	1.9645	1.9603
15:44	1.9845	2.3054	2.1832	2.4721	2.9119	3.1242	3.2303	2.8619	2.5652	2.4738	2.3903	1.9340
15:46	1.9889	2.2959	2.1632	2.4663	2.9078	3.1217	3.2279	2.8493	2.5675	2.3320	2.1057	1.8650
15:48	1.9878	2.2962	2.1423	2.4581	2.9086	3.1190	3.2261	2.8517	2.5694	2.4666	2.2248	2.0063
15:51	1.9667	2.2952	2.1728	2.4666	2.9198	3.1298	3.2287	2.8581	2.5517	2.2434	2.5270	2.0605
16:15	2.0057	2.2984	2.1724	2.4865	2.9268	3.1304	3.2273	2.8391	2.5369	2.5046	2.2723	1.7757
15:56	1.9602	2.2984	2.1314	2.4760	2.9163	3.1175	3.2216	2.8360	2.5348	2.5540	1.9205	2.1305
15:58	1.9702	2.2841	2.1595	2.4582	2.9079	3.1202	3.2224	2.8443	2.5590	2.3356	1.6403	2.0031
16:00	1.9965	2.3029	2.1673	2.4572	2.9115	3.1206	3.2254	2.8511	2.5501	2.4021	2.2261	1.9875
16:05	1.9442	2.3112	2.1574	2.4732	2.9084	3.1241	3.2247	2.8455	2.5456	2.4589	1.9599	2.1271
16:08	2.0011	2.3116	2.1488	2.4489	2.9095	3.1228	3.2251	2.8432	2.5782	2.3451	2.1660	2.1943
16:10	1.9844	2.2809	2.1950	2.4650	2.9167	3.1250	3.2320	2.8589	2.5681	2.2521	2.2083	1.9908
16:12	1.9840	2.2924	2.1477	2.4587	2.9115	3.1280	3.2295	2.8558	2.5588	2.4037	2.4649	2.1303
16:15	1.9885	2.2848	2.1542	2.4656	2.9179	3.1172	3.2206	2.8412	2.5682	2.3874	2.1070	2.0110
16:20	1.9745	2.3019	2.1771	2.4757	2.9119	3.1233	3.2299	2.8536	2.5660	2.3786	1.9355	1.9674
16:22	1.9549	2.3044	2.1438	2.4837	2.9186	3.1274	3.2298	2.8488	2.5536	2.4216	2.3562	2.0712
16:24	2.0095	2.3189	2.1635	2.4886	2.9214	3.1262	3.2280	2.8524	2.5751	2.3927	2.1218	2.0547
16:27	2.0112	2.3071	2.1536	2.4753	2.9164	3.1246	3.2274	2.8521	2.5571	2.3465	2.4827	2.0300
16:29	1.9871	2.2837	2.1736	2.4697	2.9241	3.1258	3.2266	2.8439	2.5519	2.4309	2.1755	2.0336
16:32	1.9801	2.3251	2.1877	2.4523	2.9150	3.1202	3.2221	2.8378	2.5620	2.3590	1.6993	2.0293
16:34	1.9809	2.2882	2.1742	2.4503	2.9146	3.1245	3.2276	2.8550	2.5333	2.3313	2.1348	2.1524
16:36	1.9836	2.2900	2.1678	2.4486	2.9093	3.1216	3.2278	2.8462	2.5883	2.2007	1.9816	2.0441
16:37	1.9765	2.2937	2.1586	2.5028	2.9218	3.1297	3.2302	2.8527	2.5404	2.4761	2.1275	1.9083
16:40	1.9659	2.2850	2.1759	2.4497	2.9168	3.1230	3.2265	2.8667	2.5784	2.5771	2.0893	2.0918

TABLE II (continued)

WATTENBERG - MARTIN HART HYDROFRACTURE

FRACTURE-NOVEMBER 18, 1975

TIME	180°	195°	210°	225°	240°	255°	270°	285°	300°	315°	330°	345°
5:31	1.7762	1.9056	2.0622	1.8420	2.0956	2.0900	1.9698	2.0038	1.9066	1.8932	1.9406	1.9794
5:35	2.2168	2.1414	2.0589	1.8331	2.0786	2.0812	1.9703	2.0054	1.9171	1.8775	1.9489	1.9833
5:40	2.1011	2.2358	1.9282	1.8461	2.1065	2.0953	1.9725	2.0045	1.9178	1.8736	1.9457	1.9854
5:45	2.1824	2.1768	2.0025	1.8059	2.0822	2.0833	1.9688	2.0045	1.9121	1.8648	1.9456	1.9757
5:50	1.9585	1.8774	1.9019	1.8347	2.0895	2.0377	1.9096	2.0044	1.9115	1.8570	1.9416	1.9646
5:55	1.9049	2.0355	2.0380	1.8576	2.0756	2.0859	1.9074	2.0038	1.9217	1.8859	1.9396	1.9623
6:00	1.9732	1.9009	2.0520	1.8652	2.0837	2.0396	1.9098	2.0065	1.9132	1.9075	1.9438	1.9704
6:05	2.0225	1.9257	1.9625	1.8233	2.0858	2.0827	1.9075	2.0049	1.9100	1.8633	1.9455	1.9795
6:10	1.9384	2.1101	1.9377	1.8845	2.0571	2.0783	1.9698	2.0030	1.9233	1.8782	1.9467	1.9893
6:15	2.0006	2.1137	2.0730	1.8599	2.0716	2.0884	1.9684	2.0044	1.9148	1.8651	1.9385	1.9647
6:20	2.1760	2.1399	2.0055	1.8620	2.1320	2.0900	1.9702	2.0063	1.9055	1.8548	1.9447	1.9776
6:25	2.0134	1.9438	2.0405	1.8319	2.1065	2.1514	2.0311	2.0703	1.9804	1.9351	1.9971	2.0161
6:30	2.3471	2.1941	1.9659	1.7695	2.1277	2.1528	2.0413	2.0801	1.9926	1.9415	2.0108	2.0407
6:35	2.1523	2.0720	2.0757	1.7853	2.1333	2.1416	2.0215	2.0605	1.9635	1.9404	1.9964	2.0363
6:40	1.9502	1.9329	2.0035	1.8432	2.1055	2.1242	2.0154	2.0548	1.9613	1.9176	1.9376	2.0200
6:45	2.3166	2.2358	2.0430	1.8179	2.0798	2.0942	1.9714	1.9919	1.9221	1.8985	1.9509	1.9576
6:50	2.0619	2.0447	2.1276	1.8112	2.0737	2.0805	1.9657	2.0045	1.9485	1.8910	1.9453	1.9851
6:55	2.1506	2.1023	2.0039	1.8281	2.0364	2.0853	1.9756	1.9985	1.9165	1.8926	1.9458	1.9773
7:00	2.1976	2.0932	2.0103	1.7818	2.0738	2.0824	1.9079	2.0045	1.9338	1.8556	1.9347	1.9536
7:10	1.9496	2.1104	2.0023	1.7945	2.0815	2.0860	1.9714	1.9902	1.9041	1.8795	1.9465	1.9992
7:15	2.0200	2.0702	2.0415	1.7796	2.0737	2.0903	1.9085	2.0092	1.9274	1.9159	1.9641	2.0199
7:20	2.0315	1.9540	1.9688	1.7997	2.0753	2.0805	1.9687	1.9920	1.9098	1.8858	1.9452	1.9863
7:25	2.2344	2.0994	2.0050	1.7657	2.0820	2.0949	1.9721	2.0007	1.9303	1.8460	1.9379	1.9911
7:30	2.1060	1.9757	1.9904	1.7678	2.0651	2.0875	1.9677	1.9932	1.9089	1.8604	1.9481	1.9930
7:35	2.0620	2.0315	2.0373	1.7990	2.0734	2.0773	1.9671	1.9985	1.9065	1.8579	1.9481	1.9774
7:45	1.9735	2.0356	2.0143	1.8007	2.0773	2.0946	1.9758	2.0049	1.9252	1.8892	1.9489	1.9656
7:50	1.7808	2.0081	2.0240	1.9161	2.0760	2.0924	1.9737	1.9933	1.8976	1.8722	1.9410	1.9754
7:55	2.0430	2.0235	1.9535	1.7918	2.0737	2.0870	1.9622	2.0024	1.9493	1.8736	1.9383	1.9720
8:00	2.0120	2.1178	1.9530	1.7965	2.0755	2.0991	1.9772	1.9390	1.8785	1.8689	1.9324	1.9846
8:05	1.8542	1.9392	1.9055	1.8115	2.0540	2.0751	1.9611	2.0177	1.9112	1.8515	1.9188	1.9534
8:10	1.8960	2.0143	1.9020	1.8085	2.0405	2.0598	1.9444	1.9619	1.8920	1.8787	1.9290	1.9629
8:15	1.8075	2.0456	1.9371	1.7535	2.0551	2.0755	1.9632	2.0038	1.9168	1.8621	1.9377	1.9717
8:20	2.1304	2.0954	1.9482	1.7795	2.0655	2.0823	1.9498	1.9902	1.8957	1.8525	1.9217	1.9630
8:30	2.0024	2.0742	2.0034	1.8200	2.0853	2.0947	1.9725	1.9201	1.8425	1.8009	1.9463	1.9831
8:40	2.1303	2.1352	2.0313	1.8207	2.0898	2.0948	1.9779	1.9383	1.8652	1.8819	1.9375	1.9741
8:45	2.2002	2.0349	2.0313	1.7892	2.0737	2.0907	1.9733	1.9365	1.8743	1.9116	1.9452	1.9813
8:50	2.0355	1.9039	1.9337	1.7153	2.0754	2.0395	1.9869	2.0119	1.8997	1.9056	1.9570	1.9933
8:55	2.0749	2.0386	2.0364	1.8387	2.0828	2.0814	1.9599	2.0569	1.9317	1.9287	1.9515	1.9836
9:00	2.0837	2.0061	1.9052	1.7966	2.0827	2.1055	1.9818	2.0530	1.8911	1.8768	1.9000	2.0003
9:05	2.1255	2.1255	2.0773	1.8554	2.0622	2.0951	1.9810	2.0052	1.8821	1.8521	1.9484	1.9893
9:10	2.2399	2.1038	2.0143	1.8599	2.1034	2.1065	1.9825	1.9774	1.8719	1.8833	1.9498	1.9872
9:15	2.1394	2.1582	1.9732	1.7714	2.0770	2.0905	1.9727	2.0168	1.8805	1.8619	1.9503	1.9804
9:20	2.0916	2.0348	1.9429	1.8297	2.0892	2.1089	1.9873	2.0009	1.8896	1.8466	1.9379	1.9782

Start pumping

54,600 gal.

TABLE II (continued)

WATTENBERG - MARTIN HART HYDROFRACTURE

FRACTURE-NOVEMBER 18, 1975

TIME		180°	195°	210°	225°	240°	255°	270°	285°	300°	315°	330°	345°
9:25		1.7840	2.1654	1.9788	1.8245	2.0913	2.1012	1.9855	2.0351	1.9012	1.9010	1.9494	1.9940
9:30		1.8931	2.1273	2.2130	1.9797	2.0914	2.1651	1.9853	2.0141	1.9316	1.8669	1.9522	1.9879
9:40		2.0272	2.3999	1.9739	1.6978	2.0829	2.1030	1.9823	1.9977	1.8336	1.8673	1.9492	1.9892
9:45		1.8708	2.0830	2.0741	1.8775	2.0893	2.1633	1.9784	1.9985	1.8710	1.8539	1.9476	1.9834
9:50		1.7677	1.7826	2.3785	1.8107	2.0801	2.0926	1.9826	2.0470	1.9035	1.9122	1.9553	1.9810
9:55	96,600 gal.	2.1993	2.3555	2.0850	1.9053	2.0907	2.1688	1.9863	2.0380	1.8952	1.8863	1.9560	1.9899
10:00		2.0697	1.8652	1.8729	1.7002	2.0875	2.0887	1.9766	2.0305	1.8998	1.8821	1.9477	1.9935
10:05		2.1843	1.8487	1.9871	1.7261	2.1096	2.0962	1.9803	2.0290	1.8895	1.8593	1.9503	1.9778
10:15		2.0302	2.3014	2.0354	1.8331	2.0907	2.1008	1.9752	1.9914	1.8688	1.8746	1.9479	1.9978
10:20		1.8818	2.0842	2.0402	1.8667	2.1132	2.0993	1.9864	1.9923	1.8701	1.8992	1.9526	1.9910
10:25		2.0541	2.0537	2.1237	1.8935	2.0957	2.1355	1.9800	2.0314	1.8873	1.8788	1.9546	1.9925
10:30		1.6540	2.0125	.7353	1.9338	2.0796	2.0892	1.9804	2.0021	1.8682	1.8710	1.9513	1.9833
10:35		1.7885	2.1002	2.0584	1.7844	2.0858	2.1021	1.9815	2.0233	1.8869	1.9619	1.9483	1.9873
10:40		1.5373	2.0263	2.0480	1.8043	2.0896	2.0934	1.9819	2.0263	1.8939	1.8830	1.9513	1.9840
10:45		1.8997	1.9715	2.0824	1.8466	2.0970	2.0948	1.9853	1.9392	1.8415	1.8425	1.9475	1.9857
10:50		1.8280	2.1822	2.0896	1.8733	2.0786	2.0947	1.9762	2.0117	1.8713	1.8761	1.9463	1.9829
10:55		1.8517	2.1703	2.0641	1.9046	2.0759	2.0803	1.9578	2.0077	1.8701	1.8654	1.9312	1.9689
11:00	153,300 gal.	1.6595	1.8380	1.8439	1.7477	2.0577	2.0392	1.9743	2.0510	1.9007	1.8949	1.9554	1.9943
11:05		1.8623	1.7402	2.1530	1.8739	2.0923	2.1157	1.9877	2.1039	1.9423	1.8795	1.9564	1.9868
11:10		1.7043	1.2452	2.0404	1.7288	2.0758	2.1020	1.9757	2.0007	1.9053	1.8751	1.9412	1.9759
11:15		1.6956	2.3885	2.0418	1.7739	2.0888	2.1053	1.9849	2.0373	1.8913	1.8704	1.9489	1.9865
11:20		2.6593	2.3136	2.0034	1.5994	2.0830	2.0713	2.0669	1.9888	1.8716	1.8483	1.9451	1.9881
11:25		2.0052	1.9448	2.0639	1.8090	2.0809	2.0845	1.9931	2.0443	1.8955	1.8762	1.9483	1.9820
12:00		2.2812	2.2601	2.2394	1.7459	2.0854	2.0685	1.9959	2.0334	1.8390	1.8646	1.9554	1.9898
12:05	200,000 gal.	2.2534	2.1205	2.1398	1.7571	2.0915	2.0795	1.9605	2.0383	1.8912	1.8780	1.9518	1.9905
12:10		2.2380	2.3775	2.1888	1.7709	2.0888	2.0782	2.0069	1.9968	1.8754	1.9121	1.9535	1.9933
12:15		2.1432	2.0661	2.0202	1.6891	2.0818	2.0768	2.0047	2.0122	1.8867	1.8793	1.9497	1.9923
12:23		2.1103	2.0496	2.1212	1.7597	2.0937	2.0740	1.9769	1.9685	1.8529	1.8767	1.9525	1.9939
12:30		2.2603	2.1855	2.2128	1.7421	2.0885	2.0742	1.9891	2.0270	1.8780	1.8877	1.9348	1.9818
12:35		2.2308	1.9138	1.9080	1.6897	2.0750	2.0773	1.9950	1.9613	1.8446	1.8827	1.9458	1.9869
12:40		1.9262	1.9342	2.0263	1.7834	2.0975	2.0816	2.0409	1.9761	1.8587	1.8883	1.9528	1.9763
12:45		1.9515	2.1820	2.1232	1.8571	2.0921	2.0703	2.0058	1.9689	1.8631	1.8666	1.9537	1.9922
13:00		2.2077	2.0503	1.8701	1.8395	2.0770	2.0785	1.9987	2.0116	1.8824	1.9130	1.9589	2.0026
13:05	252,000 gal.	2.0001	1.9137	1.9689	1.8565	2.1047	2.0761	2.0477	2.0053	1.8357	1.8799	1.9509	1.9857
13:10		1.9838	2.3307	2.0559	1.7858	2.0858	2.0715	2.0381	2.0148	1.8915	1.8482	1.9489	1.9834
13:18		2.0722	2.0253	2.0538	1.8259	2.0988	2.0571	2.0342	2.0297	1.9061	1.8414	1.9524	1.9915
13:25		2.0777	1.7316	1.9953	1.8298	2.0835	2.0746	2.0370	2.0110	1.8775	1.8828	1.9468	1.9841
13:30		1.9565	2.2902	2.1192	1.8549	2.1102	2.0818	2.0423	1.9374	1.8587	1.8643	1.9554	2.0034
13:38		2.1760	1.7357	2.0753	2.2022	2.0425	2.0340	2.0380	2.0381	2.8727	3.2455	3.1442	2.9326
13:45		2.2042	1.9535	2.0798	1.8555	2.0877	2.0748	2.0345	2.0241	1.8883	1.8826	1.9459	1.9787
13:55		2.1779	2.3345	1.9274	1.8377	2.0825	2.0615	2.0275	1.9977	1.8597	1.8985	1.9492	1.9855
14:05	305,000 gal.	1.7484	1.9964	2.1184	1.7541	2.0612	2.0573	2.0238	1.9967	1.8486	1.8201	1.9342	1.9775
14:10		2.2301	2.1842	1.9647	1.8297	2.0787	2.0641	2.0263	1.9990	1.8758	1.8960	1.9481	1.9910

TABLE II (continued)

WATTENBERG - MARTIN HART HYDROFRACTURE

FRACTURE-NOVEMBER 18, 1975

TIME		180°	195°	210°	225°	240°	255°	270°	285°	300°	315°	330°	345°
14:15		2.0572	2.1228	1.8335	1.8404	2.0793	2.0707	2.0332	2.0330	1.8758	1.9103	1.9453	1.9753
14:20		2.0992	2.2043	2.1058	1.8074	2.0882	2.0644	2.0263	2.0173	1.8902	1.9354	1.9212	1.9554
14:25		1.8423	1.8385	1.9754	1.8257	2.0735	2.0525	2.0191	2.0252	1.8757	1.8414	1.8941	2.0241
14:30		2.1754	2.1958	2.0325	1.8181	2.0873	2.0564	2.0204	2.0036	1.8636	1.8446	1.9259	1.9564
14:35		2.5073	2.4454	1.9458	1.7828	2.0639	2.0520	2.0139	1.9941	1.8511	1.8430	1.9287	1.9697
14:40	Stop pumping	2.1458	2.1322	2.1383	1.8733	2.0551	2.0555	2.0180	1.9658	1.8483	1.9651	1.9313	1.9575
14:45		2.3354	2.1950	2.0511	1.8428	2.0550	2.0384	2.0053	2.0028	1.8687	1.8497	1.9233	1.9397
14:50	Total Volume-317,000 gal.	1.9976	2.2332	1.8366	1.7091	2.0489	2.0334	1.9990	2.0058	1.8745	1.8702	1.9087	1.9387
14:55		2.1250	1.8471	1.9420	1.9277	2.0429	2.0372	1.9933	2.0236	1.8771	1.9296	1.9116	1.9651
15:00		1.9227	1.9044	1.9515	1.7542	2.0435	2.0343	2.0043	1.9249	1.8133	1.8225	1.9172	1.9558
15:05		2.0512	1.8883	1.9670	1.8271	2.0504	2.0396	2.0013	1.9865	1.8435	1.8231	1.9174	1.9501
15:10		2.0895	2.2504	2.0454	1.8616	2.0609	2.0413	2.0065	1.9879	1.8451	1.8348	1.9104	1.9417
15:15		2.1394	2.0025	2.0213	1.8445	2.0597	2.0313	1.9355	1.9348	1.8627	1.8212	1.9144	1.9475
15:20		1.5780	2.0657	1.9535	1.8057	2.0553	2.0337	2.0001	1.9703	1.8491	1.8434	1.9211	1.9673
15:38		1.6940	1.9354	1.9350	1.8252	2.0499	2.0370	1.9988	2.0249	1.8861	1.8849	1.9244	1.9760
15:40		1.9933	2.0356	1.8889	1.7045	2.0514	2.0399	1.9984	1.9733	1.8352	1.8381	1.9117	1.9439
15:44		1.9410	1.9334	1.9418	1.8544	2.0598	2.0395	2.0008	1.9727	1.8508	1.8283	1.9111	1.9442
15:46		2.0579	2.0395	1.9715	1.8539	2.0564	2.0435	2.0013	2.0143	1.8693	1.8284	1.9152	1.9600
15:48		1.8541	1.8334	2.0481	1.8416	2.0509	2.0305	2.0013	1.9979	1.8585	1.8633	1.9188	1.9614
15:51		1.8743	1.7520	2.1183	1.8488	2.0572	2.0442	2.0074	1.9417	1.8250	1.8341	1.9132	1.9346
16:15		2.0641	1.9343	1.9451	1.7575	2.0513	2.0304	2.0053	1.9750	1.8402	1.8511	1.9231	1.9675
15:56		2.0323	1.9839	1.9732	1.8428	2.0478	2.0302	1.9991	1.9827	1.8656	1.8236	1.9092	1.9445
15:58		2.3310	2.3372	1.9673	1.8831	2.0622	2.0349	1.9992	2.0175	1.8723	1.8440	1.9176	1.9577
16:00		2.0372	1.9741	1.8939	1.8083	2.0600	2.0466	2.0033	1.9982	1.8656	1.8783	1.9228	1.9531
16:05		2.0597	2.0924	1.9310	1.8513	2.0495	2.0309	2.0055	1.9698	1.8509	1.8484	1.9355	1.9402
16:08		2.2581	2.1256	2.0303	1.8255	2.0556	2.0342	1.9990	2.0174	1.8820	1.8591	1.9149	1.9673
16:10		1.9370	1.9812	1.9379	1.7912	2.0570	2.0306	1.9995	2.0137	1.8677	1.8360	1.9173	1.9547
16:12		2.0500	1.9175	2.0570	1.9196	2.0554	2.0446	2.0029	1.9791	1.8557	1.8460	1.9205	1.9565
16:15		2.0407	2.0125	1.8382	1.7357	2.0511	2.0447	2.0062	1.9623	1.8355	1.8252	1.9129	1.9594
16:20		2.1199	2.0937	2.0000	1.8456	2.0583	2.0352	2.0079	1.8334	1.7873	1.8433	1.9113	1.9580
16:22		2.0579	1.8021	2.1505	1.9446	2.0526	2.0331	1.9996	2.0060	1.8431	1.8262	1.9138	1.9354
16:24		1.9507	2.0074	1.9434	1.8600	2.0651	2.0413	2.0047	1.9605	1.8395	1.8618	1.9149	1.9686
16:27		1.8720	1.7953	1.9631	1.7503	2.0567	2.0355	2.0085	1.9150	1.8105	1.8556	1.9192	1.9581
16:29		1.9656	1.8170	2.0692	1.7923	2.0569	2.0325	1.9973	2.0013	1.8722	1.8287	1.9129	1.9519
16:32		2.1229	2.3153	2.0243	1.8646	2.0517	2.0355	2.0092	1.9639	1.8343	1.8753	1.9149	1.9401
16:34		2.4261	2.1587	2.1153	1.9197	2.0501	2.0399	2.0017	1.9742	1.8358	1.8409	1.9246	1.9593
16:36		2.0000	2.1945	2.0704	1.7554	2.0545	2.0339	2.0048	1.9766	1.8425	1.7909	1.9163	1.9629
16:37		2.1344	2.0559	1.9406	1.7853	2.0519	2.0327	1.9987	1.9886	1.8512	1.8509	1.9099	1.9561
16:40		2.2246	2.1084	2.0431	1.9200	2.0475	2.0395	2.0003	2.0145	1.8527	1.8539	1.9150	1.9499

APPENDIX B

TABLE I

MATTENBERG - SALAZAR HYDROFRACTURE

FRACTURE-DECEMBER 16, 1975

TIME		15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	
7:15		.1735	-.0025	.0939	-.0059	-.0174	-.0722	-.1083	-.1451	-.2140	.0706	-.0419	-.3528
7:21		.1065	-.0021	-.0035	-.1239	-.0686	-.1034	-.1166	-.1261	-.1154	.0298	-.0052	.0153
7:23		.1602	.0024	-.0254	-.1002	-.3717	-.3258	-.2934	-.1605	-.0525	.0381	.1312	.1593
7:25		.0814	-.0025	-.1301	-.1130	-.1326	-.1536	-.1563	-.1465	-.1558	.1751	.0059	.0100
7:40		.0103	.0035	-.1574	-.2001	-.2481	-.2471	-.1933	-.1470	-.1163	.1137	.0788	.0918
8:44		-.0105	-.0095	-.3380	-.1996	-.1673	-.1659	-.1566	-.1224	-.0406	.3114	.0275	.0728
8:46		-.0489	.0023	.0094	-.2171	-.1718	-.1542	-.1388	-.0973	-.0547	.0146	.0500	.1051
9:00		.4080	.0035	.2080	.0861	-.1817	-.2391	-.2704	-.2980	-.3213	.1512	-.0393	-.0547
9:05		.2744	.0027	.1726	.0447	-.1442	-.1573	-.1519	-.1412	-.1299	.0325	.0045	.0466
9:10		.1384	-.0004	.1329	-.0562	.0901	.0034	-.0702	-.1581	-.2176	.0556	-.0951	-.1273
9:15		.0483	-.0028	-.1808	-.1001	.0463	-.0895	-.1393	-.3029	-.3219	-.2887	-.1785	-.1257
9:23		.2567	-.0018	.0917	.0684	-.0354	-.0790	-.0354	-.0802	-.0642	.0392	-.0081	.0118
9:25		.2533	.0026	.1142	.0448	-.2929	-.2588	-.1916	-.1219	-.0717	.0380	.0812	.1519
9:30	Start pumping	-.5780	.0018	-.5758	-.6094	-.3793	-.2936	-.1960	-.0704	-.0458	.4127	.1905	.1679
9:35		.3794	.0019	.4174	.1180	-.0853	-.1308	-.1544	-.1681	-.1409	-.0112	-.0290	.0015
9:40		.0155	-.0027	-.0099	-.1989	-.1149	-.1350	-.1441	-.1558	-.1275	-.0080	-.0418	.0014
9:45		.6127	-.0028	.4173	.3224	-.3362	-.3392	-.3195	-.2765	-.2514	.0206	-.0022	.0452
9:50		.0972	-.0005	.1093	-.1308	.0324	-.0284	-.0379	-.0523	-.0076	.2097	.0978	.1173
9:55		.1051	.0023	.0049	-.0688	-.1624	-.1981	-.1968	-.2400	-.2626	.2516	-.0151	-.0279
10:00	61,000 gal.	.0190	-.0033	-.1154	-.1270	-.1489	-.1405	-.1302	-.1167	-.1167	.0082	-.0428	.0958
10:05		.1336	.0005	-.0367	-.0731	-.1704	-.1896	-.1965	-.1910	-.1435	.0229	-.0271	-.0042
10:10		.0338	-.0020	-.1390	-.1860	-.1746	-.1998	-.1985	-.1894	-.1853	.1165	-.0698	.0131
10:15		.1390	-.0008	.0543	-.0218	-.2107	-.1979	-.1780	-.1469	-.1504	.0714	.0193	.0327
10:20		.0541	-.0023	-.0609	-.1210	-.3299	-.3253	-.2824	-.2273	-.3140	.0072	.0239	.0859
10:25		.1102	.0051	-.1528	-.1150	-.1444	-.2232	-.2400	-.2362	-.1432	.1203	-.1676	.2089
10:30		.0037	.0008	-.0669	-.1345	-.2150	-.2192	-.2031	-.1832	-.0559	-.0343	.1084	.0324
10:35		-.0020	-.0013	-.0572	-.1640	-.0745	-.1672	-.1392	-.2182	-.1720	-.0794	-.0749	-.0389
10:40		.0080	-.0016	-.1257	-.1714	-.1759	-.2146	-.2263	-.2287	-.1539	-.0808	-.0191	.0208
10:45		.0858	-.0001	-.1149	-.1526	-.2477	-.2452	-.2304	-.2101	-.3051	.1205	.0244	.0167
10:50		.0250	.0050	-.2003	-.2192	-.1931	-.2183	-.2203	-.2105	-.1733	.0602	-.0657	.0412
10:55		.0280	.0000	-.0317	-.1019	-.1816	-.1383	-.1841	-.1779	-.1558	-.0638	-.0455	.0188
11:00	116,000 gal.	.0671	-.0013	.0331	-.1129	-.2077	-.2270	-.2170	-.2186	-.1995	.0824	-.0414	-.0193
11:05		.0399	-.0043	-.0132	-.0988	-.2915	-.2255	-.2206	-.2131	-.4236	.0213	-.0317	.0026
11:10		.0402	.0013	-.0449	-.1005	-.1999	-.2037	-.2213	-.2388	-.2000	.1244	-.0842	-.0750
11:15		-.0046	-.0005	-.0388	-.1602	-.2137	-.2350	-.2207	-.2026	-.1805	.0548	.3427	.0133
11:20		.1400	.0007	.0959	-.0905	-.1840	-.2084	-.1992	-.1655	-.1570	.0858	-.0392	-.0348
11:25		.0521	-.0017	-.1139	-.1832	-.2110	-.2325	-.2403	-.2423	-.2341	.0020	-.0366	-.0487
11:30		.0580	.0053	-.1228	-.1708	-.1892	-.1765	-.1715	-.1680	-.1181	-.0242	.0300	.0196
11:55		.2148	.0018	.0533	-.0239	-.2564	-.2524	-.2398	-.2167	-.1573	-.1130	.0185	.0308
12:00	172,000 gal.	.0074	.0000	-.1118	-.1955	-.0558	-.1075	-.1431	-.1858	-.2255	.0077	.0000	-.0741
12:05		-.0952	-.0017	-.2028	-.2306	-.2885	-.2623	-.2442	-.2034	-.1240	-.0219	-.0954	.0574
12:10		.2065	-.0008	.0829	.0045	-.2465	-.2479	-.2309	-.2063	-.1522	-.1187	-.0694	.0354
12:20		.1664	.0056	.0105	-.0628	-.0105	-.0850	-.1134	-.1453	-.1847	.0586	.0390	.0750
12:30		-.0897	-.0009	-.1981	-.2582	-.2218	-.1807	-.1925	-.1576	-.1935	-.0180	.1424	.0298
12:35		-.0494	-.0023	-.2231	-.2151	-.0670	-.1316	-.1699	-.2080	-.2330	.0811	.0043	-.1154

TABLE I (continued)

WATTENBERG - SALAZAR HYDROFRACTURE												
FRACTURE-DECEMBER 16, 1975												
TIME	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°
12:45	-.0561	.0010	-.0911	-.0865	.0253	-.1314	-.2509	-.4636	-.4326	-.3266	.0024	-.2131
12:50	-.2540	-.0016	-.4667	-.4161	-.0882	-.1591	-.1886	-.2367	-.3118	.2701	.0017	-.1466
12:55	.0617	.0025	-.1328	-.1902	-.0927	-.1515	-.1589	-.1723	-.1567	-.0263	.0008	-.0193
13:00	.0434	.0031	-.1245	-.1760	-.1535	-.1924	-.2132	-.2313	-.2622	.0379	-.0058	-.0347
13:05	.3976	-.0017	.1800	.0549	-.3694	-.3332	-.2939	-.2783	-.2514	.0842	.0017	-.0747
13:10	.1276	.0044	.0259	-.0617	-.1277	-.1879	-.2392	-.2889	-.3383	.0357	-.0634	-.1272
13:15	.0369	-.0010	-.0629	-.1449	-.1896	-.1875	-.1650	-.1320	-.0579	-.2592	.0010	.1731
13:20	.1559	-.0037	-.0539	-.0925	-.1431	-.1687	-.2193	-.2565	-.2545	-.0777	-.0510	-.0723
13:25	.2726	.0554	.1559	.0277	-.1466	-.1665	-.1876	-.2039	-.2071	-.0278	-.0153	-.0235
13:30	.2239	.0074	.0699	-.0342	-.3673	-.2347	-.1891	-.1320	-.0717	.1215	.0783	.0683
13:35	.1403	.0024	.0155	-.0480	-.2364	-.2393	-.2208	-.1945	-.1185	-.1684	-.0332	.0433
13:40	-.1703	.0023	-.3058	-.3298	-.1292	-.1289	-.1317	-.1296	-.2019	.1654	.0169	-.0365
13:45	.0769	.0084	-.0189	.0005	-.1549	-.1632	-.1602	-.1527	-.2622	.0967	-.0100	-.0068
13:50	-.4000	0.0000	-.0371	-.0666	-.3211	-.3831	-.3394	-.2967	-.2244	.0334	.0553	.0800
14:00	.5422	-.0002	.2841	.2248	-.1804	-.1669	-.1361	-.0916	-.0110	.0588	.0420	.1521
14:05	.0669	-.0004	-.1147	-.1743	-.2265	-.2375	-.2267	-.1975	-.1971	.0662	-.0320	-.0426
14:10	.3536	.0015	.1195	.0175	-.3433	-.2595	-.1758	-.0624	-.1431	.4251	.0966	.1311
14:15	.0314	.0011	-.1763	-.1956	-.1911	-.1916	-.1674	-.1192	-.0335	-.0325	.0011	.0718
14:20	.3105	-.0011	.1017	-.0621	.1270	.0056	-.8746	-.1737	-.2574	.1995	-.1291	-.1662
14:25	.0555	.0004	-.0412	-.0437	-.2509	-.2358	-.2493	-.2513	-.2426	.1548	-.0490	-.0763
14:30	.1352	.0005	.0327	-.0486	-.2524	-.3179	-.3627	-.3874	-.3484	-.1611	-.1622	-.0463
14:35	.2172	-.0007	.0488	-.0198	-.2175	-.2318	-.2104	-.1963	-.1396	.1306	-.1568	-.0175
14:40	.1549	-.0013	.0170	-.0542	-.1507	-.1325	-.2159	-.2440	-.1468	-.0073	-.2080	-.0937
14:45	-.0448	.0034	-.2311	-.2155	-.0447	-.1187	-.1975	-.1874	-.0654	.2236	.0405	.1415
14:50	.0404	-.0001	-.1458	-.1402	-.1724	-.1835	-.2030	-.1939	-.1441	.1159	-.2192	.0432
14:55	.0506	.0005	-.1091	-.0684	-.1391	-.1708	-.1963	-.1991	-.2309	-.0739	-.0409	.0020
15:00	.0636	.0005	-.1137	-.0389	-.1253	-.1469	-.1536	-.1626	-.1285	-.0845	.1262	.1474
15:05	.2522	.0004	.0905	.0231	-.0376	-.0845	-.1172	-.1456	-.1644	-.0512	-.1015	-.0367
15:10	.2307	.1849	.0533	.0582	-.0591	-.1295	-.0712	-.0381	-.0240	-.0932	.1591	.0008
15:15	.1929	.0963	.0405	-.0072	-.0730	-.1681	-.0792	-.0797	-.1141	.1125	-.1034	.1466
15:20	.1907	.0516	.0345	-.0416	-.0785	-.0925	-.0817	-.0608	.0636	-.2676	.0011	.0623
15:25	.1298	.0555	.0576	-.0567	-.0260	-.0667	-.0972	-.0932	-.0595	.0573	-.0637	-.0197
15:30	.1224	.0779	.0979	-.0677	-.1130	-.1455	-.1341	-.1333	-.2033	.1771	.0496	-.0438
15:35	.1353	-.0739	-.0643	-.1925	-.2265	-.1781	-.1316	-.0516	-.0992	.2619	.1169	-.0204
15:40	.1566	.0159	.0414	.0653	-.0154	-.0811	-.0957	-.1390	-.1345	-.0935	-.0729	.0306
15:45	.1136	-.0125	-.0730	-.0892	-.2434	-.2633	-.2363	-.1775	-.1376	-.0550	-.0912	-.1255
15:50	.0871	.0696	.0402	-.0386	-.1451	-.1866	-.1508	-.1301	-.0996	.0303	.0141	.0271
15:55	.1396	.0170	.0170	-.0629	-.0915	-.0898	-.1413	-.1063	-.0901	-.0117	.0219	-.0156
16:00	.2015	.1115	.0510	.0159	-.0693	-.0877	-.0994	-.0910	-.0876	.0581	-.0694	.1287
16:05	.1753	.0140	.0478	.0243	-.0779	-.0946	-.1185	-.1340	-.1256	.1538	.0194	.0149
16:10	.0902	.0113	-.0546	-.0935	-.0892	-.1078	-.1139	-.1169	-.1260	.0802	-.0217	-.0854
16:15	.1519	.0820	.0089	-.0845	-.0926	-.0975	-.0553	-.0628	-.0426	.1390	.0523	-.0239
16:20	.1185	.0047	.0040	-.0516	-.0526	-.0663	-.0739	-.0695	-.2672	.2309	-.0495	-.0137
16:30	.2376	.2128	.1784	.0604	-.0834	-.1015	-.1137	-.0975	-.1939	.1379	.0860	.5696
16:33	.1628	.0835	-.0356	-.1153	-.0343	-.0191	.0043	.0460	.1179	.0969	.0451	-.0677

TABLE I (continued)

HATTENBERG - SALAZAR HYDROFRACTURE

FRACTURE-DECEMBER 16, 1975

TIME	180°	195°	210°	225°	240°	255°	270°	285°	300°	315°	330°	345°
7:15	-.0879	.0028	.1217	.2365	.6660	.7510	.7744	.7730	.5675	.4855	.2501	.3047
7:21	-.0933	.1110	.1746	.2655	.6972	.7709	.7990	.7998	.5565	.4829	.2442	.2260
7:23	.3115	.2472	.3668	.5238	.6604	.7587	.7963	.7961	.5770	.5178	.2478	.2650
7:25	.0010	.1071	.2078	.3133	.7558	.8272	.8359	.8096	.5736	.4636	.2599	.1951
7:40	.1376	.2021	.2930	.4400	.8566	.8621	.8512	.8122	.5496	.4443	.1800	.1255
8:44	.1804	.1795	.2363	.3401	.6777	.7584	.7395	.7076	.4711	.3890	.1278	.0773
8:46	.2394	.3869	.2633	.3600	.6726	.7513	.7518	.6958	.4554	.3583	.1734	.1172
9:00	-.1293	.0003	.2453	.3646	.6052	.7404	.8445	.8655	.6959	.6667	.3840	.5269
9:05	.1127	.1483	.2329	.3536	.5749	.7207	.7732	.7918	.6130	.5681	.3343	.4022
9:10	-.1905	-.0448	.0954	.1496	.6567	.7772	.8093	.7827	.5688	.4957	.2525	.2833
9:15	.1430	.3387	.0587	.1470	.6582	.7391	.7433	.7170	.4888	.4040	.1756	.1363
9:23	.0084	.3998	.1323	.3099	.5234	.6765	.7455	.7586	.5702	.5581	.3248	.3758
9:25	.2748	.2691	.3462	.4628	.5734	.7344	.7336	.8179	.6253	.6015	.3141	.3717
9:30	-.0598	.2525	.4115	.5678	1.1201	1.0343	.8590	.6780	.3050	-.0061	-.1795	-.4245
9:35	.0977	.1256	.1833	.3000	.4867	.6705	.7465	.7876	.6321	.5933	.4144	.5427
9:40	.0461	.1147	.1553	.2526	.6677	.7614	.7657	.7490	.5091	.4241	.1914	.1847
9:45	.1247	.1645	.2547	.3853	.2370	.4950	.6749	.7541	.6788	.7437	.4875	.7033
9:50	.1094	.1720	.2244	.2679	.5589	.6337	.7348	.6869	.4973	.4225	.2423	.2514
9:55	-.0439	.0559	.1903	.3092	.5819	.7286	.7776	.7876	.5921	.5231	.2640	.3078
10:00	.0895	.1233	.1782	.2642	.5250	.6370	.6565	.6135	.4268	.3372	.1427	.1102
10:05	.0253	.0916	.1714	.2732	.5786	.6949	.7224	.7227	.5222	.4565	.2142	.2371
10:10	.0531	.1272	.1982	.3096	.6296	.7358	.7318	.7166	.4943	.3956	.1608	.1300
10:15	.0401	.1247	.2110	.3162	.4911	.6293	.6693	.6679	.4859	.4352	.2274	.2525
10:20	.1897	.2139	.2778	.3873	.6122	.6942	.7084	.6350	.4820	.3930	.1725	.1663
10:25	.0105	.0640	.1734	.2755	.5732	.6923	.7110	.7195	.5296	.4351	.1758	.1627
10:30	.1445	.1739	.2075	.2954	.5470	.6911	.7403	.7094	.4975	.4355	.2002	.1777
10:35	.0689	.0745	.1260	.2204	.5903	.6925	.6936	.6784	.4470	.3640	.1662	.1531
10:40	-.0492	.0657	.1589	.2048	.6020	.7094	.7075	.6912	.4515	.3634	.1436	.1323
10:45	-.0008	.0937	.2119	.3294	.6644	.7146	.7466	.7247	.5176	.4019	.1770	.1751
10:50	.1149	.1245	.1866	.1423	.6013	.7841	.7354	.7654	.5345	.4411	.1778	.1235
10:55	.1225	.1440	.1777	.2653	.5796	.6898	.7139	.7047	.4742	.4090	.2098	.1729
11:00	-.0273	.0750	.1734	.2876	.5974	.7292	.6761	.6915	.4890	.4028	.2042	.2070
11:05	.0467	.1022	.1912	.3413	.6316	.6945	.7018	.6808	.4890	.3954	.1916	.1714
11:10	-.1652	.0004	.1414	.2564	.5827	.6875	.6823	.6878	.4081	.3612	.1550	.1522
11:15	.0640	.1157	.1934	.3024	.6033	.7099	.6848	.6589	.4328	.3428	.1367	.1063
11:20	-.0200	.0716	.1835	.2970	.5283	.6595	.7217	.7173	.5412	.4731	.2722	.2920
11:25	0.0000	.0855	.1517	.2704	.6095	.7195	.7280	.7025	.4695	.4091	.1710	.1637
11:30	.0822	.1311	.1652	.2705	.5859	.6981	.7168	.6008	.5013	.4203	.1825	.1485
11:55	.2102	.1585	.2512	.2990	.5235	.6819	.7249	.7366	.5541	.5115	.2676	.3214
12:00	-.0841	.0033	.0918	.1855	.6341	.7218	.6519	.7111	.5021	.3910	.1753	.1264
12:05	.2101	.1770	.2393	.3438	.6095	.6983	.6608	.6111	.3990	.2724	.0722	.0007
12:10	.1223	.1963	.2157	.3143	.4815	.6177	.6417	.7019	.5240	.4823	.2665	.3142
12:20	-.1002	-.0151	.0925	.1743	.5357	.6640	.7494	.7270	.5337	.4817	.2314	.2633
12:30	.1268	.1336	.1824	.2655	.6597	.7214	.6288	.6507	.4046	.2889	.3818	.0047
12:35	-.1521	-.0250	.0971	.2689	.7374	.7369	.6909	.6778	.4425	.3247	.1003	.0444

TABLE I (continued)

WATTENBERG - SALAZAR - HYDROFRACTURE

FRACTURE-DECEMBER 16, 1975

TIME		180°	195°	210°	225°	240°	255°	270°	285°	300°	315°	330°	345°
12:45		.0258	-.0207	-.0277	.0535	.5496	.5835	.6044	.5151	.3254	.2203	.0710	.5207
12:50		-.3955	-.0994	.1009	.2843	.8920	.8867	.7535	.7113	.4144	.2309	.0095	-.1329
12:55		.0247	.0737	.1503	.2437	.7240	.7317	.8100	.7298	.5171	.4130	.1892	.1752
13:00	231,000 gal.	.0095	.0556	.1417	.2548	.6874	.7550	.7656	.7294	.5180	.4186	.1865	.1663
13:05		.0074	.1159	.2523	.3575	.4981	.6160	.7440	.7255	.5720	.5620	.3194	.4114
13:10		-.1124	-.1157	.0925	.2090	.4063	.6181	.6387	.6613	.4887	.4311	.2171	.2089
13:15		.2501	.3206	.2311	.2917	.5701	.7095	.7058	.7077	.4959	.4140	.1977	.1634
13:20		.0240	-.0150	.0909	.2532	.5741	.7518	.7760	.7522	.5812	.5655	.2368	.2535
13:25		.0746	.0820	.1402	.2406	.4235	.5915	.6347	.6890	.5316	.5194	.2730	.3602
13:30		.0617	.1496	.2398	.3481	1.6901	.6793	.7259	.7429	.5639	.5317	.2827	.3342
13:35		.1740	.1488	.2035	.3076	.5570	.6587	.6741	.7098	.4989	.4619	.1945	.2212
13:40		-.0795	.0501	.1446	.2693	.7946	.8316	.8365	.7152	.4575	.3653	.3662	-.1360
13:45		-.0109	.0913	.1638	.2441	.6005	.7959	.8294	.8197	.5774	.5634	.2335	.2212
13:50		.0502	.1432	.2820	.3911	1.0798	.9432	.8554	.7140	.3692	.1758	-.3773	-.2628
14:00		.0903	.1453	.2250	.3008	.3641	.5565	.7112	.7816	.6531	.7140	.4473	.6342
14:05	282,000 gal.	.0801	.1202	.2102	.3020	.6013	.8141	.8432	.8159	.5873	.4949	.2222	.1957
14:10		-.0480	.1786	.3436	.4035	.4713	.6575	.7434	.8042	.6508	.6445	.0835	.4760
14:15		.1930	.1979	.2138	.3042	-.0059	.7351	.7546	.7677	.4899	.4014	.1756	.1544
14:20		-.2037	-.0396	-.0233	.0565	.6877	.7173	.7925	.8327	.6604	.6515	.3687	.4360
14:25		-.1478	.0484	.1713	.3113	.5515	.6091	.6182	.6018	.4163	.3398	.1453	.1275
14:30		.1337	.1003	.1731	.2951	.4795	.6343	.6565	.6387	.4502	.4068	.1951	.2278
14:35		-.1054	.0594	.1966	.3205	0.3000	.7832	.8080	.8123	.6065	.5299	.2807	.3132
14:40		-.1190	.0169	.1426	.2520	.5450	.6485	.6683	.6901	.5092	.4376	.2208	.2510
14:45	Stop pumping	.1093	.1654	.2774	.3333	.7153	.7279	.7386	.6617	.4453	.2998	.0940	.3427
14:50		.1534	.1512	.2235	.3351	.4187	.7071	.5892	.6918	.4828	.3680	.1675	.1504
14:55	Total Volume-312,000 gal.	.1236	.1105	.1676	.2933	.7764	.7250	.7215	.6932	.4764	.3772	.1221	.1250
15:00		.2593	.2150	.1990	.3159	.3612	.9159	.8522	.8343	.5800	.4563	.2020	.1994
15:05		.1108	.1135	.1850	.2999	.7659	.8655	.9427	.9223	.6981	.6448	.3519	.4278
15:10		.5558	.2754	.2715	.3227	.6848	.8111	.8044	.8520	.6409	.5763	.3015	.3515
15:15		.0730	-.0081	.2212	.3696	.6637	.8220	.9156	.8283	.5985	.5137	.2619	.2550
15:20		.5013	.3154	.2724	.3892	.6105	.7935	.8945	.8087	.5863	.5174	.2083	.2875
15:25		.0769	.1268	.2211	.3378	.8278	.8069	.8057	.8000	.5820	.4893	.2353	.2345
15:30		.0405	.1259	.3001	.3927	.7230	.8431	.8291	.7860	.5644	.4798	.2106	.2158
15:35		.1381	.1392	.3394	.4748	.5759	.8095	.8768	.8414	.6102	.5156	.2453	.2516
15:40		.1199	.0353	.1733	.2876	.6354	.7445	.7427	.7480	.5409	.4687	.2391	.2655
15:45		.1909	.2034	.3303	.4770	.8976	.8631	.8226	.7973	.5551	.4093	.2182	.2097
15:50		.1178	.2255	.2692	.4020	.6332	.8020	.8146	.7994	.5556	.4808	.2206	.2241
15:55		.1743	.3096	.2530	.3666	.7889	.8164	.8228	.8114	.5355	.5146	.2392	.2545
16:00		.0618	.1414	.2242	.3472	.6521	.8123	.8413	.8256	.6144	.5477	.2714	.3141
16:05		-.0128	.1155	.2179	.3547	.6476	.7670	.7965	.7345	.5835	.5085	.2705	.2924
16:10		.1829	.1920	.2382	.2859	.7403	.8605	.8125	.7805	.5444	.4489	.2148	.1993
16:15		.1111	.1617	.2527	.3694	.5783	.8127	.8088	.8567	.5880	.5087	.2563	.2591
16:20		-.3582	-.0015	.1934	.3405	.9383	.8236	.8304	.8057	.5738	.4827	.2350	.2420
16:25		-.1636	.0198	.2248	.3522	.6512	.7772	.8350	.8515	.6514	.5986	.3421	.4232
16:30		.2251	.2205	.2972	.3663	.4891	.8268	.8200	.8113	.6310	.5375	.4659	.3094

APPENDIX C

TABLE I

WATTEBERG - UPRR22 HYDROFRACTURE

BACKGROUND-JANUARY 26,1976

TIME	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°
11:51	.8393	.3726	-.3036	-.0886	-.2196	-.3640	-.3634	-.4437	-.5255	-.4819	-.4369	-.4748
11:53	.8506	.3363	.0249	-.1524	-.2764	-.3753	-.4499	-.4678	-.5237	-.4731	-.5103	-.4446
11:55	.8566	.3576	.0537	-.0769	-.1973	-.3170	-.3645	-.4167	-.4942	-.4553	-.4925	-.4673
11:57	.9136	.4088	.0518	-.1334	-.2743	-.4138	-.4439	-.4876	-.5512	-.4893	-.5195	-.4710
11:58	.8393	.3473	.0352	-.1479	-.2842	-.3758	-.4476	-.4853	-.5531	-.4980	-.5343	-.4763
12:03	-.0966	-.0798	-.0707	.0392	.1625	.4513	.9162	1.5829	2.0853	2.4160	1.9847	1.1255
12:05	-.6028	-.5278	-.3266	-.1291	.1670	.5974	1.2148	1.9961	2.5900	2.9599	2.5868	1.7015
12:07	-.5041	-.4010	-.2637	-.1085	.1633	.5289	1.1406	1.9171	2.4831	2.8435	2.4583	1.5774
12:08	-.4068	-.3032	-.1426	-.0966	.1518	.5324	1.1006	1.8508	2.4257	2.7861	2.4227	1.5268
12:10	-.4296	-.3687	-.2528	-.0664	.2249	.5541	1.0616	1.7816	2.3162	2.6547	2.2432	1.3656
12:22	-1.3811	-.8151	-.3520	.0133	.3976	.8482	1.5015	2.2997	2.9403	3.2481	2.8689	1.9749
12:24	-1.3953	-.8459	-.3775	.0184	.3885	.8735	1.4723	2.2537	2.8923	3.1928	2.8344	1.9245
12:26	-1.3569	-.7907	-.3459	.0104	.3835	.8757	1.5310	2.3313	2.9778	3.2909	2.9061	2.0115
12:28	-1.3371	-.7726	-.3126	-.0294	.3532	.8350	1.4006	2.2812	2.9379	3.2598	2.8533	2.0018
12:29	-1.3959	-.8266	-.3836	-.0259	.3374	.8202	1.4442	2.2386	2.8860	3.2077	2.8389	1.9515
13:00	.1992	-.3127	-.1466	-.1171	-.0735	.6411	.3093	.6695	.9199	1.1285	.9135	.5111
13:05	.3081	-.0980	-.0076	-.1043	-.0476	.8828	.2977	.6507	.8953	1.1028	.9294	.4821
13:10	.2763	-.0753	-.0054	-.0985	-.0486	.8815	.3087	.6505	.8883	1.0891	.8892	.4564
13:15	.2055	-.0002	-.0852	-.0453	-.0579	.0597	.2519	.5919	.8243	1.0296	.8291	.4175
13:20	.2660	.0346	-.1002	-.0793	-.0688	.0763	.2865	.6246	.8586	1.0570	.8593	.4255
13:25	.1439	-.0475	-.1197	-.1082	-.0683	.0620	.3012	.6522	.8994	1.1040	.9001	.4873
13:30	.2157	.0138	-.0444	-.1015	-.0565	.6586	.2343	.6269	.8714	1.0779	.8654	.4538
13:35	.2260	.0074	-.0844	-.0790	-.0113	.1133	.3640	.7164	.9714	1.1709	.9614	.5410
13:40	.0772	-.1195	-.1714	-.5791	-.0441	.1312	.3311	.6397	.8752	1.0741	.8683	.4417
13:45	.2094	.0138	-.0565	-.0685	-.0306	.0940	.3163	.6548	.8921	1.0862	.9180	.4566
13:50	.1727	-.0200	-.1104	-.0852	-.0424	.0704	.3249	.6665	.9094	1.1087	.9032	.4714
13:55	.2550	.0486	-.0500	-.1266	-.0445	.1535	.3800	.7558	1.0170	1.2218	1.0266	.5994
14:00	.2036	-.0128	-.1050	-.0786	-.0579	.0839	.2890	.6280	.8573	1.0569	.8568	.4236

TABLE I (continued)

WATTENBERG - UPRR22 HYDROFRACTURE

BACKGROUND-JANUARY 26, 1975

TIME	0°	15°	30°	45°	65°	75°	90°	105°	120°	135°	150°	165°
14:05	.2036	.0376	-.0344	-.1023	-.0814	.1075	.3215	.6749	.9138	1.1220	.9191	.4988
14:10	.2353	.0283	-.0732	-.1174	-.0775	.1123	.3333	.7071	.9535	1.1592	.9923	.5378
14:15	.2162	.0107	-.0734	-.1325	-.0859	.0752	.3434	.7169	.9797	1.1913	.9949	.5753
14:20	.2244	.0371	-.0145	-.0791	-.0632	.0714	.3207	.6623	.9037	1.1001	.9048	.4661
14:25	.2381	.1078	.0032	-.1356	-.0641	.0764	.3399	.7077	.9659	1.1735	.9761	.5552
14:30	.2500	-.1247	-.1725	-.1454	-.0569	.1205	.4089	.7934	1.0593	1.2778	1.1000	.6577
14:35	.2581	.0557	-.0390	-.1142	-.0310	.0392	.2734	.6200	.8657	1.0743	.8625	.4645
14:40	.2440	.0326	-.0866	-.0932	-.0711	.0589	.3015	.6475	.8913	1.0918	.8843	.4699
14:45	.2452	.0184	-.1021	-.0924	-.0337	.0592	.3438	.6978	.9450	1.1453	.9467	.5103
14:50	.2227	-.0077	-.1038	-.1235	-.0744	.0810	.2875	.6452	.8983	1.1068	.9341	.5005
14:55	.2209	.0187	-.0784	-.1245	-.0487	.0892	.3115	.6944	.9498	1.1623	.9696	.5459
15:00	.2455	.0352	-.0470	-.1033	-.0608	.0762	.3347	.6586	.9036	1.1051	.8973	.4832
15:05	.2605	.0031	-.0259	-.1540	-.0890	-.0070	.2659	.6249	.8754	1.0904	.8936	.4874
15:10	.2640	.0500	-.0619	-.0370	-.0497	.0703	.3245	.6712	.9119	1.1062	.9081	.4779
15:15	.1416	-.0651	-.1390	-.1422	-.0671	.0448	.3314	.7073	.9679	1.1753	.9782	.5573
15:20	.2039	.0005	-.0714	-.1055	-.0783	.0944	.3002	.6456	.8913	1.0934	.8925	.4702
15:25	.1517	-.0432	-.1014	-.1359	-.0664	.0595	.3371	.7031	.9619	1.1714	.9074	.5582
15:30	.2144	.0249	-.1231	-.1001	-.0438	.0316	.0795	.6864	.9351	1.1394	.4507	.5131
15:35	.2374	.0142	-.1105	-.0860	-.0515	.0713	.3114	.6417	.8851	1.0820	.8683	.4577
15:40	.2149	.0092	-.0592	-.1365	-.0837	.0502	.2943	.6513	.9083	1.1179	.9348	.5077
15:45	.1700	-.0277	-.1082	-.1142	-.0525	.1005	.3282	.6811	.9372	1.1437	.9385	.5171
15:55	.2410	.0337	-.0512	-.1026	-.0511	.0324	.3253	.6797	.9279	1.1345	.9158	.5056
16:00	.2220	.0133	-.0633	-.1353	-.0533	.0876	.3340	.6848	.9412	1.1498	.9213	.5209
16:05	.2351	.0295	-.0518	-.0874	-.0393	.1102	.3383	.6944	.9426	1.1491	.9519	.5343
16:10	.1361	-.0232	-.1077	-.1101	-.0564	.0715	.3260	.6930	.9293	1.1367	.9369	.5117
16:15	.2152	-.0032	-.1230	-.1227	-.0698	.0563	.3175	.6768	.9250	1.1341	.9308	.5076
16:20	.2045	-.0052	-.0910	-.1113	-.0636	.0283	.3177	.6735	.9202	1.1268	.9695	.5015

TABLE I (continued)

WATTEBERG - UPRR22 HYDROFRACTURE

BACKGROUND-JANUARY 26, 1976

TIME	180°	195°	210°	225°	240°	255°	270°	285°	300°	315°	330°	345°
11:51	-.4458	-.3931	.3541	-.1816	.0502	.4076	.9327	1.6937	2.5037	2.8995	2.1898	1.5285
11:53	-.4039	-.3462	-.3168	-.0819	.1318	.4675	1.0549	1.8220	2.6861	3.0650	2.4067	1.5557
11:55	-.4491	-.4050	-.2448	-.1199	.1095	.4834	1.0122	1.7847	2.6278	3.0138	2.3959	1.5553
11:57	-.4343	-.3654	-.2066	-.0517	.1894	.5573	1.1554	1.9383	2.9609	3.3262	2.5195	1.6295
11:58	-.4985	-.3774	-.1741	-.1521	.0742	.4509	.9437	1.7220	2.5131	2.9054	2.3482	1.5238
12:03	.4477	.0279	-.1975	-.3520	-.3688	-.3775	-.3286	-.3105	-.3314	-.2944	-.1814	-.1245
12:05	.9631	.4686	.0686	-.0291	-.2105	-.3865	-.4487	-.5106	-.4985	-.5715	-.6131	-.6557
12:07	.8608	.3754	-.0030	-.1538	-.2758	-.4273	-.4675	-.5134	-.4907	-.5425	-.5696	-.5473
12:08	.8079	.3383	.0049	-.2482	-.3882	-.4072	-.5224	-.5518	-.5185	-.5417	-.5044	-.4678
12:10	.6478	.2055	-.0631	-.2092	-.3147	-.3958	-.4448	-.4858	-.5626	-.5745	-.4936	-.4679
12:22	1.2359	.7151	.1917	.3043	-.3762	-.8768	-1.4949	-2.2984	-3.1172	-3.5533	-2.9639	-2.1261
12:24	1.1932	.5789	.1900	.0301	-.3382	-.8451	-1.4654	-2.2822	-3.1633	-3.5961	-2.9649	-2.1378
12:26	1.2656	.7370	.2252	-.0162	-.3714	-.8768	-1.4862	-2.2957	-3.1589	-3.5632	-2.9445	-2.0977
12:28	1.2689	.7322	.2342	-.0373	-.3936	-.8778	-1.4885	-2.2889	-3.1623	-3.5771	-2.9154	-2.0709
12:29	1.2236	.7202	.2274	.0066	-.3705	-.8601	-1.4909	-2.3096	-3.1760	-3.6153	-2.9792	-2.1346
13:00	.1768	-.0211	-.1394	-.1276	-.0795	.0593	.3033	.6569	1.0532	1.2214	.9252	.5212
13:05	.1477	-.0466	-.1187	-.2453	-.1331	.0351	.2975	.6615	1.0912	1.2914	1.0110	.6375
13:10	.1228	-.0778	-.1244	-.2394	-.1791	-.0253	.2413	.6684	1.0118	1.2103	.9640	.5637
13:15	.0919	-.0333	-.1409	-.1754	-.1179	.0177	.2594	.6142	.9952	1.1844	.9266	.5273
13:20	.8889	-.1040	-.2350	-.1385	-.0533	.1171	.3575	.7383	1.1754	1.3524	1.0191	.6006
13:25	.1528	-.0437	-.1232	-.1354	-.1181	-.0122	.2279	.5607	.9453	1.1115	.8417	.4490
13:30	.1305	-.0594	-.1318	-.1725	-.1121	.0215	.2523	.6268	1.0656	1.2416	.9380	.5283
13:35	.1971	-.0045	-.0753	-.0746	.0384	.1317	.3778	.7741	1.3292	1.4668	1.0148	.5651
13:40	.1101	-.0834	-.1544	-.1015	-.0722	.0304	.2384	.5577	.9657	1.0582	.8022	.3843
13:45	.1056	-.0927	-.1642	-.1932	-.1255	.0698	.2547	.6155	1.0503	1.2294	.9299	.5293
13:50	.1335	-.0692	-.1481	-.1562	-.1181	.0075	.2494	.6060	1.0284	1.1979	.8924	.4902
13:55	.2486	.0323	-.0587	-.2136	-.1440	.0128	.2633	.6224	1.0293	1.2203	.9603	.5691
14:00	.1846	-.1020	-.1705	-.1323	-.0652	.0653	.3137	.6786	1.1128	1.2812	.9592	.5319

TABLE I (continued)

WATTENBERG - UPRK22 HYDROFRACTURE

BACKGROUND-JANUARY 26, 1976

TIME	180°	195°	210°	225°	240°	255°	270°	285°	300°	315°	330°	345°
14:05	.1594	-.0396	-.0995	-.1898	-.1321	.0034	.2511	.5963	.9876	1.1709	.9139	.5176
14:10	.1917	-.0126	-.0914	-.1659	-.1021	.6415	.2906	.6669	1.1243	1.2963	.9660	.5568
14:15	.2336	-.0255	-.0577	-.1766	-.1144	.0119	.2659	.6247	1.0381	1.2180	.9375	.5291
14:20	.1316	-.0606	-.1306	-.2195	-.1597	-.0221	.2237	.5868	1.0223	1.2152	.9322	.5352
14:25	.2128	.0031	-.0923	-.2325	-.2089	-.0512	.2067	.5856	1.0181	1.2256	.9562	.5963
14:30	.2985	.0765	-.0670	-.1157	-.0981	-.0119	.1935	.5142	.9015	1.0517	.7646	.3590
14:35	.1394	-.0470	-.1159	-.2352	-.1662	-.0122	.2479	.6080	.9880	1.1923	.9662	.5771
14:40	.1354	-.0516	-.1242	-.1763	-.1029	.0522	.3121	.6691	1.0544	1.2359	.9726	.5737
14:45	.1637	-.0434	-.1072	-.1488	-.0653	.0831	.3474	.7354	1.0812	1.2628	.9933	.5799
14:50	.1726	-.0157	-.1331	-.1354	-.0729	.0658	.3160	.6749	1.0751	1.2693	.9865	.5523
14:55	.2165	.1114	-.0853	-.1978	-.1431	.0084	.2567	.6103	.9845	1.1790	.9303	.5377
15:00	.1476	-.0514	-.1343	-.1649	-.0958	.0559	.3118	.6917	1.1539	1.3305	.9925	.5717
15:05	.1612	-.0303	-.1155	-.1936	-.1127	.0415	.3127	.6864	1.1287	1.3222	1.0314	.6121
15:10	.1391	-.0520	-.1231	-.1794	-.1093	.0419	.3102	.6770	1.0743	1.2624	.9938	.5895
15:15	.2232	.0152	-.1090	-.1175	-.0697	.0411	.2708	.6166	1.0294	1.1907	.8787	.4569
15:20	.1304	-.0537	-.1158	-.1671	-.1065	.0277	.2733	.6273	1.0476	1.2242	.9370	.5266
15:25	.2177	.0124	-.0938	-.1768	-.1292	-.0202	.2224	.5536	.9257	1.1617	.8585	.4573
15:30	.1690	-.0332	-.0950	-.2251	-.1621	-.0252	.2124	.5656	.9260	1.1191	.8773	.5267
15:35	.1235	-.0723	-.1352	-.1651	-.0833	.0338	.3165	.6780	1.0550	1.2375	.9687	.5582
15:40	.1747	-.0212	-.0385	-.1717	.1101	.0227	.2799	.6354	1.0387	1.2208	.9456	.5346
15:45	.1752	-.0315	-.1328	-.2410	.1932	-.0352	.2029	.4966	.6770	.8906	.8368	.4774
15:50	.1581	-.0450	-.1256	-.2035	-.1327	.0392	.2666	.6299	1.0288	1.2157	.9503	.5537
16:00	.1855	-.0152	-.0527	-.1644	-.0939	.0356	.2855	.6541	1.1057	1.2851	.9576	.5415
16:05	.2019	.0107	-.0383	-.1757	-.1023	.0300	.2889	.6551	1.0365	1.2725	.9685	.5577
16:10	.1745	-.0332	-.1045	-.1671	-.1156	.0157	.2618	.6990	.9000	1.1502	.9632	.4973
16:15	.1653	-.0385	-.1236	-.2072	-.1468	-.0374	.2433	.6860	.9226	1.1251	.9174	.5148
16:20	.4929	.3370	-.1000	-.1779	-.1852	.0293	.2735	.6241	1.0283	1.2043	.9369	.5183

TABLE II

WATTEBERG - UPRR22 HYDROFRACTURE

FRACTURE-JANUARY 27, 1976

TIME	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°
7:00	.2206	.0153	-.0690	-.1121	-.3611	.0715	.3221	.6749	.9223	1.1283	.9358	.5101
7:03	.2918	.0379	-.0591	-.0735	-.3529	.0761	.3104	.6543	.8851	1.0856	.8879	.5101
7:05	.2423	.0425	-.0499	-.0805	-.3372	.0895	.3455	.6989	.9475	1.1525	.9644	.5101
7:10	.2172	.0057	-.0310	-.1211	-.3644	.0680	.3137	.6641	.9672	1.1124	.9194	.5101
7:15	.2460	.0317	-.0598	-.3658	-.5376	.0900	.3319	.6794	.9186	1.1153	.9230	.5101
7:20	.2109	.0056	-.0949	-.0992	-.3458	.0792	.3180	.6660	.9050	1.1065	.9159	.5101
7:25	.1849	-.0157	-.0990	-.1237	-.3811	.0596	.3566	.6577	.9564	1.1118	.9236	.5620
7:30	.2083	.0071	-.0919	-.1198	-.3819	.0537	.2959	.6448	.6915	1.0983	.9112	.5102
7:35	.2046	-.0057	-.1186	-.1123	-.3948	.0815	.3500	.6826	.9271	1.1282	.9371	.5215
7:45	.2199	.0216	-.0802	-.3851	-.3333	.0919	.3248	.6614	.9010	1.0907	.8959	.4712
7:48	.2191	.0098	-.0865	-.1311	-.0776	.0628	.3117	.6631	.9155	1.1233	.9270	.5215
7:50	.2346	.0294	-.0559	-.1675	-.1097	.0415	.3064	.6765	.9326	1.1485	.9744	.5669
7:55	.1859	-.0254	-.1073	-.1503	-.3990	.0474	.3029	.6598	.9118	1.1211	.9333	.5145
8:00	.2245	.0186	-.0612	-.1960	-.0528	.0732	.3231	.6645	.9099	1.1094	.9265	.5008
8:05	.2146	.0084	-.0949	-.1191	-.0786	.0550	.3089	.6646	.9198	1.1217	.9377	.5218
8:10	.2280	.0172	-.0673	-.1005	-.0532	.0715	.3076	.6473	.8884	1.0885	.8940	.4756
8:15	.1761	-.0281	-.1065	-.1354	-.0713	.0599	.3238	.6771	.9339	1.1394	.9568	.5354
8:20	.2645	.0502	-.0768	-.1274	-.0876	.0563	.3028	.6510	.9023	1.1054	.9149	.5028
8:25	.2093	-.0097	-.0923	-.1399	-.3632	.0700	.3121	.6554	.8995	1.0988	.9150	.4904
8:30	.2327	.0173	-.0740	-.1233	-.0628	.0605	.3205	.6660	.9137	1.1173	.9281	.5097
8:35	.2801	.0719	-.0570	-.1397	-.3822	.0546	.3104	.6528	.9069	1.1103	.9189	.4915
8:40	.2228	.0175	-.0712	-.1097	-.0712	.0774	.3226	.6679	.9155	1.1160	.9278	.5063
8:45	.1835	-.0224	-.1028	-.1095	-.3485	.0748	.3230	.6644	.9199	1.1050	.9190	.4936
8:50	.2130	.0100	-.0773	-.0922	-.3377	.0935	.3427	.6931	.9405	1.1402	.9529	.5247
8:55	.2169	.0370	-.0856	-.1655	-.3619	.0818	.3313	.6799	.9275	1.1270	.9423	.5182
9:00	.1975	-.0040	-.0923	-.0739	-.3384	.0985	.3401	.6801	.9197	1.1102	.9202	.4933
9:05	.2040	.0001	-.0883	-.1381	-.0740	.0773	.3291	.6753	.9275	1.1248	.9374	.5101
9:10	.2146	.0053	-.0812	-.1938	-.0730	.0830	.3314	.6782	.9299	1.1315	.9423	.5195
9:13	.2146	.0082	-.0773	-.1359	-.0760	.0705	.3296	.6866	.9446	1.1495	.9738	.5505
9:16	.1734	-.0213	-.1034	-.0890	-.0550	.0971	.3347	.6761	.9172	1.1106	.9180	.4871
9:19	.2073	.0054	-.0600	-.3745	-.3492	.1039	.3424	.6815	.9207	1.1093	.9142	.4843
9:22	.2532	.0450	-.0486	-.1136	-.0835	.0514	.2987	.6410	.8925	1.0919	.9070	.4827
9:25	.2177	.0164	-.0654	-.1313	-.1017	.0634	.3183	.6712	.9258	1.1276	.9413	.5176
9:28	.1818	-.0256	-.0937	-.0839	-.0641	.0875	.3311	.6686	.9114	1.1025	.9081	.4751
9:30	.2279	.0058	-.0776	-.1305	-.0720	.0590	.3241	.6796	.9326	1.1327	.9494	.5212
9:33	.2431	.0386	-.0515	-.1141	-.0693	.0756	.3336	.6841	.9353	1.1392	.9533	.5204
9:36	.1797	-.0203	-.0381	-.1161	-.0635	.0734	.3315	.6846	.9382	1.1395	.9573	.5302
9:39	.2105	.0045	-.0740	-.1204	-.0782	.0691	.3226	.6722	.9258	1.1273	.9433	.5177
9:42	.2086	-.0009	-.0795	-.1052	-.0526	.0829	.3305	.6791	.9359	1.1317	.9428	.5181
9:45	.1737	-.0339	-.0966	-.1373	-.0886	.0708	.3353	.6980	.9525	1.1566	.9718	.5426

Start pumping

55,000 gal.

TABLE II (continued)

WATTENBERG - UPRR22 HYDROFRACTURE

FRACTURE-JANUARY 27, 1976

TIME	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°
9:48	.2112	.3113	-.0659	-.1533	-.3916	.0560	.3143	.6773	.9383	1.1433	.9085	.5476
9:51	.2025	-.0045	-.0926	-.0932	-.0388	.0959	.3441	.6098	.9321	1.1323	.9384	.5093
9:54	.1991	-.0062	-.0334	-.1246	-.0632	.0572	.3289	.6027	.9359	1.1404	.9551	.5294
9:57	.2375	.0329	-.0439	-.1086	-.0349	.0885	.3375	.6070	.9419	1.1412	.9559	.5219
10:00	.1059	-.1432	-.1192	-.0911	-.0463	.0797	.3218	.6014	.9034	1.1015	.9090	.4687
10:03	.2100	.0126	-.0705	-.1382	-.0520	.0740	.3279	.6757	.9273	1.1270	.9465	.5112
10:06	.2075	.0043	-.0702	-.1210	-.0693	.0684	.3245	.6025	.9348	1.1409	.9588	.5283
10:09	.1894	-.0087	-.0907	-.0949	-.0539	.0725	.3261	.6675	.9162	1.1151	.9254	.4918
10:12	.1947	-.0054	-.0840	-.1019	-.0535	.0708	.3174	.6601	.9033	1.1004	.9145	.4830
10:15	.2247	.0071	-.0614	-.1090	-.0619	.0663	.3114	.6548	.9054	1.1036	.9156	.4860
10:18	.1971	-.0119	-.0600	-.1185	-.0655	.0814	.3204	.6733	.9209	1.1219	.9342	.5095
10:21	.1902	-.0073	-.0742	-.1309	-.0715	.0710	.3241	.6792	.9354	1.1339	.9532	.5205
10:24	.2070	.0057	-.0731	-.1222	-.0696	.0580	.3209	.6735	.9242	1.1282	.9425	.5128
10:27	.1980	-.0120	-.0843	-.1135	-.0655	.0789	.3351	.6821	.9331	1.1331	.9494	.5166
10:30	.1731	-.0347	-.1190	-.0897	-.0639	.0818	.3209	.6735	.9141	1.1134	.9175	.4842
10:33	.1981	-.0128	-.0643	-.0912	-.0437	.0737	.3202	.6635	.9064	1.1013	.9319	.4783
10:36	.1007	-.0157	-.0336	-.1273	-.0642	.0701	.3274	.6781	.9250	1.1334	.9474	.5175
10:39	.1958	-.0147	-.0802	-.1159	-.0638	.0596	.3211	.6777	.9245	1.1168	.9575	.5137
10:42	.1949	-.0058	-.0644	-.1123	-.0631	.0666	.3270	.6761	.9270	1.1295	.9401	.5154
10:45	.1947	-.0126	-.0800	-.1373	-.0757	.0694	.3344	.6924	.9539	1.1556	.9651	.5201
10:48	.2092	.0033	-.0747	-.1223	-.0654	.0544	.3250	.6745	.9373	1.1372	.9570	.5252
10:51	.2082	.0029	-.0654	-.1258	-.0677	.0762	.3359	.6961	.9466	1.1514	.9730	.5414
10:54	.2109	.0124	-.0557	-.1259	-.0559	.0745	.3314	.6869	.9461	1.1455	.9670	.5340
10:57	.1933	-.0093	-.0700	-.1158	-.0667	.0733	.3292	.6817	.9383	1.1335	.9524	.5220
11:00	.1920	-.0098	-.0753	-.1114	-.0562	.0900	.3437	.6950	.9534	1.1520	.9640	.5366
11:03	.2041	.0058	-.0649	-.1160	-.0723	.0915	.3336	.6928	.9445	1.1480	.9382	.5209
11:06	.2090	.0035	-.0671	-.1179	-.0650	.0929	.3274	.6764	.9320	1.1381	.9454	.5148
11:09	.2244	.0213	-.0528	-.1053	-.0491	.0870	.3410	.6900	.9397	1.1398	.9515	.5175
11:12	.1823	-.0150	-.0636	-.1225	-.0490	.0717	.3289	.6788	.9360	1.1395	.9554	.5300
11:15	.2102	.0049	-.0631	-.1036	-.0562	.0900	.3430	.6915	.9511	1.1519	.9761	.5303
11:18	.1809	-.0082	-.0640	-.1242	-.0707	.0934	.3255	.6800	.9355	1.1420	.9714	.5274
11:21	.1913	-.0039	-.0407	-.1143	-.0592	.0739	.3302	.6970	.9395	1.1367	.9525	.5240
11:24	.2030	.0124	-.0520	-.1050	-.0560	.0814	.3318	.6854	.9360	1.1328	.9551	.5121
11:27	.2174	.0091	-.0744	-.1188	-.0501	.0723	.3401	.7014	.9545	1.1626	.9699	.5449
11:30	.2150	.0054	-.0559	-.1123	-.0657	.0801	.3366	.6779	.9381	1.1356	.9439	.5228
11:33	.2444	.0527	-.0338	-.0983	-.0490	.0958	.3355	.6759	.9217	1.1225	.9460	.4962
11:36	.2332	.0150	-.0525	-.1159	-.0552	.0761	.3153	.6633	.9183	1.1136	.9293	.4996
11:39	.1050	-.0277	-.0443	-.0936	-.0339	.0721	.3272	.6656	.9168	1.1127	.9150	.4823
11:42	.2120	.0145	-.0531	-.1570	-.0806	.0720	.3431	.7116	.9349	1.1881	2.1563	4.2738
11:54	.2324	.0396	-.0347	-.1099	-.0517	.0653	.3241	.6753	.9272	1.1268	.9395	.5133

TABLE II (continued)

WATTENBERG - UPRR22 HYDROFRACTURE

FRACTURE-JANUARY 27, 1976

TIME	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	160°
11:57	.2153	.0071	-.0635	-.1473	-.0997	.0691	.3396	.7032	.9677	1.1789	.9938	.5731
12:03	.1981	-.0420	-.0300	-.1399	-.0488	.0852	.3403	.6949	.9463	1.1537	.9734	.5331
12:08	.2184	.0123	-.0437	-.1126	-.0716	.1532	.3418	.6969	.9463	1.1450	.9582	.5153
12:10	.1899	-.0113	-.0559	-.0955	-.0498	.1257	.3241	.6726	.9223	1.1152	.9125	.4938
12:15	.1807	-.0194	-.0738	-.1188	-.0632	.0537	.3437	.7024	.9555	1.1560	.9631	.5337
12:18	.1943	-.0157	-.1134	-.1130	-.0659	.0950	.3496	.7050	.9655	1.1617	.9686	.5411
12:21	.2247	.0192	-.0393	-.0723	-.0377	.0885	.3282	.6712	.9088	1.0988	.9219	.4603
12:24	.2259	.0159	-.0445	-.1024	-.0463	.1258	.3582	.7056	.9672	1.1595	.9682	.5325
12:27	.1952	-.0084	-.0689	-.1111	-.0591	.0579	.3333	.6791	.9397	1.1340	.9577	.5151
12:30	.2170	.0092	-.0587	-.1130	-.0555	.0889	.3408	.6931	.9538	1.1548	.9626	.5264
12:33	.1854	-.0029	-.0318	-.1093	-.0549	.0842	.3493	.6919	.9573	1.1567	1.0104	.5363
12:36	.1985	-.0102	-.0637	-.1151	-.0574	.1238	.3434	.7028	.9555	1.1534	.9571	.5331
12:39	.2152	.0130	-.0558	-.1071	-.0710	.0747	.3434	.6958	.9517	1.1518	.9719	.5297
12:42	190,000 gal.	.2027	-.0010	-.0495	-.0998	.1398	.3426	.7062	.9514	1.1491	.9515	.5265
12:45	.2145	.0103	-.0438	-.1058	-.0734	.1334	.3391	.6917	.9463	1.1441	.9487	.5200
12:48	.2080	-.0012	-.0534	-.1206	-.0612	.0458	.3343	.6903	.9456	1.1480	.9366	.5222
12:51	.1941	-.0082	-.0550	-.1085	-.0507	.1040	.3412	.6957	.9528	1.1513	.9963	.5285
12:54	.2168	.0138	-.0451	-.1195	-.0553	.1254	.3312	.6928	.9439	1.1457	.9577	.5284
12:57	.4051	.6547	.0893	-.1089	-.0549	.0965	.3518	.6999	.9675	1.1703	.9324	.5466
13:00	.2254	.0222	-.0455	-.0959	-.0405	.0694	.3516	.7009	.9543	1.1495	.9585	.5191
13:05	.1995	-.0015	-.0315	-.1029	-.0419	.1140	.3471	.7017	.9570	1.1580	.9455	.5374
13:08	.2045	.0033	-.0432	-.1119	-.0564	.0966	.3352	.6813	.9442	1.1472	.9624	.5205
13:15	.2248	.0173	-.0377	-.1029	-.0308	.0932	.3456	.7098	.9609	1.1593	.9835	.5288
13:18	.2197	.0177	-.0299	-.0906	-.0729	.0851	.3398	.6905	.9444	1.1454	.9209	.5228
13:21	.2227	.0178	-.0454	-.1067	-.0395	.0956	.3632	.7142	.9717	1.1737	.9691	.5443
13:24	.1944	-.0050	-.0443	-.1105	-.0612	.0884	.3393	.6976	.9541	1.1572	.9538	.5313
13:30	.2175	.0083	-.0582	-.1168	-.0482	.0916	.3533	.7191	.9713	1.1735	.9920	.5514
13:33	.1676	-.0232	-.0473	-.1159	-.0664	.0487	.3235	.6708	.9364	1.1401	.9583	.5131
13:36	.2305	.0231	-.0128	-.1335	-.0554	.0784	.3329	.6823	.9386	1.1382	.9270	.5137
13:39	235,000 gal.	.2137	.0017	-.0498	-.1137	-.0574	.0809	.3485	.6996	1.1069	.9769	.5467
13:42	.2161	.0054	-.0553	-.1154	-.0639	.0588	.3387	.6899	.9508	1.1552	.9617	.5273
13:45	.2197	.0076	-.0266	-.1152	-.0615	.0584	.3318	.6940	.9417	1.1407	.9446	.5128
13:51	.2145	.0077	-.0516	-.0929	-.0422	.0876	.3386	.6871	.9339	1.1303	.9416	.4964
13:54	.2151	-.0055	-.0255	-.1254	-.0685	.0882	.3311	.6901	.9458	1.1524	.9657	.5266
14:00	.2048	.0050	-.0530	-.1118	-.0660	.0775	.3386	.6948	.9550	1.1570	.9634	.5299
14:03	.1944	-.0059	-.0620	-.1117	-.0435	.0645	.3384	.6943	.9527	1.1562	.9560	.5255
14:06	.2094	.0043	-.0349	-.1135	-.0650	.0725	.3310	.6785	.9414	1.1437	.9556	.5130
14:09	.1912	-.0101	-.0544	-.1123	-.0551	.0379	.3346	.6935	.9524	1.1515	.9408	.5232
14:15	.2013	-.0053	-.0479	-.1223	-.0751	.0684	.3268	.6846	.9407	1.1454	.9463	.5175
14:18	.2351	.0408	-.0240	-.1069	-.0585	.0728	.3272	.6887	.9348	1.1351	.9428	.5077

TABLE II (continued)

WATFENDERS - UPRR22 HYDROFRACTURE

FRACTURE-JANUARY 27, 1976

TIME	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°
14:21	.2109	.174	-.0394	-.1355	-.0855	.0253	.3165	.6729	.9361	1.1406	.9306	.5150
14:24	.2093	-.0133	-.0563	-.1181	-.0531	.0851	.3447	.7369	.9671	1.1666	.9706	.5414
14:27	.2066	-.0053	-.0532	-.1011	-.0505	.0968	.3559	.7775	.9753	1.1852	1.0043	.5536
14:30	.2186	.0034	-.0458	-.0761	-.0349	.1144	.3577	.7162	.9701	1.1728	.9875	.5430
14:33	.1805	-.0154	-.0590	-.1135	-.0615	.0652	.3383	.7610	.9588	1.1652	.9689	.5334
14:36	.1773	-.0221	-.0503	-.1232	-.0632	.0811	.3517	.7204	.9779	1.1839	.9812	.5554
14:39	.1719	-.0332	-.0748	-.1391	-.0831	.0713	.3238	.6914	.9479	1.1575	.9733	.5319
14:42	.1848	-.0110	-.0634	-.1259	-.0661	.0885	.3436	.7122	.9748	1.1849	.9955	.5532
14:45	.2280	.0192	-.0351	-.1060	-.0669	.0555	.3138	.6710	.9228	1.1291	.9257	.4972
14:48	.2225	.0154	-.0232	-.1222	-.0676	.0377	.3297	.6543	.9467	1.1528	.9544	.5243
14:51	.2289	.0200	-.0418	-.1194	-.0623	.0849	.3330	.6912	.9453	1.1507	.9519	.5243
14:54	.1973	-.0055	-.0558	-.1112	-.0590	.0396	.3432	.6995	.9557	1.1625	.9601	.5333
14:57	.2115	.0070	-.0471	-.1173	-.0558	.1289	.3333	.6869	.9462	1.1465	.9459	.5169
15:00	.2167	.0154	-.0303	-.1181	-.0626	.1058	.3350	.6855	.9479	1.1546	.9523	.5309
15:03	.1765	-.0181	-.0564	-.1282	-.0784	.0428	.3216	.6848	.9387	1.1463	.9515	.5204
15:09	.1891	-.0038	-.0626	-.1200	-.0817	.0540	.3259	.6863	.9423	1.1511	.9617	.5198
15:12	.2139	.0050	-.0531	-.1154	-.0654	.0709	.3299	.6836	.9452	1.1517	.9739	.5235
15:15	.2700	.0463	-.0234	-.1251	-.0763	.0716	.3277	.6894	.9485	1.1552	.9354	.5342
15:18	.2025	.0023	-.0422	-.1082	-.0745	.0937	.3411	.6991	.9542	1.1602	.9563	.5285
15:21	.2373	.0245	-.0124	-.1170	-.0695	.0791	.3349	.6931	.9545	1.1612	.9767	.5327
15:24	.2051	.0007	-.0396	-.1178	-.0585	.0368	.3387	.6918	.9549	1.1584	.9782	.5253
15:27	.1953	.0019	-.0508	-.1243	-.0663	.0830	.3397	.7025	.9559	1.1610	.9862	.5344
15:30	.1336	-.0051	-.0370	-.1453	-.0860	.0424	.3161	.6811	.9398	1.1512	.9473	.5191
15:33	.2192	.0160	-.0349	-.1216	-.0589	.0674	.3347	.6940	.9553	1.1643	.9695	.5351
15:36	.2017	.0024	-.1404	-.1231	-.0735	.0702	.3272	.6963	.9407	1.1532	.9566	.5304
15:39	.2002	.0441	-.0155	-.1146	-.0715	.0517	.3171	.6869	.9397	1.1152	.9031	.4879
15:42	.1348	-.0122	-.0513	-.1329	-.0360	.0381	.3031	.6683	.9209	1.1283	.9369	.5080
15:45	.2200	.0634	-.0451	-.1205	-.0603	.0734	.3214	.6822	.9343	1.1368	.9444	.5029
15:48	.2094	-.0003	-.0545	-.1072	-.0565	.0533	.3314	.6963	.9432	1.1496	.9342	.5123
15:51	.1601	-.0401	-.0758	-.1102	-.0600	.0843	.3295	.6898	.9414	1.1438	.9671	.5150
15:54	.2242	.0125	-.0254	-.1399	-.0580	.0759	.3329	.6852	.9438	1.1501	.9586	.5101
15:57	.2133	.0073	-.0409	-.1074	-.0538	.0939	.3536	.7161	.9725	1.1801	.9930	.5468
16:00	.2033	-.0003	-.0562	-.1256	-.0667	.0547	.3168	.6738	.9315	1.1415	.9421	.5166
16:03	.1967	-.0039	-.0542	-.1134	-.0653	.0694	.3319	.6853	.9451	1.1489	.9349	.5174
16:06	.2025	-.0023	-.0559	-.1159	-.0671	.0888	.3224	.6774	.9335	1.1410	.9397	.5131
16:09	.2004	-.0033	-.0552	-.1214	-.0701	.0723	.3148	.6716	.9256	1.1289	.9417	.5010
16:12	.2153	.0179	-.0210	-.1155	-.0598	.0927	.3394	.6997	.9597	1.1831	.9693	.5230
16:15	.2250	.0085	-.0029	-.1089	-.0614	.0724	.3415	.7032	.9624	1.1591	.9806	.5392
16:18	.1982	-.0034	-.0649	-.1318	-.0711	.0674	.3385	.7056	.9696	1.1780	.9826	.5583
16:21	.1997	-.0106	-.0683	-.1205	-.0619	.0754	.3439	.7083	.9727	1.1842	.9948	.5503

TABLE II (continued)

WATTENBERG - UPRR22 HYDROFRACTURE

FRACTURE-JANUARY 27, 1975

TIME	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°
16:24	.2218	.0122	-.0432	-.1344	-.0681	.0752	.3412	.7099	.9674	1.1720	.9877	.5456
16:27	.2089	.0001	-.0430	-.1219	-.0602	.0782	.3458	.7132	.9714	1.1815	.9834	.5504
16:30	.2038	-.0012	-.0643	-.1208	-.0662	.0753	.3272	.6906	.9473	1.1530	.9452	.5223
16:39	.2762	.0601	.0006	-.0983	-.0439	.0885	.3575	.7193	.9813	1.1863	1.0206	.5573
16:42	.2406	.0357	-.0212	-.1127	-.0579	.0827	.3398	.6999	.9503	1.1626	.9447	.5324
16:45 Start flush	.2444	.0300	-.0276	-.1020	-.0487	.1018	.3562	.7148	.9758	1.1823	.9843	.5509
16:48	.2618	.0536	-.0126	-.0941	-.0406	.0317	.3587	.7154	.9771	1.1848	.9753	.5603
16:51 Finish	.2056	-.0023	-.0561	-.1138	-.0580	.0799	.3367	.6948	.9575	1.1567	.9665	.5346
16:54	.2599	.0425	-.0255	-.1061	-.0551	.0982	.3453	.7049	.9623	1.1696	.9737	.5477
16:57 Total Volume-297,000 gal.	.2221	.0183	-.0472	-.1042	-.0501	.0737	.3442	.7050	.9657	1.1652	.9931	.5344
17:00	.2431	.0299	-.0201	-.0917	-.0411	.0847	.3554	.7148	.9683	1.1724	.9768	.5400
17:03	.2500	.0489	-.0145	-.1015	-.0483	.0841	.3422	.6927	.9584	1.1654	.9690	.5408
17:09	.2500	.0428	-.0239	-.1110	-.0545	.0731	.3359	.6993	.9544	1.1631	.9859	.5421
17:12	.2436	.0406	-.0419	-.1054	-.0433	.0881	.3471	.7298	.9699	1.1825	.9751	.5624
17:15	.2145	.0089	-.0649	-.1127	-.0526	.0825	.3556	.7176	.9846	1.1946	.9885	.5766
17:19	.2489	.0426	-.0412	-.0858	-.0309	.0954	.3410	.7002	.9521	1.1582	.9502	.5333
17:21	.2104	.0140	-.0479	-.0924	-.0386	.1054	.3461	.6984	.9584	1.1626	.9473	.5383
17:23	.2344	.0250	-.0177	-.0875	-.0608	.1035	.3518	.7148	.9650	1.1661	.9680	.5413
17:25	.2254	.0150	-.0489	-.0853	-.0320	.1041	.3493	.7116	.9637	1.1646	.9700	.5348
17:26	.1600	-.0314	-.0854	-.0861	-.0358	.1154	.3500	.7108	.9634	1.1616	.9620	.5344
17:28	.2415	.0304	-.0724	-.0665	-.0274	.1130	.3576	.7222	.9703	1.1751	.9905	.5504
17:30	.1977	-.0357	-.0684	-.1044	-.0479	.0967	.3434	.7101	.9655	1.1709	.9665	.5448
17:31	.2363	.0213	-.0528	-.1205	-.0699	.0665	.3176	.6835	.9417	1.1448	.9200	.5178
17:33	.2401	.0218	-.0485	-.1033	-.0612	.0760	.3259	.6908	.9377	1.1468	.9369	.5195
17:34	.1524	-.0444	-.1070	-.1191	-.0747	.0600	.3098	.6599	.9145	1.1193	.8994	.4814

TABLE II (continued)

WITTENBERG - UPRR22 HYDROFRACTURE

FRACTURE-JANUARY 27, 1975

TIME	180°	195°	210°	225	240°	255°	270°	285°	300°	315°	330°	345°
7:33	.1819	-.5139	-.1124	-.1848	-.0932	.0455	.3054	.6610	1.0841	1.2664	.9806	.5423
7:40	.1363	-.5014	-.1434	-.1884	-.1139	.0267	.2915	.6575	1.0839	1.2596	.9931	.5714
7:45	.2055	.0018	-.1911	-.2583	-.1399	.0026	.2596	.6279	1.0676	1.2538	.9745	.5657
7:49	.1729	-.5234	-.1151	-.1729	-.1059	.0314	.2838	.6381	1.0542	1.2369	.9528	.5355
7:55	.1609	-.5279	-.1139	-.1173	-.0341	.6831	.3528	.7564	1.3135	1.4711	1.3472	.5823
7:59	.1672	-.5283	-.1134	-.2103	-.1457	.0019	.2472	.5824	.9080	1.1040	.9193	.5280
8:05	.1768	-.5235	-.1177	-.2356	-.1870	-.0339	.2330	.5176	.7671	.9767	.8673	.4382
8:10	.1660	-.5271	-.1170	-.1726	-.1020	.0341	.2815	.6375	1.0483	1.2262	.9571	.5318
8:15	.1762	-.5218	-.1192	-.1820	-.0950	.0355	.2861	.6430	1.0558	1.2294	.9481	.5231
8:19	.1350	-.5050	-.1577	-.1924	-.1278	.0162	.2708	.6344	1.0423	1.2231	.9632	.5464
8:24	.1363	-.5085	-.1695	-.1695	-.1043	.0209	.2837	.6443	1.0376	1.2507	.9515	.5359
8:30	.2301	.3414	-.0529	-.1889	-.1177	.0174	.2850	.6518	1.0734	1.2613	.9893	.5611
8:35	.1793	-.5037	-.1288	-.1651	-.1015	.0291	.2710	.6100	.9858	1.1639	.9217	.4994
8:40	.1056	-.5298	-.1161	-.1458	-.0074	.0518	.3150	.6928	1.1800	1.3458	.9919	.5529
8:45	.1910	-.5051	-.1095	-.1889	-.1214	.0247	.2699	.6240	1.0569	1.1909	.9464	.5329
8:49	.1410	-.5037	-.1319	-.1258	-.0900	.0376	.3394	.7234	1.2293	1.3881	1.0130	.5614
8:55	.2021	-.5007	-.0982	-.1434	-.0821	.0397	.2820	.6403	1.0641	1.2343	.9326	.4993
9:00	.1725	-.5029	-.1253	-.1898	-.1074	.0399	.3044	.6801	1.1198	1.3052	1.0247	.5938
9:05	.1501	-.5073	-.1283	-.1743	-.1073	.0288	.2762	.6340	1.0412	1.2189	.9564	.5277
9:10	.1733	-.5256	-.1157	-.1893	-.0976	.0381	.2899	.6633	1.1183	1.2910	.9904	.5496
9:15	.1903	-.5003	-.1677	-.2184	-.1335	.0107	.2799	.6613	1.0843	1.2762	1.0232	.5993
9:19	.1567	-.5293	-.1138	-.1776	-.0987	.0345	.2819	.6460	1.0823	1.2610	.9792	.5449
9:25	.1561	-.5035	-.1281	-.1593	-.1034	.0323	.2635	.6155	.9942	1.1674	.9254	.4963
9:30	.1900	-.5120	-.1132	-.1427	-.0789	.0495	.2921	.6531	1.0860	1.2525	.9632	.5307
9:35	.1874	-.5010	-.1047	-.1509	-.0834	.0430	.2919	.6554	1.0830	1.2557	.9702	.5367
9:40	.1507	-.5072	-.1336	-.1478	-.0856	.0431	.2772	.6377	1.0425	1.2161	.9448	.5203
9:45	.1764	-.5216	-.1142	-.1617	-.0856	.0374	.2766	.6392	1.0567	1.2246	.9571	.5261
9:50	.1839	-.5158	-.1030	-.1605	-.0929	.0402	.2813	.6591	1.0529	1.2286	.9578	.5316
9:55	.2204	.0225	-.0749	-.1570	-.0829	.0498	.2938	.6614	1.0915	1.2640	.9756	.5418
10:00	.1513	-.5050	-.1359	-.1752	-.1154	.0204	.2530	.5960	.9531	1.1297	.9105	.4958
10:05	.1407	-.5061	-.1403	-.1929	-.1391	-.0026	.2429	.6157	1.0243	1.2135	.9114	.4451
10:10	.1538	-.5099	-.1215	-.2238	-.1477	.0090	.2586	.6209	1.0025	1.1969	.9780	.5635
10:15	.1617	-.5023	-.1225	-.1581	-.0995	.0384	.2431	.6527	1.0861	1.2625	.9803	.5453
10:20	.1387	-.5020	-.1473	-.1622	-.1035	.0385	.2674	.6249	1.0123	1.1895	.9323	.5619
10:25	.1659	-.5194	-.1034	-.1748	-.1036	.0325	.2760	.6392	1.0501	1.2280	.9666	.5341
10:30	.1399	-.5119	-.1013	-.1906	-.1176	.0261	.2763	.6479	1.0743	1.2553	.9845	.5619
10:35	.1959	-.5052	-.1037	-.1734	-.1080	.0239	.2530	.6001	.9788	1.1522	.9136	.4901
10:40	.1821	-.5218	-.1136	-.1709	-.1128	.0217	.2641	.6285	1.0451	1.2209	.9512	.5277
10:45	.1804	-.5125	-.0846	-.1614	-.0930	.0344	.2815	.6470	1.0852	1.2542	.9569	.5257
10:50	.2032	.0023	-.0932	-.1510	-.0832	.0274	.2766	.6360	1.0561	1.2238	.9343	.4958

II

TABLE II (continued)

WATTENBERG - UPRR22 HYDROFRACTURE

FRACTURE-JANUARY 27, 1976

TIME	180°	195°	210°	225°	240°	255°	270°	285°	300°	315°	330°	345°	
9:48	.2161	.2216	-.0836	-.1998	-.1352	.0045	.2422	.5982	.9797	1.1623	.9337	.5276	
9:51	.1608	-.0344	-.1289	-.1333	-.0673	.0474	.3012	.6772	1.1431	1.3064	.9737	.5312	
9:54	.1900	-.0082	-.0933	-.1749	-.1102	.0323	.2625	.6222	1.0150	1.1924	.9318	.5165	
9:57	.1881	-.0154	-.1098	-.1788	-.1025	.0350	.2813	.6529	1.1002	1.2775	.9848	.5574	
10:00	.1413	-.0593	-.1435	-.1159	-.0548	.0664	.2917	.6637	1.1465	1.2956	.9459	.4885	
10:03	.1801	-.0131	-.1139	-.1843	-.1130	.0223	.2645	.6292	1.0574	1.2323	.9545	.5351	
10:06	.1841	-.0050	-.1028	-.1735	-.1166	.0234	.2550	.6205	1.0280	1.2033	.9430	.5242	
10:09	.1592	-.0420	-.1265	-.1902	-.1205	.0134	.2479	.5972	.9798	1.1599	.9248	.5108	
10:12	.1489	-.0521	-.1341	-.1759	-.1057	.0225	.2598	.6214	1.0422	1.2170	.9378	.5170	
10:15	.1520	-.0398	-.1253	-.1880	-.1177	.0211	.2661	.6293	1.0371	1.2167	.9582	.5423	
10:18	.1734	-.0358	-.1138	-.1651	-.0994	.0357	.2649	.6257	1.0258	1.2031	.9361	.5126	
10:21	.1903	-.0247	-.1017	-.1603	-.0938	.0368	.2738	.6337	1.0447	1.2176	.9442	.5201	
10:24	.1779	-.0237	-.1088	-.1865	-.1162	.0203	.2619	.6215	1.0206	1.2007	.9491	.5397	
10:27	.1881	-.0205	-.1130	-.1719	-.1054	.0279	.2699	.6322	1.0355	1.2103	.9426	.5153	
10:30	.1451	-.0617	-.1354	-.1495	-.0901	.0323	.2619	.6247	1.0268	1.1943	.9159	.4930	
10:33	.1409	-.0597	-.1391	-.1502	-.0877	.0364	.2762	.6375	1.0542	1.2254	.9435	.5151	
10:36	.1799	-.0224	-.1107	-.1697	-.1052	.0237	.2571	.6139	1.0198	1.1934	.9230	.5035	
10:39	103,000 gal.	.1769	-.0275	-.1098	-.1525	.0366	.2753	.6347	1.0541	1.2283	.9423	.5168	
10:42		.1792	-.0236	-.1101	-.1599	.0374	.2674	.6332	1.0503	1.2226	.9429	.5158	
10:45		.2114	-.0359	-.0956	-.1649	.0332	.2672	.6353	1.0546	1.2239	.9369	.5134	
10:48		.1895	-.0181	-.0949	-.1888	.0237	.2588	.6183	1.0068	1.1872	.9424	.5261	
10:51		.1996	-.0052	-.0985	-.1661	.0312	.2767	.6369	1.0661	1.2381	.9522	.5249	
10:54		.1897	-.0131	-.1019	-.1895	.0174	.2609	.6210	1.0155	1.1975	.9483	.5275	
10:57		.1823	-.0325	-.1186	-.1730	.0316	.2701	.6335	1.0490	1.2238	.9445	.5215	
11:00		.2019	-.0053	-.0920	-.1718	.0206	.2575	.6158	1.0151	1.1926	.9280	.5105	
11:03		.1918	-.0041	-.1008	-.1778	.0266	.2584	.6253	1.0392	1.2165	.9429	.5301	
11:06		.1769	-.0118	-.1434	-.2079	.0221	.2610	.6254	1.0276	1.2066	.9358	.5254	
11:09		.1790	-.0258	-.1253	-.1913	.0148	.2514	.6212	1.0167	1.2019	.9495	.5469	
11:12		.1919	-.0058	-.0994	-.1641	.0273	.2647	.6220	1.0313	1.2040	.9304	.5079	
11:15		.1891	-.0340	-.1058	-.1745	.0254	.2683	.6391	1.0821	1.2542	.9545	.5292	
11:18		.1915	-.0123	-.1003	-.2108	-.0054	.2273	.5682	.8900	1.0085	.8918	.5103	
11:21		.1842	-.0080	-.1073	-.1706	.0247	.2620	.6235	1.0311	1.2034	.9310	.5316	
11:24		.1773	-.0246	-.1109	-.1745	.0210	.2621	.6266	1.0412	1.2176	.9437	.5315	
11:27		.2071	-.0093	-.0966	-.1503	.0585	.2947	.6764	1.1313	1.3042	.9791	.5467	
11:30		.1847	-.0453	-.1013	-.1645	.0319	.2655	.6290	1.0320	1.2096	.9386	.5228	
11:33		.1547	-.0750	-.1299	-.2110	.0150	.2560	.6336	1.0554	1.2407	.9714	.5642	
11:36		.1692	-.0234	-.1071	-.1885	.0155	.2524	.6273	1.0342	1.2146	.9469	.5410	
11:39	148,000 gal.	.1441	-.0615	-.1403	-.1968	.0243	.2515	.6078	.9839	1.1664	.9088	.4888	
11:42		1.8554	.5312	4.4527	-.1790	-.1149	.0156	.2524	.6170	1.0138	1.1962	.9384	.5285
11:54		.0002	-.0061	-.0934	-.1953	-.1168	.0322	.2766	.6494	1.0614	1.2432	.9814	.5713

TABLE II (continued)

WATTENBERG - UPRR22 HYDROFRACTURE

FRACTURE-JANUARY 27, 1976

TIME	180°	195°	210°	225°	240°	255°	270°	285°	300°	315°	330°	345°
11:57	.0000	.0399	-.0316	-.1802	-.1100	.0341	.2854	.6312	1.0089	1.1919	1.0563	.5375
12:03	.0001	.0114	-.0532	-.1541	-.1037	.0135	.2387	.5949	.9923	1.1606	.8835	.4897
12:06	-.0000	-.1366	-.1939	-.1731	-.1032	.0265	.2682	.5413	1.0724	1.2490	.9591	.5363
12:10	.1467	-.0227	-.1165	-.1589	-.0900	.0377	.2683	.5341	1.0671	1.2317	.9335	.5094
12:15	.1996	-.0074	-.0317	-.1297	-.0696	.0507	.2891	.5651	1.1105	1.2838	.9535	.5207
12:18	.2834	.0153	-.0843	-.1505	-.0372	.0425	.2728	.6322	1.0343	1.2883	.9332	.5125
12:21	.1316	-.1037	-.1335	-.1603	-.1103	.0223	.2682	.6372	1.0522	1.2419	.9552	.5374
12:24	.1920	-.1775	-.1091	-.1877	-.1153	.0201	.2603	.6271	1.0357	1.2142	.9517	.5371
12:27	.1777	-.0012	-.0408	-.1736	-.1107	.0216	.2445	.6136	1.0124	1.1861	.9232	.5053
12:30	.1674	-.0171	-.0312	-.1559	-.0818	.0211	.2801	.6628	1.1210	1.2876	.9656	.5296
12:33	.1903	-.0353	-.0823	-.2039	-.1514	-.0070	.2249	.5603	.8819	1.0728	.8096	.4911
12:36	.1903	-.0007	-.0843	-.1853	-.1273	.0059	.2381	.5854	.9463	1.1280	.9084	.5046
12:39	.1952	.0059	-.0771	-.1730	-.1050	.0317	.2625	.6357	1.0469	1.2223	.9543	.5370
12:42 190,000 gal.	.1395	-.0152	-.0440	-.1568	-.0995	.0365	.2663	.6376	1.0504	1.2287	.9439	.5201
12:45	.1792	-.0394	-.1031	-.1627	-.0917	.0373	.2710	.6448	1.0797	1.2533	.9562	.5327
12:48	.1754	-.0197	-.0924	-.1754	-.1075	.0250	.2583	.6270	1.0251	1.2029	.9369	.5157
12:51	.1390	-.0102	-.0384	-.1753	-.1185	.0162	.2454	.6001	.9673	1.1514	.9181	.5079
12:54	.1346	-.0324	-.0397	-.1710	-.1053	.0331	.2600	.6294	1.0178	1.2005	.9436	.5312
12:57	.2105	.0338	-.0003	-.5841	2.2244	.1311	.4126	.7167	1.1898	1.1687	2.2831	2.5356
13:00	.1863	.0001	-.0891	-.2203	-.1090	.0243	.2585	.6356	1.0552	1.2403	.9542	.5359
13:03	.1903	-.0336	-.0785	-.1811	-.1093	.0173	.2512	.6161	1.0147	1.1944	.9369	.5083
13:09	.1791	-.0394	-.0924	-.1757	-.1110	.0254	.2537	.6178	.9901	1.1712	.9283	.5182
13:15	.1392	-.0368	-.0475	-.1744	-.1032	.0323	.2651	.6336	1.0419	1.2291	.9562	.5387
13:18	.1792	-.0321	-.0309	-.1803	-.1238	.0137	.2468	.6125	1.0035	1.1968	.9413	.5309
13:21	.2021	.0126	-.0740	-.1020	-.0801	.0524	.2431	.6550	1.1070	1.2779	.9747	.5420
13:24	.1362	.0004	-.0915	-.1615	-.1036	.0236	.2584	.6255	1.0460	1.2223	.9399	.5119
13:30	.2009	.0129	-.0379	-.1795	-.1145	.0223	.2527	.6216	1.0227	1.2063	.9356	.5267
13:33	.1013	-.0193	-.0724	-.1346	-.0931	.0277	.2574	.6052	1.0281	1.1967	.9147	.4866
13:36	.1742	-.0440	-.0739	-.1863	-.1170	.0274	.2677	.6392	1.0425	1.2302	.9711	.5497
13:39 235,000 gal.	.2022	.0021	-.0035	-.1034	-.0981	.0341	.2647	.6373	1.0578	1.2287	.9454	.5237
13:42	.1857	-.0227	-.0801	-.1092	-.1009	.0278	.2594	.6369	1.0527	1.2343	.9480	.5252
13:45	.1731	-.0417	-.0897	-.1568	-.0878	.0431	.2371	.6010	1.1170	1.2904	.9681	.5358
13:51	.1570	-.0532	-.0743	-.2453	-.1071	.0271	.2625	.6377	1.0635	1.2407	.9512	.5202
13:54	.1614	-.0222	-.0222	-.1777	-.1044	.0246	.2542	.6234	1.0344	1.2150	.9395	.5125
14:00	.1897	-.0113	-.0940	-.1807	-.1122	.0236	.2535	.6226	1.0143	1.1980	.9359	.5221
14:03	.1815	-.1207	-.0353	-.1853	-.1199	.0135	.2459	.6073	.9891	1.1715	.9186	.5020
14:06	.1730	-.0316	-.0944	-.1795	-.1037	.0236	.2674	.6429	1.0755	1.2543	.9564	.5306
14:09	.1846	.0084	-.0355	-.2173	-.1514	-.0121	.2228	.5551	.8553	1.0523	.8895	.4954
14:15	.1756	-.0306	-.0893	-.1845	-.0921	.0393	.2713	.6477	1.0853	1.2539	.9446	.5201
14:18	.1601	-.0519	-.0904	-.2175	-.1352	.0028	.2465	.6249	1.0482	1.2416	.9002	.5012

TABLE II (continued)

WATTEBERG - UPRR22 HYDROFRACTURE

FRACTURE-JANUARY 27, 1976

TIME	180°	195°	210°	225°	240°	255°	270°	285°	300°	315°	330°	345°
14:21	.1676	-.0332	-.1035	-.1708	-.0952	.0349	.2714	.6593	1.1271	1.3016	.9671	.5392
14:24	.1957	-.0248	-.0684	-.1024	-.1095	.0284	.2619	.6251	1.0211	1.2019	.9370	.5181
14:27	.2114	-.0036	-.0538	-.1069	-.0955	.0360	.2726	.6375	1.0553	1.2334	.9457	.5198
14:30	.1956	-.0710	-.0750	-.1910	-.1172	.0180	.2489	.6193	1.0145	1.2010	.9368	.5237
14:33	.1939	-.0238	-.0573	-.1076	-.1221	.0070	.2290	.5935	.9702	1.1559	.9083	.4926
14:36	.2070	-.0043	-.0795	-.2157	-.1545	-.0189	.2116	.5438	.8636	1.0562	.8765	.4829
14:39	.1905	.0074	-.0827	-.1564	-.0901	.0346	.2605	.6164	1.0105	1.1898	.9175	.4903
14:42 270,000 gal.	.2114	-.0049	-.0338	-.1734	-.1098	.0211	.2542	.6157	1.0084	1.1881	.9242	.5052
14:45	.1618	-.0226	-.1031	-.2000	-.1227	.0120	.2509	.6205	1.0343	1.2205	.9473	.5326
14:48	.1655	-.0133	-.0868	-.1844	-.1083	.0326	.2696	.6419	1.0566	1.2403	.9645	.5421
14:51	.1649	-.0127	-.0838	-.1335	-.0949	.0557	.3092	.7127	1.2193	1.3858	1.0011	.5553
14:54	.1936	-.0032	-.0710	-.1755	-.1013	.0270	.2589	.6249	1.0279	1.2080	.9339	.5103
14:57	.1777	-.0286	-.1010	-.1788	-.1043	.0328	.2711	.6378	1.0552	1.2333	.9597	.5347
15:00	.1932	-.0197	-.0589	-.1866	-.1129	.0285	.2669	.6415	1.0560	1.2362	.9567	.5383
15:06	.1875	-.0353	-.0579	-.1848	-.1137	.0232	.2576	.6083	.9851	1.1695	.9262	.5007
15:09	.1791	-.0035	-.0747	-.1830	-.1284	.0565	.2379	.5916	.9705	1.1561	.9097	.5004
15:12	.1832	-.0096	-.0524	-.1800	-.1074	.0218	.2579	.6391	1.0629	1.2428	.9476	.5279
15:15	.1937	-.0112	-.0732	-.0516	.0345	.1450	.4011	.8564	1.5613	1.6888	1.1012	.6000
15:18	.1876	-.0138	-.0866	-.1638	-.0993	.0340	.2705	.6514	1.1086	1.2813	.9541	.5230
15:21 Stop Pumping	.1913	-.0203	-.0804	-.1669	-.0844	.0505	.2979	.6878	1.1666	1.3494	1.0055	.5616
15:24	.1836	-.0398	-.0344	-.0664	.0202	.1357	.3963	.8461	1.5421	1.6689	1.0326	.8008
15:27	.1870	-.0241	-.0865	-.1756	-.1061	.0234	.2667	.6290	1.0303	1.2119	.9420	.5222
15:30	.1704	-.0400	-.1497	-.2777	-.2358	-.0833	.1293	.3958	.4935	.7136	.7632	.4190
15:33	.1910	-.0356	-.0793	-.1560	-.0814	.0498	.2874	.6733	1.1282	1.3034	.9743	.5442
15:36	.1874	-.0040	-.0699	-.1683	-.0993	.0316	.2712	.6439	1.0984	1.2679	.9491	.5208
15:39	.1524	-.0511	-.1059	-.1888	-.1107	.0306	.2816	.6643	1.1223	1.3032	.9882	.5677
15:42	.1748	-.0311	-.0777	-.2125	-.1500	-.0040	.2323	.5603	.8909	1.0928	.9089	.4961
15:45	.1597	-.0408	-.0580	-.1812	-.1124	.0273	.2655	.6401	1.0500	1.2354	.9572	.5325
15:48	.1711	-.0354	-.0971	-.1209	-.0443	.0744	.3151	.7196	1.2420	1.4033	.9980	.5373
15:51	.1758	-.0540	-.0824	-.1448	-.0650	.0385	.2683	.6110	.9913	1.1365	.8782	.4735
15:54	.1755	-.0418	-.0843	-.1625	-.0888	.0436	.2898	.6744	1.1394	1.3150	.9857	.5412
15:57	.2035	-.0030	-.0763	-.1795	-.1068	.0296	.2712	.6445	1.0603	1.2429	.9567	.5335
16:00	.1750	-.0235	-.0897	-.1848	-.1168	.0178	.2524	.6184	1.0112	1.1939	.9310	.5124
16:03	.1751	-.0379	-.0898	-.1805	-.1165	.0167	.2553	.6266	1.0376	1.2192	.9395	.5153
16:06	.1751	-.0159	-.0824	-.1869	-.1119	.0205	.2565	.6197	1.0212	1.2059	.9390	.5148
16:09	.1611	-.0517	-.0956	-.1728	-.1021	.0312	.2593	.6381	1.0490	1.2293	.9444	.5227
16:12	.1794	-.0435	-.1057	-.1940	-.1221	.0137	.2550	.6259	1.0482	1.2287	.9523	.5326
16:15	.1902	-.0033	-.0742	-.1939	-.1190	.0205	.2504	.6246	1.0019	1.1940	.9431	.5344
16:18	.2144	.0224	-.0620	-.1433	-.0773	.0524	.2894	.6693	1.1117	1.2813	.9588	.5227
16:21	.2030	.0203	-.0710	-.1100	-.0316	.0879	.3278	.7363	1.2762	1.4365	1.0099	.5356

TABLE II (continued)

WATTENBERG - UPRR22 HYDROFRACTURE

FRACTURE-JANUARY 27, 1976

TIME	180°	195°	210°	225°	240°	255°	270°	285°	300°	315°	330°	345°
16:24	.2009	-.0197	-.0772	-.1799	-.1032	.0299	.2681	.6416	1.0486	1.2371	.9644	.5385
16:27	.2068	-.0126	-.0725	-.2251	-.1937	-.0047	.2335	.5934	.9503	1.1559	.9388	.5276
16:30	.1771	-.0391	-.0966	-.1693	-.1216	.0158	.2565	.6089	.9833	1.1599	.9147	.5105
16:39	.2158	-.0004	-.0551	-.0797	-.0059	.1238	.3503	.8123	1.4345	1.5844	1.3845	.6104
16:42	.1854	-.0553	-.0995	-.1621	-.0936	.0466	.2336	.6576	1.0556	1.2425	.9727	.5583
16:45 Start flush	.2032	-.0055	-.0830	-.1518	-.0985	.0442	.2829	.6588	1.0744	1.2687	.9892	.5615
16:48	.2198	.0307	-.0522	-.1552	-.0691	.0562	.3114	.7118	1.1954	1.3856	1.0358	.5904
16:51 Finish	.1923	-.0299	-.0920	-.2051	-.1442	-.0023	.2251	.5556	.8363	1.0327	.8920	.5084
16:54	.2030	.0135	-.0909	-.1359	-.0522	.0795	.3264	.7324	1.2319	1.4109	1.0350	.5914
16:57 Total Volume-297,000 gal.	.1905	-.0497	-.0952	-.2020	-.1351	.0105	.2497	.5864	.8900	1.0953	.9204	.5231
17:00	.2036	.0631	-.0767	-.1385	-.0639	.0655	.3061	.6956	1.1499	1.3191	.9655	.5571
17:03	.1986	-.0106	-.0917	-.1209	-.0473	.0802	.3315	.7464	1.2640	1.4380	1.0440	.5945
17:09	.2020	.0006	-.0413	-.1353	-.0635	.0694	.3303	.7136	1.1842	1.3750	1.0232	.5823
17:12	.2200	.0196	-.0703	-.1413	-.0784	.0579	.3134	.6787	1.1105	1.2864	.9734	.5663
17:15	.2313	.0359	-.0352	-.1340	-.0764	.0535	.2984	.6466	1.0484	1.2255	.9391	.5265
17:19	.1967	.0210	-.0506	-.1473	-.0621	.0579	.3585	.6647	1.0626	1.2483	.9718	.5661
17:21	.1943	-.0053	-.0706	-.2124	-.1929	-.0104	.2335	.5468	.8075	1.0153	.8787	.5109
17:23	.2000	-.0042	-.0997	-.1631	-.1150	.0258	.2475	.6254	.9813	1.1716	.9045	.5444
17:25	.1926	-.0156	-.1180	-.1572	-.0936	.0423	.2927	.6465	1.0493	1.2358	.9547	.5462
17:26	.1959	-.0122	-.1015	-.2452	-.2088	-.0607	.1671	.4422	.5849	.8667	.7942	.4476
17:28	.2180	.0135	-.0438	-.1499	-.0744	.0568	.3029	.6844	1.1442	1.3322	.9943	.5600
17:30	.2047	.0113	-.0945	-.0965	-.1175	.0173	.2639	.6039	.9577	1.1577	.9295	.5168
17:31	.1707	-.0134	-.1301	-.1150	-.0361	.0893	.3430	.7482	1.2940	1.4531	1.0147	.5624
17:33	.1795	-.0255	-.1135	-.1283	-.0450	.0732	.3334	.7356	1.3109	1.4661	1.0057	.5564
17:34	.1450	-.0583	-.0387	-.2029	-.1443	-.0131	.2261	.5900	.9140	0.0000	0.0000	0.0000

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