

WELL TEST REPORT
PUEBLO VALLEY 52-22A
DECEMBER 6, 1993

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FOR

ANADARKO PETROLEUM COMPANY
835 Piner Road
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January 14, 1994

ANADARKO
PETROLEUM CORPORATION
PROPRIETARY DATA

WELL TEST REPORT
PUEBLO VALLEY 52-22A

SUMMARY

On December 6, 1993, a flow test was conducted on Pueblo Valley 52-22A located near Fields, Oregon. This well is a second stepout to Anadarko's discovery Well 25-22A. Pueblo Valley 52-22A was drilled with a core rig to a total depth of 2520'. The well was completed with 4-1/2" casing set at 1322'. The open hole section from 1322' to total depth was drilled with an HQ(3.8") diamond core bit. During a four-hour flow period, the combined flow rate of steam and hot water through a 4" flow-line stabilized at 193 GPM (11% flash). Wellhead temperature was 290 degrees F and flowing wellhead pressure was 68 psia. Wellhead pressures were recorded on Wells 25-22A and 66-22A starting well before the flow period and ending several hours after the end of the test.

Downhole pressure measurements were made with a quartz transducer attached to a capillary tubing hung at 2150' along with a Kuster temperature instrument. This is just above a fractured interval at 2194' where a significant loss of circulation was encountered during coring. A brecciated zone believed to be the productive interval, occurs from 2270-2300'. Flowing downhole temperature stabilized at 311.5 degrees F. A drawdown of 2.8 psi was measured while producing a total flow of 193 gpm. As was the case with the other wells, this well is capable of considerably higher producing rates with additional drawdown.

During the last 15 minutes of the flow test, something occurred that lowered both downhole and surface pressures. This was not associated with the shut-in but was likely the removal of a restriction in the flow line, such as some scale breaking off.

Figure 1 shows the surface and downhole data as it was collected in 15 minute intervals during the flow test.

The well was shut-in at 2:15 pm. Pressure fully recovered in less than 10 minutes. Using Horner pressure analysis, an estimate of transmissivity (KH) for the producing interval of 698,000 md-ft was obtained using a Horner buildup plot. Skin factor of 1.5 was also obtained.

TEST RESULTS

Prior to flowing the well, a pressure and temperature survey was conducted to measure static downhole conditions. While going in the hole, the Kuster instruments encountered an obstruction at 2296', 224' above total depth. This area of the well from 2270-2300' contains extensive fracturing and probably

is the producing interval. This section could be irregular and present vugs and cracks to the logging tools and prevent passage. It may also be possible that a bridge has formed, thus preventing the wireline instruments from reaching bottom. Figure 2 shows the temperature and pressure profiles of the well prior to discharge. The sharp increase in temperature gradient occurring at 2190' is consistent with the first loss of circulation and the beginning of the productive interval. Static temperature reached a maximum of 305 degrees F at 2296', but would have been higher if the temperature instrument could have gone deeper. After pulling up to 2150', the instrument was allowed to hang for 30 minutes. Maximum temperature observed during this 30 minute period was 311 F. For all practical purposes, this is the same temperature that was measured during the flow period.

Discharge of the well was started at 10:15 am on December 6, 1993, and continued for four hours. Figure 3 is a Schematic Flow Diagram of the Test. Effluent from the well was piped to a separator and discharged into a baker tank. Water flow was gauged through a weir box and also through sight gauges installed on the tanks. Figure 4 is a plot of the data measured at the surface. Water production and wellhead pressure stabilized after about 2 hours at 173 GPM and 68 psia respectively. The data show an anomalous decrease in wellhead pressure and an increase in wellhead temperature near the end of the test. Downhole pressure also decreased 0.5 psi. Since there was no deliberate attempt to regulate the well and the behavior is not indicative of a reservoir productivity, this anomaly was probably caused by removal of some restriction at the surface such as some calcium carbonate scale breaking loose. Total withdrawal of 193 GPM is based on a flash fraction of 11% assuming theoretical mass and energy balances.

Figure 5 is a plot of the downhole pressure during and after the flow period. Three events are clearly shown. Behavior during the first hour-and-a-half shows the effects of well cleanup. After that, pressure gradually stabilizes to around 939.7 psia until the last 15 minutes when a decrease of 0.5 psi occurs. If not for this event, pressure behavior would be considered very straightforward.

After four hours of flow the well was shut-in at 2:15 pm. The subsequent pressure buildup was rapid and typical of a fractured system and similar to the buildup observed in Well 25-22A. Pressure transient analysis of the buildup data (see Figure 6, Horner Plot) results in a transmissivity of 698,000 md-ft and a skin factor of 1.5. The slightly positive skin factor is probably attributable to drilling mud that was lost into the producing interval and did not cleanup completely.

A reliable type-curve match was not obtained to verify the Horner analysis, but the results seem reasonable when compared to the other wells.

PRESSURE INTERFERENCE BETWEEN WELLS

A wellhead pressure gauge has been recording data at Well 25-22A since October 22, 1993. For the most part, daily variations in wellhead pressure of 0.1 psi were typically observed. During the flow test of Well 52-22A, the data show no observable indication of interference. Likewise a wellhead pressure gauge was installed at Well 66-22A. From the beginning of the flow test to 23.5 hours after the test, pressure varied 0.05 psi on either side of the initial pressure. Again this pressure behavior showed no indication of interference.

COMPARISONS TO 25-22A and 66-22A

The following comparisons may be made with the two prior Pueblo Valley wells.

	52-22A	66-22A	25-22A
	-----	-----	-----
Temperature(deg F)	312	325	310
Depth to production(ft)	2194	2076	1100
Total flow rate(GPM)	193	292	400
Productivity Index(PI)	69	29	100
KH(md-ft)	698,000	?>1,000,000	
Skin Factor	1.5	?	-.12

CONCLUSIONS

1. Pueblo Valley 52-22A produced 312 F hot water at a rate of 193 GPM from a zone at 2200'.
2. Transmissivity was calculated from a Horner plot to be 698,000 md-ft. Skin factor was 1.5.
3. Temperatures could well exceed 312 F below 2300'
4. The well has artesian pressure of 50 psia at static conditions.
5. The well produced at a total withdrawal rate of 193 GPM with a drawdown of 2.8 psi. Assuming a linear productivity index (PI), the well would be capable of 2000 GPM with a drawdown of 29 psi.
6. There is an obstruction in the well at 2296' that precluded any further logging.

7. Based on the test results so far from the three Pueblo Valley wells, there is a commercial geothermal resource available for development using binary technology. Several such binary power plants using resources with similar downhole temperatures as Pueblo Valley are operating in Nevada. The geochemistry of the geothermal system suggests that much higher temperatures do exist and if encountered, could provide added value to the development.

FIGURES

FIGURE 1

FLOW TEST DATA - 12/06/93
 PUEBLO VALLEY WELL 62-22A
 ANADARKO PETROLEUM COMPANY

TIME	WATER FLOW *(GPM)	FWHP (PSIA)	FWHT (DEG F)	FDHP (PSIA)	FDHT (DEG F)	DELTA P (PSI)
10:15 AM		47	270	940.0	277.9	
	216	59	280	939.3	310.8	3.2
	246	63	284	939.6	311.5	2.9
	242	64	286	939.6	311.5	2.9
11:15 AM	220	65	288	939.9	311.5	2.6
	204	66	288	940.0	311.5	2.5
	204	67	289	939.9	311.5	2.6
	188	67	289	940.1	311.5	2.4
12:15 PM	188	67	290	939.9	311.5	2.6
	182	67	290	939.8	311.5	2.7
	176	68	290	939.8	311.5	2.7
	176	68	290	939.8	311.5	2.7
1:15 PM	176	68	290	939.7	311.5	2.8
	176	68	290	939.7	311.5	2.8
	173	68	290	939.7	311.5	2.8
	173	68	290	939.7	311.5	2.8
2:15 PM	173	65	293	939.2	311.5	3.3

Notes:

* Measured with wier

DOWNHOLE MEASUREMENTS MADE @ 2150'
 STATIC PRESSURE = 942.5 PSIA
 STATIC TEMPERATURE = 311 deg F



DATE: 12/05/93
TIME: 14:30:00

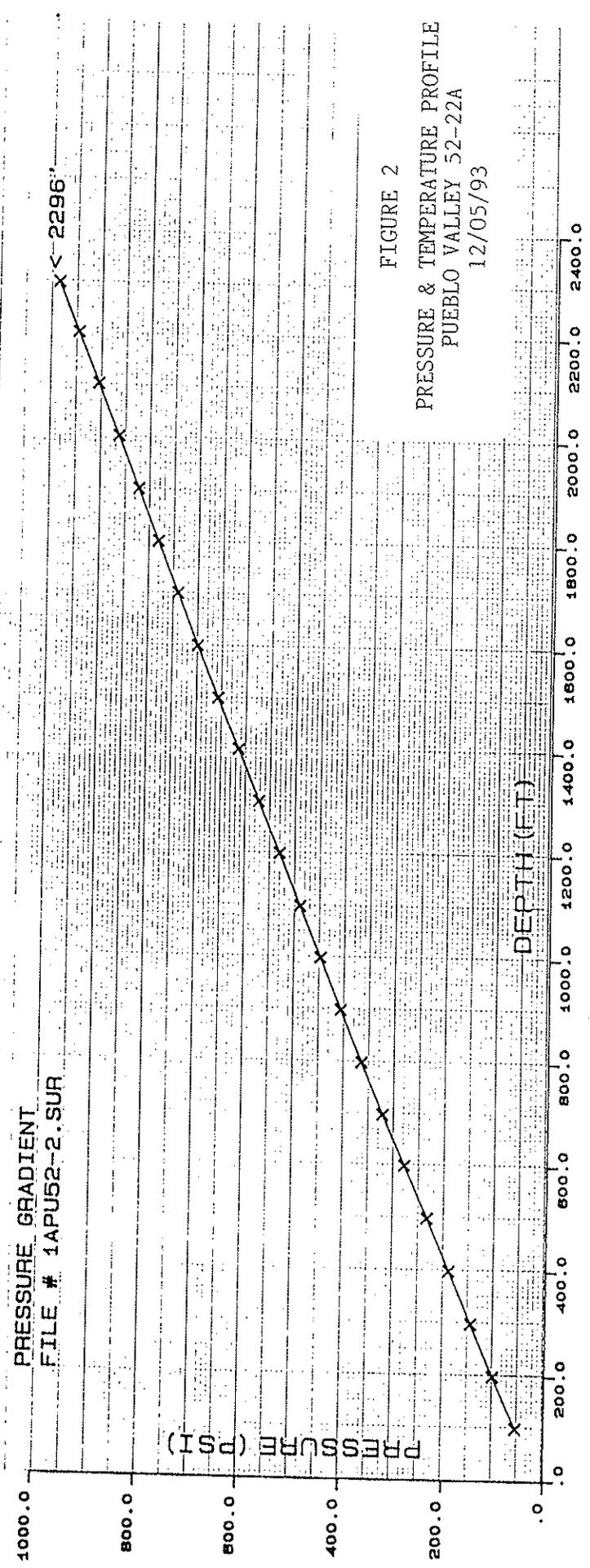
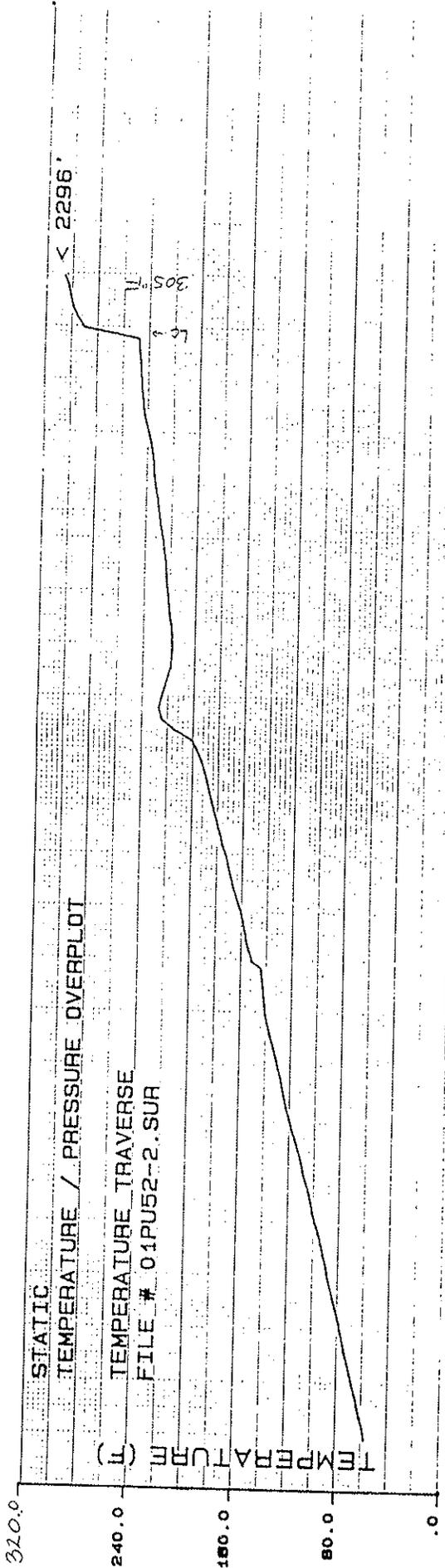
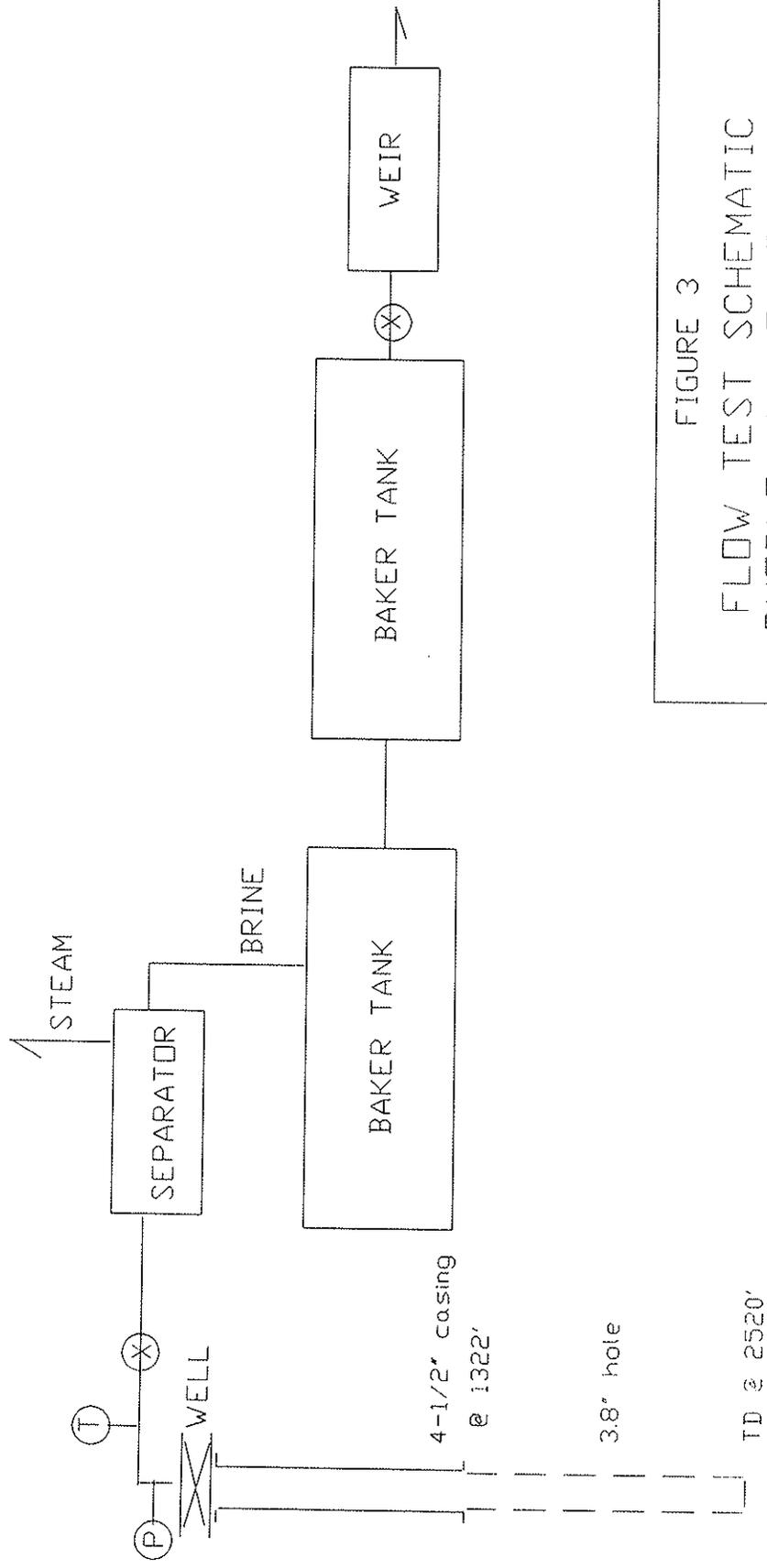


FIGURE 2
PRESSURE & TEMPERATURE PROFILE
PUEBLO VALLEY 52-22A
12/05/93



NOTE: P & T Instruments
in hole @ 2150'

FIGURE 3
FLOW TEST SCHEMATIC
PUEBLO VALLEY 52-22A
ANADARKO PETROLEUM COMPANY
12/6/93

FIGURE 4

WELL TEST DATA

PUEBLO VALLEY 52-22A

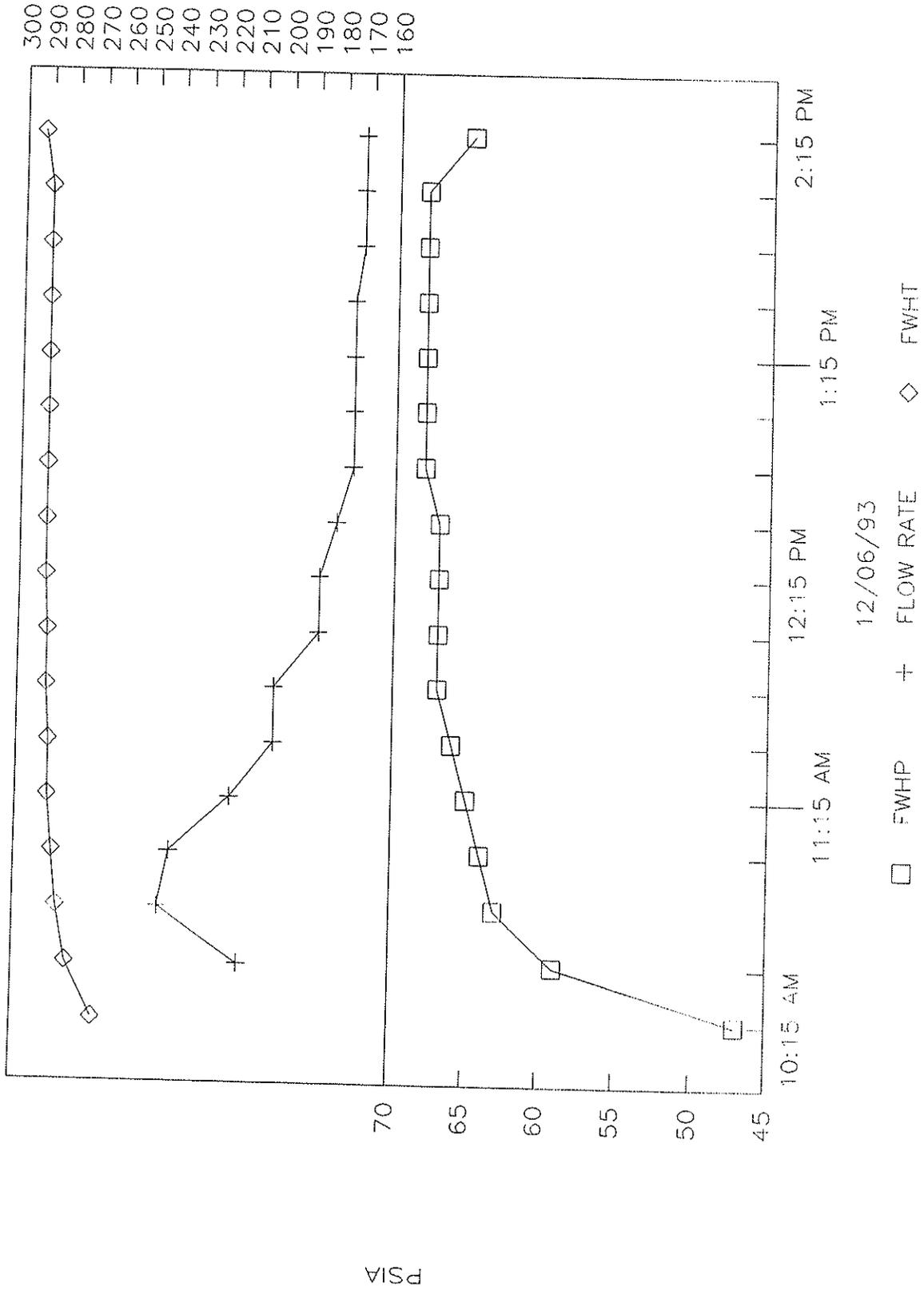


FIGURE 5
FLOWING DOWNHOLE PRESSURE
PUEBLO VALLEY 52-22A

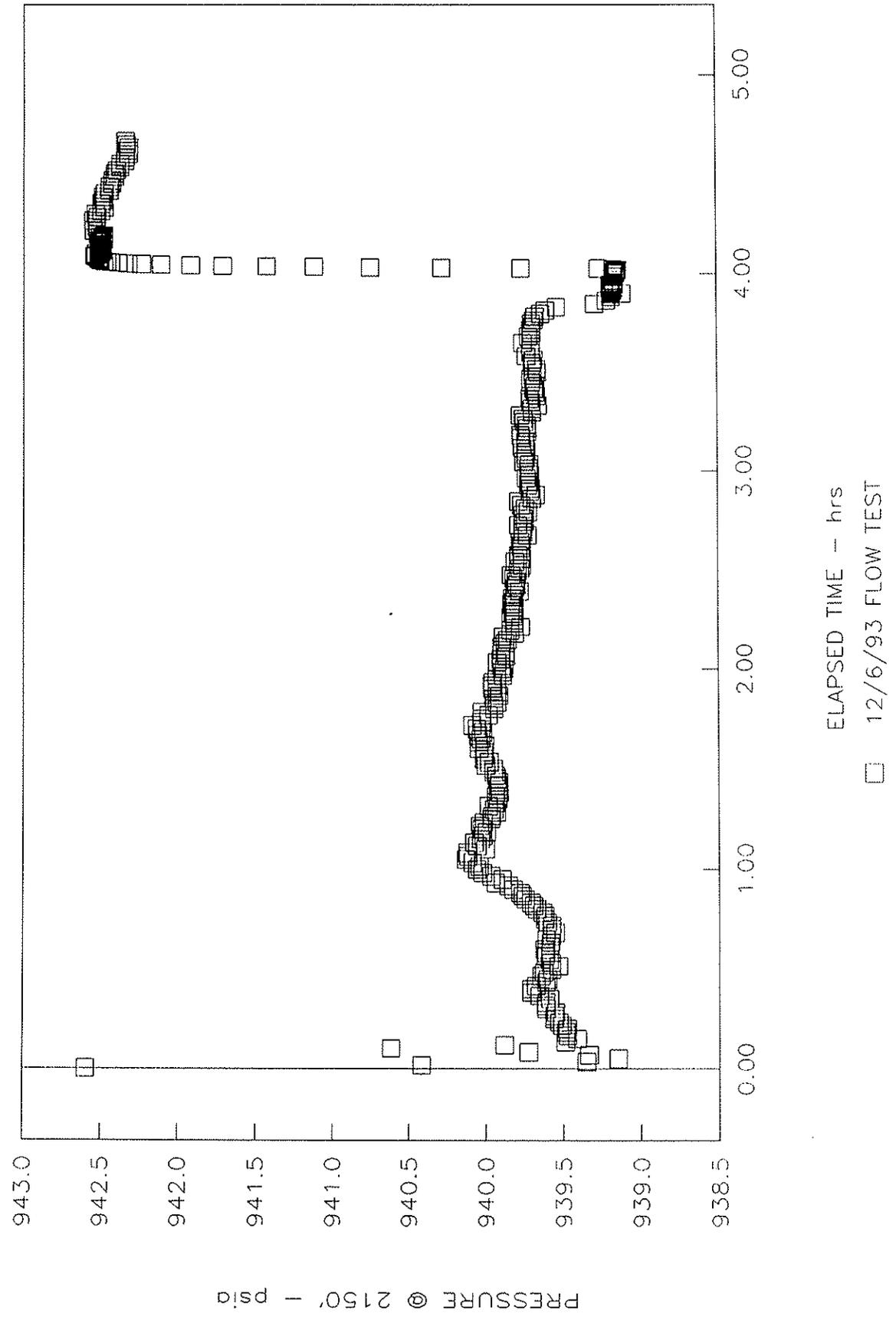
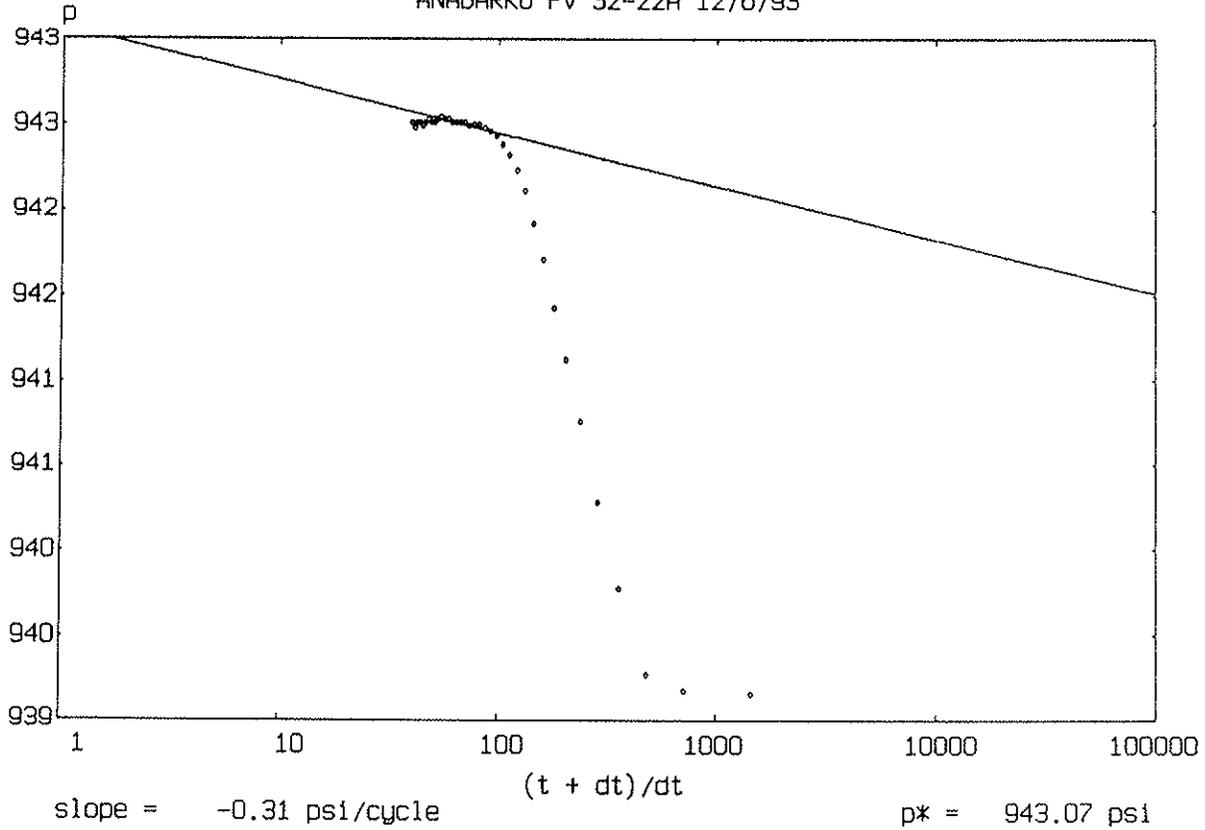


FIGURE 6
 HORNER SEMI-LOG PLOT
 ANADARKO PV 52-22A 12/6/93



TEST INFORMATION:

Rate = -6617.00 bbl/Day
 Volume Factor = 1.12000
 Viscosity = 0.18000 cp
 Porosity = 0.05000
 Compressibility = 0.00000300 1/psi
 Wellbore radius = 0.170000 ft
 Thickness = 10.00 ft

ANALYSIS RESULTS: (Horner Method)

p (1 hr) = 942.86 psi Slope = -0.31 psi/cycle
 p^* = 943.07 psi
 Est kh = 697636.6984 md-ft Est k = 69763.6698 md
 Est Skin = 1.53

