

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

CORE ANALYSIS REPORT

FOR

CITIES SERVICES OIL CO.

STATE "DS" NO. 1
BRAVO DOME CO2
HARDING COUNTY, NEW MEXICO

CITIES SERVICES OIL CO. DATE : 5-6-81 FILE NO : AEE12314
STATE "IS" NO. 1 FORMATION : TURR ANALYSTS : REINHEIMER
BRAVO DOME CO2 DRILG. FLUID: FRESH WATER MUD LABORATORY: MIDLAND TEXAS
HARDING COUNTY, NEW MEXICO LOCATION : 1980' FNL & 1980' FEL, SEC. 29, T-18-N, R-30-F

FULL DIAMETER ANALYSIS

SAMPLE NUMBER	DEPTH FEET	PERM MAXIMUM	PERM 90 DEG	HE FOR	GRAIN DEN	DESCRIPTION
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CORE NO. 1 2002.0-2062.0 CUT 60' REC 59.2'

1	2002.0-3.0	8.2	8.2	19.0	2.68	SD SL/SHY SL/LMY SHLAM
2	2003.0-4.0	17.	17.	19.1	2.66	IDL SL/LMY
3	2004.0-5.0	7.2	7.2	18.3	2.66	SD SL/LMY
4	2005.0-6.0	2.3	2.2	16.5	2.67	SD
5	2006.0-7.0	7.9	7.6	17.9	2.68	SD SL/LMY
6	2007.0-8.0	0.37	0.34	10.7	2.69	SD F
7	2008.0-9.0	0.04	0.04	12.1	2.68	SD
8	2009.0-10.0	0.06	0.04	9.6	2.69	SD
9	2010.0-11.0	0.62	0.56	14.1	2.69	SD SL/LMY
10	2011.0-12.0	7.9	7.6	17.8	2.66	SD SL/LMY
11	2012.0-14.0					NA SH
12	2014.0-15.0	1.4	1.4	16.1	2.65	SD SL/LMY
13	2015.0-16.0	1.0	0.99	11.9	2.69	SD
14	2016.0-17.0	3.3	3.1	15.1	2.67	SD SL/LMY
15	2017.0-22.0					NA SH
16	2022.0-23.0	2.9	2.7	16.3	2.67	SD
17	2023.0-24.0	8.3	8.0	19.0	2.68	SD SL/LMY
18	2024.0-25.0	5.7	5.5	17.8	2.67	SD
19	2025.0-26.0	8.0	8.0	19.7	2.69	SD SL/LMY SL/SHY
20	2026.0-27.0	11.	11.	18.8	2.66	SD
21	2027.0-28.0	11.	11.	19.1	2.67	SD
22	2028.0-29.0	15.	14.	19.4	2.67	SD SL/LMY
23	2029.0-30.0	21.	21.	20.6	2.68	SD SL/LMY
24	2030.0-31.0	22.	18.	20.0	2.66	SD

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FORMATION : TUBB

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ANALYSTS : REINHEIMER

FULL DIAMETER ANALYSIS

SAMPLE NUMBER	DEPTH FEET	PERM MAXIMUM	PERM 90 DEG	HE POR	GRAIN DEN	DESCRIPTION
23	2031.0-32.0	17.	17.	19.4	2.61	SD SL/LMY
24	2032.0-33.0	13.	13.	18.7	2.67	SD SL/LMY
25	2033.0-34.0	6.8	6.6	16.8	2.68	SD SL/LMY
26	2034.0-35.0	11.	10.	17.2	2.69	SD SL/LMY
27	2035.0-36.0	11.	11.	18.4	2.67	SD SL/LMY
28	2036.0-37.0	5.4	5.4	15.6	2.68	SD SL/LMY
29	2037.0-38.0	7.9	7.9	17.5	2.67	SD SL/LMY
30	2038.0-39.0	6.3	6.1	15.5	2.68	SD SL/LMY
31	2039.0-40.0	11.	10.	16.6	2.67	SD SL/LMY SHLAM
32	2040.0-41.0	7.2	6.5	14.4	2.67	SD SL/LMY SHLAM
	2041.0-49.0					NA SH
33	2049.0-50.0	0.33	0.25	14.0	2.66	SD VF
34	2050.0-51.0	0.78	0.67	13.6	2.66	SD
35	2051.0-52.0	0.51	0.45	13.4	2.66	SD SL/LMY VF
36	2052.0-53.0	0.32	0.23	12.4	2.65	SD SL/LMY SHLAM
37	2053.0-54.0	0.19	0.14	11.9	2.66	SD SL/LMY
38	2054.0-55.0	1.1	1.1	12.8	2.66	SD SL/LMY SHLAM
	2055.0-56.0					NA SH
39	2056.0-57.0	0.16	0.14	11.9	2.69	SD SL/LMY
40	2057.0-58.0	0.15	0.11	10.3	2.66	SD SL/LMY
41	2058.0-59.0	0.10	0.06	10.0	2.72	SD SL/LMY
42	2059.0-60.0	0.11	0.11	9.0	2.65	SD SL/LMY
	2060.0-61.2					NA SH
43	2061.0-62.0					LOST CORE

CORE NO. 2 2062.0-2122.0 CUT 60' REC 60'

2062.0-64.0 NA SH SL/SDY

2064.0-65.0 SD

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SAMPLE NUMBER	DEPTH FEET	PERM MAXIMUM	PERM 90 DEG	HE FOR	GRAIN DEN	DESCRIPTION
44	2065.0-66.0	2.7	2.7	17.6	2.67	SD
45	2066.0-67.0	4.6	4.6	17.7	2.69	SD
46	2067.0-68.0	6.8	6.4	18.1	2.68	SD
47	2068.0-69.0	6.7	6.5	18.4	2.69	SD
48	2069.0-70.0	7.5	7.5	18.1	2.67	SD
49	2070.0-71.0	2.7	2.6	19.9	2.66	SD
50	2071.0-72.0	18.	18.	19.1	2.66	SD SL/LMY
51	2072.0-73.0	11.	11.	17.9	2.66	SD
52	2073.0-74.0	10.	10.	17.4	2.65	SD SL/LMY
53	2074.0-75.0	6.0	5.7	13.6	2.66	SD SL/LMY
54	2075.0-76.0	0.14	0.07	5.9	2.70	SD SL/LMY
55	2076.0-80.0					NA SH
	2080.0-81.0	0.32	0.28	10.9	2.67	SD SL/LMY
	2081.0-82.0					NA SH SL/SDY
56	2082.0-83.0	4.6	4.2	17.3	2.65	SD
	2083.0-84.0					NA SH
57	2084.0-85.0	6.4	6.2	18.0	2.65	SD
58	2085.0-86.0	10.	9.1	18.2	2.64	SD
59	2086.0-87.0	3.4	3.1	17.3	2.64	SD
60	2087.0-88.0	3.5	3.5	17.3	2.64	SD
61	2088.0-89.0	2.4	2.3	16.9	2.65	SD
62	2089.0-90.0	1.9	1.8	16.5	2.66	SD
63	2090.0-91.0	9.4	8.8	20.3	2.69	SD
64	2091.0-92.0	7.6	7.3	18.6	2.66	SD
65	2092.0-93.0	29.	28.	21.6	2.67	SD
66	2093.0-94.0	28.	28.	20.7	2.65	SD PP
67	2094.0-95.0	117.	114.	22.7	2.67	SD PP
68	2095.0-96.0	53.	52.	18.3	2.64	SD SL/LMY PP
69	2096.0-97.0	51.	50.	19.3	2.63	SD SL/LMY PP
70	2097.0-98.0	47.	47.	18.8	2.65	SD SL/LMY PP

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SAMPLE NUMBER	DEPTH FEET	PERM MAXIMUM	PERM 90 DEG	HE POR	GRAIN DEN	DESCRIPTION
71	2098.0-99.0	27.	26.	15.9	2.65	SD SL/LMY PP
72	2099.0- 0.0	4.5	4.2	13.9	2.68	SD
	2100.0-14.0					NA SH SL/SDY
73	2114.0-15.0	0.68	0.37	11.7	2.66	SD
74	2115.0-16.0	2.3	1.0	12.0	2.68	SD VF
75	2116.0-17.0	0.49	0.39	7.7	2.68	SD VF
76	2117.0-18.0	1.7	0.33	7.2	2.69	SD VF
77	2118.0-19.0	1.6	1.6	16.2	2.65	SD SL/LMY
78	2119.0-20.0	2.5	2.5	16.6	2.65	SD
79	2120.0-21.0	3.0	2.9	17.4	2.70	SD
80	2121.0-22.0	6.0	5.7	16.9	2.64	SD SL/LMY
CORE NO. 3 2122.0-2164.0 CUT 42' REC 33'						
81	2122.0-23.0	2.0	1.9	16.1	2.67	SD SHY SL/LMY
82	2123.0-24.0	3.2	3.1	17.1	2.67	SD SL/LMY SL/SHY
83	2124.0-25.0	1.9	1.9	14.7	2.68	SD SL/SHY SL/LMY
84	2125.0-26.0	1.3	1.3	15.1	2.67	SD SL/SHY SL/LMY SHLAM
85	2126.0-27.0	0.51	0.46	12.5	2.68	SD SL/SHY SL/LMY SHLAM
	2127.0-32.0					NA SH
86	2132.0-33.0	0.42	0.37	9.8	2.65	SD SHY F
87	2133.0-34.0	0.30	0.30	7.4	2.66	SD
* 88	2134.0-35.0	3.3	<0.01	13.9	2.66	SD SL/SHY
89	2135.0-36.0	17.	13.	13.6	2.65	SD
90	2136.0-37.0	557.	510.	15.7	2.64	SD
91	2137.0-38.0	163.	162.	14.3	2.65	SD F
92	2138.0-39.0	15.	14.	11.3	2.62	SD
93	2139.0-40.0	18.	18.	11.8	2.63	SD
94	2140.0-41.0	4.7	4.2	11.3	2.63	SD

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SAMPLE NUMBER	DEPTH FEET	PERM MAXIMUM	PERM 90 DEG	HE FOR	GRAIN DEN	DESCRIPTION
95	2141.0-42.0	45.	21.	12.6	2.63	SD
96	2142.0-43.0	0.14	0.14	9.5	2.70	SD
97	2143.0-44.0	0.28	0.28	9.6	2.64	SD SL/F
98	2144.0-45.0	1.1	0.56	7.7	2.69	SD SL/F
99	2145.0-48.0					NA SH
100	2148.0-49.0	<0.01	4.0	2.9	2.64	SD
101	2149.0-50.0	2.9	1.4	8.1	2.63	SD
102	2150.0-51.0	0.24	0.20	6.3	2.63	SD
	2151.0-52.0	0.35	0.35	5.7	2.63	SD SL/F
	2152.0-55.0					NA SH
	2155.0-64.0					LOST CORE
CORE NO. 4 2164.0- 2203.0 CUT 39' REC 30'						
103	2164.0-65.0					SD
104	2165.0-66.0	0.20	0.25	6.0	2.71	SD SL/LMY
105	2166.0-67.0	1.1		8.9	2.72	SD
106	2167.0-68.0	66.	60.	14.4	2.61	SD
107	2168.0-69.0	78.	71.	15.5	2.63	SD
108	2169.0-70.0	9.7		12.6	2.68	SD
109	2170.0-71.0	4.0	2.4	8.3	2.62	SD
	2171.0-72.0	8.4	8.0	9.7	2.63	SD
	2172.0-76.0					NA CONGL
110	2176.0-77.0	0.37	0.34	4.3	2.66	SD LMY CONGL
111	2177.0-78.0	6.1	4.9	9.6	2.63	SD CONGL
112	2178.0-79.0	56.	52.	14.4	2.67	SD CONGL
	2179.0-81.0					NA CONGL
113	2181.0-82.0	3.1	1.7	5.2	2.66	SD SL/LMY F CONGL
	2182.0-85.0					NA CONGL

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FULL DIAMETER ANALYSIS

SAMPLE NUMBER	DEPTH FEET	PERM		HE FOR	GRAIN DEN	DESCRIPTION
		MAXIMUM	90 DEG			
114	2185.0-86.0	5.6	3.7	4.9	2.67	SD SL/F CONGL
	2186.0-89.0					NA CONGL
115	2189.0-90.0	11.	8.1	5.3	2.67	SD SL/F CONGL
	2190.0-94.0					NA CONGL
	2194.0 - 03.0					LOST CORE

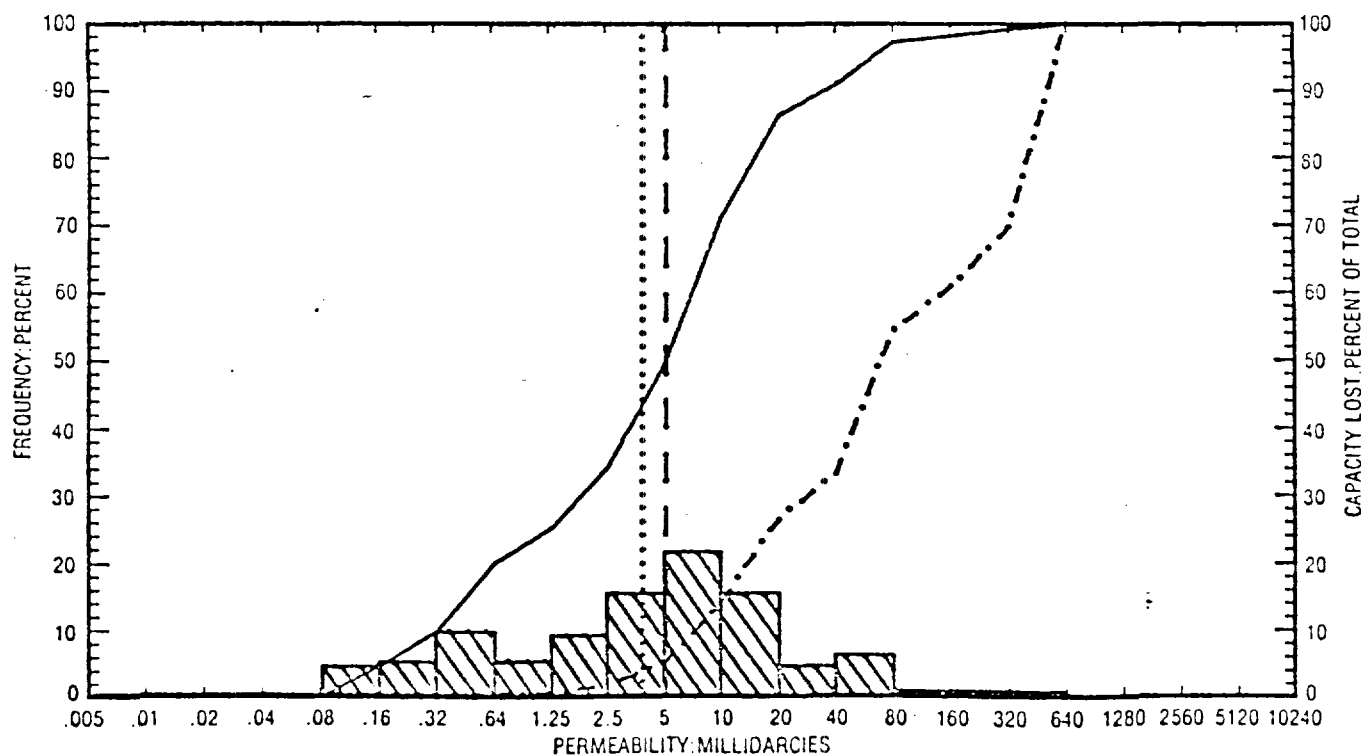
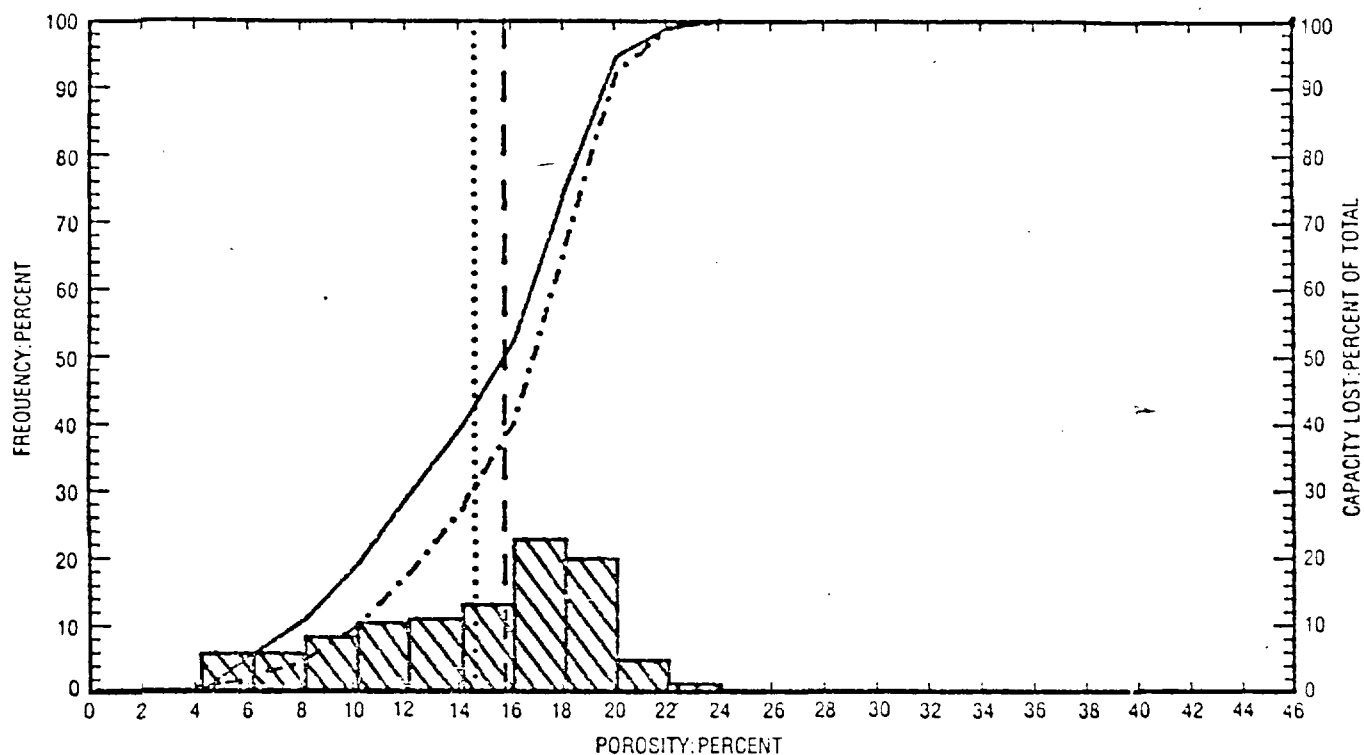
* INDICATES PLUG PERMEABILITY

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LITHOLOGICAL ABBREVIATIONS

ANH(Y)	ANHYDRITE, ANHYDRITIC	LM(Y)	LIMESTONE, LIMY
ARK	ARKOSE, ARKOSIC	MG	MEDIUM GRAINED
BAN	BAND, BANDED	MTX	MATRIX
BREC	BRECCIA, BRECCIATED	NA	INTERVAL NOT ANALYZED (AT REQUEST OF CLIENT)
CALC	CALCITE, CALCAREOUS	NOD	NODULE, NODULAR
CARB	CARBONACEOUS	OO	OOOLITIC
CG	COARSE GRAINED	PISO	PISOLITIC
CHK(Y)	CHALK, CHALKY	PP	PINPOINT POROSITY
CHT(Y)	CHERT, CHERTY	PT	PARTING
CONGL	CONGLOMERATE, CONGLOMERITIC	PYR	PYRITE, PYRITIC
CXLN	COARSELY CRYSTALLINE	SD(Y)	SANDSTONE, SANDY
DNS	DENSE	SH(Y)	SHALE, SHALY
DOL(C)	DOLOMITE, DOLOMITIC	SHR	SOLID HYDROCARBON RESIDUE
F	RANDOMLY ORIENTED FRACTURES	SL/	SLIGHTLY
FG	FINE GRAINED	SLT(Y)	SILT, SILTY
FOSS	FOSSILIFEROUS	STY	STYLOLITE, STYLOLITIC
FR	FRIABLE	SUC	SUCROSCIC
FXLN	FINELY CRYSTALLINE	SUL	SULPHUR
GAL	GALENA	TBFA	TOO BROKEN FOR ANALYSIS
GLAUC	GLAUCONITE, GLAUCONITIC	TRIP	TRIPOLITE
GRAN	GRANITE	V/	VERY
GUP	GYPSEUM, GYPSIFEROUS	VF	PREDOMINANTLY VERTICALLY FRACTURED
HF	PREDOMINANTLY HORIZONTALLY FRACTURED	V	VUGULAR
INC	INCLUSION	XBD	CROSSEDDED
INTBD	INTERBEDDED	XLN	MEDIUM CRYSTALLINE
LAM	LAMINATED	XTL	CRYSTAL

THE FIRST WORD IN THE DESCRIPTION COLUMN OF THE CORE ANALYSIS REPORT DESCRIBES THE ROCK TYPE. FOLLOWING ARE ROCK MODIFIERS IN DECREASING ABUNDANCE AND MISCELLANEOUS DESCRIPTIVE TERMS.



PERMEABILITY AND POROSITY HISTOGRAMS

CITIES SERVICES OIL CO.
STATE "DS" NO. 1
BRAVO DOME CO2
HARDING COUNTY, NEW MEXICO

LEGEND
ARITHMETIC MEAN POROSITY
GEOMETRIC MEAN PERMEABILITY
MEDIAN VALUE
CUMULATIVE FREQUENCY
CUMULATIVE CAPACITY LOST

1000.

100.

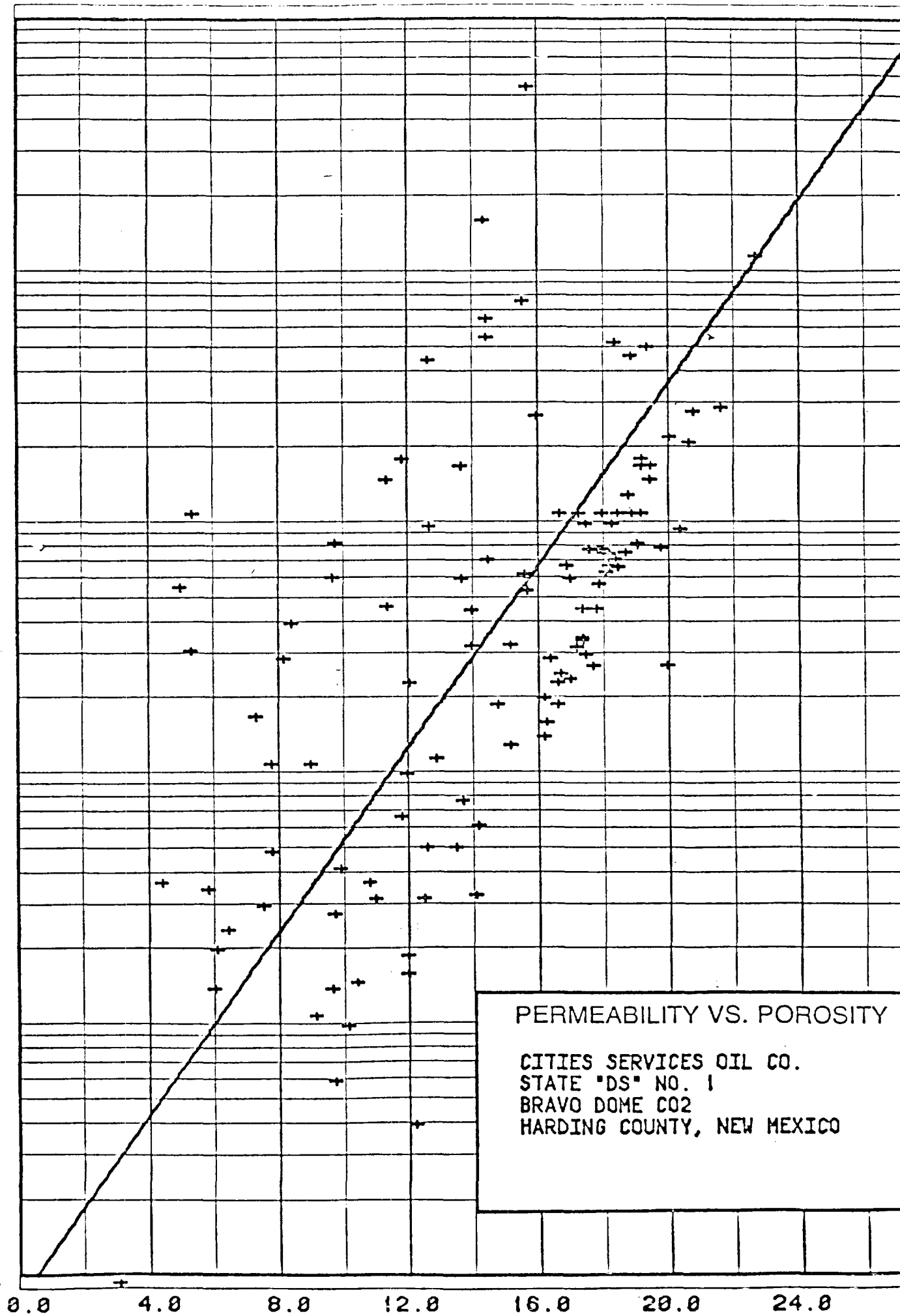
PERMEABILITY: MILLIDARCIES

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0.01



RESERVOIR PARAMETERS

WEST BRAVO DOME AREA

Average Net Pay	26 Feet
Average Porosity	18 %
Average Water Saturation	50%
Average Reservoir Pressure	650 PSI
Gas Formation Volume Factor	57 SCF/RCF
Recovery Factor	80%

$$\text{OGIP} = (640 \text{ Ac}) (43,560 \text{ Ft}^2/\text{Ac}) (26 \text{ Ft}) (.18) (.50) (57) = 3.7 \text{ BCF/Section}$$

$$\text{Reserves} = (3.7 \text{ BCF/Section}) (.80) = 3.0 \text{ BCF/Section (640 acres)}$$

Analysis of 18 wells (Cities Service)

COMPARISON OF PAY QUALITY BY LOG ANALYSIS

	INTERVAL	NET PAY*	AVG. ϕ	AVG. Sw (Water Saturation)
<u>WEST BRAVO DOME AREA</u> (Cities Service)				
State "DC" No. 1	1996-2058	31	.210	.45
State "DD" No. 1	1946-1994	33	.195	.51
State "DE" No. 1	1926-1994	30	.185	.56
State "DF" No. 1	1934-2053	52	.220	.48
State "DG" No. 1	2075-2096	22	.200	.42
State "DH" No. 1	2763-2767	4	.180	.57
State "DK" No. 1	2038-2053	10	.160	.52
State "DL" No. 1	2640-2717	7	.165	.50
State "DM" No. 1	1978-2063	44	.185	.49
State "DN" No. 1	1972-1993	17	.200	.45
State "DO" No. 1	2026-2038	8	.160	.60
State "DS" No. 1	1994-2033	16	.160	.60
Trujillo No. 1	2800-2880	23	.160	.55
Smith No. 1	2924-2990	42	.185	.55
<u>AMOCO BDCDGU WELLS</u>				
1931 351	2116-2142	20	.180	.58
1933 351G	2494-2596	41	.210	.50
1835 071A	2110-2302	100	.210	.45

*Porosity >.12, Sw<.60

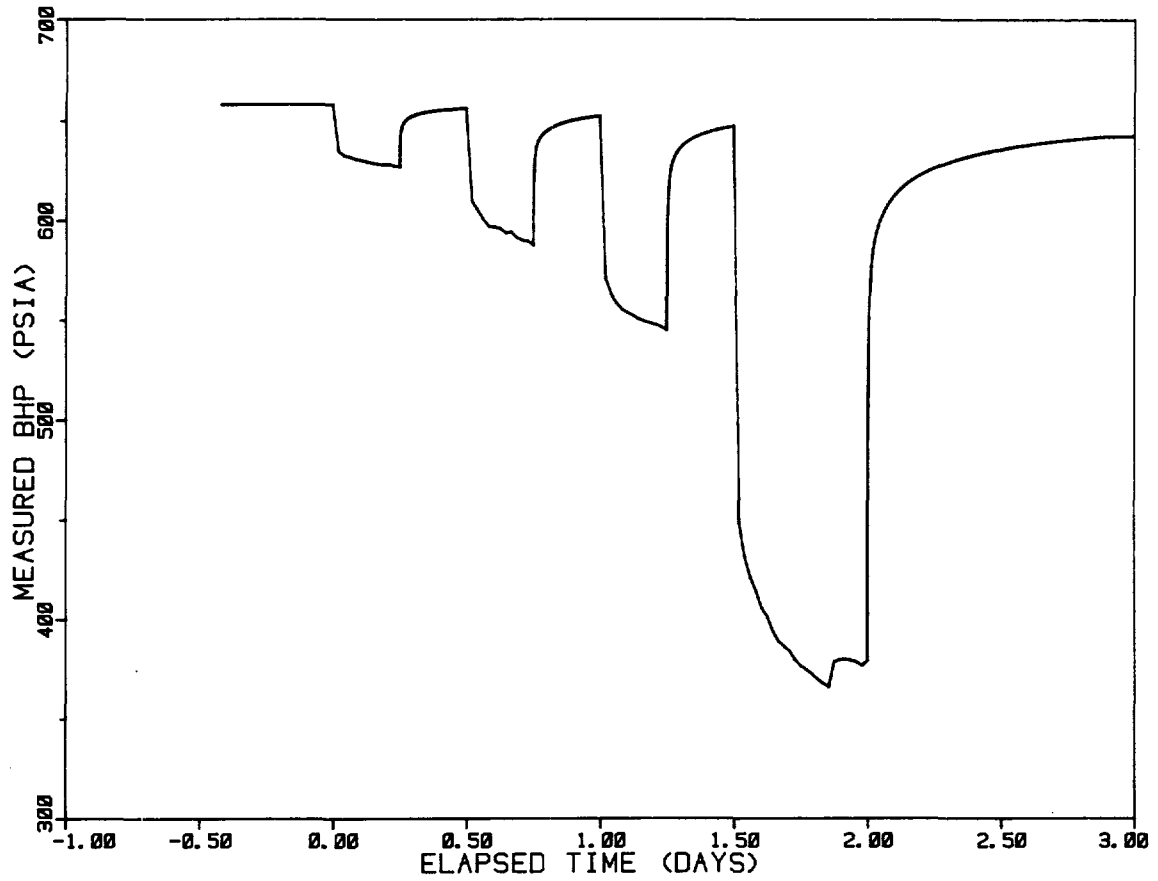
PRODUCTION SCHEDULES

	1 WELL 640 AC. SPACING MMCF	4 WELLS 160 AC. SPACING MMCF
1986	344	1148
1987	308	724
1988	276	456
1989	247	288
1990	221	184
1991	198	116
1992	178	48
1993	159	
1994	143	
1995	128	
1996	114	
1997	102	
1998	92	
1999	82	
2000	74	
2001	66	
2002	59	
2003	53	
2004	47	
2005	<u>43</u>	<u> </u>
	2934	2964

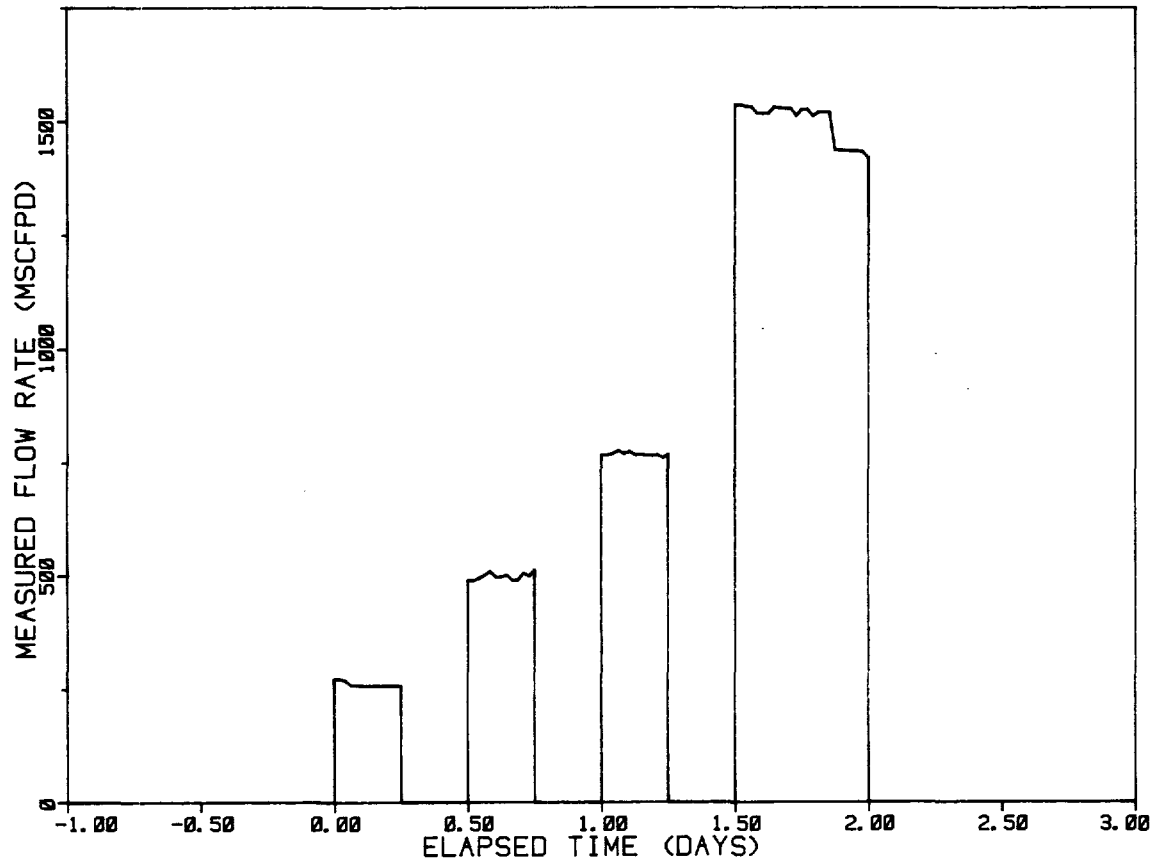
ECONOMIC EVALUATION OF TYPICAL WELL
WEST BRAVO DOME AREA

	640 Ac. SPACING	160 Ac. SPACING
Reserves, MMCF	2934	740
Cash from Operations, M\$	1219	197
Capital Investment, M\$	489	343
Net Cash Production, M\$	731	-146
Discounted at 20%, M\$	34	-112
DCF Rate of Return, %	24.1	-
Payout (BFIT), % <i>Before Tax</i>	276	50
Payout (AFIT), % <i>After Tax</i>	249	58
Pay Out Period, Years	3.9	-

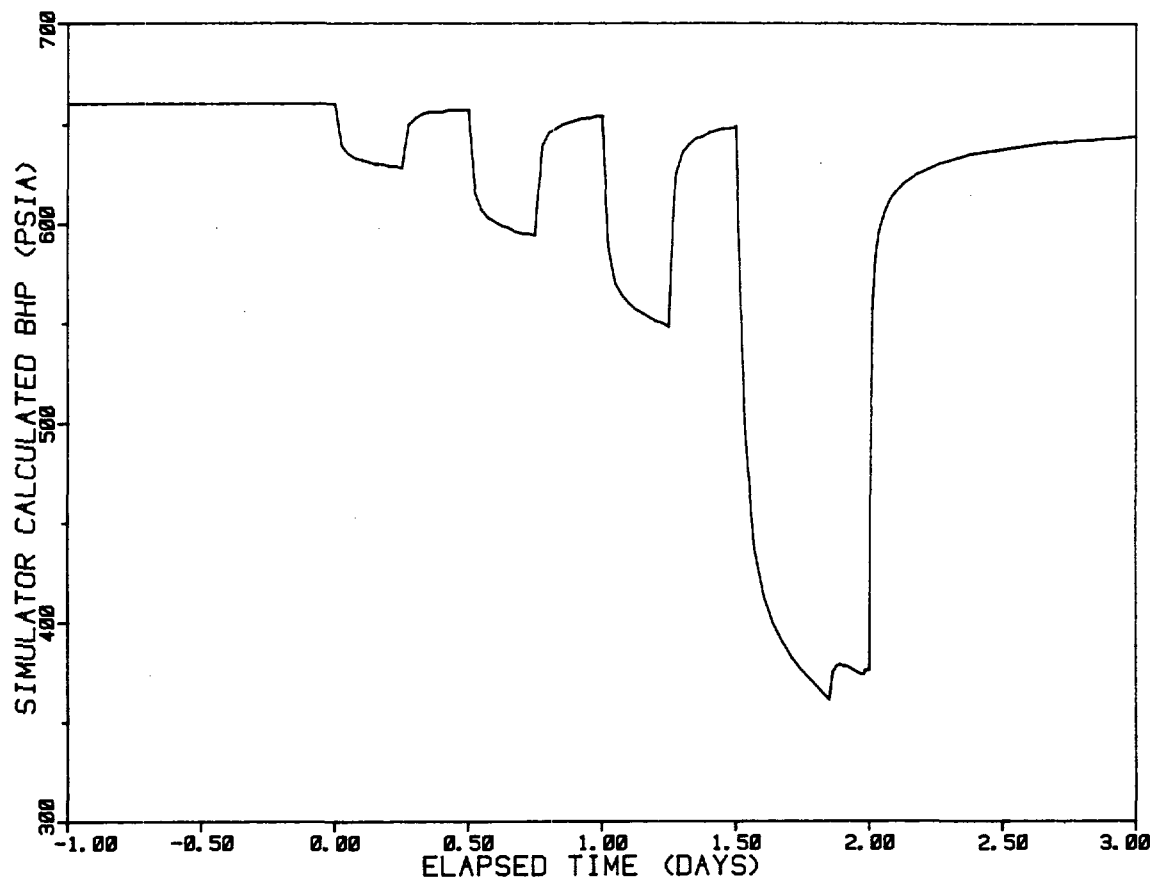
ISOCHRONAL TEST - MEASURED PRESSURES



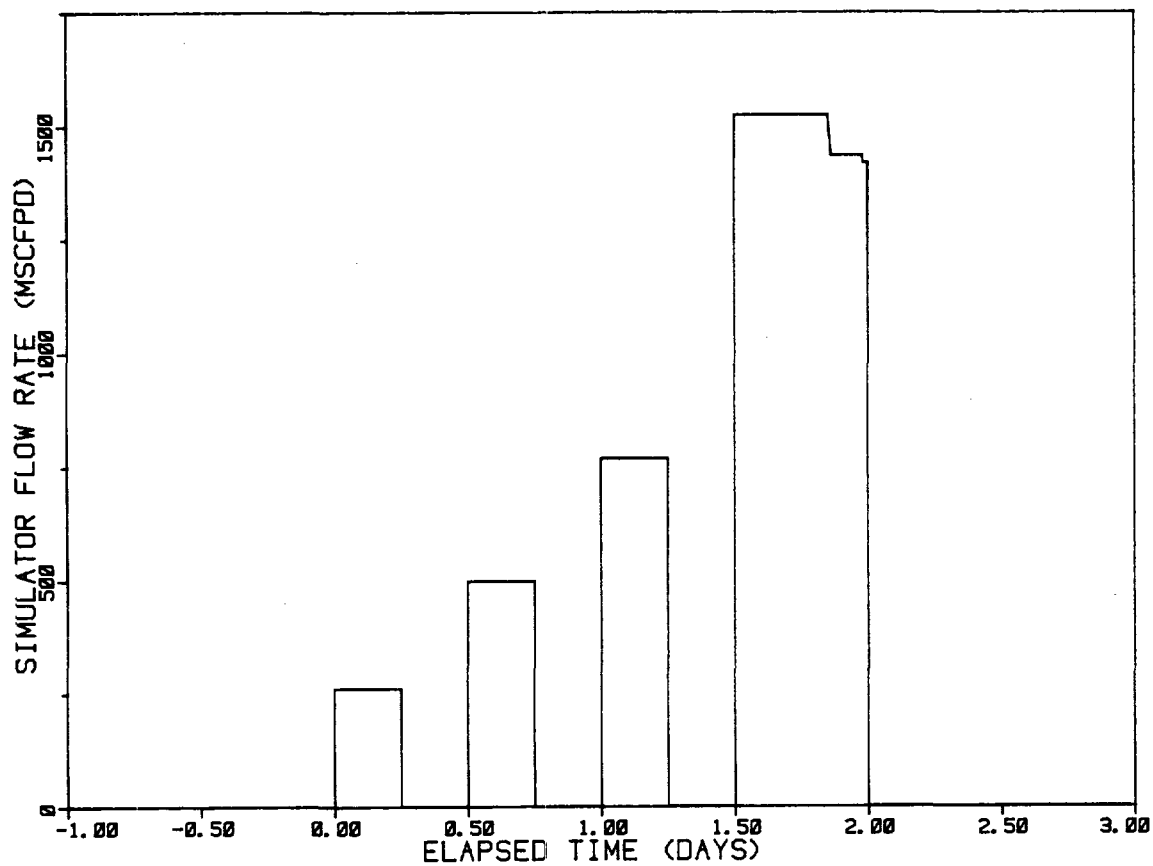
ISOCHRONAL TEST - MEASURED FLOW RATES



ISOCHRONAL TEST - SIMULATED PRESSURES

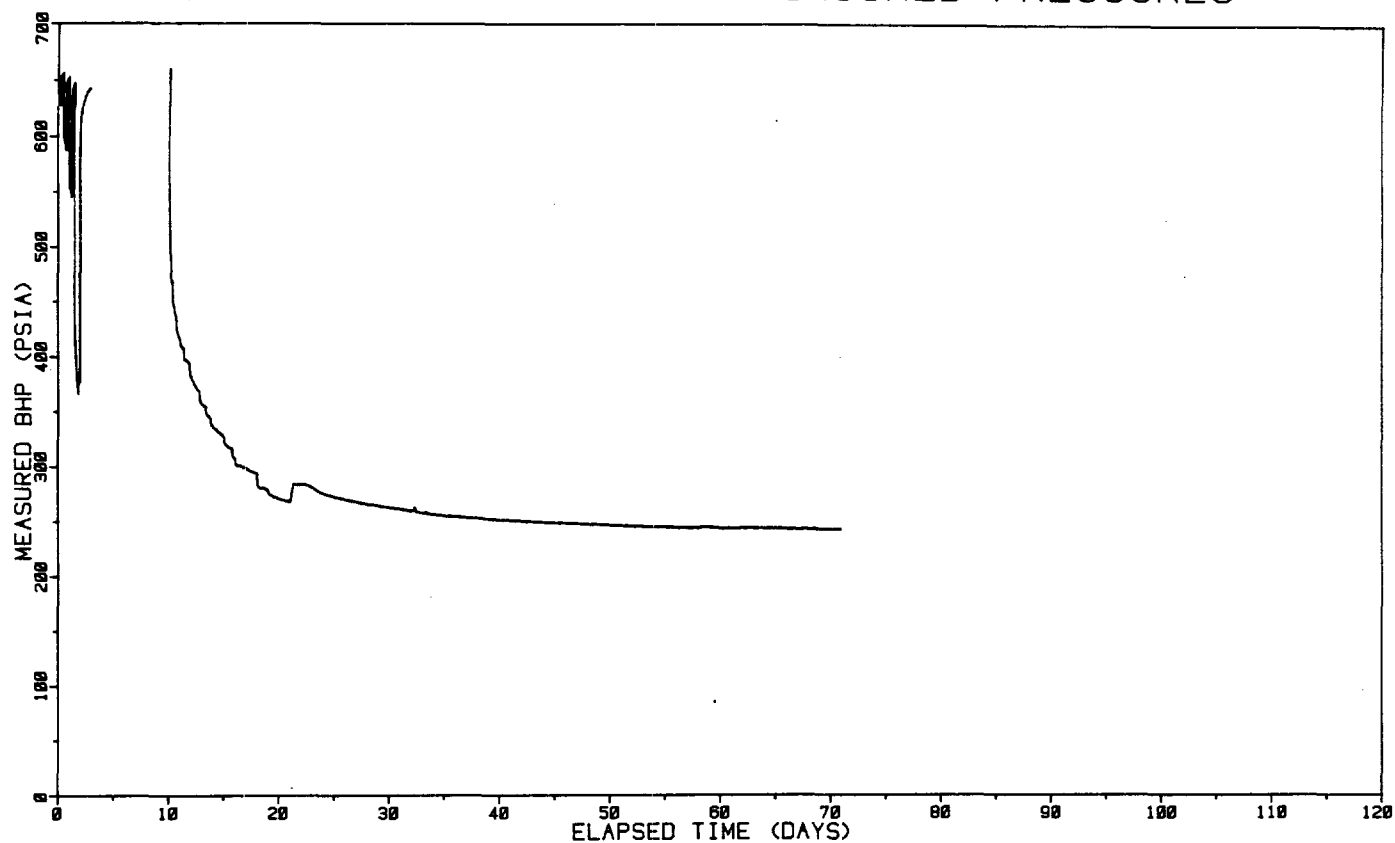


ISOCHRONAL TEST - SIMULATED FLOW RATES

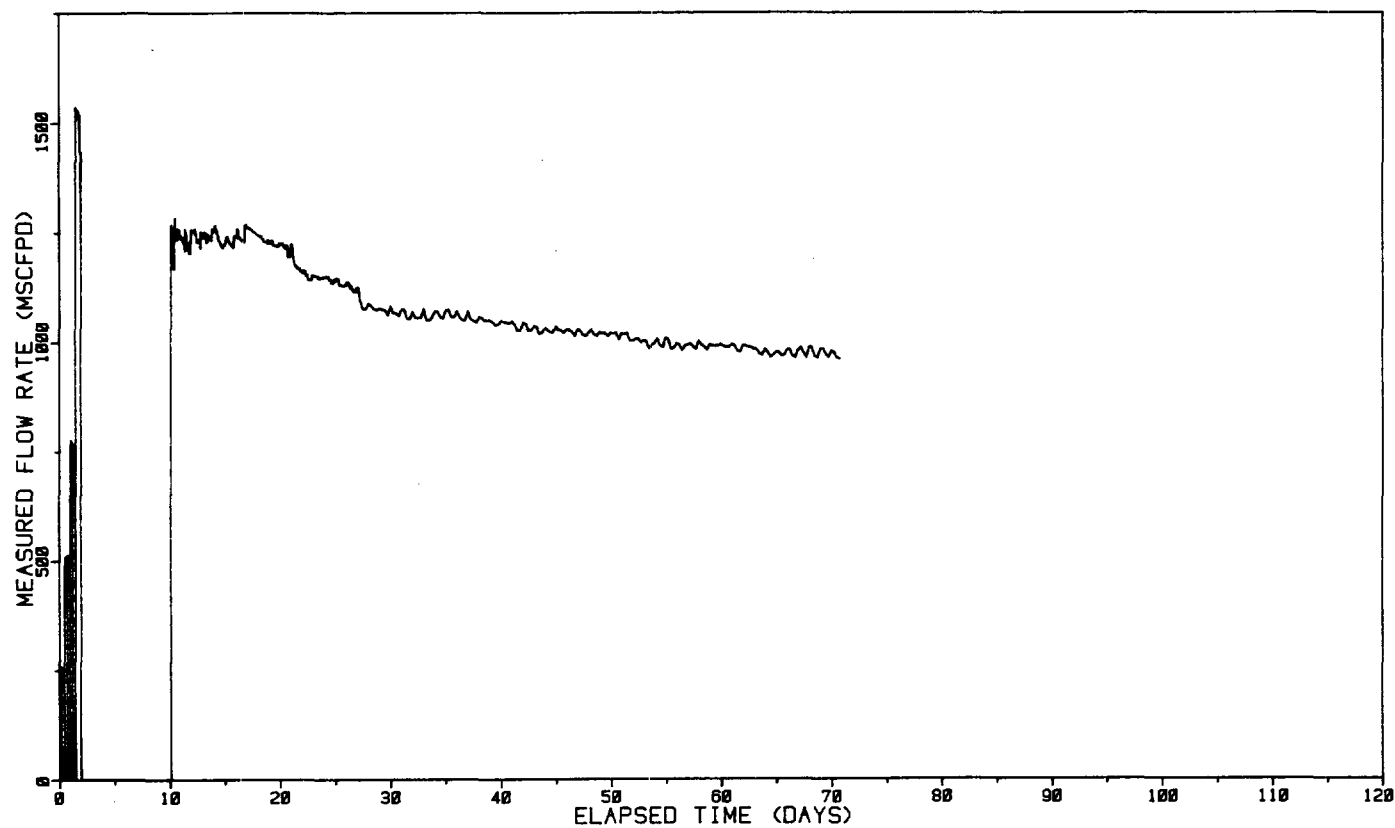


EX.14

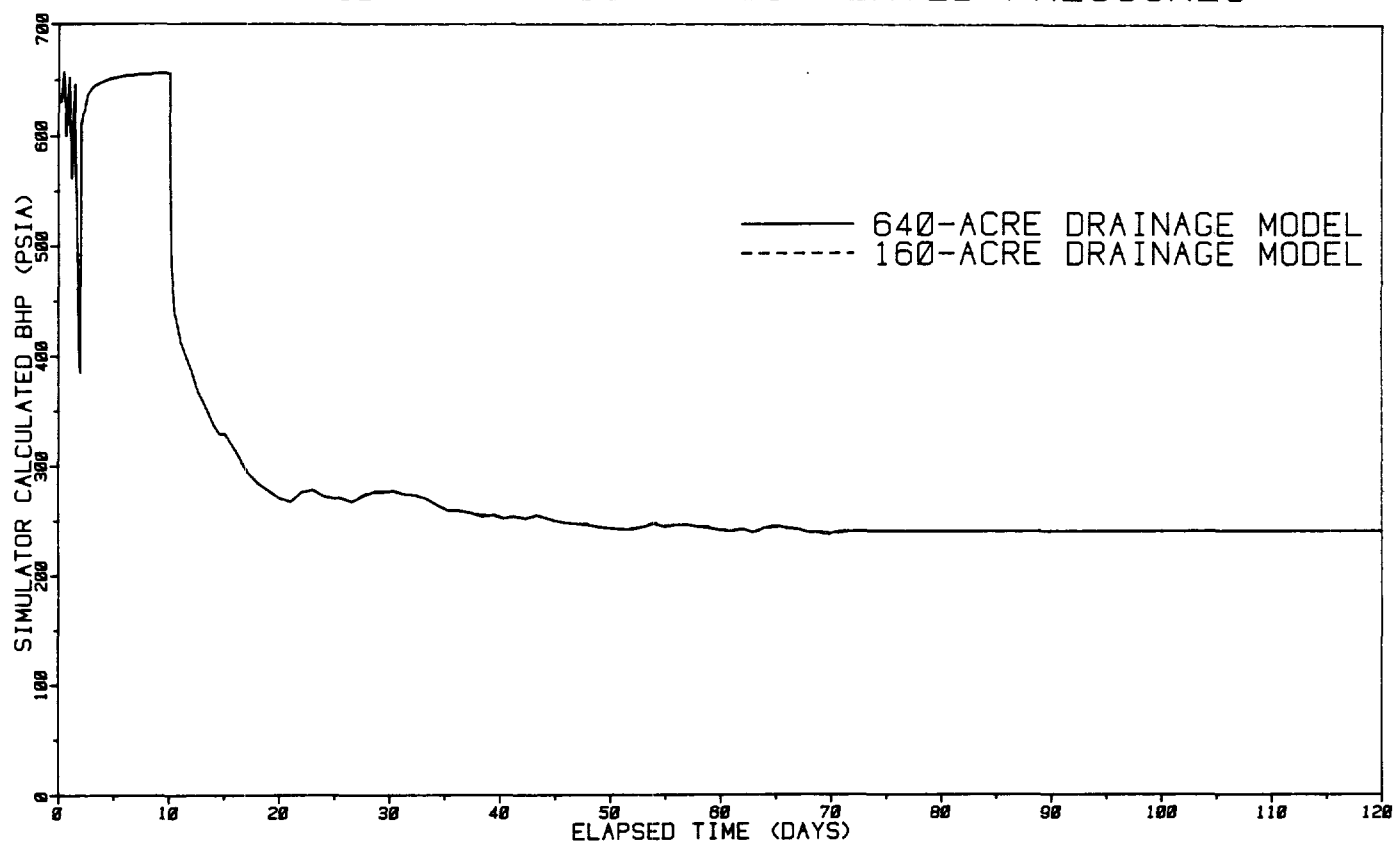
EXTENDED FLOW TEST - MEASURED PRESSURES



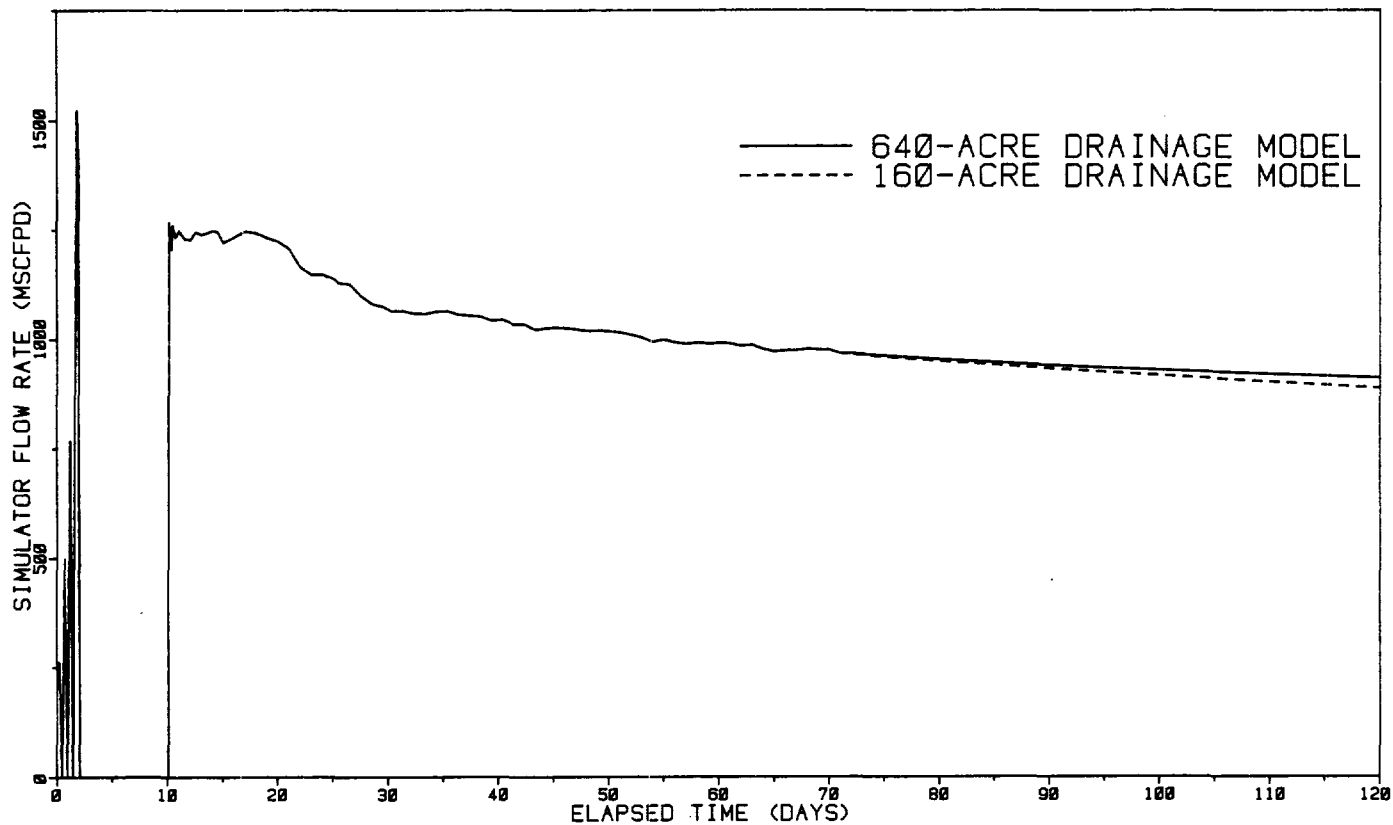
EXTENDED FLOW TEST - MEASURED FLOW RATES



EXTENDED FLOW TEST - SIMULATED PRESSURES

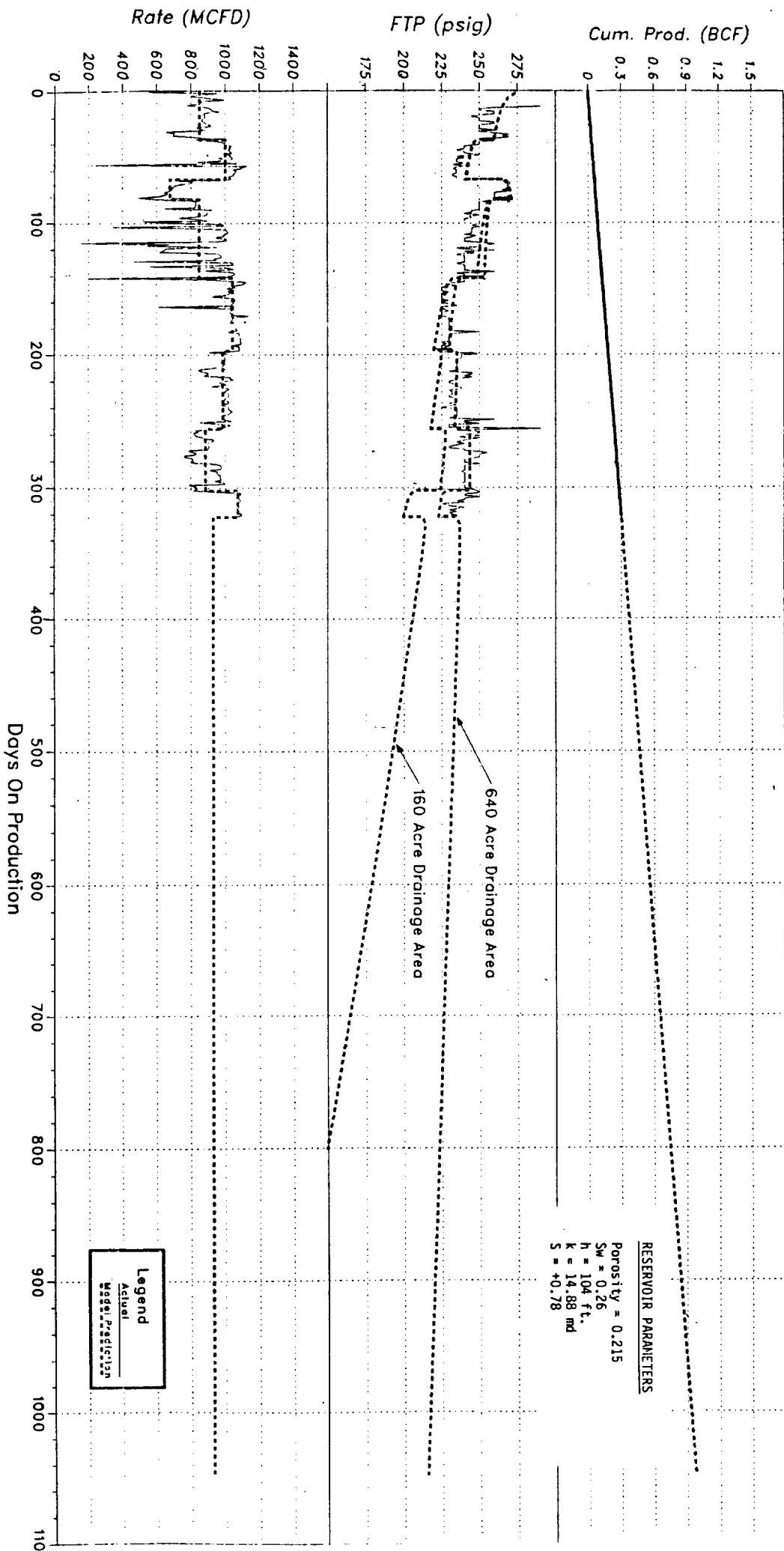


EXTENDED FLOW TEST - SIMULATED FLOW RATES

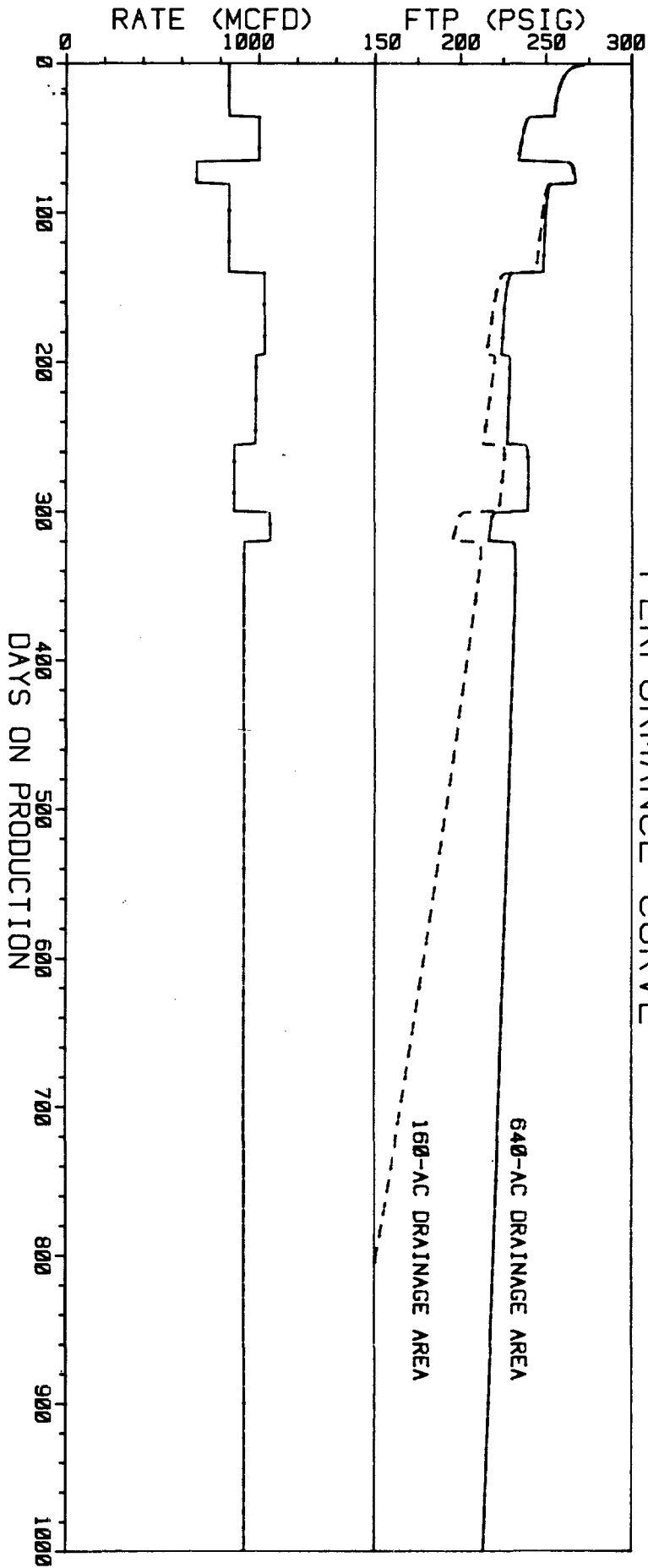


Brave Dome CO₂ Gas Unit
 BDCCGU Well No. 1934 2016
 Performance Curve

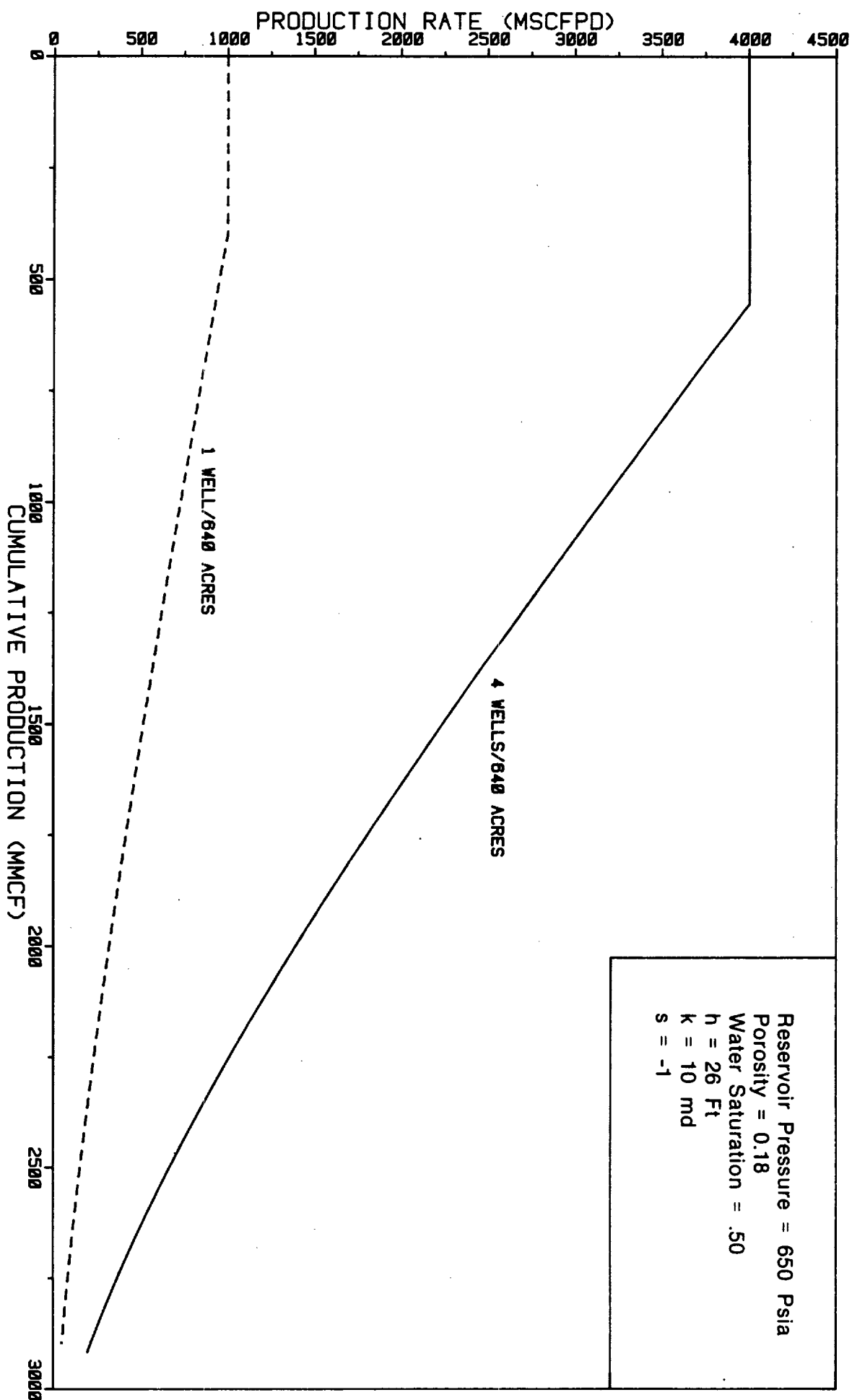
BEFORE THE
 OIL CONSERVATION COMMISSION
 Santa Fe, New Mexico
 Case No. 8490 Exhibit No. 13
 Submitted by Amoco
 Hearing Date 5-15-84



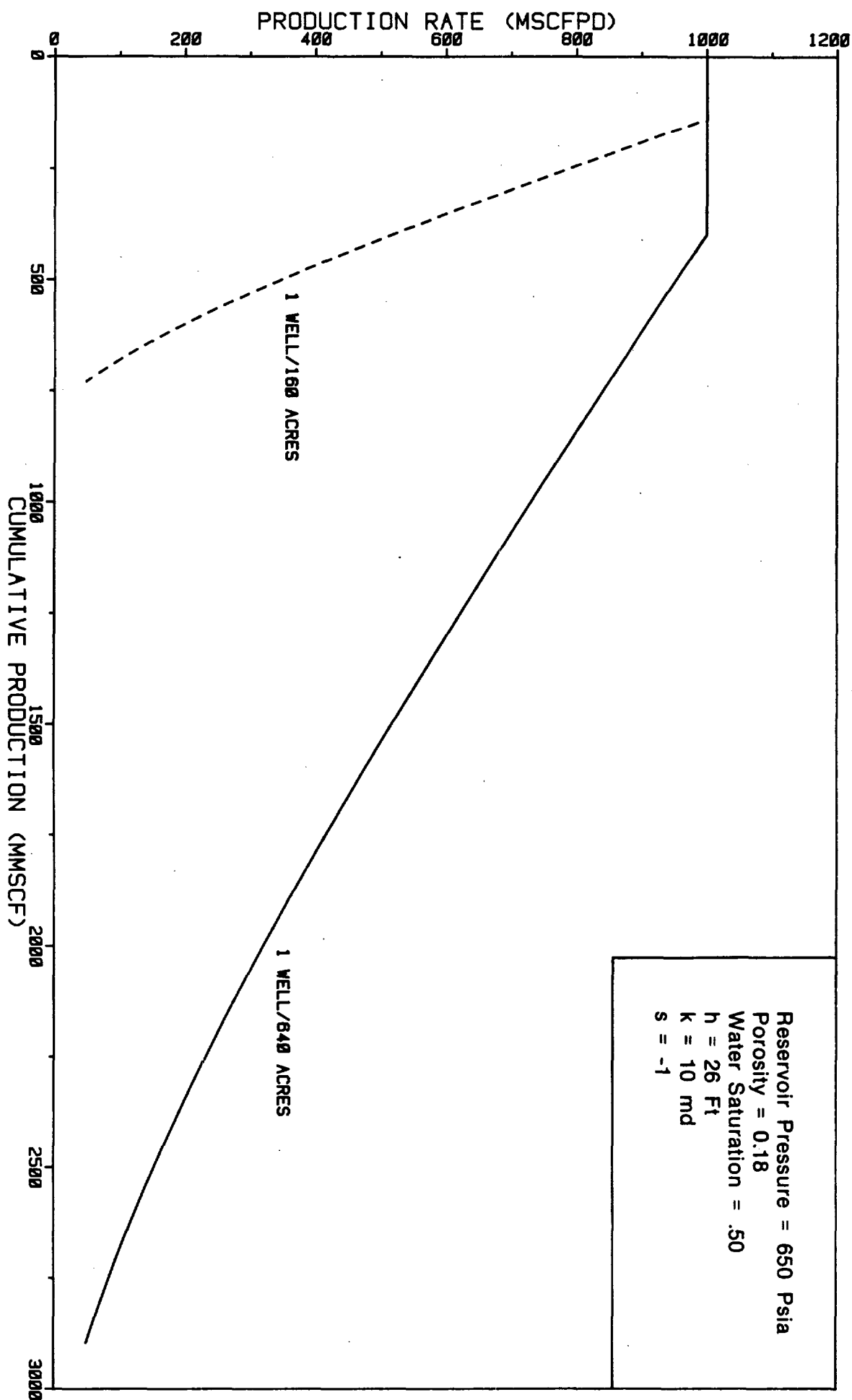
BRAVO DOME CO2 GAS UNIT
BDCDGU WELL NO. 1934 201G
PERFORMANCE CURVE



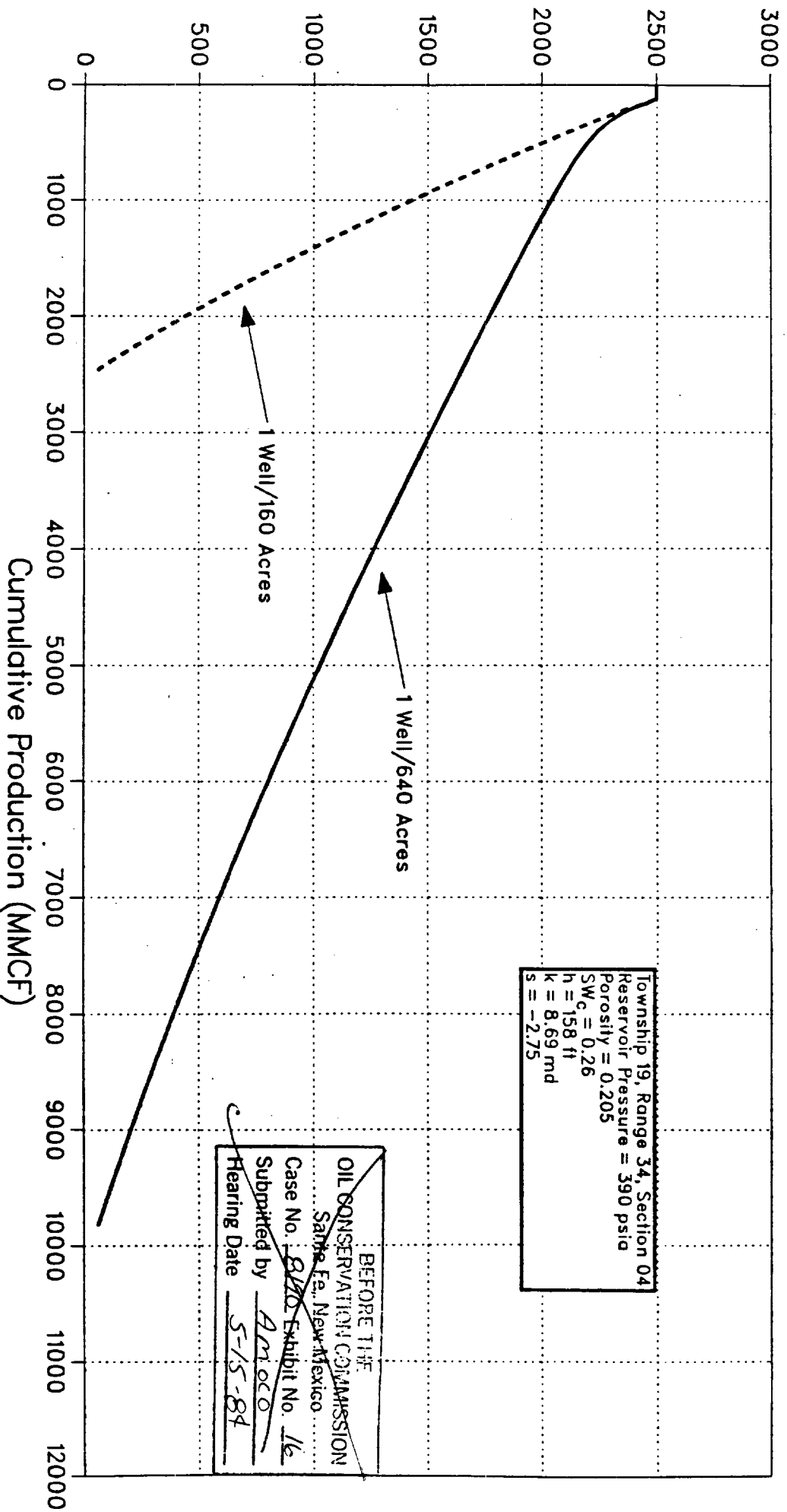
TYPICAL WELL PERFORMANCE CURVE



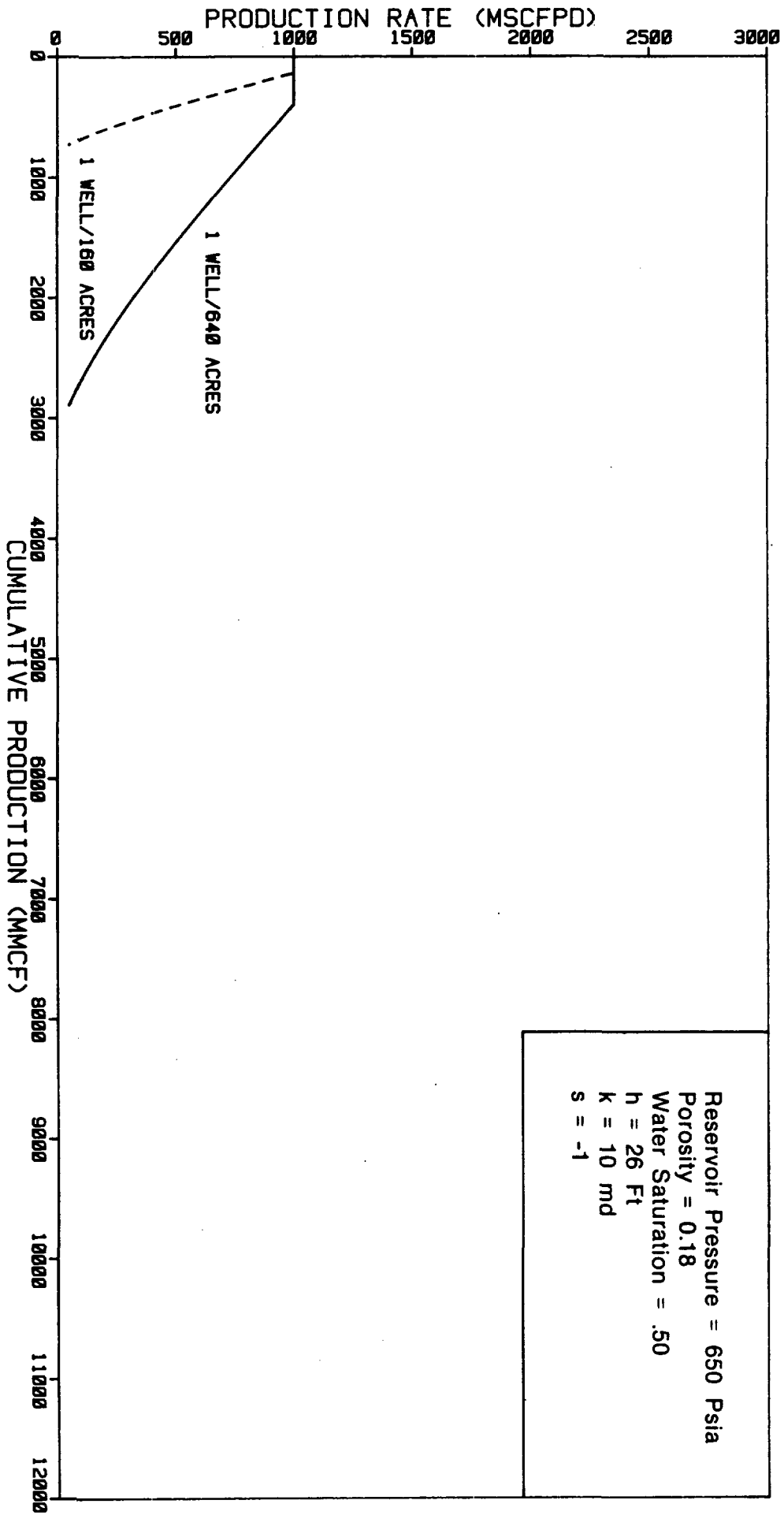
TYPICAL WELL PERFORMANCE CURVE



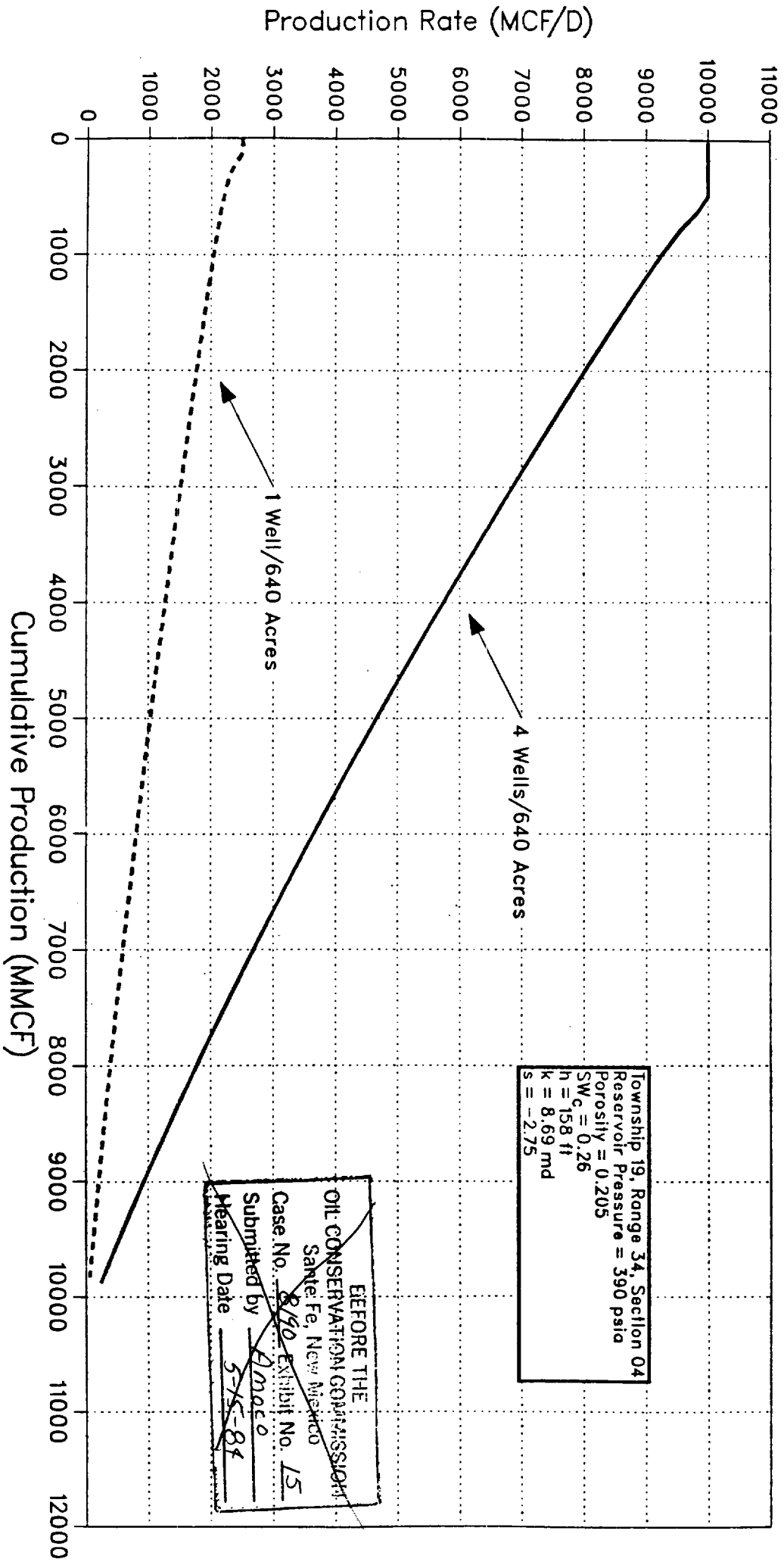
Bravo Dome CO₂ Gas Unit Typical Well Performance Curve



TYPICAL WELL PERFORMANCE CURVE



Bravo Dome CO₂ Gas Unit Typical Well Performance Curve



TYPICAL WELL PERFORMANCE CURVE

