SAI
July 1979

UGR FILE #252

SUMMARY REPORT

KY/WV

WELL #7246

UGR 252 KY

JULY 1979

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1.0 SUMMARY

Well No. 7246 is one of the three wells situated on the KY/WV acreage in the Big Branch area of Perry County, Kentucky. The objective of the proposed testing program is to evaluate the effectiveness of the foam fracturing technique in improving gas production performance of Devonian Shale wells in Eastern Kentucky.

Well No. 7246 was drilled to a total depth of 3576 ft. through Devonian Shale on March 27, 1976. Data available on casing, cementing and logging operations is very limited. Accordingly, it indicates that a 4½ in. casing was set at the depth of 3560 ft. and was cemented with 125 cubic feet of neat cement. No core was retrieved from this well. A cement log was run to establish the quality and top of the cement.

The designated interval 3169' - 3488' was perforated on August 10, 1976 and was stimulated with a 1000 bbl. Foam fracture treatment on August 12, 1976.

The treatment consisted of 326 bbl. of water, 578,000 scf of Nitrogen, 49,000 pounds of 20/40 mesh sand and 3,000 pounds of 80/100 mesh sand. After clean-up, the well was put into production, for about 7 months.

Cumulative gas produced after approximately seven months is 9,987 MCF. The average daily production after the well was put into production was 124 MCFD and is presently down to 31 MCFD against an average line pressure of 158 psi.

2.0 WELL SITING

Kentucky-West Virginia gas company well #7246 in William R. Fields, Perry County, Kentucky was drilled through Devonian Shale on March 27, 1976. The well is located in South Eastern Kentucky as shown in Figure 2.1. Figure 2.2 shows the location of the well, and its proximity to major lineations in the area. Also shown are other wells drilled in the area. The well was drilled by KY/WV in accordance with contract No. 3 (46-1) 8501 awarded through ERDA (DOE). Site selection of this well was based on geologic and other information obtained from the wells previously drilled (#7239) in the area. The following criteria were used for the site selection of these wells:

- Reasonable distance to existing pipeline for production purposes.
- Close proximity to existing producing hydraulic fractured shale wells - for production comparison.
- Sizeable block of acreage controlled by Kentucky-West Virginia for future development.
- Geological information - area with good subsurface control.
- Close Proximity to Major Landsat Lineament.

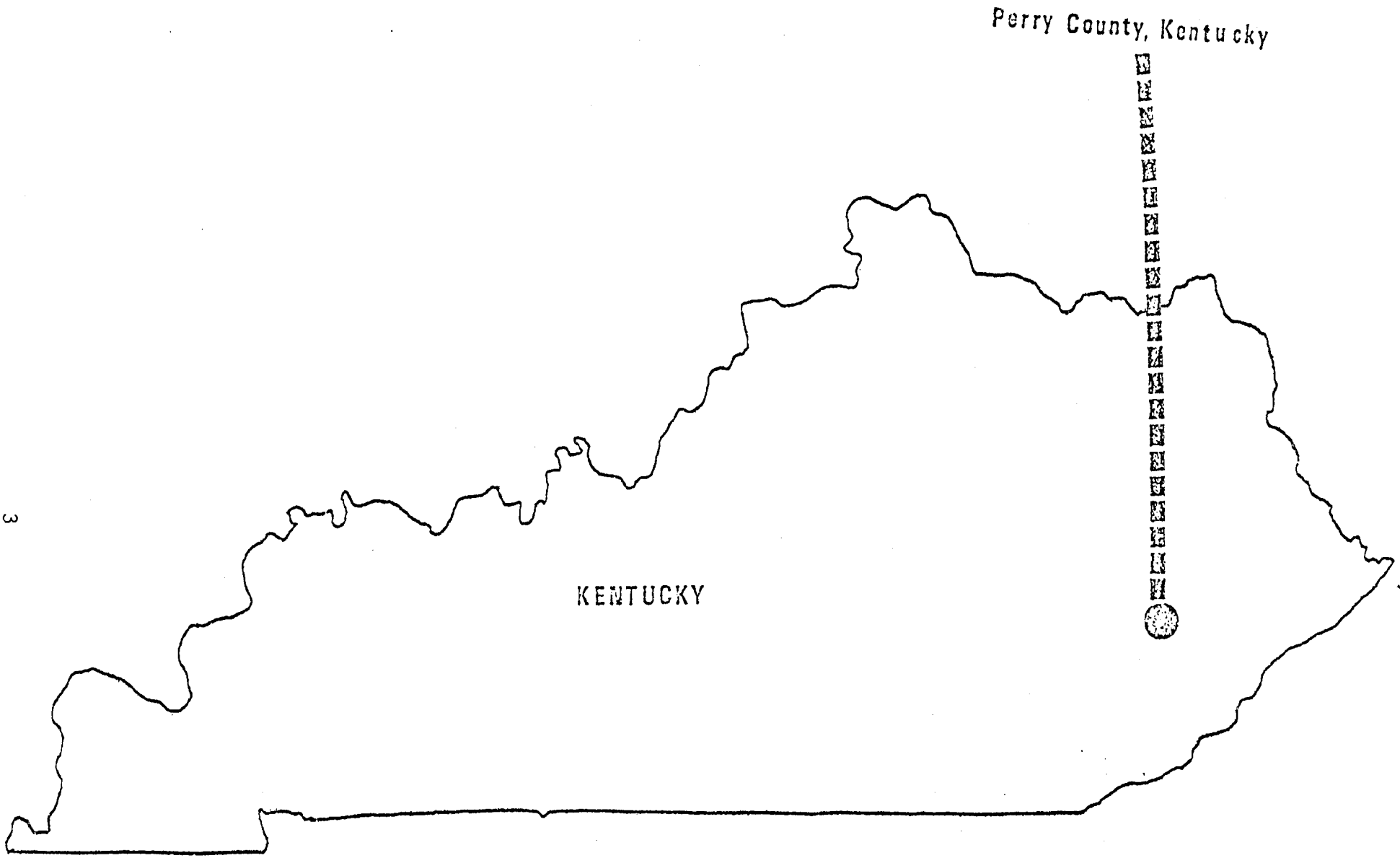
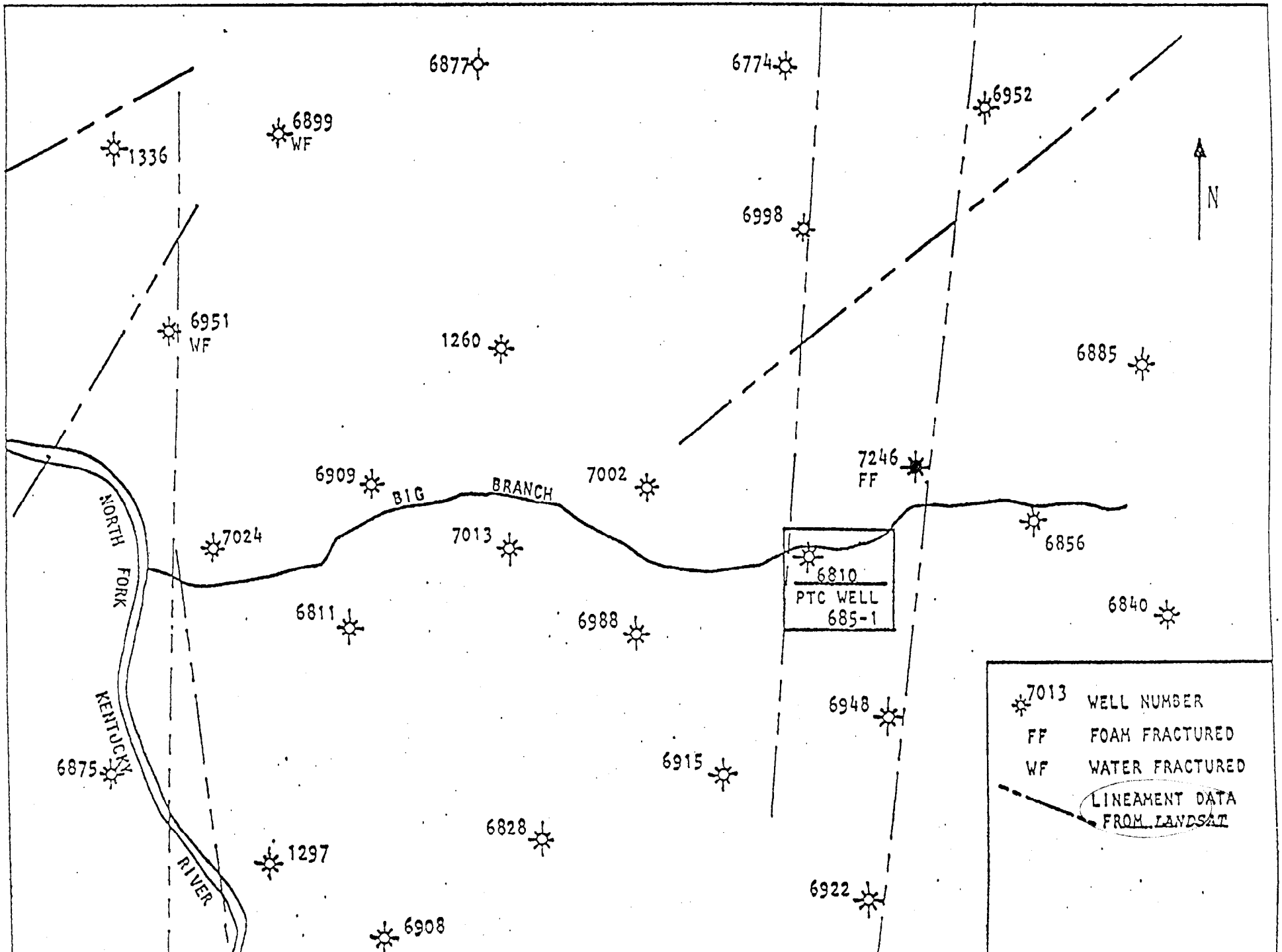


Figure 2.1 Location of KY-WV #7246 Well

Figure 2.2 SITE LOCATION, PERRY COUNTY, KENTUCKY



3.0 DRILLING/CASING, LOGGING, CEMENTING AND CORING OPERATIONS

Drilling/Casing Operations

The well was drilled to a total depth of 3576 ft. with air on March 27, 1976. A 4½-inch casing was installed to a depth of 3560 ft. Thirty-five hundred feet (3500') of 2-inch production tubing was installed after stimulation. A schematic diagram of the well is shown in Figure 3.1.

Logging Operations

Gamma Ray, compensated density and temperature logs were run. A copy of the log over the interval stimulated is presented in the attachment at the end of this report. The cement quality log indicated good cement through the Devonian Shale section with the top of cement at 2590 ft.

Cementing Operation

The 4½-inch production casing was cemented with 125 cubic ft. of neat cement. The top of the cement was recorded at 2590 ft.

Coring Operations

No core was extracted from this well.

Gas Analysis

Gas analysis of the samples collected from the well is presented in Table 3.1, and the chromatographic analysis of the gas is shown in Table 3.2.

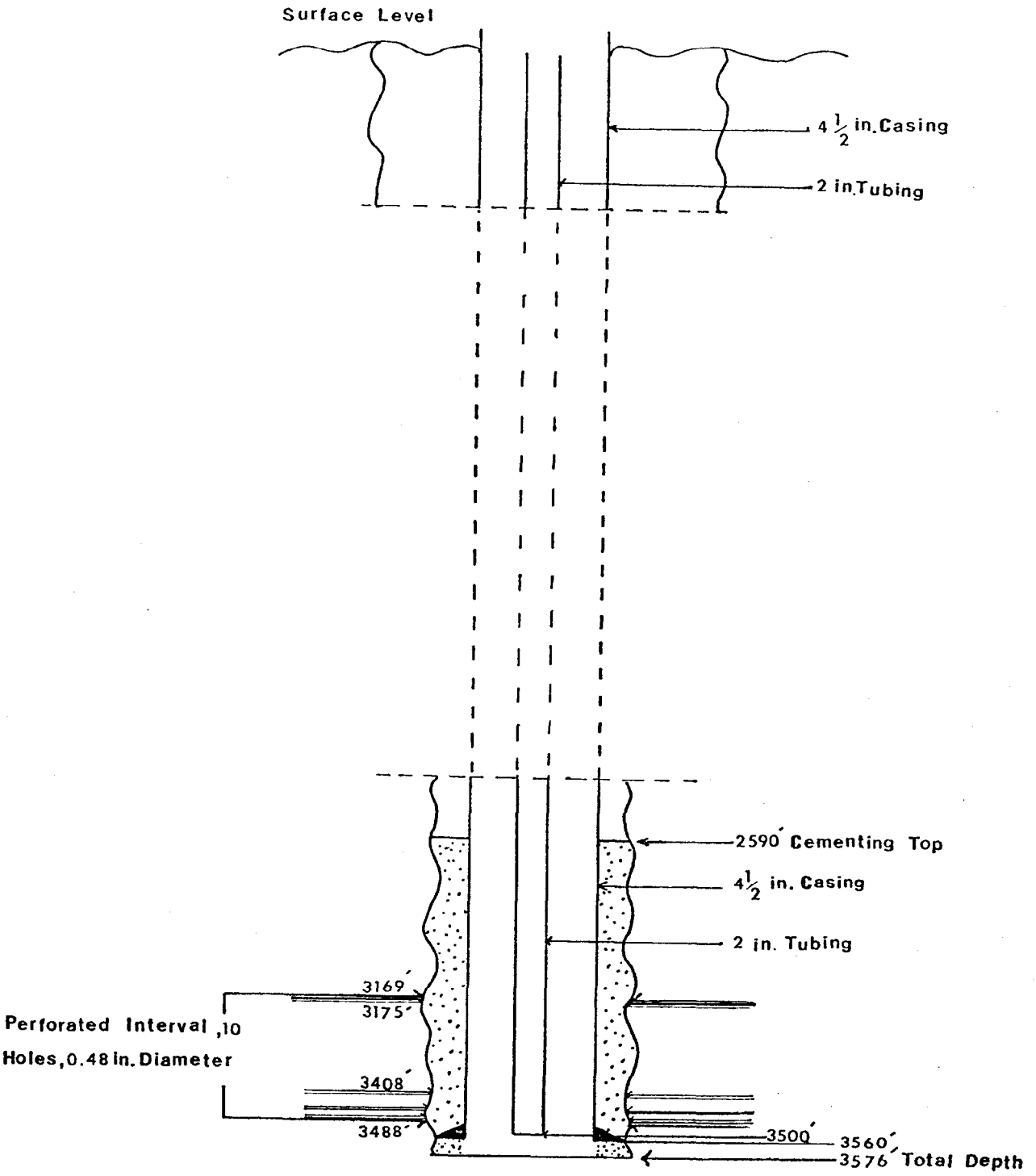


Figure 3.1 **Schematic Diagram of Well #7246**

TABLE 3.1

Gas Analysis of the Shale Samples Collected At Different Times

SAMPLE ID - Not Available

COLLECTION DATE & TIME*		9/8/76-4:00 p.m.	9/8/76-10:35 p.m.	9/10/76-8:00 a.m.
HYDROGEN	H_2			
OXYGEN	O_2	20.48	21.06	19.09
NITROGEN	N_2	67.90	70.10	64.32
CARBON MON	CO			
METHANE	CH_4	9.24	6.95	12.47
ETHANE	C_2H_6	1.68	1.35	2.91
CARBON DIOX	CO_2	0.05	0.05	0.05
ETHYLENE	C_2H_4			
PROPANE	C_3H_8	0.55	0.40	0.96
ISO-BUTANE	iC_4H_{10}	0.02	0.03	0.05
BUTANE	C_4H_{10}	0.08	0.06	0.15

* Sample Collector: Albert B. Yost II
Morgantown Energy Technology Center

TABLE 3.2

Chromatographic Analysis of The Gas from Well #7246*

	(MOL.%)
NITROGEN	2.65
CARBON DIOXIDE	----
METHANE	72.99
ETHANE	16.62
PROPANE	5.66
ISO BUTANE	0.41
N-BUTANE	1.17
ISO PENTANE	0.28
N-PENTANE	0.12
HEXANES-PLUS	0.10
TOTAL	100%

* Performed by Kentucky Hydrocarbon Company

4.0 STIMULATION

Two shale intervals were selected for a single foam fracturing treatment. The Foam Frac is basically made up of surfactants, water and nitrogen blended into a foam for the sand carrying agent. The advantages of the Foam Frac over a conventional water frac are listed as the following:

1. Greater frac area is created using less water.
2. Formation damage is reduced because less water is injected into the Shale formation.
3. Clean-up time is shortened because of the use of energy assist fluids.

The intervals from 3169-3175 ft. and 3408-3488 ft. were perforated by Allegheny Nuclear Surveys using a carrier gun on August 10, 1976. The well was perforated with then (10) 0.41 inch holes at depths listed as the following: 3169', 3172', 3175', 3408', 3412', 3449', 3453', 3478', 3483', and 3488.

After the well was perforated on August 11, 1976, the formation was broken down with 1000 gallons of 15% Dowell mud acid. The injection record for pre-treatment with mud acid is given in Table 4.1 and the treating log in Figure 4.1.

After the perf balls sealed the perforations, the casing was pressured up to 4000 psi to make sure that all holes were open. The well was then swabbed off and made ready for the foam frac. Gas was measured at 1.5 MCFD before stimulation.

Treatment

The well was treated with a 1000 bbl., 75 quality foam frac on August 12, 1976. The treatment consisted of 326 bbl. of water, 578,000 SCF of nitrogen, 49,000 pounds of 20/40 mesh sand and 3,000 pounds of 80/100 mesh sand. The summary of treatment is given in Table 4.4.

The average surface treating pressure was 1150 psi and the fluid injection rate was 6¼ bbl. per minute. This injection rate when equated to 75 quality foam would be 25 bbl. per minute. The treatment was completed at 4:15 p.m. on August 12, 1976. The schedule developed for the treatment is given in Table 4.2 and the treating log in Figure 4.2. The actual treatment schedule along with amounts of materials used is presented in Table 4.3.

The treating equipment was disassembled and the well rigged up with a beam choke system and connected to a tank for flow back. At 5:06 p.m., the well was opened and allowed to flow back. Details of flow back record are given in Table 4.5. A total of 70 bbl. was recovered during the flow backstage. The open flow measured on August 20, 1976 after flow back was 337 MCFD for 7½ hour open flow test.

The costs associated with this stimulation treatment are presented in Appendix B. Cost of a conventional water frac is shown for comparison.

TABLE 4.1

Injection Record For Pre-Treatment with Mud Acid

TIME	INJECTION RECORD						PRESSURE	
	Liquid Rate BBM	TYPE OF FLUID	Stage Vol.BBS.	Cum. Vol. BBS.	Prop. Type	Prop. Gal.	CSG.	TBG.
1430								400
1430½					--	--	0	
1431¼		Mud Acid	4	4	--	--	0	
1432¼		" "	9	13	--	--	0	
1433½		" "	10	23	--	--	0	
1434		" "	1	24	--	--	0	
1437		Water	33	57	--	--	0	
1438		Water	1	58	--	--	4000	

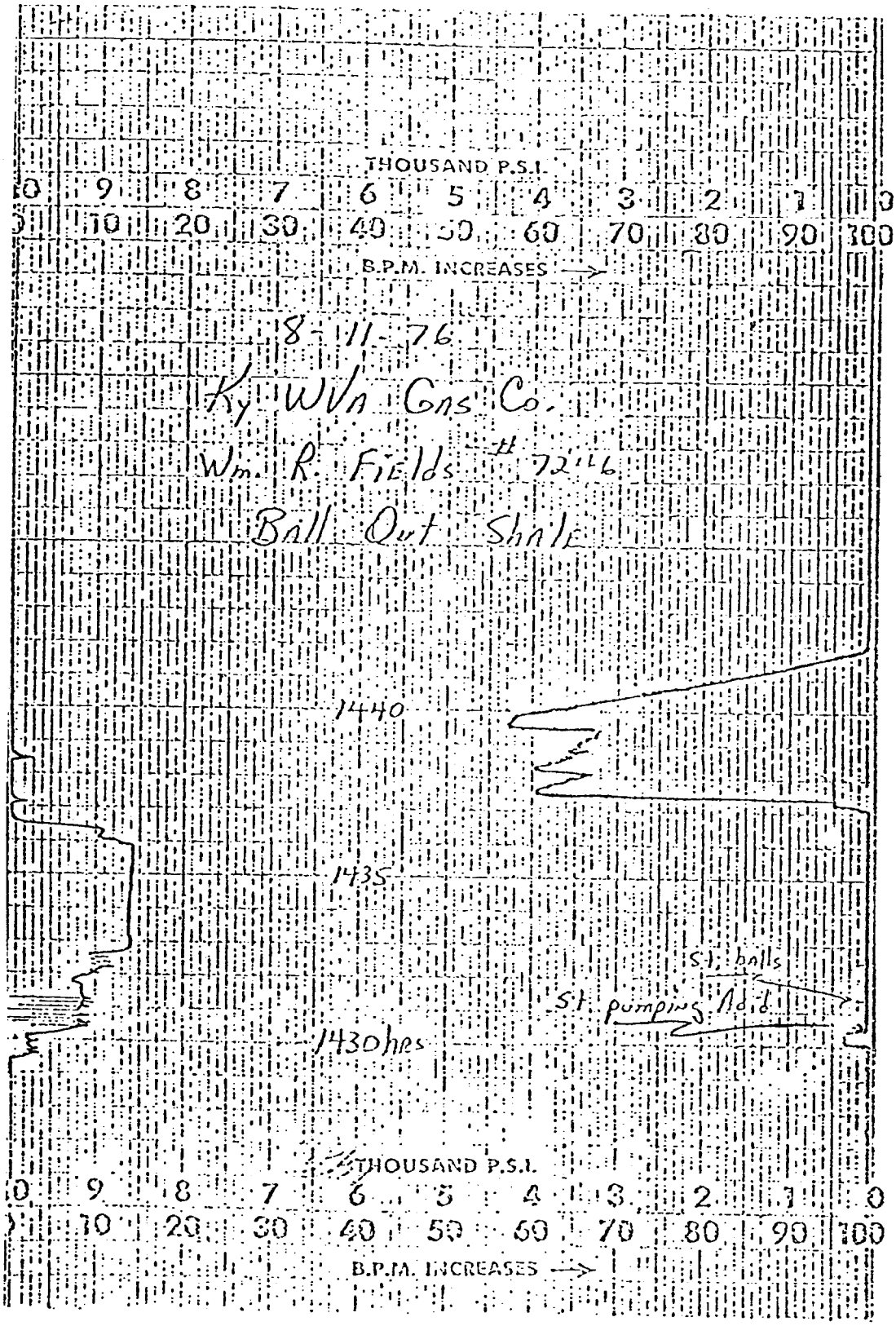


Figure 4.1 Treating Log for Balling Out Procedure

TABLE 4.2

DOE APPROVED TREATMENT DESIGN

KY/WV Gas Co. - William Fields #7246 - Hazard Field - Foam Frac - 8/12/76

Inc foam volume BBL	Sand Conc blender PPG	Sand Conc foam PPG	Sand LES	Inc Vol N_2 SCF	Inc Vol H_2O EPL	Inc time MIN	Cum time MIN	Cumulative Sand LBS	Cumulative N_2 MSCF	Cumulative H_2O BBL
100	pad	0	0	64,000	25	4.0	4.0	0	64	25
200	2.5 (80/100)	0.63	5,250	128,000	50	8.0	12.0	5,250	192	75
100	2.0 (20/40)	0.5	2,100	64,000	25	4.00	16.0	7,350	256	100
100	4.0 (20/40)	1.0	4,200	64,000	25	4.00	20.0	11,550	320	125
640	6.0 (20/40)	1.5	40,320	409,600	160	25.60	45.60	51,870	729.6	285
56	flush	0	0	35,840	14	2.24	47.84	51,870	765.44	299
TOTALS 1,196			51,870	765,440	299	47.84	47.84	51,870	765.44	299

N_2 Assume BHTP = 2500 PSIA

Q_{N_2} = 1600 SCFM

BHTO = 2500 PSIA

T_{N_2} = 100°F

Z = 1.05

T = .75

T_{RES} = 97°F = 557°R

d = 3450 ft.

Q_F = 25 BPM

Q_W = 6.25 BPM

TABLE 4.3

Treatment Schedule for Well #7246

TIME	Liquid Rate BPM	Type of Fluid	INJECTION RECORD Stage Vol. BBLS	Cum. Vol. BBLS	Prop. Type	Prop. Gal.	PRESSURE CSG	TBG.
1522		H-20						2800
			SAFETY MEETING					
1523		water & N-2 W22 & L42				--	--	
1525½	5½+½	" "	14	14		--	--	
1527½	5½+½	" "	12	26	--	--	1100	
1531	5 3/4 + ½	" "	22	48	80/100	2#	1150	
1533	5 3/4 + ½	" "	12	60	80/100	2#	1150	
1537	5 3/4 + ½	" "	25	85	20/40	2#	1150	
1541	5 3/4 + ½	" "	25	110	20/40	3#	1150	
1545	5 3/4 + ½	" "	25	135	20/40	4#	1150	
1554½	5 3/4 + ½	" "	59	194	20/40	6#	1150	
1612	5 3/4 + ½	" "	109	303	20/40	6#	1150	
1614½	5 3/4 + ½	" "	16	319	0	0	1150	
1615½	6½ + ½	Fresh Water	7	326	0	0	750	

Total materials used for stimulation of designed interval.

Nitrogen- 550,000 standard cubic feet

80-100 mesh sand - 3,000 pounds

20-40 mesh sand - 49,000 pounds

Clay stabilizer L-42, 120 gallons

Surfactant W-22 foam builder -108 gallons

Water - 326 barrels

TABLE 4.3 (Cont'd) Injection Rates of Nitrogen

Time	Rate (SCF)	Total Nitrogen (Standard Cubic Feet)
7 minutes	15,000	105,000
2 minutes	9,000	18,000
22 minutes	11,000	242,000
19 minutes	10,000	190,000
Total Nitrogen		555,000

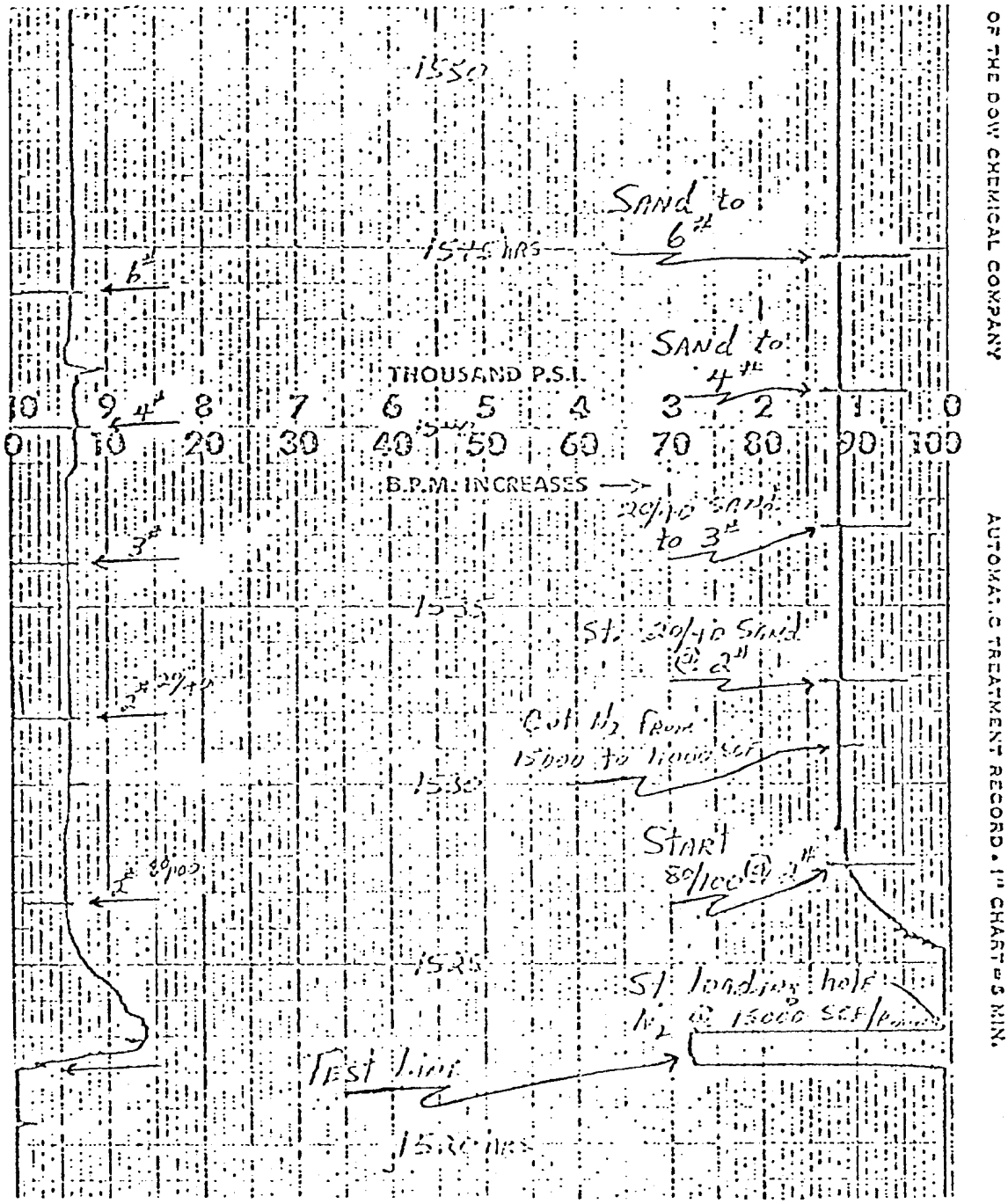


Figure 4.2 Treating Logs

Table 4.4 Treatment Summary for Well #7246:

Treatment Parameter	Design	Actual
Well Number	7246	7246
County, State	Perry, Kentucky	Perry, Kentucky
Interval Number	1	1
Perforated Interval	3169'-3488'	3169'-3488'
Treatment Date	-----	August 12, 1976
Treatment type/Quality	Foam Frac/75	Foam Frac/ 75
Treatment Size		
Nitrogen gas (SCF)	765,440	555,000
Water (bbl)	299	326
Total Sand (lbs)		
(80/100 mesh 3000 + 20/40 mesh 49000)	51,870	52,000
Average Pumping Rate (BPM)		
Minimum Pumping Rate(BPM)		
Average Treating Pressure (PSI)	-----	1150
Average Injection Rate (BPM)	25	6.25 (25 BPM for 75 quality foam)
Instantaneous shut-in Pressure (PSIG)	-----	600

TABLE 4.5

KENTUCKY WEST VIRGINIA GAS COMPANY

FLOW BACK DATA
WELL NO. 7246

Time Thursday	Choke Pressure PSIA	Choke Size and Cofficiant	Flow Rate MCF	Est. Fluid Returned (Gals.)	Cum. Time (Hrs.)	Comments
5:06 P.M.	540	8/64" - 6.25	187.50		0	Flow back begins
5:14	548	8/64" - 6.25	190.28		0.13	Pulsating water- no sand
5:25	562	8/64" - 6.25	195.14		0.32	Pulsating water- no sand
5:30	575	8/64" - 6.25	199.65		0.40	Pulsating water- no sand
5:36	580	8/64" - 6.25	201.38		0.50	Pulsating water- no sand
5:43	595	8/64" - 6.25	206.59		0.62	Pulsating water- no sand
5:52	598	8/64" - 6.25	207.90		0.77	Pulsating water- no sand
5:58	590	8/64" - 6.25	204.13		0.87	Returning foam - no sand
6:05	585	8/64" - 6.25	203.12		0.98	Returning foam - no sand
6:12	577	8/64" - 6.25	200.34	460	1.10	Returning foam - no sand
6:19	576	8/64" - 6.25	199.26		1.22	Returning foam - no sand
6:27	582	18/64" - 34.49	1115.17		1.35	Change orifice to 18/64
6:29	570	18/64" - 34.49	1092.18		1.38	Foam back - no sand
6:33	565	18/64" - 34.39	1082.60		1.45	Foam back - no sand
6:35	563	18/64" - 34.49	1078.78	699	1.48	Foam back - no sand
6:39	567	18/64" - 34.39	1084.44		1.55	Foam back - no sand
6:48	570	18/64" - 34.39	1092.18		1.70	Foam back - no sand
6:53	580	18/64" - 34.39	1111.34		1.78	Foam back - no sand
7:10						Off line - change orifice
7:15						On line - orifice 26/64"
7:30	550	26/64" - 72.42	2212.83		2.40	Foam & some sand returned
7:34	562	26/64" - 72.42	2261.11		2.47	Foam & some sand returned
7:47	592	26/64" - 72.42	2381.81	1408	2.65	Foam & some sand returned
7:50						Off line
7:53	590	26/64" - 72.42	2373.96		2.73	On line - foam and some sand
8:00		18/64" - 34.49				Off line - reduce orifice to 1[illegible]

TABLE 4.5 (Cont'd)

FLOW BACK DATA (Cont.)

Time	Choke Pressure PSIA	Choke Size and Cofficiant	Flow Rate MCF	Est. Fluid Returned (Gals.)	Cum. Time (Hrs.)	Comments
8:10	612	18/64" - 34.49	1172.66		3.07	Foam - no sand
8:25	613	18/64" - 34.49	1174.58		3.32	Foam - no sand
8:31	609	18/64" - 34.49	1166.91		3.42	Foam - no sand
8:38	610	18/64" - 34.49	1168.83		3.53	Foam - no sand
8:53	605	18/64" - 34.49	1159.25		3.78	Foam - no sand
9:17	589	18/64" - 34.49	1128.59		4.15	Foam - no sand
9:20						Off line - no sign of san
9:29						On line
10:02	569	18/64" - 34.49	1090.27		4.93	Foam - no sign of sand
10:07						Off line
						Change orifice size of 26/
10:19						On line - no foam or sand
10:25		26/64" - 72.42		1410	5.33	Hydrocarbon fraction incre
10:27	529	26/64" - 72.42	2128.34		5.35	No sand - foam & water
11:01	463	26/64" - 72.42	1862.80		5.92	No sand - foam & water
11:08	450	26/64" - 72.42	1810.50		6.03	No sign of liquid or foam
11:20	435	26/64" - 72.42	1750.15		6.23	No sign of liquid or foam
11:30						Pressure Chart on
11:45	400	26/64" - 72.42	1609.33		6.65	No sign of liquid or foam
12:00 A.M.	376	26/64" - 72.42	1512.77		6.90	No sand or foam returning
12:15	350	26/64" - 72.42	1408.17		7.15	No sand or foam returning
12:32	330	26/64" - 72.42	1327.70		7.43	Foam - no sand returning
12:45	315	26/64" - 72.42	1267.35		7.65	Foam - no sand returning
12:50	308	26/64" - 72.42	1239.19		7.73	Check choke - no abbratio
12:53	335	26/64" - 72.42	1347.82		7.78	No foam
1:15	295	26/64" - 72.42	1186.88		8.15	Foaming
1:32	266	26/64" - 72.42	1070.21		8.43	Foam - no sand returning
1:50	254	26/64" - 72.42	1021.92		8.76	Foam - no sand
[illegible]	[illegible]	[illegible]	[illegible]		8.93	Foam - no sand

TABLE 4.5 (Cont'd)

FLOW BACK DATA (CONTINUED)

Time	Choke Pressure PSIA	Choke Size and Cofficiant	Flow Rate MCF	Est. Fluid Returned (Gals.)	Cum. Time (Hrs.)	Comments
2:05						Off line - Change orifice to
2:12	237	30/64" -104.59	1376.44		9.10	No sand flowing back
2:17	217	30/64" -104.59	1260.29		9.18	No sand flowing back
2:21	205	30/64" -104.59	1103.47		9.25	No sand flowing back
2:38	157	30/64" -104.59	911.82		9.53	No sand flowing back
2:40						Off Line
		36/64" -144.2				Change orifice to 36/64"
2:45						On line - returning foam
2:49	215	36/64" -144.2	1722.39		9.72	Blowing back foam - no sand
3:05	162	36/64" -144.2	1297.80		9.98	Blowing back foam - no sand
3:23	150	36/64" -144.2	1201.67		10.28	Blowing back foam - no sand
3:38	145	36/64" -144.2	1161.61		10.53	Blowing back foam - no sand
3:45		48/64" -260.99				Off line - change to 48/64"
3:50		48/64" -260.99				On line - foam & water
4:02	80	48/64" -260.99	1159.96		10.93	On line - foam & water
4:08	100	48/64" -260.99	1449.94		11.07	On line - foam & water
4:35	102	48/64" -260.99	1478.94		11.48	On line - foam & water
5:10	85	48/64" -260.99	1232.45		12.07	On line - foam & water
5:30	82	48/64" -260.99	1188.96		12.40	On line - foam & water
6:00	55	48/64" -260.99	787.45		12.80	On line - foam & water
						Off line - remove orifice
6:30	27					Flow back through 2-inch
3:00 P.M.		2-inch	377 - 421		21.90	Shut In (8-13-76)
			Total Fluid Return	2930 Gallons		

IAS

5.0 PRODUCTION DATA

Well Testing

The open flow before and after stimulation was measured and increased from 1.5 MCFD to 337 MCFD (7½ hous test). The rock pressure after a 16 hours shut-in was 390 psi. Table C.1 in Appendix C presents the shut-in and flow periods after stimulation to list the well's potential.

No additional prestimulation production tests were conducted. After stimulation, between the dates of 9/8/76--10/14/76, a series of well tests were performed. These tests were made up of the following:

- Modified Isochronal test
- Pressure Buildup test
- Pressure Drawdown test

Data from these tests are presented in Appendix C.

Well Production

The well was put into production, and production record for approximately 18 months is shown in Table 5.1. Cumulative gas production after 18 months on line was 23,896 MCF. The average daily production after the well was put into production was initially 128 MCFD at 148 psi and down to 33 MCFD against a line pressure of 108 psi after 18 months.

Table 5.1 - Production of the Well #7246

1977			TOTAL MCF	AVERAGE MCF PER DAY	AVERAGE PRESSURE
1)	3/4-23	est.	2,425	128	148
2)	3/23-4/20	est.	1,800	64	(B)
3)	4/20-5/18	est.	725	26	(B)
4)	5/18-6/22	est.	895	26	118
5)	4/22-7/20	est.	960	34	150
6)	7/20-8/24	est.	717	20	155
7)	8/24-9/21	est.	1,603	57	130
8)	9/21-10/19	est.	862	31	158
9)	10/19-11/23		1,180	34	125
10)	11/23-12/21		1,621	58	82
1978					
1)	12/21-1/18		1,226	44	87
2)	1/18-2/22		1,724	49	92
3)	2/22-3/22		1,436	51	88
4)	3/22-4/19		1,318	47	102
5)	4/19-5/24		1,602	46	102
6)	5/24-6/21		1,333	48	118
7)	6/21-7/19		1,317	47	123
8)	7/19-8/23		1,152	33	108

B) Estimates--Pressure not available due to meter failure

APPENDIX A

STIMULATION INFORMATION

This appendix includes documents of the stimulation work performed by Dowell and Air Co. well. It includes both pre-stimulation with acid and actual treatment, with a schedule and treating logs.

SERVICE ORDER, RECEIPT, AND INVOICE NUMBER
1-19-1696
SHOW THIS NUMBER ON ALL REMITTANCES

DEPT. 76
TULSA, OKLAHOMA 74182
(REMIT TO ABOVE ADDRESS)

SALES CODE & JOB COD
1/1

TERMS: DUE END OF MONTH FOLLOWING MONTH OF

CUSTOMER NUMBER	DATE	CUSTOMER P.O. NUMBER	SHIPPED VIA	SERVICE FROM DOWELL LOCATION	STATE
[illegible]	8-11-76	[illegible]	Dowell Units	Prestonsburg	

WELL NAME AND NUMBER: Wm. R. Fields #7246
LOCATION AND POOL: Big Branch — Hazard
COUNTY, CITY (IF WITHIN CITY LIMITS) & STATE: Perry Co., Ky
TYPE OF SERVICE: Acidize

CUSTOMER'S NAME: Ky WVa Gas Co.
ADDRESS:
CITY, STATE & ZIP CODE: Prestonsburg, Ky ZIP CODE 41653

SERVICE INSTRUCTIONS:

ITEM NO.	QUANTITY	UNIT	Material, Equipment and Services Used	Unit Price	AMOUNT
18000-002	1	ea	Allison Pumper	770.00	770.00
00101-000	1000	gal	Reg Mud Acid	.75	750.00
4013-055	4	gal	A 170 Inhibitor	13.40	53.60
13017-054	4	gal	W22	16.80	67.20
13048-050	2	gal	F 75	17.75	35.50
59200-001	130	mi.	Mileage Chg. 2 units @ 65 mi.	1.13	146.90
			SUB TOTAL		1,823.20
			Gallons License Fee		
			Gallons License Fee		
	%		Tax on $		— 0 —
	%		Tax on $		
			TOTAL		$1,823.20

THIS IS NOT AN INVOICE

SERVICE ORDER
IMPORTANT: SEE OTHER SIDE FOR TERMS & CONDITIONS
I have read, understood and agreed to the terms and conditions printed on the reverse side hereof and represent that I have full authority to accept and sign this order.
CUSTOMER BY
AUTHORIZED AGENT

DOWELL REPRESENTATIVE: Ken Boilon
PAYROLL: Kf

RECEIPT: THE UNDERSIGNED HEREBY CERTIFIES THAT MATERIALS AND EQUIPMENT LISTED ABOVE WERE RECEIVED AND THE SERVICES WERE PERFORMED IN A WORKMANLIKE
CUSTOMER BY
AUTHORIZED

Thank you!

CNTY AND SSA NUMBER

24

UWL-269-N PRINTED IN U.S.A.

WELL NAME AND NUMBER	LOCATION	CUSTOMER REPRESENTATIVE	TREATMENT NUMBER
Wm. R. Fields # 7246	Big Branch	Mike Walker	1-19-1696

COUNTY	FORMATION	JOB DONE DOWN: TUBING / CASING / ANNULUS	ALLOWABLE PRESSURE: TBG:	CSG:
Harlan	Shale	☐ / ☒ / ☐	—	4000

COUNTY	STATE	TYPE OF WELL: OIL / GAS / WATER / INJ.
Perry	Ky	☐ / ☒ / ☐ / ☐

TYPE OF SERVICE	SERVICE NAME
☒ Acidizing ☐ Sand Control ☐ Fracturing ☐ Other	Acidize & ball out

AGE OF WELL: NEW WELL	REWORK	TOTAL DEPTH	STATIC BHT.
☒	☐	3576	—

CASING SIZE	CASING DEPTH	TUBING SIZE	TUBING DEPTH
4½	3560	—	—

LINER SIZE	LINER TOP-BOTTOM	PACKER TYPE	PACKER DEPTH
—	—	—	—

OPEN HOLE	CASING VOL.	TUBING VOL.	ANNULAR VOL.
—	57	—	—

CUST. NAME: K. Wilson Co.

ADDRESS:

CITY, STATE ZIP CODE: Prestonsburg, Ky

REMARKS: 41653

1 Allison

FOR CONVERSION PURPOSES 24 BBLS EQUALS 1000 GALLONS

ARRIVED ON LOCATION: 1330 LEFT LOCATION: 1530

PERFORATED INTERVALS

TOP	TO	BOTTOM	NO. OF HOLES	TOP	TO	BOTTOM	NO. OF HOLES
3169	TO	75	3		TO		
3409	TO	12	2		TO		
3449	TO	53	2		TO		
3478	TO	88	3		TO		

DIAMETER OF PERFORATIONS = .41

INJECTION RECORD

TIME	LIQUID RATE BPM	TYPE OF FLUID	STAGE VOL. BBLS.	CUM. VOL. BBLS.	PROP TYPE	PROP #/GAL.	PRESSURE CSG.	PRESSURE TBG.	NOTATIONS
1330								400	Pre-Job Pressure Test
			Safety Meeting						
1430½					—	—	0		SI pumping Acid
1431½		Mud Acid	4	4	—	—	0		SI dropping balls
1432½		" "	9	13	—	—	0		9 balls Run in 9 bbls Ac
1433½		" "	10	23	—	—	0		Pump 10 bbls Acid with ba
1434		" "	1	24	—	—	0		Run 15 Perf balls - SI
1437		H_2O	33	57	—	—	0		Balls on bottom
1438		H_2O	1	58	—	—	4000		Shut down

FRAC. GRADIENT	AVG. INJECTION RATES: NO	W/PROP	TOTAL FLUID	TOTAL PROP
—		—	58 BBLS	— LBS

TREATING PRESSURE SUMMARY: blew off

AVG.	FINAL	AVG.	IMMED. SIP.	15 MIN SIP
4100	4300	—		

PREVIOUS TREATMENTS AND DATES: None

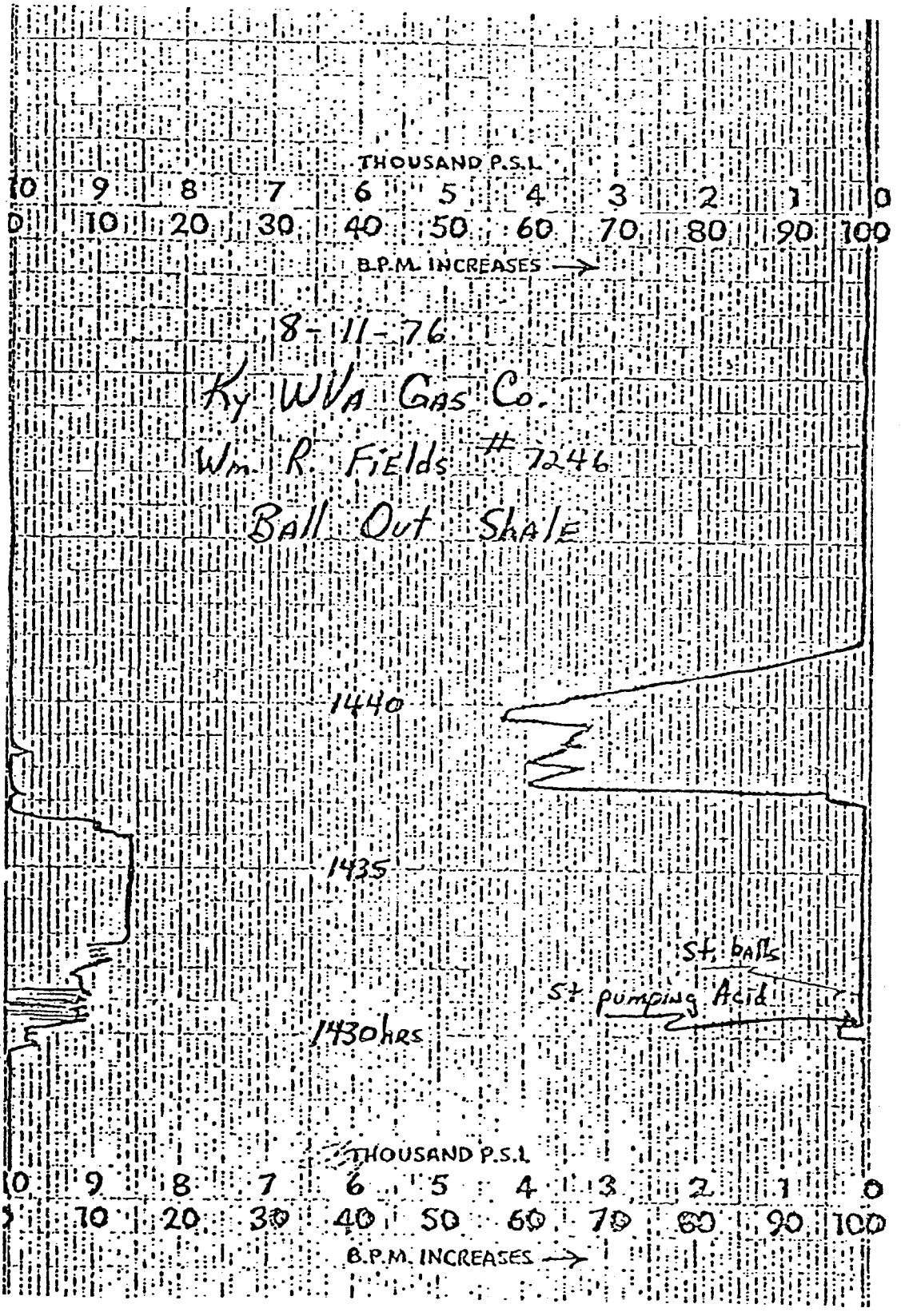
OTHER MATERIALS INJECTED

TYPE	PURPOSE	AMOUNT
A	Acid	1000 gal
WG 2		4 gal
F75		3 gal

PRODUCTION PRIOR TO THIS TR.: None ☐ Test ☐ Stabilized

DOWELL LOCATION: Prestonsburg, Ky

DOWELL TREATMENT SUPERVISOR: Ken Boiles


THOUSAND P.S.I.
10 9 8 7 6 5 4 3 2 1 0
0 10 20 30 40 50 60 70 80 90 100
B.P.M. INCREASES →
8-11-76
Ky WVA Gas Co.
Wm. R. Fields #7246
Ball Out Shale
1440
1435
St. balls
St. pumping Acid
1430hrs
THOUSAND P.S.I.
10 9 8 7 6 5 4 3 2 1 0
0 10 20 30 40 50 60 70 80 90 100
B.P.M. INCREASES →

DOWELL DIVISION OF THE DOW CHEMICAL COMPANY

WELL NAME AND NUMBER: L. R. Fields # 7246	LOCATION: BIG BRANCH	CUSTOMER REPRESENTATIVE: E. B. Jenkins	TREATMENT NUMBER: 01-19-1699
FIELD: HAZARD	FORMATION: Shale	JOB DONE DOWN: TUBING ☐ CASING ☒ ANNULUS ☐	ALLOWABLE PRESSURE: TBG: CSG: 4000
COUNTY: Perry	STATE: Ky.	TYPE OF WELL: OIL ☐ GAS ☒ WATER ☐ INJ. ☐	
TYPE OF SERVICE: ☐ Acidizing ☒ Fracturing ☐ Sand Control ☐ Other	SERVICE NAME: Foam Frac (75 qty)	AGE OF WELL: NEW WELL ☒ REWORK ☐	TOTAL DEPTH: 3576 / STATIC BHT.
CUST. NAME: Ky. W. Va. Gas Co.		CASING SIZE: $4\frac{1}{2}$ / CASING DEPTH: 3560	TUBING SIZE / TUBING DEPTH
ADDRESS		LINER SIZE / LINER TOP-BOTTOM	PACKER TYPE / PACKER DEPTH
CITY, STATE ZIP CODE: Prestonsburg, Ky. 41653		OPEN HOLE / CASING VOL. 57	TUBING VOL. / ANNULAR VOL.
REMARKS:			

PERFORATED INTERVALS

TOP	TO	BOTTOM	NO. OF HOLES	TOP	TO	BOTTOM	NO. OF HOLES
3169	TO	75	3		TO		
3408	TO	12	2		TO		
3449	TO	53	2		TO		
3478	TO	88	3		TO		

DIAMETER OF PERFORATIONS = .41

O: Allison — One Stage

CO2 CONVERSION PURPOSES 24 BBLS EQUALS 1000 GALLONS

ARRIVED ON LOCATION: 1200 — LEFT LOCATION: 1800

INJECTION RECORD

TIME	FLUID RATE BPM	TYPE OF FLUID	STAGE VOL BBLS	CUM VOL BBLS	PROP TYPE	PROP #/GAL	PRESSURE CSG.	PRESSURE TBG.	NOTATIONS
1 22		H-20						2800	Pre-Job Pressure Test
			SAFETY MEETING						
1523		water & N-2 W22 & L42				—	—		N-2 @ 15,000 SCF St pumping to fill
1 25½	5½+½	" "	14	14		—	—		Hole Full
1527½	5½+½	" "	12	26	—	—	1100		St 80/100 sand @ 2# gal.
1 31	5¾+½	" "	22	48	80/100	2#	1150		Cut N-2 back to 11000SCF
1533	5¾+½	" "	12	60	80/100	2#	1150		Cut 80/100 St 20/40@2#
1 37	5¾+½	" "	25	85	20/40	2#	1150		20/40 Sand to 3# Gal.
1541	5¾+½	" "	25	110	20/40	3#	1150		20/40 Sand to 4# Gal.
1545	5¾+½	" "	25	135	20/40	4#	1150		20/40 Sand to 6# Gal.
1554½	5¾+½	" "	59	194	20/40	6#	1150		Cut N-2 back to 10000SCF
1612	5¾+½	" "	109	303	20/40	6#	1150		Cut Sand & St Flush
1 14½	5¾+½	" "	16	319	0	0	1150		Cut N-2
1615½	6½+½	Fresh Water	7	326	0	0	750		Flush in - Shut down

Treatment was pumped @ 5 3/4 BPM with Allison & ½ BPM with SPC Pumping Suds

(BHTP estimated @ 1100Psi)

Total of 578,000 SCF of N-2 Used

GRADIENT	AVG. INJECTION RATES: BD 6.5	W/DROP 6.25	TOTAL FLUID 326 BBLS	TOTAL PROP 52,000 LBS

TREATING PRESSURE SUMMARY: 1150 | FINAL 750 | AVG. 1150 | 10 MIN. SIP 600 | 15 MIN. SIP 200

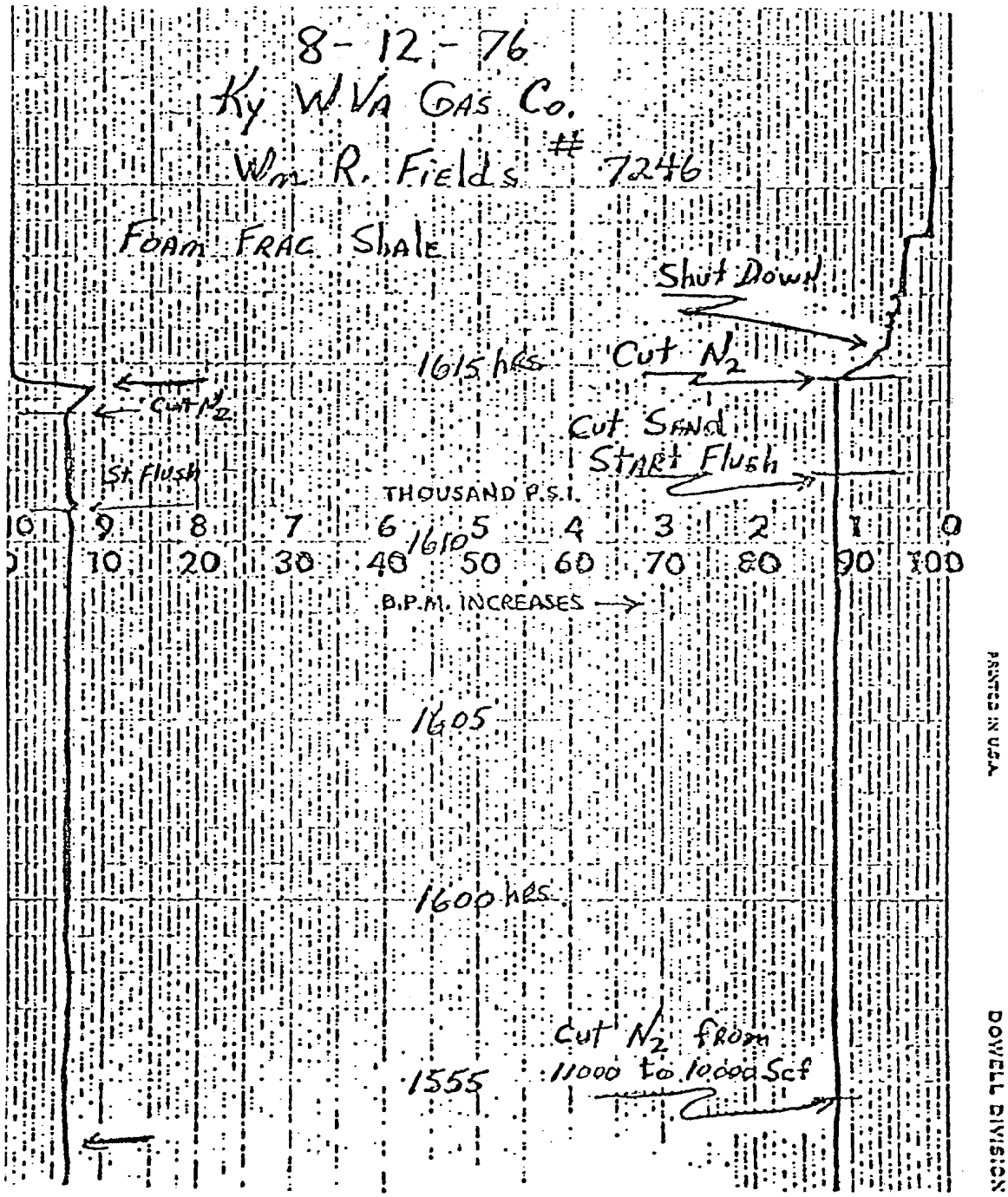
PREVIOUS TREATMENTS AND DATES: Well was balled out & cleaned up 8-11-76

OTHER MATERIALS INJECTED		
TYPE	PURPOSE	AMOUNT
S	80/100	3000#
S	20/40	49000#
W22		108 gal.
L42		120 gal.

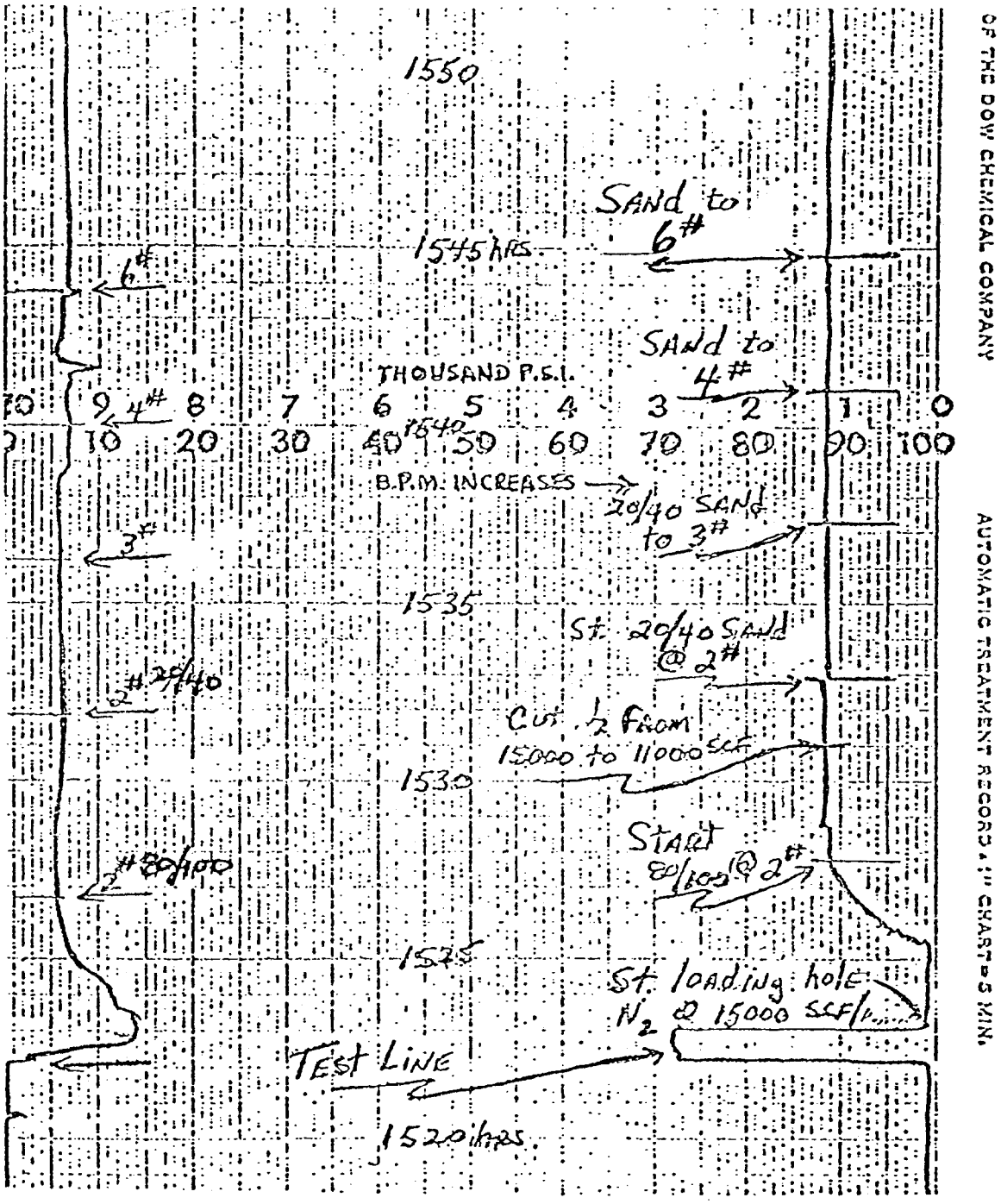
ACTION PRIOR TO THIS TR: NONE — ☐ Test ☐ Stabilized

DOWELL LOCATION: Prestonsburg, Ky.

DOWELL TREATMENT SUPERVISOR: Ken Boilon



PRINTED IN USA
DOWELL DIVISION


1550
SAND to 6#
1545 hrs.
6#
SAND to 4#
THOUSAND P.S.I.
9 4# 8 7 6 5 4 3 2 1 0
10 20 30 40 1540 50 60 70 80 90 100
B.P.M. INCREASES
20/40 SAND to 3#
3#
1535
St. 20/40 SAND @ 2#
2# 20/40
Cut ½ from 15000 to 11000 scf
1530
Start 80/100 @ 2#
2# 80/100
1525
St. loading hole N2 @ 15000 scf/
TEST LINE
1520 hrs.
OF THE DOW CHEMICAL COMPANY
AUTOMATIC TREATMENT RECORD

TREATMENT REPORT AIRCOWELL PRESSURE GAS SERVICES DEPARTMENT, AIRCO INDUSTRIAL GASES
A DIVISION OF AIR REDUCTION COMPANY, INCORPORATED

DATE: 8-12-76

WELL NAME AND NUMBER: Wm. R. Fields
LOCATION: Caney Extension
CUSTOMER REPRESENTATIVE: David Roblader
SERVICE COMPANY: Dowell
OIL: JEFF - HAZZARD
FORMATION: Shale
JOB DONE DOWN: TUBING A ☐ CASING B ☒ ANNULUS C ☐
ALLOWABLE PRESSURE: TBG. CSG. 4,000
COUNTY: Perry
STATE: Ky.
TYPE OF WELL: OIL ☐ GAS ☒ STORAGE ☐ WATER ☐ OTHER ☐
TYPE OF SERVICE: Foam Frac.
AGE OF WELL: NEW ☒ REWORK ☐
TOTAL DEPTH: 3560
STATIC BHT:
CASING SIZE: 4 1/2"
CASING DEPTH: 3560
TUBING SIZE:
TUBING DEPTH:
LINER SIZE:
LINER DEPTH:
PACKER TYPE:
PACKER DEPTH:
OPEN HOLE:
CASING OR ANNULAR VOLUME:
TUBING VOLUME:
CUSTOMER NAME: Ky. W.Va. Gas
ADD-RESS:
REMARKS:

PERFORATED INTERVALS

DEPTH	NO. OF HOLES	DEPTH	NO. OF HOLES	DEPTH	NO. OF HOLES
3487 88	10				

TIME ARRIVED AT LOCATION: 0630
STIMULATION FLUID (TYPE): Foam
SERVICE COMPANY ENGINEER: KEN Bolin - Jerry Norton
TIME ARRIVED AT LOCATION: 1230
AMOUNT TOTAL: 300 BBl
AVERAGE INJECTION PRESSURE: 1250 PSI
AIRCOWELL EQUIPMENT OPERATORS AND TRUCK NUMBERS: 1. Conrad - 5358
TIME LEFT LOCATION: 1700
AMOUNT WITH NITROGEN: 296
AVERAGE INJECTION TEMPERATURE: °F
2. Smith - 5360
AVERAGE INJECTION RATE: 6.0 BPM
MAXIMUM INJECTION RATE: 6.0
3. Wiles - 6126 + Heetz Tractor.
TOTAL NITROGEN USED: 590,000
NITROGEN RATE - SCF/BBL
7min @ 15,000
2min " 9,000
22 " " 11,000
19 " " 10,000
NITROGEN TEMPERATURE
REMARKS: Had to wait 5 Hours on tractor to Get on loc.
TITLE

FORM A32173 4/67 Prtd. In U.S.A.

APPENDIX B

STIMULATION COST

PROPOSED FOAM FRAC

DESIGN AND COSTS

PROPOSED FOAM FRAC DESIGN AND COSTS

Well Information

Company:	KY. WV. GAS	
State:	Kentucky	
County:	Perry	
Field:	Hazard	
Well:	William Fields #7246	
CSG. Size:	4½	
Perforations:	3	3174-3180
	7	3412-3491
	10	.5" perfs

Treatment Size

50,000 Gal. 75/25 Foam Quality
50,000 #20/40 Sand
5,000 #80/100 Sand
300 BBL water w/L-42 10 Gas./1,000, 7 Gas. w22/1000
825,000 SCF/N2
Rate 25 BPM

FOAM FRAC TREATMENT COST-DOWELL

	Unit Cost	
Pumper (1 Allison)	$770.00	770.00
Blender	500.00	500.00
Cementer/Pump Detergent	530.00	530.00
Mileage on above units (60 mi.ea.)	1.10 mi.	198.00
Fluid handling charge 12,600 gal.	.05	630.00
Prop agent charge 55,000 #	.20	110.00
Maximum Sand Concentration 0.0-6.0 PPG	.03	378.00
50,000# 20/40 Sand	3.15	1575.00
5,000# 80-100 Sand	3.55	177.50
Mileage - 27.5 ton 60 mi.	.37	610.50
L-42 120 gal.	12.75	1530.00
W 22 100 gal.	16.00	1600.00
		$8609.00

To breakdown the formation and Ball-out with perf balls as we have done in the past, the cost would be as follows:

1 - Acid Pumper		340.00
Mileage on pumper 60mi.	@1.10	66.00
1000 gal mud acid	@ .75	750.00
Ball injector		75.00
10 - DS9 Perf balls 7/8"	@1.36	13.60
2 Gal. F33	@12.25	24.50
2 Gal. A170 Inhibitor	@12.75	25.50
2 Gal. W 44	@16.00	32.00
		$1326.60

By breaking down with acid the day before the foam-frac, the only extra cost would be the acid pumper and mileage @ cost of $406.00, using such procedure as this could eliminate waiting and stand by time on Aircowell's equipment the following day.

TREATMENT COST - AIRCOWELL

3-N_2 pumpers 1st. 4 hours	$750.00 ea.	2250.00
N_2 225,000 SCF	NC	NC
300,000 SCF	.90	2700.00
325,000 SCF	.85	2762.50
Mileage: 3 pumpers Ripley, WV 474 Rt./Mi.	.80	1137.60
1 N_2 transport Warren,Ohio 974 Rt./Mi.	.80	779.20
2 hrs. STBY. on transport	25.00 hr.	50.00
Royalty Charge - 850,000 SCF	.04	340.00
	TOTAL	$10,019.30

SAI
July 1979

SAND PUMPING SCHEDULE

Foam BBL	Water BBL			
100	25	Pad Volume		
200	50	80/100 Sand	2½ ppg.	5250
100	25	20/40 Sand	2 ppg.	2100
100	25	20/40 Sand	4 ppg.	4200
640	160	20/40 Sand	6 ppg.	40320
				51870 # Sand
42	14	Flush		

Carl, Dowell has established an on location safety policy to which Dowell Personnel must adhere. A Pre-job tail-gate safety meeting will be held with company representatives and others on location personnel to familiarize everyone with existing hazards and safety procedures. Remote control pumping units will be utilized to remove personnel from high-risk, potentially hazardous areas. We would appreciate close cooperation between customer representatives and the Dowell Representative to insure a smooth and safe operation.

Thank you for this opportunity of working with you.

Sincerely,

Gary "Whitey" Westfall

Gary "Whitey" Westfall

GW/hrn

PROPOSED TREATMENT COSTS

Services:	Unit Cost	Cost
fluid handling charge, 12,600 gal.	$ 0.05	$630.00
proppant charge, 55,000 lb.	0.002	110.00
sand concentration charge, 12,600 lb.	0.03	378.00
nitrogen royalty charge, 850 MSCF	0.04	340.00
Materials:		
5,000 lb. 80/100 sand	0.0355	177.50
50,000 lb. 20/40 sand	0.0315	1575.00
1,650 ton-miles transport, sand	0.37	610.50
120 gal. L-42	12.75	1530.00
100 gal. W-22	16.00	1600.00
20 DS9 perf balls (7/8 in.)	1.36	27.20
225 MSCF nitrogen	N.C.	N.C.
300 MSCF nitrogen	9.00	2700.00
325 MSCF nitrogen	8.50	2762.50
		$18655.50

The above equipment will generate the specified fracturing foam from the specified materials and displace it into KY-WV Well No. 7246.

Technical Job Specification

The foam fracturing operation as listed in these specifications is to be conducted by the prime contractor, Kentucky-West Virginia Gas Compan (KY-WV) on KY-WV Well No. 7246 in Perry County, KY. The treatment is to consist of:

50,000 gal. 75 quality N_2-water foam

50,000 lb. 20/40 sand

5,000 lb. 80/100 sand

12,500 gal. treated water, including

120 gal L-42

100 gal W-22

825,000 SCF nitrogen

Specifically, the treatment will use the following equipment, services, an materials.

Equipment:	Unit Cost	Cost
1 Allison pumper	$770.00	$770.00
1 blender	500.00	500.00
1 cementer	530.00	530.00
180 miles (mileage on above)	1.10	198.00
3 nitrogen pumpers	750.00	2250.00
1 nitrogen transport	N.C.	N.C.
2396 miles (mileage on above)	0.80	1916.80
2 hours transport standby	25.00	50.00

COST FOR A WATER FRAC

DOWELL DIVISION OF THE DOW CHEMICAL COMPANY

SERVICE RECOMMENDATION

July 2, 1976

E.R.D.A.
Box 880
Morgantown, W. Va. 26505

Mr. Carl Frohme:

The following is a waterfrac treatment that Dowell performed on the shale in eastern Kentucky for Ky. W. Va. Gas Company that you requested in our telephone conversation the other day. The treatment is priced-out so that you might compare with the foam-frac treatment that I mailed to you earlier.

WELL INFORMATION

Company:	Ky. W. Va. Gas Company
State:	Kentucky
Field:	Hazard
Formation:	Shale
CSG Size:	4½

DOWELL WATERFRAC TREATMENT

	Unit Cost	
1982 HHP	1.75	3468.50
Blended 54 B.P.M.	691.00	691.00
30,000 lbs. 20/40 Sand	3.15 CWT	945.00
24,000 lbs. 10/20 Sand	3.55 CWT	852.00
300 CWT Prop Agent Charge 20/40	.20	60.00
240 CWT Prop Agent Charge 10/20	.45	108.00
850 lbs. J140	1.35	1147.50
30 Gal F52	12.00	360.00
1620 TM Hauling (54,000 lbs. 60 mi.)	.39	631.80
500 Gal Mud Acid	.75	375.00
2 Gal A130 Inhibitor	13.40	26.80
1 Ball Injector	75.00	75.00
5 DS9 Perf-balls	.78	3.90
300 Miles (5 Units 60 mi.)	1.13	339.00
		$9083.50

ACTUAL COST

KENTUCKY WEST VIRGINIA GAS COMPANY
INCORPORATED
SECOND NATIONAL BANK BUILDING
ASHLAND, KENTUCKY 41101

P. O. Box No. 1388

IN ACCOUNT WITH United States Energy & Development Admin.
P. O. Box E
Oak Ridge, Tenn. 37830

DATE October 12, 1976

Attn: F. O. Christie
Director Contract Div.
Oak Ridge Operations

Reimbursable costs incurred to perform frac on W. R Fields Well No. 7246, drilled under Work Order #C-4656	
Aircowell, Division of Airco, Inc. P. O. Box 55429 Houston, Texas 770555 Voucher No. 9-213-1976 (invoice No. A11031) Pump N2 to generate foam as per instructions	$ 6,979.
Dowell, Division of The Dowell Chemical Company Dept. 76 Tulsa, Okla 741812 Voucher No. 9-46-1976	
Foam frac service (invoice No. 01-19-1699)	8,450.
Acidize service (invoice No. 01-19-1696)	1,823.
Total reimbursable costs	$17,253.

SERVICE ORDER, RECEIPT AND INVOICE NUMBER
1-19-1699

W THIS NUMBER ON ALL REMITTANCES

DEPT. 76
TULSA, OKLAHOMA 74182
(REMIT TO ABOVE ADDRESS)

SALES CODE & JOB COUNT
7101

TERMS: DUE END OF MONTH FOLLOWING MONTH OF SALE

OMER NUMBER	DATE	CUSTOMER P.O. NUMBER	SHIPPED VIA	SERVICE FROM DOWELL LOCATION	STATE NO
	8-12-76		Dowell Units	Prestonsburg	

WELL NAME AND NUMBER	LOCATION AND POOL
W. R. Fields #7246	Big Branch — Hazard

COUNTY, CITY (IF WITHIN CITY LIMITS) & STATE	TYPE OF SERVICE
Perry Co., Ky	Foam Frac

CUSTOMER'S NAME: Ky WVA Gas Co.

ADDRESS:

CITY, STATE & ZIP CODE: Prestonsburg, Ky ZIP CODE 41653

SERVICE INSTRUCTIONS:

ITEM NO.	QUANTITY	UNIT	Material, Equipment and Services Used	Unit Price	AMOUNT
8 00-002	176	ea	HHP 1150 Av. Psi	1.75	MIN 770.00
2067-000	1	ea	10% of HHP chg.	77.00	77.00
3400-000	1	ea	6.25 BPM Blender	350.00	~~350.00~~
8 12-000	1	ea	15% of Blender Chg.	—	MIN. 500.00
9118-000	13,398	gal	Fluid Handling Chg.	.05	669.90
9 17-001	11,634	gal	Sand Concentration Chg.	.03	349.02
9110-000	520	cwt	Prop Pump Chg.	.20	104.00
00-000	1690	Tm	Hauling 52,000# for 65mi	.39	659.10
5008-000	490	cwt	20/40 Sand	3.20	1568.00
032-000	30	cwt	20/100 Sand	3.70	111.00
12017-030	120	gal	L42	13.40	1608.00
017-054	108	gal	W22	16.80	1814.40
9200-001	195	mi	Mileage Chg @ 65mi 3 Units	1.13	220.35
			SUB TOTAL		8450.77
			Gallons License Fee		
			Gallons License Fee		
%			Tax on $		— 0 —
%			Tax on $		
			TOTAL		$8450.77

Thank you!

CITY AND SSA NUMBER

43

SERVICE ORDER

IMPORTANT: SEE OTHER SIDE FOR TERMS & CONDITIONS

I have read, understood and agreed to the terms & conditions printed on the reverse side hereof and represent that I have full authority to accept same and sign this order.

CUSTOMER BY

AUTHORIZED AGENT

DOWELL REPRESENTATIVE: Ken Bailey

PAYROLL INIT: KPB

RECEIPT: THE UNDERSIGNED HEREBY CERTIFIES THAT THE MATERIALS AND EQUIPMENT LISTED ABOVE WERE RECEIVED AND THE SERVICES WERE PERFORMED IN A WORKMANLINE MANNER

CUSTOMER BY

AUTHORIZED AGENT

No. 250 PRINTED IN U.S.A.

1134/79

HCO

AIRCOWELL
NITROGEN GAS SERVICE DEPARTMENT
AIRCO INDUSTRIAL GASES, A DIVISION OF AIRCO, INC.

INVOICE NO.
A 11031

Ky. W.Va. Gas Co.
O JEFF, Ky.

Ky. W.Va. Gas Co. - Steel 1135
T P. O. BOX 431
Prestonsburg, Ky 41602

PLEASE MAIL CHECKS TO:
AIRCOWELL
P.O. BOX 360004M
PITTSBURGH, PA 15230

DATE 8-12-79

CUSTOMER ORDER NO.

ADDRESS CORRESPONDENCE TO:
AIRCOWELL
P.O. BOX 55429
HOUSTON, TEXAS 77055

TERMS: ☐ NET CASH ☒ NET 30 DA
ADD LEGAL INTERES THEREAFTER

ER NO.	SHIP. PT.	SHIP VIA	TAX AREA	TAX EX.	NO INV. REQ'D.	TYPE A/C	SALESMAN'S NO.
7-00251	316	1	16-193-0000	02	3	2	9707

SERVICE ORDER
Important: SEE OTHER SIDE FOR TERMS AND CONDITIONS
I HAVE READ, UNDERSTOOD AND AGREED TO THE TERMS AND CONDITIONS PRINTED ON THE REVERSE SIDE HEREOF AND REPRESENT THAT I HAVE FULL ALTHORITY TO ACCEPT SAME AND SIGN THIS ORDER.
CUSTOMER:
BY: D. Wayne Robinson TITLE

CE FROM AIRCOWELL STA.: Ripley, W.Va.
WELL NAME, NUMBER & LOCATION
☒ NEW WELL ☐ WORK OVER
TY AND STATE: ERY Ky.
TYPE OF SERVICE SCHEDULE: INDUSTRIAL ☐ OIL FIELD: ☒ LAND ☐ OFF-SHORE ☐ INLAND WATER
CE INSTRUCTIONS: Pump N2 to Generate Foam as per Instructions

CT CODE	DESCRIPTION OF CHARGES	UM	QUANTITY	UNIT PRICE	AMOUNT
9-8001	NITROGEN	SCF			
-8001	NITROGEN	SCF			
9-8001	NITROGEN	SCF			
-8001	NITROGEN – PATENTED METHOD	SCF	150,000	N.C.	-0-
9-8001	NITROGEN – PATENTED METHOD	SCF	100,000	.90	900.00
8001	~~MISCELLANEOUS~~ Nitrogen - Patented Method	SCF	340,000	.85	2890.00
	STORAGE VESSEL CHARGE: Tank Vol _____ Gals.	DAYS			
9-8002	PUMPING 2 Pumper Unit No(s): 5358, 5360	EA.	# 1	1500.00	1500.00
-0045	TUBE TRAILER RENTAL - Unit No:	MOS.			
-0002	MILEAGE (Round Trip) 3 Units	MI.	1392	.80	1113.60
-0003	PUMPER STANDBY CHARGE Arrival Time 0800 Departure Time 1600 No. of Elapsed Hours 8 Less Hours 4 Total Standby Hours 4 x 2	HRS.	8	30.00	240.00
-0003	LIQUID TRANSPORT STANDBY CHARGE Arrival Time 0800 Departure Time 1600 No. of Elapsed Hours 8 Less Hours 4 Total Standby Hours 4	HRS.	4	25.00	100.00
99-0004	MINIMUM CHARGE (Unit Called Out But Not Used)	EA.			
-3069	NITROGEN ROYALTY CHARGE		590,000	.04	236.00
0-0001	TAXES		% TAX ON $		
				TOTAL	6979.6
				PAY AMOUNT A	

D METER READING (SCF)
ART 975,000
SH 385,000
rence 590,000

WE HEREBY CERTIFY THAT THESE GOODS WERE PRODUCED IN COMPLIANCE WITH ALL APPLICABLE REQUIREMENTS OF SECTIONS 6, 7 AND 12 OF THE FAIR LABOR STANDARDS ACT AS AMENDED AND OF REGULATIONS AND ORDERS OF THE UNITED STATES DEPARTMENT OF LABOR ISSUED UNDER SECTION 14 THEREOF.
THE PURCHASER, BY ACCEPTANCE AND USE OF THE GOODS SPECIFIED HEREIN, ACCEPTS AND AGREES TO BE BOUND BY THE CONDITIONS PRINTED ON THE REVERSE SIDE.

CUSTOMER SIGN HERE | BY: D. Wayne Robinson TITLE | DATE | TIME

Received Payment of $ _____ By _____

D. Wayne Robinson Aircowell Gerald Smith Miles

APPENDIX C

PRODUCTION TESTS

OPEN FLOW TEST

Table C.1 - Shut-In and Flow Tests

Date	Comments
8-16-76	Well shut in for 66 hours. Rock pressure at 540 psi. Open flow after 6 hours was 130/10 (481 MCF) Gas sample was analyzed to contain 5.63% N_2.
8-17-76	Commenced blowing off well at 8:00 A.M. Open flow was 8/10 Hg-2" (440 MCF) after 7 1/2 hours. Gas was analyzed and contained 2.65% N_2.
8-18-76	After 16 hours shut in the rock pressure was 410 psi. Two-inch tubing was run to 3488
8-19-76	After 16 hours shut in time, the rock pressure was 380 psi in casing and tubing. Well was blown for 7 1/2 hours and gauged at 74/10 H_2O 2-inch (363 MCF)
8-20-76	After 16 hours shut in time, rock pressure was 390 psi. 7 1/2 hours open flow was 64/10 H_2O 2-inch (337 MCF)

The fluid return after frac was measured into a 210 bbl. horizontal tank and a total of 70 bbls. was recovered during the Flow Back Stage. Approximately 6 bbls. of fluid was swabbed from the well prior to tubing. Thus the total fluid returned was 76 bbls. or 23% of total fluid injected during treatment.

SHORT TERM WELL TESTS

MODIFIED ISOCHRONAL TEST

MODIFIED ISOCHRONAL TEST

CRITICAL FLOW PROVER

$qsc = CPF_{tf}\ Fg\ Fpv$

$Fpv \approx 1.0$

Fg = specific gravity factor (AGA #4, p. 49, TABLE 15)

F_{tf} - flowing temperature factor (AGA #4, p. 48, TABLE 14)

P = flowing pressure upstream of the prover, psia

C = coefficient of the orifice

Run #	Plate	C	Temp.	Fg	F_{tf}	$Q=CPF_{tf}$ Fg (1)	Psig
1	.125	.3499	77	1.1868			461
			73	1.1868			
			78	1.1868			
			74	1.1868			
G = .71	.125	.3499	76	1.1868	0.985	182,727	432
2	.1875	.8035	91	1.1868			448
		.8035	69	1.1868	0.9915	346,994	367
3	.250	1.436	70	1.1868			417
		1.436	61	1.1868	0.9990	496,682	277
4	.375	3.142	60	1.1868			365
		3.142	59	1.1868	1.001	641,008	157

SUBSURFACE PRESSURE MEASUREMENTS

COMPANY Ky West Virginia WELL NAME William Field #7246

DATE OF TEST 9-8-76 LOCATION PAGE 1 OF

CHART READINGS AND CALCULATIONS FOR BUILDUP OR DRAWDOWN TEST

Date	Orifice	Time	Temp.	Gauge Pressure psig	DWT psig	Recorder psig
9-8-76	.0625	9:30 a.m.	74°	460		458
		:35	72°	460		458
Trial Flow		:40	72°	460		458
		:45	71°	459		457
		:50	70°	459		457
		:55	70°	459		457
		10:00	70°	458	459	456
----------Shut in 30 minutes						
FLOW #1						
9-8-76	.125	10:30 a.m.	77°	461	459	458
		:35	74°	459	458	456
		:40	76°	458	456	455
		:45	74°	457	454	454
		:50	73°	456	453	452
		:55	73°	455	452	451
		11:00 a.m.	73°	454	451	450
		:10	73°	451	448	448
		:20	73°	449	446	446
		:30	73°	447	444	444
		:40	74°	445	442	442
		:50	74°	444	440	440
		12:00 a.m.	74°	442	438	438
		:10	75°	440	437	437
		:20	75°	438	435	435
		:30	75°	436	434	434
		:40	77°	434	433	432
		:50	77°	433	432	431
		1:00 p.m.	76°	432	431	430
9-8-76		1:00 p.m.	shut in	shot fluid level		
		2:00 p.m.		442	440	
		:30		445	444	
		3:00		446	445	
		:30		448	447	
FLOW #2						
9-8-76	.1875	3:30 p.m.	91°	448	447	445
		:35	82°	441	440	441
		:40	77°	437	438	438
		:45	75°	433	434	433
		:50	74°	429	429	430
		:55	74°	426	425	426
		4:00 p.m.	74°	423	422	422
		:10	72°	416	415	415
		:20	72°	411	410	410
		:30	72°	406	405	406
		:40	72°	401	400	400
		:50	71°	396	395	395
		5:00 p.m.	70°	391	391	390

O-12A-6-71

COMPANY Ky West Virginia WELL NAME William Field #7246

DATE OF TEST 9-8-76 LOCATION PAGE 2 OF

CHART READINGS AND CALCULATIONS FOR BUILDUP OR DRAWDOWN TEST

Date	Orifice	Time	Temp.	Gauge Pressure psig	DWT psig	Recorder psig
Cont. FLOW #2						
	.1875					
9-8-76		5:10 p.m.	70°	386	386	385
		:20	70°	382	382	382
		:30	69°	376	377	376
		:40	69°	374	374	374
		:50	69°	370	371	370
		6:00 p.m.	69°	367	368	368
		6:00 p.m.	Shut in	Built on pressures on Recorder Shot Fluid Level		
FLOW #3						
9-8-76	.250	8:30 p.m.	70°	417	417	
		:35	66°	392	392	390
		:40	64°	384	385	382
		:45	64°	379	379	377
		:50	63°	373	372	371
		:55	63°	367	368	366
		9:00 p.m.	63°	361	361	358
		:10	63°	349	349	347
		:20	63°	341	340	338
		:30	62°	332	332	330
		:40	62°	322	323	321
		:50	62°	314	315	313
		10:00 p.m.	62°	307	307	305
Misting Water		:10	62°	300	300	298
		:20	62°	294	296	295
		:30	61°	292	292	290
		:40	61°	287	287	286
		:50	61°	281	282	280
		11:00 p.m.	61°	277	277	275
		11:00 p.m.	Shut in	Shot fluid level		
		:05		312		
		:10		317		
		:15		318		
		:45		326		
		12:15		343		
9-9-76		1:30 a.m.		365		
		1:30	Shot Fluid level & Start Flow #4			

SUBSURFACE PRESSURE MEASUREMENTS

COMPANY Ky West Virginia WELL NAME William Field #7246

DATE OF TEST 9-9-76 LOCATION PAGE 3 OF

CHART READINGS AND CALCULATIONS FOR BUILDUP OR DRAWDOWN TEST

Date	Orifice CF ft	TIME	Temp.	Gauge Pressure psia	DWT psig	Recorder psig
FLOW #4	.375					
9-9-76		1:30 a.m.	60°	365	366	
		:35	60°	259	260	257
Misting Water		:40	60°	247	247	246
		:45	59°	249	249	248
		:50	59°	249	249	249
		:55	59°	246	246	244
		2:00 a.m.	60°	242	241	240
		:10	60°	229	229	227
		:20	60°	217	217	215
		:30	60°	208	208	205
		:40	60°	198	198	196
		:50	60°	194	194	192
		3:00 a.m.	60°	188	188	186
		:10	60°	182	183	181
		:20	60°	174	175	173
		:30	60°	172	172	170
		:40	60°	166	165	164
		:50	60°	160	160	158
		4:00 a.m.	59°	157	157	156
		4:00 a.m.	Shut in, shot fluid level changed			
			orifice back to .250 for stabilization			
9-9-76	.250	5:05 a.m.	59°	200		198
		:10	59°	199	198	197
		:20	59°	199	198	197
		:30	59°	198	197	195
		:40	59°	196	195	194
		:50	59°	145	195	194
		5:00 a.m.	59°	191	190	188
		6:00 a.m.	59°	191	190	190
		:30	59°	190	189	187
		7:30 a.m.	59°	182	182	180
		8:00 a.m.	59°	177	177	176
		11:30	72°	166	164	164
		12:00	74°	165	163	164
		1:00 p.m.	75°	161	160	161
		2:00	75°	157	155	156
		3:00	73°	154	153	154

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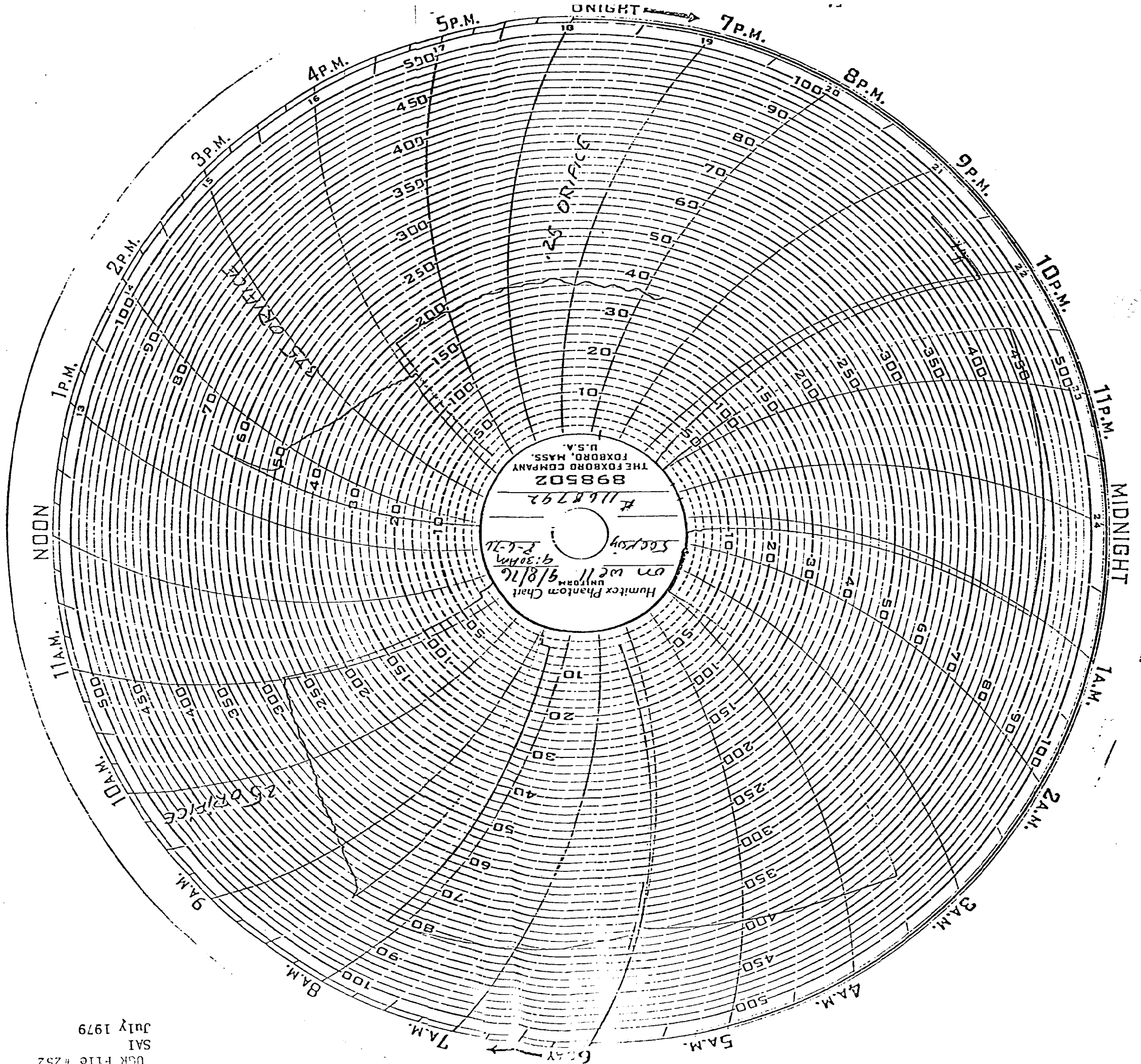

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July 1979

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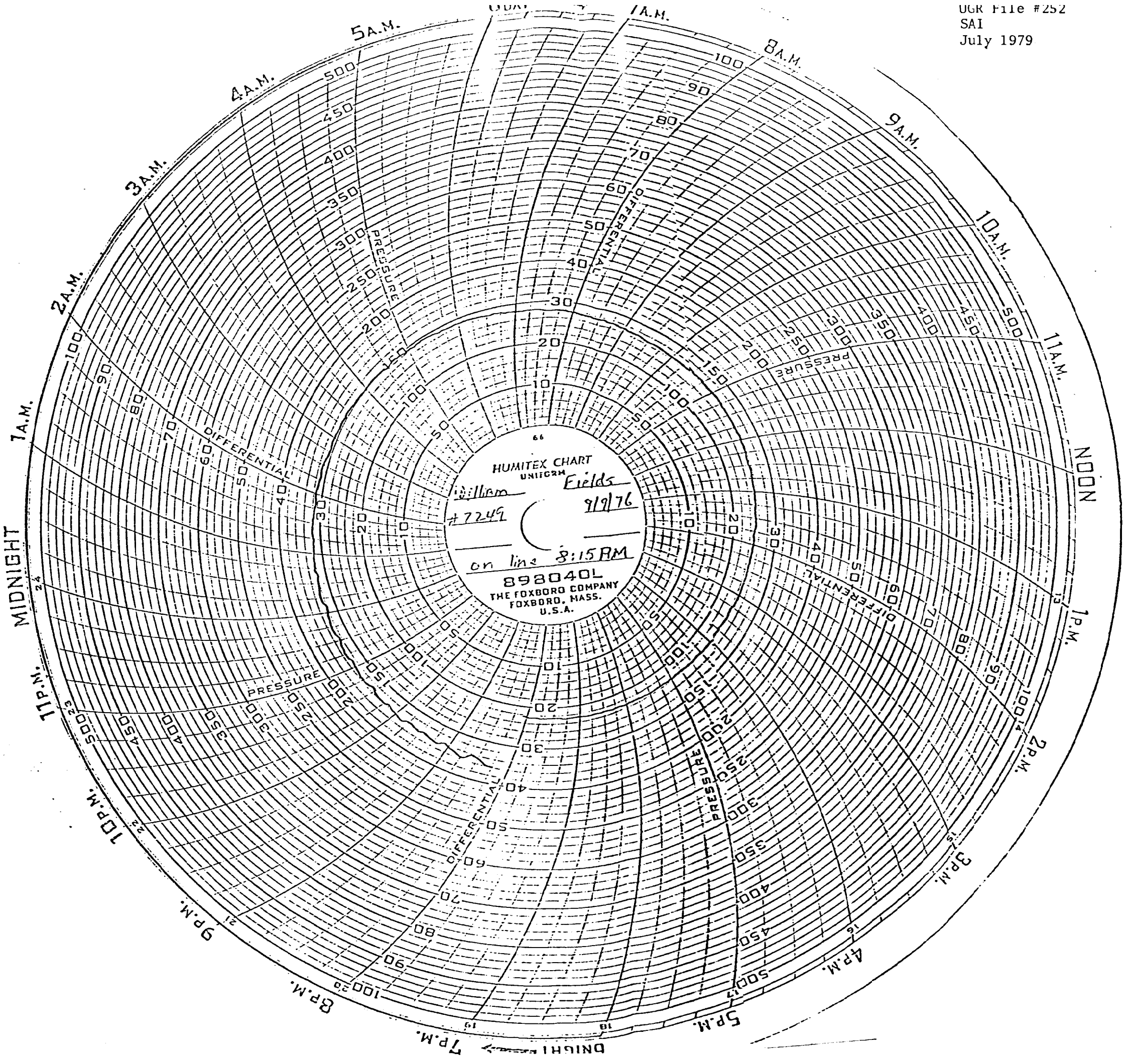
July 1979



PRESSURE DRAWDOWN AND PRESSURE BUILDUP TESTS

UGR File #252
SAI
July 1979

Date 10-12-76

Page 1

BOTTOM-HOLE PRESSURE INTERPRETATION SHEET

Company Ky-West Virginia Lease William Fields Well 7246
Township-District County Perry State Ky
Type of Test Pressure Drawdown Instrument RPG-3 1000 psig (20504)
Depth Investigated 3450 Clock (hours) 72
Shut-in: Date Time Datum
Chart No. 1 From: Date 10/5/76 Time 11:37 To: Date 10/6/76 Time 1300
Previous Test

Time shut-in hours		Deflection, inches	Correction factor	Pressure, psig		Remarks
1137	0	1.0530		527.50		
	1	1.0545		528.25		
	2	1.0545		528.25		
1427	2-50	1.0547		528.35		
	3	1.0430		522.50		
	4	.9641		483.05		
	5	.9047		453.35		
	6	.8498		425.90		
	7	.8004		401.20		
	8	.7589		380.56		
2037	9	.7140		358.20		
	9-50	.6768		339.70		Short Press.
	9-55	.6749		338.75	*	Increase on
	10	.6648		333.70		Curve
	11	.6170		309.90		
	12	.5625		282.85		
0037	13	.5140		258.70		
	14	.4652		234.40		
	15	.4173		210.55		
	15-05	.4084		206.20		Short Press.
	15-10	.4070		205.50	*	Decrease on Curve
	15-40	.3858		194.80		Press. Decrease
	15-41	.3803		192.05	*	on Curve
	16	.3660		184.80		
	17	.3270		165.20		
	18	.3050		154.00		
0637	19	.2852		144.00		
	20	.2705		136.65		
	21	.2590		130.80		
	22	.2477		125.05		
	23	.2405		121.45		
	24	.2340		118.20		
1237	25	.2295		115.95		Start out (1300)
						Time on chart
						= 1237 (23 min.
						short)

WILLIAM FIELDS #7246 DRAWDOWN TEST

TIME	p^{wr}	p^{gage}	p^{pr}	$T^{o}F$
2:30	481	482.5	0	92
2:35	475	476	100	80
2:40	470	470	100	65
2:45	465	466	90	58
2:50	460	460	100	56
2:55	457	458	100	58
3:00	452	454	100	57
3:05	450	450	100	57
3:10	447	448	105	56
3:15	443	444	105	55
3:20	440	440	105	55
3:25	437	437	105	55
3:30	432	434	105	55
3:40	428	428	110	55
3:50	421	421	110	55
4:00	415	415	110	55
4:10	410	410	110	55
4:20	402	402	110	55
4:30	400	400	110	55
4:40	392	393	110	55
4:50	388	388	110	55
5:00	382	384	110	55
5:10	377	378	110	55
5:20	373	374	110	55
5:30	369	369	110	55
5:40	363	363	110	55
5:40	360	360	110	55
6:00	352	352	110	55
6:10	349	349	110	55
6:20	343	343	110	55
6:30	340	340	110	55
6:40	334	334	110	55
6:50	328	328	110	54
7:00	324	324	110	54
7:15	320	320	110	54
7:30	310	310	110	54
7:45	306	306	110	54
8:00	300	300	110	53
8:15	292	293	110	53
8:30	289	290	110	53
8:45	280	280	110	53
9:00	276	276	110	53
9:15	272	272	125	53
9:30	269	270	125	53
9:45	260	260	125	53
10:00	254	258	125	53
10:15	250	254	125	53
10:30	244	250	125	53

WILLIAM FIELDS #7246 DRAWDOWN TEST
-Continued-

TIME	p^{wr}	p^{gage}	p^{pr}	$T^{o}F$
10:45	239	242	125	53
11:00	230	231	125	53
11:15	228	229	125	53
11:30	220	221	125	53
11:45	215	216	125	53
12:00	210	211	125	53
12:15	205	208	125	53
12:30	197	199	125	53
12:45	195	196	125	54
1:00	190	190	125	54
1:15	183	185	125	54
1:30	175	176	125	54
1:45	171	172	125	55
2:00	169	170	125	55
2:15	161	163	125	55
2:30	160	161	125	55
2:45	152	153	25	56
3:00	149	150	125	56
3:15	148	150	129	57
3:30	143	144	125	57
3:45	135	136	125	57
4:00	130	130	122	57
4:15	128	127	120	58
12:00	88	88	81	62
12:15	87	88	81	62
12:45	84	84.5	80	65
1:15	132			
Build up				
2:15 opened up				
	180			

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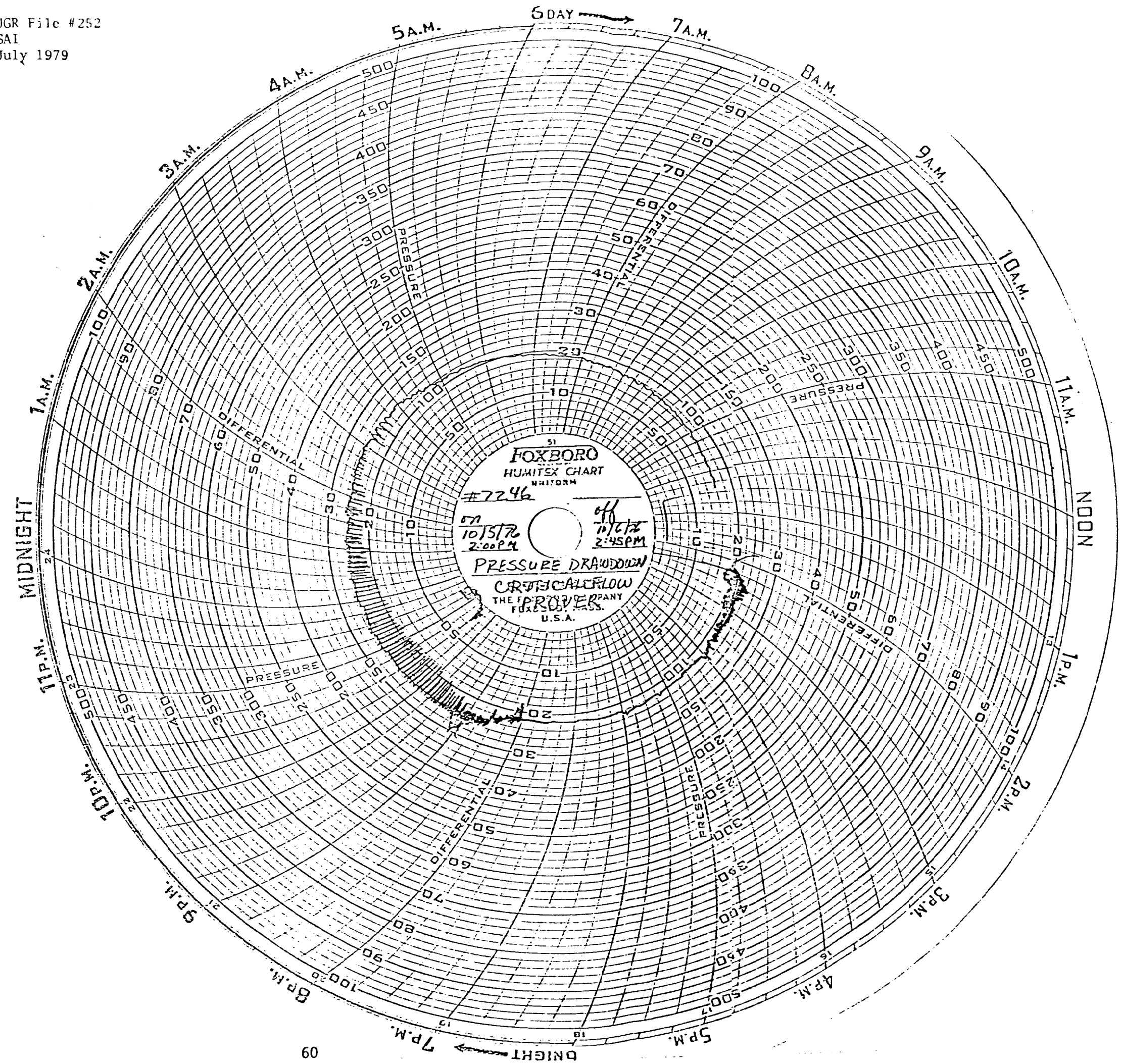

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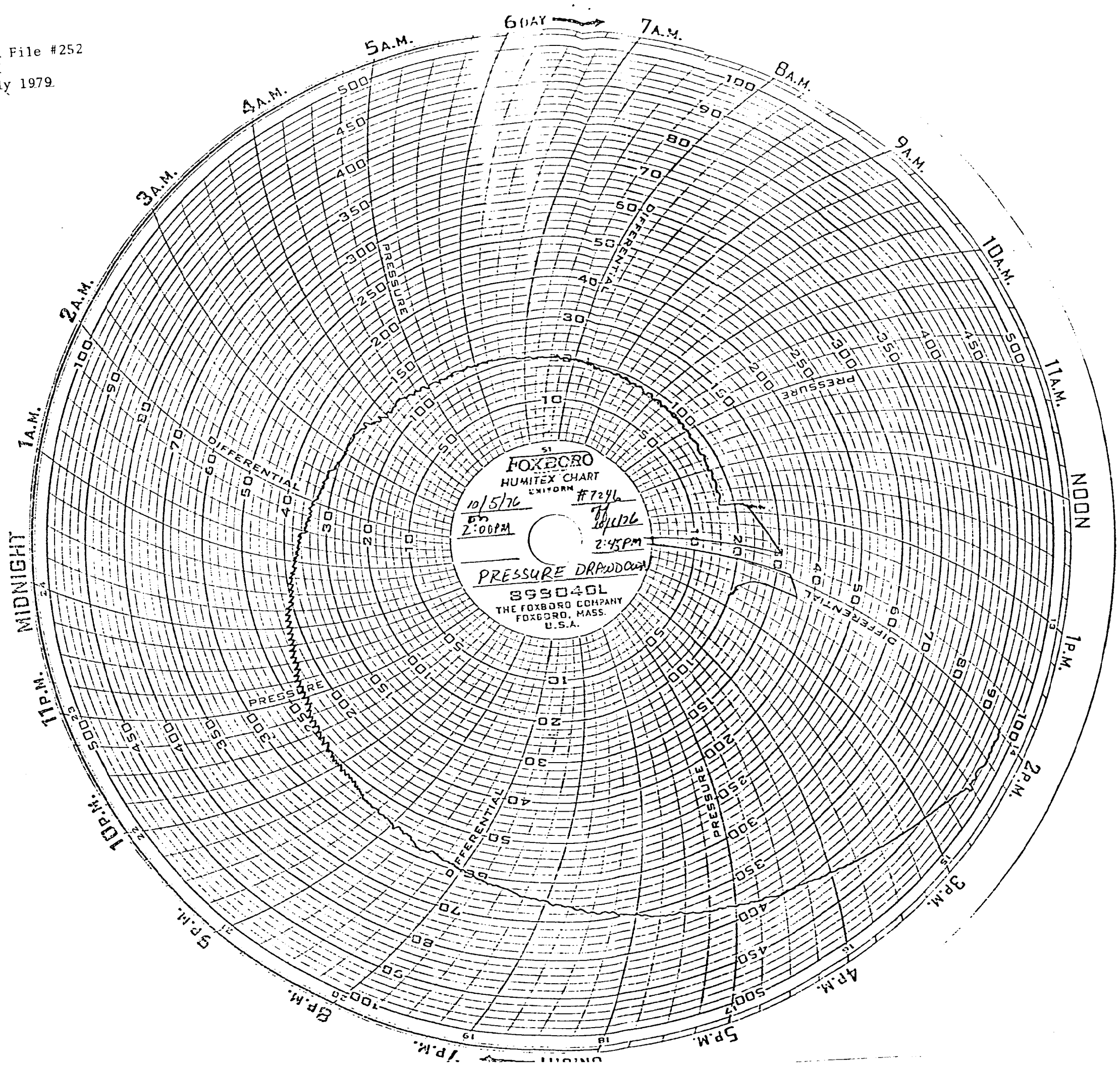

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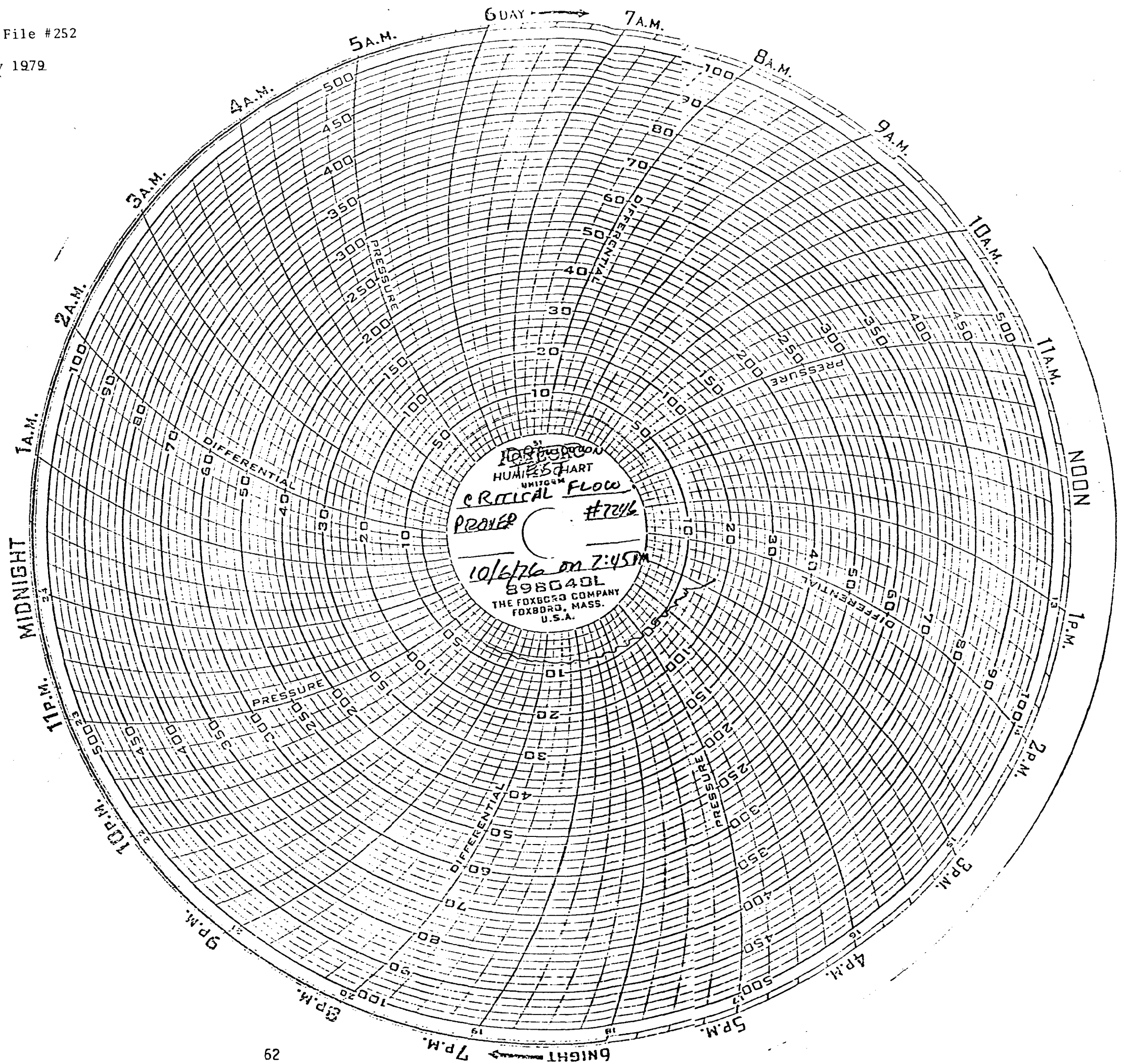

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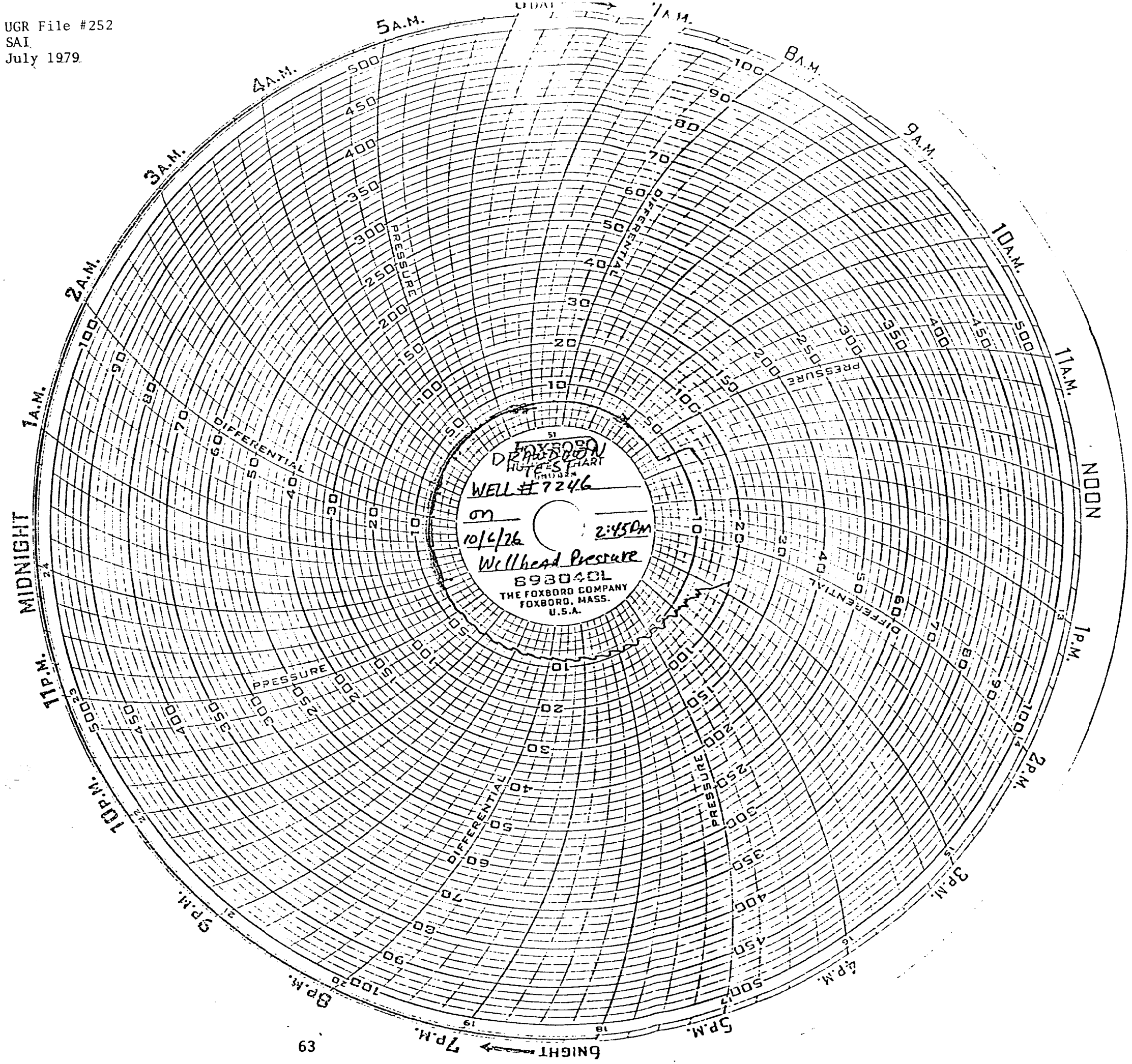


SAI
July 1979

BOTTOM HOLE TESTING DATA SHEET

Date 10/5/76

Company KY--WV Gas Co. Lease William Fields Well 7246

Dist.-Twp. _____ County Derry State KY

Type of Test _____ Instrument 1000 psi

Depth Investigated _____ Clock Type _____ hr.

Shut-In: Date _____ Time _____ a.m. p.m. Datum _____

Sequence of Run Events

	Time from shut-in	Time	Depth	Remarks, Dates
10/5/76	clock on	10:21 a.m.	3450 ft.	Draw base line, engage stylus and clock open valve on well.
	72 hr. clock	start in 11:45	a.m.	Gage readings - Tubing _____
		in 11:37	a.m.	Annulus _____, start in well
10/6/76		start out 1:00	p.m.	
		out 1:30	p.m.	
	disengage clock	2:31 p.m.		
	changed chart, tore down			
10/7/76	180 hrs. clock buildup test			
	clock engaged	9:35 a.m.		
	start in	10:45 a.m.		
	* in	11:25 a.m.		Investigation zone, arrival.
	shut in well	11:30 a.m.		
10/14/75	*start out	10:07 a.m.		
	out	10:26 a.m.		
	released pressure in lubricate			Investigation zone, departure.
		10:37 a.m.		

Comments:

Closed valve.

Stylus and clock disengaged.

Test Run By: Albert B. Yost II
Petroleum Engineer

Date 10-27-76

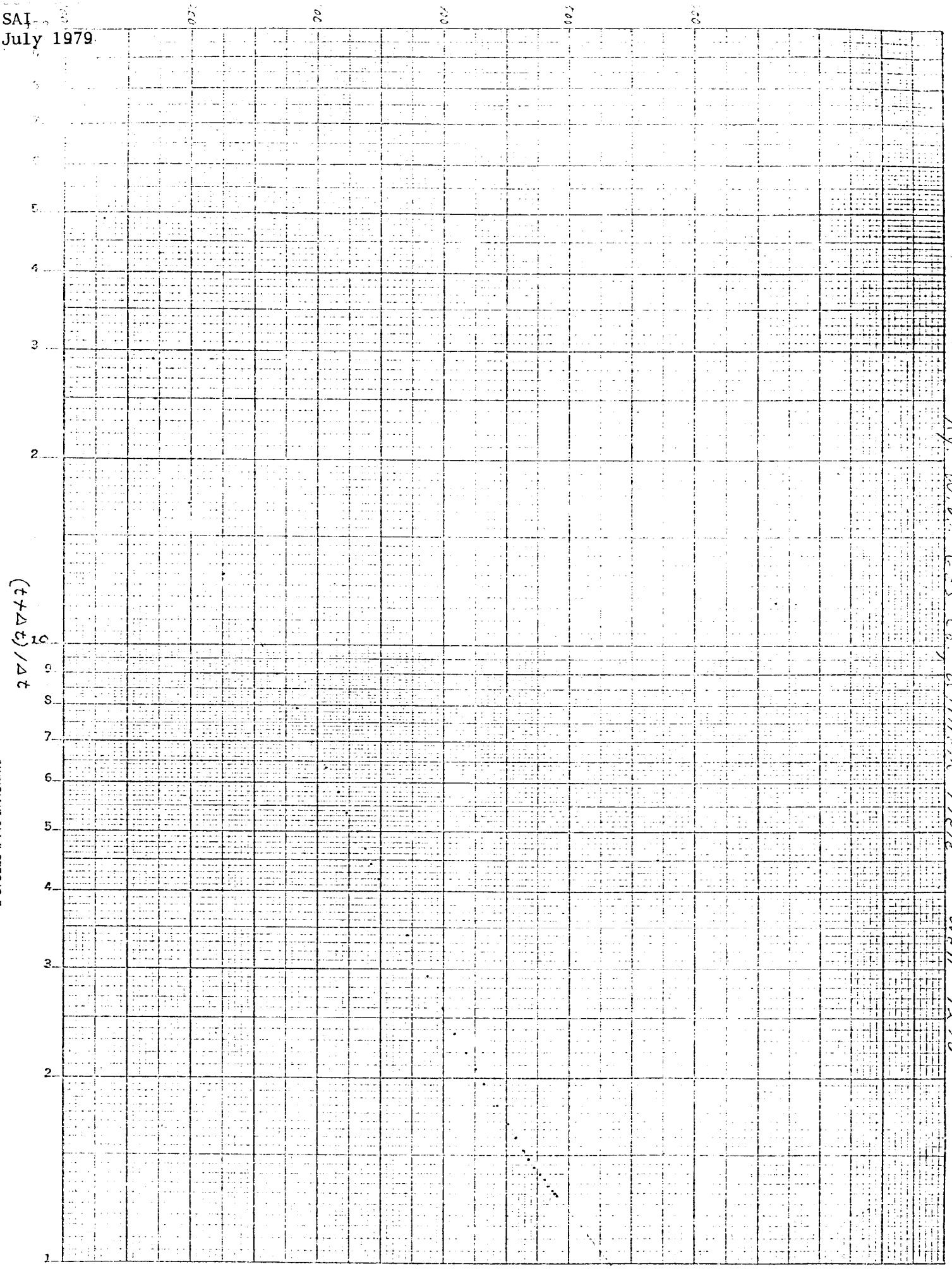
Page 2

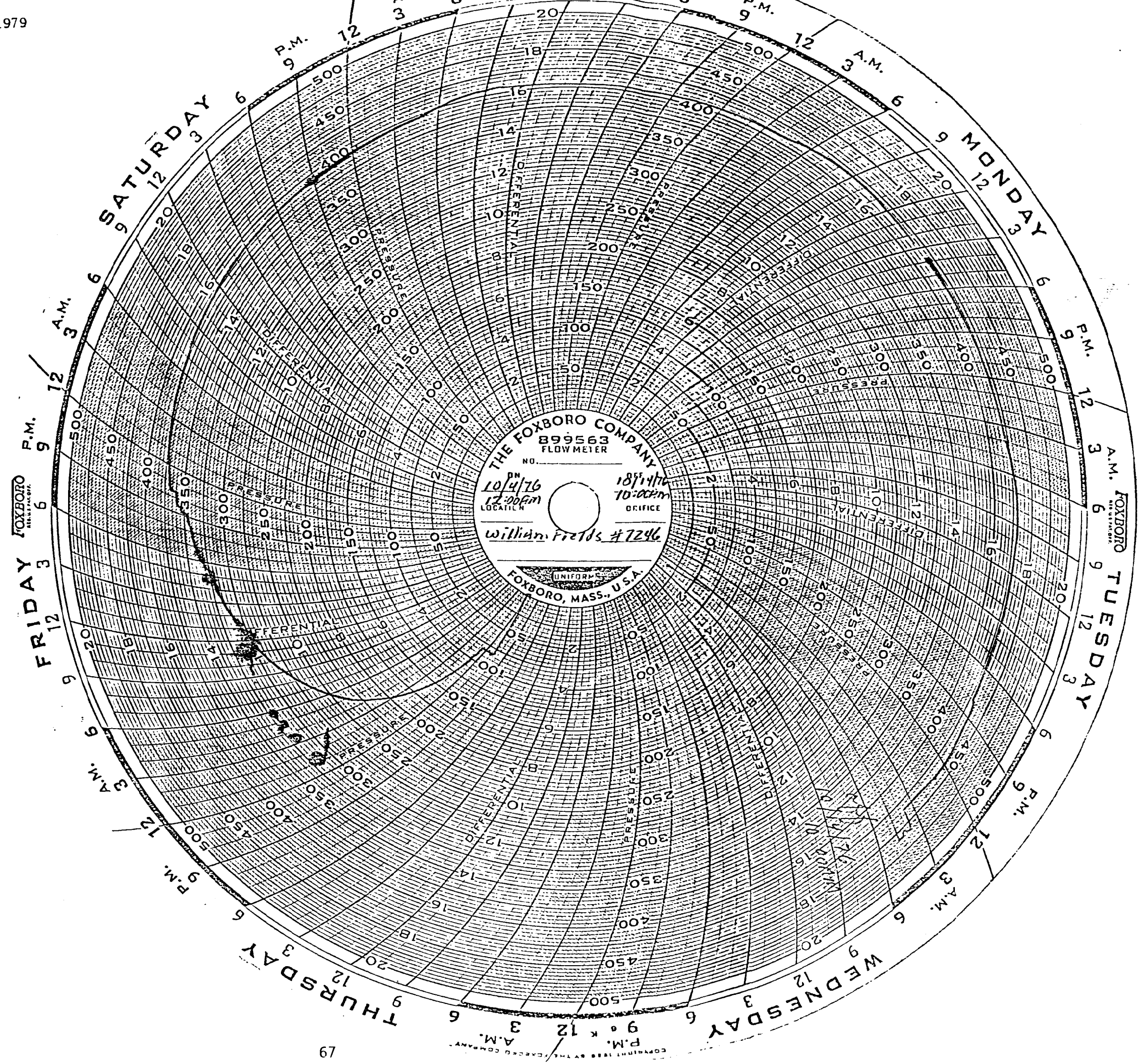
BOTTOM-HOLE PRESSURE INTERPRETATION SHEET

Chart No. 1 Lease William Fields Well 7246

From: Date 10-7-76 Time 11:25 To: Date 10-14-76 Time 1007

Time, shut-in hr	Deflection inches	Correction Factor	Pressure, psig	Buildup rate lb/hr	Remarks
0	.2065		104.25		c 3450'
1	.2610		131.80		
2	.3380		170.70		
3	.3945		199.25		
4	.4470		225.40		
5	.4950		249.30		
6	.5320		267.70		
7	.5645		283.85		
8	.5880		295.50		
9	.6085		305.75		
10	.6290		315.90		
11	.6430		322.90		
12	.6585		330.55		
13	.6730		337.80		
14	.6820		342.30		
15	.6955		349.05		
20	.7395		370.85		
25	.7728		387.50		
30	.7978		399.90		
35	.8170		409.50		
40	.8350		418.50		
45	.8490		425.50		
50	.8620		432.00		
60	.8830		442.50		
70	.9000		451.00		
80	.9135		457.75	.675	
90	.9255		463.75	.60	
100	.9350		468.50	.475	
110	.9440		473.00	.45	
120	.9520		477.00	.40	
130	.9590		480.50	.35	
140	.9652		483.60	.31	
150	.9710		486.50	.29	
160	.9760		489.00	.25	
166	.9783		490.15		166 2/3 hr. (clock about 2/3 hr short)

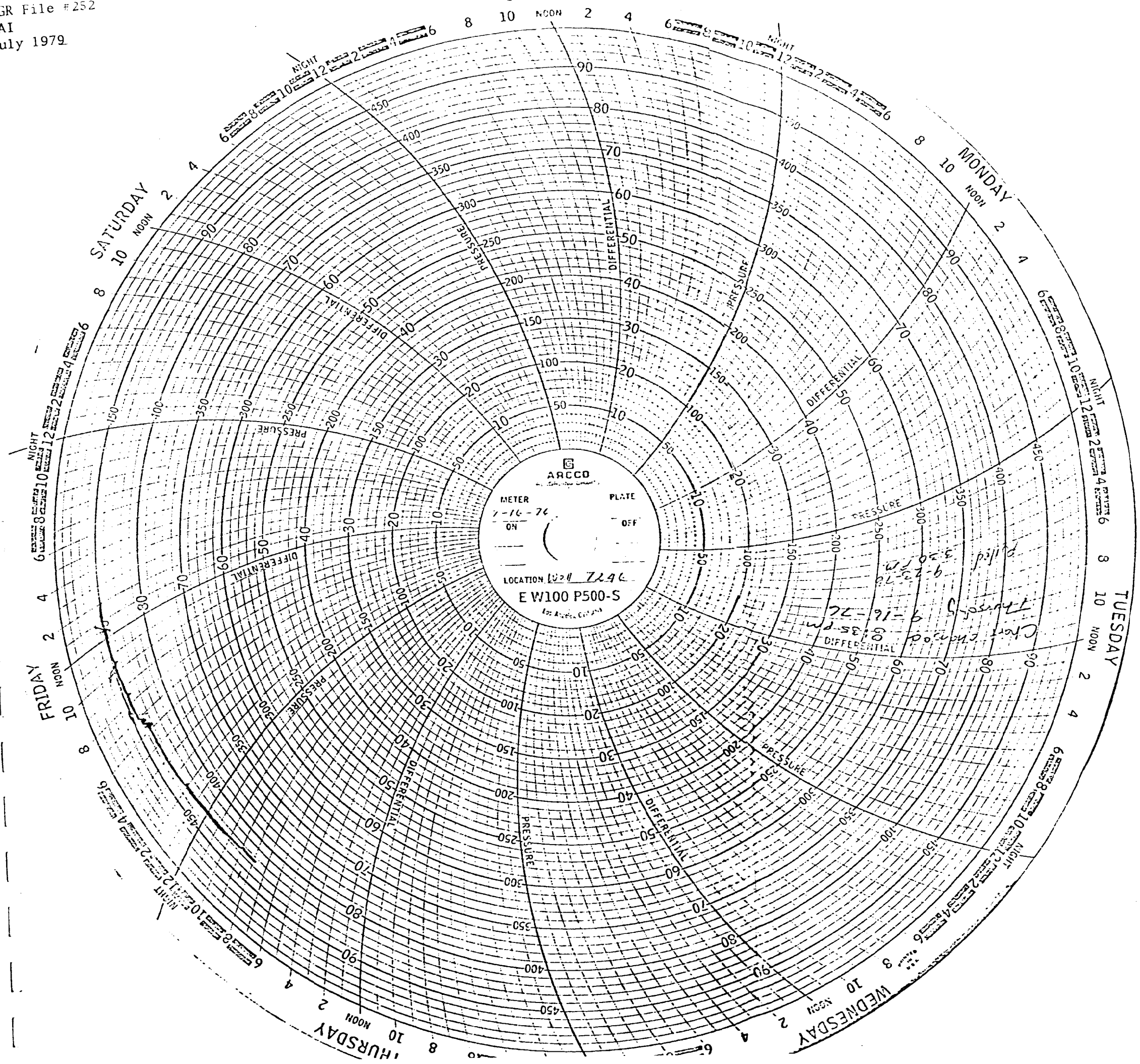

$2\Delta/(t+\Delta t)$
10
9
8
7
6
5
4
3
2
1
KEUFFEL & ESSER CO.
2 CYCLES X 140 DIVISIONS
MADE IN U.S.A.


THE FOXBORO COMPANY
899563
FLOW METER
NO.
ON
10/4/76
12:00pm
OFF
18/4/76
10:00am
LOCATION
ORIFICE
William Fields #7246
UNIFORM
FOXBORO, MASS., U.S.A.
SATURDAY
MONDAY
TUESDAY
WEDNESDAY
THURSDAY
FRIDAY
DIFFERENTIAL
PRESSURE
FOXBORO

PRESSURE BUILDUP WILLIAM FIELDS 7246						
Psurface	Pbottom	Δt	Psurface	Pbottom	Δt	
116		0	429		114.5	
151		0.5	430		117.5	
231		3.5	430		120.5	
287		6.5	430		123.5	
310		9.5	430		126.5	
325		12.5	430		129.5	
335		15.5	430		132.5	
345		18.5	430		135.5	
353		21.5	431		138.5	
360		24.5	432		141.5	
373		27.5	436		144.5	
380		30.5	437		147.5	
380		33.5	438		150.5	
382est		36.5	439		153.5	
385		39.5	440		156.5	-shut off
388		42.5			159.5	
391		45.5			162.5	
395		48.5			165.5	
400		51.5			168.5	
406		54.5				
407		57.5				
409		60.5				
411		63.5				
413		66.5				
415		69.5				
417		72.5				
422		75.5				
420		78.5				
422		81.5				
424		84.5				
425		87.5				
426		90.5				
427est		93.5				
429		96.5				
430		99.5				
429		102.5				
429		105.5				
429		108.5				
429		111.5				

chart on 9/10/76 8:00 a.m.
chart off 9/16/76 8:30 p.m.

UGR File #252
SAI
July 1979



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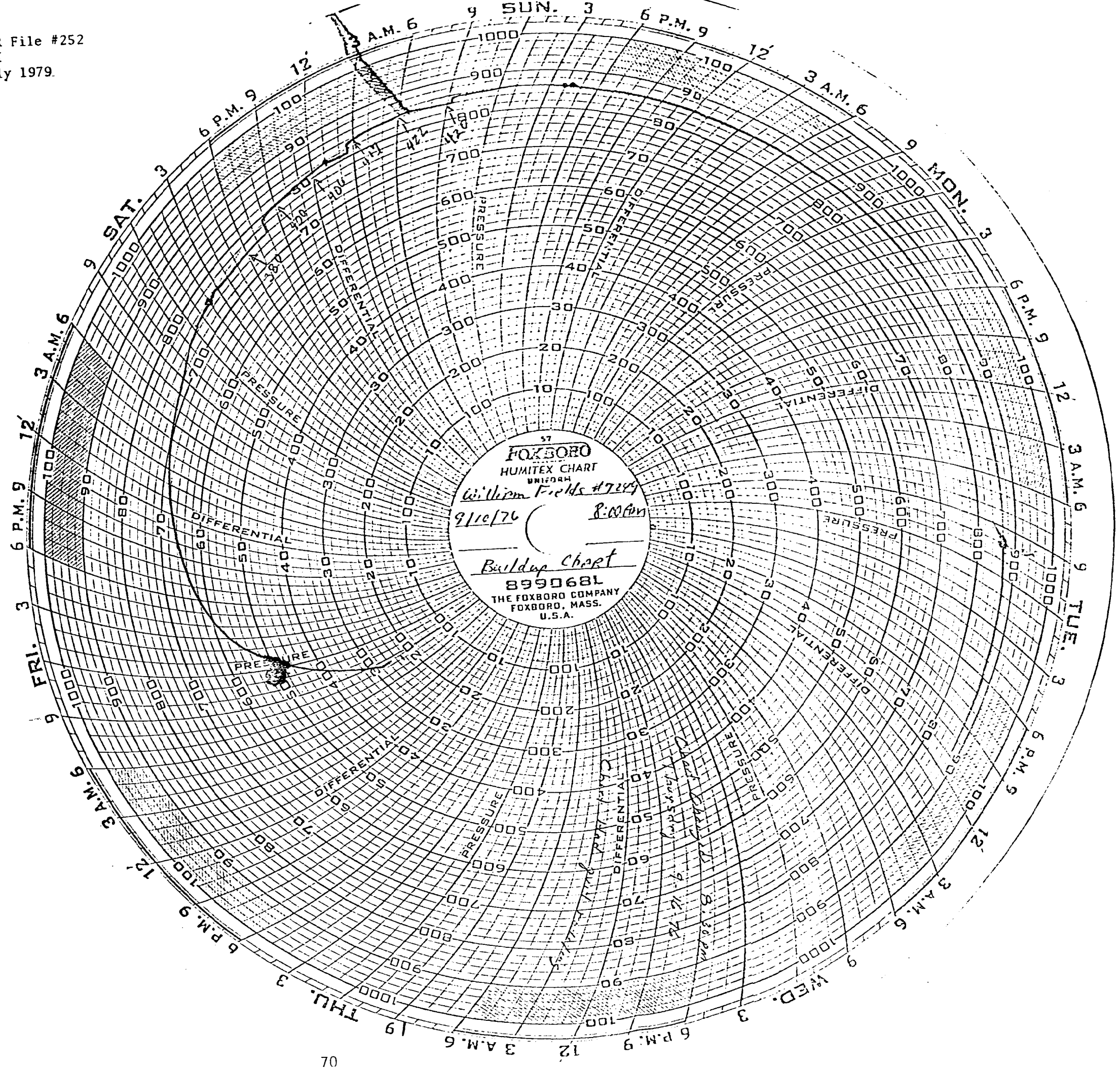
July 1979



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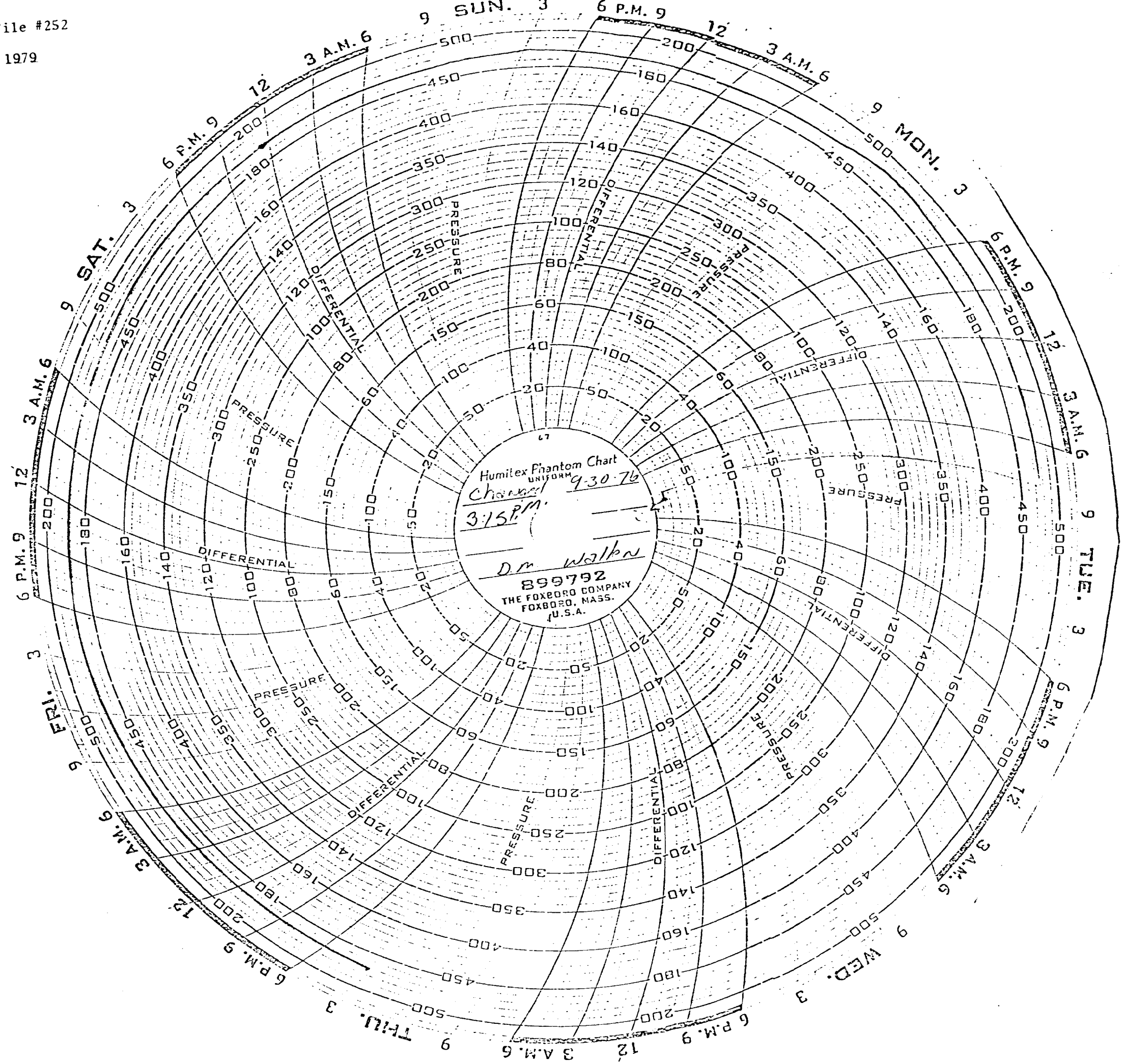

APPENDIX D

PIPE TALLY FOR 2" TUBING

SAI
July 1979

KENTUCKY--WEST VIRGINIA WELL #7246 TUBING TALLY

Size = 2 in. tubing

	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.
1	9	10	31	11	32	--	31	11
2	32	--	31	11	31	10	32	--
3	31	11	32	2	32	1	31	11
4	32	1	32	--	31	10	32	--
5	31	10	32	--	31	11	31	11
6	32	--	32	--	31	10	31	11
7	31	10	31	11	32	1	31	10
8	31	10	32	--	31	10	32	1
9	31	11	31	11	32	--	32	1
10	31	10	31	11	32	--	31	11
11	32	1	31	10	31	11	32	--
12	31	11	31	10	31	11	31	10
13	31	11	31	10	31	8	31	10
14	31	11	31	10	31	11	31	11
15	31	10	32	1	31	11	31	11
16	31	9	31	10	31	11	31	11
17	31	10	32	1	32	1	32	--
18	32	--	31	11	31	11	32	--
19	32	--	32	--	31	11	31	11
20	31	10	31	11	32	1	32	--
21	32	--	31	11	32	--	32	--
22	32	--	32	--	31	11	31	10
23	31	11	32	--	31	11	32	--
24	32	--	32	--	31	11	31	11
25	32	--	31	11	31	11	31	11

	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.
1	32	--						
2	31	10						
3	31	11						
4	32	--						
5	31	11						
6	32	2						
7	32	1						
8	32	--						
9	32	--						
10	32	1						
11	10	--						

Length 3500 Ft. 9 In.

Total Joints 109

APPENDIX E

SCOPE OF WORK

This appendix includes the statement of work, objectives, and scope work agreed between ERDA (DOE) and Kentucky-West Virginia Gas Company.

STATEMENT OF WORK

Cost Sharing Contract for Testing and Evaluation of Foam Fracturing as a Completion Technique in the Devonian Shale of Eastern Kentucky.

A. Background:

(1) Authorization: The Morgantown Energy Research Center of U. S. Energy Research and Development Administration (ERDA) is carrying out a continuing research program on stimulation of oil and gas reservoirs, and one of the authorized areas of investigation is the development of marginal gas resources by fracturing.

The Devonian Shale formations of Kentucky, West Virginia, and Ohio form low permeability reservoirs holding large in-place gas resources close to Eastern industrial and home fuel markets. Due to the severely restricted natural permeability of the Shale, utilization of these gas resources has been limited to date, and the Shale has been targeted for stimulation research by the Morgantown Energy Research Center.

(2) Cooperator. Kentucky-West Virginia Gas Company (KY-WV) has been engaged in developing Devonian Shale gas production in Eastern Kentucky, and has made completion and production data available to ERDA. These Devonian Shale well records form a data base for the performance of conventional hydraulic fracturing in stimulating the Shale. KY-WV now has available three wells, drilled and cased through the Shale section, and has offered these wells to ERDA to test the effectiveness of foam fracturing.

B. Objective:

(1) Purpose. The objective of the proposed testing program is to evaluate the effectiveness of the f am fracturing technique in improving gas production performance of Devonian Shale wells in Eastern Kentucky. Gas deliverability data obtained from the wells after foam fracturing will be compared to similar data on conventionally water-fractured wells already existing in the general test area. This will permit a direct comparison of gas production performance and cost effectiveness of foam versus water fracturing in the Shale.

C. Scope of Work:

(1) General: A three-step program of foam fracture tests is being proposed. The three test wells are situated on KY-WV acreage in the Big Branch area of Perry County, Kentucky, and are to be fractured consecutively. The first well is to be treated with 1200 bbl foam. The well will then be given a short-term production test to evaluate productivity. If well performance is satisfactory to KY-WV and ERDA, the second well is to be fractured with a 1000 bbl foam treatment. This second well will also be production tested over a short term before the decision to fracture the third well is made by KY-WV in consultation with ERDA. If the results are satisfactory, the third well is to be fractured with 1000-1200 bbl of foam.

KY-WV is to be prime contractor for the proposed three well program. KY-WV is to retain ownership and responsibility over the wells at all

times and shall have ownership of any natural gas or petroleum liquids that might be produced from the wells. KY-WV shall charge no management fee for serving as prime contractor to ERDA.

The testing and evaluation of initial production performance of the three wells shall be conducted jointly by KY-WV and ERDA. These initial tests will be followed by more extensive production and reservoir tests to evaluate the foam fractures. These tests will consist of an isochronal deliverability test followed by a pressure build-up and/or draw-down to determine reservoir limits. ERDA personnel will conduct the tests in cooperation with KY-WV and shall have free access to the well locations.

ERDA makes no claims of relative success or failure of the fracturing methods to be tested, and makes no claims on any gas production that may result. KY-WV will make available to ERDA reservoir and well data necessary to conduct the productivity tests and to evaluate the fracturing program. Such data includes geophysical logs, well equipment records, and production records after fracturing. KY-WV will place no restraints on the disclosure of such data with respect to publication of test results.

(2) Well Location. The three wells are located in the Big Branch of Leatherwood Creek area of southern Perry County, Kentucky, close to the area of the conventionally fractured wells.

(3) Prime Contractor Responsibilities. KY-WV as contractor shall make all arrangements to perforate, foam fracture, and do short-term production tests on the three wells as specified in this contract. KY-WV

shall consult with ERDA on the specific foam fracture job designs to be used on the three wells and on the short-term test results.

KY-WV shall maintain control and responsibility over the three wells and all subcontractor personnel and equipment utilized to perform the specified work.

KY-WV shall maintain control and responsibility over the well during the production testing phase to be conducted by ERDA and shall make available to ERDA a well head with full-open valve and miscellaneous piping that might be necessary to permit safe flaring of gas during the isochronal and draw-down tests.

(4) Fracturing Design Specifications. The final design is under consideration; but will include the following:

The well(s) will be foam-fractured with single stage treatments over intervals of about 150 feet, utilizing perforation balls during formation break-down to open up as many casing perforations as possible. The well is to be broken down with acid. Foam is to be generated with water, nitrogen gas, and foaming agent and will be chemically tailored for compatibility with the Devonian Shale. The three wells shall be fractured respectively with 1200 bbl, 1000 bbl, and 1000 or 1200 bbl foam treatments and shall be propped with 40,000 to 50,000 pounds each of sand.

D. Contract Responsibilities and Duties:

(1) Prime Contractor.

a. KY-WV shall make available three wells perforated in the Devonian Shale for foam fracturing and evaluation.

b. Shall break down and ball off the perforations using acid as break-down fluid, and then swab the well(s) dry.

c. Shall foam-fracture the well(s)

d. Shall equip the wells with surface production facilities to permit testing and production of the fractured wells. Such equipment shall include a vertical full-opening valve on the well head and facilities to permit temporary venting or flaring of wells.

e. Shall perform short-term productivity tests after each fracturing operation.

f. Shall permit access to the well(s) to ERDA personnel to conduct extended well performance tests.

g. Shall maintain individual well production records for a period of one year or until the well is plugged due to insufficient production or mechanical problems in less than one year. The records shall be made available to ERDA on a request basis.

h. Shall prepare and submit to ERDA a comprehensive final report on the specified work at the conclusion of the well fracturing program.

(2) ERDA.

a. Shall reimburse the prime contractor for the billed cost by the fracturing service and nitrogen service subcontractors up to a maximum of $10,000 per fractured well, or a maximum of $30,000 total

for the three wells, as outlined under Costs and Payments.

b. Shall consult with KY-WV on foam fracturing final designs for the well(s).

c. Shall consult with KY-WV on short-term production tests.

d. Shall conduct detailed well performance tests on fractured wells, including:

1. Modified isochronal flow test
2. Pressure build-up test to stabilized or semi-stabilized well pressure and/or draw-down test from stabilized or semi-stabilized pressure.
3. Shall provide personnel and test equipment to conduct the test, exclusive of piping for flaring, if necessary.

e. Shall conduct an engineering evaluation of the three well fracturing program. The study will compare the gas production performance of the foam fractured well(s) to the performance of conventionally fractured KY-WV wells in the general test area.

f. Shall provide the prime contractor with copies of the evaluation and the final engineering evaluation report(s). Such final report(s) shall be published by ERDA in the literature or in government reports.

g. Shall assign a Technical Project Officer to monitor the Contract.

E. Costs and Payments:

(1) General. KY-WV, as prime contraqtor, shall charge no management fee or corporate personnel or overhead costs to ERDA for the performance of the Contract.

(2) Contract Payments to Prime Contractor. Costs charged by KY-WV to ERDA will be limited to the billed subcontractor charges for fracturing and nitrogen services and supplies. Allowable charges will be further limited to a maximum ceiling of $10,000 per well, or $30,000 for three wells. Contract costs will thus vary from less than $10,000 to a maximum of $30,000.

h. Payment. The prime contractor shall submit itemized bills upon completion of each foam fracturing job. Amounts due will be paid by ERDA on receipt of bills.

i. Property. Property or equipment furnished during the performance of this contract by either the prime contractor or ERDA shall remain the property of the contributor. Any and all gas and oil production that may result from this contract will be the sole property of KY-WV.

j. Technical Project Officer. The Technical Project Officer (TPO) designated by the Contracting Officer will receive for the Government reports and material called for in the contract and will represent the Contracting Officer in technical aspects of the work. The TPO is not authorized to change any of the terms and conditions of the contract. Changes in scope of work will be made only by the Contracting Officer in writing to the prime contractor. K-H. Frohne of the Morgantown Energy Research Center of ERDA will serve as TPO for ERDA on this contract.

k. Ownership of Data and Records. All field test data and records collected by ERDA personnel and all ERDA evaluation of such data and

other data submitted by the prime contractor shall remain the property of ERDA. Copies of such data and evaluations shall not be released without approval of the Administrator.

1. Publication of Evaluation Results. It is understood that the primary purpose of the contract is to provide data for an evaluation of various fracturing techniques in the Devonian Shale of Kentucky, and that such evaluation will be published so that industry will be able to utilize the information in other Devonian Shale wells to possibly improve gas well performance. Any ERDA publication plans will be made known to the contractor for his comments as to content and accuracy. Likewise, any publication of data or evaluation of the prime contractor is permitted. However, ERDA reserves the right to review any such contractor manuscript for technical accuracy prior to publication. Any publication or announcement by either party shall recognize the other party as a cooperator in the research effort, unless otherwise agreed to by both parties.