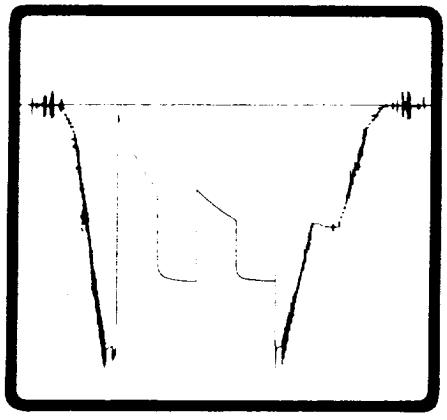
FORMATION TESTING SERVICE REPORT



PRODUCTION WELL FILE

EXPLORATION WELL FILE

HALLIBURTON SERVICES

Duncan, Oklahoma 73536

A Halliburton Company

GRAHAM 4 FEDERAL — LEASE NAME

1 — WELL NO.

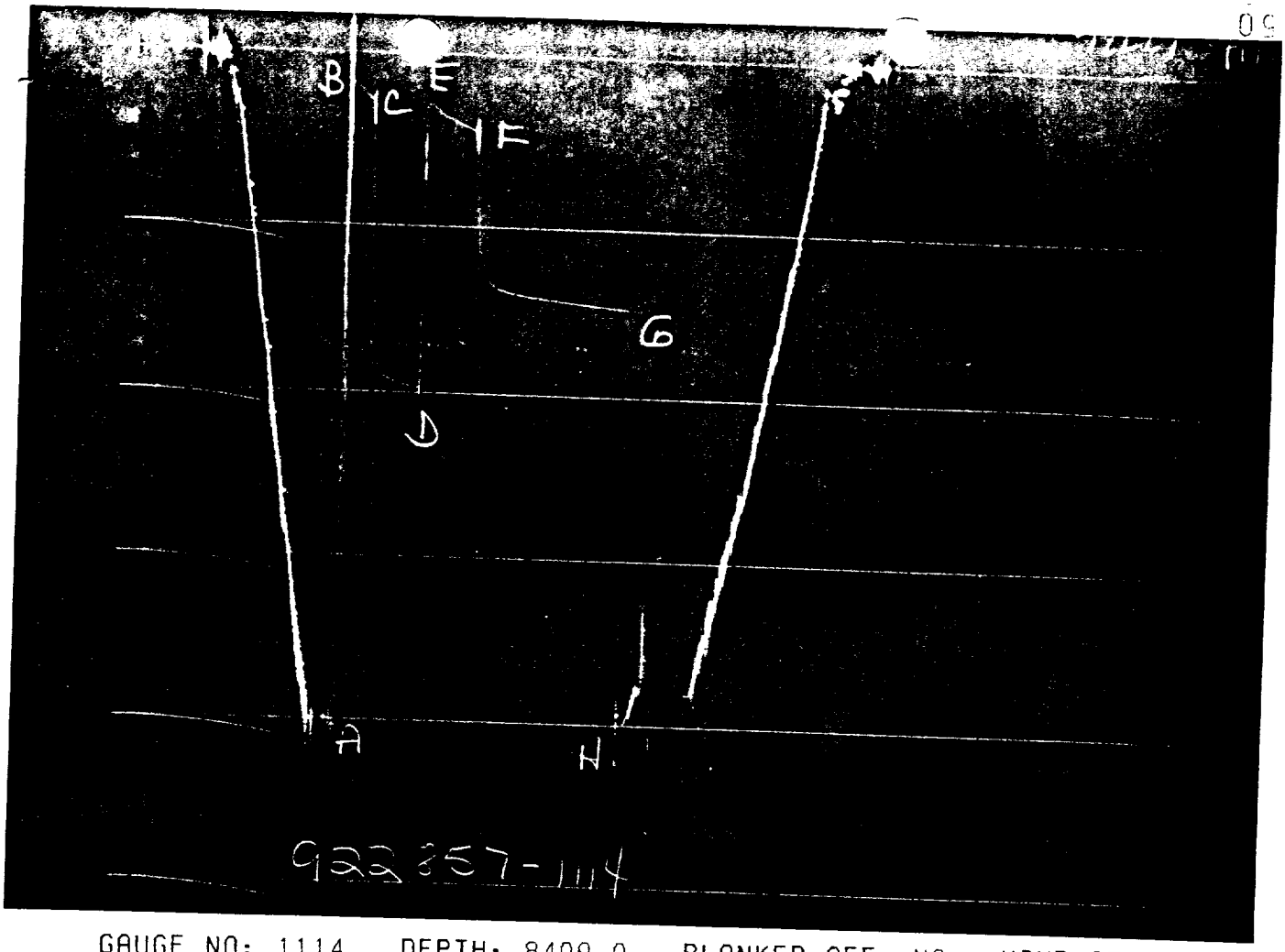
2 — TEST NO.

8430.' - 8540.' — TESTED INTERVAL

HELMERICH & PAYNE, INCORPORATED — LEASE OWNER/COMPANY NAME

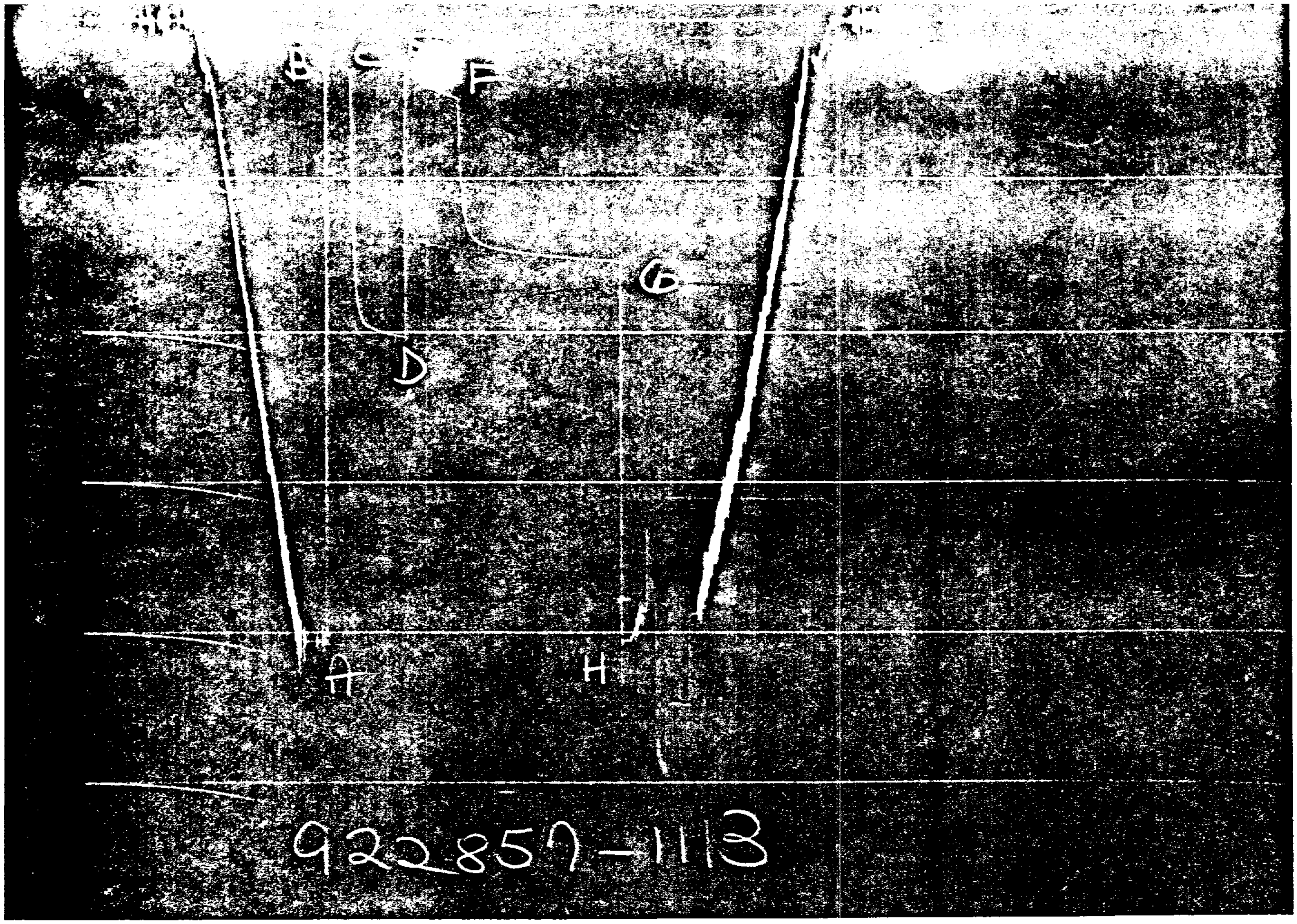
NOMENCLATURE

B	= Formation Volume Factor (Res Vol / Std Vol)	——
c_t	= System Total Compressibility	(Vol / Vol) / psi
DR	= Damage Ratio	——
h	= Estimated Net Pay Thickness	Ft
k	= Permeability	md
m	= (Liquid) Slope Extrapolated Pressure Plot	psi/cycle
	= (Gas) Slope Extrapolated m(P) Plot	MM psi^2/cp/cycle
$m(P^*)$	= Real Gas Potential at P^*	MM psi^2/cp
$m(P_f)$	= Real Gas Potential at P_f	MM psi^2/cp
AOF_1	= Maximum Indicated Absolute Open Flow at Test Conditions	MCFD
AOF_2	= Minimum Indicated Absolute Open Flow at Test Conditions	MCFD
P^*	= Extrapolated Static Pressure	Psig
P_f	= Final Flow Pressure	Psig
Q	= Liquid Production Rate During Test	BPD
Q_1	= Theoretical Liquid Production w/ Damage Removed	BPD
Q_g	= Measured Gas Production Rate	MCFD
r_i	= Approximate Radius of Investigation	Ft
r_w	= Radius of Well Bore	Ft
S	= Skin Factor	
t	= Total Flow Time Previous to Closed-in	Minutes
Δt	= Closed-in Time at Data Point	Minutes
T	= Temperature Rankine	°R
ϕ	= Porosity	——
μ	= Viscosity of Gas or Liquid	cp
Log	= Common Log	



GAUGE NO: 1114 DEPTH: 8409.0 BLANKED OFF: NO HOUR OF CLOCK: 24

ID	DESCRIPTION	PRESSURE		TIME		TYPE
		REPORTED	CALCULATED	REPORTED	CALCULATED	
A	INITIAL HYDROSTATIC	3989	3991.0			
B	INITIAL FIRST FLOW	160	163.9	30.0	27.6	F
C	FINAL FIRST FLOW	272	273.2			
C	INITIAL FIRST CLOSED-IN	272	273.2	60.0	60.6	C
D	FINAL FIRST CLOSED-IN	1973	1969.1			
E	INITIAL SECOND FLOW	288	304.7	60.0	60.1	F
F	FINAL SECOND FLOW	431	438.1			
F	INITIAL SECOND CLOSED-IN	431	438.1	180.0	181.8	C
G	FINAL SECOND CLOSED-IN	1479	1472.8			
H	FINAL HYDROSTATIC	4037	3990.4			



GAUGE NO: 1113 DEPTH: 8537.0 BLANKED OFF: YES HOUR OF CLOCK: 24

ID	DESCRIPTION	PRESSURE REPORTED	PRESSURE CALCULATED	TIME REPORTED	TIME CALCULATED	TYPE
A	INITIAL HYDROSTATIC	4225	4057.[illegible]			
B	INITIAL FIRST FLOW	217	227.[illegible]	30.0	27.6	F
C	FINAL FIRST FLOW	325	328.[illegible]			
C	INITIAL FIRST CLOSED-IN	325	328.[illegible]	60.0	60.6	C
D	FINAL FIRST CLOSED-IN	2057	2025.[illegible]			
E	INITIAL SECOND FLOW	307	357.4	60.0	60.1	F
F	FINAL SECOND FLOW	479	481.			
F	INITIAL SECOND CLOSED-IN	[illegible]	[illegible]	[illegible]	1?1.8	[illegible]
G	FINAL SECOND CLOSED-IN	[illegible]	[illegible]			
H	FINAL HYDROSTATIC	[illegible]	[illegible]			

EQUIPMENT & HOLE DATA

FORMATION TESTED: BONESPRING
NET PAY (ft):
GROSS TESTED FOOTAGE: 110.0
ALL DEPTHS MEASURED FROM: KB
CASING PERFS. (ft):
HOLE OR CASING SIZE (in): 7.875
ELEVATION (ft): 3803
TOTAL DEPTH (ft): 8540.0
PACKER DEPTH(S) (ft): 8424, 8430
FINAL SURFACE CHOKE (in): 0.387
BOTTOM HOLE CHOKE (in): 0.750
MUD WEIGHT (lb/gal): 9.20
MUD VISCOSITY (sec): 28
ESTIMATED HOLE TEMP. (°F):
ACTUAL HOLE TEMP. (°F): 123 @ 8536.0 ft

TICKET NUMBER: 92285700

DATE: 12-3-84 TEST NO: 2

TYPE DST: OPEN HOLE

HALLIBURTON CAMP: ARTESIA

TESTER: STAN MC KEE

WITNESS: KYLE POSSEY, J.B. JOHNSON

DRILLING CONTRACTOR: MC VAY #4

FLUID PROPERTIES FOR RECOVERED MUD & WATER

SOURCE	RESISTIVITY		CHLORIDES
MUD PIT	0.090 @	65 °F	89000 ppm
BOTTOM RECOVERY	0.090 @	65 °F	85000 ppm
MIDDLE RECOVERY	0.090 @	65 °F	89000 ppm
	@	°F	ppm
	@	°F	ppm
	@	°F	ppm

SAMPLER DATA

Psig AT SURFACE:
cu.ft. OF GAS:
cc OF OIL:
cc OF WATER:
cc OF MUD:
TOTAL LIQUID cc:

HYDROCARBON PROPERTIES

OIL GRAVITY (°API): 37.5 @ 60°F
GAS/OIL RATIO (cu.ft. per bbl):
GAS GRAVITY:

CUSHION DATA

TYPE	AMOUNT	WEIGHT

RECOVERED:

5.3 BBLS. OF OIL
3 BBLS. OF OIL & GAS CUT DRILLING FLUID

MEASURED FROM TESTER VALVE

REMARKS:

FLUID PROPERTIES COULD NOT BE DETERMINED FOR THE TOP RECOVERY - CONSISTED OF OIL.

TYPE & SIZE MEASURING DEVICE: 6" POSITIVE CHOKE | TICKET NO: 92285700

TIME	CHOKE SIZE	SURFACE PRESSURE PSI	GAS RATE MCF	LIQUID RATE BPD	REMARKS
12-3-84					
2000					ON LOCATION
2345					PICKED-UP TOOLS
12-4-84					
0100					STARTED IN HOLE WITH TOOLS
0330					OPENED TOOL - GOOD BLOW -
					BOTTOM OF BUCKET.
0335		4			INCREASE IN SURFACE PSI
0340	3/8"	16			PUT ON 3/8" CHOKE
0345	3/8"	25			INCREASE IN SURFACE PSI
0347	3/8"	25			GAS TO THE SURFACE
0350	3/8"	28	145		INCREASE IN SURFACE PSI
0355	3/8"	29	148.4		
0400	3/8"	29	148.4		CLOSED TOOL
0500	3/8"	1			REOPENED TOOL - GOOD BLOW -
					GAS TO THE SURFACE.
0505	3/8"	3			INCREASE IN SURFACE PSI
0510	3/8"	10	83.8		"
0515	3/8"	12	90.61		"
0520	3/8"	15.5	102.51		"
0525	3/8"	15.5	102.51		STABILIZED
0530	3/8"	11.5	88.91		PRESSURE DECREASE
0535	3/8"	13.5	95.71		PRESSURE INCREASE
0540	3/8"	12.5	92.31		PRESSURE DECREASE
0545	3/8"	13	94.01		PRESSURE INCREASE
0550	3/8"	12.5	92.31		PRESSURE DECREASE
0555	3/8"	12.5	92.31		STABILIZED
0600	3/8"	10.5	85.51		PRESSURE DECREASE - CLOSED TOOL
0900	3/8"				PULLED OFF BOTTOM - PULLED
					5 STANDS.
0930					DROPPED BAR AND REVERSED OUT
					PULLED OUT OF HOLE

TICKET NO: 92285700

CLOCK NO: 13736 HOUR: 24

HALLIBURTON SERVICES

GAUGE NO: 1114

DEPTH: 8409.0

FIRST FLOW

REF		MINUTES	PRESSURE	ΔP	$\frac{t \times \Delta t}{t+\Delta t}$	$\log\frac{t+\Delta t}{\Delta t}$
B	1	0.0	163.9			
	2	2.0	167.7	3.8		
	3	4.0	175.4	7.7		
	4	6.0	179.9	4.5		
	5	8.0	184.5	4.6		
	6	10.0	191.8	7.4		
	7	12.0	201.3	9.4		
	8	14.0	210.5	9.3		
	9	16.0	223.7	13.1		
	10	18.0	234.2	10.5		
	11	20.0	241.9	7.7		
	12	22.0	250.2	8.3		
	13	24.0	259.0	8.8		
	14	26.0	268.1	9.1		
C	15	27.6	273.2	5.1		

FIRST CLOSED-IN

C	1	0.0	273.2			
	2	1.0	865.7	592.5	1.0	1.444
	3	2.0	1288.7	1015.5	1.8	1.177
	4	3.0	1476.9	1203.7	2.7	1.005
	5	4.0	1607.5	1334.2	3.5	0.895
	6	5.0	1679.6	1406.4	4.2	0.814
	7	6.0	1737.0	1463.8	4.9	0.748
	8	7.0	1779.2	1506.0	5.6	0.694
	9	8.0	1807.1	1533.9	6.2	0.650
	10	9.0	1829.9	1556.7	6.8	0.608
	11	10.0	1844.8	1571.6	7.3	0.574
	12	12.0	1866.5	1593.3	8.3	0.519
	13	14.0	1882.4	1609.2	9.3	0.473
	14	16.0	1894.4	1621.2	10.1	0.435
	15	18.0	1902.7	1629.5	10.9	0.403
	16	20.0	1910.2	1637.0	11.6	0.377
	17	22.0	1916.1	1642.9	12.2	0.352
	18	24.0	1921.5	1648.3	12.8	0.332
	19	26.0	1925.8	1652.6	13.4	0.313
	20	28.0	1930.2	1657.0	13.9	0.297
	21	30.0	1933.4	1660.2	14.4	0.283
	22	35.0	1941.4	1668.2	15.4	0.252
	23	40.0	1948.1	1674.9	16.3	0.228
	24	45.0	1954.5	1681.3	17.1	0.208
	25	50.0	1959.9	1686.7	17.8	0.191
	26	55.0	1964.5	1691.3	18.4	0.176
D	27	60.6	1969.1	1695.9	18.9	0.163

SECOND FLOW

.E	1	0.0	304.7	
	2	4.0	290.1	-14.6

REF		MINUTES	PRESSURE	ΔP	$\frac{t \times \Delta t}{t+\Delta t}$	$\log\frac{t+\Delta t}{\Delta t}$
	SECOND FLOW - CONTINUED					
	3	8.0	282.0	-8.1		
	4	12.0	305.5	23.5		
	5	16.0	322.4	16.9		
	6	20.0	342.4	20.0		
	7	24.0	355.0	12.6		
	8	28.0	361.8	6.7		
	9	32.0	373.3	11.5		
	10	36.0	381.9	8.6		
	11	40.0	393.4	11.5		
	12	44.0	401.6	8.2		
	13	48.0	412.0	10.4		
	14	52.0	422.2	10.2		
	15	56.0	428.6	6.4		
F	16	60.1	438.1	9.5		

SECOND CLOSED-IN

F	1	0.0	438.1			
	2	1.0	893.0	454.9	1.0	1.949
	3	2.0	976.4	538.3	1.9	1.659
	4	3.0	1050.9	612.8	2.9	1.477
	5	4.0	1105.9	667.8	3.8	1.364
	6	5.0	1147.2	709.1	4.7	1.266
	7	6.0	1178.0	739.9	5.6	1.196
	8	7.0	1205.5	767.4	6.5	1.132
	9	8.0	1226.9	788.9	7.3	1.080
	10	9.0	1245.5	807.4	8.1	1.032
	11	10.0	1260.1	822.1	9.0	0.990
	12	12.0	1287.8	849.7	10.5	0.920
	13	14.0	1307.6	869.6	12.1	0.862
	14	16.0	1321.1	883.1	13.6	0.811
	15	18.0	1333.2	895.1	14.9	0.769
	16	20.0	1341.6	903.6	16.3	0.732
	17	22.0	1349.7	911.7	17.6	0.697
	18	24.0	1357.0	919.0	18.9	0.667
	19	26.0	1362.0	923.9	20.0	0.641
	20	28.0	1365.5	927.4	21.2	0.617
	21	30.0	1369.6	931.5	22.4	0.593
	22	35.0	1379.0	940.9	25.0	0.545
	23	40.0	1385.3	947.3	27.5	0.504
	24	45.0	1391.8	953.8	29.7	0.470
	25	50.0	1397.9	959.8	31.9	0.440
	26	55.0	1402.0	963.9	33.8	0.414
	27	60.0	1406.1	968.1	35.6	0.391
	28	70.0	1414.1	976.0	38.9	0.353
	29	80.0	1422.0	984.0	41.8	0.321
	30	90.0	1427.6	989.5	44.4	0.295
	31	100.0	1433.6	995.6	46.7	0.273
	32	110.0	1440.1	1002.1	48.8	0.255
	33	120.0	1445.7	1007.6	50.7	0.238
	34	135.0	1452.9	1014.8	53.2	0.217
	35	150.0	1459.7	1021.6	55.3	0.200
	36	165.0	1465.9	1027.8	57.3	0.185

REMARKS:

TICKET NO: 92285700

CLOCK NO: 13736 HOUR: 24

HALLIBURTON SERVICES

GAUGE NO: 1114

DEPTH: 8409.0

REF	MINUTES	PRESSURE	ΔP	$\frac{t \times \Delta t}{t + \Delta t}$	$\log \frac{t + \Delta t}{\Delta t}$
	SECOND CLOSED-IN - CONTINUED				
G	37	181.8	1472.8	1034.8	59.1	0.171

REF	MINUTES	PRESSURE	ΔP	$\frac{t \times \Delta t}{t + \Delta t}$	$\log \frac{t + \Delta t}{\Delta t}$

REMARKS:

TICKET NO: 92265700

CLOCK NO: 4365 HOUR: 24

HALLIBURTON SERVICES

GAUGE NO: 1113

DEPTH: 8537.0

FIRST FLOW

REF		MINUTES	PRESSURE	ΔP	$\frac{t \times \Delta t}{t + \Delta t}$	$\log \frac{t + \Delta t}{\Delta t}$
B	1	0.0	227.5			
	2	2.0	224.7	-2.9		
	3	4.0	226.7	2.0		
	4	6.0	231.5	4.9		
	5	8.0	235.5	4.0		
	6	10.0	242.2	6.7		
	7	12.0	250.3	8.1		
	8	14.0	260.5	10.1		
	9	16.0	273.5	13.0		
	10	18.0	285.4	11.9		
	11	20.0	294.2	8.9		
	12	22.0	301.5	7.2		
	13	24.0	309.4	7.9		
	14	26.0	318.1	8.7		
C	15	27.6	326.0	7.9		

FIRST CLOSED-IN

C	1	0.0	326.0			
	2	1.0	771.1	445.1	1.0	1.447
	3	2.0	1075.6	749.6	1.8	1.173
	4	3.0	1378.7	1052.7	2.7	1.007
	5	4.0	1538.5	1212.5	3.5	0.897
	6	5.0	1658.1	1332.1	4.2	0.815
	7	6.0	1730.6	1404.6	4.9	0.749
	8	7.0	1785.1	1459.1	5.6	0.692
	9	8.0	1823.2	1497.2	6.2	0.649
	10	9.0	1857.9	1531.9	6.8	0.607
	11	10.0	1878.6	1552.6	7.4	0.574
	12	12.0	1909.2	1583.2	8.4	0.517
	13	14.0	1928.8	1602.8	9.3	0.472
	14	16.0	1943.4	1617.4	10.1	0.434
	15	18.0	1953.4	1627.4	10.9	0.403
	16	20.0	1961.2	1635.2	11.6	0.376
	17	22.0	1968.5	1642.5	12.2	0.352
	18	24.0	1973.9	1647.9	12.8	0.332
	19	26.0	1979.4	1653.4	13.4	0.314
	20	28.0	1982.9	1656.9	13.9	0.298
	21	30.0	1987.0	1661.0	14.4	0.283
	22	35.0	1995.9	1669.9	15.4	0.252
	23	40.0	2002.4	1676.4	16.3	0.228
	24	45.0	2008.6	1682.7	17.1	0.207
	25	50.0	2014.9	1688.9	17.8	0.191
	26	55.0	2020.3	1694.3	18.4	0.176
D	27	60.6	2025.7	1699.7	18.9	0.163

SECOND FLOW

E	1	0.0	357.4			
	2	4.0	332.5	-25.0		

REF		MINUTES	PRESSURE	ΔP	$\frac{t \times \Delta t}{t + \Delta t}$	$\log \frac{t + \Delta t}{\Delta t}$
	SECOND FLOW - CONTINUED					
	3	8.0	332.5	0.0		
	4	12.0	358.1	25.7		
	5	16.0	376.7	18.6		
	6	20.0	393.5	16.8		
	7	24.0	406.7	13.2		
	8	28.0	413.1	6.3		
	9	32.0	423.0	9.9		
	10	36.0	433.7	10.7		
	11	40.0	444.1	10.5		
	12	44.0	451.9	7.8		
	13	48.0	461.7	9.8		
	14	52.0	471.6	9.9		
	15	56.0	477.9	6.3		
F	16	60.1	488.6	10.7		

SECOND CLOSED-IN

F	1	0.0	488.6			
	2	1.0	754.5	265.9	1.0	1.965
	3	2.0	912.9	424.3	2.0	1.649
	4	3.0	1014.4	525.8	2.9	1.480
	5	4.0	1081.1	592.5	3.8	1.361
	6	5.0	1135.1	646.5	4.7	1.269
	7	6.0	1161.4	692.8	5.6	1.193
	8	7.0	1216.3	727.7	6.5	1.131
	9	8.0	1247.6	758.9	7.3	1.078
	10	9.0	1272.2	783.6	8.1	1.033
	11	10.0	1294.4	805.8	9.0	0.991
	12	12.0	1324.1	835.5	10.6	0.918
	13	14.0	1348.2	859.6	12.1	0.860
	14	16.0	1365.0	876.4	13.6	0.811
	15	18.0	1378.8	890.2	14.9	0.769
	16	20.0	1389.9	901.3	16.3	0.730
	17	22.0	1399.0	910.4	17.6	0.697
	18	24.0	1406.1	917.5	18.8	0.668
	19	26.0	1412.4	923.8	20.1	0.640
	20	28.0	1417.8	929.1	21.2	0.616
	21	30.0	1422.4	933.8	22.3	0.594
	22	35.0	1432.1	943.4	25.0	0.545
	23	40.0	1439.9	951.3	27.5	0.504
	24	45.0	1446.7	958.1	29.8	0.469
	25	50.0	1451.9	963.3	31.8	0.440
	26	55.0	1457.4	968.8	33.8	0.414
	27	60.0	1461.6	972.9	35.6	0.391
	28	70.0	1469.6	981.0	38.9	0.353
	29	80.0	1475.7	987.1	41.8	0.321
	30	90.0	1482.1	993.5	44.4	0.295
	31	100.0	1487.5	998.9	46.7	0.273
	32	110.0	1494.1	1005.5	48.8	0.255
	33	120.0	1498.7	1010.1	50.7	0.238
	34	135.0	1506.6	1018.0	53.2	0.217
	35	150.0	1513.5	1024.9	55.3	0.200
	36	165.0	1519.8	1031.1	57.3	0.185

REMARKS:

TICKET NO: 92285700

CLOCK NO: 4365 HOUR: 24

HALLIBURTON SERVICES

GAUGE N 1113

DEPTH: 8537.0

REF	MINUTES	PRESSURE	ΔP	$\frac{t \times \Delta t}{t + \Delta t}$	$\log \frac{t + \Delta t}{\Delta t}$
	SECOND CLOSED-IN - CONTINUED				
G 37	181.8	1527.5	1038.9	59.1	0.171

REF	MINUTES	PRESSURE	ΔP	$\frac{t \times \Delta t}{t + \Delta t}$	$\log \frac{t + \Delta t}{\Delta t}$

REMARKS:

TICKET NO. 92285700

		O.D.	I.D.	LENGTH	DEPTH
1	DRILL PIPE.....	4.500	3.826	7820.0	
3	DRILL COLLARS.....	6.250	2.250	484.0	
50	IMPACT REVERSING SUB.....	5.750	3.000	1.0	8304.0
3	DRILL COLLARS.....	6.250	2.250	91.0	
5	CROSSOVER.....	5.750	3.000	1.0	
13	DUAL CIP SAMPLER.....	5.000	0.750	7.0	
60	HYDROSPRING TESTER.....	5.000	0.750	5.0	8407.0
80	AP RUNNING CASE.....	5.000	3.060	4.0	8409.0
15	JAR.....	5.000	1.750	5.0	
16	VR SAFETY JOINT.....	5.000	1.000	3.0	
70	OPEN HOLE PACKER.....	6.750	1.530	5.8	8424.0
70	OPEN HOLE PACKER.....	6.750	1.530	5.8	8430.0
19	ANCHOR PIPE SAFETY JOINT.....	5.750	1.500	5.0	
5	CROSSOVER.....	5.750	3.000	1.0	
3	DRILL COLLARS.....	6.250	2.250	87.0	
5	CROSSOVER.....	5.750	3.000	1.0	
20	FLUSH JOINT ANCHOR.....	5.750	2.870	10.0	
81	BLANKED-OFF RUNNING CASE.....	5.750		4.0	8537.0

TOTAL DEPTH 8540.0

EQUIPMENT DATA

EQUATIONS FOR DST LIQUID WELL ANALYSIS

Transmissibility	$\frac{kh}{\mu} = \frac{162.6\ QB}{m}$	$\frac{\text{md-ft}}{\text{cp}}$
Indicated Flow Capacity	$kh = \frac{kh}{\mu}\ \mu$	md-ft
Average Effective Permeability	$k = \frac{kh}{h}$	md
Damage Ratio	$DR = .183\ \frac{P^* - P_f}{m}$	—
Theoretical Potential w / Damage Removed	$Q_1 = Q\ DR$	BPD
Approx. Radius of Investigation	$r_i = 4.63\ \sqrt{kt}$	ft

EQUATIONS FOR DST GAS WELL ANALYSIS

Indicated Flow Capacity	$kh = \frac{1637\ Q_g\ T}{m}$	md-ft
Average Effective Permeability	$k = \frac{kh}{h}$	md
Skin Factor	$S = 1.151\ \left[\frac{m(P^*) - m(P_f)}{m} - \text{LOG}\ \frac{k(t/60)}{\phi\ \mu\ c_t r_w^2} + 3.23 \right]$	—
Damage Ratio	$DR = \frac{m(P^*) - m(P_f)}{m(P^*) - m(P_f) - 0.87\ mS}$	—
Indicated Flow Rate (Maximum)	$AOF_1 = \frac{Q_g\ m(P^*)}{m(P^*) - m(P_f)}$	MCFD
Indicated Flow Rate (Minimum)	$AOF_2 = Q_g \sqrt{\frac{m(P^*)}{m(P^*) - m(P_f)}}$	MCFD
Approx. Radius of Investigation	$r_i = 0.032 \sqrt{\frac{k(t.60)}{\phi \mu c_t}}$	ft