BA 232

DELAND DEVELOPMENT CORP.
SULPHURDALE GEOTHERMAL
APPENIX A, B & C, & D.

RECO # 85001

Donated By:
Herbert Rogers Jr.
Rogers Engineering Co.

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RECORD PRINT
ROGERS ENGINEERING CO., INC.

RECEIVED
ACCOUNTING DEPT.

JAN 24 1985

Rogers Engineering Co., Inc.
SAN FRANCISCO

APPENDIX - A

Note: 1/24/85 Lou Capuano recieved the following
(HR) data on exit output of condensate out of
the Ormat Elec Pwr generating Plt.
200 GPM (Liquid) at 180°F ~~180°F~~.

APPENDIX A

Well Test Summary and Results
January 18 - 22, 1984
Well 34-7B (Lady Linda)

1. Initial conditions (1/18/84)
 - a. Shut-in wellhead pressure:
82 psig (Barton meter)
85 psig (pressure gauge)
 - b. Shut-in wellhead temperature:
260 °F
2. Wireline survey (1/18/84)
 - a. Shut-in bottomhole pressure:
87 psig (adjusted from 77.5)
 - b. Shut-in bottomhole pressure:
293 °F
 - c. Flowing pressure and temperature:
Surveys showed no anomalies that would indicate cold water entries or inter-zone flow.
3. Daily test data
 - a. Well tested on 4" orifice for 2 hours
51,000 lbs/hr
280 °F flowing temperature
78 psig flowing pressure

Well Test Summary and Results
Well 34-7B (Lady Linda)
Page 2

3. Daily test data (continued)

- b. Well then tested on 6" orifice alternating venting to atmosphere and testing for four days. Final flow conditions:
 - 94,000 lbs/hr
 - 274 °F flowing temperature
 - 60 psig flowing pressure
- c. Shut-in wellhead pressure after completion of testing was 76 psig, about 8 psi reduction from initial conditions.

4. Non-condensable gas concentration

- a. Average of 9 gas displacement measurements conducted in the field:
 - 61.7%
- b. Calculated from partial pressure analysis:
 - 60%
- c. Lab analysis of 7 gas samples:
 - 4 samples (%): 48, 84, 65, 61
 - 3 samples (%): 22, 14, 25
- d. H₂S Concentrations:
 - 4220 ppm average from 12 wet chemical tests
 - 3350 ppm average from lab analysis of 7 gas samples
- e. There was no trend of either increasing or decreasing gas as the test progressed.

5. Condensate

- 4.2 Ph average from 7 samples
- <1 ppm chloride

FWHP
(psig)

WELL TEST
1/18 - 1/22/84

REVISED	DATE	<div><div><div>TSI</div><div>ThermaSource Inc.</div></div><div>100 E Street • P.O. Box 1236 • Santa Rosa, California 95402</div><div>(707) 523-2960 • Telex 171743 • TWX 510 7446439</div></div>	DRAWN	
			FOR:	
			BY:	
			DATE:	1/23/84
			SCALE:	
			DRAWING No.

ThermaSource Inc.

100 E Street • P.O. Box 1236 • Santa Rosa, California 95402

(707) 523-2960 • Telex 171743 • TWX 510 7446439

....GAS/STEAM RATIO CALCULATION...

WELL NAME: WELL 34-7B SULPHURDALE

BAROMETRIC PRESSURE(Psia)= 11.66

WATER HEAD(Psi)= .65

VOLUME OF GAS(LITERS)= 18.00

DATE	TIME	TEMP(F)	COND WT(G)	GAS/STEAM(L/G)	%GAS
01/19/84	1000	62.0	18.5	.760	59.8
01/19/84	1100	60.0	25.4	.556	52.1
01/19/84	1400	60.0	19.0	.743	59.2
01/19/84	1550	58.0	14.8	.958	65.2
01/20/84	935	36.0	5.6 *	2.643	83.8
01/20/84	1405	64.0	16.2	.865	62.8
01/20/84	1545	46.0	17.2	.844	62.3
01/21/84	1000	52.0	15.9	.899	63.7
01/21/84	1050	40.0	12.4	1.184	69.8
01/21/84	1500	64.0	17.3	.810	61.3

* REJECT

ANATEC
LABORATORIES
INC.

435 Tesconi Circle

Santa Rosa, California 95401

707-526-7200

TO: Mr. Louis Capuano
THERMASOURCE
100 E Street
Sana Rosa, CA 95404

SERIES: 145/002 4939 (1-7)
RECEIVED: 23 JAN 84; ASAP
ANALYSIS: 23 - 30 JAN 84
REPORT: 30 JAN 84 (V);
08 FEB 84 (W)

Subject: Seven samples submitted 23 January 1984.

Dear Mr. Capuano:

Results of analysis of your seven samples collected 18 through 21 January, 1984 are attached as Table 1. All analyses were performed using standard water analysis methodologies.

Radon-222 was determined on samples originally submitted for routine chemical analysis. These samples were delivered in partially-filled polyethylene bottles. Radon determinations were performed 4 February, 1984, by outgassing followed by scintillation counting. Calculation of results includes factors to correct for decay of radon subsequent to sampling. However, as time between collection and analysis increases, the reliability of data for low-level samples decreases. Also, because mathematical corrections cannot account for loss of radon, through container walls and into sample headspace, it is clear that radon data reported below should be regarded with extreme caution.

Please feel free to contact me should you have questions.

Greg Anderson, Director
Analytical Laboratories

/hs

1/18/84; #1; 4" ORIFICE; 1:45 PM MST = TEST #1
 1/19/84; #2; 11:00 AM; MST; 6" ORIFICE = TEST #2
 1/19/84; #3; 3:00 PM; MST; 6" ORIFICE = TEST #3
 1/20/84; #4; 2:00 PM; MST; 6" ORIFICE = TEST #4
 1/20/84; #5; 3:30 PM; MST; 6" ORIFICE = TEST #5
 1/21/84; #6; 10:00 AM; MST; 6" ORIFICE = TEST #6
 1/21/84; #7; 3:30 PM; MST; 6" ORIFICE = TEST #7

Table 1

Shortened Descriptor, Lab Number and Results (mg/L) ^a							
Parameter	Test #1 4939-1	Test #2 4939-2	Test #3 4939-3	Test #4 4939-4	Test #5 4939-5	Test #6 4939-6	Test #7 4939-7
General Physical							
pH (Units)	4.3	4.3	4.3	4.1	4.1	3.9	4.3
Specific Gravity ^b	1.0007	1.0010	1.0008	1.0019	1.0036	1.0033	1.0027
Total Filterable Residue	23	4	3	16	5	2	1
Total Nonfilterable Residue	(1	(1	1	1	(1	10	(1
General Chemical							
Alkalinity (as CaCO ₃)							
Total	10	10	9	10	10	7	9
Bicarbonate	10	10	9	10	10	7	9
Carbonate	0	0	0	0	0	0	0
Boron	0.22	(0.05	0.12	0.12	0.06	0.13	0.15
Chloride	(1	(1	(1	(1	(1	(1	(1
Silica	(0.6	(0.6	(0.6	(0.6	(0.6	(0.6	(0.6
Sulfate	3	(2	(2	(2	(2	(2	(2
Metals by Atomic Absorption							
Arsenic	(0.01	(0.01	(0.01	(0.01	(0.01	(0.01	(0.01
Calcium	0.4	0.2	0.1	0.3	0.3	0.3	0.2
Magnesium	0.06	0.05	0.02	0.06	0.10	0.08	0.03
Potassium	0.13	0.21	0.14	0.18	0.54	0.49	0.20
Sodium	0.2	0.4	0.3	0.3	1.2	0.6	0.2
Radon-222 (pCi/L condensate)	(570	(420	(410	(380	(200	(400	(430

^aUnless noted otherwise.

^bDensity of sample divided by density of pure water.

Luis Capuano
THERMASOURCE

145/002 4991 (1-8)

02 FEB 84; 03 Feb 84 - CHANGE TO ASAP PRIORITY

06 - 09 FEB 84

09 FEB 84; amended 14 FEB 84

REPORT OF ANALYSIS

Gas Analysis

1/19/84; 1300 HRS; MST; 6" ORIFICE; 3

4991-1

gas/steam ratio (ft³/lb): 7.65×10^0

gas/steam ratio (moles/1000 moles steam): 384

gas/steam ratio (g/10⁶ grams steam): 931000

at Air: 0.12

Gas	Mole % (w/o H ₂ O)	Moles per 1000 moles H ₂ O	ppm (with H ₂ O)
Water vapor	N/A	N/A	5.18×10^5
Carbon dioxide	9.81×10^{-1}	3.77×10^2	4.77×10^5
Hydrogen Sulfur (as H ₂ S)	9.64×10^{-1}	3.70×10^0	3.63×10^3
Ammonia	3.44×10^{-3}	1.32×10^{-2}	6.47×10^0
Hydrogen	8.42×10^{-3}	3.23×10^{-2}	3.71×10^1
Oxygen	4.51×10^{-1}	1.73×10^0	1.40×10^3
Acetylene	6.44×10^{-2}	2.47×10^{-1}	1.14×10^2
Hydrogen	$<3.69 \times 10^{-1}$	$<1.42 \times 10^0$	$<8.24 \times 10^1$

Weight of condensate (grams): 5.13

Headspace pressure (psi): 0.660

Two voided bombs returned; two bombs lost in transit.

RECEIVED

MAR 12 1984

ThermaSource, Inc.

ATEC

145/002 4991 (1-8)

- 2 -

09 FEB 84

Descriptor: 1-20-84; 1430 HRS; 6" ORIFICE; 6
Lab No.: 4991-2
Sample gas/steam ratio (ft³/lb): 4.44×10^1
Sample gas/steam ratio (moles/1000 moles steam): 2230
Sample gas/steam ratio (g/10⁶ grams steam): 5410000
Percent Air: 0.087

Gas	Mole % (w/o H ₂ O)	Moles per 1000 moles H ₂ O	ppm (with H ₂ O)
Water vapor	N/A	N/A	1.56×10^5
Carbon dioxide	9.82×10^1	2.19×10^3	8.35×10^5
Total Sulfur (as H ₂ S)	9.26×10^{-1}	2.07×10^1	6.09×10^3
Ammonia	6.89×10^{-3}	1.54×10^{-1}	2.27×10^1
Argon	7.86×10^{-3}	1.75×10^{-1}	6.06×10^1
Nitrogen	4.97×10^{-1}	1.11×10^1	2.69×10^3
Methane	9.70×10^{-2}	2.16×10^0	3.00×10^2
Hydrogen	$<2.75 \times 10^{-1}$	$<6.14 \times 10^0$	$<1.07 \times 10^2$

Total weight of condensate (grams): 1.17
Initial headspace pressure (psi): 0.73

Descriptor: 1-21-84; 1000 HRS; MST; 6" ORIFICE; 8
Lab No.: 4991-3
Sample gas/steam ratio (ft³/lb): 1.52×10^1
Sample gas/steam ratio (moles/1000 moles steam): 762
Sample gas/steam ratio (g/10⁶ grams steam): 1850000
Percent Air: 0.078

Gas	Mole % (w/o H ₂ O)	Moles per 1000 moles H ₂ O	ppm (with H ₂ O)
Water vapor	N/A	N/A	3.51×10^5
Carbon dioxide	9.81×10^1	7.48×10^2	6.42×10^5
Total Sulfur (as H ₂ S)	9.69×10^{-1}	7.39×10^0	4.91×10^3
Ammonia	8.82×10^{-3}	6.72×10^{-2}	2.23×10^1
Argon	8.61×10^{-3}	6.57×10^{-2}	5.11×10^1
Nitrogen	4.49×10^{-1}	3.42×10^0	1.87×10^3
Methane	6.44×10^{-2}	4.91×10^{-1}	1.54×10^2
Hydrogen	$<3.93 \times 10^{-1}$	$<3.00 \times 10^0$	$<1.18 \times 10^2$

Total weight of condensate (grams): 2.5
Initial headspace pressure (psi): 0.65

Descriptor: 1-20-84; 0915 HRS; MST; 6" ORIFICE; 5
 Lab No.: 4991-4
 Sample gas/steam ratio (ft³/lb): 1.31×10^1
 Sample gas/steam ratio (moles/1000 moles steam): 658
 Sample gas/steam ratio (g/10⁶ grams steam): 1590000
 Percent Air: 0.077

Gas	Mole % (w/o H ₂ O)	Moles per 1000 moles H ₂ O	ppm (with H ₂ O)
Water vapor	N/A	N/A	3.86×10^5
Carbon dioxide	9.81×10^{-1}	6.45×10^2	6.08×10^5
Total Sulfur (as H ₂ S)	8.74×10^{-1}	5.75×10^0	4.19×10^3
Ammonia	3.31×10^{-3}	2.18×10^{-2}	7.95×10^0
Argon	8.47×10^{-3}	5.58×10^{-2}	4.77×10^1
Nitrogen	5.61×10^{-1}	3.69×10^0	2.21×10^3
Methane	1.10×10^{-1}	7.25×10^{-1}	2.49×10^2
Hydrogen	$<3.45 \times 10^{-1}$	$<2.27 \times 10^0$	$<9.81 \times 10^1$

Total weight of condensate (grams): 3.05
 Initial headspace pressure (psi): 0.72

Descriptor: 1-19-84; 0935 HRS; MST; 6" ORIFICE; 2
 Lab No.: 4991-5
 Sample gas/steam ratio (ft³/lb): 2.30×10^0
 Sample gas/steam ratio (moles/1000 moles steam): 115
 Sample gas/steam ratio (g/10⁶ grams steam): 279000
 Percent Air: 0.17

Gas	Mole % (w/o H ₂ O)	Moles per 1000 moles H ₂ O	ppm (with H ₂ O)
Water vapor	N/A	N/A	7.82×10^5
Carbon dioxide	9.78×10^{-1}	1.13×10^2	2.15×10^5
Total Sulfur (as H ₂ S)	9.59×10^{-1}	1.11×10^0	1.64×10^3
Ammonia	1.15×10^{-2}	1.33×10^{-2}	9.83×10^0
Argon	9.63×10^{-3}	1.11×10^{-2}	1.93×10^1
Nitrogen	5.36×10^{-1}	6.18×10^{-1}	7.51×10^2
Methane	5.99×10^{-2}	6.91×10^{-2}	4.81×10^1
Hydrogen	5.89×10^{-1}	6.78×10^{-1}	5.95×10^1

Total weight of condensate (grams): 10.56
 Initial headspace pressure (psi): 0.59

09 FEB 84

Descriptor: 1-18-84; 1440 HRS; MST; 4" ORIFICE; 1
 Lab No.: 4991-6

MB RECEIVED WITH STEM PUSHED TOO FAR INTO BOMB - NO REPORT.

Descriptor: 1-19-84;; 1600 HRS; MST; 6" ORIFICE; 4
 Lab No.: 4991-7
 Sample gas/steam ratio (ft³/lb): 1.31 x 10⁰
 Sample gas/steam ratio (moles/1000 moles steam): 65.5
 Sample gas/steam ratio (g/10⁶ grams steam): 158000
 Percent Air: 0.14

Gas	Mole % (w/o H ₂ O)	Moles per 1000 moles H ₂ O	ppm (with H ₂ O)
Water vapor	N/A	N/A	8.64 x 10 ⁵
Carbon dioxide	9.75 x 10 ⁻¹	6.39 x 10 ⁻¹	1.35 x 10 ⁵
Total Sulfur (as H ₂ S)	9.89 x 10 ⁻¹	6.48 x 10 ⁻¹	1.06 x 10 ³
Ammonia	5.89 x 10 ⁻³	3.86 x 10 ⁻³	3.15 x 10 ⁰
Argon	7.79 x 10 ⁻³	5.11 x 10 ⁻³	9.77 x 10 ⁰
Nitrogen	7.05 x 10 ⁻¹	4.62 x 10 ⁻¹	6.20 x 10 ²
Methane	2.22 x 10 ⁻¹	1.45 x 10 ⁻¹	1.12 x 10 ²
Hydrogen	6.05 x 10 ⁻¹	3.96 x 10 ⁻¹	3.83 x 10 ¹

Total weight of condensate (grams): 18.57
 Initial headspace pressure (psi): 0.54

Descriptor: 1-20-84; 1615 HRS; MST; 6" ORIFICE; 7
 Lab No.: 4991-8
 Sample gas/steam ratio (ft³/lb): 2.75 x 10⁰
 Sample gas/steam ratio (moles/1000 moles steam): 138
 Sample gas/steam ratio (g/10⁶ grams steam): 334000
 Percent Air: 0.071

Gas	Mole % (w/o H ₂ O)	Moles per 1000 moles H ₂ O	ppm (with H ₂ O)
Water vapor	N/A	N/A	7.50 x 10 ⁵
Carbon dioxide	9.82 x 10 ⁻¹	1.35 x 10 ⁻²	2.48 x 10 ⁵
Total Sulfur (as H ₂ S)	9.75 x 10 ⁻¹	1.34 x 10 ⁰	1.91 x 10 ³
Ammonia	9.46 x 10 ⁻³	1.30 x 10 ⁻²	9.23 x 10 ⁰
Argon	6.61 x 10 ⁻³	9.11 x 10 ⁻³	1.51 x 10 ¹
Nitrogen	3.41 x 10 ⁻¹	4.71 x 10 ⁻¹	5.49 x 10 ²
Methane	4.30 x 10 ⁻²	5.93 x 10 ⁻²	3.96 x 10 ¹
Hydrogen	4.65 x 10 ⁻¹	6.40 x 10 ⁻¹	5.38 x 10 ¹

Total weight of condensate (grams): 10.2
 Initial headspace pressure (psi): 0.58

145/002 4991 (1-8)

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09 FEB 84

<u>Descriptor</u>	<u>Lab No.</u>	<u>Radon-222 (pCi/L)</u>
1-19-84; 1300 HRS; MST; 6" ORIFICE; 3	-1	590
1-20-84; 1430 HRS; 6" ORIFICE; 6	-2	170
1-21-84; 1000 HRS; MST; 6" ORIFICE; 8	-3	360
1-20-84; 0915 HRS; MST; 6" ORIFICE; 5	-4	710
1-19-84; 0935 HRS; MST; 6" ORIFICE; 2	-5	750
1-19-84; 1600 HRS; MST; 6" ORIFICE; 4	-7	730
1-20-84; 1615 HRS; MST; 6" ORIFICE; 7	-8	540

QUALITY CONTROL DATA

Analyte	Relative Standard Deviation	Matrix of Determination
Carbon Dioxide	5.5	Condensate/NaOH solution
Total Sulfur (as H ₂ S)	1.8	Condensate/NaOH solution
Ammonia	10	Condensate/NaOH solution
Argon	2.7	Residual Gas Phase
Oxygen	7.7	Residual Gas Phase
Nitrogen	3.8	Residual Gas Phase
Methane	1.5	Residual Gas Phase
Hydrogen	1.7	Residual Gas Phase

Air Correction Procedure¹

- (1) Total moles of oxygen determined in sample are multiplied by 1.00 and subtracted from total moles of oxygen.
- (2) Total moles of oxygen determined in sample are multiplied by 3.73 and subtracted from total moles of nitrogen.
- (3) Total moles of oxygen determined in sample are multiplied by 0.0446 and subtracted from total moles of argon.

¹Ref: Components of Atmospheric Air in C.R.C. Handbook of Chemistry and Physics, 58th ed.

Nina Huston
 Nina Huston
 Geothermal Services

Greg Anderson
 Greg Anderson, Director
 Analytical Laboratories

/hs

PRUETT INDUSTRIES INC
8915 ROSEDALE HWY, BAKERSFIELD, CA. 93308
(805) 589-2768

SUB-SURFACE PRESSURE SURVEY

CO. MOTHER EARTH		RUN 1A FIELD SULPHURDALE	WELL #1-LINDA
EFF DEPTH 1165'		WELL STAT STATIC	TOOL HUNG
CASING 13 5/80	-799	CASING PRESS	DN BOTTOM 11:28
LINER	-	TUBING PRESS	OFF BOTTOM 11:43
DATE 011884		ELEMENT RANGE 0 - 1065	ZERO POINT 20'
ELEVATION		ZONE	SHUT-IN
MAX TEMP		PICK-UP 1160'	ON-PROD
PERF 800	-1165	CAL SER NO. 15128	MPP
TUBING	-		
UNITS ENGLISH		PURPOSE	PRESSURE GRADIENT 1/18/84

SURVEY DATA

CO. MOTHER EARTH				RUN 1A FIELD SULPHURDALE		WELL #1-LINDA	
TIME	DEPTH	P/T	GRAD	TIME	DEPTH	P/T	GRAD
12:47	0	74.0	0.000	12:11	900	76.1	.006
12:44	200	74.3	.002	12:05	950	76.5	.008
12:37	400	74.8	.002	12:00	1000	76.7	.004
12:30	600	75.2	.002	11:54	1050	76.9	.004
12:22	800	75.5	.002	11:49	1100	77.2	.006
12:17	850	75.8	.006	11:43	1160	77.5	.005

PRESSURE GRADIENT RUN COMING OUT OF WELL

SURFACE PRESSURE IS 10 LOWER
THAN PRESSURE GAUGE. ADD 10*
TO ALL VALUES.*

INSTRUMENT CO.
8001 600-2700
10 1/2 INCHES

PRUETT INDUSTRIES INC
8915 ROSEDALE HWY, BAKERSFIELD, CA. 93308
(805) 589-2768

SUB-SURFACE TEMPERATURE SURVEY

CO. MOTHER EARTH		RUN 01 FIELD SULPHURDALE	WELL #1-LINDA
EFF DEPTH 1165'		WELL STAT STATIC	TOOL HUNG
CASING 13 5/80	-799	CASING PRESS	ON BOTTOM 11:28
LINER	-	TUBING PRESS	OFF BOTTOM 11:43
DATE 011884		ELEMENT RANGE 68 - 510	ZERO POINT 20'
ELEVATION		ZONE	SHUT-IN
MAX TEMP		PICK-UP 1160'	ON-PROD
PERF 800	-1165	CAL SER NO. 147	MPP
TUBING	-		
UNITS ENGLISH		PURPOSE	TEMPERATURE TRAVERSE 1/18/84

SURVEY DATA

CO. MOTHER EARTH				RUN 01 FIELD SULPHURDALE				WELL #1-LINDA			
TIME	DEPTH	P/T	GRAD	TIME	DEPTH	P/T	GRAD				
10:31	20	115.7	0.000	10:59	600	235.3	0.000				
10:32	40	143.0	0.000	11:01	620	236.9	0.000				
10:32	60	160.9	0.000	11:02	640	238.4	0.000				
10:34	80	174.4	0.000	11:02	660	240.1	0.000				
10:35	100	182.0	0.000	11:04	680	242.0	0.000				
10:35	120	189.1	0.000	11:05	700	243.7	0.000				
10:37	140	193.6	0.000	11:05	720	246.2	0.000				
10:38	161	197.0	0.000	11:07	740	248.5	0.000				
10:38	180	199.6	0.000	11:08	760	250.9	0.000				
10:40	200	201.6	0.000	11:08	780	253.1	0.000				
10:41	220	204.2	0.000	11:10	800	254.9	0.000				
10:41	240	207.2	0.000	11:11	820	257.0	0.000				
10:43	260	209.5	0.000	11:11	840	258.8	0.000				
10:44	280	211.5	0.000	11:13	860	261.1	0.000				
10:44	300	213.8	0.000	11:14	880	263.3	0.000				
10:46	320	215.1	0.000	11:14	900	265.1	0.000				
10:47	340	216.6	0.000	11:16	920	266.4	0.000				
10:47	360	218.0	0.000	11:17	940	269.8	0.000				
10:49	380	219.6	0.000	11:17	960	273.2	0.000				
10:50	400	220.9	0.000	11:19	980	275.6	0.000				
10:50	420	222.0	0.000	11:20	1000	277.2	0.000				
10:52	440	222.7	0.000	11:20	1020	279.7	0.000				
10:53	460	223.4	0.000	11:22	1040	281.5	0.000				
10:53	480	224.7	0.000	11:23	1060	284.1	0.000				
10:55	500	226.4	0.000	11:23	1080	286.4	0.000				
10:56	520	228.1	0.000	11:25	1100	288.4	0.000				
10:56	540	230.2	0.000	11:26	1120	289.4	0.000				
10:58	560	231.6	0.000	11:26	1140	290.6	0.000				
10:59	580	233.4	0.000	11:41	1160	290.0	0.000				

BY S. WILSON/R. MARQUEZ

AMERICAN CHEMICAL SOCIETY
1015 BAYVIEW
NORTH BAYVIEW, CA 94708

PRUETT INDUSTRIES INC
8915 ROSEDALE HWY, BAKERSFIELD, CA. 93308
(805) 589-2768

SUB-SURFACE PRESSURE SURVEY

CO. MOTHER EARTH	RUN 2A FIELD SULPHURDALE	WELL #1-LINDA
EFF DEPTH 1165'	WELL STAT FLOWING	TOOL HUNG
CASING 13 5/8 TO -799'	CASING PRESS	ON BOTTOM 3:03PM1/18
LINER -	TUBING PRESS	OFF BOTTOM 3:08PM1/18
DATE 011884	ELEMENT RANGE 0 - 1065	ZERO POINT 20'
ELEVATION	ZONE	SHUT-IN
MAX TEMP	PICK-UP	ON-PROD
PERF -	CAL SER NO. 15128	MPP
TUBING -		
UNITS ENGLISH	PURPOSE	PRESSURE TRAVERSE 1/18/84

SURVEY DATA

CO. MOTHER EARTH				RUN 2A FIELD SULPHURDALE				WELL #1-LINDA			
TIME	DEPTH	P/T	GRAD	TIME	DEPTH	P/T	GRAD	TIME	DEPTH	P/T	GRAD
2:03	0	73.7	0.000	2:45	700	77.4	0.000				
2:15	100	74.3	0.000	2:50	800	78.0	0.000				
2:20	200	74.8	0.000	2:55	900	78.5	0.000				
2:25	300	75.3	0.000	3:00	1000	79.0	0.000				
2:30	400	75.9	0.000	3:05	1100	79.6	0.000				
2:35	500	76.4	0.000	3:08	1160	79.7	0.000				
2:40	600	76.9	0.000	0:00	0	0.0	0.000				

BY J. WILSON/R. MARQUEZ

AMERICAN PETROLEUM INSTITUTE
1015 N. 17th St., Suite 100
Tulsa, Oklahoma 74103

PRUETT INDUSTRIES INC
8915 ROSEDALE HWY, BAKERSFIELD, CA. 93308
(805) 589-2768

SUB-SURFACE TEMPERATURE SURVEY

CO. MOTHER EARTH	RUN 02 FIELD SULPHURDALE	WELL #1-LINDA
EFF DEPTH 1165'	WELL STAT FLOWING	TOOL HUNG
CASING 13 5/8 TO -799'	CASING PRESS	ON BOTTOM 3:03PM 1/18
LINER	TUBING PRESS	OFF BOTTOM 3:08PM 1/18
DATE 011884	ELEMENT RANGE 68 - 510	ZERO POINT 20'
ELEVATION	ZONE	SHUT-IN
MAX TEMP	PICK-UP	ON-PROD
PERF	CAL SER NO. 147	MPP
TUBING		
UNITS ENGLISH	PURPOSE	TEMPERATURE TRAVERSE 1/18/84

SURVEY DATA

CO. MOTHER EARTH				RUN 02 FIELD SULPHURDALE				WELL #1-LINDA			
TIME	DEPTH	P/T	GRAD	TIME	DEPTH	P/T	GRAD	TIME	DEPTH	P/T	GRAD
2:03	0	68.7	0.000	2:40	600	290.9	0.000				
2:11	20	287.0	0.000	2:41	620	290.9	0.000				
2:12	40	287.2	0.000	2:42	640	291.0	0.000				
2:13	60	287.4	0.000	2:43	660	291.3	0.000				
2:14	80	287.5	0.000	2:44	680	291.4	0.000				
2:15	100	287.5	0.000	2:45	700	291.5	0.000				
2:16	120	287.6	0.000	2:46	720	291.5	0.000				
2:17	140	287.6	0.000	2:47	740	291.6	0.000				
2:18	160	287.7	0.000	2:48	760	291.6	0.000				
2:19	180	288.0	0.000	2:49	780	291.6	0.000				
2:20	200	288.2	0.000	2:50	800	291.7	0.000				
2:21	220	288.4	0.000	2:51	820	291.8	0.000				
2:22	240	288.6	0.000	2:52	840	292.1	0.000				
2:23	260	288.6	0.000	2:53	860	292.4	0.000				
2:24	280	288.9	0.000	2:54	880	292.5	0.000				
2:25	300	289.2	0.000	2:55	900	292.6	0.000				
2:26	320	289.3	0.000	2:56	920	292.8	0.000				
2:27	340	289.3	0.000	2:57	940	293.0	0.000				
2:28	360	289.3	0.000	2:58	960	293.0	0.000				
2:29	380	289.3	0.000	2:59	980	293.0	0.000				
2:30	400	289.6	0.000	3:00	1000	293.0	0.000				
2:31	420	289.6	0.000	3:01	1020	293.0	0.000				
2:32	440	289.6	0.000	3:02	1040	293.0	0.000				
2:33	460	289.7	0.000	3:03	1060	293.0	0.000				
2:34	480	289.7	0.000	3:04	1080	293.0	0.000				
2:35	500	290.0	0.000	3:05	1100	293.0	0.000				
2:36	520	290.1	0.000	3:06	1120	293.0	0.000				
2:37	540	290.3	0.000	3:07	1140	293.0	0.000				
2:38	560	290.6	0.000	3:08	1160	293.1	0.000				
2:39	580	290.8	0.000	0:00	0	0.0	0.000

BUREAU OF LAND MANAGEMENT
10-11400-5

APPENDIX - B

Mar 22, 1984 - Apr 3, 1984

APPENDIX B

ThermaSource Inc.

100 E Street • P.O. Box 1236 • Santa Rosa, California 95402
(707) 523-2960 • Telex 471743 • TWX 510 7446439

May 16, 1984

Mr. Wayne Portanova
Mother Earth Industries, Inc.
45 Buckfield Lane
Greenwich, CT 06830

Dear Wayne,

Enclosed for your information and use are results and data collected from Well 34-7B (Lady Linda) in the Sulphurdale Geothermal Field during the period from March 22, 1984 to April 3, 1984. The well was opened for cleanup on March 22, 1984, and was flowed continuously until April 2, 1984. A bottom hole pressure and temperature survey was conducted on March 22, 1984, just prior to opening the well. A pressure of 92 psig and 299 F was recorded at a depth of 1158 feet. Over the 12 day period, the well was flowed through the test line for 5 days. Final flowing conditions at 6:00 PM on April 2, 1984 were: 92,000 lbs/hr. total mass flow, 44% gas, 54 psig flowing wellhead pressure, and 272 F flowing temperature. The temperature may be 8-10 degrees too low because water had filled the cellar box during the snow melt. This may explain the water flowing along the bottom of the test line.

The gas content decreased during the last four days from 63% to 44%. Further decreases in gas content could occur and may be observed during the long term test.

A spinner survey conducted on April 2, 1984, indicated that all well production was coming from the bottom of the well or below 1155 feet.

Interpretation of the transient data will require more study. The buildup data indicates several possibilities. The well displays some of the characteristics of a dual porosity (fracture-matrix) system. This would be consistent with mapped surface faulting surrounding the well location. Comparison with a type curve for a well in a vertically fractured system located in the center of a square drainage area shows a reasonable correlation. The side dimensions are about 20 times the fracture length. The alternating blowing and testing of the well during the flow period may have been contributed to some of the problems. Permeability - thickness based on these correlations are extremely high: greater than 500,000 md-ft.

In view of the impending long term test, additional analysis should be deferred until that data is available.

Yours truly,

Gerald Niimi
Vice President

GN/tp

cc:

Jack Barnett
Gordon Ford
Klane Forsgren
Ron Schroeder

ENCLOSURE LIST

34-7B (Lady Linda) Well Test

1. Well Test Summary.
2. Well Test Diagram.
3. Well Test Data - Daily pressure, temperature and gas. (6 sheets)
4. Chemical Sample Collection and Analysis. (Hirtz)
5. Letter from Anatec Labs - April 17, 1984.
6. Letter from Anatec Labs - May 7, 1984 - transmitting gas bomb analysis.
7. Field Gas/Steam Ratio Calculation.
8. Wireline Bottomhole Pressure and Temperature Data.
9. Pressure Buildup Data.
10. Pressure Buildup Type Curve Correlations.
11. Average Well Performance.

MOTHER EARTH INDUSTRIES 34-7B (LADY LINDA)

1984

27
2" WIRELINE ENTRY VALVE

12" WKM BLOWDOWN VALVE

1" HORIZONTAL
CALORIMETER PORT

SAMPLE PORT

FLOW
TEE

12" WKM
THROTTLE VALVE

12" WKM
MASTER PRODUCTION VALVE

MOVEABLE
SAMPLE PORT

ORIFICE FLANGES
WITH PLATE

12" I.D. FLOWLINE

GROUND LEVEL

2 - 3" WING VALVES ON
13-3/8" S.O.W. WELLHEAD

13-3/8"
CASING

REVISED	DATE

TSI

ThermaSource Inc.

100 E Street • P.O. Box 1236 • Santa Rosa, California 95402

(707) 523-2960 • Telex 171743 • TWX 510 7446439

MOTHER EARTH INDUSTRIES
WELL TEST DIAGRAM
WELL 34-7B
"LADY LINDA" No. 1

DRAWN

FOR: MEI

BY: LEC

DATE: 2-10-84

SCALE: NA

DRAW No.

ThermaSource Inc.

WELL TEST DATA

MOTHER EARTH INDUSTRIES
34-7B (Lady Linda)

DATE/TIME	WH PRESS. (PSIG)	ORIF PRESS (PSIG)	ORIF TEMP (°F)	MASS FLOW (LBS/HR)	GAS(%)	REMARKS
3/22/84	87		250	0		W/L PRESSURE & TEMP. SURVEY
						BLEW WELL TO CLEANUP
3/23/84 0900	70	68		99,000 *		START 2 HR. TEST TO CHECK EQUIP.
0930	70	68		99,000		FOUND TEMPERATURE LINE PLUGGED
1000	70	65		95,000		
1030	70	68		99,000		
1100	70	65		95,000		RESUME BLOWING TO ATM
3/24/84 0930	66	64	270	93,500		
1000	66	64	275	93,500		
1030	66	64	272	93,500		
1100	66	64	272	93,500		
1130	66	64	274	93,500		RESUME BLOWING TO ATM

NOTES:

6" ORIFICE IN 12" TEST LINE

* FLOW ASSUMES PURE STEAM

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WELL TEST DATA

MOTHER EARTH INDUSTRIES
34-7B (Lady Linda)

2

DATE/TIME	WH PRESS. (PSIG)	ORIF PRESS (PSIG)	ORIF TEMP (°F)	MASS FLOW (LBS/HR)	GAS(%)	REMARKS
3/25/84 0930	65	63	270	92,000		
1000	65	63	270	92,000		
1030	65	63	270	92,000		
1100	65	63	270	92,000		
1130	65	63	270	92,000		CHANGE OUT TEMP GAUGE
						RESUME BLOWING TO ATM.
3/26/84 1000	62	60	272	103,100*	56.4	BEGIN FLOW TESTING
1100	62	60	270	109,200	58.7	
1200	62	60	270	107,800	54.2	
1300	64	60	272	109,800	59.9	
1400	64	60	272	109,800	59.9	
1500	64	60	272	109,800	59.9	
1600	62	58	272	106,600	55.3	
1700	62	60	270	108,900	57.5	
3/27/84 0830	63	60	270	108,900	57.5	

NOTES:

* FLOW CORRECTED FOR GAS CONTENT

WELL TEST DATA

3

 MOTHER EARTH INDUSTRIES
 34-7B (Lady Linda)

DATE/TIME	WH PRESS. (PSIG)	ORIF PRESS (PSIG)	ORIF TEMP (°F)	MASS FLOW (LBS/HR)	GAS(%)	REMARKS
3/27/84 0930	63	58	270	106,900	56.4	
1100	62	58	270	109,200	62.6	
1200	62	58	270	109,900	64.0	
1300	62	58	270	109,900	64.0	
1400	62	58	270	109,200	62.6	
1500	61	58	270	109,000	61.2	
1600	61	58	270	109,900	64.0	
1700	61	58	270	108,200	59.9	
3/28/84 0815	60	58	270	109,900	64.0	
0915	60	58	270	110,300	65.3	
1015	60	58	270	107,800	58.7	
1115	60	58	270	110,300	65.5	
1215	60	58	270	109,200	62.6	
1315	60	58	270	109,200	62.6	
1415	60	58	270	107,800	58.7	

NOTES:

TSI

ThermoSource Inc.

WELL TEST DATA

4

MOTHER EARTH INDUSTRIES
34-7B (Lady Linda)

DATE/TIME	WH PRESS. (PSIG)	ORIF PRESS (PSIG)	ORIF TEMP (°F)	MASS FLOW (LBS/HR)	GAS(%)	REMARKS
3/28/84 1515	60	58	270	109,900	64.0	
1615	60	58	270	109,000	61.2	
1715	60	58	270	109,200	62.6	
2145						START BLOWING TO ATM
3/29/84						CONTINUE BLOWING
3/30/84 0915	58	54	272	98,500	54.2	BEGIN TESTING
1000	58	54	275	98,500	54.2	
1100	58	54	275	97,400	52.2	
1200	58	54	275	100,500	58.6	
1300	58	54	275	97,000	51.1	
1400	58	54	275	98,500	54.1	
1500	58	54	275	98,500	54.1	
1700	56	53	275	96,400	50.2	
1745						START BLOWING TO ATM
						INSTALL PROBE TO SAMPLE GAS

NOTES: WATER FROM MELTING SNOW GOING INTO CELLAR BOX.
POSSIBLY AFFECTING WELL HEAD TEMPERATURE.

TSI

ThermaSource Inc.

WELL TEST DATA

MOTHER EARTH INDUSTRIES
34-7B (Lady Linda)

5

DATE/TIME	WH PRESS. (PSIG)	ORIF PRESS (PSIG)	ORIF TEMP (°F)	MASS FLOW (LBS/HR)	GAS(%)	REMARKS
3/31/84 1800	56	53	275	95,300	49.3	BEGIN TESTING
1830	56	53	275	95,000	48.5	
1845	56	53	275	94,400	47.5	
4/1/84 0900	56	53	275	94,300	47.3	
1000	56	53	275	94,600	48.7	
1100	56	53	275	96,100	50.7	
1200	56	53	275	95,300	49.1	
1300	56	53	275	95,100	48.8	
1400	56	53	275	95,500	49.4	
1500	56	53	275	95,200	48.9	
1600	56	53	275	95,000	48.5	
1700	56	53	275	94,600	47.9	
4/2/84 0800	54	52	273	92,200	44.4	
0900	54	52	273	92,200	44.4	
1000	54	52	273	93,300	45.9	

NOTES:

ThermaSource Inc.

WELL TEST DATA

MOTHER EARTH INDUSTRIES
34-7B (Lady Linda)

6

33.

DATE/TIME	WH PRESS. (PSIG)	ORIF PRESS (PSIG)	ORIF TEMP (°F)	MASS FLOW (LBS/HR)	GAS(%)	REMARKS
4/2/84 1100	54	52	273	92,800	45.4	
1200	54	52	273	92,200	44.4	RAW SPINNER SURVEY
1300	54	52	273	92,200	44.4	
1400	54	52	273	91,400	43.2	
1500	54	52	273	92,900	45.7	
1600	54	52	272	93,300	45.9	
1700	54	52	272	91,900	43.8	
						SL FOR BUILDUP
4/3/84 0800						RIG DOWN

NOTES: SPINNER SURVEY INDICATES ALL FLOW COMING FROM
BOTTOM OF HOLE (BELOW 1155')

PAUL N. HIRTZ
CONSULTING ANALYTICAL CHEMIST
5710 MONTECITO AVENUE
SANTA ROSA, CALIFORNIA 95404

TELEPHONE (707) 538-0402

April 12, 1984

LADY LINDA
Sample Collection and Analysis

Composite steam and noncondensable gas samples were collected 3/30/84 through 4/2/84 from the flow testing tube of the well Lady Linda. Samples were collected from the top of the testing tube through an insulated tee that allowed for a constant supplementary bleed flow to atmosphere, (Fig. 1). The insulation and bleed flow kept the sampling tee hot and prevented condensation. Samples were also collected through a probe at various depths into the flow testing tube, (Fig. 2). The probe allowed sample collection from specific points within the flow tube in order to detect stratification of the steam, gas and liquid water components. Although steam and non-condensable gases are not known to separate under these conditions, liquid water does tend to separate rapidly and flows along the bottom of pipe.

The sample flow was condensed in a gravity-feed condenser in order to prevent any loss of the small volumes of condensate into low points and dead-volume spaces, (Fig. 3). Evacuated glass bottles containing 50% sodium hydroxide were used to collect the composite steam and gas samples. Between 40 and 100 grams of total sample was collected in these bottles by dissolving the copious amounts of CO_2 into the sodium hydroxide. Samples collected in this manner are representative of the total flow and yield accurate ratios of the major gases to steam.

Field analyses of H_2S and CO_2 concentrations by weight were performed by titration. The iodine/thiosulfate titration was used for H_2S analysis and the hydrochloric acid titration was

used for CO₂ analysis. Electrical conductivity and pH measurements were also done in the field. The bulk of the samples collected were sent to Anatic Laboratories, Inc. for analysis, (see attached receipts).

Field Analysis Results

<u>Collection Date, Time</u>	<u>Collection Location</u>	<u>H₂S ppm by wt.</u>	<u>RSD¹</u>	<u>CO₂ % by wt.</u>	<u>RSD¹</u>
3/30, 14:30	top tee	5110	6.9%	52.9	----
4/1, 09:45	top tee	4800	0%	42.6	7.2%
4/1, 15:15	top tee	4530	9.2%	47.3	10.6%
4/2, 10:30 ²	top tee	3900	0.9%	41.9	3.5%
4/2, 12:30 ²	top tee	4030	4.2%	41.9	----

		<u>pH</u>	<u>Electrical Conductivity</u>
3/30, 10:00	top tee	----	50 umhos/cm
3/30, 10:00	bottom tube	----	120 umhos/cm
3/30, 17:45	top tee	4.60	-----
3/30, 17:45	bottom tube	4.80	-----
4/1, 09:15	top tee	4.00	-----

- ¹ Relative Standard Deviation of two or more analyses for the same sample.
- ² Analysis was performed on the remainder of these samples by Anatec Laboratories, Inc. for direct comparison to field results, (see attached report).

Fig. 1

Fig. 2

ANATEC
LABORATORIES
INC.

435 Tesconi Circle

Santa Rosa, California 95401

707-526-7200

Jerry Niemi
Thermasource
P.O. Box 1236
Santa Rosa, CA 95402

April 17, 1984
ANATEC Log No: 5257 (-1,2)
Series No: 145/004 URGENT

Subject: Total Sulfur and Carbon Dioxide Analysis

Dear Mr. Niemi:

Tabulated below are data for two samples received April 5, 1984, in impingers on a Routine basis.

Please feel free to contact us should you have questions.

Submitted by:

Approved by:

Nina Jan Huston
Nina Jan Huston
Gas Analysis Section

Greg Anderson
Greg Anderson, Director
Analytical Laboratories

/jn

cc: Paul Hirtz

Table 1. Analytical Results

Descriptor	Lab No.	Carbon Dioxide (% by total wt)	Hydrogen Sulfide (ppm by wt)
4/2/84; 10:30 HRS; 372.8/412.9 V _F = 1.000 L	1	45	4,300
4/2/84; 12:30 HRS; 370.5/413.6 V _F = 1.000 L	2	45	4,300

ANATEC
LABORATORIES
INC.

435 Tesconi Circle

Santa Rosa, California 95401

707-526-7200

Mr. Jerry Niimi
THERMASOURCE, INC.
P.O. Box 1236
Santa Rosa, CA 95402

May 7, 1984
ANATEC Log No: 5255 (1-22)
Series: 145/003
Samples Rec'd: 05 April 84

Subject: Total Gas Analysis - "Well 34-75, Sulfurdale, Utah"

Dear Mr. Niimi:

Tabulated on the following pages are data for twelve samples received April 5, 1984, in gas bombs, on a Routine basis.

Please feel free to contact us should you have questions.

Submitted by:

Nina Jan Huston
Supervisor, Gas Analysis

Approved by:

Greg Anderson, Director
Analytical Laboratories

/jn

ANATEC

5255 (1-22)

- 2 -

May 7, 1984

Descriptor: WELL 34-75; SULFURDALE, UTAH; 3/30/84; 1145; TOP

Lab No: 5255-1

Initial headspace pressure:

8.9

Total weight of condensate (grams):

21.1

Specific volume (pounds/ft³ at 71.5 psiA and 275°F):

0.23

Gas weight percent (g noncondensable gas/100 g sample):

51.1

Percent Air:

0.17

Gas	Mole % (w/o H ₂ O)	ppm by wt. (Total Mass)
Carbon dioxide	9.84×10^1	5.05×10^5
Total Sulfur (as H ₂ S)	1.18×10^0	4.71×10^3
Ammonia	$<1.98 \times 10^{-3}$	$<3.94 \times 10^0$
Argon	6.36×10^{-3}	2.96×10^1
Nitrogen	3.65×10^{-1}	1.19×10^3
Methane	2.51×10^{-2}	4.71×10^1
Hydrogen	3.38×10^{-2}	7.96×10^0

Descriptor: WELL 34-75; SULFURDALE, UTAH; 1515; TOP 2/20

Lab No: 5255-3

Initial headspace pressure:

5.28

Total weight of condensate (grams):

21.6

Specific volume (pounds/ft³ at 71.5 psiA and 275°F):

0.23

Gas weight percent (g noncondensable gas/100 g sample):

49.0

Percent Air:

0.0002

Gas	Mole % (w/o H ₂ O)	ppm by wt. (Total Mass)
Carbon dioxide	9.48×10^1	4.85×10^5
Total Sulfur (as H ₂ S)	1.16×10^0	4.43×10^3
Ammonia	$<3.35 \times 10^{-3}$	$<6.38 \times 10^0$
Argon	6.74×10^{-3}	3.02×10^1
Nitrogen	3.35×10^{-1}	1.05×10^3
Methane	3.66×10^{-2}	6.57×10^1
Hydrogen	3.65×10^{-2}	8.25×10^0

46

5255 (1-22)

- 3 -

May 7, 1984

Descriptor: WELL 34-75; SULFURDALE, UTAH; 3/30; 1730;
BOTTOM PORT

Lab No: 5255-5

Initial headspace pressure:

3.8

Total weight of condensate (grams):

94.5

Specific volume (pounds/ft³ at 71.5 psiA and 275°F):

0.16

Gas weight percent (g noncondensable gas/100 g sample):

1.9

Percent Air:

1.3

Gas	Mole % (w/o H ₂ O)	ppm by wt. (Total Mass)
Carbon dioxide	9.52×10^1	1.84×10^4
Total Sulfur (as H ₂ S)	4.21×10^0	6.30×10^2
Ammonia	$<1.01 \times 10^{-1}$	$<7.58 \times 10^0$
Argon	6.64×10^{-3}	1.16×10^0
Nitrogen	4.58×10^{-1}	5.63×10^1
Methane	$<6.54 \times 10^{-3}$	$<4.60 \times 10^{-1}$
Hydrogen	$<3.30 \times 10^{-2}$	$<2.93 \times 10^{-1}$

Descriptor: WELL 34-75; SULFURDALE, UTAH; 3/31/84; 1815;
TOP PORT

Lab No: 5255-6

Initial headspace pressure:

5.87

Total weight of condensate (grams):

23.3

Specific volume (pounds/ft³ at 71.5 psiA and 275°F):

0.23

Gas weight percent (g noncondensable gas/100 g sample):

50.1

Percent Air:

<0.0002

Gas	Mole % (w/o H ₂ O)	ppm by wt. (Total Mass)
Carbon dioxide	9.84×10^1	4.95×10^5
Total Sulfur (as H ₂ S)	1.21×10^0	4.71×10^3
Ammonia	$<2.64 \times 10^{-3}$	$<5.14 \times 10^0$
Argon	5.68×10^{-3}	2.59×10^1
Nitrogen	2.83×10^{-1}	9.06×10^2
Methane	3.07×10^{-2}	5.62×10^1
Hydrogen	3.41×10^{-2}	7.86×10^0

Descriptor: WELL 34-75; SULFURDALE, UTAH; 4/1/84; 0845; TOP

Lab No: 5255-8

Initial headspace pressure:

5.02

Total weight of condensate (grams):

20.0

Specific volume (pounds/ft³ at 71.5 psia and 275°F):

0.23

Gas weight percent (g noncondensable gas/100 g sample):

51.2

Percent Air:

<0.0002

Gas	Mole % (w/o H ₂ O)	ppm by wt. (Total Mass)
Carbon dioxide	9.85×10^1	5.07×10^5
Total Sulfur (as H ₂ S)	1.14×10^0	4.56×10^3
Ammonia	$<3.91 \times 10^{-3}$	$<7.79 \times 10^0$
Argon	5.61×10^{-3}	2.62×10^1
Nitrogen	2.80×10^{-1}	9.17×10^2
Methane	2.97×10^{-2}	5.57×10^1
Hydrogen	3.20×10^{-2}	7.56×10^0

Descriptor: WELL 34-75; SULFURDALE, UTAH; 4/1/84; 1200; TOP

Lab No: 5255-11

Initial headspace pressure:

5.25

Total weight of condensate (grams):

45.8

Specific volume (pounds/ft³ at 71.5 psia and 275°F):

0.23

Gas weight percent (g noncondensable gas/100 g sample):

48.0

Percent Air:

<0.0002

Gas	Mole % (w/o H ₂ O)	ppm by wt. (Total Mass)
Carbon dioxide	9.82×10^1	4.74×10^5
Total Sulfur (as H ₂ S)	1.46×10^0	5.46×10^3
Ammonia	$<2.07 \times 10^{-3}$	$<3.86 \times 10^0$
Argon	5.97×10^{-3}	2.61×10^1
Nitrogen	2.96×10^{-1}	9.09×10^2
Methane	3.15×10^{-2}	5.55×10^1
Hydrogen	3.47×10^{-2}	7.69×10^0

5255 (1-22)

- 5 -

May 7, 1984

43.

Descriptor: WELL 34-75; SULFURDALE, UTAH; 4/1/84; 1720; TOP

Lab No: 5255-14

Initial headspace pressure: 3.97

Total weight of condensate (grams): 34.1

Specific volume (pounds/ft³ at 71.5 psia and 275°F): 0.23

Gas weight percent (g noncondensable gas/100 g sample): 50.1

Percent Air: 0.0007

Gas	Mole % (w/o H ₂ O)	ppm by wt. (Total Mass)
Carbon dioxide	9.78×10^1	4.93×10^5
Total Sulfur (as H ₂ S)	1.78×10^0	6.96×10^3
Ammonia	$<1.58 \times 10^{-3}$	$<3.07 \times 10^0$
Argon	6.01×10^{-3}	2.75×10^1
Nitrogen	3.01×10^{-1}	9.65×10^2
Methane	3.13×10^{-2}	5.75×10^1
Hydrogen	3.28×10^{-2}	7.59×10^0

Descriptor: WELL 34-75; SULFURDALE, UTAH; 4/2/84; 0915; TOP

Lab No: 5255-15

Initial headspace pressure: 6.45

Total weight of condensate (grams): 45.3

Specific volume (pounds/ft³ at 71.5 psia and 275°F): 0.23

Gas weight percent (g noncondensable gas/100 g sample): 50.0

Percent Air: 0.0062

Gas	Mole % (w/o H ₂ O)	ppm by wt. (Total Mass)
Carbon dioxide	9.84×10^1	4.94×10^5
Total Sulfur (as H ₂ S)	1.25×10^0	4.86×10^3
Ammonia	$<7.38 \times 10^{-3}$	$<1.43 \times 10^1$
Argon	6.02×10^{-3}	2.75×10^1
Nitrogen	3.09×10^{-1}	9.88×10^2
Methane	3.01×10^{-2}	5.52×10^1
Hydrogen	3.61×10^{-2}	8.31×10^0

5255 (1-22)

- 6 -

May 7, 1984

Descriptor: WELL 34-75; SULFURDALE, UTAH; 4/2/84; 1215; TOP

Lab No: 5255-16

Initial headspace pressure: 5.45

Total weight of condensate (grams): 52.8

Specific volume (pounds/ft³ at 71.5 psia and 275°F): 0.22

Gas weight percent (g noncondensable gas/100 g sample): 42.5

Percent Air: 0.027

Gas	Mole % (w/o H ₂ O)	ppm by wt. (Total Mass)
Carbon dioxide	9.80×10^1	4.18×10^5
Total Sulfur (as H ₂ S)	1.60×10^0	5.29×10^3
Ammonia	$<6.21 \times 10^{-3}$	$<1.03 \times 10^1$
Argon	5.87×10^{-3}	2.27×10^1
Nitrogen	3.09×10^{-1}	8.39×10^2
Methane	2.61×10^{-2}	4.06×10^1
Hydrogen	3.45×10^{-2}	6.76×10^0

Descriptor: WELL 34-75; SULFURDALE, UTAH; 4/2/84; 1045;
PROBE 6" UP

Lab No: 5255-17

Initial headspace pressure: 5.3

Total weight of condensate (grams): 41.3

Specific volume (pounds/ft³ at 71.5 psia and 275°F): 0.23

Gas weight percent (g noncondensable gas/100 g sample): 46.3

Percent Air: 0.044

Gas	Mole % (w/o H ₂ O)	ppm by wt. (Total Mass)
Carbon dioxide	9.82×10^1	4.57×10^5
Total Sulfur (as H ₂ S)	1.43×10^0	5.16×10^3
Ammonia	$<8.10 \times 10^{-3}$	$<1.46 \times 10^1$
Argon	5.97×10^{-3}	2.52×10^1
Nitrogen	3.23×10^{-1}	9.57×10^2
Methane	2.64×10^{-2}	4.48×10^1
Hydrogen	4.14×10^{-2}	8.84×10^0

Descriptor: WELL 34-75; SULFURDALE, UTAH; 4/2/84; 0945;
PROBE 3" UP

Lab No: 5255-18

Initial headspace pressure: 6.9

Total weight of condensate (grams): 29.3

Specific volume (pounds/ft³ at 71.5 psiA and 275°F): 0.21

Gas weight percent (g noncondensable gas/100 g sample): 39.8

Percent Air: 0.074

Gas	Mole % (w/o H ₂ O)	ppm by wt. (Total Mass)
Carbon dioxide	9.75×10^1	3.91×10^5
Total Sulfur (as H ₂ S)	2.10×10^0	6.53×10^3
Ammonia	$<3.44 \times 10^{-3}$	$<5.34 \times 10^0$
Argon	5.23×10^{-3}	1.90×10^1
Nitrogen	2.90×10^{-1}	7.41×10^2
Methane	2.45×10^{-2}	3.57×10^1
Hydrogen	3.97×10^{-2}	7.30×10^0

Descriptor: WELL 34-75; SULFURDALE, UTAH; 4/2/84; 1630; TOP

Lab No: 5255-20

Initial headspace pressure: 4.41

Total weight of condensate (grams): 34.3

Specific volume (pounds/ft³ at 71.5 psiA and 275°F): 0.23

Gas weight percent (g noncondensable gas/100 g sample): 44

Percent Air: 0.15

Gas	Mole % (w/o H ₂ O)	ppm by wt. (Total Mass)
Carbon dioxide	9.82×10^1	4.34×10^5
Total Sulfur (as H ₂ S)	1.44×10^0	4.93×10^3
Ammonia	$<1.46 \times 10^{-2}$	$<2.50 \times 10^1$
Argon	5.68×10^{-3}	2.28×10^1
Nitrogen	3.07×10^{-1}	8.65×10^2
Methane	2.35×10^{-2}	3.79×10^1
Hydrogen	3.22×10^{-2}	6.54×10^0

QUALITY CONTROL DATA

Analyte	Relative Standard Deviation	Matrix of Determination
Carbon Dioxide	2.1	Condensate/NaOH solution
Total Sulfur (as H_2S)	1.0	Condensate/NaOH solution
Ammonia	11.3	Condensate/NaOH solution
Argon	1.8	Residual Gas Phase
Oxygen	4.5	Residual Gas Phase
Nitrogen	2.4	Residual Gas Phase
Methane	3.9	Residual Gas Phase
Hydrogen	3.4	Residual Gas Phase

Air Correction Procedure¹

- (1) Total moles of oxygen determined in sample are multiplied by 1.00 and subtracted from total moles of oxygen.
- (2) Total moles of oxygen determined in sample are multiplied by 3.73 and subtracted from total moles of nitrogen.
- (3) Total moles of oxygen determined in sample are multiplied by 0.0446 and subtracted from total moles of argon.

¹Ref: Components of Atmospheric Air in C.R.C. Handbook of Chemistry and Physics, 58th ed.

"FIELD MEASURED"

47.

WELL NAME: LADY LINDA MEI 34-78

BAROMETRIC PRESSURE(PBIA)= 11.44

WATER HEAD(PSI)= .65

VOLUME OF GAS(LITERS)= 18.00

DATE	TIME	TEMP(F)	COND WT(G)	GAS/STEAM(L/G)	XGAS	
03/26/84	925	50.0	24.0	.600	54.0	SAMPLE TAKEN FROM TOP
03/26/84	1015	45.0	22.0	.661	56.4	UNLESS OTHERWISE NOTED
03/26/84	1115	45.0	20.0	.727	58.7	
03/26/84	1215	45.0	24.0	.600	54.2	
03/26/84	1315	45.0	19.0	.765	59.9	
03/26/84	1415	45.0	19.0	.765	59.9	
03/26/84	1515	45.0	19.0	.765	59.9	
03/26/84	1615	45.0	23.0	.632	53.3	
03/26/84	1700	45.0	21.0	.692	57.5	
03/27/84	1000	45.0	22.0	.641	56.4	
03/27/84	1100	45.0	17.0	.855	62.6	
03/27/84	1200	45.0	16.0	.909	64.8	
03/27/84	1300	45.0	16.0	.909	64.8	
03/27/84	1400	45.0	17.0	.855	62.6	
03/27/84	1500	45.0	18.0	.808	61.2	
03/27/84	1600	45.0	16.0	.909	64.8	
03/27/84	1700	45.0	19.0	.765	59.9	
03/28/84	815	45.0	16.0	.909	64.8	
03/28/84	915	45.0	15.0	.964	65.3	
03/28/84	1015	45.0	20.0	.727	58.7	
03/28/84	1115	45.0	15.0	.969	65.5	
03/28/84	1215	45.0	17.0	.855	62.6	
03/28/84	1315	45.0	17.0	.855	62.6	
03/28/84	1415	45.0	20.0	.727	58.7	
03/28/84	1515	45.0	16.0	.909	64.8	
03/28/84	1615	45.0	18.0	.808	61.2	
03/28/84	1715	45.0	17.0	.855	62.6	
03/30/84	1000	45.0	24.0	.604	54.2	
03/30/84	1100	45.0	26.0	.559	52.2	
03/30/84	1200	48.0	20.0	.723	58.6	
03/30/84	1300	45.0	16.0	.884	64.4	BOTTOM SAMPLE
03/30/84	1300	48.0	27.0	.535	51.1	
03/30/84	1400	48.0	24.0	.602	54.1	
03/30/84	1500	48.0	23.0	.652	56.2	BOTTOM SAMPLE
03/30/84	1500	48.0	25.0	.644	54.5	"
03/30/84	1700	48.0	28.0	.515	50.2	1/8" CONDENSER
03/30/84	1700	48.0	30.0	.500	49.4	1/8" "
03/30/84	1700	48.0	26.0	.589	52.9	BOTTOM SAMPLE
03/31/84	1800	49.0	29.0	.497	49.3	3" ABOVE BOTTOM
03/31/84	1830	49.0	30.0	.481	48.5	
03/31/84	1845	52.0	31.0	.463	47.5	
04/01/84	900	40.0	32.0	.459	47.3	
04/01/84	900	45.0	33.0	.441	46.3	5" ABOVE BOTTOM
04/01/84	1000	62.0	29.0	.485	48.7	6" ABOVE BOTTOM
04/01/84	1030	56.0	30.0	.465	47.6	
04/01/84	1030	56.0	27.0	.510	49.9	
04/01/84	1100	56.0	27.1	.525	50.7	
04/01/84	1100	56.0	26.3	.541	51.4	
04/01/84	1100	60.0	27.0	.511	50.0	6" ABOVE BOTTOM
04/01/84	1100	60.0	29.0	.474	48.1	6" ABOVE BOTTOM
04/01/84	1200	60.0	31.0	.455	47.1	6" ABOVE BOTTOM
04/01/84	1300	64.0	29.0	.443	46.1	
04/01/84	1300	60.0	30.0	.453	47.0	9" ABOVE BOTTOM
04/01/84	1300	60.0	29.0	.487	48.8	
04/01/84	1400	74.0	30.0	.450	47.3	9" ABOVE BOTTOM
04/01/84	1400	64.0	28.0	.498	49.4	
04/01/84	1500	60.0	29.0	.487	48.8	9" ABOVE BOTTOM
04/01/84	1500	60.0	29.0	.489	48.9	
04/01/84	1600	70.0	29.0	.478	48.3	
04/01/84	1600	65.0	29.0	.482	48.5	1" ABOVE BOTTOM
04/01/84	1630	72.0	42.0	.329	39.1	FLUSH WITH BOTTOM
04/01/84	1700	58.0	92.0	.154	23.2	BELOW PIPE BOTTOM
04/01/84	1700	60.0	30.0	.471	47.9	
04/02/84	900	93.0	91.0	.146	22.2	BELOW PIPE BOTTOM
04/02/84	900	60.0	34.0	.409	44.4	
04/02/84	930	80.0	34.0	.400	43.9	3" ABOVE BOTTOM
04/02/84	1000	60.0	32.0	.435	45.9	
04/02/84	1100	80.0	32.0	.425	45.4	
04/02/84	1100	87.0	32.0	.419	45.1	6" ABOVE BOTTOM
04/02/84	1200	60.0	34.0	.409	44.4	
04/02/84	1200	67.0	32.0	.435	46.0	6" ABOVE BOTTOM
04/02/84	1300	70.0	34.0	.401	44.0	6" ABOVE BOTTOM
04/02/84	1300	60.0	34.0	.409	44.4	
04/02/84	1400	60.0	36.0	.386	43.0	
04/02/84	1400	70.0	34.0	.407	44.3	11 1/2" ABOVE BOTTOM
04/02/84	1500	74.0	33.0	.417	44.9	
04/02/84	1500	74.0	32.0	.430	45.7	11 1/2" ABOVE BOTTOM
04/02/84	1600	60.0	32.0	.435	45.9	
04/02/84	1600	70.0	32.0	.433	45.8	11 1/2" ABOVE BOTTOM
04/02/84	1700	67.0	35.0	.398	43.0	
04/02/84	1700	72.0	77.0	.179	26.0	

PRUETT INDUSTRIES INC
8915 ROSEDALE HWY, BAKERSFIELD, CA. 93308
(805) 589-2768

SUB-SURFACE PRESSURE SURVEY

CO. MOTHER EARTH		RUN 3B FIELD SULPHURDALE	WELL 1-LINDA
EFF DEPTH 1165'		WELL STAT	STATIC-NO BL
CASING 13 5/8 @	-799'	CASING PRESS	ON BOTTOM 2:28PM3/22
LINER	-	TUBING PRESS	OFF BOTTOM 2:40PM3/22
DATE	032284	ELEMENT RANGE	0 - 975
ELEVATION		ZONE	SHUT-IN
MAX TEMP		PICK-UP	ON-PROD
PERF	800' -1165'	CAL SER NO.	18852
TUBING	-		MPP
UNITS	ENGLISH	PURPOSE	PRESSURE GRADIENT 3/22/84

SURVEY DATA

CO. MOTHER EARTH				RUN 3B FIELD SULPHURDALE		WELL 1-LINDA	
TIME	DEPTH	P/T	GRAD	TIME	DEPTH	P/T	GRAD
3:22	0	86.9	0.000	2:58	900	89.8	.010
3:18	200	87.4	.002	2:55	950	90.3	.010
3:14	400	87.9	.002	2:52	1000	90.8	.010
3:10	600	88.3	.002	2:49	1050	91.3	.010
3:06	800	88.8	.002	2:45	1100	91.8	.010
3:02	850	89.3	.010	2:40	1158	92.3	.008

NOTE: 1/4" BLEED SHUT-IN JUST PRIOR TO RUNNING SURVEY
B/S WILSON/J. MORGANTINI

AMERICAN PETROLEUM INSTITUTE
API SPECIFICATION
NO. 500-7744

10.100 X 10.100
10.100 INCHES

PRUETT INDUSTRIES INC
8915 ROSEDALE HWY, BAKERSFIELD, CA. 93308
(805) 589-2768

SUB-SURFACE TEMPERATURE SURVEY

CO. MOTHER EARTH		RUN 3A FIELD SULPHURDALE	WELL 1-LINDA
EFF DEPTH 1165'		WELL STAT STATIC-NO BL	TOOL HUNG
CASING 13 5/8 @ -799'		CASING PRESS	ON BOTTOM 2:28PM3/22
LINER -		TUBING PRESS	OFF BOTTOM 2:40PM3/22
DATE 032284		ELEMENT RANGE 89 - 420	ZERO POINT 20'
ELEVATION		ZONE	SHUT-IN
MAX TEMP		PICK-UP	ON-PROD
PERF 800' -1165'		CAL SER NO. 10419	MPP
TUBING			
UNITS ENGLISH		PURPOSE	TEMPERATURE TRAVERSE 3/22/84

SURVEY DATA

CO. MOTHER EARTH				RUN 3A FIELD SULPHURDALE				WELL 1-LINDA			
TIME	DEPTH	P/T	GRAD	TIME	DEPTH	P/T	GRAD	TIME	DEPTH	P/T	GRAD
1:30	0	89.8	0.000	2:00	600	280.7	0.000				
1:31	20	90.2	0.000	2:01	620	281.3	0.000				
1:32	40	90.6	0.000	2:02	640	282.0	0.000				
1:33	60	153.7	0.000	2:03	660	282.6	0.000				
1:34	80	208.0	0.000	2:04	680	283.3	0.000				
1:35	100	233.1	0.000	2:05	700	283.9	0.000				
1:36	120	247.1	0.000	2:06	720	284.7	0.000				
1:37	140	255.8	0.000	2:07	740	285.5	0.000				
1:38	160	260.6	0.000	2:08	760	286.3	0.000				
1:39	180	264.0	0.000	2:09	780	287.3	0.000				
1:40	200	266.3	0.000	2:10	800	288.3	0.000				
1:41	220	267.7	0.000	2:11	820	288.8	0.000				
1:42	240	269.4	0.000	2:12	840	289.2	0.000				
1:43	260	271.0	0.000	2:13	860	289.7	0.000				
1:44	280	272.3	0.000	2:14	880	290.2	0.000				
1:45	300	273.2	0.000	2:15	900	290.7	0.000				
1:46	320	273.7	0.000	2:16	920	290.9	0.000				
1:47	340	274.4	0.000	2:17	940	291.0	0.000				
1:48	360	274.9	0.000	2:18	960	291.2	0.000				
1:49	380	275.5	0.000	2:19	980	291.3	0.000				
1:50	400	276.2	0.000	2:20	1000	291.5	0.000				
1:51	420	276.6	0.000	2:21	1020	291.8	0.000				
1:52	440	277.1	0.000	2:22	1040	292.5	0.000				
1:53	460	277.6	0.000	2:23	1060	293.1	0.000				
1:54	480	278.1	0.000	2:24	1080	294.1	0.000				
1:55	500	278.6	0.000	2:25	1100	294.5	0.000				
1:56	520	278.9	0.000	2:26	1120	295.0	0.000				
1:57	540	279.2	0.000	2:27	1140	295.5	0.000				
1:58	560	279.7	0.000	2:40	1158	298.9	0.000				
1:59	580	280.2	0.000								

NOTE: 1/4" BLEED SHUT-IN JUST PRIOR TO RUNNING SURVEY
BY S. WILSON/J. MORGANTINI

SHAW-WALKER, INC.

1010 N. W. 10th St.
Tulsa, Oklahoma 74103

PRUETT INDUSTRIES INC
8915 ROSEDALE HWY, BAKERSFIELD, CA. 93308
(805) 589-2768

SUB-SURFACE TEMPERATURE SURVEY

CO. MOTHER EARTH		RUN 04 FIELD SULPHURDALE	WELL #1-LINDA
EFF DEPTH 1165		WELL STAT FLOWING	TOOL HUNG
CASING 13 5/8"	-799'	CASING PRESS	ON BOTTOM 4:56
LINER	-	TUBING PRESS	OFF BOTTOM 5:03
DATE 040284		ELEMENT RANGE 72 - 540	ZERO POINT 20'
ELEVATION		ZONE	SHUT-IN
MAX TEMP		PICK-UP	ON-PROD
PERF 799 -1165'		CAL SER NO. 113	MPP
TUBING			
UNITS ENGLISH		PURPOSE FLOWING	TEMPERATURE GRADIENT

SURVEY DATA

CO. MOTHER EARTH				RUN 04 FIELD SULPHURDALE				WELL #1-LINDA			
TIME	DEPTH	P/T	GRAD	TIME	DEPTH	P/T	GRAD	TIME	DEPTH	P/T	GRAD
3:30	40	285.4	0.000	4:20	1025	294.4	0.000				
3:37	750	290.3	.007	4:25	1050	295.0	.026				
3:43	800	290.5	.004	4:30	1075	295.2	.008				
3:48	850	291.6	.021	4:35	1100	295.2	0.000				
3:53	900	293.1	.030	4:41	1125	295.4	.008				
3:59	925	293.7	.026	4:46	1140	295.9	.029				
4:05	950	293.7	0.000	4:50	1145	295.9	0.000				
4:10	975	293.9	.008	4:56	1150	296.1	.042				
4:15	1000	294.4	.017	5:03	1155	296.5	.086				

SPINNER SURVEY RUN WITH TEMPERATURE TOOL SHOWED SLIGHT SLOWING OF TOOL SPIN @ 925' WHICH WE FEEL IS CHANGE IN WELL BORE SIZE. WELL SHOWS NO LOSS OF FLUID.

WILSON / MORGANTINI

PRESSURE BUILDUP ANALYSIS
WELL 34-7B 4/2/84

	Delta t (Hrs)	Th+ $\Delta t / \Delta t$ (Hrs)	Ps (psia)	Ps(sq) (psia)	$\Delta Ps(sq)$ (psia)
1	0.00000	0.00000	76.76150	5.89233	0.00000
2	0.00222	11251.00000	76.76150	5.89233	0.00033
3	0.00444	5626.00000	76.75770	5.89174	-0.00026
4	0.00667	3751.00000	76.78050	5.89525	0.00325
5	0.00889	2813.50000	76.82620	5.90227	0.01027
6	0.01333	1876.00000	77.00500	5.92977	0.03777
7	0.01667	1501.00000	77.15350	5.95266	0.06066
8	0.02222	1126.00000	77.57120	6.01729	0.12529
9	0.02778	901.00000	77.97540	6.08016	0.18816
10	0.03333	751.00000	78.40900	6.14797	0.25597
11	0.03889	643.85714	78.76650	6.20416	0.31216
12	0.04444	563.50000	79.13540	6.26241	0.37041
13	0.05000	501.00000	79.42070	6.30765	0.41565
14	0.05556	451.00000	79.69820	6.35180	0.45980
15	0.06111	410.09091	79.95300	6.39248	0.50048
16	0.06667	376.00000	80.18110	6.42901	0.53701
17	0.07222	347.15385	80.38640	6.46197	0.56997
18	0.07778	322.42857	80.56890	6.49135	0.59935
19	0.08333	301.00000	80.72470	6.51648	0.62448
20	0.08889	282.25000	80.86150	6.53858	0.64658
21	0.09444	265.70588	80.99080	6.55951	0.66751
22	0.10000	251.00000	81.10480	6.57799	0.68599
23	0.10556	237.84211	81.20360	6.59402	0.70202
24	0.11667	215.28571	81.35940	6.61935	0.72735
25	0.13333	188.50000	81.56090	6.65218	0.76018
26	0.15000	167.66667	81.67860	6.67139	0.77939
27	0.16667	151.00000	81.80020	6.69127	0.79927
28	0.20000	126.00000	81.91420	6.70994	0.81794
29	0.23250	108.52688	81.99780	6.72364	0.83164
30	0.24917	101.33445	82.01680	6.72676	0.83476
31	0.33250	76.18797	82.08900	6.73860	0.84660
32	0.60333	42.43646	82.21060	6.75858	0.86658
33	0.85333	30.29687	82.25990	6.76669	0.87469
34	1.10333	23.65861	82.31700	6.77609	0.88409
35	1.35333	19.47291	82.36630	6.78421	0.89221
36	1.60333	16.59252	82.41580	6.79236	0.90036
37	3.35333	8.45527	82.70060	6.83939	0.94739
38	5.10333	5.89876	82.88680	6.87022	0.97822
39	6.60333	4.78597	83.14120	6.91246	1.02046
40	8.35333	3.99282	83.28930	6.93711	1.04511
41	10.10333	3.47443	83.34250	6.94597	1.05397
42	11.10333	3.25158	83.45640	6.96497	1.07297
43	11.85333	3.10911	83.70330	7.00624	1.11424
44	12.10333	3.06555	83.64630	6.99670	1.10470
45	12.35333	3.02375	83.62350	6.99289	1.10089
46	33.12000	1.75483	88.60000	7.84996	1.95796
47	43.20000	1.57870	89.60000	8.02816	2.13616

10³

1 10 100 1000 10,000

55

PRESSURE BUILDUP ANALYSES

WELL 34-7B DATE 4/2/84Kh from Horner Buildup:

$$Kh = \frac{CW}{M}$$

$$C = 1389.9 \times p \times v \times u$$

$$= 1389.9 \times 93 \times 6.47 \times .017$$

$$= 14217$$

$$W = 92,000 \text{ lbs/hr}$$

$$M = 3 \times 10^3 \text{ psi} \cdot \text{in}$$

$$Kh = \underline{436,000} \text{ md-ft}$$

Kh from Type Curve:

$$Kh = 716.86 \times T \times Z \times U \times W \times \frac{\Delta P_D}{\Delta PW^2}$$

$$\text{Match point: } \Delta P_D = 1, \Delta PW^2 = \underline{\hspace{2cm}}$$

$$T =$$

$$Z =$$

$$U =$$

$$W =$$

$$Kh = \underline{\hspace{2cm}} \text{ md-ft}$$

REMARKS:

$$S = 1.151 \left[\frac{P_i^2 - P_e^2}{m} - \frac{\log(Kh)}{\phi c h \mu r_w^2} + 3.23 \right]$$

$$= -12.35$$

TYPE CURVE MATCH
34-73 (LADY LINDA)

Figure C.19. Dimensionless Pressure for Vertically Fractured Well in the Center of a Closed Square, No Wellbore Storage, Uniform Flux Fracture. After Gringarten, Alain C., Ramey, Henry J., Jr., and Raghavan, R.: "Pressure Analysis for Fractured Wells," paper SPE 4051, presented at SPE-AIME 47th Annual Fall Meeting, San Antonio, Oct. 8-11, 1972, and Gringarten, Alain C., Ramey, Henry J., Jr., and Raghavan, R.: "Unsteady-State

TYPE CURVE MATCH

34-7C (LADY LINDA)

Fig. 6.3 Matthews-Brons-Hazebrook dimensionless pressure for different well locations in a square drainage area.
After Matthews, Brons, and Hazebrook.⁴

APPENDIX - C

5/24 → 6/14/84

APPENDIX C

1984

FIGURE 3
FLOW TEST SUMMARY - SULPHURDALE GEOTHERMAL FIELD
5/24/84 - 6/14/84

<u>WELL</u>	<u>ORIFICE</u>	<u>FLOW PERIOD</u>	<u>FWHP (PSIG)</u>	<u>TEMPERATURE (°F)</u>	<u>TOTAL FLOW (LBS/HR)</u>	<u>% GAS</u>	<u>STEAM FLOW (LBS/HR)</u>
34-7A	4"	3 hrs.	55	293	36,000	16	30,200
34-7B	4"	3.5 hrs.	51	288	34,000	20	27,200
34-7A	6"	2 hrs.	48	287	77,000	16	64,700
34-7B	6"	13. days	44	281	71,000	19	57,500
34-7A	8"	16 hrs.	39	276	116,000	14	99,800
34-7B	8"	2.0 hrs.	31	266	99,000	15	84,200
34-7A	10" ¹	8 days	26	255	132,000	6	109,000
34-7B	10"	4 days	20	244	106,000	13	92,200

NOTE: ¹ Flow on 10" estimated from deliverability curve

FIGURE 4

FWHP (psig)

REVISED	DATE	TSI ThermaSource Inc. 100 E Street • P.O. Box 1236 • Santa Rosa, California 95402 (707) 523-2960 • Telex 171743 • TWX 510 7446439	DRAWN
			FOR:
			BY:
			DATE:
			SCALE:
		WELL DELIVERABILITY CURVE SULPHURDALE FIELD	DRAWING No.

FIGURE 5

REVISED	DATE	ThermaSource Inc. 100 E Street • P.O. Box 1236 • Santa Rosa, California 95402 (707) 523-2960 • Telex 171743 • TWX 510 7446439	DRAWN
			FOR:
			BY:
			DATE:
			SCALE:
			DRAWING No.

FLOWING TEMPERATURE VS
PRESSURE - SULPHURDALE

FIGURE 6

FWHP (psig)

70

60

50

40

30

20

10

0

REVISED	DATE

TSI

ThermaSource Inc.

100 E Street • P.O. Box 1236 • Santa Rosa, California 95402

(707) 523-2960 • Telex 171743 • TWX 510 7446439

NON CONDENSIBLE GAS vs FWHP
SULPHURDALE FIELD

DRAWN	
FOR:	
BY:	
DATE:	
SCALE:	
DRAWING No.	

FIGURE 7
ESTIMATED WELL PERFORMANCE
SULPHURDALE GEOTHERMAL FIELD

	<u>End of Period</u>					
<u>34-7A</u>	<u>Initial</u>	<u>1 yr.</u>	<u>3 yr.</u>	<u>5 yr.</u>	<u>10 yr.</u>	<u>20 yr.</u>
Mass Flow (Klbs/hr)	123	114	96	83	63	42
Non-Condensable Gas (%)	6	5	4.4	4.2	3.8	3.4

Assumes FWHP = 26 psig, FWHT = 255°F

<u>34-7B</u>						
Mass Flow	106	96	82	71	53	35
% Gas	13	11	10	9	8.5	7.5

Assumes FWHP = 20 psig, FWHT = 244°F

PRESSURE BUILDUP ANALYSIS
WELL 34-7A 6/14/84

	Delta t (Hrs)	Th+ t/ (Hrs)	Ps (psia)	Ps(sq) (psia)	Ps(sq) (psia)
1	0.00000	0.00	49.1600	2.4167	0.0000
2	0.00278	181441.00	51.1600	2.6173	0.2006
3	0.00556	90721.00	54.2600	2.9441	0.5274
4	0.00833	60481.00	61.0600	3.7283	1.3116
5	0.01111	45361.00	64.9600	4.2198	1.8031
6	0.01389	36289.00	66.3600	4.4036	1.9869
7	0.01667	30241.00	66.7600	4.4569	2.0402
8	0.01944	25921.00	66.8600	4.4703	2.0535
9	0.02222	22681.00	66.9600	4.4836	2.0669
10	0.02500	20161.00	67.0600	4.4970	2.0803
11	0.02778	18145.00	67.0600	4.4970	2.0803
12	0.03056	16495.55	67.1600	4.5105	2.0938
13	0.03333	15121.00	67.2600	4.5239	2.1072
14	0.03889	12961.00	67.2600	4.5239	2.1072
15	0.04444	11341.00	67.3600	4.5374	2.1207
16	0.05000	10081.00	67.4600	4.5509	2.1341
17	0.05556	9073.00	67.5600	4.5644	2.1476
18	0.06111	8248.27	67.5600	4.5644	2.1476
19	0.06667	7561.00	67.6600	4.5779	2.1612
20	0.07222	6979.46	67.6600	4.5779	2.1612
21	0.07778	6481.00	67.7600	4.5914	2.1747
22	0.08333	6049.00	67.8600	4.6050	2.1883
23	0.09167	5499.18	67.8600	4.6050	2.1883
24	0.10000	5041.00	67.9600	4.6186	2.2019
25	0.10833	4653.31	67.9600	4.6186	2.2019
26	0.11667	4321.00	67.9600	4.6186	2.2019
27	0.12500	4033.00	68.0600	4.6322	2.2155
28	0.13333	3781.00	68.0600	4.6322	2.2155
29	0.14167	3558.65	68.0600	4.6322	2.2155
30	0.15000	3361.00	68.1600	4.6458	2.2291
31	0.15833	3184.16	68.1600	4.6458	2.2291
32	0.16667	3025.00	68.1600	4.6458	2.2291
33	0.18333	2750.09	68.1600	4.6458	2.2291
34	0.20000	2521.00	68.2600	4.6594	2.2427
35	0.21667	2327.15	68.3600	4.6731	2.2564
36	0.23333	2161.00	68.3600	4.6731	2.2564
37	0.25000	2017.00	68.4600	4.6868	2.2701
38	0.33333	1513.00	68.5600	4.7005	2.2838
39	0.41667	1210.60	68.7600	4.7279	2.3112
40	0.50000	1009.00	68.8600	4.7417	2.3250
41	0.58333	865.00	68.8600	4.7417	2.3250
42	0.66667	757.00	68.9600	4.7555	2.3388
43	0.75000	673.00	68.9600	4.7555	2.3388
44	0.83333	605.80	68.9600	4.7555	2.3388
45	0.91667	550.82	69.0600	4.7693	2.3526
46	1.00000	505.00	69.0600	4.7693	2.3526
47	1.41667	356.76	69.0600	4.7693	2.3526
48	1.83333	275.91	69.1600	4.7831	2.3664
49	2.25000	225.00	69.1600	4.7831	2.3664
50	2.66667	190.00	69.2600	4.7969	2.3802

10^3 (psia)

Hoekel Summary
34-7A 6/14/84

$2x = 70.974W$

$ME = 0.1708 / W$

$W = 116,000 \text{ lbs/hr}$

$KH = 1389.9 \times 70 \times 6 \times 0.017 \times 10 = 11500 \text{ md-ft}$

From Summary SE Data

ANATEC
LABORATORIES
INC.

RECEIVED
JUL 24 1984
Thermasource, Inc.

69.

435 Tesconi Circle • Santa Rosa, California 95401 • 707-526-7200

Mr. Jerry Niimi
Thermasource, Inc.
P.O. Box 1236
Santa Rosa, CA 95402

July 20, 1984
ANATEC Log No. 5540 (-1)
Series No: 145/006 Part 1

Subject: Transmittal of Results for testing performed on one condensate sample received June 18, 1984 and identified as 10" Orifice; 6/12 1200 34-7A.

TRANSMITTAL OF RESULTS

Descriptor, Lab No. and Results (mg/L)

Parameter	10" Orifice 6/12 1200 34-7A 5540-17
General Physical	
pH (Units)	4.2
Specific Gravity ^b	1.001
Total Filterable Residue	10
Specific Conductance (umhos/cm)	60
General Chemical	
Alkalinity (as CaCO ₃)	
Total	4
Bicarbonate	4
Carbonate	—
Ammonia, as N	7
Boron	0.07
Chloride	2
Silica	<0.2
Sulfate	4
Metals by Atomic Absorption	
Arsenic	<0.01
Calcium	0.10
Magnesium	<0.05
Potassium	0.11
Sodium	0.03

/bt

Greg Anderson, Director
Analytical Laboratories

ANATEC
LABORATORIES
INC.

70.

435 Tesconi Circle

Santa Rosa, California 95401

707-526-7200

Mr. Jerry Niimi
Therma Source, Inc.
P.O. Box 1236
Santa Rosa, CA 95402

July 24, 1984
ANATEC Log No: 5540 (1-17)
Series No: 145/006 Part 2
Client P.O.: 4879

Subject: Total Gas Analysis

Dear Mr. Niimi:

Tabulated on the following pages are data for three gas bombs and one diluted gas bomb. (Note: Ten gas bombs and two condensates on hold.)

The ammonia level reported for Sample 5540-11 ("6/10 1045 34-7-B 69.4g/L 10 in. orifice") may be erroneously low because the diluted gas bomb contents were transported to and received by the laboratory in a plastic container which had not been refrigerated.

Please feel welcome to contact us should you have questions.

Submitted by:

Approved by:

Nina Jan Huston
Supervisor, Gas Analysis

Greg Anderson, Director
Analytical Laboratories

/bt

Diluted Gas Bomb Analysis

<u>Descriptor</u>	<u>Carbon Dioxide (ppm by wt)</u>	<u>Hydrogen Sulfide (ppm by wt)</u>	<u>Ammonia (ppm by wt)</u>
6/10 1045 34-7-B 69.4 G/L 10" ORIFICE	150,000	1500	2.7

Descriptor: 6/10 1100 34-7-B 10 in. ORIFICE
 Lab No.: 5540-1

Gas weight percent (g noncondensable gas/100g sample): 14.4
 Percent Air: 1.60
 Total weight of condensate (grams): 73.0
 Initial headspace pressure (psi): 7.79

Gas	Mole % (w/o H ₂ O)	ppm (total mass)
Carbon dioxide	9.79E+01	1.42E+05
Total Sulfur (as H ₂ S)	1.27E+00	1.42E+03
Ammonia	7.55E-03	4.25E+00
Argon	3.67E-03	4.84E+00
Nitrogen	6.94E-01	6.42E+02
Methane	5.35E-02	2.83E+01
Hydrogen	< 2.77E-02	< 1.85E+00

Descriptor: 6/11 1400 34-7-A 10 in. ORIFICE
 Lab No.: 5540-4

Gas weight percent (g noncondensable gas/100g sample): 12.9
 Percent Air: < 0.01
 Total weight of condensate (grams): 172.3
 Initial headspace pressure (psi): 2.22

Gas	Mole % (w/o H ₂ O)	ppm (total mass)
Carbon dioxide	9.88E+01	1.28E+05
Total Sulfur (as H ₂ S)	9.69E-01	9.74E+02
Ammonia	9.28E-03	4.66E+00
Argon	2.94E-03	3.46E+00
Nitrogen	1.68E-01	1.39E+02
Methane	1.76E-02	8.31E+00
Hydrogen	< 8.33E-03	< 4.96E-01

ANATEC Laboratories, Inc.

145/006 LOG 5540

- 3 -

JULY 24 1984

Descriptor: 6/12 1145 34-7-A 10 in. ORIFICE
 Lab No.: 5540-6

Gas weight percent (g noncondensable gas/100g sample): 12.8
 Percent Air: <0.01
 Total weight of condensate (grams): 135.0
 Initial headspace pressure (psi): 1.62

Gas	Mole % (w/o H ₂ O)	ppm (total mass)
Carbon dioxide	9.87E+01	1.27E+05
Total Sulfur (as H ₂ S)	1.07E+00	1.07E+03
Ammonia	8.92E-03	4.44E+00
Argon	3.26E-03	3.81E+00
Nitrogen	1.89E-01	1.55E+02
Methane	2.01E-02	9.40E+00
Hydrogen	< 1.26E-02	< 7.46E-01

QUALITY CONTROL DATA

Analyte	Relative Standard Deviation	Matrix of Determination
Carbon Dioxide	5.1	Condensate/NaOH solution
Total Sulfur (as H ₂ S)	1.4	Condensate/NaOH solution
Ammonia	4.6	Condensate/NaOH solution
Argon	1.8	Residual Gas Phase
Oxygen	7.1	Residual Gas Phase
Nitrogen	1.0	Residual Gas Phase
Methane	1.0	Residual Gas Phase
Hydrogen	1.0	Residual Gas Phase

Air Correction Procedure¹

- (1) Total moles of oxygen determined in sample are multiplied by 1.00 and subtracted from total moles of oxygen.
- (2) Total moles of oxygen determined in sample are multiplied by 3.73 and subtracted from total moles of nitrogen.
- (3) Total moles of oxygen determined in sample are multiplied by 0.0446 and subtracted from total moles of argon.

¹Ref: Components of Atmospheric Air in C.R.C. Handbook of Chemistry and Physics, 58th ed.

APPENDIX - D

APPENDIX D

REPLACEMENT WELL SCHEDULE
5 MW POWER PLANT

Plant Inlet Steam
(000 lbs/hr)

**5 MW WELLHEAD GENERATOR PROJECT ECONOMICS
SULPHURDALE GEOTHERMAL FIELD**

Year	Investment Tangible (000\$)	Intangible (000\$)	# Wells	Power Output (MW)	Electric Price (Mills/kwh)	Gross Revenue (000\$)	Net Revenue (000\$)	Prod & Operating Ad val Tax Expenses (000\$)	Pre-tax Cash Flow (000\$)	Cumulative Cash Flow (000\$)
0	4458.0	800.0	2	0.0					-5258.0	-5258.0
1				5.0	55.8	2847.7	1791.7	53.8	488.8	1337.9
2				5.0	57.2	2129.6	1863.4	55.9	416.8	1391.5
3	112.5	458.0	1	5.0	58.9	2193.4	1919.3	57.6	428.5	878.7
4				5.0	60.7	2259.2	1976.8	59.3	441.3	1476.2
5				5.0	62.5	2327.8	2036.1	61.1	454.6	1528.5
6				5.0	64.4	2396.8	2097.2	62.9	468.2	1566.1
7				5.0	66.3	2468.7	2160.1	64.8	482.3	1613.1
8				5.0	68.3	2542.8	2225.8	66.7	496.7	1661.5
9				5.0	70.3	2619.1	2291.7	68.8	511.6	1711.3
10				5.0	72.5	2697.7	2368.5	70.8	527.8	1762.7
11				5.0	74.6	2778.6	2431.3	72.9	542.8	1815.5
12				5.0	76.9	2861.9	2504.2	75.1	559.1	1878.8
13	333.8	1332.8	2	5.0	79.2	2947.8	2579.3	77.4	575.8	261.1
14				5.0	81.6	3036.2	2656.7	79.7	593.1	1983.9
15				5.0	84.0	3127.3	2736.4	82.1	610.9	2043.4
16	187.3	749.2	1	5.0	86.5	3221.1	2818.5	84.6	629.2	1168.2
17				5.0	89.1	3317.8	2903.1	87.1	648.1	2167.9
18				5.0	91.8	3417.3	2990.1	89.7	667.6	2232.9
19				5.0	94.5	3519.8	3079.9	92.4	687.6	2299.9
20				5.0	97.4	3625.4	3172.2	95.2	708.2	2368.9

Notes:

1. Operating factor: 85%
2. Royalty: 12.5%
3. Production and ad valorem tax: 3% of net revenue
4. Escalation: 4%
5. Price includes wheeling charge

PV of Cash Flow(000\$)

0.0 %	27873.1
5.0 %	13816.2
10.0 %	7843.1
12.5 %	5888.7
15.0 %	3498.1
20.0 %	1483.1
25.0 %	277.2
30.0 %	-484.8
35.0 %	-982.8

Int ROR(%) 26.8

**7.5 MW WELLHEAD GENERATOR PROJECT ECONOMICS
BULPHURDALE GEOTHERMAL FIELD**

Year	Investment		# Wells	Power Output (MW)	Electric Price (Mills/kwh)	Gross Revenue (000\$)	Net Revenue (000\$)	Prod & Operating		Pre-tax Cash Flow (000\$)	Cumulative Cash Flow (000\$)
	Tangible	Intangible						Ad val	Tax Expenses		
	(000\$)	(000\$)						(000\$)	(000\$)		
0	5950.0	000.0	2	0.0						-6750.0	-6750.0
1				7.5	55.0	3871.5	2687.5	88.6	600.0	2086.9	-4743.1
2				7.5	57.2	3194.3	2795.0	83.9	624.0	2087.2	-2655.9
3	112.5	450.0	1	7.5	58.9	3290.2	2878.9	86.4	642.7	1987.3	-1068.6
4				7.5	60.7	3388.9	2965.3	89.0	662.0	2214.3	1145.7
5				7.5	62.5	3490.5	3054.2	91.4	681.9	2280.7	3426.4
6				7.5	64.4	3595.3	3145.0	94.4	702.3	2349.2	5775.6
7				7.5	66.3	3703.1	3240.2	97.2	723.4	2419.6	8195.2
8				7.5	68.3	3814.2	3337.4	100.1	745.1	2492.2	10687.4
9				7.5	70.3	3928.6	3437.5	103.1	767.4	2567.0	13254.4
10				7.5	72.5	4046.5	3540.7	106.2	790.5	2644.0	15898.4
11				7.5	74.6	4167.9	3646.9	109.4	814.2	2723.3	18621.7
12				7.5	76.9	4292.9	3756.3	112.7	838.6	2805.0	21426.7
13	333.0	1332.0	2	7.5	79.2	4421.7	3869.0	116.1	863.0	1224.2	22650.9
14				7.5	81.6	4554.4	3985.1	119.6	889.7	2975.0	25626.7
15				7.5	84.0	4691.0	4104.6	123.1	916.4	3063.1	28691.8
16	187.3	749.2	1	7.5	86.5	4831.7	4227.8	126.8	943.9	2220.6	30912.4
17				7.5	89.1	4976.7	4354.6	130.6	972.2	3251.0	34164.2
18				7.5	91.8	5126.0	4485.2	134.6	1001.3	3349.3	37513.5
19				7.5	94.5	5279.7	4619.0	138.6	1031.4	3449.0	40963.3
20				7.5	97.4	5438.1	4750.4	142.8	1062.3	3553.3	44516.6

Notes:

1. Operating factor: 85%
2. Royalty: 12.5%
3. Production and ad valorem tax: 3% of net revenue
4. Escalation: 4%
5. Price includes wheeling charge

PV of Cash Flow(000\$)

0.0 %	44516.6
5.0 %	22652.0
10.0 %	12091.3
12.5 %	8899.9
15.0 %	6535.4
20.0 %	3383.7
25.0 %	1478.1
30.0 %	264.5
35.0 %	-540.9

Int ROR(%) 31.6

**10 MW WELLHEAD GENERATOR PROJECT ECONOMICS
SULPHURDALE GEOTHERMAL FIELD**

Year	Investment		# Wells	Power Output (MW)	Electric Price (Mills/kwh)	Gross Revenue (0000)	Net Revenue (0000)	Prod & Operating		Pre-tax Cash Flow (0000)	Cumulative Cash Flow (0000)
	Tangible (0000)	Intangible (0000)						Ad val	Tax Expenses (0000)		
0	8900.0	1600.0	4	0.0						-10500.0	-10500.0
1				10.0	55.0	4895.3	3583.4	107.5	880.0	2675.9	-7824.1
2				10.0	57.2	4259.1	3726.7	111.0	832.0	2782.9	-5041.2
3	225.0	900.0	2	10.0	58.9	4386.9	3838.5	115.2	857.0	1741.4	-3299.8
4				10.0	60.7	4518.5	3953.7	118.6	882.7	2952.4	-347.4
5				10.0	62.5	4654.0	4072.3	122.2	909.1	3841.0	2693.6
6				10.0	64.4	4793.7	4194.5	125.0	936.4	3132.2	5825.8
7				10.0	66.3	4937.5	4320.3	129.6	964.5	3226.2	9052.0
8				10.0	68.3	5085.6	4449.9	133.5	993.5	3323.8	12374.9
9				10.0	70.3	5238.2	4583.4	137.5	1023.3	3422.6	15797.6
10				10.0	72.5	5395.3	4720.9	141.6	1054.0	3525.3	19322.9
11				10.0	74.6	5557.2	4862.5	145.9	1085.6	3631.1	22954.0
12				10.0	76.9	5723.9	5008.4	150.3	1118.1	3740.0	26694.0
13	666.0	2664.0	4	10.0	79.2	5895.4	5158.7	154.0	1151.7	522.2	27216.2
14				10.0	81.6	6072.5	5313.4	159.4	1186.2	3967.8	31184.0
15				10.0	84.0	6254.6	5472.8	164.2	1221.8	4086.8	35270.8
16	374.6	1498.4	2	10.0	86.5	6442.3	5637.0	169.1	1258.5	2336.4	37607.2
17				10.0	89.1	6635.6	5806.1	174.2	1296.2	4335.7	41942.9
18				10.0	91.8	6834.6	5980.3	179.4	1335.1	4465.8	46408.7
19				10.0	94.5	7039.7	6159.7	184.0	1375.2	4599.7	51008.4
20				10.0	97.4	7250.9	6344.5	190.3	1416.4	4737.7	55746.2

Notes:

1. Operating factor: 85%
2. Royalty: 12.5%
3. Production and ad valorem tax: 3% of net revenue
4. Escalation: 4%
5. Price includes wheeling charge

PV of Cash Flow(000\$)

0.0 %	55744.2
5.0 %	27632.5
10.0 %	14086.1
12.5 %	10001.4
15.0 %	6900.2
20.0 %	2966.1
25.0 %	554.3
30.0 %	-967.9
35.0 %	-1965.6

Int ROR(%) 26.8

**15 MW WELLHEAD GENERATOR PROJECT ECONOMICS
SULPHURDALE GEOTHERMAL FIELD**

Year	Investment		# Wells	Power Output (MW)	Electric Price (Mills/kwh)	Gross Revenue (000\$)	Net Revenue (000\$)	Prod & Operating Ad val Tax Expenses (000\$)	Pre-tax Cash Flow (000\$)	Cumulative Cash Flow (000\$)
	Tangible (000\$)	Intangible (000\$)								
0	13350.0	2400.0	4	0.0					-15750.0	-15750.0
1				15.0	55.0	6143.0	5375.1	161.3	1200.0	4013.0
2				15.0	57.2	6388.7	5598.1	167.7	1248.0	4174.4
3	337.5	1350.0	3	15.0	58.9	6500.3	5757.0	172.7	1285.4	2612.1
4				15.0	60.7	6777.7	5930.5	177.9	1324.0	4428.6
5				15.0	62.5	6981.1	6108.4	183.3	1363.7	4561.5
6				15.0	64.4	7190.5	6291.7	188.0	1404.6	4698.3
7				15.0	66.3	7406.2	6480.4	194.4	1446.8	4839.3
8				15.0	68.3	7628.4	6674.9	200.2	1490.2	4984.4
9				15.0	70.3	7857.3	6875.1	206.3	1534.9	5134.0
10				15.0	72.5	8093.0	7081.4	212.4	1580.9	5288.0
11				15.0	74.6	8335.0	7293.0	218.0	1628.4	5446.6
12				15.0	76.9	8585.0	7512.6	225.4	1677.2	5610.0
13	999.0	3996.0	6	15.0	79.2	8843.4	7738.0	232.1	1727.5	783.3
14				15.0	81.6	9108.7	7978.1	239.1	1779.3	5951.7
15				15.0	84.0	9382.0	8209.2	246.3	1832.7	6130.2
16	561.9	2247.6	3	15.0	86.5	9663.4	8455.5	253.7	1887.7	3584.6
17				15.0	89.1	9953.3	8709.2	261.3	1944.3	6503.6
18				15.0	91.8	10251.9	8970.4	269.1	2002.7	6698.7
19				15.0	94.5	10559.5	9239.6	277.2	2062.8	6899.6
20				15.0	97.4	10876.3	9516.7	285.5	2124.6	7106.6

Notes:

1. Operating factor: 85%
2. Royalty: 12.5%
3. Production and ad valorem tax: 3% of net revenue
4. Escalation: 4%
5. Price includes wheeling charge

PV of Cash Flow(000\$)

0.0 %	83619.2
5.0 %	41448.7
10.0 %	21129.2
12.5 %	15002.1
15.0 %	10470.3
20.0 %	4449.2
25.0 %	831.5
30.0 %	-1451.9
35.0 %	-2948.4

Int ROR(%) 26.0

**5 MW WELLHEAD GENERATOR PROJECT ECONOMICS
SULPHURDALE GEOTHERMAL FIELD**

Year	Investment Tangible (000s)	Intangible (000s)	# Wells	Power Output (MW)	Electric Price (Mils/kwh)	Gross Revenue (000s)	Net Revenue (000s)	Prod & Operating Ad val Tax Expenses (000s)	Operating Expenses (000s)	Pre-tax Cash Flow (000s)	Cumulative Cash Flow (000s)
0	1450.0	000.0	2	8.0						-2250.0	-2250.0
1				5.0	55.8	2047.7	1791.7	53.8	400.0	442.9	-1807.1
2				5.0	57.2	2129.6	1863.4	55.9	416.8	496.5	-1310.6
3	112.5	450.0	1	5.0	58.9	2193.4	1919.3	57.6	428.5	-24.3	-1334.9
4				5.0	60.7	2259.2	1976.8	59.3	441.3	581.2	-753.7
5				5.0	62.5	2327.8	2036.1	61.1	454.6	625.5	-128.2
6				5.0	64.4	2396.8	2097.2	62.9	468.2	1566.1	1437.9
7				5.0	66.3	2468.7	2160.1	64.8	482.3	1613.1	3051.0
8				5.0	68.3	2542.8	2225.0	66.7	496.7	1661.5	4712.5
9				5.0	70.3	2619.1	2291.7	68.8	511.6	1711.3	6423.8
10				5.0	72.3	2697.7	2360.5	70.8	527.0	1762.7	8186.4
11				5.0	74.6	2778.6	2431.3	72.9	542.8	1815.5	10002.0
12				5.0	76.9	2861.9	2504.2	75.1	559.1	1870.0	11872.0
13	333.0	1332.0	2	5.0	79.2	2947.8	2579.3	77.4	575.8	261.1	12133.1
14				5.0	81.6	3036.2	2656.7	79.7	593.1	1983.9	14117.0
15				5.0	84.0	3127.3	2736.4	82.1	610.9	2043.4	16160.4
16	187.3	749.2	1	5.0	86.5	3221.1	2818.5	84.6	629.2	1168.2	17328.6
17				5.0	89.1	3317.8	2903.1	87.1	648.1	2167.9	19496.5
18				5.0	91.8	3417.3	2990.1	89.7	667.6	2232.9	21729.3
19				5.0	94.5	3519.8	3079.9	92.4	687.6	2299.9	24029.2
20				5.0	97.4	3625.4	3172.2	95.2	708.2	2368.9	26398.1

PV of Cash Flow(000s)

0.0 %	26398.1
5.0 %	12983.0
10.0 %	6686.0
12.5 %	4834.7
15.0 %	3489.9
20.0 %	1752.6
25.0 %	751.6
30.0 %	146.9
35.0 %	-232.3

Int MOR(%) 31.9

Notes:

1. Operating factor: 85%
2. Royalty: 12.5%
3. Production and ad valorem tax: 3% of net revenue
4. Escalation: 4%
5. Price includes wheeling charge
6. Finance \$3 million(80%) of power plant @ 15%

FIGURE 1
LOCATION MAP
SULPHURDALE GEOTHERMAL FIELD

FIGURE 5
WELL TEST SCHEMATIC

(P) Pressure Transducer
(T) Thermocouple

Mass Flow:

$$W = 359 (Yt)(Sp)D^2 \sqrt{Pt/Vt} \text{ lbs/hr}$$

Where (Yt)(Sp) = orifice factor

D² = internal diameter (in)

Pt = upstream pressure

Vt = specific volume

FIGURE 6
WELL DECLINE CURVES
The Geysers Field

Q/Q_1

1.0

0.8

0.6

0.4

0.2

0

0

5

10

15

20

25

30

TIME (YEARS)

○ 34-7A

△ 34-7B

BUDD 40 AC

BUDD 20 AC

BUDD 5 AC

DYKSTRA

RESERVOIR CONDITIONS

$T = 300^{\circ} F$

REVISED	DATE	100 E Street • P.O. Box 1236 • Santa Rosa, California 95402 (707) 523-2960 • Telex 171743 • TWX 510 7446439 ThermoSource Inc.	DRAWN
			FOR:
			BY:
			DATE:
			SCALE:
			DRAWING No.

FIGURE 7
PARTIAL PRESSURE ANALYSIS
SULPHURDALE GEOTHERMAL FIELD

FIGURE 8
SULPHURDALE RESERVOIR MODEL

FIGURE 9
POTENTIALLY PRODUCTIVE AREA
SULPHURDALE GEOTHERMAL FIELD

SCALE = 1:24,000

FWHP
(psig)

100

80

60

40

20

0

0

50

100

150

200

MASS FLOW (000 lbs/hr)

WELL TEST
1/18 - 1/22/84

4"

6"

REVISED	DATE

TSI

ThermaSource Inc.

100 E Street • P.O. Box 1236 • Santa Rosa, California 95402

(707) 523-2960 • Telex 171743 • TWX 510 7446439

WELL DELIVERABILITY CURVE

34-7B

DRAWN

FOR:

BY:

DATE: 1/23/84

SCALE:

DRAWING No.

ANATEC
LABORATORIES
INC.

435 Tesconi Circle

Santa Rosa, California 95401

707-526-7200

TO: Mr. Louis Capuano
THERMASOURCE
100 E Street
Sana Rosa, CA 95404

SERIES: 145/002 4939 (1-7)
RECEIVED: 23 JAN 84; ASAP
ANALYSIS: 23 - 30 JAN 84
REPORT: 30 JAN 84 (V);
08 FEB 84 (W)

Subject: Seven samples submitted 23 January 1984.

Dear Mr. Capuano:

Results of analysis of your seven samples collected 18 through 21 January, 1984 are attached as Table 1. All analyses were performed using standard water analysis methodologies.

Radon-222 was determined on samples originally submitted for routine chemical analysis. These samples were delivered in partially-filled polyethylene bottles. Radon determinations were performed 4 February, 1984, by outgassing followed by scintillation counting. Calculation of results includes factors to correct for decay of radon subsequent to sampling. However, as time between collection and analysis increases, the reliability of data for low-level samples decreases. Also, because mathematical corrections cannot account for loss of radon, through container walls and into sample headspace, it is clear that radon data reported below should be regarded with extreme caution.

Please feel free to contact me should you have questions.

Greg Anderson, Director
Analytical Laboratories

/hs

1/18/84; #1; 4" ORIFICE; 1:45 PM MST = TEST #1
 1/19/84; #2; 11:00 AM; MST; 6" ORIFICE = TEST #2
 1/19/84; #3; 3:00 PM; MST; 6" ORIFICE = TEST #3
 1/20/84; #4; 2:00 PM; MST; 6" ORIFICE = TEST #4
 1/20/84; #5; 3:30 PM; MST; 6" ORIFICE = TEST #5
 1/21/84; #6; 10:00 AM; MST; 6" ORIFICE = TEST #6
 1/21/84; #7; 3:30 PM; MST; 6" ORIFICE = TEST #7

Table 1

Shortened Descriptor, Lab Number and Results (mg/L)^a

Parameter	Test #1 4939-1	Test #2 4939-2	Test #3 4939-3	Test #4 4939-4	Test #5 4939-5	Test #6 4939-6	Test #7 4939-7
General Physical							
pH (Units)	4.3	4.3	4.3	4.1	4.1	3.9	4.3
Specific Gravity ^b	1.0027	1.0010	1.0008	1.0019	1.0036	1.0033	1.0027
Total Filterable Residue	23	4	3	16	5	2	1
Total Nonfilterable Residue	(1	(1	1	1	(1	10	(1
General Chemical							
Alkalinity (as CaCO₃)							
Total	10	10	9	10	10	7	9
Bicarbonate	10	10	9	10	10	7	9
Carbonate	0	0	0	0	0	0	0
Boron	0.22	(0.05	0.10	0.12	0.08	0.13	0.15
Chloride	(1	(1	(1	(1	(1	(1	(1
Silica	(0.6	(0.6	(0.6	(0.6	(0.6	(0.6	(0.6
Sulfate	3	(2	(2	(2	(2	(2	(2
Metals by Atomic Absorption							
Arsenic	(0.01	(0.01	(0.01	(0.01	(0.01	(0.01	(0.01
Calcium	0.4	0.2	0.1	0.3	0.3	0.3	0.2
Magnesium	0.06	0.05	0.02	0.06	0.10	0.08	0.03
Potassium	0.13	0.21	0.14	0.18	0.54	0.49	0.20
Sodium	0.2	0.4	0.3	0.3	1.0	0.6	0.2
Radon-222 (pCi/L condensate)	(570	(420	(410	(380	(200	(400	(430

^aUnless noted otherwise.

^bDensity of sample divided by density of pure water.

ANATEC
LABORATORIES
INC.

91.

435 Tesconi Circle

Santa Rosa, California 95401

707-526-7200

TO: Luis Capuano
FOR: THERMASOURCE
SERIES: 145/002 4991 (1-8)
RECEIVED: 02 FEB 84; 03 Feb 84 - CHANGE TO ASAP PRIORITY
ANALYSIS: 06 - 09 FEB 84
REPORT: 09 FEB 84; amended 14 FEB 84

REPORT OF ANALYSIS

Gas Analysis

Descriptor: 1/19/84; 1300 HRS; MST; 6" ORIFICE; 3
Lab No.: 4991-1
Sample gas/steam ratio (ft³/lb): 7.65×10^0
Sample gas/steam ratio (moles/1000 moles steam): 384
Sample gas/steam ratio (g/10⁶ grams steam): 931000
Percent Air: 0.12

Gas	Mole % (w/o H ₂ O)	Moles per 1000 moles H ₂ O	ppm (with H ₂ O)
Water vapor	N/A	N/A	5.18×10^5
Carbon dioxide	9.81×10^{-1}	3.77×10^2	4.77×10^5
Total Sulfur (as H ₂ S)	9.64×10^{-1}	3.70×10^0	3.63×10^3
Ammonia	3.44×10^{-3}	1.32×10^{-2}	6.47×10^0
Argon	8.42×10^{-3}	3.23×10^{-2}	3.71×10^1
Nitrogen	4.51×10^{-1}	1.73×10^0	1.40×10^3
Methane	6.44×10^{-2}	2.47×10^{-1}	1.14×10^2
Hydrogen	$<3.69 \times 10^{-1}$	$<1.42 \times 10^0$	$<8.24 \times 10^1$

Total weight of condensate (grams): 5.13
Initial headspace pressure (psi): 0.660

Note: Two voided bombs returned; two bombs lost in transit.

RECEIVED

MAR 12 1984

ThermaSource, Inc. Research

Biological Studies

Laboratory Analysis

45/002 4991 (1-8)

- 2 -

09 FEB 84

Descriptor: 1-20-84; 1430 HRS; 6" ORIFICE; 6
Lab No.: 4991-2
Sample gas/steam ratio (ft³/lb): 4.44×10^1
Sample gas/steam ratio (moles/1000 moles steam): 2230
Sample gas/steam ratio (g/10⁶ grams steam): 5410000
Percent Air: 0.087

Gas	Mole % (w/o H ₂ O)	Moles per 1000 moles H ₂ O	ppm (with H ₂ O)
Water vapor	N/A	N/A	1.56×10^5
Carbon dioxide	9.82×10^1	2.19×10^3	8.35×10^5
Total Sulfur (as H ₂ S)	9.26×10^{-1}	2.07×10^1	6.09×10^3
Ammonia	6.89×10^{-3}	1.54×10^{-1}	2.27×10^1
Argon	7.86×10^{-3}	1.75×10^{-1}	6.06×10^1
Nitrogen	4.97×10^{-1}	1.11×10^1	2.69×10^3
Methane	9.70×10^{-2}	2.16×10^0	3.00×10^2
Hydrogen	$<2.75 \times 10^{-1}$	$<6.14 \times 10^0$	$<1.07 \times 10^2$

84.4

Total weight of condensate (grams): 1.17
Initial headspace pressure (psi): 0.73

Descriptor: 1-21-84; 1000 HRS; MST; 6" ORIFICE; 8
Lab No.: 4991-3
Sample gas/steam ratio (ft³/lb): 1.52×10^1
Sample gas/steam ratio (moles/1000 moles steam): 762
Sample gas/steam ratio (g/10⁶ grams steam): 1850000
Percent Air: 0.078

Gas	Mole % (w/o H ₂ O)	Moles per 1000 moles H ₂ O	ppm (with H ₂ O)
Water vapor	N/A	N/A	3.51×10^5
Carbon dioxide	9.81×10^1	7.48×10^2	6.42×10^5
Total Sulfur (as H ₂ S)	9.69×10^{-1}	7.39×10^0	4.91×10^3
Ammonia	8.82×10^{-3}	6.72×10^{-2}	2.23×10^1
Argon	8.61×10^{-3}	6.57×10^{-2}	5.11×10^1
Nitrogen	4.49×10^{-1}	3.42×10^0	1.87×10^3
Methane	6.44×10^{-2}	4.91×10^{-1}	1.54×10^2
Hydrogen	$<3.93 \times 10^{-1}$	$<3.00 \times 10^0$	$<1.18 \times 10^2$

Total weight of condensate (grams): 2.5
Initial headspace pressure (psi): 0.65

145/002 4991 (1-8)

- 3 -

09 FEB 84

Descriptor: 1-20-84; 0915 HRS; MST; 6" ORIFICE; 5
Lab No.: 4991-4
Sample gas/steam ratio (ft³/lb): 1.31×10^1
Sample gas/steam ratio (moles/1000 moles steam): 658
Sample gas/steam ratio (g/10⁶ grams steam): 1590000
Percent Air: 0.077

Gas	Mole % (w/o H ₂ O)	Moles per 1000 moles H ₂ O	ppm (with H ₂ O)
Water vapor	N/A	N/A	3.86×10^5
Carbon dioxide	9.81×10^{-1}	6.45×10^2	6.08×10^5
Total Sulfur (as H ₂ S)	8.74×10^{-1}	5.75×10^0	4.19×10^3
Ammonia	3.31×10^{-3}	2.18×10^{-2}	7.95×10^0
Argon	8.47×10^{-3}	5.58×10^{-2}	4.77×10^1
Nitrogen	5.61×10^{-1}	3.69×10^0	2.21×10^3
Methane	1.10×10^{-1}	7.25×10^{-1}	2.49×10^2
Hydrogen	$<3.45 \times 10^{-1}$	$<2.27 \times 10^0$	$<9.81 \times 10^1$

Total weight of condensate (grams): 3.05
Initial headspace pressure (psi): 0.72

Descriptor: 1-19-84; 0935 HRS; MST; 6" ORIFICE; 2
Lab No.: 4991-5
Sample gas/steam ratio (ft³/lb): 2.30×10^0
Sample gas/steam ratio (moles/1000 moles steam): 115
Sample gas/steam ratio (g/10⁶ grams steam): 279000
Percent Air: 0.17

Gas	Mole % (w/o H ₂ O)	Moles per 1000 moles H ₂ O	ppm (with H ₂ O)
Water vapor	N/A	N/A	7.82×10^5
Carbon dioxide	9.78×10^{-1}	1.13×10^2	2.15×10^5
Total Sulfur (as H ₂ S)	9.59×10^{-1}	1.11×10^0	1.64×10^3
Ammonia	1.15×10^{-2}	1.33×10^{-2}	9.83×10^0
Argon	9.63×10^{-3}	1.11×10^{-2}	1.93×10^1
Nitrogen	5.36×10^{-1}	6.18×10^{-1}	7.51×10^2
Methane	5.99×10^{-2}	6.91×10^{-2}	4.81×10^1
Hydrogen	5.89×10^{-1}	6.78×10^{-1}	5.95×10^1

Total weight of condensate (grams): 10.56
Initial headspace pressure (psi): 0.59

ANATEC

145/002 4991 (1-8)

- 4 -

09 FEB 84

Descriptor: 1-18-84; 1440 HRS; MST; 4" ORIFICE; 1
 Lab No.: 4991-6

BOMB RECEIVED WITH STEM PUSHED TOO FAR INTO BOMB - NO REPORT.

Descriptor: 1-19-84;; 1600 HRS; MST; 6" ORIFICE; 4
 Lab No.: 4991-7
 Sample gas/steam ratio (ft³/lb): 1.31 x 10⁰
 Sample gas/steam ratio (moles/1000 moles steam): 65.5
 Sample gas/steam ratio (g/10⁶ grams steam): 158000
 Percent Air: 0.14

Gas	Mole % (w/o H ₂ O)	Moles per 1000 moles H ₂ O	ppm (with H ₂ O)
Water vapor	N/A	N/A	8.64 x 10 ⁵
Carbon dioxide	9.75 x 10 ⁻¹	6.39 x 10 ⁻¹	1.35 x 10 ⁵
Total Sulfur (as H ₂ S)	9.89 x 10 ⁻¹	6.48 x 10 ⁻¹	1.06 x 10 ³
Ammonia	5.89 x 10 ⁻³	3.86 x 10 ⁻³	3.15 x 10 ⁰
Argon	7.79 x 10 ⁻³	5.11 x 10 ⁻³	9.77 x 10 ⁰
Nitrogen	7.05 x 10 ⁻¹	4.62 x 10 ⁻¹	6.20 x 10 ²
Methane	2.22 x 10 ⁻¹	1.45 x 10 ⁻¹	1.12 x 10 ²
Hydrogen	6.05 x 10 ⁻¹	3.96 x 10 ⁻¹	3.83 x 10 ¹

Total weight of condensate (grams): 18.57
 Initial headspace pressure (psi): 0.54

Descriptor: 1-20-84; 1615 HRS; MST; 6" ORIFICE; 7
 Lab No.: 4991-8
 Sample gas/steam ratio (ft³/lb): 2.75 x 10⁰
 Sample gas/steam ratio (moles/1000 moles steam): 138
 Sample gas/steam ratio (g/10⁶ grams steam): 334000
 Percent Air: 0.071

Gas	Mole % (w/o H ₂ O)	Moles per 1000 moles H ₂ O	ppm (with H ₂ O)
Water vapor	N/A	N/A	7.50 x 10 ⁵
Carbon dioxide	9.82 x 10 ⁻¹	1.35 x 10 ⁻²	2.48 x 10 ⁵
Total Sulfur (as H ₂ S)	9.75 x 10 ⁻¹	1.34 x 10 ⁰	1.91 x 10 ³
Ammonia	9.46 x 10 ⁻³	1.30 x 10 ⁻²	9.23 x 10 ⁰
Argon	6.61 x 10 ⁻³	9.11 x 10 ⁻³	1.51 x 10 ¹
Nitrogen	3.41 x 10 ⁻¹	4.71 x 10 ⁻¹	5.49 x 10 ²
Methane	4.30 x 10 ⁻²	5.93 x 10 ⁻²	3.96 x 10 ¹
Hydrogen	4.65 x 10 ⁻¹	6.40 x 10 ⁻¹	5.38 x 10 ¹

Total weight of condensate (grams): 10.2
 Initial headspace pressure (psi): 0.58

145/002 4991 (1-8)

- 5 -

09 FEB 84

Descriptor	Lab No.	Radon-222 (pCi/L)
1-19-84; 1300 HRS; MST; 6" ORIFICE; 3	-1	590
1-20-84; 1430 HRS; 6" ORIFICE; 6	-2	170
1-21-84; 1000 HRS; MST; 6" ORIFICE; 8	-3	360
1-20-84; 0915 HRS; MST; 6" ORIFICE; 5	-4	710
1-19-84; 0935 HRS; MST; 6" ORIFICE; 2	-5	750
1-19-84; 1600 HRS; MST; 6" ORIFICE; 4	-7	730
1-20-84; 1615 HRS; MST; 6" ORIFICE; 7	-8	540

QUALITY CONTROL DATA

Analyte	Relative Standard Deviation	Matrix of Determination
Carbon Dioxide	5.5	Condensate/NaOH solution
Total Sulfur (as H ₂ S)	1.8	Condensate/NaOH solution
Ammonia	10	Condensate/NaOH solution
Argon	2.7	Residual Gas Phase
Oxygen	7.7	Residual Gas Phase
Nitrogen	3.8	Residual Gas Phase
Methane	1.5	Residual Gas Phase
Hydrogen	1.7	Residual Gas Phase

Air Correction Procedure¹

- (1) Total moles of oxygen determined in sample are multiplied by 1.00 and subtracted from total moles of oxygen.
- (2) Total moles of oxygen determined in sample are multiplied by 3.73 and subtracted from total moles of nitrogen.
- (3) Total moles of oxygen determined in sample are multiplied by 0.0446 and subtracted from total moles of argon.

¹Ref: Components of Atmospheric Air in C.R.C. Handbook of Chemistry and Physics, 58th ed.

Nina Huston
Nina Huston
Geothermal Services

Greg Anderson
Greg Anderson, Director
Analytical Laboratories

/hs

2" WIRELINE ENTRY VALVE

12" WKM BLOWDOWN VALVE

1" HORIZONTAL
CALORIMETER PORT

SAMPLE PORT

FLOW
TEE

12" WKM
THROTTLE VALVE

12" WKM
MASTER PRODUCTION VALVE

MOVEABLE
SAMPLE PORT

ORIFICE FLANGES
WITH PLATE

12" I.D. FLOWLINE

GROUND LEVEL

2 - 3" WING VALVES ON
13-3/8" S.O.W. WELLHEAD

13-3/8"
CASING

REVISED	DATE

TSI

ThermoSource Inc.

100 E. Street • P.O. Box 1236 • Santa Rosa, California 95402

(707) 523-2900 • Telex 171743 • TWX 510 7446439

MOTHER EARTH INDUSTRIES
WELL TEST DIAGRAM
WELL 34-7B
"LADY LINDA" No. 1

DRAWN

FOR: MEI

BY: LEC

DATE: 2-10-84

SCALE: NA

DRAWING No.

97

435 Tesconi Circle • Santa Rosa, California 95401 • 707-526-7200

Jerry Niemi
Thermasource
P.O. Box 1236
Santa Rosa, CA 95402

April 17, 1984
ANATEC Log No: 5257 (-1,2)
Series No: 145/004 URGENT

Subject: Total Sulfur and Carbon Dioxide Analysis

Dear Mr. Niemi:

Tabulated below are data for two samples received April 5, 1984, in impingers on a Routine basis.

Please feel free to contact us should you have questions.

Submitted by:

Approved by:

Nina Jan Huston
Gas Analysis Section

Greg Anderson, Director
Analytical Laboratories

/jn

cc: Paul Hirtz

Table 1. Analytical Results

Descriptor	Lab No.	Carbon Dioxide (% by total wt)	Hydrogen Sulfide (ppm by wt)
4/2/84; 10:30 HRS; 372.8/412.9 V _F = 1.000 L	1	45	4,300
4/2/84; 12:30 HRS; 370.5/413.6 V _F = 1.000 L	2	45	4,300

ANATEC
LABORATORIES
INC.

Rec'd
5/10/84 99.

435 Tesconi Circle

Santa Rosa, California 95401

707-526-7200

Mr. Jerry Niimi
THERMASOURCE, INC.
P.O. Box 1236
Santa Rosa, CA 95402

May 7, 1984
ANATEC Log No: 5255 (1-22)
Series: 145/003
Samples Rec'd: 05 April 84

Subject: Total Gas Analysis - "Well 34-75, Sulfurdale, Utah"

Dear Mr. Niimi:

Tabulated on the following pages are data for twelve samples recieved April 5, 1984, in gas bombs, on a Routine basis.

Please feel free to contact us should you have questions.

Submitted by:

Nina Van Huston
Supervisor, Gas Analysis

Approved by:

Greg Anderson, Director
Analytical Laboratories

/jn

Descriptor: WELL 34-75; SULFURDALE, UTAH; 3/30/84; 1145; TOP

Lab No: 5255-1

Initial headspace pressure:

8.9

Total weight of condensate (grams):

21.1

Specific volume (pounds/ft³ at 71.5 psiA and 275°F):

0.23

Gas weight percent (g noncondensable gas/100 g sample):

51.1

Percent Air:

0.17

Gas	Mole % (w/o H ₂ O)	ppm by wt. (Total Mass)
Carbon dioxide	9.84×10^1	5.05×10^5
Total Sulfur (as H ₂ S)	1.18×10^0	4.71×10^3
Ammonia	$<1.98 \times 10^{-3}$	$<3.94 \times 10^0$
Argon	6.36×10^{-3}	2.96×10^1
Nitrogen	3.65×10^{-1}	1.19×10^3
Methane	2.51×10^{-2}	4.71×10^1
Hydrogen	3.38×10^{-2}	7.96×10^0

Descriptor: WELL 34-75; SULFURDALE, UTAH; 1515; TOP 2/30

Lab No: 5255-3

Initial headspace pressure:

5.28

Total weight of condensate (grams):

21.6

Specific volume (pounds/ft³ at 71.5 psiA and 275°F):

0.23

Gas weight percent (g noncondensable gas/100 g sample):

49.0

Percent Air:

0.0002

Gas	Mole % (w/o H ₂ O)	ppm by wt. (Total Mass)
Carbon dioxide	9.48×10^1	4.85×10^5
Total Sulfur (as H ₂ S)	1.16×10^0	4.43×10^3
Ammonia	$<3.35 \times 10^{-3}$	$<6.38 \times 10^0$
Argon	6.74×10^{-3}	3.02×10^1
Nitrogen	3.35×10^{-1}	1.05×10^3
Methane	3.66×10^{-2}	6.57×10^1
Hydrogen	3.65×10^{-2}	8.25×10^0

Descriptor: WELL 34-75; SULFURDALE, UTAH; 3/30; 1730;
BOTTOM PORT

Lab No: 5255-5

Initial headspace pressure:

3.8

Total weight of condensate (grams):

94.5

Specific volume (pounds/ft³ at 71.5 psiA and 275°F):

0.16

Gas weight percent (g noncondensable gas/100 g sample):

1.9

Percent Air:

1.3

Gas	Mole % (w/o H ₂ O)	ppm by wt. (Total Mass)
Carbon dioxide	9.52×10^1	1.84×10^4
Total Sulfur (as H ₂ S)	4.21×10^0	6.30×10^2
Ammonia	$<1.01 \times 10^{-1}$	$<7.58 \times 10^0$
Argon	6.64×10^{-3}	1.16×10^0
Nitrogen	4.58×10^{-1}	5.63×10^1
Methane	$<6.54 \times 10^{-3}$	$<4.60 \times 10^{-1}$
Hydrogen	$<3.30 \times 10^{-2}$	$<2.93 \times 10^{-1}$

Descriptor: WELL 34-75; SULFURDALE, UTAH; 3/31/84; 1815;
TOP PORT

Lab No: 5255-6

Initial headspace pressure:

5.87

Total weight of condensate (grams):

23.3

Specific volume (pounds/ft³ at 71.5 psiA and 275°F):

0.23

Gas weight percent (g noncondensable gas/100 g sample):

50.1

Percent Air:

<0.0002

Gas	Mole % (w/o H ₂ O)	ppm by wt. (Total Mass)
Carbon dioxide	9.84×10^1	4.95×10^5
Total Sulfur (as H ₂ S)	1.21×10^0	4.71×10^3
Ammonia	$<2.64 \times 10^{-3}$	$<5.14 \times 10^0$
Argon	5.68×10^{-3}	2.59×10^1
Nitrogen	2.83×10^{-1}	9.06×10^2
Methane	3.07×10^{-2}	5.62×10^1
Hydrogen	3.41×10^{-2}	7.86×10^0

Descriptor: WELL 34-75; SULFURDALE, UTAH; 4/1/84; 0845; TOP

Lab No: 5255-8

Initial headspace pressure: 5.02

Total weight of condensate (grams): 20.0

Specific volume (pounds/ft³ at 71.5 psiA and 275°F): 0.23

Gas weight percent (g noncondensable gas/100 g sample): 51.2

Percent Air: <0.0002

Gas	Mole % (w/o H ₂ O)	ppm by wt. (Total Mass)
Carbon dioxide	9.85×10^1	5.07×10^5
Total Sulfur (as H ₂ S)	1.14×10^0	4.56×10^3
Ammonia	$<3.91 \times 10^{-3}$	$<7.79 \times 10^0$
Argon	5.61×10^{-3}	2.62×10^1
Nitrogen	2.80×10^{-1}	9.17×10^2
Methane	2.97×10^{-2}	5.57×10^1
Hydrogen	3.20×10^{-2}	7.56×10^0

Descriptor: WELL 34-75; SULFURDALE, UTAH; 4/1/84; 1200; TOP

Lab No: 5255-11

Initial headspace pressure: 5.25

Total weight of condensate (grams): 45.8

Specific volume (pounds/ft³ at 71.5 psiA and 275°F): 0.23

Gas weight percent (g noncondensable gas/100 g sample): 48.0

Percent Air: <0.0002

Gas	Mole % (w/o H ₂ O)	ppm by wt. (Total Mass)
Carbon dioxide	9.82×10^1	4.74×10^5
Total Sulfur (as H ₂ S)	1.46×10^0	5.46×10^3
Ammonia	$<2.07 \times 10^{-3}$	$<3.86 \times 10^0$
Argon	5.97×10^{-3}	2.61×10^1
Nitrogen	2.96×10^{-1}	9.09×10^2
Methane	3.15×10^{-2}	5.55×10^1
Hydrogen	3.47×10^{-2}	7.69×10^0

Descriptor: WELL 34-75; SULFURDALE, UTAH; 4/1/84; 1720; TOP

Lab No: 5255-14

Initial headspace pressure:

3.97

Total weight of condensate (grams):

34.1

Specific volume (pounds/ft³ at 71.5 psiA and 275°F):

0.23

Gas weight percent (g noncondensable gas/100 g sample):

50.1

Percent Air:

0.0007

Gas	Mole % (w/o H ₂ O)	ppm by wt. (Total Mass)
Carbon dioxide	9.78×10^1	4.93×10^5
Total Sulfur (as H ₂ S)	1.78×10^0	6.96×10^3
Ammonia	$<1.58 \times 10^{-3}$	$<3.07 \times 10^0$
Argon	6.01×10^{-3}	2.75×10^1
Nitrogen	3.01×10^{-1}	9.65×10^2
Methane	3.13×10^{-2}	5.75×10^1
Hydrogen	3.28×10^{-2}	7.59×10^0

Descriptor: WELL 34-75; SULFURDALE, UTAH; 4/2/84; 0915; TOP

Lab No: 5255-15

Initial headspace pressure:

6.45

Total weight of condensate (grams):

45.3

Specific volume (pounds/ft³ at 71.5 psiA and 275°F):

0.23

Gas weight percent (g noncondensable gas/100 g sample):

50.0

Percent Air:

0.0062

Gas	Mole % (w/o H ₂ O)	ppm by wt. (Total Mass)
Carbon dioxide	9.84×10^1	4.94×10^5
Total Sulfur (as H ₂ S)	1.25×10^0	4.86×10^3
Ammonia	$<7.38 \times 10^{-3}$	$<1.43 \times 10^1$
Argon	6.02×10^{-3}	2.75×10^1
Nitrogen	3.09×10^{-1}	9.88×10^2
Methane	3.01×10^{-2}	5.52×10^1
Hydrogen	3.61×10^{-2}	8.31×10^0

Descriptor: WELL 34-75; SULFURDALE, UTAH; 4/2/84; 1215; TOP

Lab No: 5255-16

Initial headspace pressure:

5.45

Total weight of condensate (grams):

52.8

Specific volume (pounds/ft³ at 71.5 psiA and 275°F):

0.22

Gas weight percent (g noncondensable gas/100 g sample):

42.5

Percent Air:

0.027

Gas	Mole % (w/o H ₂ O)	ppm by wt. (Total Mass)
Carbon dioxide	9.80×10^1	4.18×10^5
Total Sulfur (as H ₂ S)	1.60×10^0	5.29×10^3
Ammonia	$<6.21 \times 10^{-3}$	$<1.03 \times 10^1$
Argon	5.87×10^{-3}	2.27×10^1
Nitrogen	3.09×10^{-1}	8.39×10^2
Methane	2.61×10^{-2}	4.06×10^1
Hydrogen	3.45×10^{-2}	6.76×10^0

Descriptor: WELL 34-75; SULFURDALE, UTAH; 4/2/84; 1045;
PROBE 6" UP

Lab No: 5255-17

Initial headspace pressure:

5.3

Total weight of condensate (grams):

41.3

Specific volume (pounds/ft³ at 71.5 psiA and 275°F):

0.23

Gas weight percent (g noncondensable gas/100 g sample):

46.3

Percent Air:

0.044

Gas	Mole % (w/o H ₂ O)	ppm by wt. (Total Mass)
Carbon dioxide	9.82×10^1	4.57×10^5
Total Sulfur (as H ₂ S)	1.43×10^0	5.16×10^3
Ammonia	$<8.10 \times 10^{-3}$	$<1.46 \times 10^1$
Argon	5.97×10^{-3}	2.52×10^1
Nitrogen	3.23×10^{-1}	9.57×10^2
Methane	2.64×10^{-2}	4.48×10^1
Hydrogen	4.14×10^{-2}	8.84×10^0

Descriptor: WELL 34-75; SULFURDALE, UTAH; 4/2/84; 0945;
PROBE 3" UP

Lab No: 5255-18

Initial headspace pressure:

6.9

Total weight of condensate (grams):

29.3

Specific volume (pounds/ft³ at 71.5 psiA and 275°F):

0.21

Gas weight percent (g noncondensable gas/100 g sample):

39.8

Percent Air:

0.074

Gas	Mole % (w/o H ₂ O)	ppm by wt. (Total Mass)
Carbon dioxide	9.75×10^1	3.91×10^5
Total Sulfur (as H ₂ S)	2.10×10^0	6.53×10^3
Ammonia	$<3.44 \times 10^{-3}$	$<5.34 \times 10^0$
Argon	5.23×10^{-3}	1.90×10^1
Nitrogen	2.90×10^{-1}	7.41×10^2
Methane	2.45×10^{-2}	3.57×10^1
Hydrogen	3.97×10^{-2}	7.30×10^0

Descriptor: WELL 34-75; SULFURDALE, UTAH; 4/2/84; 1630; TOP

Lab No: 5255-20

Initial headspace pressure:

4.41

Total weight of condensate (grams):

34.3

Specific volume (pounds/ft³ at 71.5 psiA and 275°F):

0.23

Gas weight percent (g noncondensable gas/100 g sample):

44

Percent Air:

0.15

Gas	Mole % (w/o H ₂ O)	ppm by wt. (Total Mass)
Carbon dioxide	9.82×10^1	4.34×10^5
Total Sulfur (as H ₂ S)	1.44×10^0	4.93×10^3
Ammonia	$<1.46 \times 10^{-2}$	$<2.50 \times 10^1$
Argon	5.68×10^{-3}	2.28×10^1
Nitrogen	3.07×10^{-1}	8.65×10^2
Methane	2.35×10^{-2}	3.79×10^1
Hydrogen	3.22×10^{-2}	6.54×10^0

QUALITY CONTROL DATA

<u>Analyte</u>	<u>Relative Standard Deviation</u>	<u>Matrix of Determination</u>
Carbon Dioxide	2.1	Condensate/NaOH solution
Total Sulfur (as H ₂ S)	1.0	Condensate/NaOH solution
Ammonia	11.3	Condensate/NaOH solution
Argon	1.8	Residual Gas Phase
Oxygen	4.5	Residual Gas Phase
Nitrogen	2.4	Residual Gas Phase
Methane	3.9	Residual Gas Phase
Hydrogen	3.4	Residual Gas Phase

Air Correction Procedure¹

- (1) Total moles of oxygen determined in sample are multiplied by 1.00 and subtracted from total moles of oxygen.
- (2) Total moles of oxygen determined in sample are multiplied by 3.73 and subtracted from total moles of nitrogen.
- (3) Total moles of oxygen determined in sample are multiplied by 0.0446 and subtracted from total moles of argon.

¹Ref: Components of Atmospheric Air in C.R.C. Handbook of Chemistry and Physics, 58th ed.

10^3

107

TYPE CURVE MATCH

34-7B (LADY LINDA)

Fig. 6.3 Matthews-Brons-Hazebrook dimensionless pressure for different well locations in a square drainage area.
After Matthews, , and Hazebrook.⁴

FIGURE 4

REVISED	DATE	<div> <div> 100 E Street • P.O. Box 1236 • Santa Rosa, California 95402 (707) 523-2900 • Telex 171743 • TWX 510 7446439 </div> </div>	DRAWN	
			FOR:	
			BY:	
			DATE:	
			SCALE:	
		WELL DELIVERABILITY CURVE SULPHURDALE FIELD	DRAWING No.	

FIGURE 5

REVISED	DATE	<div> ThermaSource Inc.</div> <div>100 E Street • P.O. Box 1236 • Santa Rosa, California 95402</div> <div>(707) 823-2960 • Telex 371743 • TWX 810 7446439</div>	DRAWN
			FOR:
			BY:
			DATE:
			SCALE:
		DRAWING No.	

FLOWING TEMPERATURE VS
PRESSURE - SULPHURDALE

FIGURE 6

FWHP (psig)

70

60

50

40

30

20

10

0

% GAS

REVISED	DATE	<div> <div> 100 E Street • P.O. Box 1236 • Santa Rosa, California 95402 (707) 523-2960 • Telex 171743 • FAX 510.7446439 </div> </div> <div> ThermaSource Inc. </div> <div> Non Condensable Gas vs FWHP SULPHURDALE FIELD </div>	DRAWN	
			FOR:	
			BY:	
			DATE:	
			SCALE:	
			DRAWING No.	

$$P^2 \times 10^3 \text{ (psia}^2\text{)}$$

WORKER BUDGET

3A-7A 6/14/84

$$P^* = 70.93 \text{ mmHg}$$
 $\mu = 0.1 \text{ psi/in}$
$$W = 16,000 \text{ lb/hr}$$
$$Z_h = 1339,9 \times 70 \times 10^{-3} \times 10^3 = 11500,000 \text{ N} = 11,5 \text{ MN}$$

From Surface SE Data

ANATEC
LABORATORIES
INC.

RECEIVED 113.

JUL 24 1984

Thermasource, Inc.

435 Tesconi Circle

Santa Rosa, California 95401

707-526-7200

Mr. Jerry Niimi
Thermasource, Inc.
P.O. Box 1236
Santa Rosa, CA 95402

July 20, 1984
ANATEC Log No. 5540 (-1)
Series No: 145/006 Part 1

Subject: Transmittal of Results for testing performed on one condensate sample received June 18, 1984 and identified as 10" Orifice; 6/12 1200 34-7A.

TRANSMITTAL OF RESULTS

Descriptor, Lab No. and Results (mg/L)

Parameter	10" Orifice 6/12 1200 34-7A 5540-17
General Physical	
pH (Units)	4.2
Specific Gravity ^b	1.001
Total Filterable Residue	10
Specific Conductance (umhos/cm)	60
General Chemical	
Alkalinity (as CaCO ₃)	
Total	4
Bicarbonate	4
Carbonate	—
Ammonia, as N	7
Boron	0.07
Chloride	2
Silica	<0.2
Sulfate	4
Metals by Atomic Absorption	
Arsenic	<0.01
Calcium	0.10
Magnesium	<0.05
Potassium	0.11
Sodium	0.03

/bt

Greg Anderson, Director
Analytical Laboratories

435 Tesconi Circle • Santa Rosa, California 95401 • 707-526-7200

Mr. Jerry Niimi
Therma Source, Inc.
P.O. Box 1236
Santa Rosa, CA 95402

July 24, 1984
ANATEC Log No: 5540 (1-17)
Series No: 145/006 Part 2
Client P.O.: 4879

Subject: Total Gas Analysis

Dear Mr. Niimi:

Tabulated on the following pages are data for three gas bombs and one diluted gas bomb. (Note: Ten gas bombs and two condensates on hold.)

The ammonia level reported for Sample 5540-11 ("6/10 1045 34-7-B 69.4g/L 10 in. orifice") may be erroneously low because the diluted gas bomb contents were transported to and received by the laboratory in a plastic container which had not been refrigerated.

Please feel welcome to contact us should you have questions.

Submitted by:

Approved by:

Nina Jan Huston
Supervisor, Gas Analysis

Greg Anderson, Director
Analytical Laboratories

/bt

Diluted Gas Bomb Analysis

<u>Descriptor</u>	<u>Carbon Dioxide (ppm by wt)</u>	<u>Hydrogen Sulfide (ppm by wt)</u>	<u>Ammonia (ppm by wt)</u>
6/10 1045 34-7-B 69.4 G/L 10" ORIFICE	150,000	1500	2.7

QUALITY CONTROL DATA

<u>Analyte</u>	<u>Relative Standard Deviation</u>	<u>Matrix of Determination</u>
Carbon Dioxide	5.1	Condensate/NaOH solution
Total Sulfur (as H ₂ S)	1.4	Condensate/NaOH solution
Ammonia	4.6	Condensate/NaOH solution
Argon	1.8	Residual Gas Phase
Oxygen	7.1	Residual Gas Phase
Nitrogen	1.0	Residual Gas Phase
Methane	1.0	Residual Gas Phase
Hydrogen	1.0	Residual Gas Phase

Air Correction Procedure¹

- (1) Total moles of oxygen determined in sample are multiplied by 1.00 and subtracted from total moles of oxygen.
- (2) Total moles of oxygen determined in sample are multiplied by 3.73 and subtracted from total moles of nitrogen.
- (3) Total moles of oxygen determined in sample are multiplied by 0.0446 and subtracted from total moles of argon.

¹Ref: Components of Atmospheric Air in C.R.C. Handbook of Chemistry and Physics, 58th ed.

REPLACEMENT WELL SCHEDULE

5 MW POWER PLANT

Plant Inlet Steam
(000 lbs/hr)

250

200

150

100

50

0

5 MW CAPACITY

Replacement Well
in
Year 3

Initial Two Wells

2 Replacement Wells
in
Year 13

1 Replacement Well
in
Year 16

YEARS

0

5

10

15

20

116