REPORT

ON

BEOWAWE NEVADA GEOTHERMAL STEAM WELLS

FOR

MAGMA-VULCAN THERMAL POWER PROJECT

AUGUST 1961

Prepared by

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MAGMA POWER CO.
631 SOUTH WITMER STREET
LOS

TABLE OF CONTENTS

SECTION A

INTRODUCTION & CONCLUSIONS

A INTRODUCTION AND CONCLUSIONS

The Vulcan Thermal Power Company's geothermal steam wells are located about 8 miles southwest of Beowawe, Nevada, which is 48 miles from Elko, Nevada, on Highway 21 at an elevation of 5,000 ft. above sea level. There are four wells located here which were completed in June this year.

The wells are all located about 150 ft. above the valley floor on a ledge on the sloping side of a hill and are spaced approximately 300 ft. apart.

The geological fault on which the wells are located extends for a distance of almost a mile along which it is believed steam could be readily tapped.

When the wells were completed this survey was made to determine their power producing capabilities. Flow tests were made on each well with all wells blowing simultaneously and as continuously as possible all during the three weeks period of the tests. During these tests chemical analyses were made of the separated steam, water and non-condensible gases from each well which appear in Section D under "Chemical Analyses."

The wells are now being allowed to discharge to atmosphere thru the 8" pipe on each well with the well head pressures being recorded periodically. From an analysis of this record one will be able to predict with some degree of accuracy just how dependable the mass flows will be that were experienced during the tests.

Conclusions:

As the result of this survey the following general conclusions can be made:

1. The heat source is an underground pool of geothermally heated water existing at conditions somewhat below the flash point.

2. Total steam available from the four existing wells is 800 to 900,000 pounds per hour at 5 psig (17.2 psia).

3. Generation of power from these wells is feasible by several methods discussed in Section E herein.

4. The chemical constituents of the steam and non-condensable gases permit it to be used directly in a steam turbine.

5. The steam and water can be produced by means of the steam lift principle. These wells have a shut off pressure above 100 pounds with this pressure increasing to above 180 pounds in a few hours after shut off.

6. There was no noticeable change in a well's production when the flow of others is varied.

7. Many additional wells can be drilled in this area without appreciably affecting the capacity of the existing wells.

8. These wells to date have not indicated any tendency to calcite up as the wells at Steamboat Springs and Mammoth do. This is due apparently to the very low quantity of calcium in the effluent.

9. A very noticeable improvement in well flows was made by increasing the well diameter and depth as evidenced by comparison of Well #4 with a bore diameter of 12" and a depth of 767 ft, as contrasted with Wells #2 and #3 with a bore diameter of 10" and depths of 655 ft. and 715 ft.

SECTION B

WELL PERFORMANCE

B WELL PERFORMANCE

The well producing capacities were measured by allowing them to flow by means of the flashing steam. (These wells, except #1, will all shut off at above 100 psig and then gradually increase in pressure to above 180 psig.) The steam and water were separated using the piping setup as shown diagramatically on page B 3. The measured steam and water capacities are shown on pages B 6 and B 7, and as plotted on page B 9. Well #1 is not plotted as it was too small to be significant.

Two different flowing conditions were taken on Well #3 and three different conditions were taken on Well #2. All three conditions taken on Well #4 were at almost the same pressures as this well was too large to measure at other points with any accuracy using the separating equipment available. Satisfactory separation of the water from the steam flow was achieved. However, some steam carryover and flashing was encountered in the water line which would cause erroneous readings of this flow. Consequently all water flows were corrected by a factor of .70 which should result in a conservative estimate of their flows.

Well #4 produced a flow of 41,500 lbs./hr. of steam and 1.43 million lbs./hr. of water at 342°F. Combining these flows to determine the temperature at which the water is being produced before it flashes at depth we find the well was producing 1.471 million pounds per hour at 365°F. with a well head pressure of 116.5 psig. This well produces the largest quantity of all four wells, which could be attributed to the fact that it is the largest in diameter and has the greatest depth.

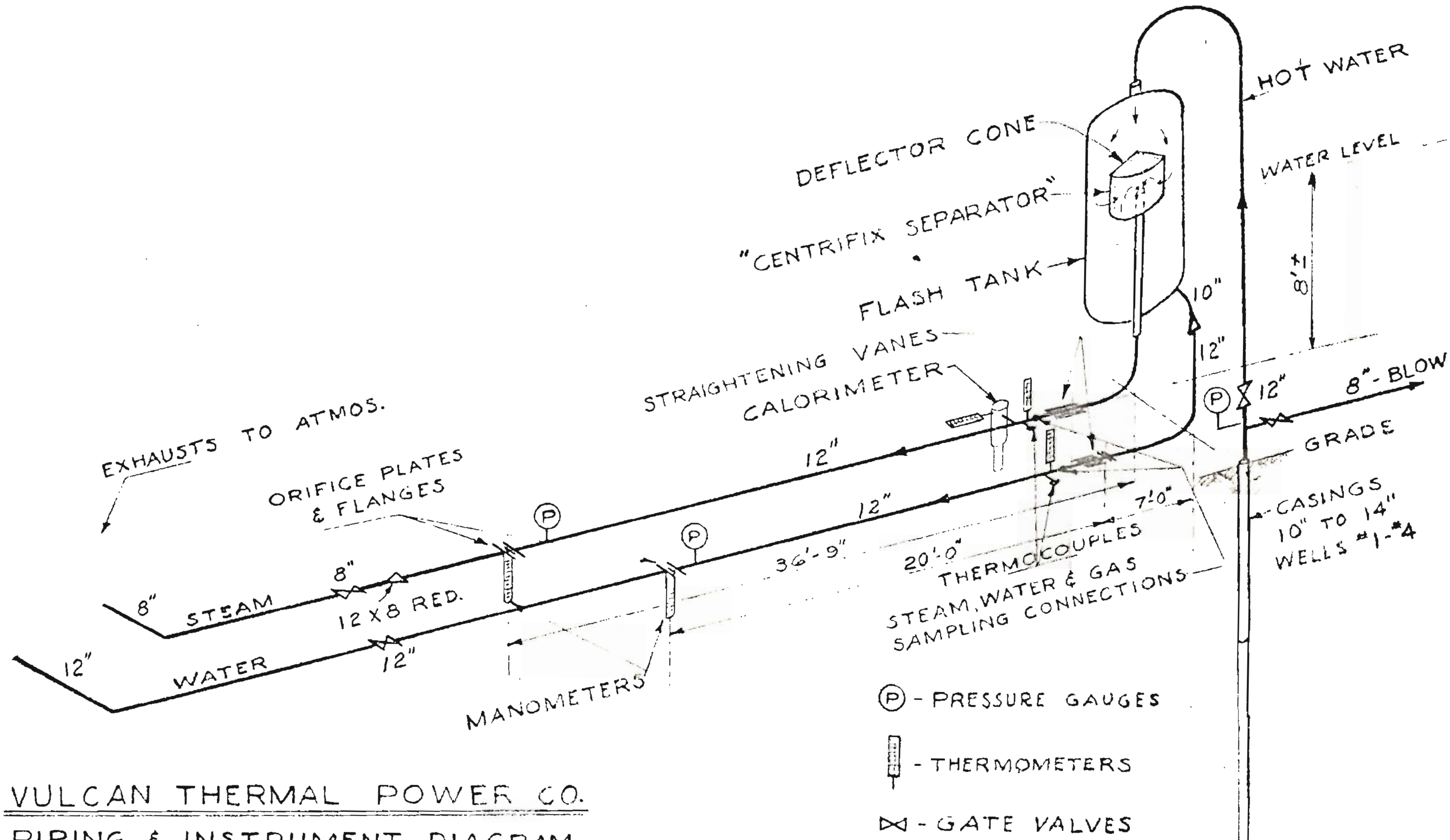
Well #3 produced a flow of 39,200 lbs./hr. of steam and 1.455 million lbs./hr. of water at 327°F. Combining these flows we find the producing flow of 1.494 million lbs./hr. of water at 348.5°F. with a well head pressure of 91 psig. The reason that this flow appears to be as great as Well #4 of course is due to the fact that we were able to handle this flow thru the test setup satisfactorily. A glance at the plots on page B 9 will show that Well #4 with a similar well head pressure of 91 psig. would produce somewhere around 620/480 times as much as Well #3.

Well #2 produced a flow of 33,300 lbs./hr. of steam and 1.455

million lbs./hr. of water at 334°F. Combining these flows, the producing flow was 1.488 million lbs./hr. at 353°F. with a well head pressure of 96 psig.

Well #1 produced a flow of 8,510 lbs./hr. of steam and 489,000 lbs./hr. of water at 259°F. giving a combined producing flow of 497,000 lbs./hr. at a well head pressure of 21 psig. This well was producing at a pressure and temperature that would make it questionable whether one would use its flow. Possibly it can be improved by some means.

All data sheets and calculations used to arrive at the above figures follow with the results plotted on page B 9. It will be noted that the calculated producing temperatures of all wells appear to be around 20°F. above the saturated steam temperatures corresponding to the well head pressure.



VULCAN THERMAL POWER CO.

PIPING & INSTRUMENT DIAGRAM
FOR
FLOW TESTS
OF
GEOTHERMAL WELLS
BEOWAWE, NEV.

ROGERS ENGINEERING CO., INC.
CONSULTING ENGINEERS
16 BEALE STREET, SAN FRANCISCO 5, CALIFORNIA

JULY 1961 RL.

STEAM FLOW TEST FOR VULCAN THERMAL POWER CO.

DATA SHEET NO. 1

SITE LOCATION: BEOWAWE, NEVADA   ELEVATION: 5000 FT.

STD. ATM. PRESS. AT ELEV.: 12.2 PSIA

SEPARATOR USED: KNOCK-OUT TYPE DRUM WITH PURIFIER

STEAM METER RUN I.D.: 12.00" WITH STRAIGHTENING VANES.

ECCENTRIC ORIFICE: 8.00" I.D., SHARP EDGE, S.S.

WATER METER RUN I.D.: 12.00" WITH STRAIGHTENING VANES.

CONCENTRIC ORIFICE: 8.00" I.D., SHARP EDGE, CARBON STL.

STEAM METER: 24" MERCURY MANOMETER

WATER METER: 24" MERCURY MANOMETER

WELL NO.	DATE	TIME	WELL HEAD PRESS.	STM. METER RDG. IN. HG. +	IN. HG. −	IN. HG. TOT.	WATER METER RDG. IN. HG. +	IN. HG. −	IN. HG. TOT.	STEAM RUN PRESS.	TEMP.	WATER RUN PRESS.	TEMP.
4	7-5-61	1:40	119	1.4	1.1	2.5	10.5	10.5	21.0	110	343	104	343
4	7-6-61	2:22	117.5	1.4	1.0	2.4	10.6	10.6	21.2	110	343	104	343
~~4~~	~~7-5-61~~	~~3:20~~	~~116.5~~	~~1.3~~	~~1.0~~	~~2.3~~	~~11.3~~	~~11.3~~	~~22.6~~	~~109~~	~~342~~	~~102~~	~~342~~
AFTER TEST WELL WAS LEFT BLOWING TO ATM. THRU 8" LINE @ 115-125 psig													
ALL OTHER WELLS WERE BLOWING TO ATM. THRU 8" LINES DURING TEST.													
3	7-6-61	3:05	97.5	1.2	0.7	1.9	5.4	5.4	10.8	91	331	88	331
~~3~~	~~7-6-61~~	~~4:05~~	~~91~~	~~0.8~~	~~1.2~~	~~2.0~~	~~12.0~~	~~12.0~~	~~24.0~~	~~87~~	~~327~~	~~79~~	~~327~~
WELL HEAD PRESSURES DURING TEST: #4-115 TO 126, #2-100 TO 111, #1-19 TO 20.													
ALL OTHER WELLS WERE BLOWING TO ATM. THRU 8" LINES DURING TEST.													
2	7-7-61	1:30	96	.9	.5	1.4	12.2	11.8	24.0	94	334	85	334
~~2~~	~~7-7-61~~	~~2:45~~	~~103~~	~~.7~~	~~.3~~	~~1.0~~	~~9.35~~	~~8.8~~	~~18.15~~	~~99~~	~~337~~	~~94~~	~~337~~
2	7-7-61	3:05	108	.6	.2	0.8	6.0	5.7	11.7	105	345	100	345
WELL HEAD PRESSURES DURING TEST: #4-115 TO 120, #3-95 TO 105, #1-18													
ALL OTHER WELLS WERE BLOWING TO ATM. THRU 8" LINES DURING TEST.													
1	7-8-61	11:30	21	.7	.3	1.0	1.4	1.1	2.5	23	259	20	259
WELL HEAD PRESSURES DURING TEST: #4-110 TO 115, #2-95 TO 100, #3-95 TO 110.													
ALL OTHER WELLS WERE BLOWING TO ATM. THRU 8" LINES DURING TEST.													
~~NOTE: ORIFICE IN STEAM METER RUN WAS REDUCED TO 6.00"~~ FOR THIS TEST ONLY.													

NOTE: TEMP. READINGS NOT CORRESPONDING TO THE SATURATED STEAM TEMP. ARE PRESUMED TO BE THE RESULT OF ERRONEOUS MEASUREMENT OF THE THERMOCOUPLE COLD JUNCTION.

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NO. 340-20 DIETZGEN GRAPH PAPER 20 X 20 PER INCH

DATA SHEET No. 2

WELL No.	DATE	TIME	CALORIMETER TEMP. °F	STEAM METER RUN PRESS. PSIG	STEAM METER RUN PRESS. PSIA	ENTHALPY BTU/LB.	PER CENT MOISTURE	PER CENT DRY STEAM
4	7-5-61	1:40	262	110	122.2	1176	1.7	98.3
~~4~~	~~7-5-61~~	~~2:22~~	~~268~~	~~110~~	~~122.2~~	~~1178~~	~~1.5~~	~~98.5~~
4	7-5-61	3:20	275	109	121.2	1183	0.8	99.2
3	7-6-61	3:05	263	91	103.2	1177	1.2	98.8
3	7-6-61	4:05	252	87	99.2	1172	1.7	98.3
2	7-7-61	1:30	258	94	106.2	1173.5	1.7	98.3
2	7-7-61	2:45	268	99	111.2	1179	1.2	98.8
2	7-7-61	3:05	274	105	116.2	1181.5	.9	99.1
~~1~~	~~7-8-61~~	~~11:30~~	~~217~~	~~23~~	~~35.2~~	~~1154~~	~~1.4~~	~~98.6~~

STEAM FLOW CALCULATION SHEET

$$W_h = 359\, S D^2 F_a F_m F_c Y_1 \sqrt{\gamma_f} \sqrt{h_w} \text{ IN LBS./HR.}$$

FOR WELLS #2, #3 & #4

$D = 12.00$ $D^2 = 144$
$d = 8.00$
$d/D = .666$
$S = .3063$ $359 S D^2 F_a F_m F_c = 15,800$
$F_a = 1.003$
$F_m = .962$, $F_m^2 = .925$
$F_c = 1.032$

FOR WELL NO. 1

$D = 12.00$ $D^2 = 144$
$d = 6.00$
$d/D = .50$
$S = .1568$ $359 S D^2 F_a F_m F_c = 7,940$
$F_a = 1.003$
$F_m = .962$, $F_m^2 = .925$
$F_c = 1.016$

B6

WELL No.	DATE	TIME	ORIFICE PRESS. P_f, PSIA	STEAM TEMP. °F	h_w 13.6× ΔP IN. OF H_2O	$\sqrt{h_w}$	$\frac{F_m^2 \times h_w}{P_f}$	Y_1	$\sqrt{\gamma_f}$	$\sqrt{\frac{\%\text{ DRY STM.}}{100}}$	W_h #/HR. ①
4	7-5-61	1:40	122.2	343	34.0	5.84	.258	.996	.5219	.993	48,300
~~4~~	~~7-5-61~~	~~2:22~~	~~122.2~~	~~343~~	~~32.6~~	~~5.16~~	~~.2465~~	~~.9963~~	~~.5219~~	~~.994~~	~~42,700~~
4	7-5-61	3:20	121.2	342	31.25	5.06	.2475	.9963	.5199	.997	41,500
3	7-6-61	3:05	103.2	331	25.8	5.07	.231	.9963	.4819	.995	38,800
~~3~~	~~7-6-61~~	~~4:05~~	~~99.2~~	~~327~~	~~27.2~~	~~5.22~~	~~.2535~~	~~.996~~	~~.4727~~	~~.993~~	~~39,200~~
2	7-7-61	1:30	106.2	332	19.03	4.37	.166	.9790	.4883	.995	33,300
2	7-7-61	2:45	111.2	336	13.6	3.69	.114	.9835	.4990	.995	28,750
2	7-7-61	3:05	116.2	339	10.9	3.305	.0867	.9985	.5046	.996	26,600
1	7-8-61	11:30	35.2	259	13.6	3.69	.357	.9951	.2899	.993	8,510

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20 X 20 PER INCH

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B7

WATER FLOW CALCULATION SHEET

$$W_n = SND^2 F_a F_m \sqrt{G_f} \sqrt{h_w} \quad \text{LBS./HR.}$$

$D = 12.00 \qquad D^2 = 144$

$N = 2835$

$d = 8.000$

$d/D = .666$

$S = .3063$

$F_a = 1.003$

$F_m = .962$

$SND^2 F_a F_m = 121,000$

$W_n = 121,000 \sqrt{G_f} \sqrt{h_w}$

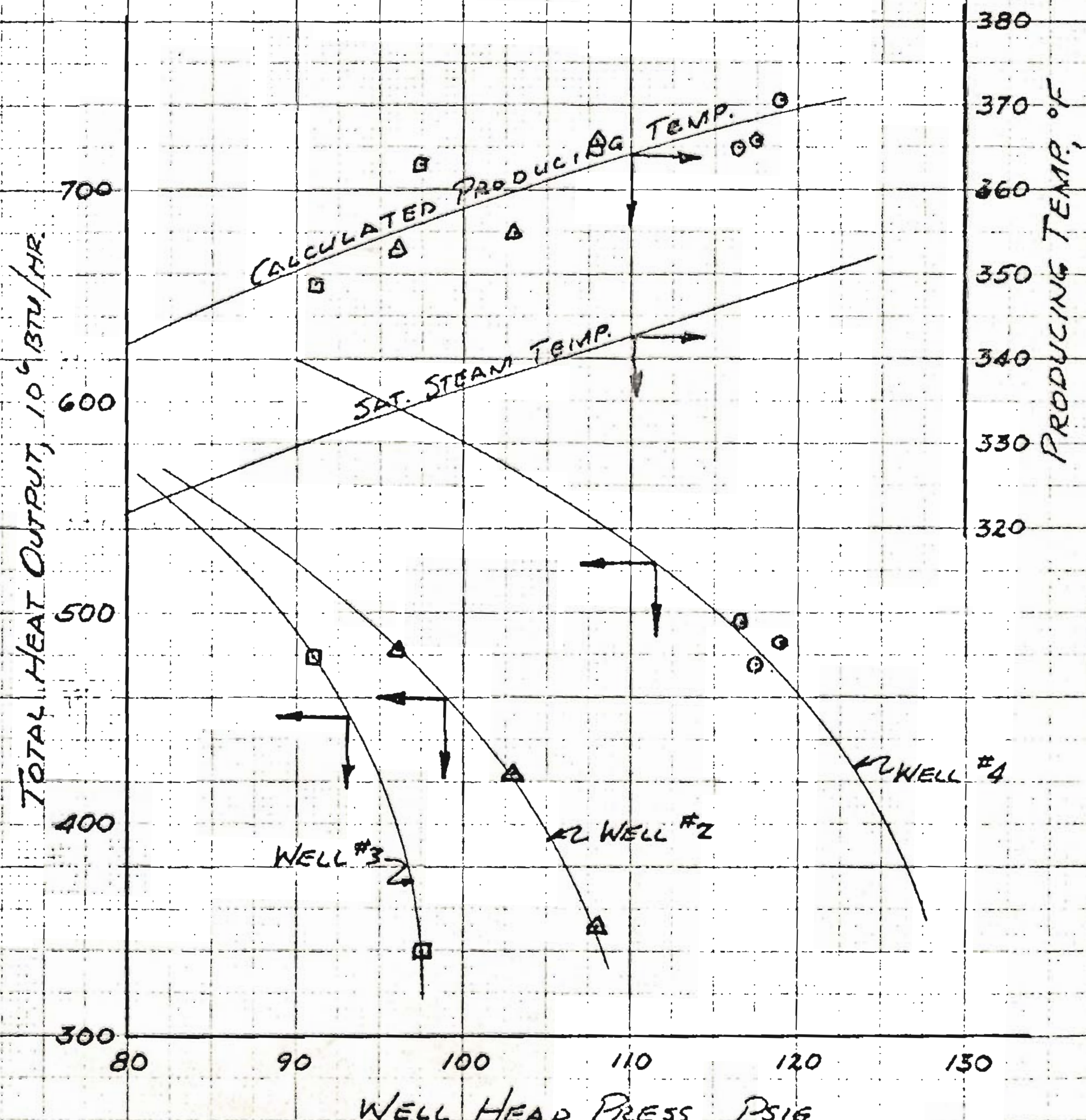
WELL NO.	DATE	TIME	WATER TEMP. °F	$\sqrt{G_f}$	h_w 13.6 × ΔP IN. OF H_2O	$\sqrt{h_w}$	W_{n_1} (2) #/HR.	* W_{n_2} CORRECTED .70 × W_{n_1}
4	7-5-61	1:40	343	.945	286	16.95	1.940×10^6	1.36×10^6
4	7-5-61	2:22	343	.945	288.5	17.0	1.940×10^6	1.36×10^6
4	7-5-61	3:20	342	.945	308	17.56	2.005×10^6	1.43×10^6
3	7-6-61	3:05	331	.950	147	12.13	1.395×10^6	$.976 \times 10^6$
3	7-6-61	4:05	327	.950	326	18.1	2.08×10^6	1.455×10^6
2	7-7-61	1:30	334	.950	326.4	18.1	2.08×10^6	1.455×10^6
2	7-7-61	2:45	337	.950	247	15.73	1.81×10^6	1.268×10^6
2	7-7-61	3:05	345	.948	159	12.62	1.449×10^6	1.014×10^6
1	7-8-61	11:30	259	.989	34.0	5.84	$.699 \times 10^6$	$.489 \times 10^6$

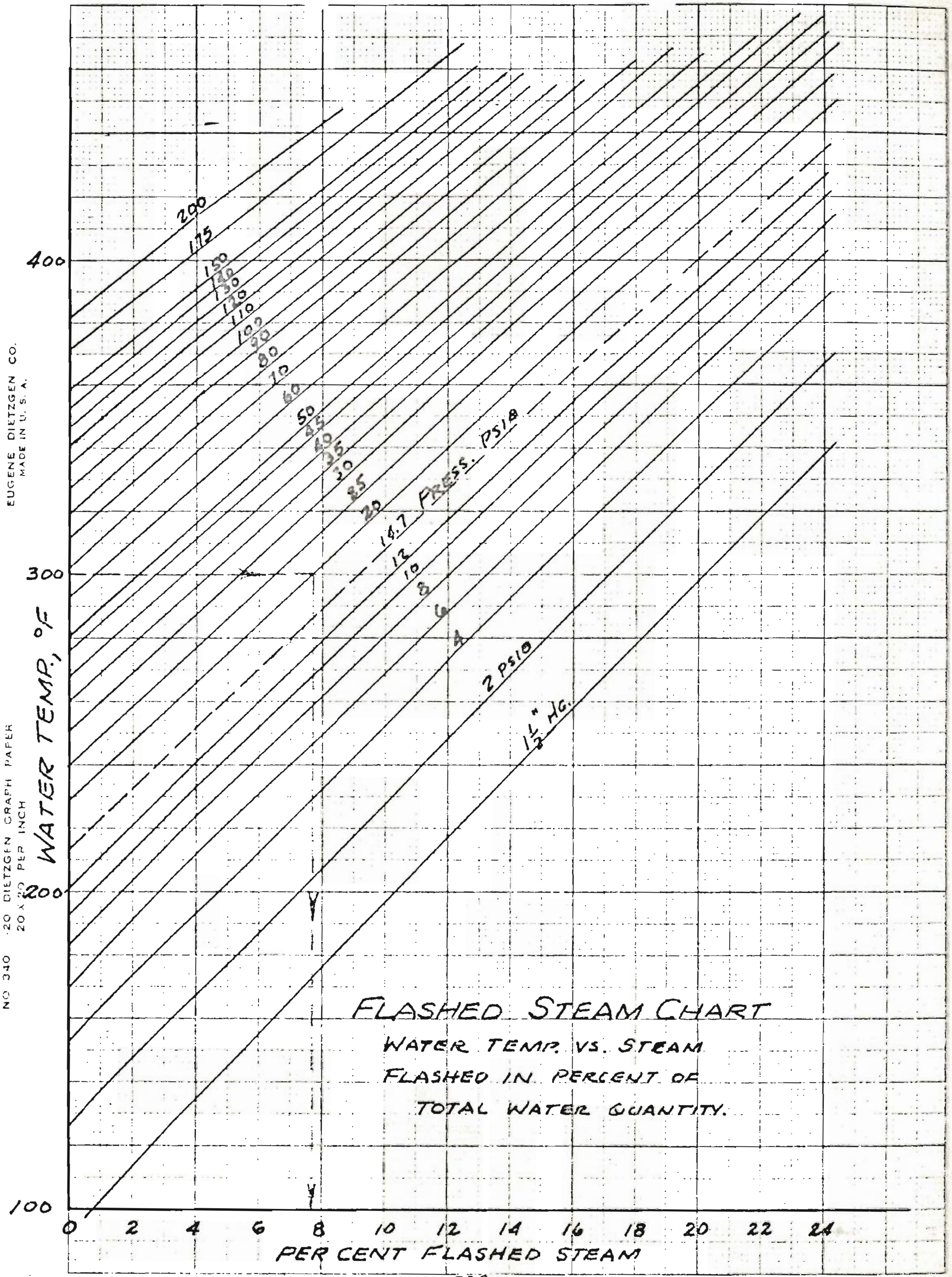
* CORRECTION DUE TO SOME STEAM BEING CARRIED WITH THE WATER.

COMBINED FLOW CALCULATION SHEET

WELL No.	TIME	(3) TOT. WT. FLOWING #/HR. (1) + (2)	(4) STEAM ENTHALPY BTU/#	(5) WATER ENTHALPY BTU/#	(6) TOT. HEAT IN STEAM BTU/HR. (1) × (4)	(7) TOT. HEAT IN WATER BTU/HR. (2) × (6)	(8) TOT. HEAT FLOW BTU/HR. (6) + (7)	(9) COMBINED ENTHALPY BTU/# (8) ÷ (3)	(10) PRODUCING TEMP. °F FROM CHART	(11) PER CENT FLASH @ 17.2 psia	(12) QUANTITY STEAM @ 17.2 psia (11) × (3)
4	1:40	1.408×10^6	1176	314	56.7×10^6	426×10^6	482.7×10^6	343.5	370.5	15	2.25×10^5
4	2:22	1.403×10^6	1178	314	50.3×10^6	426×10^6	476.3×10^6	339	366	15.5	2.18×10^5
4	3:20	1.471×10^6	1183	313	49.1×10^6	447×10^6	496.1×10^6	337.5	365	15.4	2.264×10^5
3	3:05	1.015×10^6	1177	302	45.6×10^6	294.5×10^6	340.1×10^6	335	363	15.2	1.54×10^5
3	4:05	1.494×10^6	1172	297.5	46.0×10^6	433×10^6	479×10^6	320	348.5	15.6	2.33×10^5
2	1:30	1.488×10^6	1173.5	305	39.0×10^6	444×10^6	483×10^6	325	353	14.1	2.096×10^5
2	2:45	1.296×10^6	1179	308	33.8×10^6	390×10^6	423.8×10^6	327	355	14.3	1.85×10^5
2	3:05	1.080×10^6	1181.5	316	31.45×10^6	320×10^6	351.4×10^6	338	365.5	15.5	1.61×10^5
1	11:30	$.497 \times 10^6$	1154	228	9.83×10^6	111.6×10^6	121×10^6	244	275	5.7	$.284 \times 10^5$

VULCAN THERMAL POWER CO.
BEOWAWE, NEVADA STEAM WELLS
WELL HEAD PRESS. VS. TOTAL
HEAT OUTPUT & PRODUCING TEMP.
AUG. 7, 1961
Co. M. [signature]




WATER TEMP., °F
400
300
200
100
0
2
4
6
8
10
12
14
16
18
20
22
24
PER CENT FLASHED STEAM
200
175
150
140
130
120
110
100
90
80
70
60
50
45
40
35
30
25
20
14.7
12
10
8
6
4
PRESS. PSIA
2 PSIA
1½" HG.
FLASHED STEAM CHART
WATER TEMP. VS. STEAM FLASHED IN PERCENT OF TOTAL WATER QUANTITY.
EUGENE DIETZGEN CO. MADE IN U. S. A.
NO 340 -20 DIETZGEN GRAPH PAPER 20 X 20 PER INCH

SECTION C

WELL TEMPERATURE SURVEYS
AND
COMPLETION PROFILES

C WELL TEMPERATURE SURVEYS AND COMPLETION PROFILES

A temperature survey was run on each well after it had been shut in for several hours. The intent was to determine the formation temperatures and thereby get some indication possibly of the producing strata.

All temperatures were taken by means of an Amerada RPG-3 Recording instrument with a V. E. Kuster KT thermostatic element. Temperatures versus depth were as shown on the following pages C 3 thru C 6 and as plotted on page C 7.

We were unable to run the instrument to the bottom of any of the wells due to obstructions of some sort.

Well #4 shows the hottest temperature at depth and the coolest at the surface. The cool temperature at the surface could possibly be due to the casing being shallower in this well than in any of the others. You will note that surface temperatures on Well #2 are greater than the others and also that it has the deepest casing setting.

Well #1 shows a drop off in temperature from 525 ft. on down which can possibly be due to a cold stratum of water intruding below the hotter stratum.

Both wells #2 and #3 showed increasing temperatures toward the bottom indicating that increased depth could possibly have improved their producing characteristics.

Well completion profiles are shown on pages C 8 thru C 11, which indicate the casing sizes and depth and holes sizes, depth of each. The major difference in the wells is that Well #4 was completed with the largest and deepest hole which may account for its greater producing capabilities. All data shown on these pages were taken during the drilling operation with the temperatures being taken by means of a maximum indicating thermometer mounted on the drill bit. These wells were all drilled allowing the steam to blow out the drill cuttings; therefore, static pressures and flowing pressures were recorded as they changed during drilling.

TEMPERATURE SURVEY

WELL No 1 — WELL CONDITION: SHUT IN FOR 5 HRS. PRIOR TO SURVEY.

DATE: JULY 3, 1961

MEASURING INSTRUMENT: AMERADA RPG-3 RECORDER WITH KUSTER KT ELEMENT.

INSTR. ZERO DEFLECTION: .020"

TIME	REMARKS	DEPTH, YDS	DEPTH, FT.	INSTR. DEFL.	DEFL. -.020"	TEMP. °F
2:24	INSTR. LOADED	0	0	—	—	—
2:34	ON TOP OF VALVE	0	0	—	—	—
2:36	VALVE OPENED	0	0	.335	.315	339.5
2:38	INSTR. LOWERED	7	21	.342	.322	340.8
2:40		14	42	.345	.325	341.3
2:42		21	63	.350	.330	342.2
2:44		28	84	.356	.336	343.2
2:46		35	105	.359	.339	343.7
2:48		42	126	.361	.341	344.0
2:50		49	147	.369	.349	345.4
2:52		56	168	.377	.357	346.8
2:54		63	189	.388	.368	348.6
2:56		70	210	.396	.376	350.1
2:58		77	231	.403	.383	351.3
3:00		84	252	.414	.394	353.3
3:02		91	273	.422	.402	354.7
3:04		98	294	.429	.409	356.0
3:06		105	315	.439	.419	357.8
3:08		112	336	.448	.428	359.4
3:10		119	357	.456	.436	360.7
3:12		126	378	.465	.445	361.9
3:14		133	399	.473	.453	363.0
3:16		140	420	.490	.470	365.4
3:18		147	441	.508	.488	367.9
3:20		154	462	.517	.497	369.2
3:22		161	483	.524	.504	370.2
3:24		168	504	.524	.504	370.2
3:26		175	525	.544	.524	373.0
3:28		182	546	.522	.502	369.9
3:30		189	567	.358	.338	343.5
3:32		196	588	.269	.249	325.7
3:34		203	609	.278	.258	327.6
3:36		210	630	.285	.265	329.0
3:38		217	651	.245	.225	320.8
3:40	INSTR. ON BOTTOM	217.5	652	.241	.221	320.0
3:48	START OUT					
3:52	INSTR. AT TOP	0	0			
4:04	" OUT OF PIPE	0	0			

EUGENE DIETZGEN CO. MADE IN U. S. A. NO. 340-20 DIETZGEN GRAPH PAPER 20 X 20 PER INCH

TEMPERATURE SURVEY

WELL NO. 2   WELL CONDITION: SHUT IN FOR 24 HRS. PRIOR TO SURVEY.

DATE: JUNE 30, 1961

MEASURING INSTRUMENT: AMERADA RPG-3 RECORDER WITH KUSTER KT ELEMENT.

INSTR. ZERO DEFLECTION: .026

TIME	REMARKS	DEPTH, YDS.	DEPTH FT.	INSTR. DEFL.	DEFL. -.026"	TEMP °F
2:21	INSTR. LOADED	0	0			
2:24	ON TOP OF VALVE	0	0			
2:27	VALVE OPENED	0	0	.462	.436	360.7
2:30	INSTR. LOWERED	7	21	.467	.441	361.4
2:32		14	42	.475	.449	362.5
2:34		21	63	.475	.449	362.5
2:36		28	84	.485	.459	363.9
2:38		35	105	.493	.469	365.3
2:40		42	126	.500	.474	366.0
2:42		49	147	.502	.476	366.3
2:44		56	168	.505	.479	366.7
2:46		63	189	.506	.480	366.8
2:48		70	210	.507	.481	367.0
2:50		77	231	.507	.481	367.0
2:52		84	252	.510	.484	367.4
2:54		91	273	↓	↓	↓
2:56		98	294	↓	↓	↓
2:58		105	315	.511	.485	367.5
3:00		112	336	↓	↓	↓
3:02		119	357	↓	↓	↓
3:04		126	378	↓	↓	↓
3:06		133	399	↓	↓	↓
3:08		140	420	↓	↓	↓
3:10		147	441	↓	↓	↓
3:12		154	462	↓	↓	↓
3:14		161	483	.528	.502	369.9
3:16		168	504	.550	.524	373.0
3:18		175	525	.571	.545	375.8
3:20		182	546	.577	.551	376.5
3:22		189	567	.586	.560	377.6
3:24		196	588	.598	.572	379.0
3:26	INSTR. ON BOTTOM	200	600	.610	.584	380.5
3:35	LIFTED OFF "					
3:39	INSTR AT TOP					
3:41	" OUT OF PIPE					
3:45	INSTR OUT OF PIPE					
3:49	" " OF CASE					

EUGENE DIETZGEN CO. MADE IN U. S. A.

NO 340 20 DIETZGEN GRAPH PAPER 20 X 20 PER INCH

TEMPERATURE SURVEY

WELL NO. 3 WELL CONDITION: SHUT IN FOR 48 HRS. PRIOR TO SURVEY

DATE: JUNE 30, 1961

MEASURING INSTRUMENT: AMERADA RPG-3 RECORDER WITH KUSTER KT ELEMENT

INSTR. ZERO DEFLECTION: .032"

TIME	REMARKS	DEPTH, YDS.	DEPTH, FT.	INSTR. DEFL.	DEFL. - .032"	TEMP., °F
9:55	UNIT LOADED	0	0	0	0	—
10:12	VALVE OPENED	0	0	.440	.408	355.8
10:14	INSTR. LOWERED	7	21	.440	.408	355.8
10:16		14	42	.469	.437	360.7
10:18		21	63	.474	.442	361.5
10:20		28	84	.479	.447	362.2
10:22		35	105	.483	.451	362.8
10:24		42	126	.485	.453	363.0
10:26		49	147	.488	.456	363.5
10:28		56	168			
10:30		63	189			
10:32		70	210			
10:34		77	231			
10:36		84	252	.489	.457	363.6
10:38		91	273			
10:40		98	294			
10:42		105	315			
10:44		112	336			
10:46		119	357			
10:48		126	378	.491	.459	363.9
10:50		133	399			
10:52		140	420			
10:54		147	441			
10:56		154	462			
10:58		161	483			
11:00		168	504	.492	.460	364.0
11:02		175	525	.511	.479	366.7
11:04		182	546	.532	.500	369.6
11:06		189	567	.555	.523	372.8
11:08		196	588	.576	.544	375.7
11:10		203	609	.588	.556	377.1
11:12		210	630	.590	.558	377.4
11:14		217	651	.590	.558	377.4
11:16		225	675	.592	.560	377.6
11:18	ON BOTTOM	230	690	.611	.579	379.9

TEMPERATURE SURVEY

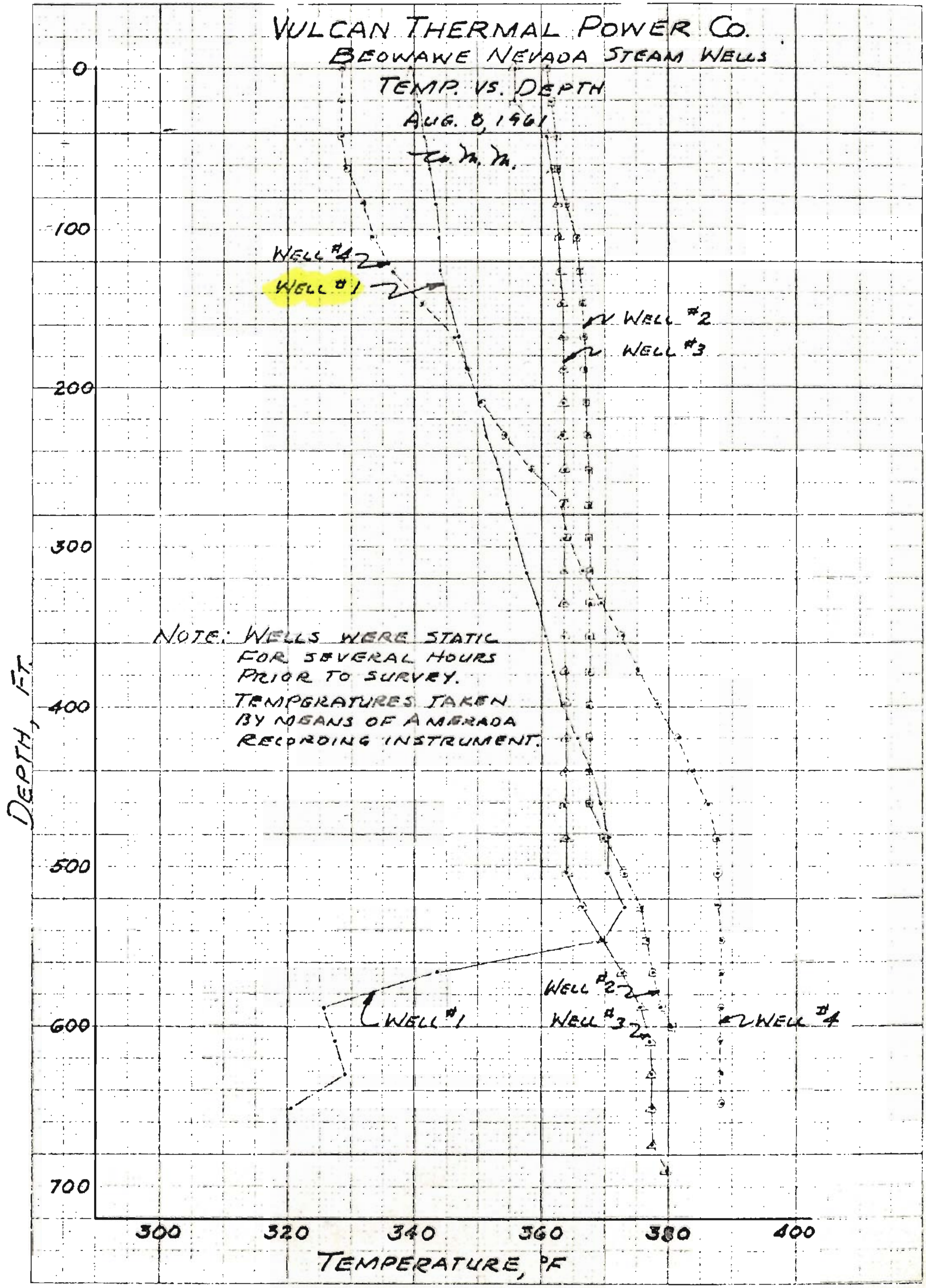
WELL NO. 4 WELL CONDITION: SHUT IN FOR 26 HRS. PRIOR TO SURVEY.

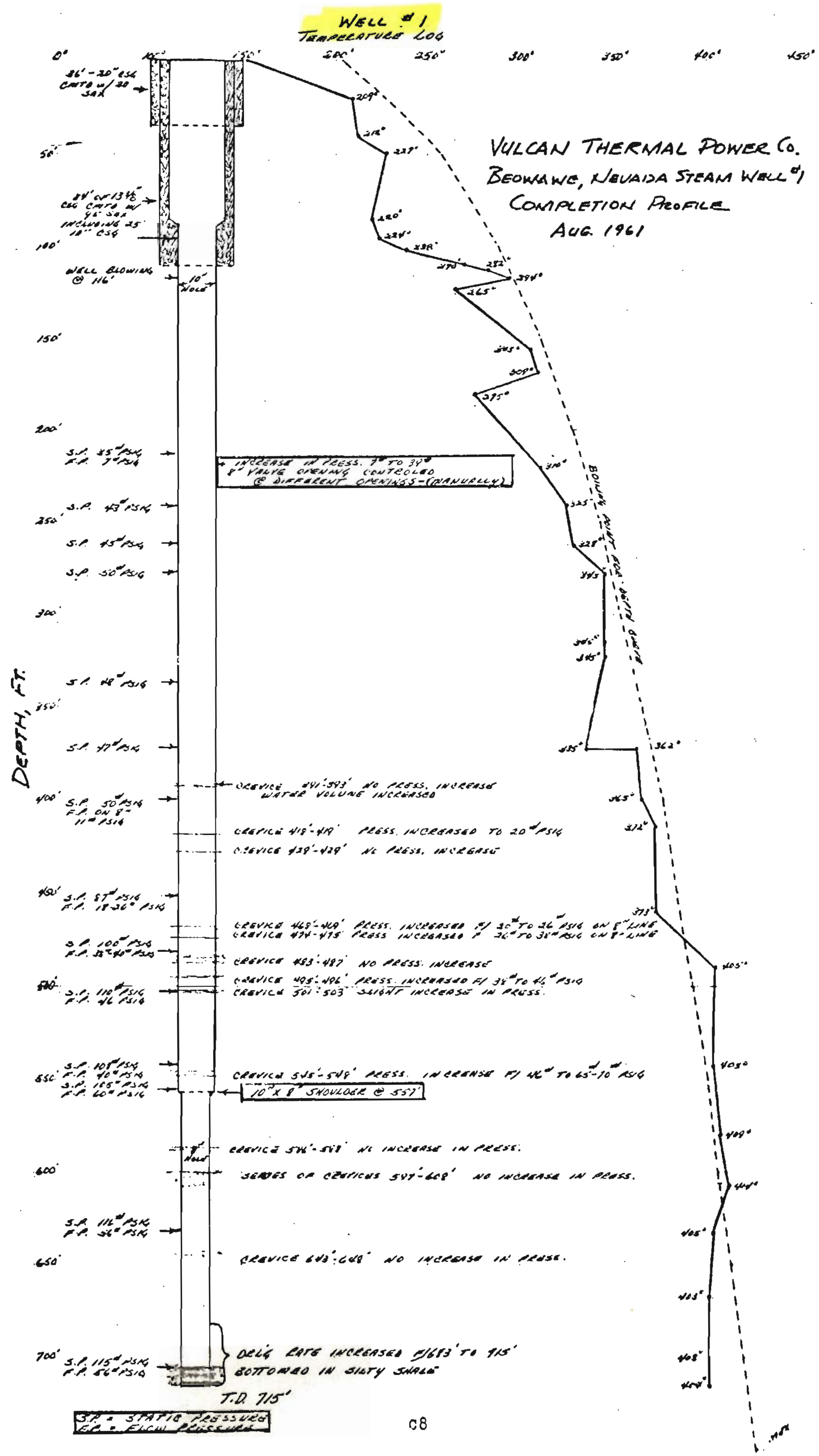
DATE: JULY 4, 1961

MEASURING INSTRUMENT AMERADA RPG-3 RECORDER WITH KUSTER KT ELEMENT.

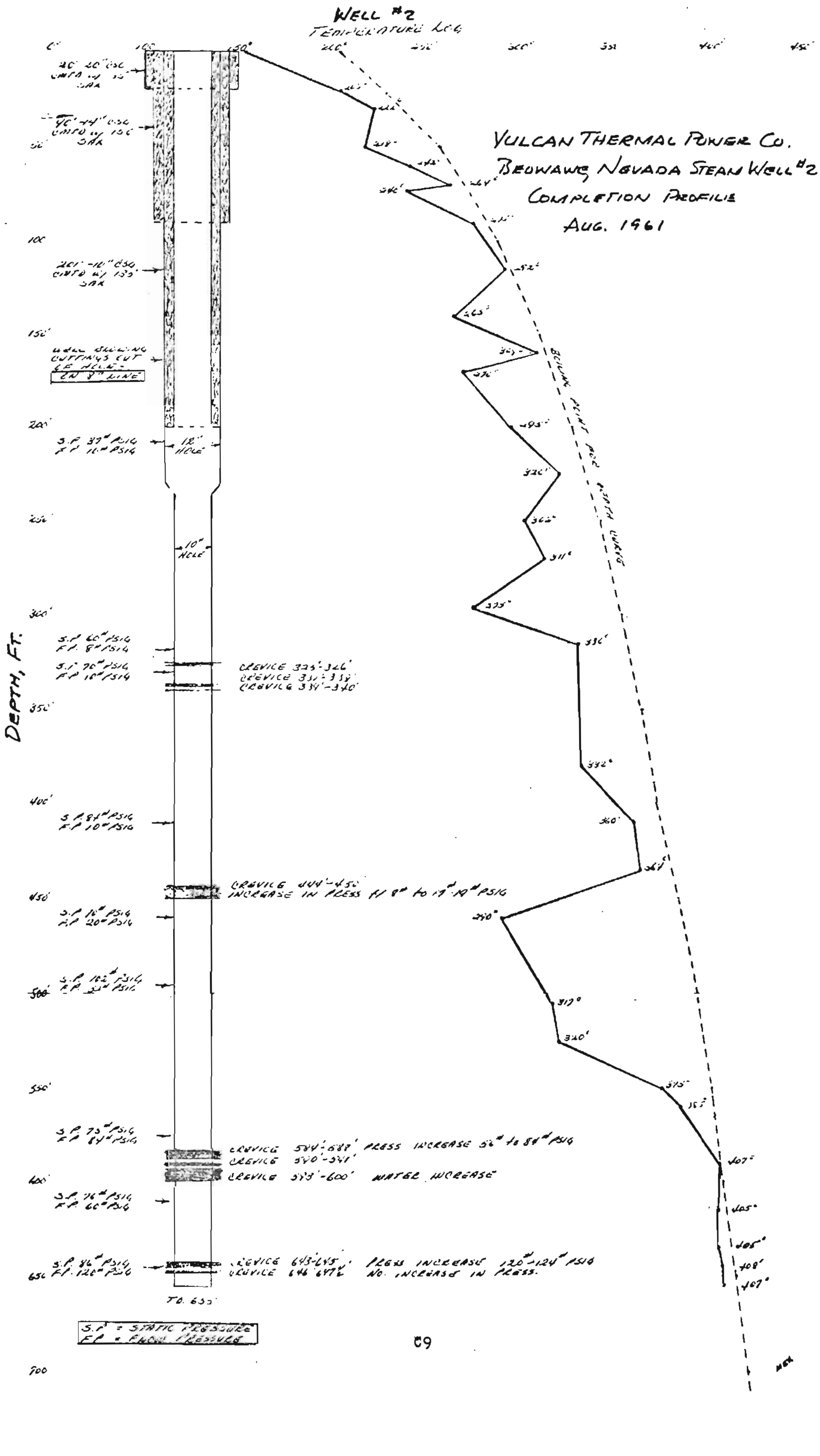
INSTR. ZERO DEFLECTION: .024"

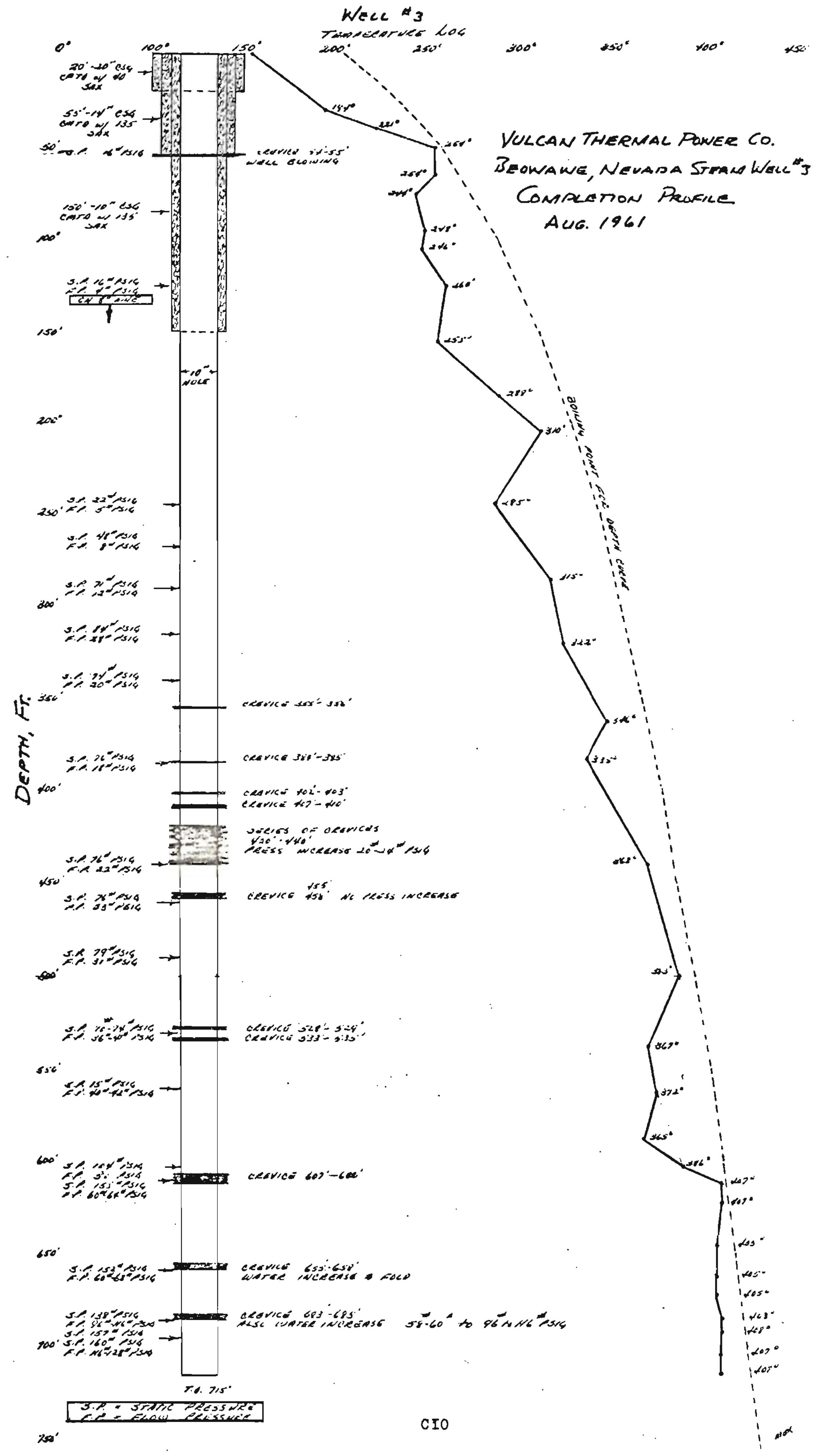
TIME	REMARKS	DEPTH, YDS	DEPTH, FT	INSTR. DEFL.	DEFL. -.024"	TEMP. °F
9:01	INSTR. LOADED	0	0	–	—	—
9:15	ON TOP OF VALVE	0	0	–	—	—
9:20	VALVE OPENED	0	0	–	—	—
9:22	INSTR. LOWERED	7	21	.287	.263	328.6
9:24		14	42	.287	.263	328.6
9:26		21	63	.290	.266	329.2
9:28		28	84	.303	.279	332.0
9:30		35	105	.311	.287	333.7
9:32		42	126	.326	.302	336.8
9:34		49	147	.348	.324	341.1
9:37		56	168	.379	.355	346.4
9:39		63	189	.390	.366	348.3
9:41		70	210	.404	.380	350.8
9:43		77	231	.424	.400	354.4
9:45		84	252	.443	.419	357.8
9:47		91	273	.478	.454	363.2
9:49		98	294	.486	.462	364.3
9:51		105	315	.502	.478	366.5
9:53		112	336	.523	.499	369.5
9:55		119	357	.545	.521	372.6
9:57		126	378	.565	.541	375.3
9:59		133	399	.590	.566	378.3
10:01		140	420	.615	.591	381.4
10:03		147	441	.633	.609	383.7
10:05		154	462	.651	.627	386.1
10:07		161	483	.662	.638	387.5
10:09		168	504	.665	.641	387.9
10:11		175	525	.664	.640	387.7
10:13		182	546	.667	.643	388.1
10:15		189	567	.667	.643	388.1
10:17		196	588	.667	.643	388.1
10:19		203	609	.667	.643	388.1
10:21		210	630	.667	.643	388.1
10:23	INSTR. ON BOTTOM	216	648	.668	.644	388.3
10:34	" OFF "					
10:40	" AT TOP	0	0			
10:43	VALVE CLOSED	0	0			


VULCAN THERMAL POWER CO.
BEOWAWE NEVADA STEAM WELLS
TEMP. VS. DEPTH
AUG. 8, 1961
Depth, Ft.
0
100
200
300
400
500
600
700
Temperature, °F
300
320
340
360
380
400
Well #4
Well #1
Well #2
Well #3
Note: Wells were static for several hours prior to survey. Temperatures taken by means of Amerada recording instrument.

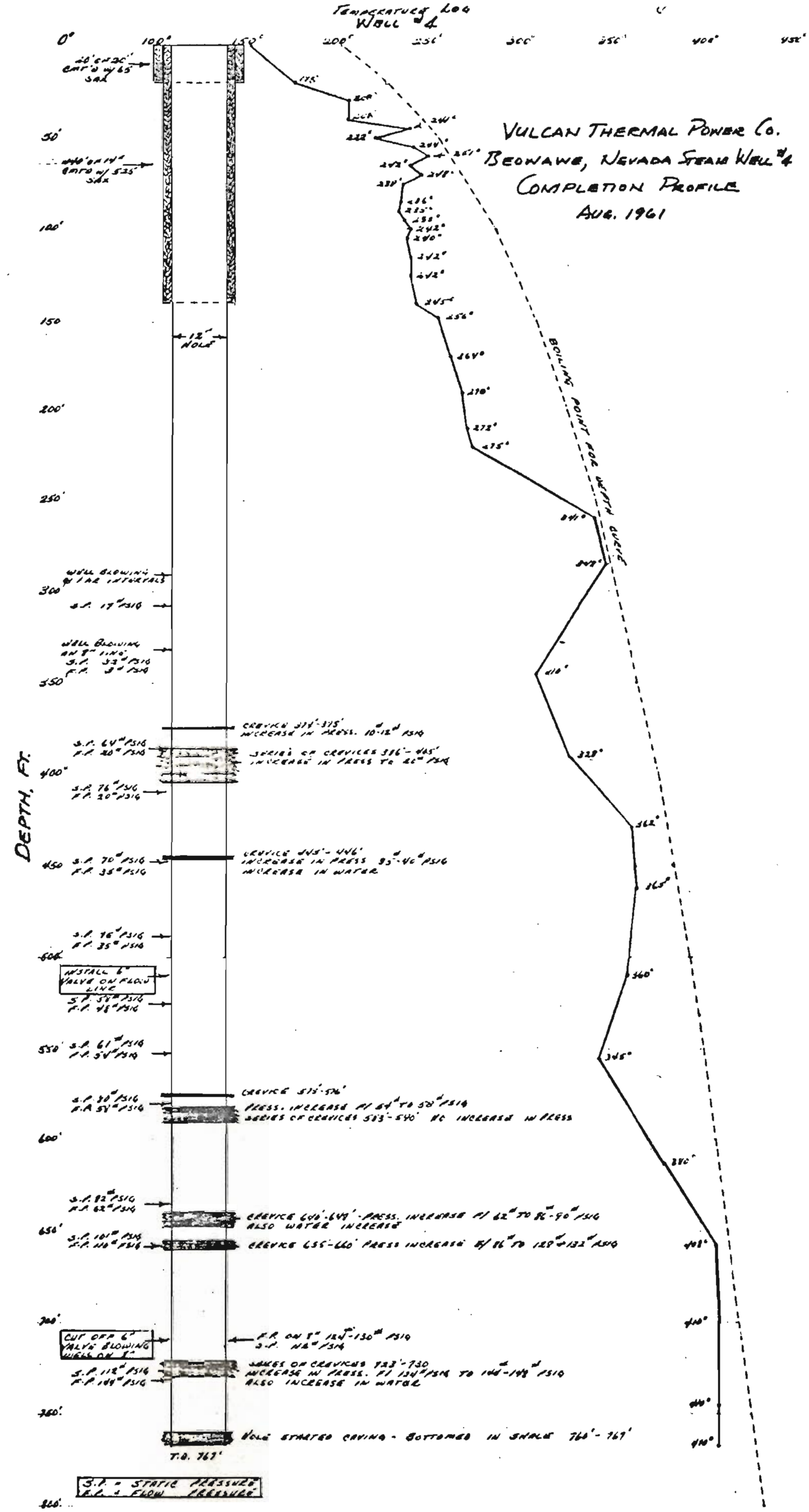


WELL #1
TEMPERATURE LOG
0° 100° 150° 200° 250° 300° 350° 400° 450°
VULCAN THERMAL POWER CO.
BEOWAWE, NEVADA STEAM WELL #1
COMPLETION PROFILE
AUG. 1961
36' - 20" CSG CMTD w/ 20 SAX
84' of 13 3/8" CSG CMTD w/ 45 SAX INCLUDING 25' 10" CSG
WELL BLOWING @ 116'
10" HOLE
DEPTH, FT.
50' 100' 150' 200' 250' 300' 350' 400' 450' 500' 550' 600' 650' 700'
S.P. 35# PSIG F.P. 7# PSIG
INCREASE IN PRESS. 7# TO 34# 8" VALVE OPENING CONTROLED @ DIFFERENT OPENINGS - (MANUALLY)
S.P. 43# PSIG
S.P. 45# PSIG
S.P. 50# PSIG
S.P. 48# PSIG
S.P. 47# PSIG
CREVICE 391'-393' NO PRESS. INCREASE WATER VOLUME INCREASED
S.P. 50# PSIG F.P. ON 8" 11# PSIG
CREVICE 418'-419' PRESS. INCREASED TO 20# PSIG
CREVICE 429'-429' NO PRESS. INCREASE
S.P. 87# PSIG F.P. 18-36# PSIG
CREVICE 469'-469' PRESS. INCREASED F/ 30# TO 36# PSIG ON 8" LINE
CREVICE 474'-475' PRESS INCREASED F/ 36# TO 38# PSIG ON 8" LINE
S.P. 100# PSIG F.P. 38-40# PSIG
CREVICE 483'-487' NO PRESS. INCREASE
CREVICE 495'-496' PRESS. INCREASED F/ 38# TO 46# PSIG
CREVICE 501'-503' SLIGHT INCREASE IN PRESS.
S.P. 110# PSIG F.P. 46 PSIG
S.P. 108# PSIG F.P. 40# PSIG S.P. 125# PSIG F.P. 60# PSIG
CREVICE 545'-548' PRESS. INCREASE F/ 46# TO 65#-70# PSIG
10" x 8" SHOULDER @ 557'
8" HOLE
CREVICE 586'-588' NO INCREASE IN PRESS.
SERIES OF CREVICES 597'-608' NO INCREASE IN PRESS.
S.P. 116# PSIG F.P. 56# PSIG
CREVICE 643'-648' NO INCREASE IN PRESS.
DRLG RATE INCREASED F/683' TO 715'
BOTTOMED IN SILTY SHALE
S.P. 115# PSIG F.P. 56# PSIG
T.D. 715'
BOILING POINT FOR DEPTH
S.P. = STATIC PRESSURE
F.P. = FLOW PRESSURE


WELL #2
TEMPERATURE LOG
VULCAN THERMAL POWER CO.
BEOWAWE NEVADA STEAM WELL #2
COMPLETION PROFILE
AUG. 1961
DEPTH, FT.
T.D. 655'
S.P. = STATIC PRESSURE
F.P. = FLOW PRESSURE
CREVICE 644'-650' INCREASE IN PRESS. F/ 8# to 17#-19# PSIG
CREVICE 598'-600' WATER INCREASE
CREVICE 646'-647½' NO. INCREASE IN PRESS.


Well #3
Temperature Log
Vulcan Thermal Power Co.
Beowawe, Nevada Steam Well #3
Completion Profile
Aug. 1961
Depth, Ft.
Boiling Point for Depth Curve
T.D. 715'
S.P. = Static Pressure
F.P. = Flow Pressure

CIO


Temperature Log Well #4
Vulcan Thermal Power Co.
Beowawe, Nevada Steam Well #4
Completion Profile
Aug. 1961
0°
100°
150°
200°
250°
300°
350°
400°
450°
Depth, Ft.
12" Hole
Boiling Point for Depth Curve
Crevice 374'-375' Increase in Press. 10-12# PSIG
Series of Crevices 386'-405' Increase in Press to 20# PSIG
Crevice 445'-446' Increase in Press 35#-40# PSIG Increase in Water
Crevice 575'-576'
Series of Crevices 583'-590' No Increase in Press
Crevice 640'-649' - Press. Increase Fr 62# to 86-90# PSIG Also Water Increase
Hole Started Caving - Bottomed in Shale 760'-767'
T.D. 767'
S.P. = Static Pressure
F.P. = Flow Pressure

SECTION D

CHEMICAL ANALYSES

D CHEMICAL ANALYSES

The following chemist's report prepared by Ed Wolfe of Abbot Hanks and the Chemical Engineer's report by Mr. Lynn Kisner are self-explanatory.

The primary features influencing power plant design are:

(1) If the geothermal steam is used directly in a conventional low pressure steam turbine low pH steam condensate will require careful selection of materials to prevent corrosion.

(2) The separated water and the steam and water mixture can be handled readily by cast iron or mild steels.

(3) The non-condensible gases consist of H_2S and CO_2 with there being two tenths of one percent by volume of the total steam and gas flow.

(4) The amount of solids found in the steam, as separated for measurement only, were greater than would exist in steam from a more efficient separating setup that would be provided for a power plant.

BRANCH LABORATORY: 1086 MARTIN AVENUE • ITA CLARA • CHERRY 8-5262 CABLE: HANX
BRANCH OFFICE: 61 JORDAN STREET • SAN RAFAEL • GLENWOOD 4-8650

ABBOT A. HANKS, INC.
ESTABLISHED 1866
1300 SANSOME STREET • SAN FRANCISCO 11, CALIFORNIA • EXBROOK 7-2464

Engineers
Assayers
Chemists
Metallurgists
Spectrographers
Soils and Foundations
Consulting · Testing · Inspecting

File No. 1941-1

July 26, 1961

Magma-Thermal Power Project
593 Market Street
San Francisco 5, California

Attention Mr. W. M. Middleton

Re: Vulcan Thermal Power Co.
Beowawe, Nevada

Gentlemen:

Fifty copies of our report on the sampling methods and chemical analyses of the water, steam condensate, and non-condensable gases from the geothermal wells at Beowawe, Nevada, are enclosed.

Sincerely,

ABBOT A. HANKS, INC.

Edward A. Wolfe

Edward A. Wolfe
By Ralph A. Nice

EAW:lm

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File No. 1941-1

SAMPLING AND ANALYSES OF GEOTHERMAL WELLS BEOWAWE, NEVADA

Test Procedures

The samples of water, steam condensate, and non-condensable gases were taken simultaneously from each well. One sampling run was conducted on Wells #2, #3 and #4. A sampling run was attempted on Well #1, but it was unsuccessful due to the manner in which the well was performing.

The water was separated from the steam and non-condensable gases by a separator mounted on the well-head. A sample of the separated water was cooled, while still under line pressure, in a stainless steel coil, and then collected in a polyethylene bottle.

A sample of the steam and non-condensable gases was cooled, while still under line pressure, in another stainless steel coil. The steam was condensed, the condensate removed in a polyethylene collection trap, and collected in a polyethylene bottle. The cool non-condensable gases were removed through the top of the collection trap and conveyed through a stainless steel line to a fully evacuated stainless steel gas cylinder. The amount of condensate and non-condensable gases collected were both measured to determine the ratio between the two.

All systems were thoroughly purged prior to taking the samples. The polyethylene collection bottles were first rinsed with distilled water and then with either the separated water or steam condensate, depending on which was to be collected in the bottle, prior to the beginning of the test run. The samples were only allowed to come in contact with either stainless steel or polyethylene at any time prior to their analysis.

TABLE NO. 1

COMPOSITION OF WATER SAMPLES

Principal Constituents Parts per Million		Well #2	Well #3	Well #4
Silica	SiO_2	478	493	465
Sodium	Na	214	214	208
Bicarbonate	HCO_3	154	101	133
Carbonate	CO_3	137	164	144
Sulfate	SO_4	68	65	71
Chloride	Cl	44	44	43
Sulfide	H_2S	41	43	45
Potassium	K	31	31	31
Fluoride	F	18	16	17
Boron	B	2	3	3
Ammonia	NH_3	1.7	0.7	1.7
Lithium	Li	0.6	0.6	0.6
Aluminum	Al	0.3	0.2	0.7

Other Properties

Specific Conductance Mmhos	750	700	700
pH	9.3	9.2	9.4
Color	None	None	None
Odor	H_2S	H_2S	H_2S
Phenolphthalein Alkalinity ppm	114	137	120
Total Alkalinity ppm	354	357	349
Residue 105°C ppm	1113	1130	1075
Residue 600°C ppm	984	960	924

Trace Constituents - Detectable but less than 0.1 ppm:

Iron, Calcium, Magnesium, Titanium, Manganese, Vanadium, Copper, Chromium and Hardness.

Sampling & Analyses of Geothermal Wells
Beowawe, Nevada

Abbot A. Hanks, Inc.
File No. 1941-1

TABLE NO. 2

COMPOSITION OF CONDENSATE SAMPLES

	Well #2	Well #3	Well #4
pH	4.2	5.6	5.4
Specific Conductance at 25°C, Mmhos	80	50	90
Color	None	None	None
Odor	H_2S	H_2S	H_2S
Residue, 105°C	4.0	7.3	11.0
Residue, 600°C	2.3	0.9	9.7
Silica	0.3	0.7	0.7
Sodium	0.7	1	2
Boron	0.3	0.2	0.1
Chloride	2	0.5	2.5
Sulfate	1	0.6	0.6
Sulfide at H_2S	26.0	5.2	17.0
Ammonia	12.5	10.9	11.0
Carbon Dioxide	545	85	200
Acidity to pH 8.2 as $CaCO_3$	587	106	295

TABLE NO. 3

NON-CONDENSABLE GASES IN STEAM AND CONDENSATE

	Well #2	Well #3	Well #4
Steam condensed, l.	18,370	18,696	16,366
Volume condensate recovered, ml.	11,000	11,195	9,800
Percent non-condensable gases in steam (% by Vol.)	0.21	0.19	0.22
Non-condensable gases recovered, ml.	35,500	35,200	34,900
CO_2 in condensate, ml.	3365	537	1100
H_2S in condensate, ml.	208	42	121
NH_3 in condensate, ml.	200	177	157
Total gases, ml.	39,273	39,956	36,278

TABLE NO. 4

COMPOSITION OF NON-CONDENSABLE GASES

		Well #2	Well #3	Well #4
Hydrogen sulfide	(H_2S) % by Vol.	0.95	0.68	0.80
	% by Wt.	0.74	0.53	0.62
Carbon dioxide	(CO_2) % by Vol. (By Difference)	99.05	99.32	99.20
	% by Wt. (By Difference)	99.26	99.47	99.38

An infrared spectra of the sample indicated that there were no other gases present.

The samples of steam condensate and non-condensable gases from Well #3 were not cooled to the desired temperature, prior to collection, due to physical conditions existing at that well that day.

DG ABBOT A. HANKS, INC.

Edward A. Wolfe

Edward A. Wolfe

By Ralph A. Nice

E. LYNN KISNER
Chemical Engineer
16330 Greenwood Lane
Los Gatos, California

August 9, 1961

Thermal Power Company
593 Market Street
San Francisco 5, California

Attn: Mr. W. M. Middleton

Subject: Interpretation of Chemical Report
Vulcan Thermal Power Co.

Gentlemen:

I have studied the analytical reports dated July 26, 1961 by Abbot A. Hanks, Inc. of water, condensate and gases from geothermal wells #2, #3 and #4 located at Beowawe, Nevada.

These samples are typical magmatic waters derived essentially from water vapor released from molten rock or otherwise produced far below the earth's crust. The presence of boron, sulphur and fluoride as well as the high free carbon dioxide content serves to differentiate them as to origin from well water and river water, for example, which are precipitated from the atmosphere.

A comparison with several other geothermal steam wells which we have examined shows that these three Nevada wells are appreciably lower with respect to total dissolved solids, chloride and boron.

The operator may consider whether or not this abundant water supply can be profitably utilized either for home use, stock watering, recreational purposes, irrigation and propagation of fish or some combination thereof. Do these waters, after separation from steam, meet the fixed or arbitrary standards for such usages under consideration? If not, can the water be treated economically in order to render it serviceable?

If the operator is not interested in any beneficial utilization but solely with disposal then its effect upon the immediate surface and underground waters would require further study. Such matters as State laws, if any, the proximity of crops, forests, etc., would be pertinent. It is quite likely that no treatment would be required.

The fluoride content in domestic supplies permitted by the U. S. Public Health Service is 1.5 parts per million. The wells averaging about 17 ppm may be reduced to a satisfactory level by the economical process of lime-soda softening in the presence of high magnesium. Although the reported tolerances of fluoride for livestock have not been in close agreement it is likely that a concentration of 17 ppm would eventually damage their teeth, bones and general health. Fish and plant life are not adversely affected.

The elemental boron content does not exceed 2.5 ppm. Up to 30 ppm in drinking water is not regarded as hazardous to human beings and the same is analogous for animals. Concentrations above 0.5 ppm are injurious to many plants and concentrations within the range of 2 to 5 ppm are considered injurious to most plants. A selection therefore of plants on the basis of tolerance to boron permits the use of these waters for irrigation purposes.

The dissolved solids averaging about 1100 ppm are lower than values found in other steam wells we have examined. These values are very close to the limit of 1000 ppm prescribed for public water supplies. The 1100 ppm is considered quite satisfactory for livestock and wildlife watering and fish propagation. Since the drainage is reported as good, these waters, with respect to solids, are also satisfactory for growing all types of plants.

Hydrogen sulphide which has the characteristic odor of rotten eggs is objectionable in drinking water but it is present in many municipal supplies. Concentrations of the order reported are considered toxic to fish but the concentration may be reduced by aeration.

The objectionable features without treatment are:

a) Drinking water: flouride too high, total solids marginal, hydrogen sulphide objectionable.

b) Stock and wild life water: fluoride marginal

c) Agriculture: Some plants are not tolerant of the boron.

d) Fish: hydrogen sulphide too high.

e) Recreation: suitable if sulphide is removed.

Table No. 2 in the laboratory report shows high concentrations of carbon dioxide, hydrogen sulphide and ammonia in the steam condensate. These gases may be reduced, if desired, by deaeration. The dissolved solids in the steam condensate range from 4-11 ppm due to the entrainment of water in the steam. The values are considerably higher than steam produced by high pressure boilers but I see no need for faulting the efficiency of the separator.

The non-condensable gases in the steam fraction are essentially carbon dioxide with about 1% hydrogen sulphide. The percentage of non-condensable in the steam by volume is shown in table #3. The corresponding percentages by weight are 0.47, 0.45 and 0.51. These latter values are necessary for equipment design purposes.

The International Nickel Company of New York conducted field tests upon various types of metallic specimens inserted in geothermal steam turbines, condensors and ejectors. They reported mild steel as apparently satisfactory 4 mils per year, cast iron 3 mils, copper 17, bronze 5 and 304 stainless less than 0.1. Steam condensate shows similar results with the exception of bronze at 11 mils. I should anticipate that the corrosion of the well water would be even lower because of its more favorable pH.

In case the corrosion rate in actual service is found to be higher than anticipated, the continuous introduction of a filming amine solution into the steam entering the turbine is recommended. This treatment protects the metals in the wetted areas against attack by forming an impervious film. The equipment and chemical costs are modest and the controls simple.

Very truly yours,

E. Lynn Kisner

E. Lynn Kisner

ELK:oe

SECTION E

POWER PRODUCING CAPABILITIES

E POWER PRODUCING CAPABILITIES

To produce power from this geothermal heat source one would tie all the wells together in a common collecting piping system and go to a common steam and water separator, flash tank or heat exchanger, depending on the chosen system of power production. All wells can be tied together and allow each to take its load without any regulation between wells.

One other fundamental steam well characteristic that should be recognized is that as the producing pressure is decreased the flow increases. Consequently one should choose a producing pressure as low as possible in order to minimize the investment in steam wells and collecting piping system.

The first scheme of power production one would consider is the use of a conventional steam turbine injecting the flashed geothermal steam direct into a turbine. In this scheme the equipment would consist of one or more flash tanks with steam purifiers depending on the number of stages of flash, a single or multiple entry turbine; a spray type barometric condenser, a cooling tower or spray pond, circulating water pumps and air ejectors. Using this scheme one could either use mechanical air ejection or steam air ejectors depending on the economics of each. With the producing pressures experienced at this location it would appear that steam air ejectors would be preferred because of their lack of moving parts and their dependability. As for the source of cooling water, whether one uses a cooling tower, pond or spray pond this would also be subject to the economics of each, realizing that there is all the real estate necessary for any type and that minimum temperatures in this area can be as low as 30°F. below zero.

From the plot of well productions shown on page B 9, it is apparent that at 80 psig. well head pressure, approximately 1,860 million BTU/hr. (6.0 million #/hr.) could be produced from these three wells at 340°F. At this temperature 12.6% would flash to steam at 17.2 psia. Using a steam rate of 27.25 lbs./KW hr. one could generate 27,700 KW in a conventional single inlet steam turbine. This would be improved by about 25% if two stages of flash were used and by about 50% if three stages of flash were used.

The second scheme for use of this heat source is for feed water heating in a conventional steam boiler-turbine plant, wherein the geothermal heat replaces the steam bled from the turbine for this purpose. In this scheme one would not separate the geothermal steam from the water and thereby be exposed to the corrosive tendencies of the acidic condensate.

The third scheme consists of a cycle wherein a low boiling point fluid such as Freon 22 drives the turbine with the geothermal steam and water cascading down thru the Freon superheater to the Freon evaporator, thence to the Freon heater from which it discharges to the atmosphere at around 150°F. By this method approximately 51,500 KW can be generated from the 6.0 million lbs./hr. of water at 340°F.

The Freon in this third scheme is maintained above atmospheric pressure at all times; therefore no air ejection is required. The geothermal water and steam is not separated in this scheme, consequently no air ejection, no corrosive gases need be handled and there are no problems handling corrosive steam condensate.

16p

94

FIELD DATA FROM GEOTHERMAL STEAM WELL TESTS

ON

BEOWAWE-NEVADA GEOTHERMAL STEAM WELLS

FOR

MAGMA-VULCAN THERMAL POWER PROJECT

MARCH 30-APRIL 1, 1962

PREPARED BY

WILLIAM W. ALLEN

ENGINEER, MAGMA POWER CO.

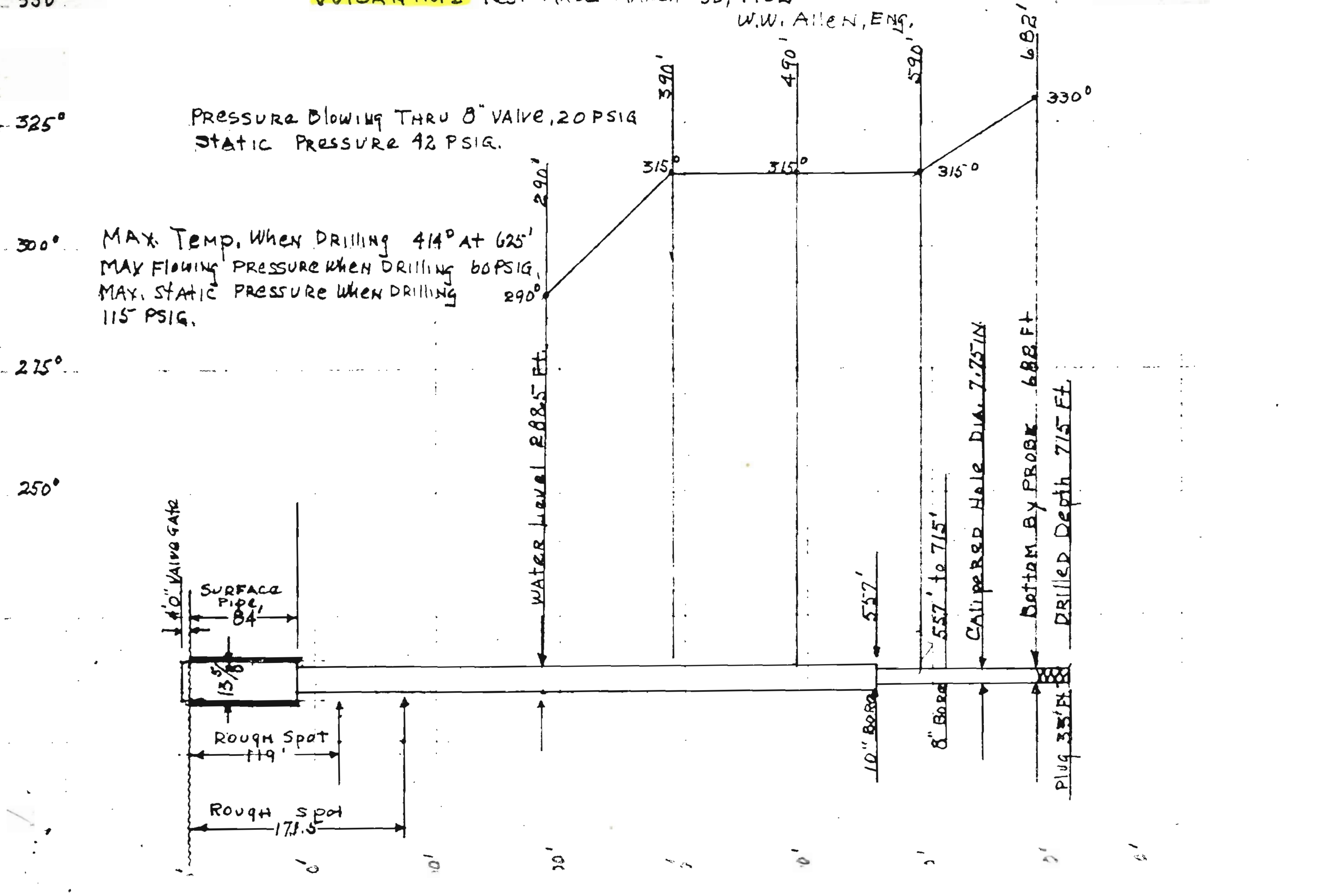
8

VULCAN No. 1 Test Made March 30, 1962

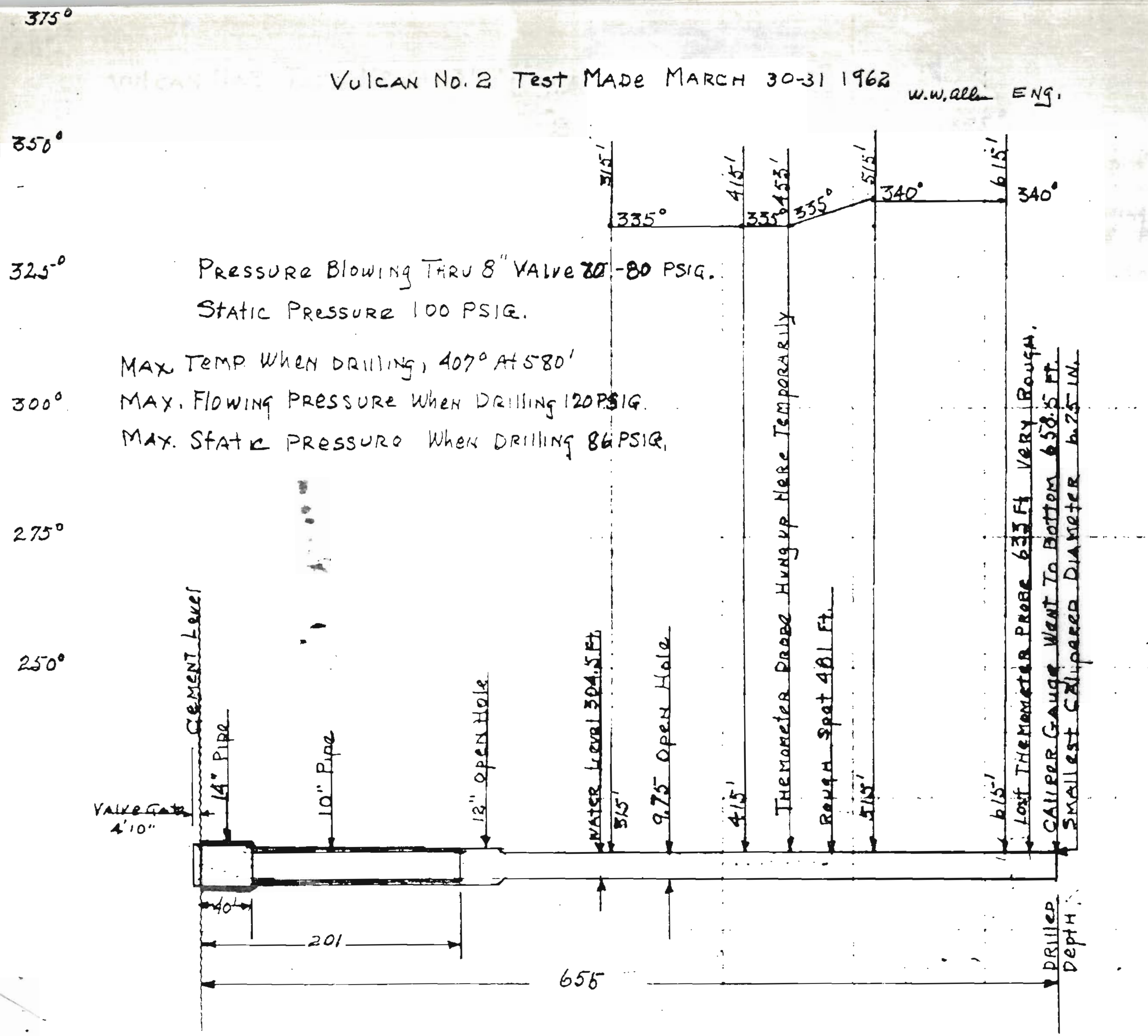
W.W. Allen, Eng.

Pressure Blowing Thru 8" Valve, 20 PSIG
Static Pressure 42 PSIG.

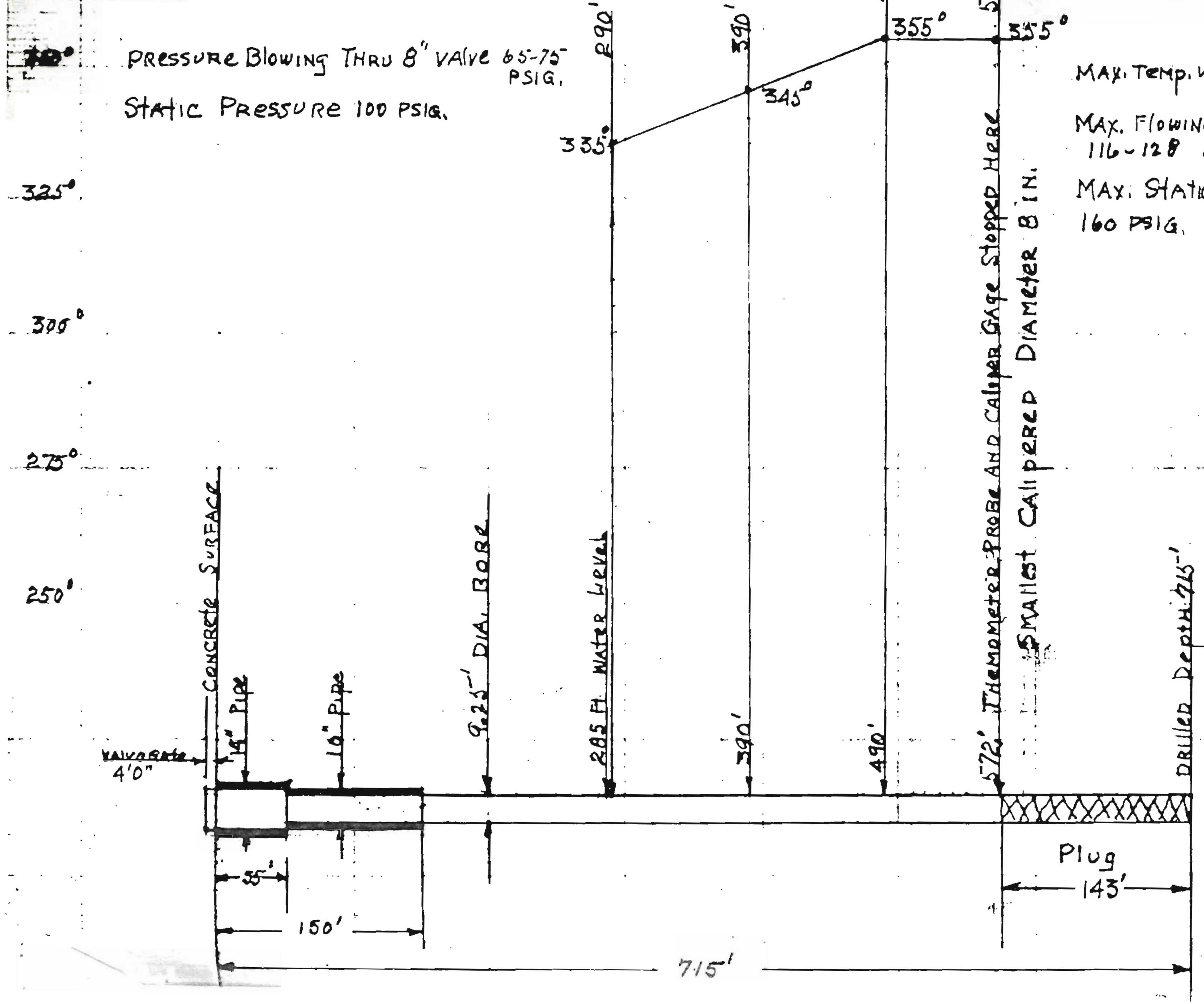
MAX. Temp. When Drilling 414° At 625'
MAX Flowing Pressure When Drilling 60 PSIG.
MAX. Static Pressure When Drilling 115 PSIG.



VULCAN No. 2 TEST MADE MARCH 30-31 1962 W. W. Allen ENG.



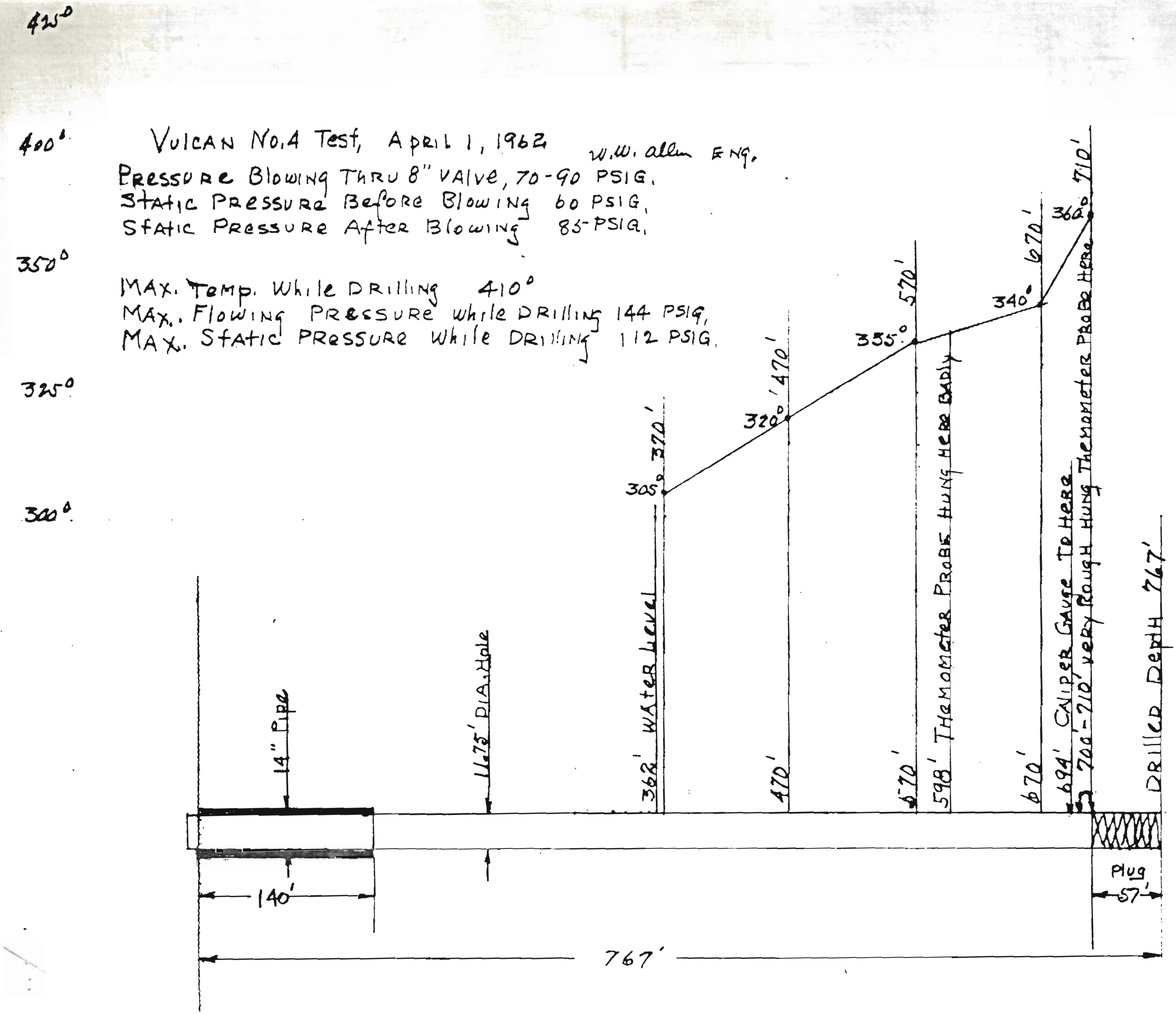
VULCAN No.3 Test MARCH 31, 1962 W.H. Allen Eng.



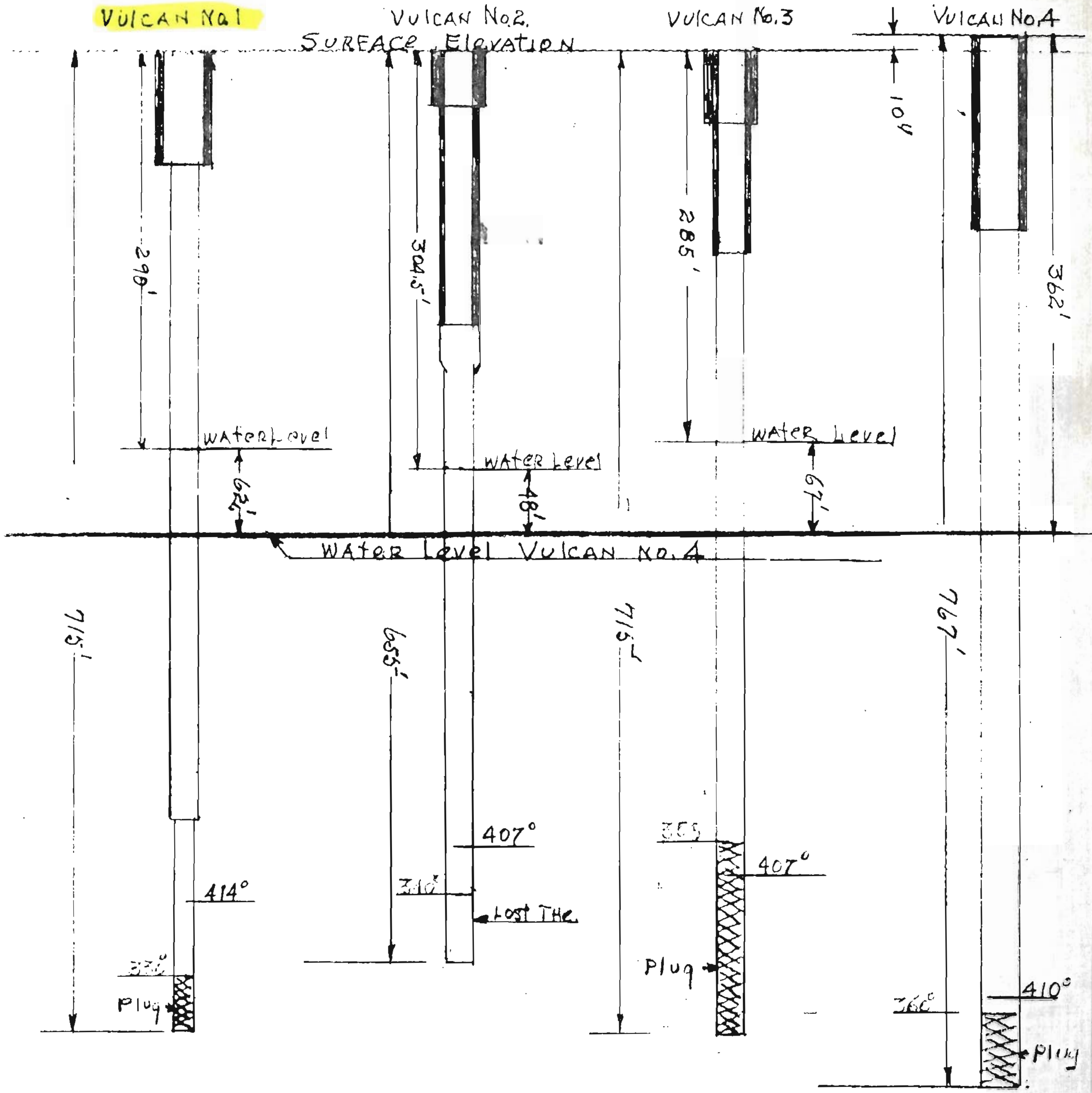
MAX. TEMP. WHEN DRILLING 407° At 600 Ft.

MAX. FLOWING PRESSURE WHEN DRILLING 116-128 PSIG.

MAX. STATIC PRESSURE WHEN DRILLING 160 PSIG.



425°
400°
350°
325°
300°
VULCAN No. 4 Test, April 1, 1962
W. W. Allen ENG.
PRESSURE BLOWING THRU 8" VALVE, 70-90 PSIG.
STATIC PRESSURE BEFORE BLOWING 60 PSIG.
STATIC PRESSURE AFTER BLOWING 85-PSIG.
MAX. TEMP. WHILE DRILLING 410°
MAX. FLOWING PRESSURE WHILE DRILLING 144 PSIG.
MAX. STATIC PRESSURE WHILE DRILLING 112 PSIG.
305°
370'
320°
470'
355°
570'
340°
670'
360°
710'
14" Pipe
11.75' DIA. Hole
362' WATER LEVEL
470'
570'
598' THERMOMETER PROBE HUNG HERE BADLY
670'
694' CALIPER GAUGE TO HERE
700'-710' VERY ROUGH HUNG THERMOMETER PROBE HERE
DRILLED DEPTH 767'
140'
Plug
57'
767'



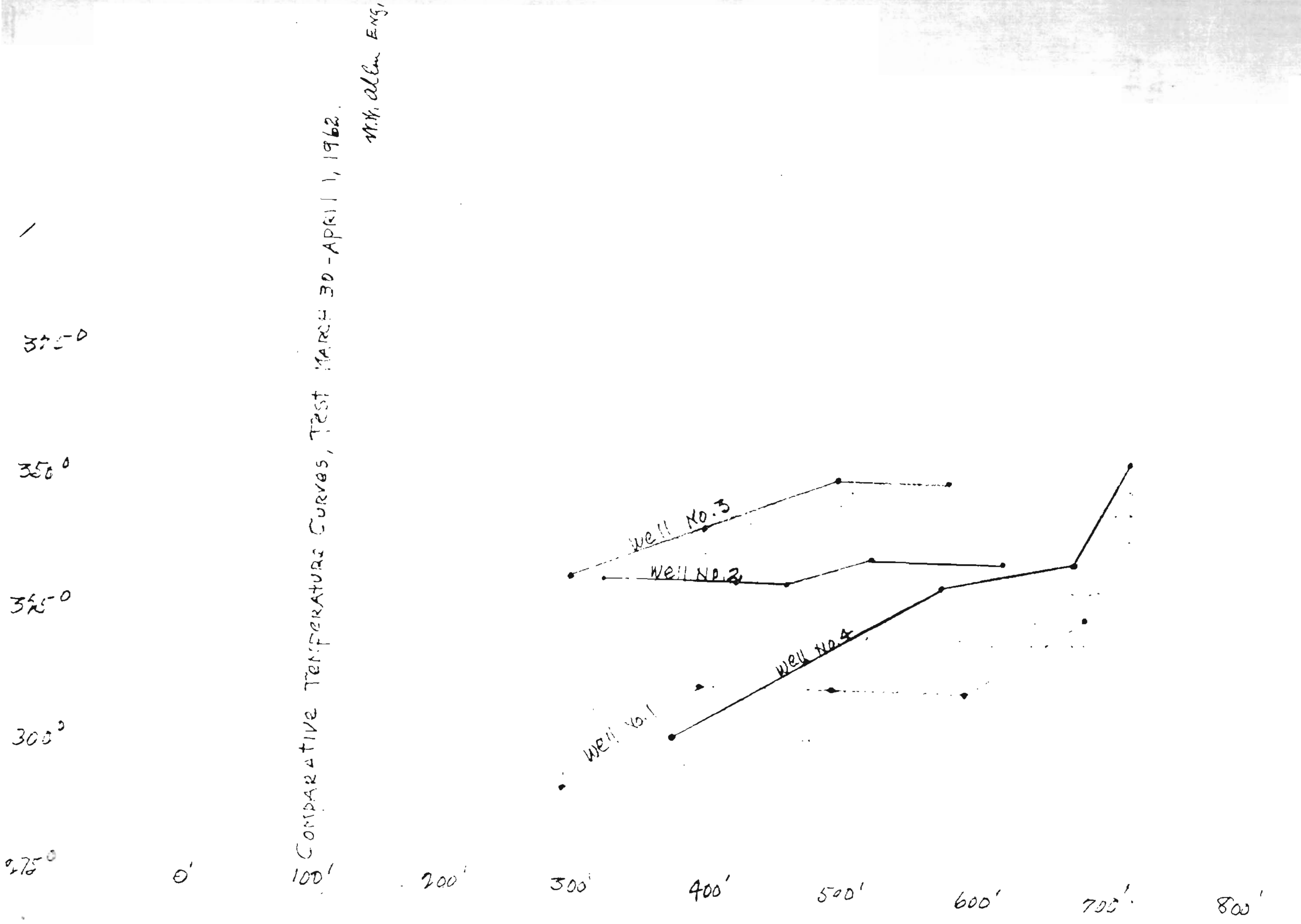
AXIMUM DRILLING TEMPERATURES AT THEIR RESPECTIVE DEPTHS IN ▬

MAXIMUM TEST TEMPERATURES AT THEIR RESPECTIVE DEPTHS IN ▬

WATER LEVELS COMPARED TO A COMMON DATUM PLANE.

TESTS MARCH 30 – APRIL 1, 1962

W. W. Allen Eng.


COMPARATIVE TEMPERATURE CURVES, TEST MARCH 30 - APRIL 1, 1962.
W.H. Allen Eng.
375°
350°
325°
300°
275°
0'
100'
200'
300'
400'
500'
600'
700'
800'
Well No.3
Well No.2
Well No.4
Well No.1

Well No. 1, Test March 30, 1962

Well No. 1 had been discharging for several months thru an 8 in. flow line.

Pressure blowing thru 8 in. flow line,	20 PSIG
Static pressure after closing well in	42 PSIG

Plumbed well with 4 x 4 x 20 in. oak float for water	
Water level from gate of 12 in. master valve	288.5 ft.
Gate of master valve above cement platform	4.0 ft.

Temperature Measurements:

Temperature measurements were taken by using maximum recording themometer, 200° to 500° range attached to a plumb weight of 1 1/2 dia. steel rod, 36 in. long.

First run to	290 ft.,	surface of boiling water	290°
Second run	390 ft.		315°
Third run	490 ft.		315°
Fourth run	590 ft.		315°
Fifth run	682 ft.	Bottomed	330°

Caliper of bore:

Calipering of the bore was done with a special built caliper consisting of four spring staves mounted axially around a monel metal shaft, 1 1/2 diameter by 4 ft. long. The staves were fixed rigidly at the upper end of the shaft and the lower ends attached to a running block which was free to slide on the shaft. The movement of the running block was restricted by a split register block, spring loaded, located below the running block. The staves were preformed to a diameter of 18 in. The weight of the shaft was sufficient to collapse the staves should they encounter diameters less than 18 in. Any collapsing of the spring staves would force the running block downward against the spring loaded register block. In this manner the register block would caliper the smallest diameter thru which the instrument passed.

At 119 ft. a very rough spot was passed thru,	
At 171.5 ft. a lesser rough spot was encountered,	
Caliper gauge bottomed at	682 ft.
Upon removal register block indicated that the smallest bore passed thru was	7.75 in.
The origional well bore	8.0 in.

This would indicate that the bore was clean of any buildup.

Well No. 1.

Well head condition:

The valves and surface pipe and flanges were in fair condition, better than any of the four wells. The packing glands on both the master valve and flow line valve should be repacked with steam packing in place of ordinary water pump packing. This would prevent a great deal of the chemical build up which occours when leaks occour around the stems and the chemical laden water flows over the valve body, bolts and flanges corroding them badly in just a few weeks. The master valve leaks slightly when the well is closed in. Otherwise the well head setup is in the best shape of any of the four.

Ground conditions around well head.

There a great many leaks, or fumeroles, in the geyserite capping upon which the well head is located. Some of these are very extensive and active. This leakage area has extended to the West and Southwest especially. There are numerous activities in this area where there were only a few prior to the drilling of the well. Doubtless some of the drop in pressure and volume in this well can be attribut ributed to the leaks thru the geyserite cap. A grout of cement and sand would seal off most of this activity.

Well No. 2	Test March 31, 1962

This well was static, having been closed in Jan. 8, 1962

Static pressure	100 PSIG.
Water plumb stopped at	304.5 ft.
Gate of master valve from cement platform	4 ft. 10 in.

Temperature measurements:

First run, top of boiling water,	315 ft.	335°
Second run,	415 ft.	335°
Third run, Plumb hung up at	453 ft.	335°

Calculated that the bore was closed at 453 ft.
So ran in the well calipers, The calipers went by the 453 ft. obstruction to a depth of 658.5 ft. Doubtless the well bore is very crooked and the themometer plumb was hanging up on the crooked hole.
Reran themometer plumb third time and by working it up and down succeeded in getting it past the crooked hole, depth 515 ft. 340°
Fourth run 615 ft. 340°
Fifth run Themometer plumb became foul at 633 ft. while attempting to work it down the hole. After working several hours to free same the themometer plumb was abandoned in the hole.

Caliper of bore:

In running the caliper gauge in the hole after the themometer plumb hung up at 453 ft. as outlined above, several very rough places were noted, the worst at 481 ft. This is the crookedest hole we have encountered to date.

Smallest hole diameter encountered	6.75 in.
Well bore when drilled	9.75 in.

The difference between the origional well bore and the calipered diameter, Ie, 3 in., could well be accounted for by the extremely crooked and rough hole.

Well No. 2

Well head condition:

The well head condition on this well is extremely bad. A thin, 1 1/4" flange is attached to the surface pipe to carry the master valve. The welding on this flange is extremely poor, steam is leaking thru the weld in several places around the flange. In order to get close enough to the well to mount the testing equipment it was necessary to wrap a heavy canvas around the master valve and surface pipe to prevent getting burned. There is a light spool mounted on the well head flange between the master valve and well head flange and in order to tie this assembly together 4 "C" clamps were cut out of 3/4" plate steel and mounted on the valve flange and well head flange. On the flow line a light 125 lb. valve is mounted. The flow line has a patch where the pipe was eroded away by blowing the well while drilling. The master valve leaks considerable when the well is closed in and this leakage allows a build up of chemicals inside the valve body as well as overflowing and creating a very bad deposit on the outside. It required several hours to get this deposit off before the testing equipment could be mounted.
In the not too distant future this well head is going to give serious trouble and should be completely replaced from the surface up.

Surface conditions around well:

As in the case of No. 1 well there are numerous fumeroles discharging a considerable volume of steam in the immediate vicinity of the well head. It is the writer's belief that these discharging vents and fumeroles can be effectively sealed off by using a sand cement grout. Undoubtedly they have some effect on the well capacity.

Well No. 3 | Test March 31, 1962

This well was static, having been closed in Jan. 8, 1962

Static pressure	100 PSIG

Water plumb stopped at	281.75 ft.

At this point the boiling was extremely violent
Valve gate 4 ft. from cement platform.

Temperature measurements:

First run,	290 ft., just below violent boiling	335°
Second run	390 ft.	345°
Third run	490 ft.	355°
Fourth run	572.25 ft. on bottom	355°

Caliper of bore:

Caliper gauge set down at	572.25 ft.
Smallest hole diameter encountered	8.0 in.
Bore diameter when drilled	9.75 In.
Difference in calipered hole and drilled hole	1.75 in.

The bore in this hole seems to be very much better than in No. 2
No rough spots were encountered either with the themometer plumb or caliper gauge.

There is a 143 ft. bridge or plug in this hole from bottom.

Well No. 3

Well head condition:

The well head condition on this well is much better than No. 2. There is a patch on the flow line as in the case of No. 2 but the well head flange is 2" and does not leak. A light 125 lb. valve is on the flow line and leaks badly around the stem, creating a heavy deposit of chemicals on the valve body. There is no water leg on the pressure gauge outlet which will cause damage to any gauge in a very short time. As in the case with No. 2 well, leakage of the master valve created a heavy chemical deposit on the valve which required several hours to remove before the testing equipment could be mounted.
Repairs to this well head are minor to put it in good operating condition. The light 125 lb. flow line valve should be replaced with a 250 lb. valve.

Surface conditions around well :

There is a large fumerole about 70 ft. Southwest of the well head. Otherwise the surface around this well is fairly good, otherwise.

Well No. 4 Test April 1, 1962

This well static, having been closed in Jan, 8, 1962

Static pressure 60 PSIG

Water plumb stopped at 362.25 ft.
No boiling activity at this depth
Valve gate 44 in. above cement platform.

Temperature measurements:

First run	370 ft.	just below water level	305°
Second run	470 ft.		320°
Third run	570 ft.		335°
Fourth run	670 ft.		340°

On the fourth run very rough hole encountered at 400 to 406 ft., had difficulty working themometer plumb down. Crooked hole at this point.
Fifth run, extremely rough hole 700 to 710 ft. Worked themometer plumb slowly down thru cavy ground to 710 ft. where the plumb fouled. Finally got plumb loose by attaching plumb line to wench on truck and pulled loose with approximately 1 ton pull. Temperature at 710 ft. 360°

Caliper of bore:

Caliper gauge went down hole much better than temperature plumb. This is undoubtedly due to the spring staves on caliper gauge holding the gauge in the center of hole allowing it to slide around the crooked part of the bore. Gauge stopped at 694 ft.

Smallest hole diameter encountered	8.5 in.
Bore diameter when drilled	11.75 in.
Difference in calipered bore and drilled bore	3.25 in.

Well No. 4

Well head condition:

There are mounted 2-250 lb. valves on the flow line. Doubtless the inner valve was damaged or cut out blowing the well while drilling. A 14" valve is mounted for the master valve, which differs from the other three wells which have 12" valves. As in the case of both No. 2 and No. 3 wells the master valve leaks and the chemical deposits were more extensive here. A very viscous deposit about 2 " thick was on the inside of the valve. This deposit had the consistency of molten glass and was very difficult to remove.
The pressure gauge outlet on this well should be replaced with a good valve and water leg.
There is leakage between the conductor pipe and surface pipe which should be grouted off.

Ground conditions around well:

The surface conditions around well head is fairly good, however there is a very active fumerole directly beneath the flow line about 25 ft. from tbhe well and another large fumerole 75 ft. Southwest of the well.

Comparison Tests

Comparitive tests run by Wm. Middleton in August 1961 with those run by William W. Allen, March 30-April 1, 1962.

	1961	1962	Difference
Well No. 1			
Depth, ft.	652	682	30
Max. temperature, degrees F	320°	330°	10°
Well No. 2			
Depth, ft.	600	658	58
Max. Temperature, degrees F	380.5°	340°	40.5°
Well No. 3			
Depth, ft.	690	572	128
Max. Temperature, degrees F	379.9	355	24.9°
Well No. 4,			
Depth, ft.	648	710	62
Max. Temperature, degrees F	388.3°	360	28.3°

It is interesting to note that in the only well blowing continuously that a 30 ft. greater depth was reached in 1962 and a 10° increase in temperature.

In wells No.'s 2, 3 and 4 which had remained static for about 3 1/2 months prior to the 1962 tests the temperatures were lower, 40.5° for No. 2, 24.9° for No. 3, and 28.3° for No. 4.

It is a good possibility that if the plugs in No's 1, 3 and 4 were removed and these wells allowed to flow that temperatures and pressures comparable to the 1961 tests would be restored. Particularly if the major fumeroles were grouted off.

An interesting fact developed in the blowing of wells 2, 3 and 4 after they had been static. Wells 2 and 3 had a static pressure of 100 PSIG and well No. 4 a static pressure of 60 PSIG before blowing. When the wells were opened to discharge wells 2 and 3 had a drop in pressure from 100 PSIG to around 65-70 PSIG while No. 4 pressure rose to around 70-90 PSIG. When this well was closed in after blowing the static pressure rose to 85 PSIG.

William W. Allen,
Eng.

TOUR REPORT

COMPANY SIERRA PACIFIC POWER CO. DATE 5/21/ , 19 65

FIELD BEOWAWE WELL NO. VULCAN NO. 1 NO. OF DAYS

☐ CABLE TOOL ☐ ROTARY

TIME	FOOTAGE DRILLED From	To	Footage	Time	Misc Time	OTHER HOURLY OPERATING WORK DONE			
TO						RIGGED UP & TOOK B.H.Ts ON MAGMA			
TO						VULCAN NO. 1 WELL			
TO									
TO	(BOTTOM HOLE TEMP.					DRILLERS DEPTH 655'			DEPTH REACHED 623'
TO	TAKEN 5' ABOVE					DEPTH	TEMP.	MIN. ON BTM.	REMARKS
TO	GROUND LEVEL)					50'	220°F	10	RAN 1 - 200-500°F
TO						100'	222°F	10	TAYLOR MAXIMUM
TO						150'	222°F	10	REGISTERING THERMOMETER
TO						200'	233°F	10	
TO						250'	264°F	10	
TO						300'	269°F	10	
TO						350'	272°F	10	
TO						400'	282°F	10	
TO						450'	295°F	10	
TO						500'	301°F	10	
TO						550'	305°F	10	
TO						600'	314°F	10	
TO						623'	323°F	10	
TO									CHECKED WATER LEVEL
TO									IN WELL AT 201' GROUND
TO									LEVEL MEASUREMENTS
TO									
TO									
TO									

TOUR TIME	TO	TO	TO
DEPTH END OF TOUR	FEET	FEET	FEET
DEPTH START OF TOUR	FEET	FEET	FEET
FOOTAGE DRILLED	FEET	FEET	FEET
DRILLED TIME	HOURS	HOURS	HOURS
DEAD TIME	HOURS	HOURS	HOURS

FROM	TO	FORMATION RECORD	CASING RECORDS DEPTH	SIZE	TEMPERATURE RECORD READING	DEPTH

NO.	SIZE	BIT MAKE AND TYPE	SERIAL NO.	FOOTAGE	DRILLING ASSEMBLY	
					D.C. OR " TOOLS O.D. NO. O.A. Length	FEET
					DRILL LINE RECORD	
					TOTAL LINE BEFORE CUTTING	FEET
					AMOUNT LINE CUT OFF	FEET
					TOTAL LINE ON DRUM	FEET

TIME	7 AM TO 7 PM	TO	TO
DRILLER	DOYLE WAKELING - 12 HRS.		
HELPER			
HELPER			
WELDER			

MISC. REPAIRS, SPECIAL DETAILS, CEMENT & CASING DATA -

SUPERVISOR E. Zapon

NEVADA BUREAU OF MINES AND GEOLOGY

BULLETIN 91

THERMAL WATERS OF NEVADA

LARRY J. GARSIDE
JOHN H. SCHILLING

Descriptions of Nevada's thermal waters in springs, wells, and mine workings: locations, geology, temperatures, flow rates, water chemistry, well depths, drilling and other exploration activities, and past and present uses.

MACKAY SCHOOL OF MINES
UNIVERSITY OF NEVADA • RENO
1979

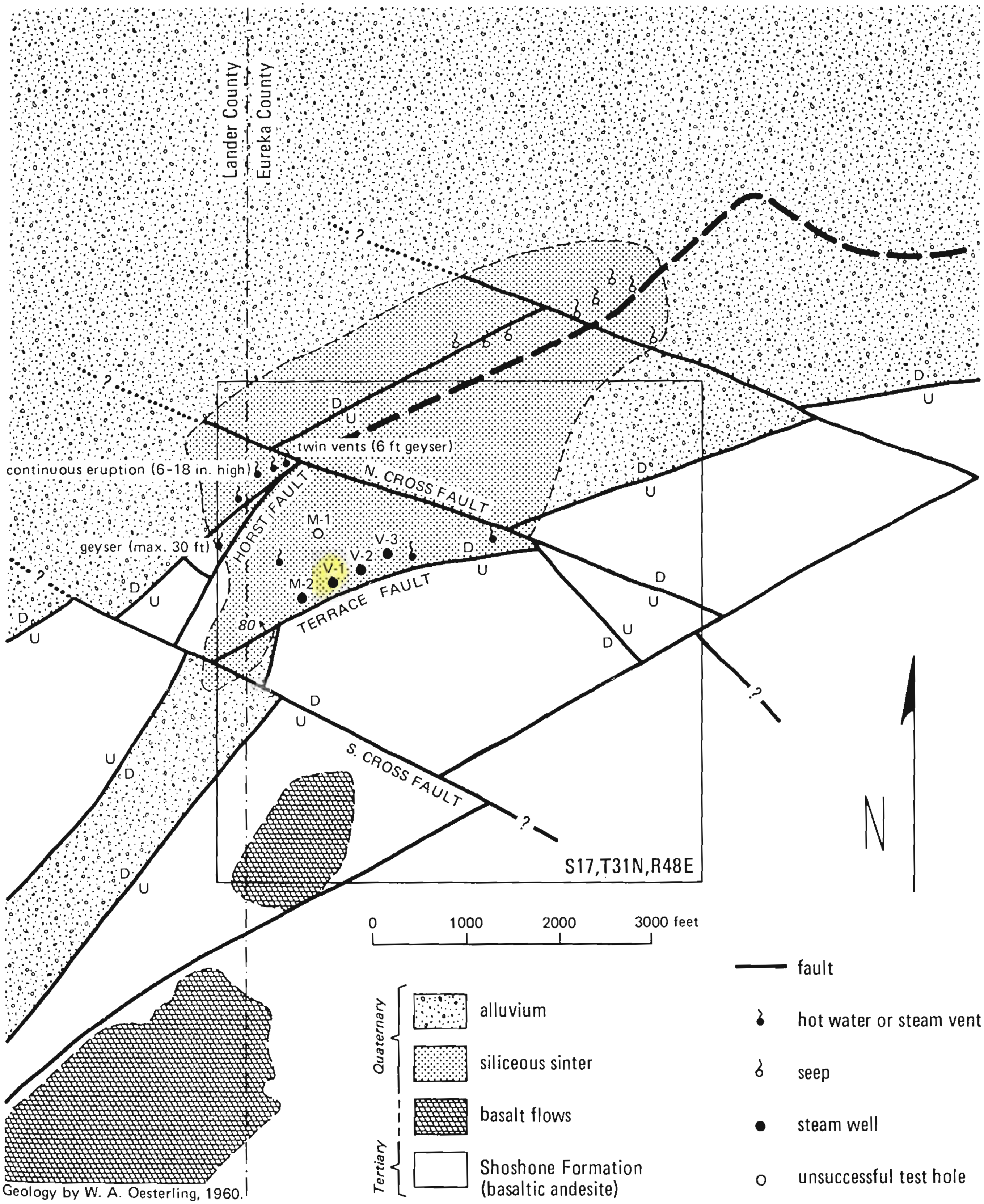


FIGURE 24. Geologic map of Beowawe Geysers, Eureka and Lander Counties (from Oesterling, 1962).

Identification number, name, location	Temp. (°F)	Discharge (gpm)	Date	SiO_2 (ppm)	Fe (ppm)	Ca (ppm)	Mg (ppm)	Na (ppm)	K (ppm)	HCO_3 (ppm)	CO_3 (ppm)	SO_4 (ppm)	Cl (ppm)	F (ppm)	NO_3 (ppm)	B (ppm)	TDS (ppm)	SC (μmhos/cm)	pH	Reference
EUREKA COUNTY (continued)																				
acidic spring S17,T31N,R48E	172	–	–	300	–	3	–	250	31	–	–	–	42	–	–	–	–	–	–	Wollenberg & others, 1977
	Remarks: U = 0.5μg/l, Ba = 190μg/l, W = 12μg/l, Br = 120μg/l, Sb = 5μg/l, Mo = 3μg/l, Rb = 215μg/l, Cs = 115μg/l, As <15μg/l, Fe = 670μg/l, Sc = 0.7μg/l, Mn = 115μg/l.																			
hot spring S17,T31N,R48E	183	–	10Mar74	345	.09	9	0.82	229	14.2	0	152	128	67	18.7	<0.1	–	964	1006	9.7	Sanders & Miles, 1974
	Remarks: PO_4 <0.1, NH_4 = 0.5, Ag <.02, As = 2.2μg/l, Ba <0.04, Be <0.005, Bi <0.1, Cd = 0.01, Cr <0.02, Cs = 1.04, Cu <0.01, Hg <0.5μg/l, Li = 2.59, Mn = .014, Ni = 0.05, Pb = 0.06, Rb = 0.266, Sb <0.1, Se <1.0μg/l, Sn = 0.05, Sr = 0.015, Zn = 2.32.																			
spring S17,T31N,R48E	205	–	–	444	–	<1	<1	241	29	148	161	78	44	–	–	2.2	1100	–	9.5	White, 1964
spring S17,T31N,R48E	190	–	–	–	–	–	–	207	–	–	–	–	56	–	–	–	–	–	–	Wollenberg & others, 1975
	Remarks: U = <0.26 ppb; W = 147 ppb; Mo = 19 ppb; Sb = 13 ppb; Ba 61 ppb.																			
spring S17,T31N,R48E	boiling	–	–	–	–	–	–	268	–	–	–	–	64	–	–	–	–	–	–	Wollenberg & others, 1975
	Remarks: Steam sample. U <0.16 ppb; W = 132 ppb; Mo = 12 ppb; Sb = 10 ppb; Ba = 50 ppb. Duplicate analysis agrees closely.																			
hot spring S17,T31N,R48E	–	–	–	413	–	tr	0	216		244	84	84	30	–	–	–	–	–	–	Nolan & Anderson, 1934
	Remarks: Al + Fe = tr.																			
small geyser S17,T31N,R48E	170	–	–	449	tr	2	0	239	33	129	173	97	47	11	–	7	–	–	–	Nolan & Anderson, 1934
	Remarks: Al = 0, As = 0, NH_4 = 4, S_2O_3 = 1, H_2S = 0. Several species of diatoms live in the warm pools.																			
pool below terrace S17,T31N,R48E	205	–	–	373	0.04	0.8	0	230	16	116	149	89	30	15	0.4	2.0	–	–	9.5	Roberts, Montgomery & Lehner, 1967
	Remarks: Al = 0, Mn = 0, Li = 1.3, NH_4 = 0.5, Br = 0.4, H_2S = 5.5, Sr = 0, I = 0.																			
geyser S17,T31N,R48E	–	–	–	418	–	tr	–	282		512	tr	91	70	–	–	–	–	–	–	Nolan & Anderson, 1934; Waring, 1965, No. 77A
	Remarks: Al + Fe = tr.																			
Beowawe Hot Springs	–	–	–	413	–	tr	0	216		244	84	–	30	–	–	–	1081	–	–	Adams, 1944
	Remarks: Fe + Al = tr.																			
hot springs	–	–	–	418	–	tr	0	282		512	tr	91	70	–	–	–	–	–	–	Adams, 1944
	Remarks: Fe + Al = tr.																			
Flame Geyser	–	–	22Aug45	–	–	32	8	164	–	351	34	53	48	–	–	2.2	–	–	–	Miller, Hardman & Mason, 1953
steam well NW¼S17,T31N,R48E	–	–	1973	500	–	1.3	0.2	250	38	505	81	64	70	<0.05	–	2.5	–	1490	9.4	Mariner & others, 1974
	Remarks: Li = 2.1.																			
well S17,T31N,R48E	steam	–	–	490	–	1.5	–	280	40	–	–	–	67	–	–	–	–	–	–	Wollenberg & others, 1977
	Remarks: From most northerly blowing well; U <0.07μg/l, Ba = 50μg/l, W = 135μg/l, Br = 145μg/l, Sb = 11μg/l, Mo = 11μg/l, Rb = 320μg/l, Cs = 220μg/l, As = 33μg/l, Fe <90μg/l, Sc <0.02μg/l, Mn <3μg/l.																			
Sierra Pacific Power Co. well S17,T31N,R48E	385	–	1964	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Roberts, Montgomery & Lehner, 1967
	Remarks: Depth – 1500 ft.																			
steam well S17,T31N,R48E	boiling	–	19Sep73	458	0.05	10	0	263	31	0	288	127	62	16	<0.1	–	1256	1211	9.9	Sanders & Miles, 1974
	Remarks: PO_4 <0.1, NH_4 = 0.9, Ag <0.004, As = 21μg/l, Ba <0.10, Be <0.005, Bi <0.10, Cd <0.002, Cr <0.04, Cs = 1.02, Cu < 0.004, Hg <0.2μg/l, Li = 3.2, Mn <0.01, Nb <10, Ni = 0.03, Pb <0.02, Rb = 0.63, Sb <0.2, Se <1μg/l, Sn <0.2, Sr = 0.04, Ta <5, Zn = 0.01.																			
Nevada Thermal (Magma Power Co.) No. 2 well NW¼S17,T31N,R48E	boiling	–	12Sep60	534	–	0.8	0.2	332	30	39	224	90	49	15	0.0	2.4	1200	1130	9.7	White, 1964
	Remarks: Al = 0.66, Fe = 0.00, As = 0.00, Sr = 0.21, Li = 1.6, NH_4 = 0.4, I = 0.0, PO_4 = 0.06, Br = 0.0. Sample may be 10 percent evaporated by boiling.																			
Vulcan Thermal Power Co. Vulcan No. 1 well NW¼SE¼SW¼NW¼ S17,T31N,R48E	414	–	1961	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	unpublished data, Sierra Pacific Power Co.
	Remarks: Depth – 638 ft.																			
[95] Raine Ranch(?) springs S6,7,T31N,R52E	warm	100+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Bradberry & Associates, 1964
[96] **Hot Springs Point (Crescent Valley)**																				
Crescent Valley Hot Springs SW¼S1,T29N,R48E	138	100	10Jun48	73	0.03	53	43	319		980	–	117	44	5.9	0.0	0.4	1140	1750	–	Zones, 1961b
spring SW¼S1,T29N,R48E	124	0	1960	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Wilson, 1960b
spring NE¼S1,T29N,R48E	124	15	1960	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Wilson, 1960b
spring SW¼S2,T29N,R48E	136	8	1960	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Wilson, 1960b
springs SE¼SE¼S2 & NE¼NE¼ S11,T29N,R48E	138	40	–	72	0.04	54	38	277	51	928	0	116	49	6.9	3.3	1.6			6.8	Roberts, Montgomery & Lehner, 1967
	Remarks: Mn = 0.09, Li = 1.0, PO_4 = 0; water analysis is reported to be from springs in S11																			

APPENDIX 2. Exploratory geothermal drilling in Nevada (Major, large-diameter wells only. Additional information on these wells may be found elsewhere in this report using the identification numbers [in brackets]).

Operator	Name	API No.	Location	Depth, ft	Completion Date	Maximum Temperature (°F)
			CHURCHILL COUNTY			
Brady's Hot Springs [10]						
Magma Power Co.	Brady No. 1	27–001–90000	NE¼ NE¼ SW¼ S12,T22N,R26E	700?	1959?	
Magma Power Co.	Brady No. 2	27–001–90001	NE¼ NE¼ SW¼ S12,T22N,R26E	241	1959?	330
Magma Power Co.	Brady No. 3	27–001–90002	SE¼ SE¼ NW¼ S12,T22N,R26E	610	1961?	335
Magma Power Co.	Brady No. 4	27–001–90003	SE¼ SE¼ NW¼ S12,T22N,R26E	723	1961?	
Magma Power Co.	Brady No. 5	27–001–90004	NW¼ SW¼ NE¼ S12,T22N,R26E	1800	1961?	340
Magma Power Co.	Brady No. 6	27–001–90005	NW¼ SW¼ NE¼ S12,T22N,R26E	770	?	
Magma Power Co.	Brady No. 7	27–001–90006	NW¼ SW¼ NE¼ S12,T22N,R26E	250	?	
Earth Energy Inc.	R Brady EE No. 1	27–001–90007	S12?,T22N,R26E	5062?	1964	414
Earth Energy Inc.	Brady Pros. No. 1	27–001–90008	S12?T22N,R26E	1758?	1965?	355
Union Oil Co. of Calif.	SP–Brady No. 1	27–001–90010	NE¼ SW¼ SE¼ S1,T22N,R26E	7275	1974	371
Magma Energy Inc.	SP–Brady No. 2	27–001–90013	NE¼ NW¼ SE¼ S1,T22N,R26E	4446	1975	
Magma Energy Inc.	SP–Brady No. 8	27–001–90014	NE¼ SE¼ NW¼ S12,T22N,R26E	3469	1975	
Desert Peak Area [12]						
Phillips Petroleum Co.	Desert Peak No. 29-1	27–001–90011	SE¼ SE¼ S29,T22N,R27E	7662	1974	
Phillips Petroleum Co.	Desert Peak B No. 21-1	27–001–90015	S½ SE¼ S21,T22N,R27E	4150	1976	406
Phillips Petroleum Co.	Desert Peak B No. 21-2	27–001–90016	NE¼ NE¼ S21,T22N,R27E	3192	1976	390
Soda Lake [13]						
Chevron–Phillips	Soda Lake No. 1-29	27–001–90012	C SE¼ SE¼ S29,T20N,R28E	4306	1974	
Chevron Resources Co.	Soda Lake No. 44-5	27–001–90020	S5,T19N,R28E	5070	1978	
Stillwater [14]						
O'Neill Geothermal Inc.	J. I. O'Neill, Jr.–Reynolds No. 1	27–001–90009	NE¼ SW¼ SW¼ S6,T19N,R31E	4237	1964	265
Union Oil Co.	Weishaupt No. 1	27–001–90017	Lot 2, S6,T19N,R31E	4000±	1976	
Union Oil Co.	Weishaupt No. 2	27–001–90018	Lot 4, S5,T19N,R31E	4000±	1977	
Union Oil Co.	De Braga No. 1	27–001–90019	Lot 1, S1,T19N,R30E	4000±	1977	
Lee Hot Springs [21]						
Oxy Geothermal Inc.	Federal No. 72-33(K)	27–001–90021	NW¼ NW¼ S34,T16N,R29E	3015	1978	
Dixie Valley [4]						
Sunoco Energy Devel. Co.	S.W. Lamb No. 1	27–001–90022	NW¼ NW¼ S18,T24N,R37E	7255	1978	425
			DOUGLAS COUNTY			
Wally's Hot Springs [45]						
U.S. Steel Corp.	Wally's No. 1	27–005–90000	SE¼ NW¼ NW¼ S22,T13N,R19E	1268	1962	181
U.S. Steel Corp.	Wally's No. 2	27–005–90001	SW¼ SW¼ NW¼ S22,T13N,R19E	499	1962	
			EUREKA COUNTY			
Beowawe Geysers [94]						
Magma Power Co.	Beowawe No. 1	27–011–90000	NE¼ SE¼? NW¼ S17,T31N,R48E	1918	1959?	
Magma Power Co.	Beowawe No. 2	27–011–90001	NW¼? NW¼ S17,T31N,R48E	715	1959?	
Vulcan Thermal Power Co.	Vulcan No. 1	27–011–90002	NW¼ SE¼ SW¼ NW¼ S17,T31N,R48E	638	1961	414
Vulcan Thermal Power Co.	Vulcan No. 2	27–011–90003	NE¼ SE¼ SW¼ NW¼ S17,T31N,R48E	655	1961	407
Vulcan Thermal Power Co.	Vulcan No. 3	27–011–90004	NW¼ SW¼ SE¼ NW¼ S17,T31N,R48E	796	1961	407
Vulcan Thermal Power Co.	Vulcan No. 4	27–011–90005	NE¼ SW¼ SE¼ NW¼ S17,T31N,R48E	767	1961	410

71p

94

Lander/Eureka

BEOWAWE GEOTHERMAL

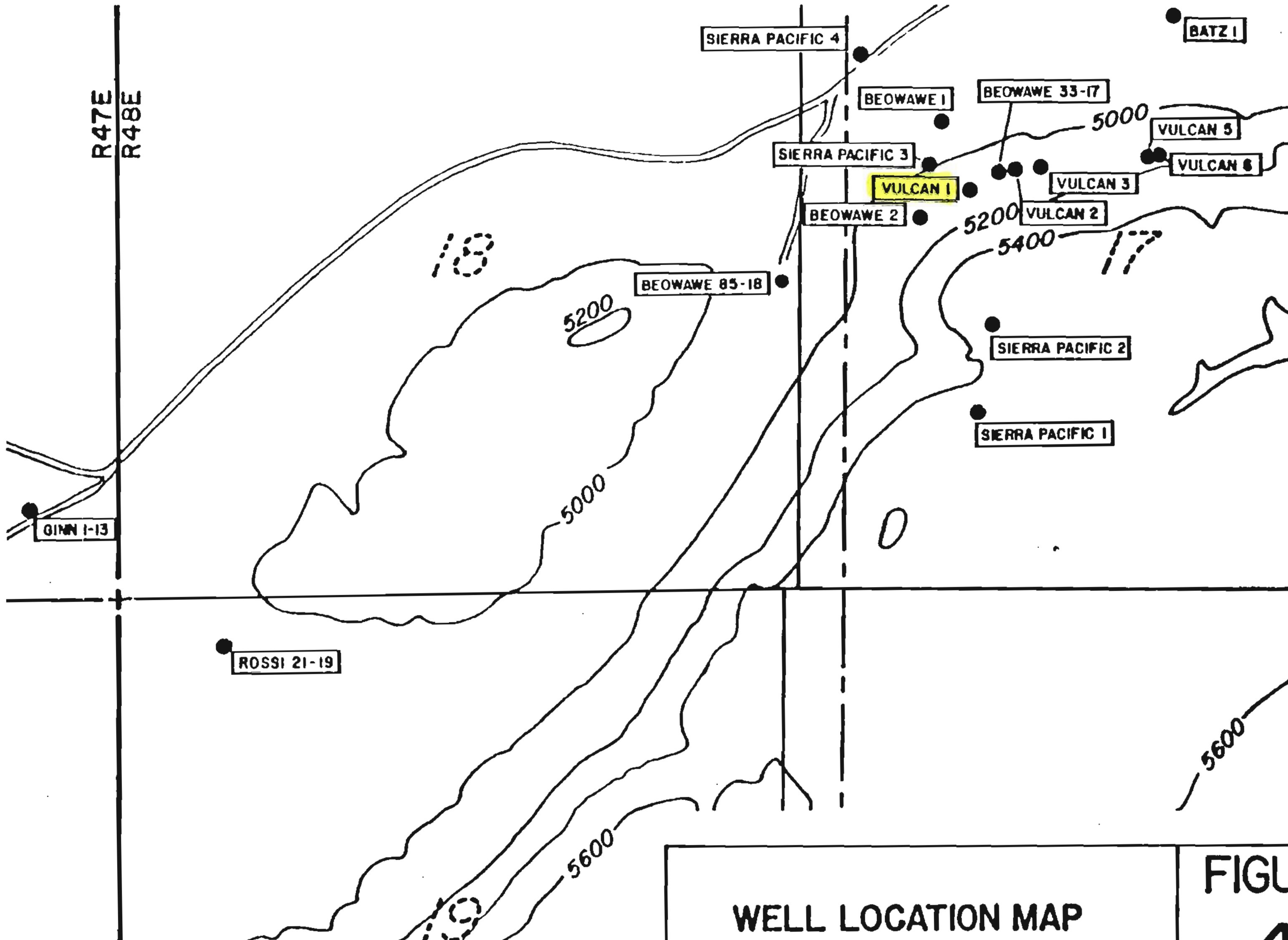
ENVIRONMENTAL ASSESSMENT

Lander and Eureka Counties, Nevada

Complete report in NBMG Geothermal Files

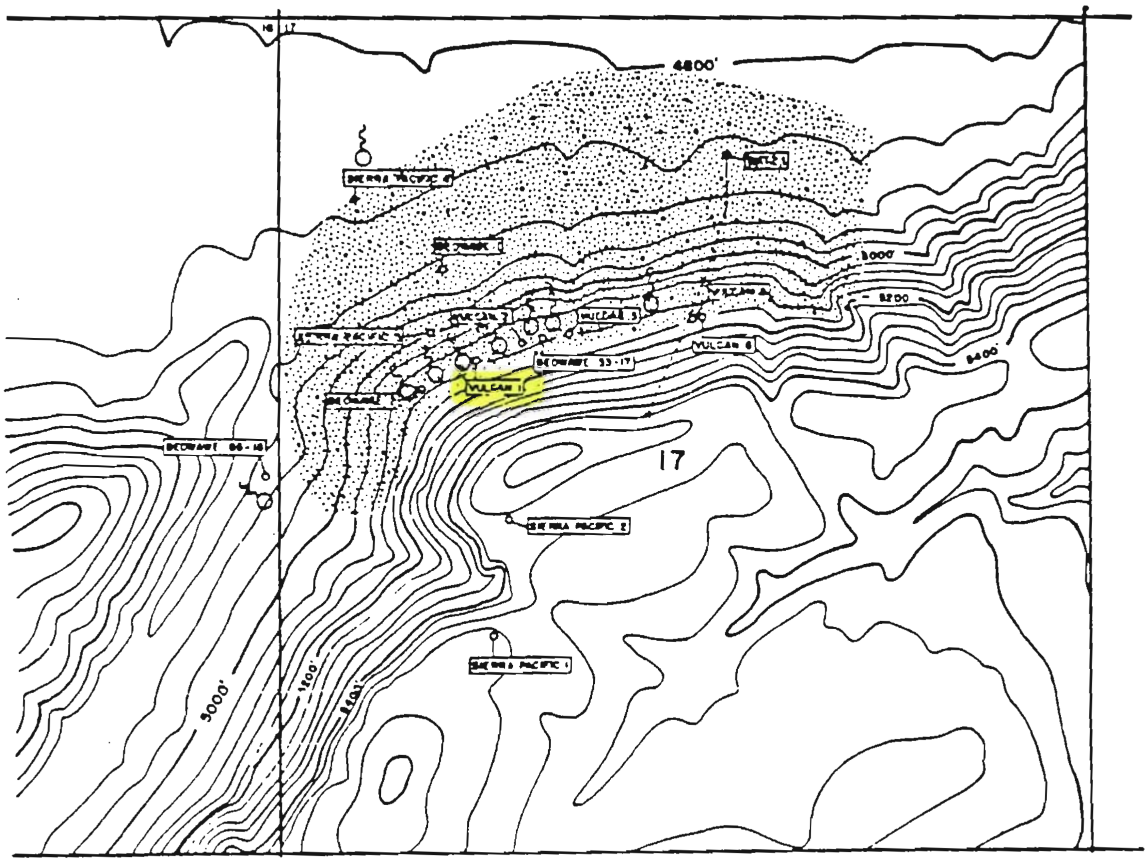
BUREAU OF LAND MANAGEMENT
BATTLE MOUNTAIN
DISTRICT OFFICE

March 1985



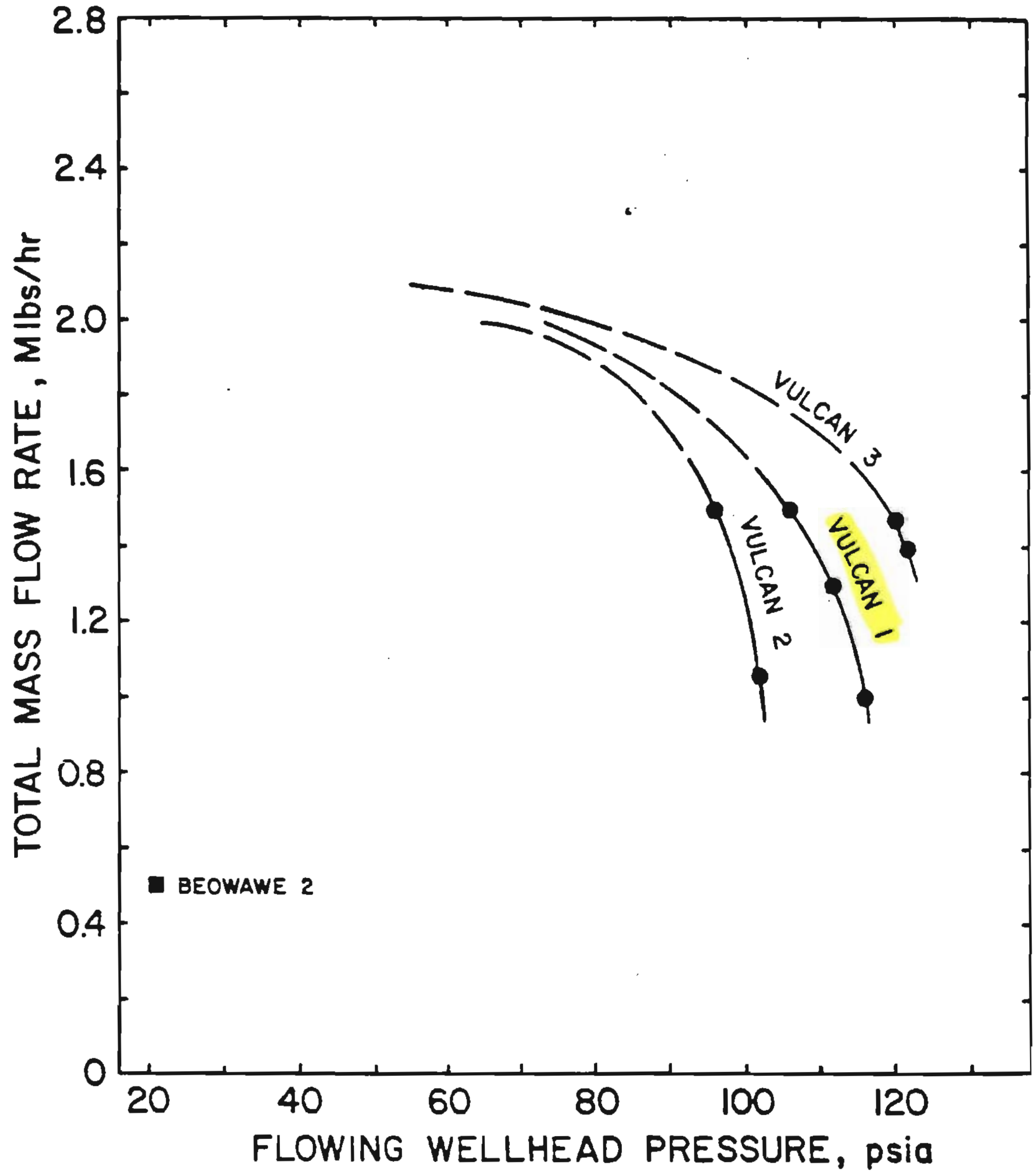
WELL LOCATION MAP

FIGURE 4



SINTER TERRACE LOCATION

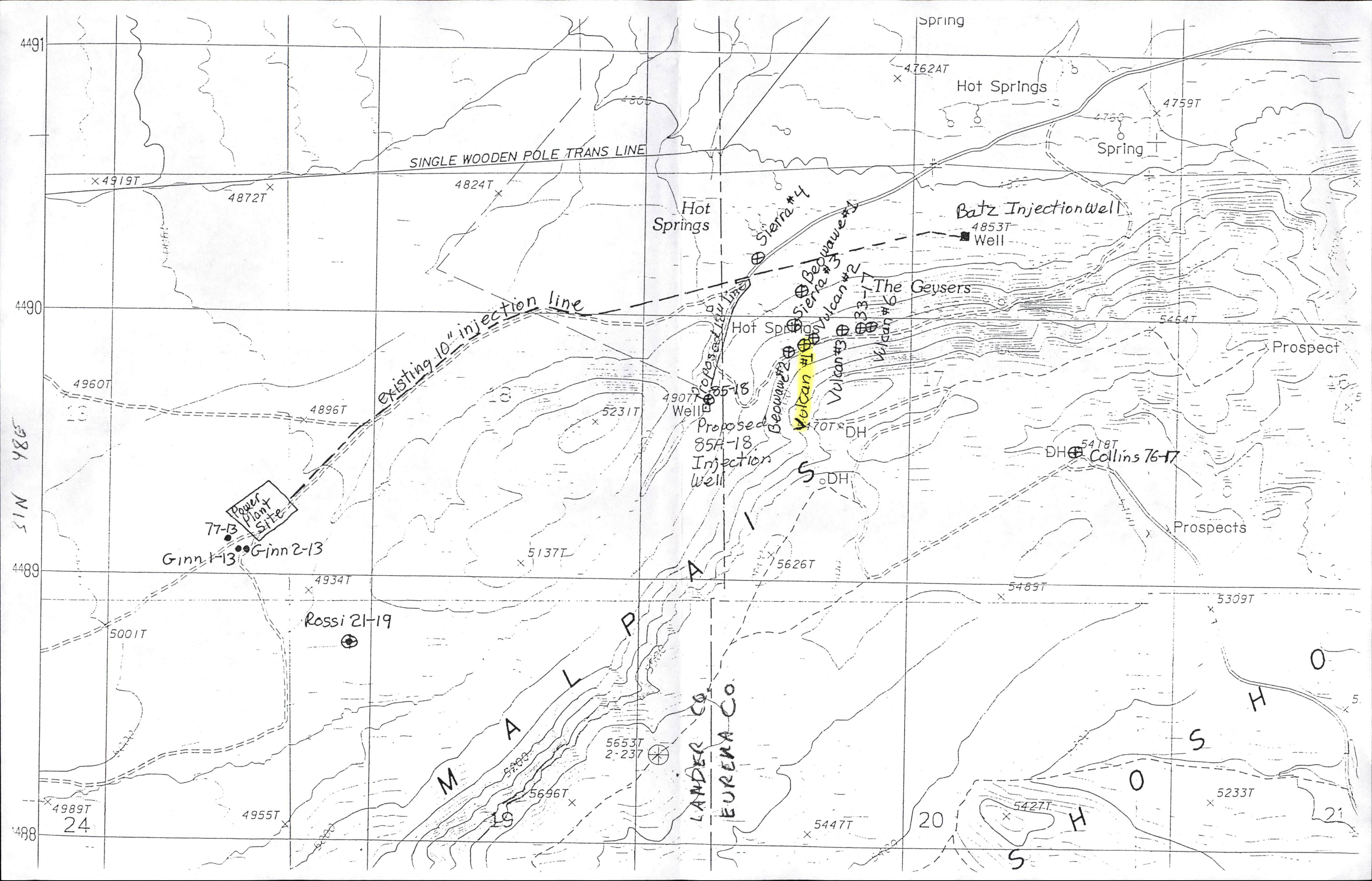
FIGURE 10



MAGMA WELL TEST DATA	FIGURE 21

BEOWAWE HOT SPRINGS, NEVADA
WELL DATA

WELL NAME	TOTAL DEPTH	HOLE SIZE	CASING DEPTH	BOTTOM HOLE TEMP.	STEAM RATE P/HR	WATER RATE P/HR.	MISC INFO.
BEOWAWE NO. 1	1913'	12¼"	[illegible]	[illegible]°F	NO	RATE	12¼" HOLE DRILLED TO 1918' PLUGGED BACK TO 525' PERF [illegible]" CSG. 150/200' 4 HOLES P/FT WELL GEYSERED
BEOWAWE NO. 2	715'	10" TO 557' 8" TO 715'	[illegible] 75' of [illegible] ¼	41[illegible]°F	SEE MIDDLETON	REPORT	DRILLED W/ CABLE TOOL BY NEV. THERMAL POWER CO
VULCAN NO. 1	655'	12"	[illegible] 101' [illegible]	[illegible]	" "	"	DRILLED W/ CABLE TOOL BY VULCAN THERMAL POWER CO
VULCAN NO. 2	715'	20"	55'-14"x¼" 152'-10¾"x¼"	[illegible]09°F	" "	"	" " " " "
VULCAN NO. 3	795'	12"	140'-14"x¼" 523'-8⅝"x¼"	448°F	" "	"	" " FISH IN HOLE AT BOTTOM OF 8⅝" CASING - ABANDONED HOLE
VULCAN NO. 5	237'	18"	50' 20"x¼"	272°F	NO	RATE	" " NEV. THERMAL POWER CO. FISH IN HOLE @ 237' ABANDONED HOLE
VULCAN NO. 6	478'	12"	40' OF 20" 303'-13⅜"x¼"	[illegible]°F	"	"	DRILLED CABLE TOOL BY NEV. THERMAL POWER CO. HAD FISHING JOB @ 447/478' REC. FISH, SUSPENDED HOLE
SIERRA PACIFIC #1	927'	15¼	42'-16"x¼	178°F	"	"	DRILLED W/ CABLE TOOL BY SIERRA PACIFIC POWER CO. HOLE ABANDONED
SIERRA PACIFIC #2	397'	?	?	?	"	"	DRILLED W/ CABLE TOOL BY SIERRA PACIFIC POWER CO HOLE ABANDONED
SIERRA PACIFIC #3	2052'	8"	241'-12¾" 996'-8⅝"	378°F	FLOW VERY LITTLE STEAM & WATER		DRILLED W/ CABLE TOOL. BY SIERRA PACIFIC POWER CO. WELL CLOSED IN AND IDLE
SIERRA PACIFIC #4	1005'	12"	90' OF 16" 257'-12¾"x¼	250°F	NO	RATE	DRILLED W/ CABLE TOOL BY SIERRA PACIFIC POWER CO. CAPPED W/ STEEL FLANGE & IDLE



4491
4490
4489
4488
SINGLE WOODEN POLE TRANS LINE
Hot Springs
Spring
4762AT
4759T
4919T
4872T
4824T
Hot Springs
Sierra #4
Beowawe #1
Batz Injection Well
4853T
Well
Beowawe #3
Sierra #3
Vulcan #2
33-17
The Geysers
Vulcan #6
Hot Springs
Vulcan #3
Vulcan #1
Beowawe #2
Proposed 85A-18 Injection Well
85-18
4907T
Well
Proposed lay line
existing 10" injection line
Power Plant Site
77-13
Ginn 1-13
Ginn 2-13
Rossi 21-19
4960T
4896T
5231T
5137T
4934T
5001T
4989T
4955T
24
DH
Collins 76-17
5418T
5464T
Prospect
Prospects
5626T
5489T
5309T
5653T
2-237
5696T
5447T
5427T
5233T
20
21
LANDER CO.
EUREKA CO.
MALPAIS
SHOSHONE
31N 48E