

File 947

WL

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RECEIVED

96 AUG 20 P 3: 15

DIV. OF WATER &
LAND DEVELOPMENT

PUNA
GEOTHERMAL VENTURE



HAWAII

August 16, 1996

Michael D. Wilson
Department of Land and Natural Resources
P.O. Box 621
Honolulu, HI 96809

DEPT. OF LAND
& NATURAL RESOURCES
STATE OF HAWAII

96 AUG 19 P 4: 27

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SUBJECT: REPORT ON ANNUAL TEMPERATURE SURVEY IN WELLS KS-4

Dear Mr. Wilson

Attached is the report regarding the mechanical integrity temperature survey of injection well KS-4 verified by annual tests performed in accordance with the Puna Geothermal Venture well casing monitoring program and Underground Injection Control (UIC) Permit UH-1529. The results show no indication of any casing leak or interzonal communication. Partial fulfillment of the required Mechanical Integrity Test was completed. The annual pressure testing will be performed later in the year, in conformance to the normal schedule.

Please contact me at (808)-965-6233, if you have any questions regarding the subject reports.

Sincerely,

Darren Hunt
Environmental/Safety Coordinator

- cc: J. Dean
- D. Stovall
- D. Hunt
- E. Tanaka
- File 5.4.3.1,2&3

PUNA GEOTHERMAL VENTURE
REPORT ON ANNUAL TEMPERATURE SURVEYS IN WELL KS-4
June 1996

Summary

Downhole temperature surveys were run in Well KS-4 in June 1996 in partial fulfillment of the requirements for annual mechanical integrity tests under the UIC permit and PGV's Casing Monitoring Program. In accordance with PGV's normal procedure, one survey was run with the well on injection, and two were run after shut-in to measure the transient temperature response. The results exhibit a completely normal temperature recovery, with no indication of any casing leak or any interzonal communication behind casing.

With concurrence from Hawaii Department of Health, Safe Drinking Water Branch, PGV scheduled these temperature surveys in KS-4 to coincide with a planned plant outage. The annual casing pressure test will be performed later in the year, in conformance to the normal schedule.

Well Completion

The mechanical configuration of KS-4 is shown in Figure 1. It has not changed since the well was completed on November 24, 1992.

Shut-in Temperature Surveys

Beginning on June 22, 1996, temperature/pressure surveys were run in KS-4 during injection and twice after the well was shut in to measure downhole pressures and define the thermal recovery profiles. The surveys were run by Pruett Industries using Amerada-type instruments. The injection survey was run beginning at 1100 hrs on June 22, and the well was shut in at 2129 hrs on June 22. At the time of the survey, the well was on injection at 1050 gpm, 230 psig wellhead pressure and 239°F injectate temperature. The first shut-in survey was begun at 0630 hrs on June 23, 9 hrs after shut-in. The second shut-in survey was begun at 1030 hrs on June 24, 39 hours after shut-in. Pruett's data sheets are included in Appendix A.

The June 1996 temperature surveys are plotted in Figure 2, along with a static survey which was run on January 10, 1993. The surveys show normal thermal recovery following injection and give no indication of fluid communication behind

PUNA GEOTHERMAL VENTURE
REPORT ON ANNUAL TEMPERATURE SURVEYS IN WELL KS-4

June 1996

Page 2

casing. The injection interval is clearly indicated by the temperature surveys to be below 6000 ft.

Robert V Verity

Robert V. Verity, P.E.

MESQUITE GROUP, INC.

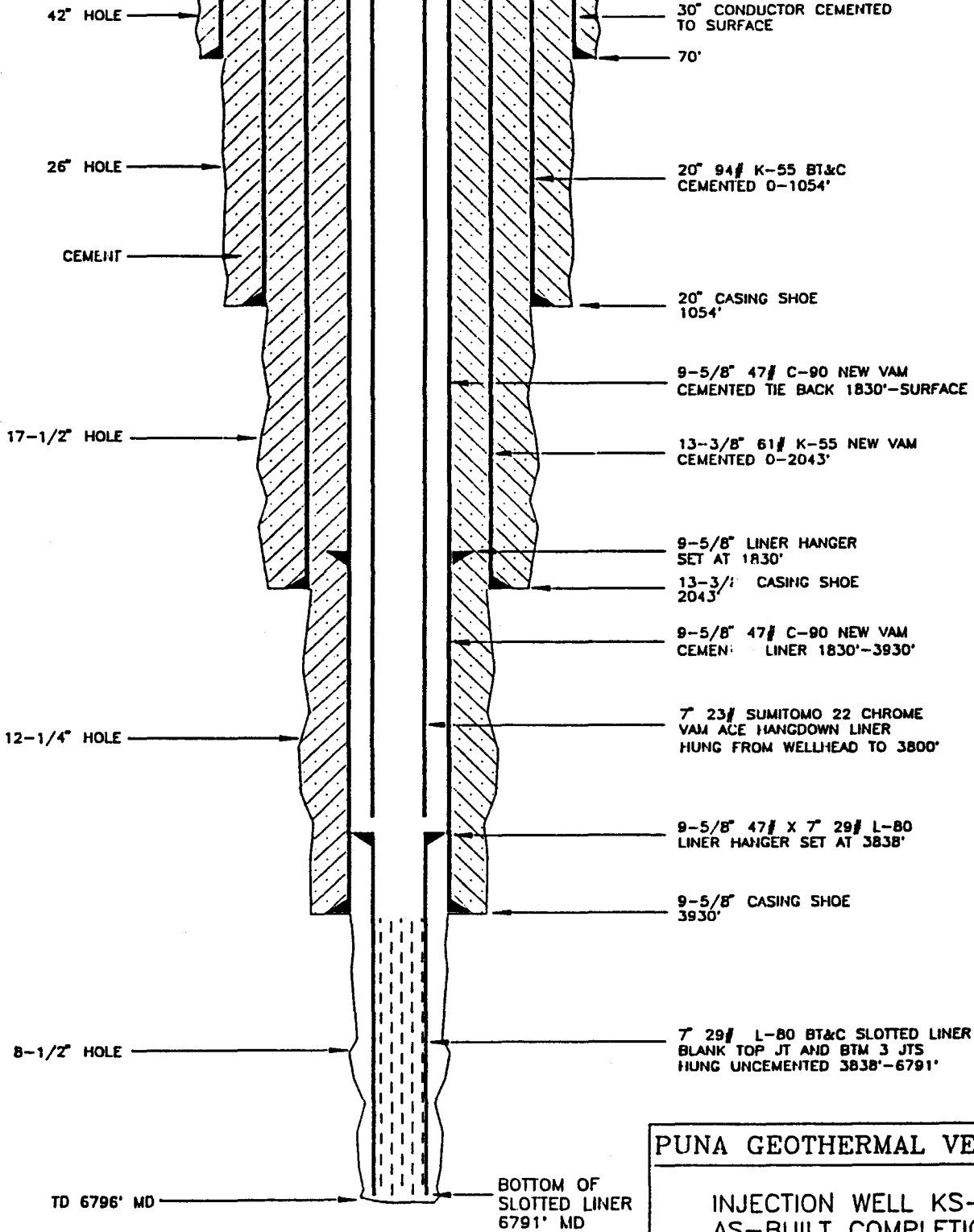
June 12, 1996

GROUND SURFACE

CELLAR

618' ABOVE MSL

ALL DEPTHS MEASURED FROM KB HEIGHT OF 25' ABOVE TOP OF CELLAR



PUNA GEOTHERMAL VENTURE

INJECTION WELL KS-4 AS-BUILT COMPLETION SCHEMATIC

DATE 11/30/92

REV. 2

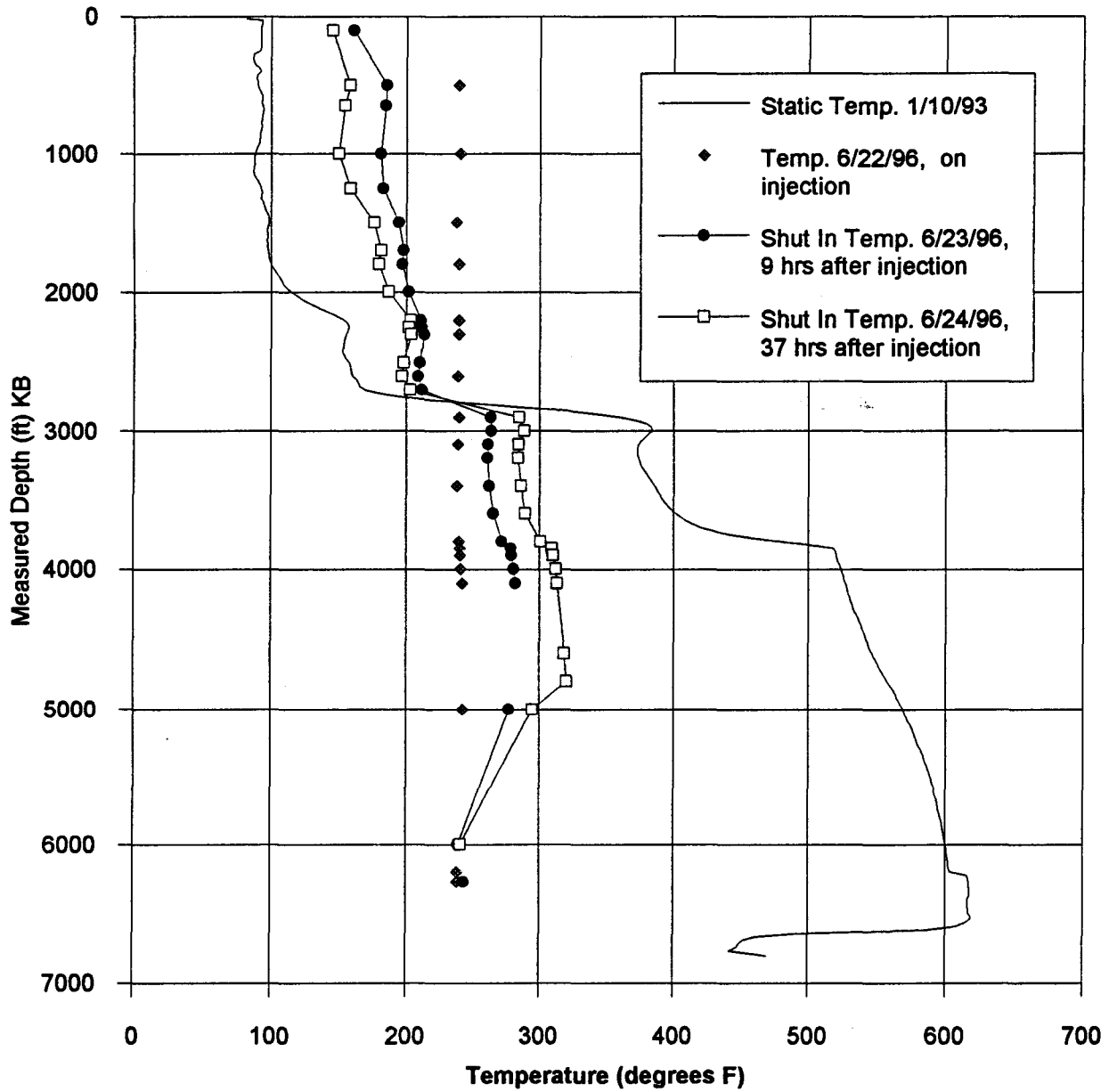
BY TEPLW

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FIGURE NO. 1

FIGURE 2

PUNA GEOTHERMAL VENTURE
KS-4 TEMPERATURE SURVEYS FOR
1996 MECHANICAL INTEGRITY TEST



Appendix A

TEMPERATURE/PRESSURE SURVEY DATA

PRUETT INDUSTRIES, INC.
 8915 ROSEDALE HWY BAKERSFIELD, CA 93312
 (805) 589-2768 FAX (805) 589-3268

SUB-SURFACE TEMPERATURE SURVEY

| | | |
|--------------------------|------------------------|----------------------|
| CO. PUNA GEOTHERMAL VENT | RUN 1A FIELD KAPOHO | WELL KS-4 |
| EFF DEPTH 6796' | WELL STAT INJECTION | TOOL HUNG |
| CASING 9.625"Ø' -3930' | CASING PRESS | ON BOTTOM 13:40 |
| LINER 7" 3838'-6791' | TUBING PRESS | OFF BOTTOM 14:00 |
| DATE 062296 | ELEMENT RANGE 89 - 724 | ZERO POINT 25' |
| ELEVATION | ZONE | SHUT-IN |
| MAX TEMP | PICK-UP 6270' | ON-PROD |
| PERF 3888' - | CAL SER NO. K5830 | MPP |
| TUBING - | | |
| UNITS ENGLISH | PURPOSE INJECTION | TEMPERATURE GRADIENT |

SURVEY DATA

| CO. PUNA GEOTHERMAL VENT | | | | RUN 1A FIELD KAPOHO | | | | WELL KS-4 | | | |
|--------------------------|-------|-------|-------|---------------------|-------|-------|-------|-----------|-------|-----|------|
| TIME | DEPTH | P-T | GRAD | TIME | DEPTH | P-T | GRAD | TIME | DEPTH | P-T | GRAD |
| 11:00 | 0 | 179.1 | .000 | 1:00 | 3400 | 238.0 | -.002 | | | | |
| 1:00 | 500 | 239.0 | .120 | 1:00 | 3800 | 239.6 | .004 | | | | |
| 1:00 | 1000 | 239.9 | .002 | 1:00 | 3850 | 240.2 | .012 | | | | |
| 1:00 | 1500 | 237.4 | -.005 | 1:00 | 3900 | 240.5 | .006 | | | | |
| 1:00 | 1800 | 239.0 | .005 | 1:00 | 4000 | 240.8 | .003 | | | | |
| 1:00 | 2200 | 239.3 | .001 | 1:00 | 4100 | 242.1 | .012 | | | | |
| 1:00 | 2300 | 239.0 | -.003 | 1:00 | 5000 | 242.4 | .000 | | | | |
| 1:00 | 2600 | 238.7 | -.001 | 1:00 | 6000 | 240.8 | -.002 | | | | |
| 1:00 | 2900 | 239.6 | .003 | 1:00 | 6200 | 238.4 | -.012 | | | | |
| 1:00 | 3100 | 238.7 | -.005 | 1:00 | 6270 | 238.4 | .000 | | | | |

BY STEVE WILSON

PRUETT INDUSTRIES, INC.
 8915 ROSEDALE HWY BAKERSFIELD, CA 93312
 (805) 589-2768 FAX (805) 589-3268

SUB-SURFACE PRESSURE SURVEY

| | | |
|--------------------------|------------------------|--------------------------------|
| CO. PUNA GEOTHERMAL VENT | RUN 03 FIELD KAPOHO | WELL KS-4 |
| EFF DEPTH | WELL STAT STATIC | TOOL HUNG |
| CASING 9.625"Ø' -3930' | CASING PRESS | ON BOTTOM 9:29 |
| LINER 7" 3838' -6791' | TUBING PRESS | OFF BOTTOM 9:36 |
| DATE 062396 | ELEMENT RANGE 0 - 4130 | ZERO POINT 25' |
| ELEVATION | ZONE | SHUT-IN |
| MAX TEMP | PICK-UP 6270' | ON-PROD |
| PERF 3888' - | CAL SER NO. K9006 | MFP |
| TUBING - | | |
| UNITS ENGLISH | PURPOSE | STATIC PRESSURE GRADIENT 9 hrs |

SURVEY DATA

| CO. PUNA GEOTHERMAL VENT | | | RUN 03 FIELD KAPOHO | | | WELL KS-4 | | |
|--------------------------|-------|-------|---------------------|------|-------|-----------|------|--|
| TIME | DEPTH | P-T | GRAD | TIME | DEPTH | P-T | GRAD | |
| 6:20 | 0 | .0 | .000 | 1:00 | 2700 | 838.0 | .416 | |
| 1:00 | 100 | .0 | .000 | 1:00 | 2900 | 917.0 | .395 | |
| 1:00 | 500 | .0 | .000 | 1:00 | 3000 | 956.5 | .395 | |
| 1:00 | 650 | .0 | .000 | 1:00 | 3100 | 995.9 | .395 | |
| 1:00 | 1000 | 137.5 | .393 | 1:00 | 3200 | 1035.4 | .394 | |
| 1:00 | 1250 | 237.6 | .400 | 1:00 | 3400 | 1114.2 | .394 | |
| 1:00 | 1500 | 340.4 | .411 | 1:00 | 3600 | 1190.8 | .383 | |
| 1:00 | 1700 | 422.9 | .413 | 1:00 | 3800 | 1267.3 | .382 | |
| 1:00 | 1800 | 464.2 | .414 | 1:00 | 3850 | 1285.9 | .372 | |
| 1:00 | 2000 | 547.1 | .414 | 1:00 | 3900 | 1304.4 | .372 | |
| 1:00 | 2200 | 630.1 | .415 | 1:00 | 4000 | 1343.6 | .392 | |
| 1:00 | 2250 | 650.9 | .415 | 1:00 | 4100 | 1382.8 | .391 | |
| 1:00 | 2300 | 671.7 | .416 | 1:00 | 5000 | 1733.1 | .389 | |
| 1:00 | 2500 | 754.8 | .416 | 1:00 | 6000 | 2141.4 | .408 | |
| 1:00 | 2600 | 796.4 | .416 | 1:00 | 6270 | 2250.9 | .405 | |

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PRUETT INDUSTRIES, INC.
 8915 ROSEDALE HWY BAKERSFIELD, CA 93312
 (805) 589-2768 FAX (805) 589-3268

SUB-SURFACE TEMPERATURE SURVEY

| | | |
|--------------------------|------------------------|-----------------------------------|
| CO. PUNA GEOTHERMAL VENT | RUN 3A FIELD KAPOHO | WELL KS-4 |
| EFF DEPTH | WELL STAT STATIC | TOOL HUNG |
| CASING 9.625"Ø' -3930' | CASING PRESS | ON BOTTOM 9:29 |
| LINER 7" 3838' -6791' | TUBING PRESS | OFF BOTTOM 9:36 |
| DATE 062396 | ELEMENT RANGE 89 - 724 | ZERO POINT 25' |
| ELEVATION | ZONE | SHUT-IN |
| MAX TEMP | PICK-UP 6270' | ON-PROD |
| PERF 3888' - | CAL SER NO. K5830 | MPP |
| TUBING - | | |
| UNITS ENGLISH | PURPOSE | STATIC TEMPERATURE GRADIENT 9 hrs |

SURVEY DATA

| CO. PUNA GEOTHERMAL VENT | | | | RUN 3A FIELD KAPOHO | | | | WELL KS-4 | | | |
|--------------------------|-------|-------|-------|---------------------|-------|-------|-------|-----------|-------|-----|------|
| TIME | DEPTH | P-T | GRAD | TIME | DEPTH | P-T | GRAD | TIME | DEPTH | P-T | GRAD |
| 6:20 | 0 | 89.3 | .000 | 1:00 | 2700 | 211.9 | .028 | | | | |
| 1:00 | 100 | 160.8 | .715 | 1:00 | 2900 | 263.3 | .257 | | | | |
| 1:00 | 500 | 185.4 | .062 | 1:00 | 3000 | 263.9 | .006 | | | | |
| 1:00 | 650 | 184.8 | -.004 | 1:00 | 3100 | 261.7 | -.022 | | | | |
| 1:00 | 1000 | 180.6 | -.012 | 1:00 | 3200 | 261.4 | -.003 | | | | |
| 1:00 | 1250 | 182.6 | .008 | 1:00 | 3400 | 262.4 | .005 | | | | |
| 1:00 | 1500 | 194.3 | .047 | 1:00 | 3600 | 265.4 | .015 | | | | |
| 1:00 | 1700 | 197.8 | .017 | 1:00 | 3800 | 271.8 | .032 | | | | |
| 1:00 | 1800 | 196.8 | -.009 | 1:00 | 3850 | 278.6 | .134 | | | | |
| 1:00 | 2000 | 201.9 | .025 | 1:00 | 3900 | 279.2 | .012 | | | | |
| 1:00 | 2200 | 210.6 | .044 | 1:00 | 4000 | 281.0 | .018 | | | | |
| 1:00 | 2250 | 211.3 | .013 | 1:00 | 4100 | 282.2 | .012 | | | | |
| 1:00 | 2300 | 213.2 | .038 | 1:00 | 5000 | 277.6 | -.005 | | | | |
| 1:00 | 2500 | 210.0 | -.016 | 1:00 | 6000 | 239.3 | -.038 | | | | |
| 1:00 | 2600 | 209.1 | -.009 | 1:00 | 6270 | 243.6 | .016 | | | | |

BY STEVE WILSON

NOTE : PEAK @ 289.5 DEG F BETWEEN 4100' & 5000' STOPS

PRUETT INDUSTRIES, INC.
 8915 ROSEDALE HWY BAKERSFIELD, CA 93312
 (805) 589-2768 FAX (805) 589-3268

SUB-SURFACE PRESSURE SURVEY

| | | |
|--------------------------|------------------------|---------------------------------|
| CO. PUNA GEOTHERMAL VENT | RUN 04 FIELD KAPOHO | WELL KS-4 |
| EFF DEPTH 6796' | WELL STAT STATIC | TOOL HUNG |
| CASING 9.625"0' -3930' | CASING PRESS | ON BOTTOM 13:28 |
| LINER 7" 3838'-6791' | TUBING PRESS | OFF BOTTOM 13:33 |
| DATE 062496 | ELEMENT RANGE 0 - 2628 | ZERO POINT 25' |
| ELEVATION | ZONE | SHUT-IN 21:50 6/22 |
| MAX TEMP | PICK-UP 6270' | ON-PROD |
| PERF 3888' - | CAL SER NO. K7688 | MPP |
| TUBING - | | |
| UNITS ENGLISH | PURPOSE | STATIC PRESSURE GRADIENT 39 hrs |

SURVEY DATA

| CO. PUNA GEOTHERMAL VENT | | | | RUN 04 FIELD KAPOHO | | | | WELL KS-4 | | | |
|--------------------------|-------|-------|------|---------------------|-------|--------|------|-----------|-------|-----|------|
| TIME | DEPTH | P-T | GRAD | TIME | DEPTH | P-T | GRAD | TIME | DEPTH | P-T | GRAD |
| 10:10 | 0 | .0 | .000 | 1:00 | 2900 | 905.3 | .415 | | | | |
| 1:00 | 100 | .0 | .000 | 1:00 | 3000 | 946.1 | .408 | | | | |
| 1:00 | 500 | .0 | .000 | 1:00 | 3100 | 985.6 | .395 | | | | |
| 1:00 | 650 | .0 | .000 | 1:00 | 3200 | 1025.2 | .395 | | | | |
| 1:00 | 1000 | 112.8 | .322 | 1:00 | 3400 | 1104.3 | .395 | | | | |
| 1:00 | 1250 | 214.1 | .405 | 1:00 | 3600 | 1184.7 | .402 | | | | |
| 1:00 | 1500 | 316.8 | .411 | 1:00 | 3800 | 1265.1 | .402 | | | | |
| 1:00 | 1700 | 399.8 | .415 | 1:00 | 3850 | 1284.9 | .396 | | | | |
| 1:00 | 1800 | 441.4 | .417 | 1:00 | 3900 | 1304.7 | .396 | | | | |
| 1:00 | 2000 | 526.4 | .425 | 1:00 | 4000 | 1344.2 | .396 | | | | |
| 1:00 | 2200 | 611.7 | .426 | 1:00 | 4100 | 1383.8 | .396 | | | | |
| 1:00 | 2250 | 632.7 | .421 | 1:00 | 4600 | 1583.3 | .399 | | | | |
| 1:00 | 2300 | 653.7 | .421 | 1:00 | 4800 | 1662.7 | .397 | | | | |
| 1:00 | 2500 | 737.9 | .421 | 1:00 | 5000 | 1742.2 | .398 | | | | |
| 1:00 | 2600 | 780.1 | .421 | 1:00 | 6000 | 2142.3 | .400 | | | | |
| 1:00 | 2700 | 822.2 | .422 | 1:00 | 6270 | 2252.8 | .409 | | | | |

BY STEVE WILSON

PRUETT INDUSTRIES, INC.
 8915 ROSEDALE HWY BAKERSFIELD, CA 93312
 (805) 589-2768 FAX (805) 589-3268

SUB-SURFACE TEMPERATURE SURVEY

| | | |
|--------------------------|------------------------|------------------------------------|
| CO. PUNA GEOTHERMAL VENT | RUN 4A FIELD KAPOHO | WELL KS-4 |
| EFF DEPTH 6796' | WELL STAT STATIC | TOOL HUNG |
| CASING 9.625"Ø' -3930' | CASING PRESS | ON BOTTOM 13:28 |
| LINER 7" 3838' -6791' | TUBING PRESS | OFF BOTTOM 13:33 |
| DATE 062496 | ELEMENT RANGE 89 - 724 | ZERO POINT 25' |
| ELEVATION | ZONE | SHUT-IN 21:50 6/22 |
| MAX TEMP | PICK-UP 6270' | ON-PROD |
| PERF 3888' - | CAL SER NO. K5830 | MPP |
| TUBING - | | |
| UNITS ENGLISH | PURPOSE | STATIC TEMPERATURE GRADIENT 39 hrs |

SURVEY DATA

| CO. PUNA GEOTHERMAL VENT | RUN 4A FIELD KAPOHO | WELL KS-4 | | | | | |
|--------------------------|---------------------|-----------|-------|------|-------|-------|-------|
| TIME | DEPTH | P-T | GRAD | TIME | DEPTH | P-T | GRAD |
| 10:10 | 0 | 89.3 | .000 | 1:00 | 2900 | 284.6 | .409 |
| 1:00 | 100 | 144.9 | .556 | 1:00 | 3000 | 288.3 | .036 |
| 1:00 | 500 | 158.5 | .034 | 1:00 | 3100 | 284.4 | -.039 |
| 1:00 | 650 | 154.3 | -.028 | 1:00 | 3200 | 283.7 | -.006 |
| 1:00 | 1000 | 149.8 | -.013 | 1:00 | 3400 | 285.9 | .011 |
| 1:00 | 1250 | 158.5 | .035 | 1:00 | 3600 | 289.5 | .018 |
| 1:00 | 1500 | 176.2 | .071 | 1:00 | 3800 | 301.1 | .058 |
| 1:00 | 1700 | 181.3 | .026 | 1:00 | 3850 | 309.6 | .170 |
| 1:00 | 1800 | 179.4 | -.019 | 1:00 | 3900 | 310.2 | .012 |
| 1:00 | 2000 | 186.7 | .037 | 1:00 | 4000 | 312.3 | .021 |
| 1:00 | 2200 | 202.8 | .081 | 1:00 | 4100 | 313.2 | .009 |
| 1:00 | 2250 | 201.9 | -.019 | 1:00 | 4600 | 318.6 | .011 |
| 1:00 | 2300 | 203.4 | .031 | 1:00 | 4800 | 320.5 | .009 |
| 1:00 | 2500 | 198.1 | -.027 | 1:00 | 5000 | 294.7 | -.129 |
| 1:00 | 2600 | 197.1 | -.009 | 1:00 | 6000 | 240.8 | -.054 |
| 1:00 | 2700 | 202.8 | .057 | 1:00 | 6270 | 246.4 | .021 |

BY STEVE WILSON

Land Division
Engineering Branch

August 26, 1996

TO: Dean Uchida, Administrator
THROUGH: Andrew Monden, Branch Chief *AM*
FROM: Hiram Young, Design Section *HY*
SUBJECT: Minerals Resources - Geothermal

Per Administrative Rules Chapter 13-183-79, all geothermal injection wells must be surveyed at least every two years, or as often as the Chairperson may order. For PGV, the UIC permit issued by Department of Health requires an annual survey. The attached temperature survey submitted by PGV fulfills both DLNR and DOH requirements. However, with the elimination of the Mineral Resources Section, there is no one to monitor, review and approval the survey.

Per Dean (8/28/96) - we still have the regulatory function for geothermal.

Hiram, pls instruct Elaine on "where" and "how" is the geothermal files so she can file future correspondances. Eric Tanaka should also have a copy for his files. Pls note Eric was "cc" a copy.