WV

PUNA GEOTHERMAL VENTURE

A Hawaii Partnership

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DIV. OF WATER & LAND DEVELOPMENT

March 4, 1993

John P. Keppeler II, Acting Chairperson
Department of Land and Natural Resources
P.O. Box 621
Honolulu, HI 96809

SUBJ: KS-4 WELL COMPLETION REPORT

Dear Mr. Keppeler,

Pursuant to Subchapter 12 (Drilling: Records and Reports of Wells), Section 13-183-85, Puna Geothermal Venture (PGV) hereby submits the attached well completion report for Well Kapoho State 4 (KS-4).

Included in this report are:

* Well record summary
* Well summary
* Well history
* Mud log
* Direction survey
* Chemical analysis of groundwater
* Gamma logs
* Wellhead schematic
* Mechanical integrity tests
* Well plot
* Well map

Should you or your staff have any questions, please contact me.

Sincerely,

Thomas G. Kizis

Thomas G. Kizis
Environmental Manager

c: S. Morris
Drilling
Mesquite

File: KS-4

14-3860 Kapoho Pahoa Road, Pahoa, Hawaii 96778 • (808) 961-2786 • Facsimile (808) 935-5562
Post Office Box 30, Pahoa, Hawaii 96778

PGV WELL RECORD

LEASE KAPOHO LAND PARTNERSHIP SPUD DATE 9/13/92 COMP DATE 11/25/92

WELL # KAPOHO STATE NO. 4 CONTRACTOR PARKER DRILLING COMPANY

FIELD PUNA RIG # 231

LOCATION 8313'N 9381'E KALIV ELEVATION: GROUND 618'

BENCHMARK KANIANA KAPOHO PUNA HAWAII CO. HAWAII

B.H.L. 514.0 N 673.5 W AT K.B. TO GROUND 25

SURFACE LOCATION K.B. TO CSG. HEAD 30.8

DEPTH: TD 6795 TVD 6713.2 ETD 6793 OBSV _____ STM _____ INJ XX

HOT WATER _____ DRY HOLE _____

APPROVED _____ COMPANY SUPERVISOR D. WEISGERBER
CHUCK WARD

CASING RECORD

SIZE	WEIGHT	GRADE	THREAD	TOP	BOTTOM	REMARKS
20"	94	K-55	BUTT	SURF	1064.89	CEMENTED SURFACE
13⅜	61	K-55	NEW VAM	SURF	2043.26	CEMENTED INTERMEDIATE
9⅝	47#	C-90	NEW VAM	1830.28	3930.0	CEMENTED LINER
9⅝	47	C-90	NEW VAM	SURF	1837.93	CEMENTED TIEBACK
7"	23	22-CHROME	VAM ACE	28.0	3800.0	HUNG W/N_2 IN ANNULUS
7"	29	L-80	BUTT	3838.62	6790.17	HUNG PERF'D LINER

WELL HEAD ASSEMBLY

	CASING HEAD	EXPANSION SPOOL	DOUGHNUT HANGER SPOOL	XO SPOOL
MAKE:	FOSTER	FOSTER	COOPER	NONE
TYPE:	SOW	FLANGED RING GROVED	DONUT	
SERIAL #:	WO1975	WO197510	P/N B39251A	
DESCRIPTION	2 SIDE OUTLETS	2 SIDE OUTLETS	DBL STUDED	
SIZE:	13⅝5MX13⅜	13⅜5MX10"-1500	10"-1500	
MIN. I.D.	12.415"	10"	9"	
LENGTH	1.35'	2.66'	0.80'	
PRESS. RATING (PSI)	5000 PSI	3750	3750	

VALVES

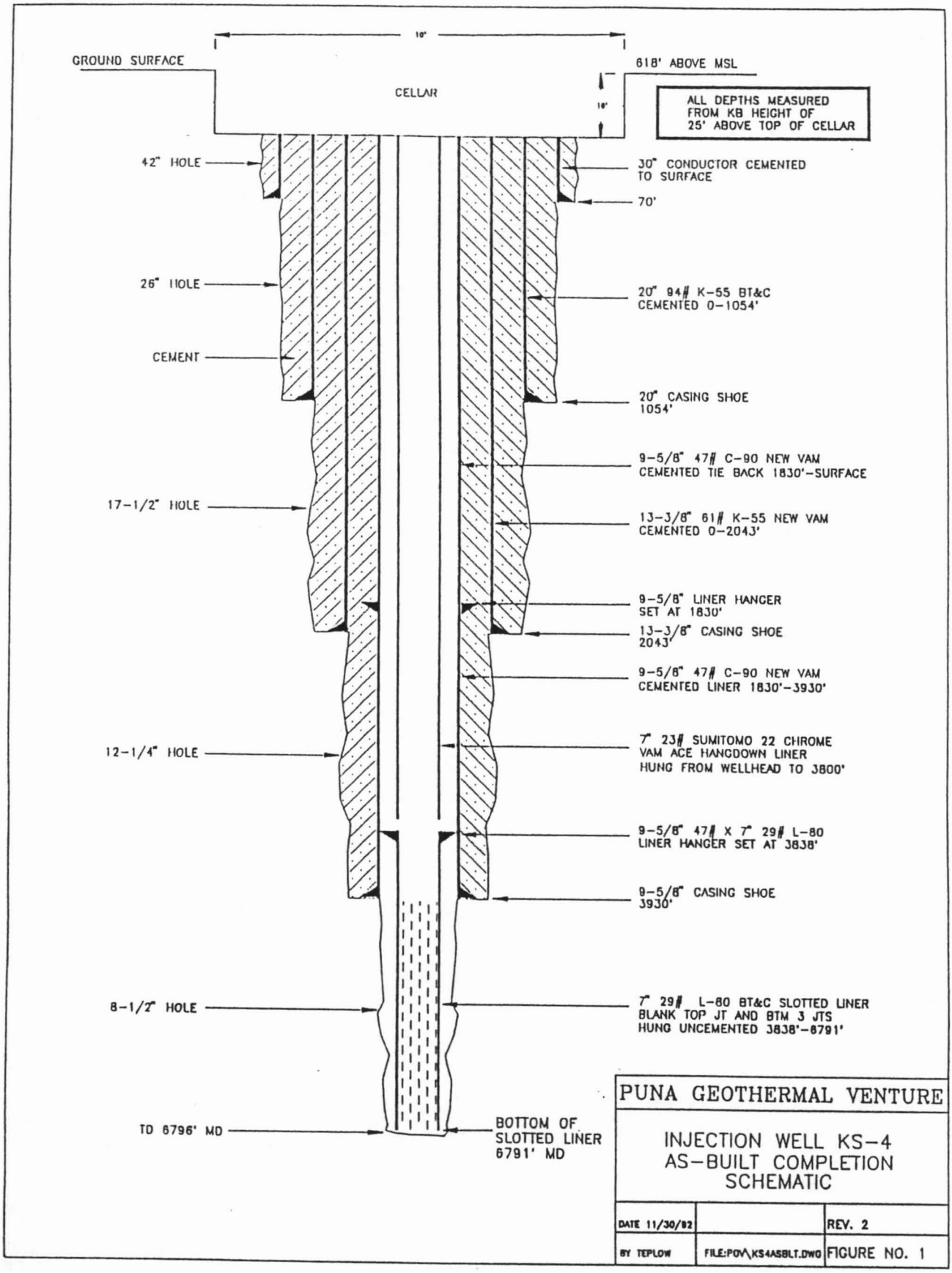
	MASTER	EXPANSION SPOOL	CASING HEAD	SWAB
MAKE:	FOSTER	BARTON	BARTON	NONE
TYPE:	DUAL SEAL	EXTENDED BONNET-EXPANDING GATE		
SERIAL #:	23888	A5201001/A5201004	A5701007/A5701010	
SIZE & I.D.	10" - 7⅛	3" - 3⅛"	3" - 3⅛"	
PRESS RATING (PSI)	3750	5000 PSI	5000 PSI	

PERFORATED LINER:	PERFORATIONS FROM	PERFORATIONS TO	BLANK FROM	BLANK TO
PERFORATION DESIGN:	3957.48	6750.81	6790	6750
SLOTS/ROW, ¼" X 3"			3742.64	3957.48

TEST DATA:

TEST DATE	WHP	TEMP	FLOW RATE
11/20/92	370	AMBIANT	31 BBLS PER MIN

REMARKS: INJECTION RATES
31 BBLS AT 370 PSI
FINAL RATE 18.9 BBLS/MIN AT 140 PSI


GROUND SURFACE
618' ABOVE MSL
CELLAR
ALL DEPTHS MEASURED FROM KB HEIGHT OF 25' ABOVE TOP OF CELLAR
42" HOLE
30" CONDUCTOR CEMENTED TO SURFACE
70'
26" HOLE
20" 94# K-55 BT&C CEMENTED 0-1054'
CEMENT
20" CASING SHOE 1054'
9-5/8" 47# C-90 NEW VAM CEMENTED TIE BACK 1830'-SURFACE
17-1/2" HOLE
13-3/8" 61# K-55 NEW VAM CEMENTED 0-2043'
9-5/8" LINER HANGER SET AT 1830'
13-3/8" CASING SHOE 2043'
9-5/8" 47# C-90 NEW VAM CEMENTED LINER 1830'-3930'
12-1/4" HOLE
7" 23# SUMITOMO 22 CHROME VAM ACE HANGDOWN LINER HUNG FROM WELLHEAD TO 3800'
9-5/8" 47# X 7" 29# L-80 LINER HANGER SET AT 3838'
9-5/8" CASING SHOE 3930'
8-1/2" HOLE
7" 29# L-80 BT&C SLOTTED LINER BLANK TOP JT AND BTM 3 JTS HUNG UNCEMENTED 3838'-6791'
TD 6796' MD
BOTTOM OF SLOTTED LINER 6791' MD
PUNA GEOTHERMAL VENTURE
INJECTION WELL KS-4
AS-BUILT COMPLETION
SCHEMATIC
DATE 11/30/92
REV. 2
BY TEPLOW
FILE:P0V\KS4ASBLT.DWG
FIGURE NO. 1

WELL HISTORY
KS-4

LOCATION: 8289.0' N & 9360.9'E of Kahiu Benchmark
ELEVATION: 620' MSL. ALL DEPTHS FROM RKB, 25' ABOVE G.L.

DATE	COMMENTS
9/10/92	Depth 70' Skidded rig from KS-3 to KS-4. Rigged up on KS-4.
9/11/92	Depth 70' Rigged up on KS-4. Rig on day rate at 0300 hours. Secured for hurricane INIKI until 1700 hours.
9/12/92	Depth 70' Rigged up sound blankets and ran noise level tests. Drilled rathole with mud moter.
9/13/92	Depth 82' Drilled rathole. Picked up air hammer. Spudded KS-4 at 1700 hours. Drilled 27" hole from 70' to 82' with 4600 SCFM air/foam and air hammer. Tripped to conductor and shut down at 1900 hours due to noise.
9/14/92	Depth 165' Drilled 27" hole with air hammer and foam from 82' to 84'. Laid down hammer due to lack of progress. Drilled 26" hole from 84' to 165' using foam and mud motor.
9/15/92	Depth 399' Drilled 26" hole with foam and mud motor from 165' to 399'. Lost returns at 308'. Increased foam to 35 gallons per minute and air to 3400 CFM. Regained returns to surface.
9/16/92	Depth 675' Drilled 26" hole with foam and mud motor from 399' to 650'. Pulled out of hole. Attempted without success to bail water samples. Ran in hole to fill at 632'. Cleaned out fill to 650'. Drilled 26" hole with foam and mud motor to 675'.
9/17/92	Depth 772' Drilled 26" hole with foam and mud motor from 675' to 695'. Pulled out of hole. Bailed water samples. Obtained good samples at 650'. Ran in hole. Drilled 26" hole with foam and mud motor from 695' to 769'. Tripped for bit. Drilled 26" hole with foam and mud motor from 769' to 772'.

9/18/92 Depth 1037'
Drilled 26" hole with foam and mud motor from 772' to 1037'. Started fourth compressor, ran 4600 SCFM air. Shut down at 2100 hours due to noise complaints.

9/19/92 Depth 1090'
Waited for daylight to resume drilling. Drilled 26" hole with foam and mud motor from 1037' to 1090'. Had drilling breaks from 1070' to 1075' and 1085' to 1090'. Pulled out of hole. Ran in hole with open ended drill pipe. Howco spotted 361 cubic feet Hawaiian cement with 3% calcium chloride through open ended drill pipe at 1086'. Pulled out of hole. Waited on cement. Made up locked reaming assembly. Waited for daylight due to noise complaints.

9/20/92 Depth 1090'
Waited for daylight. Ran in hole to tight spot at 125'. Washed and reamed to 170'. Twisted off. Pulled out of hole. Left 125' of bottom hole assembly in hole. Ran in hole with spiral grapple to top of fish at 889'. Worked over fish. Broke circulation with air/foam. Used five compressors, 5800SCFM air. Pulled fish free and worked out of hole to tight spot. Shut down due to high noise level. Worked pipe in free area below tight spot.

9/21/92 Depth 1090'
Waited on daylight. Started air compressors and worked pipe. Unable to move pipe up hole. Stuck pipe. Released overshot with top of fish at 750' and bottom of fish at 875'. Pulled out of hole. Left 124.99' of fish consisting of 26" bit , float sub, reamer, shock sub, reamer, 9" drill collar, crossover, reamer, two 9" drill collars, and crossover. Picked up bumper sub, jars, and 6" drill collars.

9/22/92 Depth 1090'
Ran in hole with redressed overshot and fishing assembly to obstruction at 773'. Unable to locate top of fish. Pulled out of hole. Had no indication of encountering fish on tools.

9/23/92 Depth 1090'
Ran in hole with 26" bit. Cleaned out to top of fish at 773'. Ran in hole with 20" guide on overshot. Worked over fish at 773'. Jarred on fish.

9/24/92 Depth 1090'
Jarred and worked fish out of hole. Recovered entire fish. Inspected all tools. Suspended operations. Prepared for move to KS-3.

9/25/92 Depth 1090'
Temporarily suspended operations. Prepared to move rig. Released rig for move. Rig off day rate at 2400 hours.

10/04/92 Depth 1090'
Skidded rig to KS-4. Rig on day rate at 0000 hrs. Rigged up on KS-4. Resumed operations on KS-4. Installed 30" riser. Ran in hole.

10/05/92 Depth 1090'
Waited until 0700 hours to start due to high noise levels. Reamed 26" hole from 206' to 317'. Had trouble with tight hole. Tripped to lay down top stabilizer. Reamed 26" hole from 317' to 555' with foam and 4400 SCFM.

10/06/92 Depth 1090'
Reamed 26" hole from 555' to 925'. Tripped out for sound log on KS-8. Cleaned out bridge at 510'. Reamed 26" hole from 925' to 1030' with foam and 5600 SCFM air

10/07/92 Depth 1090'
Reamed 26" hole from 1052' to 1070' with 5600 SCFM air and foam. Short tripped to collars. Had 25' to 30' fill on bottom. Slugged hole with 3 polymer slugs to clean out fill. Short tripped 5 stands of drill pipe and had 11' fill on bottom. Slugged hole and cleaned up hole. Chained out of hole. Rigged up and ran 29 joints of 20", 94#/ft, K-55, buttress casing.

10/08/92 Depth 1090'
Washed out 2' of fill and landed casing at 1064'. Cemented 20" casing as follows: Pumped 25 bbls water, 25 bbls super flush, 25 bbls water and 25 bbls $CaCl_2$ four times. HOWCO mixed and pumped 200 sk neat Hawaiian cement plus 873 sk Hawaiian cement with 50#/sk spherlite, 4% gel, 40% SSA-1, and 2% $CaCl_2$, and 185 sk Hawaiian cement with 40% SSA-1, 0.75% CFR-3 and 2% $CACl_2$. Displaced cement with 364 bbls water. Cement in place 0715 hours. Cut off 30" conductor. Ran 1" pipe into annulus to 415'. HOWCO mixed and pumped 500 cubic feet Hawaiian cement with 40% SSA-1, 0.75% CFR-3 and 3% $CaCl_2$ into annulus through 1" pipe. Waited on cement.

10/09/92 Depth 1090'
Located top of cement at 351'. HOWCO mixed and pumped 250 cubic feet Hawaiian cement with 40% SSA-1 and 3% $CaCl_2$ through 1" pipe. Poured 10 bags sodium silicate down annulus during job, had cement returns to surface.

Cement in place at 1000 hours. Waited on cement. Welded on 20" flange and nippled up Hydril.

10/10/92 Depth 1106'
Filled hole and pressure tested casing to 600 psi at surface, OK. Drilled float collar, cement, and shoe at 1064'. Cleaned out cement to 1090'. Drilled 17-1/2" hole from 1090' to 1106'. Performed formation leak off test, had to pump 4 BPM to see pressure. Tripped for open ended drill pipe. Closed Hydril. HOWCO mixed and pumped 250 cubic feet of Hawaiian cement with 40% SSA-1 and 2% $CaCl_2$ through OEDP at 985'. Displaced with 36 bbls water. Final squeeze pressure 800 psi. Cement in place at 2400 hours.

10/11/92 Depth 1106'
Held 800 psi on squeeze job for one hour. Tripped for bit. Waited on cement. Drilled cement from 1013' to 1079'. Performed formation leak off test. Pumped 2 BPM at 200 psi. Tripped for open ended drill pipe. HOWCO mixed and pumped 100 linear feet of Hawaiian cement with 40% SSA-1, 3% $CaCl_2$ and 0.75% CFR-3. Attempted braden head squeeze. Had 200 psi build up when cement was displaced to shoe. Cement in place 2100 hours. Tripped for bit. Waited on cement.

10/12/92 Depth 1427'
Cleaned out cement from 958' to 1106'. Drilled 17-1/2" hole from 1106' to 1427'. Plugged bit and worked out of tight hole from 1427' to 1334'. Tripped for plugged bit.

10/13/92 Depth 1798'
Washed 70' to bottom. Drilled 17-1/2" hole from 1427' to 1798'.

10/14/92 Depth 2055'
Drilled 17-1/2" hole from 1798' to 1888'. Tripped to check tools. Drilled 17-1/2" hole from 1888' to 2055'.

10/15/92 Depth 2055'
Made short trip with no fill. Strapped out of hole. Ran Gamma Ray log and Pressure-Temperature survey from 1064' to 2029'. Ran in hole to 2040'. Cleaned out fill to 2055'. Pulled out of hole. Rigged up and ran 13-3/8", 61#/ft, K-55, New Vam casing.

10/16/92 Depth 2055'
Ran 52 joints (2039.33') of 13-3/8", 61#/ft, K-55, New Vam casing with Howco guide shoe on bottom joint and Howco screw-in float collar 2 joints up. Total length 2043.26'. Landed with shoe at 2043' and float collar at

1960'. Unable to screw into float collar. Rigged up 13-3/8" cement head to do conventional cement job. Cemented as follows; Howco mixed and pumped 20 bbls water, 20 bbls $CaCl_2$ water, and 60 bbls super flush, followed by 20.5 bbls neat Hawaiian cement, and 504 bbls Hawaiian cement with 50#/sk Spherelite, 4% gel, 40% SSA-1, 1.25% CFR-3, and 0.5% H-22A, plus 48 bbls Hawaiian cement with 40% SSA-1, 0.75% CFR-3 and 3% $CaCl_2$. Displaced cement with 299 bbl water. Bumped plug. Float held. Had good cement returns to surface. Cement fell in annulus to 90'. Ran 1" pipe to 120'. Did outside job through 1" pipe with 26.7 bbls Hawaiian cement with 40% SSA-1, 0.75% CFR-3, and 2% $CaCl_2$. Cement in place at 2130 hours. Waited on cement.

10/17/92 Depth 2055'
Waited on cement. Nippled down 20" blowout prevention equipment. Cut off 20" and 13-3/8" casing. Installed 13-5/8" - 5M by 13-3/8" SOW Foster wellhead with two side outlets. Tested weld to 1250 psi, OK. Nippled up blowout prevention equipment. NOTE: Kelly bushing to lower casing head was 30.8'.

10/18/92 Depth 2055'
Nippled up blowout prevention equipment. Tested 13-5/8" 5M blowout prevention equipment and 13-3/8" casing to 2500 psi for 30 minutes, OK. Test witnessed and approved by Eric Tanaka, DLNR.

10/19/92 Depth 2056'
Laid down 17-1/2" tools. Ran in hole with 12-1/4" slick drilling assembly to 1945'. Cleaned out cement, float collar and cement to shoe. Tested casing to 0.65 gradient, OK. Cleaned out shoe and cement to 2055'. Drilled 12-1/4" hole from 2055' to 2056'. Performed formation leak off test. Formation took fluid at 2 BPM at a 0.58 frac gradient. Ran in hole with open ended drill pipe to 2056'. Howco pumped 90 cubic feet of Hawaiian cement premixed 40% SSA-1, 0.75% CFR-3 and 2% $CaCl_2$. Displaced cement with 32 bbls of water. Pulled 3 stands. Closed pipe rams and squeezed 3 bbls cement into formation. Pressure built to and held at 2,500 psi. Pulled out of hole.

10/20/92 Depth 2292'
Ran in hole to top of cement at 1947'. Cleaned out cement to 2053'. Pressure tested to 500 psi (0.68 gradient), OK. Cleaned out cement to 2056'. Drilled 12-1/4" hole from 2056' to 2292'. Twisted off at the top

of monel. Left fish in hole consisting of 12-1/4" bit and 8" monel, total length 28.92'. Top of fish at 2267'.

10/21/92 Depth 2292'
Ran in hole with overshot to 2184'. Washed to 2263'. Unable to engage fish. Tripped and cut saw tooth on guide shoe. Reran overshot. Washed from 2257' to 2267'. Unable to engage fish. Tripped for bit.

10/22/92 Depth 2292'
Reamed and cleaned out 12-1/4" hole from 2220' to top of fish at 2267'. Tripped for overshot. Worked over fish and engaged fish. Chained out of hole. Recovered entire fish.

10/23/92 Depth: 2669'
Reamed from 2157' to 2292'. Drilled 12-1/4" hole to 2669'. Tripped for mud motor.

10/24/92 Depth: 2901'
Directionally drilled 12-1/4" hole from 2669' to 2847' with minor losses from 2700' to 2787'. Tripped for drilling assembly. Reamed from 2669' to 2787'. Drilled 12-1/4" hole to 2901' with full returns.

10/25/92 Depth 3404'
Tripped for locked drilling assembly. Drilled 12-1/4" hole from 2901' to 3374'. Maximum reading thermometer on survey showed 155°F. Made short trip. Ran maximum reading thermometer after trip, temperature was 173°F after one hour static. Drilled 12-1/4" hole to 3404' with full returns.

10/26/92 Depth 3930'
Drilled 12-1/4" hole from 3404' to 3930'. Made short trip and circulated. Bottoms up temperature 168°F. Strapped out of hole.

10/27/92 Depth 3930'
Ran Gamma Ray log and Pressure-Temperature survey. Bottom hole temperature 310°F. Ran in hole. Ran gyroscopic multi-shot survey from 3903' to surface. Short tripped. Pulled out of hole. Rigged up and ran 9-5/8" liner.

10/28/92 Depth 3930'
Rigged and ran 54 joints of 9-5/8", 47#/ft, C-90, New Vam casing. Ran in hole on liner hanger and hung with shoe at 3925', float collar at 3883' and top of liner hanger at 1825'. Conditioned hole. Cemented as follows: mixed

and pumped 20 bbls lime water, 10 bbls calcium chloride water, 5 bbls water, 40 bbls super flush and 5 bbls water followed by; 20.5 bbls Hawaiian cement with 0.3% LWL and 0.5% H22-A; plus 99 barrels Hawaiian Cement with 40% SSA-1, 50#/sack Spherelite, 4% gel, 1.25% CFR-3, 0.5% H22-A and 0.3% LWL; plus 34.8 barrels Hawaiian cement with 40% SSA-1, 0.75% CFR-3, 0.3%, 0.5% H22-A, and 2 gallons/sack latex; plus 27 barrels Hawaiian cement with 40% SSA-1, 50#/sack Spherelite, 4% gel, 1.25% CFR-3, 0.5% H22-A and 0.3% LWL, plus 10.4 barrels Hawaiian cement with 40% SSA-1 and 0.75% CFR-3. Displaced with 183 bbls of water. Bumped plug. Float held. Released from liner hanger with high drag. Circulated out excess cement. Ran in hole with 12-1/4" bit to top of liner at 1830'. (Liner no longer hung at 1825'. Top of liner hanger at 1830', float at 3888' and shoe of 9-5/8" liner at 3930'.)

10/29/92 Depth 3930'
Waited on cement. Tripped in hole with 8-1/2" drilling assembly to 2000'. Performed liner lap test to a 0.9 gradient. Liner lap leaked. Established pump in rate of one BPM at 900 psi. Tripped for open ended drill pipe. Halliburton mixed and pumped 100 cubic feet of Hawaiian cement with 40% SSA-1 and 0.75% CFR-3, through OEDP at 1817', mixed first 50 cubic feet of cement with 2% calcium chloride. Displaced with 30 bbls water. Pulled 2 stands. Squeezed 75 cubic feet of cement into lap with 1500 psi final pressure. Held 1500 psi for 1 hour. Released pressure, had flow back. Held 1500 psi for 1 additional hour. Waited on cement. Tripped for 12-1/4" bit. Tagged liner top at 1830' with no cement above lap.

10/30/92 Depth 4271'
Cleaned out to liner hanger. Tested liner lap to 900 psi for 30 min, OK. Ran MRT at 2764', temperature 310°F. Cleaned out cement, float collar and cement to 3907'. Tested casing to 800 psi surface pressure for 30 min, OK. Cleaned out cement and shoe at 3930'. Drilled 8-1/2" hole from 3930' to 3937'. Performed formation leak off test to a 0.65 gradient, 775 psi surface pressure had no leak off. Drilled 8-1/2" hole from 3937' to 4271'.

10/31/92 Depth 4579'
Drilled 8-1/2" hole from 4271' to 4579'. Checked flow while surveying. Had small flow. Circulated and tripped for BHA. While out of hole the well head pressure was 225 psi. Circulated bottoms up at shoe. Had 30' fill on bottom. Ran temperature survey. Tripped to the shoe. Shut in to monitor well pressure.

11/01/92 Depth 4579'
Monitored well head pressure. Ran temperature surveys.

Highest temperature was 480°F. Highest WHP was 255 psi. Displaced hole with 10 ppg mud.

11/02/92 Depth 4579'
Conditioned 10 ppg mud. Spotted 10.7 ppg mud on bottom and pulled out of hole. Made up 9.625" EZSV. Ran in hole and set plug at 2059'. Spotted high vis pill. Tested lap to 450 psi surface pressure, OK. Tripped out.

11/03/92 Depth 4579'
Rigged and ran 9-5/8", 47#/ft, C-90, New Vam tie back casing. Total of 48 joints, 1850.93', including stab-in and float collar. Installed Foster casing centralizer. Nippled up BOPE.

11/04/92 Depth 4579'
Waited to cement 9-5/8" casing while all resources were diverted to KS-8. Rigged up Howco and cemented 9-5/8" tie back casing with 950 cubic feet Hawaiian cement with 40% silica flour, 3% gel and 1.25% CFR-3. Displaced cement with 134 bbls water. Bump plug 1500 psi. Cement in place 1550 hrs. Waited on cement.

11/05/92 Depth 4579'
Cut off 9-5/8" casing. Installed expansion spool and tested to 2000 lbs, OK. Nippled up BOPE.

11/06/92 Depth 4579'
Nippled up BOPE. Tested casing, rams, and master valve to 2500 psi and Hydril to 1500 psi, all OK. Tripped in hole and tagged cement at 1788'. Drilled out float collar and cleaned out cement to 1843'. Cleaned out to the packer top at 2059'.

11/07/92 Depth 4579'
Tripped for retrieving tool. Engaged packer and milled top slips. Recovered packer. Nippled up additional blowout preventers and Cudd equipment.

11/08/92 Depth 4579'
Nippled up BOPE and Cudd. Pressure tested working stack to 2000 psi, OK, and Hydril to 1500 psi, OK. Tripped in hole with directional drilling assembly. Rigged up to circulate.

11/09/92 Depth 4627'
Directionally drilled 8-1/2" hole from 4579' to 4627'. Poor boy swivel failed. Rigged up to drill with kelly.

11/10/92 Depth 4690'

Directionally drilled 8-1/2" hole from 4627' to 4690'. Had a 2" flow through choke line while surveying. Flow diminished to 0.5" after a half hour. Tripped for bit.

11/11/92 Depth 4703'
Washed from 4465' to 4690'. Directionally drilled 8-1/2" hole from 4690' to 4703'. Tripped out for failed turbo drill. Rigged down snubbing unit.

11/12/92 Depth 4868'
Rigged down snubbing equipment and BOPE. Prepared for conventional drilling. Tripped in and reamed turbo drill run from 4570' to 4703'. Drilled 8-1/2" hole from 4703' to 4868' with full mud returns.

11/13/92 Depth 5215'
Drilled 8-1/2" hole from 4868' to 4955' with full mud returns. Tripped looking for wash out. Ran MRT before circulating and BHT was 360°F. Drilled 8-1/2" hole from 4955' to 5215' with full mud returns.

11/14/92 Depth 5465'
Drilled 8-1/2" hole from 5215' to 5296'. Tripped for bit. Drilled 8-1/2" hole from 5296' to 5465' with full mud returns.

11/15/92 Depth 5653'
Drilled 8-1/2" hole from 5465' to 5653'. Tripped for bit. Bottoms up CO_2 was 43,000 parts per million.

11/16/92 Depth 6128'
Drilled 8-1/2" hole from 5653' to 6128' with full mud returns.

11/17/92 Depth 6304'
Drilled 8-1/2" hole from 6128' to 6219'. Tripped for bit. Drilled 8-1/2" hole from 6219' to 6304' with full mud returns.

11/18/92 Depth 6620'
Drilled 8-1/2" hole from 6304' to 6592'. Began losing circulation at 6585' with TLC at 6592'. Pumped sump water and well water with lost circulation material. Regained partial returns. Drilled 8-1/2" hole to 6620' with 70 to 90 bbls/hr mud loss. (Lost circulation; 132 bbls/hr from 6585' to 6592', TLC at 6592' and 70 to 90 bph to 6620'.)

11/19/92 Depth 6796'
Tripped for slick BHA. Drilled 8-1/2" hole from 6620' to

6735' with approximately 95% returns. Plugged bit. Hole tight. Pulled 2 stands. Circulated and worked pipe with 50% returns. Unplugged bit. Washed from 6548' to 6735'. Drilled 8-1/2" hole from 6735' to 6796' with partial loss of 50 to 100 bbl/hr.

11/20/92 Depth 6596'
Made short trip. Cleaned out 8' of fill. Tripped for profile nipple on 10 stands drill pipe. Performed 3 hour injection test. Maximum injection rate 31 BPM at 370 psi. Final rate 18.9 BPM at 140 psi. Tripped for bit on HWDP. Pumping water in kill line at 6 bbl/min. Had 2' of fill. Strapped out of hole.

11/21/92 Depth 6796'
Rigged up and ran 77 joints of 7", 29#/ft, L-80, BTC perforated casing. Total length of 2947.53', first joint and last 3 joints blank. Hung liner with guide shoe at 6791' and top of liner hanger at 3831'. Released from liner. Laid down drill pipe. Pumped into well at 6 BPM at all times. NOTE: Casing perforated with 2 rows/ft of 8 slots/row each slot 1/4" x 3".

11/22/92 Depth 6796'
Ran and set 9-5/8" RTTS at 60'. Nippled down BOPE. Installed 7" hanger spool. Tested master valve to 3500 psi, OK. Witnessed by Eric Tanaka, DLNR.

11/23/92 Depth 6796'
Tested well head and hanger spool to 2500 psi, tested OK. Witnessed by Eric Tanaka, DLNR. Laid down drill pipe and RTTS. Rigged up and ran 104 joints 7", 23#/ft, 22 chrome , Vam Ace casing while pumping water at 6 bpm. Donut hanger would not pass through master valve. Broke out donut to be modified at machine shop. (Donut has 9-11/16" OD and valve has 9-1/2" ID.)

11/24/92 Depth 6796'
Installed modified donut hanger and landed 7" casing 28' below kelly bushing with shoe at 2800'. Closed master valve. Tightened all well head bolts. Pumped down 7" at 18 BPM with well on vacuum.

11/25/92 Depth 6796'
Repacked expansion spool. Pumped 4600 SCF nitrogen at 1100 psi into 9-5/8" x 7" annulus. Nippled down BOPE.

11/26/92 Depth 6796'
Rig on standby with crews waiting for True Drilling Company.

11/27/92 Depth 6796'

Rig on standby with crews.

11/28/92 Depth 6796'
Rig on standby with crews.

11/29/92 Depth 6796'
Rig on standby with crews. Rig released at 2400 hours on November 29, 1992.

========== NORTRAK NAVIGATION SURVEY PROGRAM Ver: 2.00PC (03-31-86) ==========

Date: 11/22/1992 Time: 19:45:33 PAGE: 1
Filename: "KS4.SRV" Description: "ACTIVE "
Target Coordinates: 647.4 N 625.2 W Target TVD: 7400.000
Using Radius of curvature method.

S #	MEASURED DEPTH (feet)	DRIFT ANGLE (deg)	DRIFT DIRECTION (deg)	COURSE LENGTH (feet)	TRUE VERTCAL DEPTH (feet)	VERTCAL SECTION (feet)	--- RECTANGULAR COORDINATES (feet)	DOGLEG -SEVERITY DG/100FT
2	1326.0	1.25	N 3.00 E	226.0	1326.0	1.7	2.5 N 0.1 E	0.55
3	1417.0	1.00	N 6.00 E	91.0	1417.0	2.9	4.2 N 0.3 E	0.28
4	1614.0	1.00	N 6.00 E	197.0	1613.9	5.1	7.7 N 0.6 E	0.00
5	1758.0	3.00	N 5.00 W	144.0	1757.8	8.7	12.7 N 0.7 E	1.41
6	1788.0	3.25	N 2.00 E	30.0	1787.8	9.9	14.3 N 0.6 E	1.52
7	1881.0	4.75	N 27.00 W	93.0	1880.6	15.3	20.6 N 0.8 W	2.66
8	2005.0	4.75	N 11.00 W	124.0	2004.1	24.6	30.3 N 4.1 W	1.07
9	2452.0	5.25	N 16.00 W	447.0	2449.4	58.2	68.1 N 13.2 W	0.15
10	2712.0	6.50	N 36.00 W	260.0	2708.1	83.3	91.9 N 24.8 W	0.92
11	2974.0	9.50	N 63.00 W	262.0	2967.5	119.3	115.4 N 52.3 W	1.81
12	3098.0	9.50	N 57.00 W	124.0	3089.8	139.0	125.6 N 70.0 W	0.80
13	3220.0	10.00	N 51.00 W	122.0	3210.0	159.3	137.8 N 86.7 W	0.93
14	3343.0	9.50	N 48.00 W	123.0	3331.2	180.0	151.3 N 102.5 W	0.58
15	3464.0	9.50	N 44.00 W	121.0	3450.6	200.0	165.1 N 116.9 W	0.55
16	3588.0	9.25	N 46.00 W	124.0	3572.9	220.2	179.4 N 131.2 W	0.33
17	3715.0	9.00	N 46.00 W	127.0	3698.3	240.3	193.4 N 145.7 W	0.20
18	3838.0	9.25	N 45.00 W	123.0	3819.8	259.8	207.1 N 159.6 W	0.24
19	3900.0	9.50	N 48.00 W	62.0	3880.9	269.9	214.0 N 166.9 W	0.89
20	4090.0	8.50	N 49.00 W	190.0	4068.6	299.5	233.7 N 189.2 W	0.53
21	4235.0	8.00	N 54.00 W	145.0	4212.1	320.2	246.7 N 205.4 W	0.60
22	4493.0	7.75	N 58.00 W	258.0	4467.7	354.7	266.4 N 234.7 W	0.23
23	4577.0	7.00	N 58.00 W	84.0	4551.0	365.2	272.2 N 243.9 W	0.89
24	4650.0	8.75	N 61.00 W	73.0	4623.3	374.8	277.2 N 252.5 W	2.46

S #	MEASURED DEPTH (feet)	DRIFT ANGLE (deg)	DRIFT DIRECTION (deg)	COURSE LENGTH (feet)	TRUE VERTCAL DEPTH (feet)	VERTCAL SECTION (feet)	--- RECTANGULAR COORDINATES (feet)	DOGLEG -SEVERITY DG/100FT
25	4688.0	10.25	N 66.00 W	38.0	4660.8	380.7	280.0 N 258.1 W	4.50
26	4818.0	10.75	N 60.00 W	130.0	4788.6	403.1	290.8 N 279.2 W	0.92
27	5000.0	11.25	N 64.00 W	182.0	4967.2	436.1	307.1 N 309.9 W	0.50
28	5125.0	11.75	N 66.00 W	125.0	5089.7	459.4	317.6 N 332.4 W	0.51
29	5282.0	12.00	N 71.00 W	157.0	5243.4	488.8	329.5 N 362.5 W	0.67
30	5405.0	12.50	N 66.00 W	123.0	5363.6	512.5	339.0 N 386.8 W	0.95
31	5561.0	12.50	N 59.00 W	156.0	5515.9	544.5	354.6 N 416.7 W	0.97
32	5863.0	14.00	N 58.00 W	302.0	5809.8	611.5	390.8 N 475.7 W	0.50
33	5990.0	14.00	N 55.00 W	127.0	5933.0	641.5	407.7 N 501.3 W	0.57
34	6097.0	14.00	N 55.00 W	107.0	6036.9	667.0	422.6 N 522.5 W	0.00
35	6232.0	14.50	N 58.00 W	135.0	6167.7	699.4	440.9 N 550.2 W	0.66
36	6341.0	14.75	N 58.00 W	109.0	6273.2	726.1	455.5 N 573.6 W	0.23
37	6498.0	14.75	N 60.00 W	157.0	6425.0	764.7	476.1 N 607.8 W	0.32
38	6796.0	14.75	N 60.00 W	298.0	6713.2	837.6	514.0 N 673.5 W	0.00

--- Final Closure Direction: N 52.65 W
--- Final Closure Distance: 847.274 feet

BREWER ENVIRONMENTAL INDUSTRIES, INC.
a C. BREWER company

LABORATORY ANALYSIS REPORT
Environmental Laboratories Division

CLIENT: PUNA GEOTHERMAL VENTURE
P.O. BOX 30
PAHOA, HAWAII 96778

ATTN: BILL TEPLOW

JOB NUMBER: 8388

DATE: OCT. 12, 1992

SAMPLE LOCATION:

Date/Time Sampled: 09/17/92 @ 0200
Date/Time Received: 09/17/92 @ 1138

Matrix: WATER
SAMPLE #: KS4A
600'

ANALYSIS	RESULT mg/L	DETECTION LIMIT mg/L	ANALYSIS DATE	METHOD NUMBER
CHLORIDE	16.5	1	09/18/92	325.2
FLUORIDE	0.34	0.1	09/28/92	340.2
NITRATE	0.25	0.01	09/21/92	353.3
pH (units)	6.9		09/19/92	150.1
SULFATE	115	5	09/23/92	375.4
TOTAL DISSOLVED SOLIDS	356	1	09/22/92	160.1
TOTAL SUSPENDED SOLIDS	1420	1	09/21/92	160.2
ENDRIN	ND	0.0002	09/30/92	508
LINDANE	ND	0.0002	09/30/92	508
METHOXYCHLOR	ND	0.04	09/30/92	508
TOXAPHENE	ND	0.003	09/30/92	508
2,4-D	ND	0.03	10/07/92	515.1
2,4,5-TP (SILVEX)	ND	0.01	10/07/92	515.1

ND = NOT DETECTED

BREWER ENVIRONMENTAL LABORATORIES
PO BOX 552
PAPAIKOU, HI 96781
PHONE (808) 964-5522
FAX (808) 964-5309

Approved by: Jana Malcolm-Bro

BREWER ENVIRONMENTAL INDUSTRIES, INC.
a C. BREWER company

LABORATORY ANALYSIS REPORT
Environmental Laboratories Division

CLIENT: PUNA GEOTHERMAL VENTURE
P.O. BOX 30
PAHOA, HAWAII 96778

ATTN: BILL TEPLOW

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SAMPLE LOCATION:

Date/Time Sampled: 09/17/92 @ 0200
Date/Time Received: 09/17/92 @ 1138

Matrix: WATER
SAMPLE #: KS4A
600'

ANALYSIS	RESULT mg/L	DETECTION LIMIT mg/L	ANALYSIS DATE	METHOD NUMBER
ARSENIC	ND	0.005	09/28/92	206.2
BARIUM	0.13	0.10	09/28/92	200.7
CADMIUM	ND	0.01	09/28/92	200.7
CHROMIUM	0.04	0.02	09/28/92	200.7
LEAD	ND	0.05	09/28/92	200.7
MERCURY	ND	0.002	09/25/92	7471
SELENIUM	ND	0.005	09/28/92	270.2
SILVER	ND	0.05	09/28/92	200.7
CALCIUM	60.8	0.10	09/28/92	200.7
MAGNESIUM	15.9	0.25	09/28/92	200.7
NICKEL	ND	0.1	09/28/92	200.7
POTASSIUM	8.6	1.0	09/28/92	200.7
SODIUM	49.2	0.1	09/28/92	200.7
VANADIUM	0.12	0.05	09/28/92	200.7
LITHIUM	ND	0.01	09/22/92	200.7
IRON	33.0	0.05	09/28/92	200.7
BORON	0.21	0.01	09/28/92	200.7
SILICA	83.5	0.01	09/28/92	370.1

ND = NOT DETECTED

Approved by: Jana Malcolm-Bisa

BREWER ENVIRONMENTAL LABORATORIES
PO. BOX 552
PAPAIKOU, HI 96781
PHONE (808) 964-5522
FAX (808) 964-5309

To: File

From: Skip Matlick, Mesquite Group, Inc

Subject: KS-4 Gamma Log, 1064 - 2056 ft.

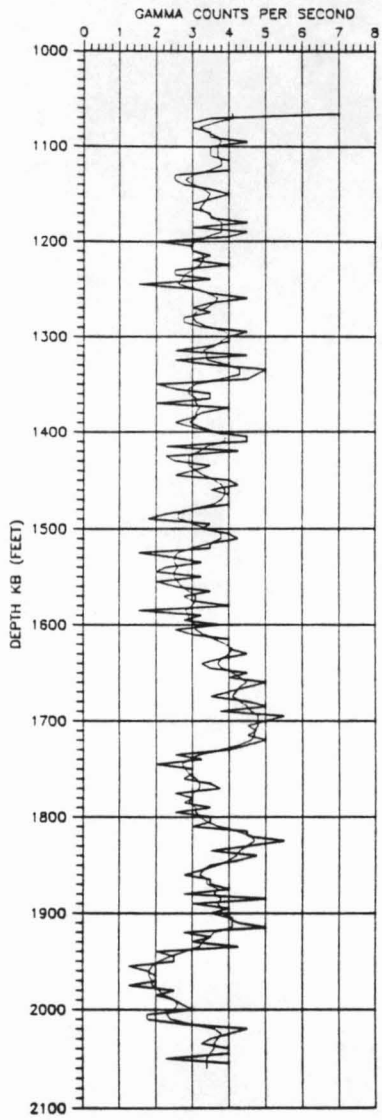
On October 15,1992, Flo-Log Inc. ran a gamma log in KS-4 before the intermediate casing was run and cemented in the 17½-in. hole. The logging tool utilized a sodium iodide crystal to detect gamma rays which were measured in standard API counts. The hole was logged down at 20 ft/min at a scale of 0 to 50 API counts (Attached).

Figure 1 shows a digitized and smoothed gamma log for the depths logged. Only the lowest count per five foot interval was digitized. The smoothing routine utilized a three point (33/33/33 %) function.

In the lower interval of the gamma log, the higher gamma counts correspond to hard basalt dikes with the lower counts correlating to scoria or vesicular basalt. It is recommended that all further wells be gamma logged below 1000 ft until the temperature rating of the gamma tool (600 °F) is exceeded.

Figure 1

NATURAL GAMMA RAY LOG
KS-4, 17-1/2 IN. HOLE
10/15/92



To: File

From: Skip Matlick

Date: February 9, 1992

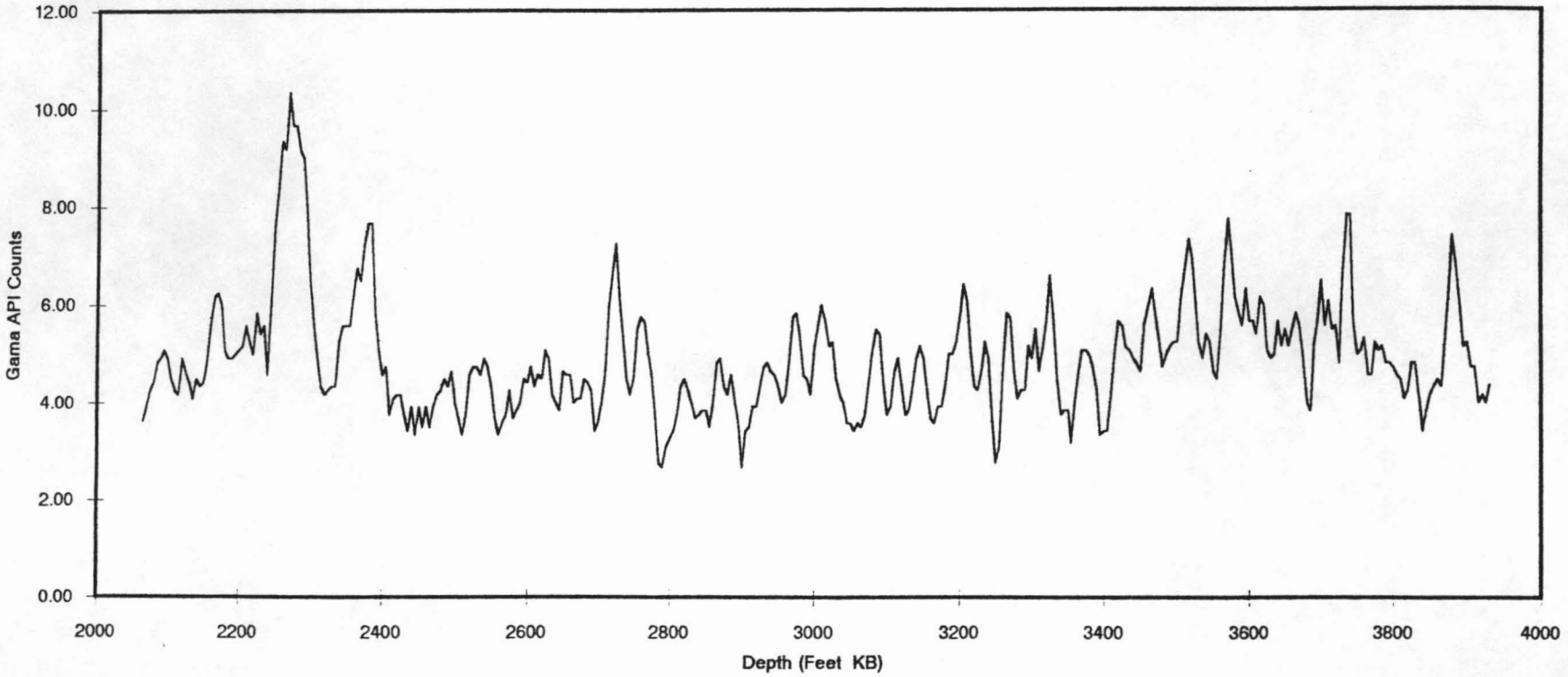
Subject: KS-4 Gamma Log, 2020 - 3932 ft.

On October 27, 1992, Flo-Log Inc. ran a gamma log in Well KS-4 before the production casing was run and cemented in a 12 1/4-in. hole. The logging tool utilized a sodium iodide crystal to detect gamma rays which were measured in standard API counts. The hole was logged down at 20 ft/min at a scale of 0 to 70 API counts (Attached).

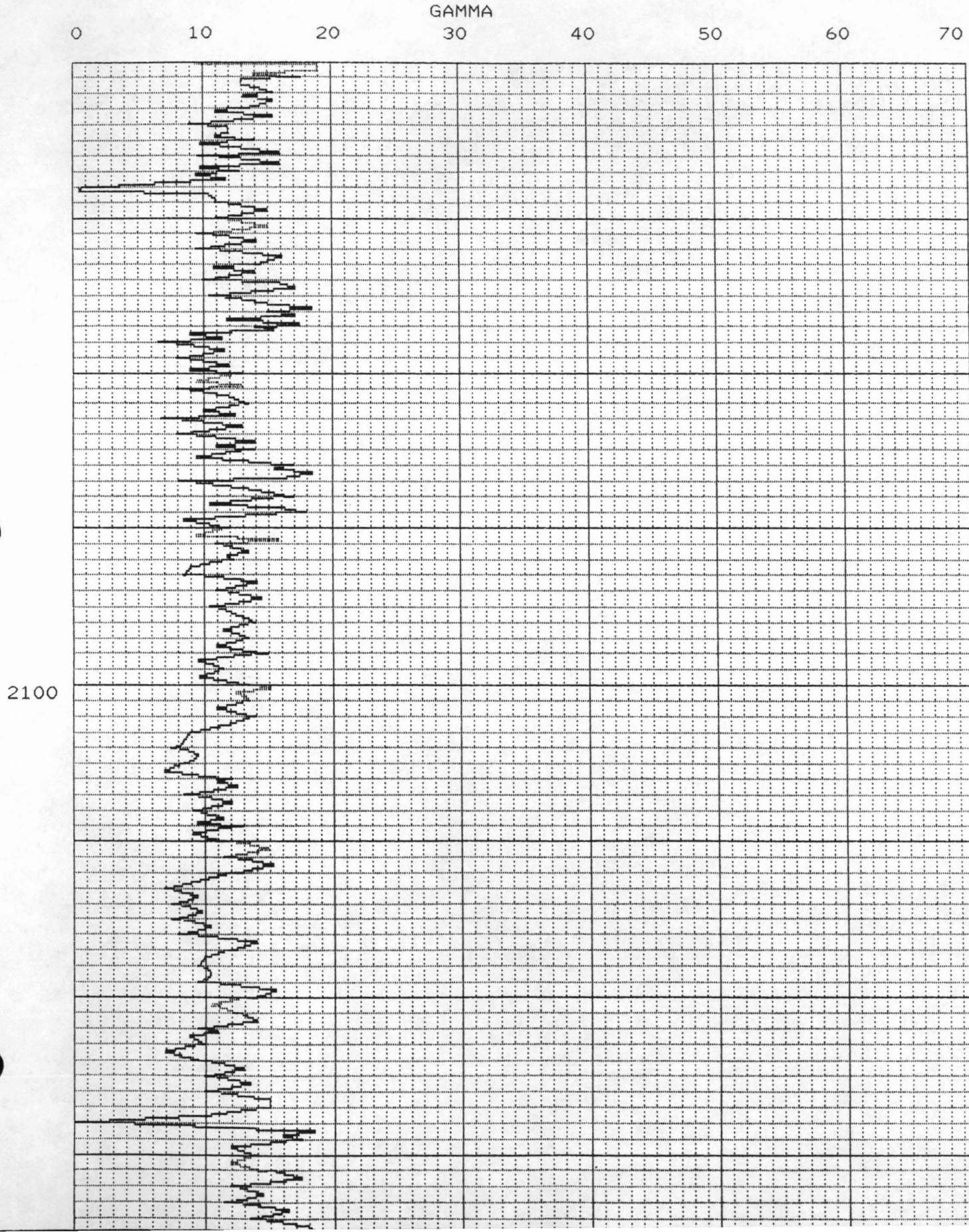
Figure 1 shows a digitized and smoothed gamma log for the depths logged. Only the lowest count per five foot interval was digitized. The smoothing routine utilized a three-point (33/33/33%) function except the first and last gamma count which utilized a two-point (50/50%) function.

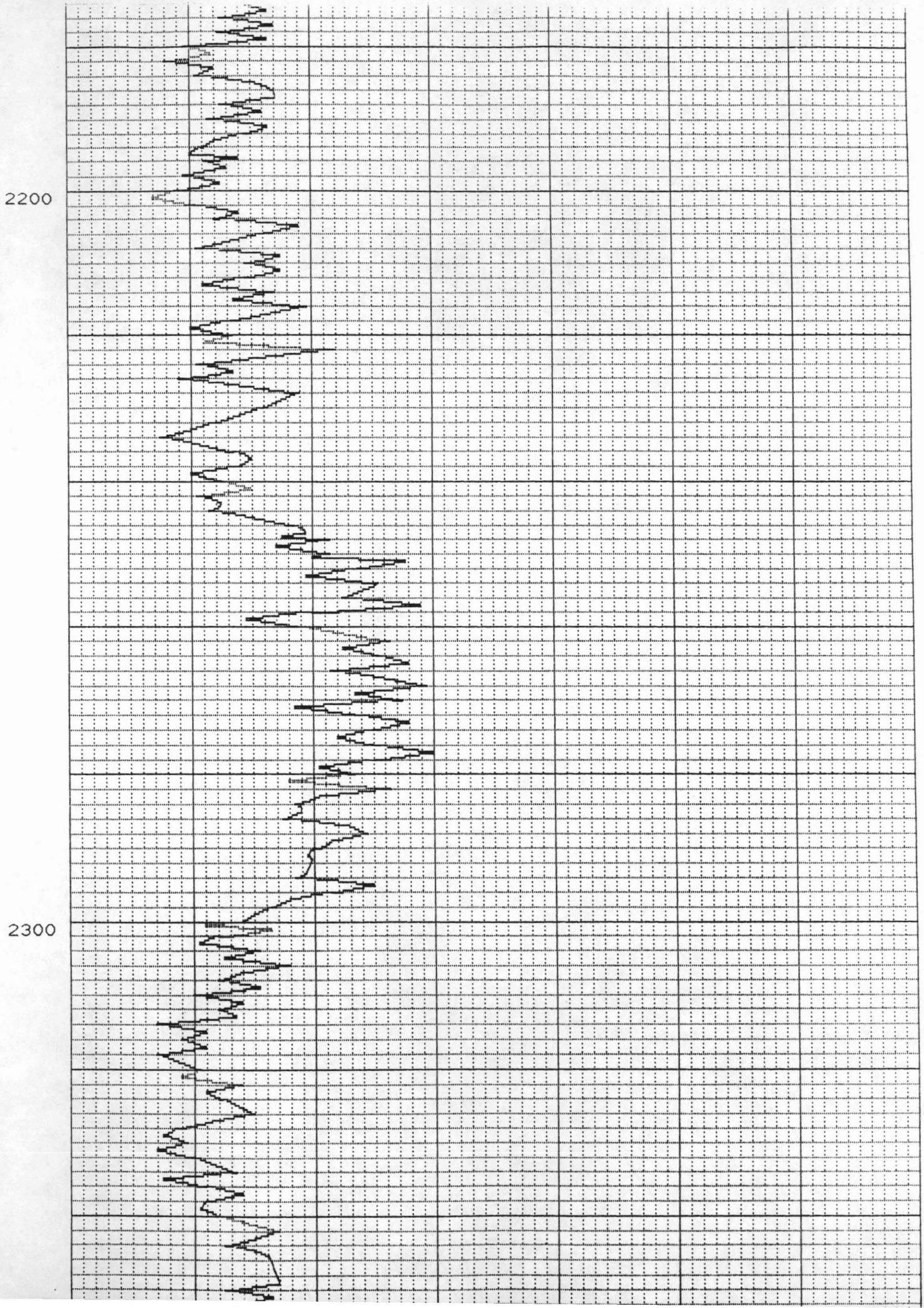
The API counts on the digitized gamma log range from less than 4 to 10. Comparison of the gamma log and mud log does not show any direct correlation.

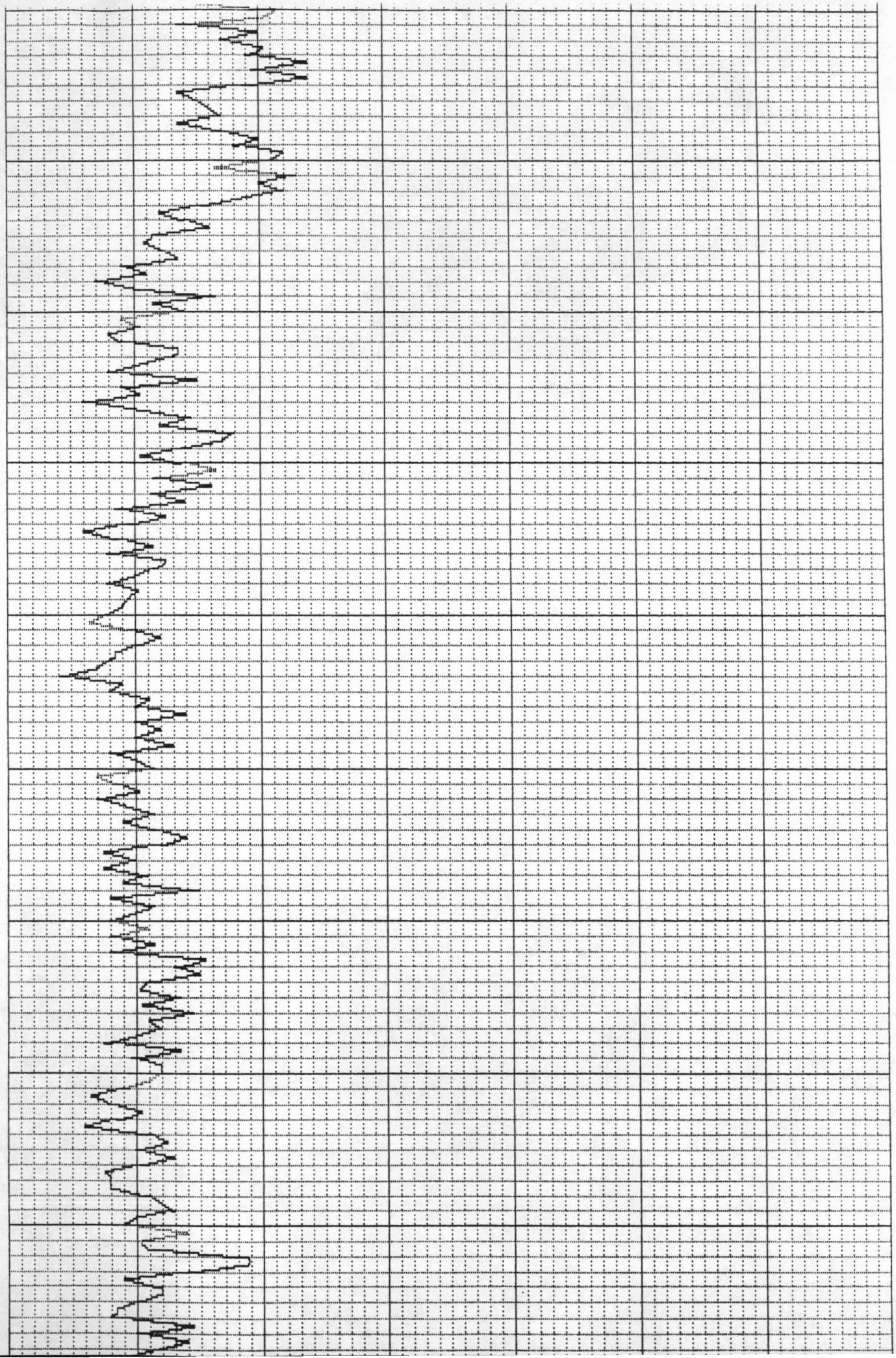
Gama Log
KS-4

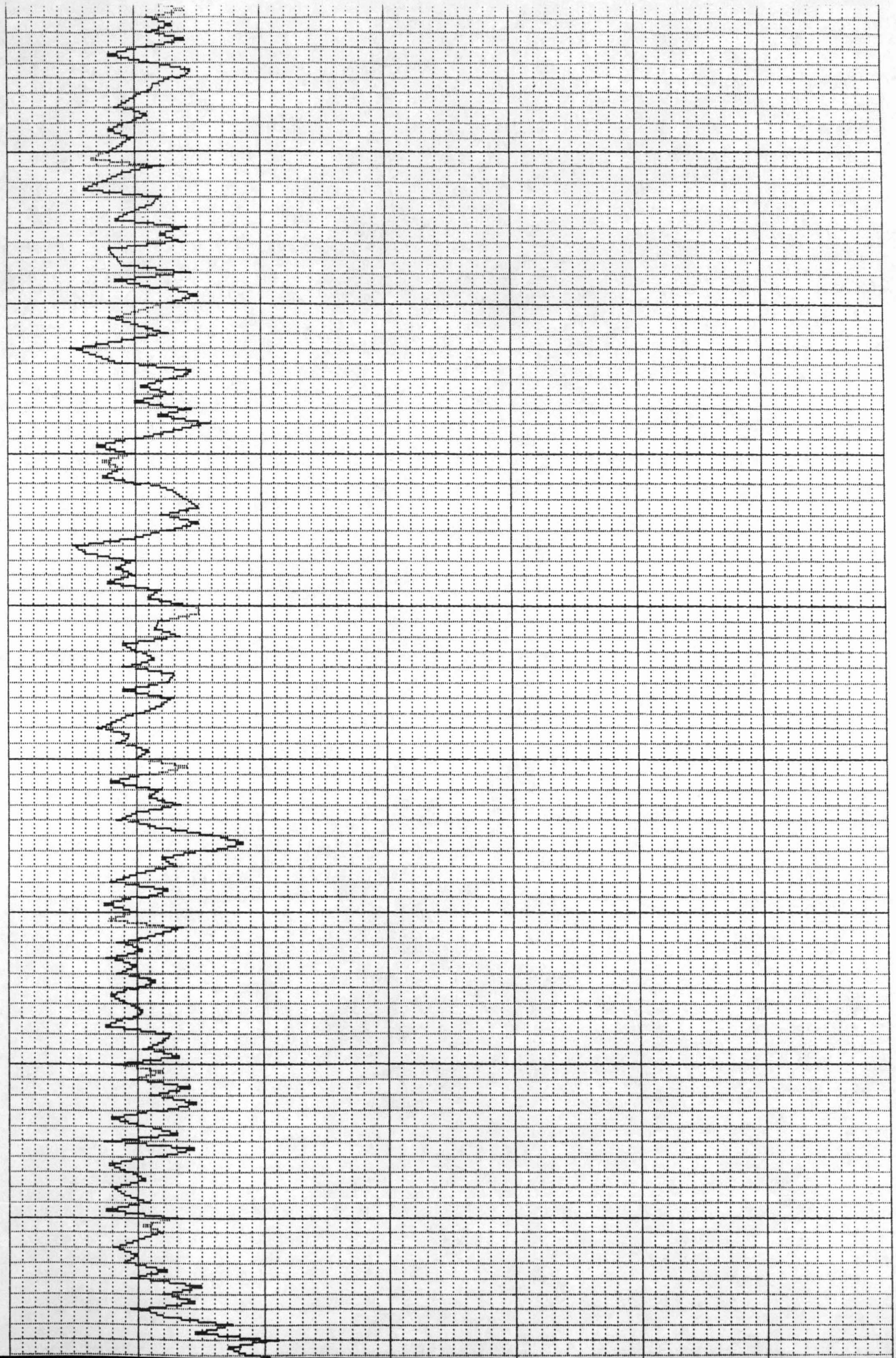

12.00
10.00
8.00
6.00
4.00
2.00
0.00
Gama API Counts
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
Depth (Feet KB)

Company Name PUNA GEOTHERMAL Date 10-27-92 Well # KS-4
Pick-Up Depth 3932' Max Temp 313 @ 3927'
Comments




2200
2300


2400
2500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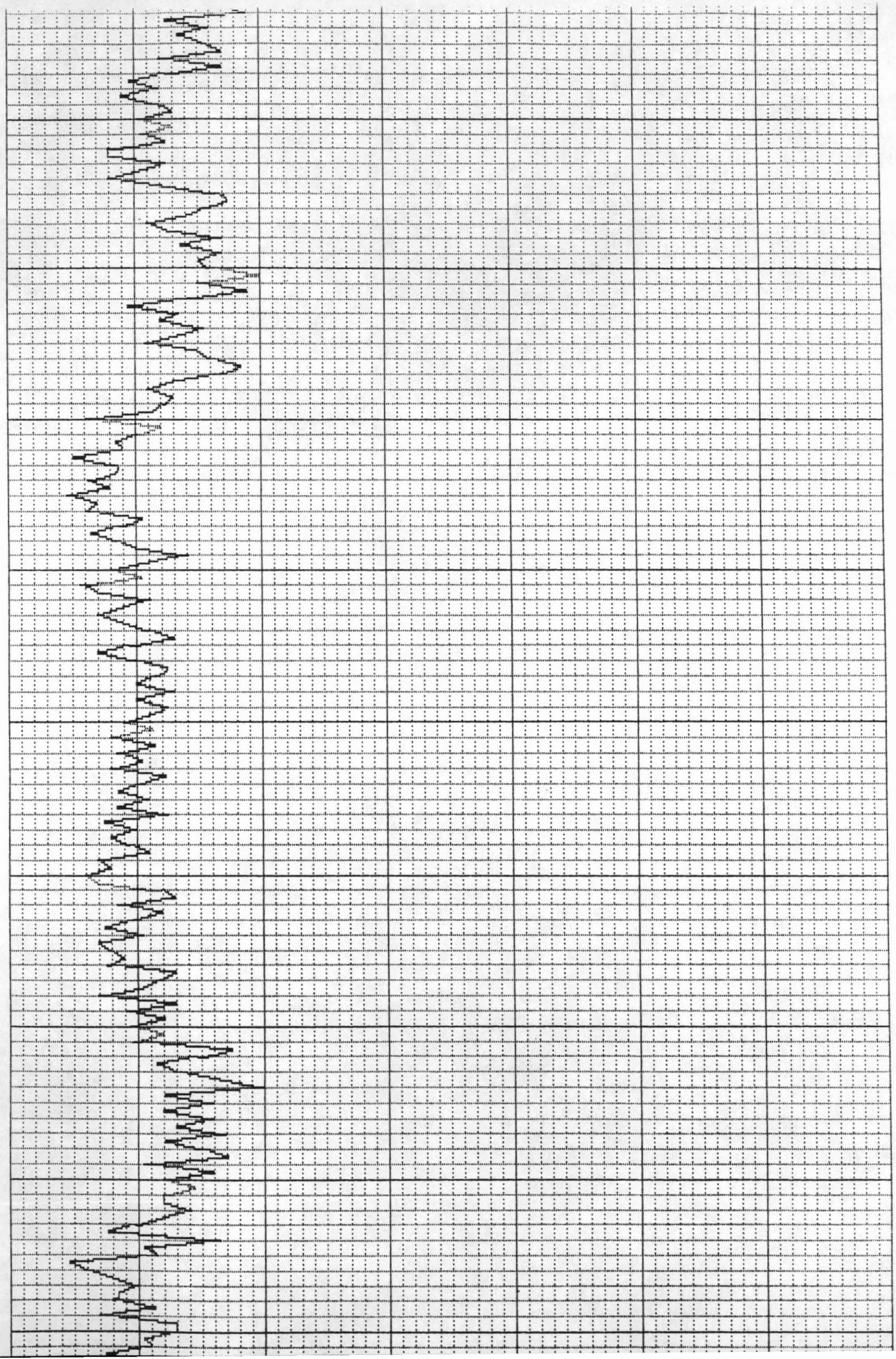
2700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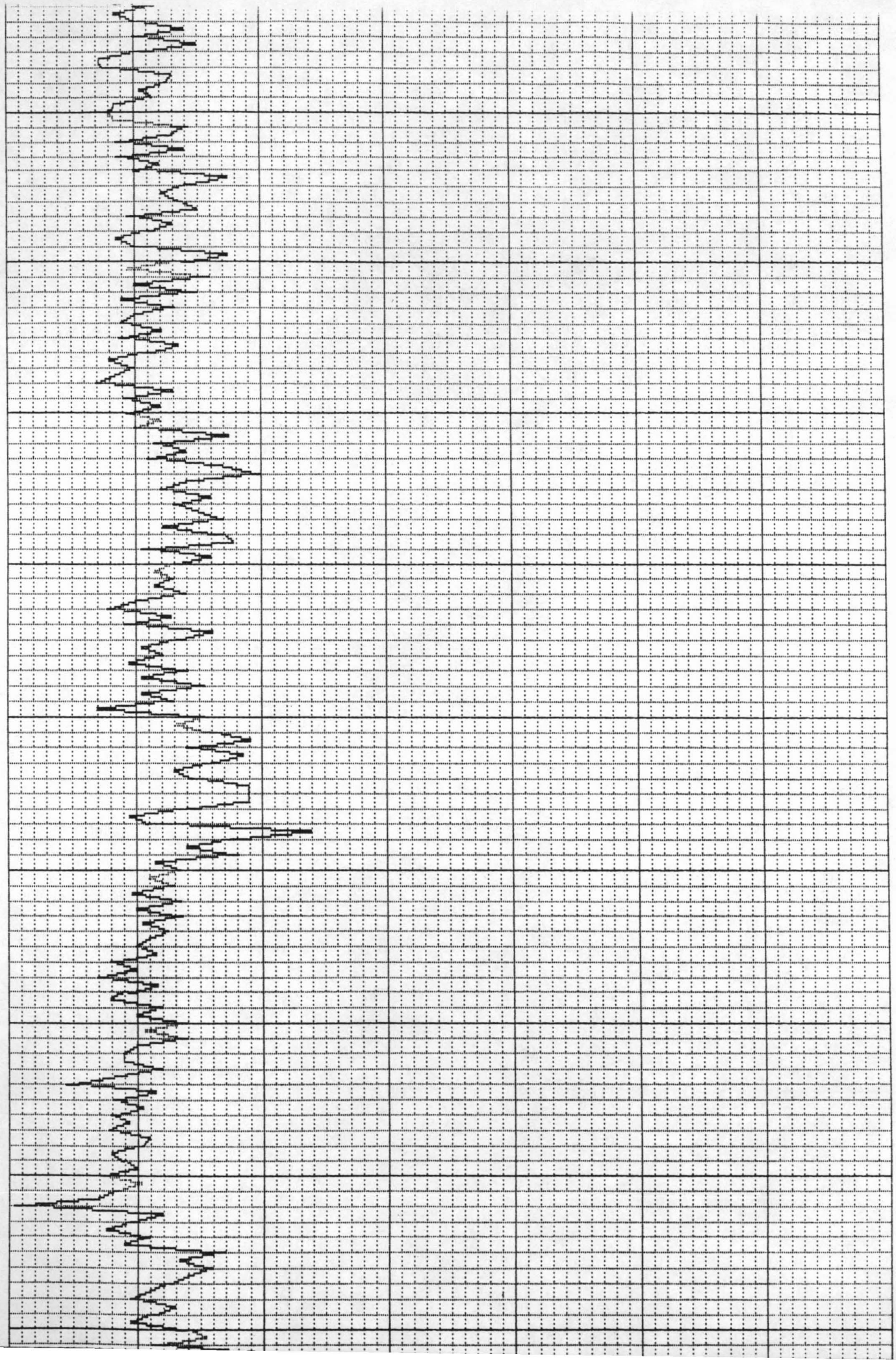
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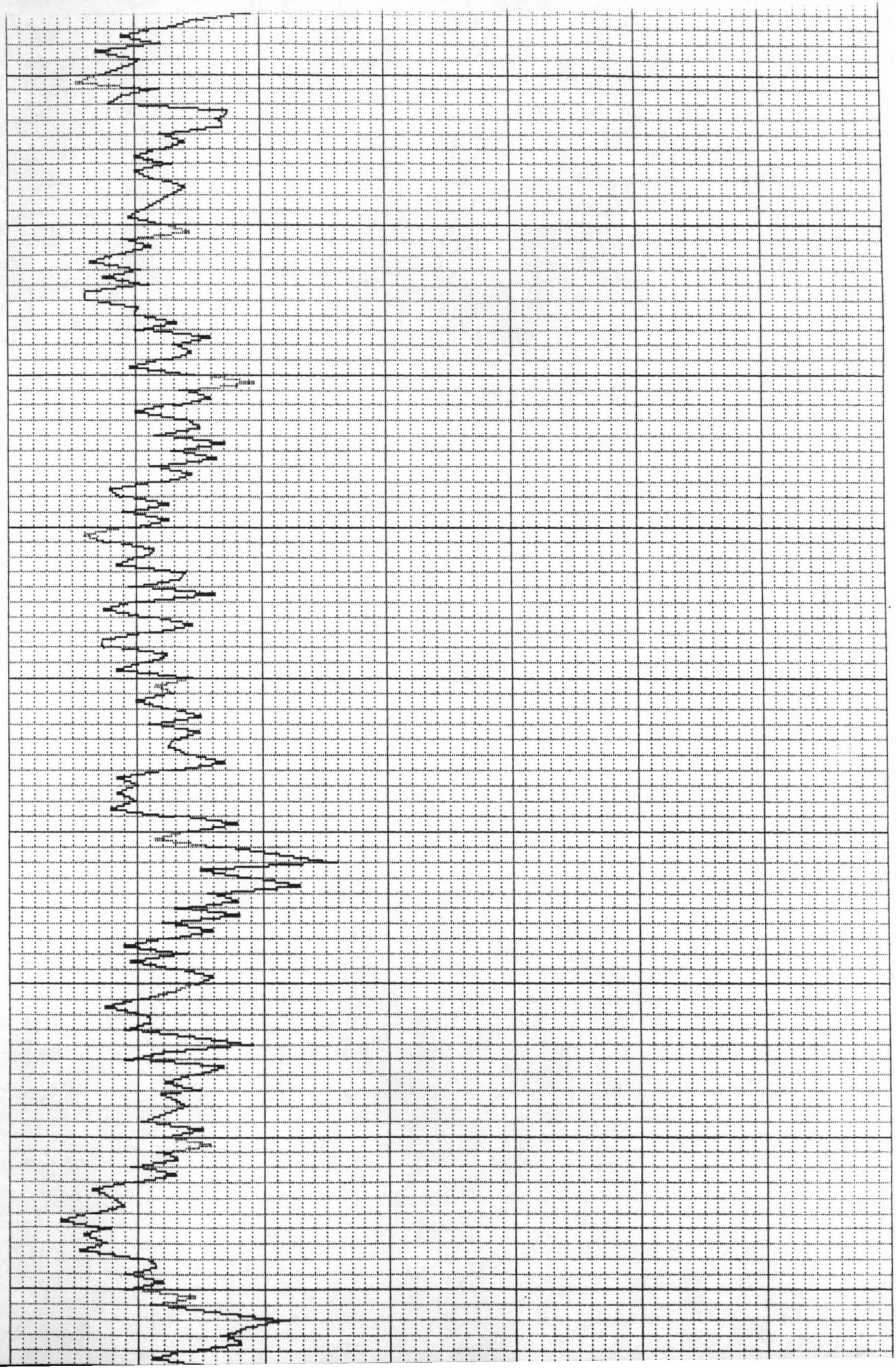
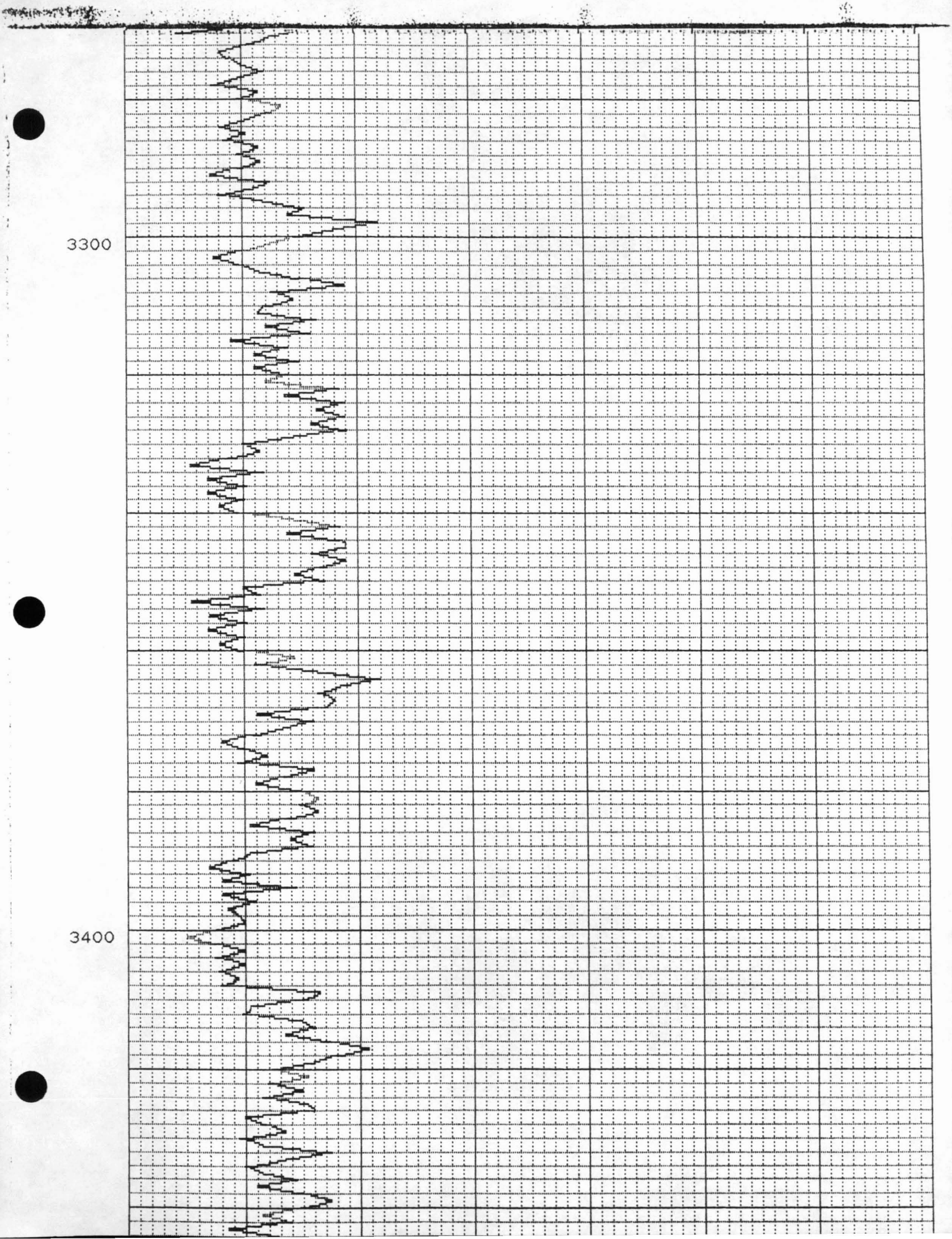

3100
3200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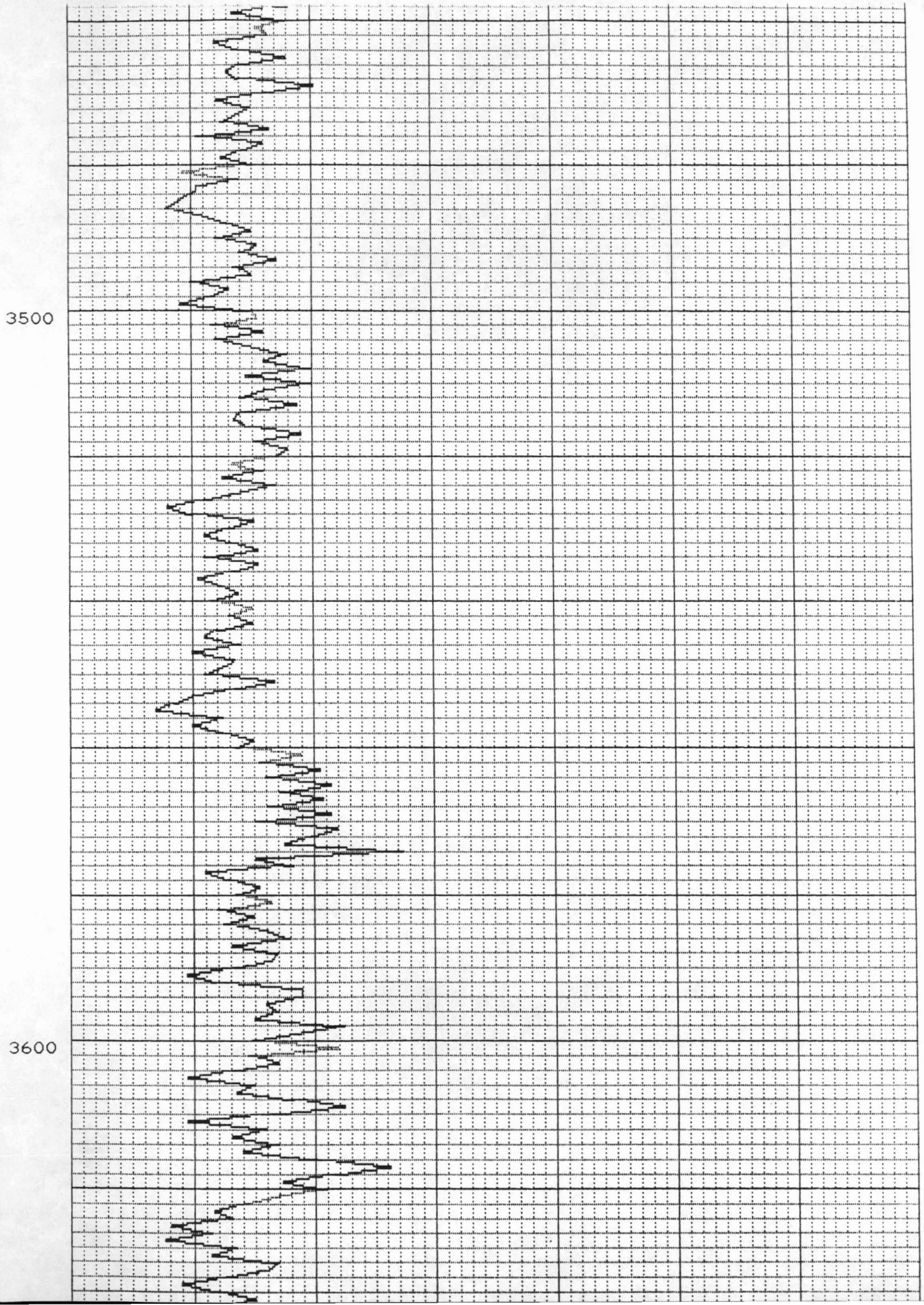
3400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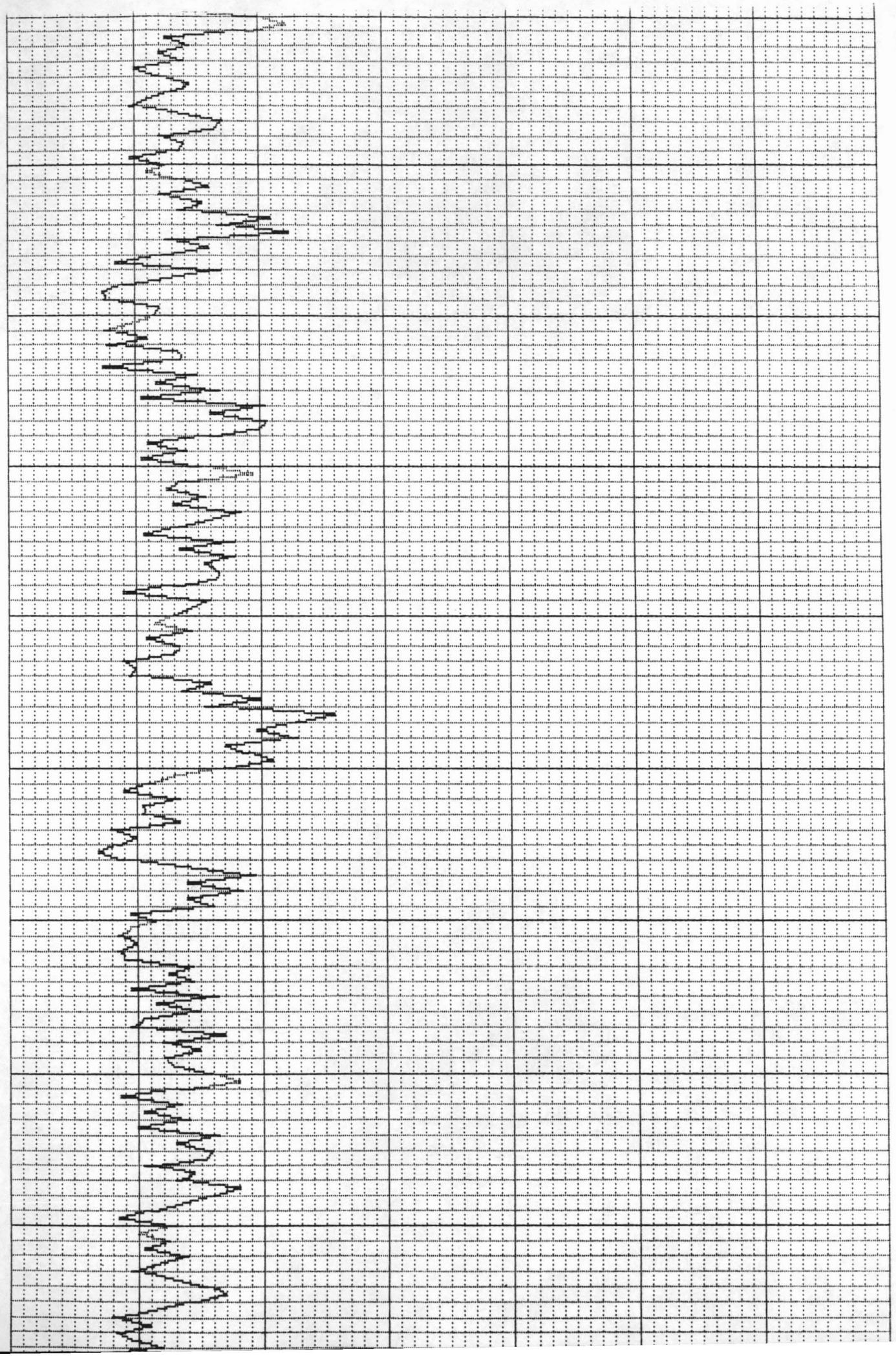
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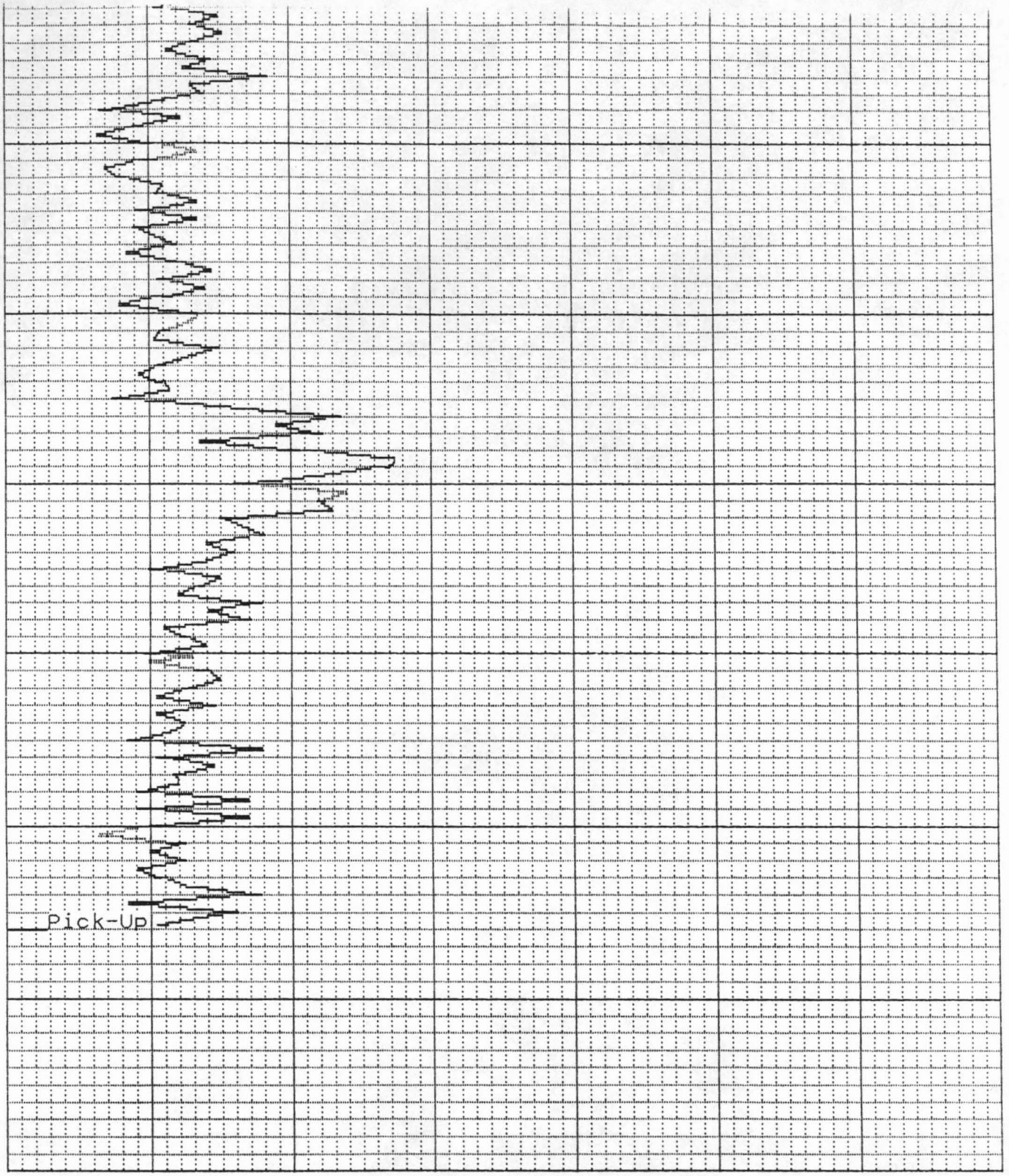
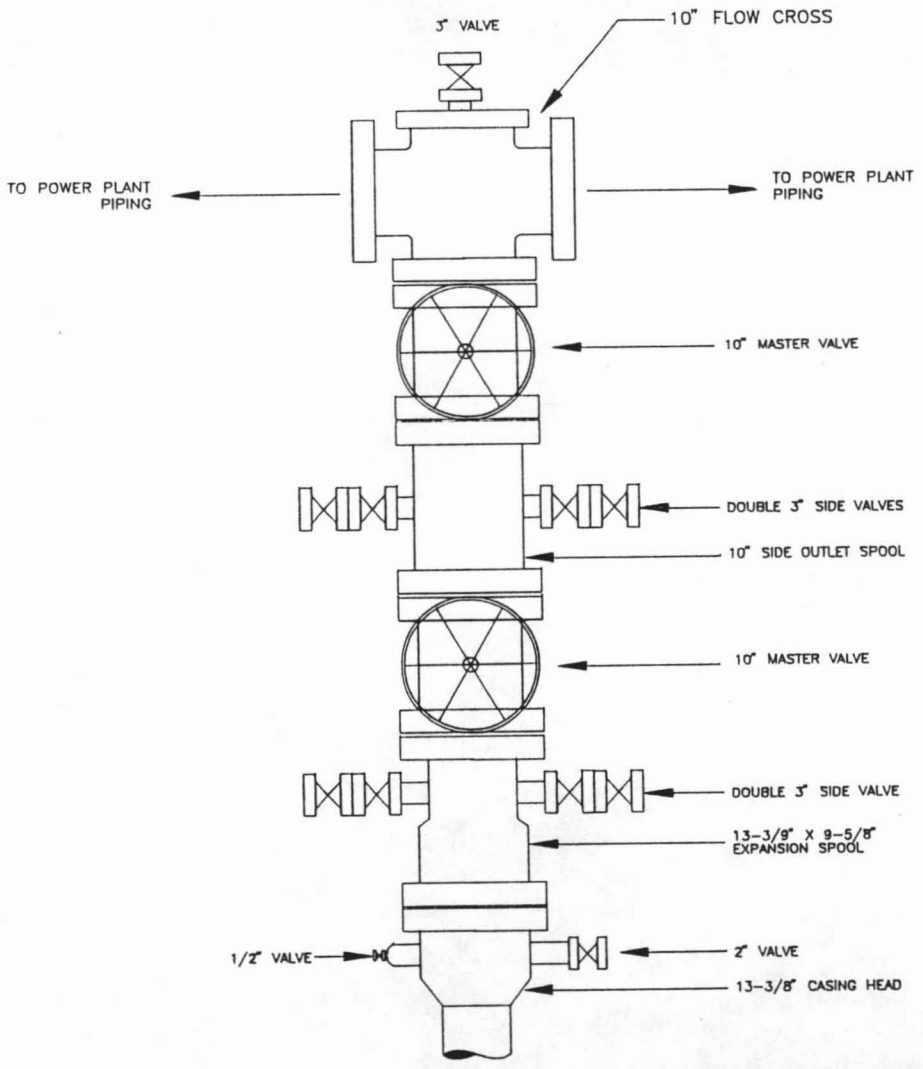
3800

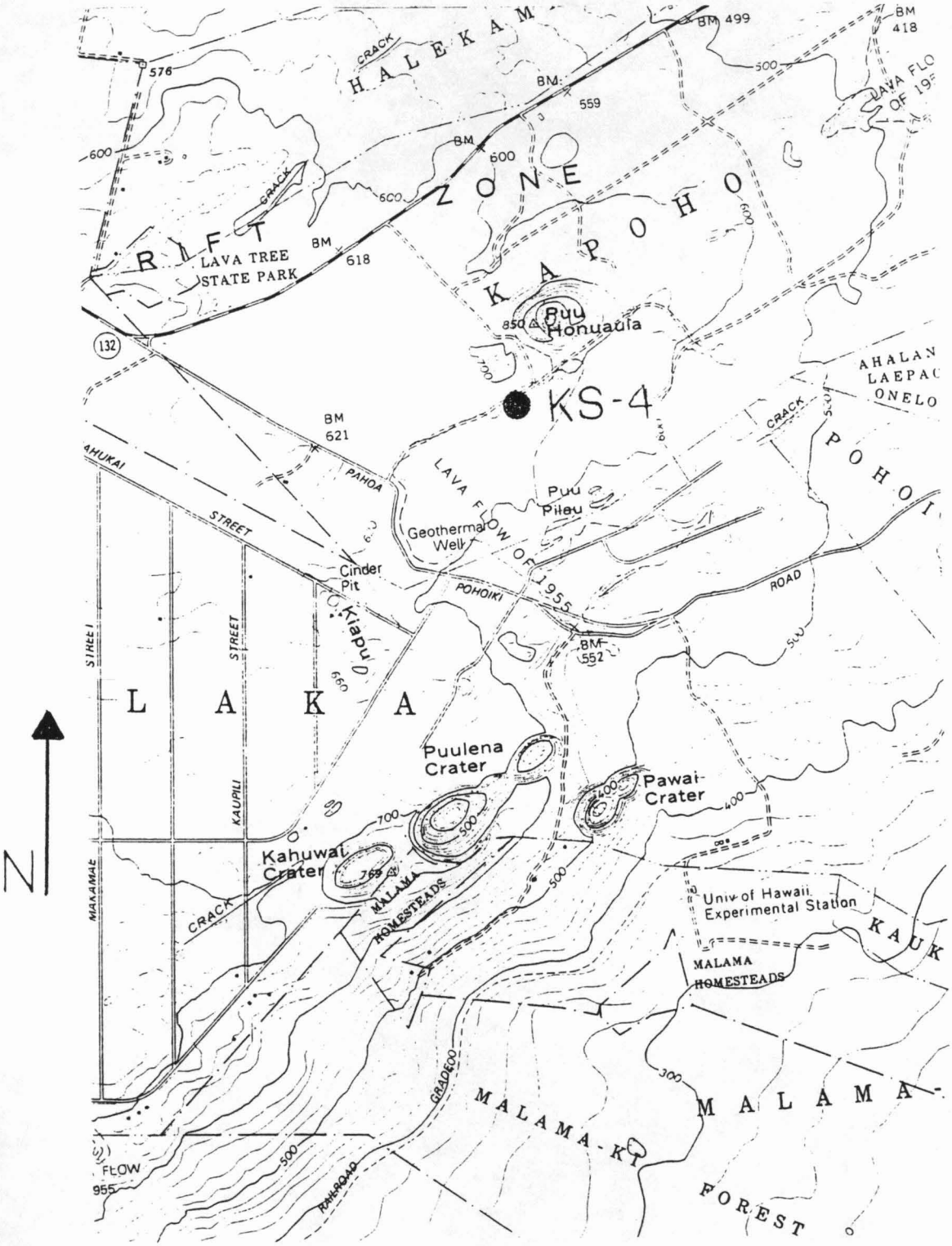

3900
Pick-Up



PUNA GEOTHERMAL VENTURE		
KS-9 PRODUCTION WELLHEAD SCHEMATIC FOR KS-9		
DATE 2/7/93		REV. 1
BY TEPLOW	FILE:PGV\KS9WH.DWG	FIGURE NO.

WELL LOCATION MAP

KS - 4



PUNA GEOTHERMAL VENTURE

MECHANICAL INTEGRITY TESTS OF WELL KS-4
October 1992 - January 1993

1.0 Summary

Well KS-4 was spudded on September 13, 1992 and completed as an injection well on November 24, 1992. The well is completed as shown in Figure 1, with the interval 3,930 ft to 6,791 ft KB open to injection. Mechanical integrity tests and an injection test were performed in accordance with Puna Geothermal Venture's Casing Monitoring Program (CMP), and the results are presented in this report.

Injection test results indicate that the well has an injection capacity in excess of 860 gpm at zero WHP and a projected capacity of about 1,100 gpm at 150 psig WHP. The pressure testing and logging results demonstrate that the well has good mechanical integrity and is suitable for injection service.

2.0 Casing Pressure Tests and Casing Shoe Tests

All three cemented casing strings and the 9⅝-inch tieback casing were tested in accordance with the CMP. The test operations are documented in the pertinent Daily Drilling Reports (Appendix A), and results are summarized below.

2.1 20-inch Casing Tests

CASING PRESSURE TEST

DATE: 10/10/92
CASING: 20-inch, 94 lb/ft, K-55, BT&C
DEPTH OF CASING SHOE: 1,064 ft KB
MUD DENSITY IN HOLE: 8.3 ppg
MINIMUM SURFACE TEST PRESSURE PER CMP: 766 psig
ACTUAL TEST PRESSURE: 800 psig (squeeze pressure)
TEST DURATION: 1 hour
ALLOWABLE PRESSURE DECLINE: 64 psi
ACTUAL PRESSURE DECLINE: ~0 psi
RESULT: Passed

In order to obtain a successful pressure test of cement integrity at the 20-inch casing shoe, it was necessary to cement off the natural formation permeability immediately below the shoe. After doing the first squeeze cement job and drilling out to 1,079 ft, the formation broke down when tested to 200 psig surface pressure (equivalent to 0.62 psi/ft gradient). A second cement job was done, and after drilling out below the shoe, a test was performed by verifying that the hole would circulate without loss of mud (Refer to summary of test data below.). This imposed a 280 psi pressure

differential relative to the groundwater aquifer and demonstrated the required integrity of the cement around the 20-inch casing at the shoe.

PRESSURE TEST AT CASING SHOE

DATE: 10/12/92
DEPTH OF CASING SHOE: 1,064 ft KB
DEPTH DRILLED TO BEFORE TEST: 1,106 ft
MUD DENSITY IN HOLE: 8.5 ppg
SURFACE TEST PRESSURE: 0 psig (hole full)
EQUIVALENT GRADIENT FROM SURFACE: 0.44 psi/ft
RESULT: Passed

2.2 13⅜-inch Casing Tests

CASING PRESSURE TEST

DATE: 10/18/92
CASING: 13⅜-inch, 61 lb/ft, K-55, New VAM
DEPTH OF CASING SHOE: 2,043 ft
MUD DENSITY IN HOLE: 8.5 ppg
MINIMUM SURFACE TEST PRESSURE PER CMP: 1,010 psig
ACTUAL TEST PRESSURE: 2,500 psig
TEST DURATION: 30 minutes
ALLOWABLE PRESSURE DECLINE: 200 psi
ACTUAL PRESSURE DECLINE: 10 psi
RESULT: Passed

PRESSURE TEST AT CASING SHOE

DATE: 10/20/92
DEPTH OF CASING SHOE: 2,043 ft
DEPTH DRILLED OUT TO BEFORE TEST: 2,053 ft
MUD DENSITY IN HOLE: 8.5 ppg
SURFACE TEST PRESSURE: 500 psig
EQUIVALENT GRADIENT FROM SURFACE: 0.69 psi/ft
RESULT: Passed

2.3 9⅝-inch Liner Tests

CASING PRESSURE TEST

DATE: 10/29/92
CASING: 9⅝-inch, 47 lb/ft, L-80, New VAM
DEPTH OF CASING SHOE: 3,930 ft
MUD DENSITY IN HOLE: 8.6 ppg
MINIMUM SURFACE TEST PRESSURE PER CMP: 1,095 psig
(based on rating of exposed 13⅜-inch csg at 1,830 ft)
ACTUAL TEST PRESSURE: 1,500 psig (squeeze pressure)
TEST DURATION: 1 hour
ALLOWABLE PRESSURE DECLINE: 144 psi
ACTUAL PRESSURE DECLINE: 0 psi

PRESSURE TEST AT CASING SHOE

DATE: 10/30/92
DEPTH OF CASING SHOE: 3,930 ft
DEPTH DRILLED OUT TO BEFORE TEST: 3,937 ft
MUD DENSITY IN HOLE: 8.6 ppg
SURFACE TEST PRESSURE: 775 psig
EQUIVALENT GRADIENT FROM SURFACE: 0.65 psi/ft
RESULT: Passed

2.4 9⅝-inch Tieback Casing Test

CASING PRESSURE TEST

DATE: 11/6/92
CASING: 9⅝-inch, 47 lb/ft, L-80, New VAM
DEPTH OF CASING SHOE: 1,830 ft
MUD DENSITY IN HOLE: 9.5 ppg
MINIMUM SURFACE TEST PRESSURE PER CMP: 2,000 psig
ACTUAL TEST PRESSURE: 2,500 psig
TEST DURATION: 30 minutes
ALLOWABLE PRESSURE DECLINE: 200 psi
ACTUAL PRESSURE DECLINE: 0 psi
RESULT: Passed

3.0 Injection Test

3.1 Pre-test Conditions

As shown in Figure 1, KS-4 is equipped with a 7-inch hangdown liner to a depth of 3,800 ft. The annulus between the hangdown liner and the 9⅝-inch tieback casing has been pressurized with nitrogen since November 25, 1992.

On January 10, 1993, the day before the injection test, a static pressure and temperature log was run by Flo-Log with electric line logging tools. At the time of the log, the well had been shut in for 46 days. The temperature profile is plotted in Figure 2, and the data listing and a copy of the log are included in Appendix B. This and all subsequent logs are depth-referenced to ground level.

Nitrogen pressure in the annulus at the time of the log was holding constant at 1,108 psig at the wellhead. The calculated depth of the nitrogen/water interface is 3,150 ft KB under the conditions of the static log. Nitrogen pressure declined after injection started because of normal thermal and pressure effects in the wellbore.

3.2 Test Facility

For the KS-4 injection test, temporary piping was installed to connect the well directly to the water supply system fed by the electric submersible pump in MW-3. The flow was routed through the KS-3 orifice flow meter, which was spanned for a maximum range of 1,014 gpm. The injection rate, wellhead pressure and annulus nitrogen pressure on KS-4 were recorded on a strip chart recorder, and readings were taken manually throughout the test.

3.3 Injection Test and Logs

On January 11, 1993, an injection test was performed on KS-4. It was planned as a nominal 12-hour test, but was extended to 16 hours to get a sufficiently long period of injection at a stable rate and to complete the planned logging. From 0714 hours (the start of the test) until 0825 hours, injection was interrupted five times by automatic shutdowns of the MW-3 submersible pump due to high discharge pressure. This was because the initial injectivity of KS-4 was very low. By 0825 hours, the injection capacity of KS-4 had increased sufficiently to allow the MW-3 pump to operate continuously. Injectivity continued to improve, and there were no more interruptions in the test.

The test data, listed in Table 1, show a relatively constant injection rate of 860 gpm at a declining wellhead pressure for the final six hours of the test. The increasing injectivity throughout the test is characteristic of injection wells at Puna during the first injection period or when injection resumes after an extended shut-in period.

During the last four hours of injection, pressure, temperature and spinner logs were run for the principal purpose of defining the injection zone(s). Flo-Log's logs and data listings are included in Appendix B. The three parameters were logged simultaneously from surface to 6,780 ft at 100 ft/min and then up the hole from 6,770 ft to 3,700 ft at 100 ft/min. The logs show injection in the approximate interval 6,600 ft to 6,800 ft, which corresponds to the interval of lost circulation during drilling. Interpretation of the spinner data, shown in Table 2, indicates that all of the injection flow (within the limits of expected accuracy) is accounted for in the open hole below the 9⅝-inch casing shoe to a depth of 6,100 ft. Therefore, there is no water leaving the wellbore at the shoe. Of the intervals selected for the analysis in Table 2, the first is near the bottom of the 7-inch hangdown liner and the other two are in the slotted liner below the casing shoe. The latter two

intervals were chosen because: (1) the spinner logs exhibited stable performance and (2) the formation is hard, porphyritic basalt, which can be expected to retain the nominal hole gauge of 8.50 inches. The two spinner log runs allow a calculation of the volumetric flow rate at each interval, and the results show essentially no loss of injection water to the formations above 6,100 feet.

From 6,200 ft to 6,600 ft the spinner logs indicate a higher flow velocity. This is most likely due to loose formation material packing around the slotted liner and reducing the effective flow area. It does not represent an increased volumetric flow rate. Below 6,600 ft, the flow velocity drops off rapidly, indicating that water is going away in the formation.

Figure 3 is a graph of pressure and temperature at a depth of 3,750 ft as a function of elapsed time from stopping injection. It begins 9 minutes before shut-in and records the pressure falloff and temperature recovery for eight hours after shut-in. The data were logged by Flo-Log with electric line pressure and temperature logging tools. A listing of the data is included in Appendix B.

The pressure falloff at 3,750 ft is essentially complete at 1,167 psia, 40 minutes after shut-in. After that, the pressure begins rising due to thermal recovery in the wellbore below. The final injection pressure was 1,467 psia. The injectivity index (II) is calculated as:

II = Injection rate/(injection press-static pressure)

= 860 gpm/(1,467 psia - 1,167 psia) = 2.87 gpm/psi

Taking this injectivity index value as a constant, and allowing for flowing pressure loss in the hangdown liner, the calculated injection capacity of KS-4 at 150 psig wellhead pressure is 1,100 gpm, of 150°F water.

The temperature at 3,750 ft was also recorded during the final 9 minutes of injection and for eight hours after. As shown in the data listing, the water temperature at 3,750 ft during the final 9 minutes of injection was 111°F.

4.0 Shut-in Temperature Logs

Shut-in temperature logs were run in KS-4 at elapsed times of 8 and 36 hours after stopping injection. Both logs are plotted in Figure 2 and superimposed on a plot of the January 10, 1993 static profile. All three logs were run by Flo-Log

using electric line logging tools. Logs and data listings are included in Appendix B.

The temperature profiles in Figure 2 exhibit a normal post-injection thermal recovery, indicating that injection is confined to depths below 6,230 ft. The interval 6,580 ft to 6,800 ft is confirmed to be the main injection zone, and the interval 6,230 ft to 6,580 ft apparently takes a minor portion of the injected water.

Another feature of the temperature profiles in Figure 2 which has prompted discussion of some previous mechanical integrity tests is that there is no significant temperature contrast among the logs above 2,100 ft. This is because the injection water temperature was close to that of the groundwater, and for that reason, the shut-in temperature logs would not be useful to reveal a direct leak into the groundwater aquifer. However, in the case at hand, a direct leak is ruled out by the fact that the casing holds nitrogen pressure, and the only possible remaining leak path to the groundwater aquifer is upward behind casing from a depth at or near the shoe of the 9⅝-inch casing. The shut-in temperature logs plotted in Figure 2 and the spinner log calculations in Table 2 rule out the possibility of leakage around the casing shoe.

Table 1
KS-4 INJECTION TEST
1/11/93

Time	Wellhead Pressure (psig)	Injection Rate(gpm)	Inj Water Temp (F)	Annulus Nitrogen Press(psig)	Comments
07:14		203		1108	Began injection.
07:19		122		1108	MW-3 pump SD on HP.
07:25	70	203		1106	Restarted MW-3 pump.
07:31	23	132		1104	MW-3 pump SD on HP.
07:46		203		1102	Restarted MW-3 pump.
07:53	77	132		1102	MW-3 pump SD on HP.
08:02		203		1100	Restarted MW-3 pump.
08:08	78	314		1098	
08:13	79	152		1098	
08:14	82	157		1098	MW-3 pump SD on HP.
08:16		324		1098	Restarted MW-3 pump.
08:20		157		1098	MW-3 pump SD on HP.
08:25		314		1096	Restarted MW-3 pump.
08:29	5	233		1096	
08:31	25	304		1096	
08:32	52	324		1096	
08:41	73	324		1094	
08:47	74	324		1092	
08:57	74	335		1090	
09:02	70	335	101	1090	
09:07	68	355	101	1088	
09:22	64	385	101	1086	
09:37	52	421	100	1084	
09:52	46	446	101	1082	
10:07	38	472	103	1080	
10:22	35	497	105	1080	
10:37	29	517	106	1080	
10:54	25	532	106	1080	
11:07	20	548	106	1080	
11:22	17	568	105	1080	
11:37	12	578	105	1080	
11:52	10	588	105	1080	
12:07	8	608	105	1080	
12:22	3	619	105	1080	
12:37	2	619	105	1070	
12:52	3	624	106	1060	
13:07	4	639	105	1060	
13:22	2	649	105	1060	
13:37	2	649	105	1060	
13:52	2	649	105	1060	
14:07	2	649	103	1060	

Table 1
KS-4 INJECTION TEST
1/11/93

Time	Wellhead Pressure (psig)	Injection Rate(gpm)	Inj Water Temp (F)	Annulus Nitrogen Press(psig)	Comments
14:22	2	649	105	1060	Increase inj rate.
14:37	32	771	105	1070	
14:52	33	771	105	1070	
15:07	32	781	105	1075	
15:22	29	791	107	1080	
15:39	26	801	107	1075	
15:52	25	811	106	1075	
16:22	19	826	105	1070	
16:52	15	842	105	1060	
17:22	12	857	105	1060	
17:52	8	872	105	1050	
18:25	5	882	105	1050	
18:52	2	902	105	1040	
19:22	vac	913	105	1040	RIH w/ logging tools.
19:47	vac	921	105	1040	Throttled back to
19:52	vac	867	105	1030	incr flow line press
20:22	vac	866	105	1024	
20:52	vac	865	105	1020	
21:22	vac	865	105	1014	
21:52	vac	864	105	1010	
22:22	vac	863	105	1008	
22:52	vac	862	105	1006	
23:17	vac	862	105	1004	Shut in. End test.
		0			

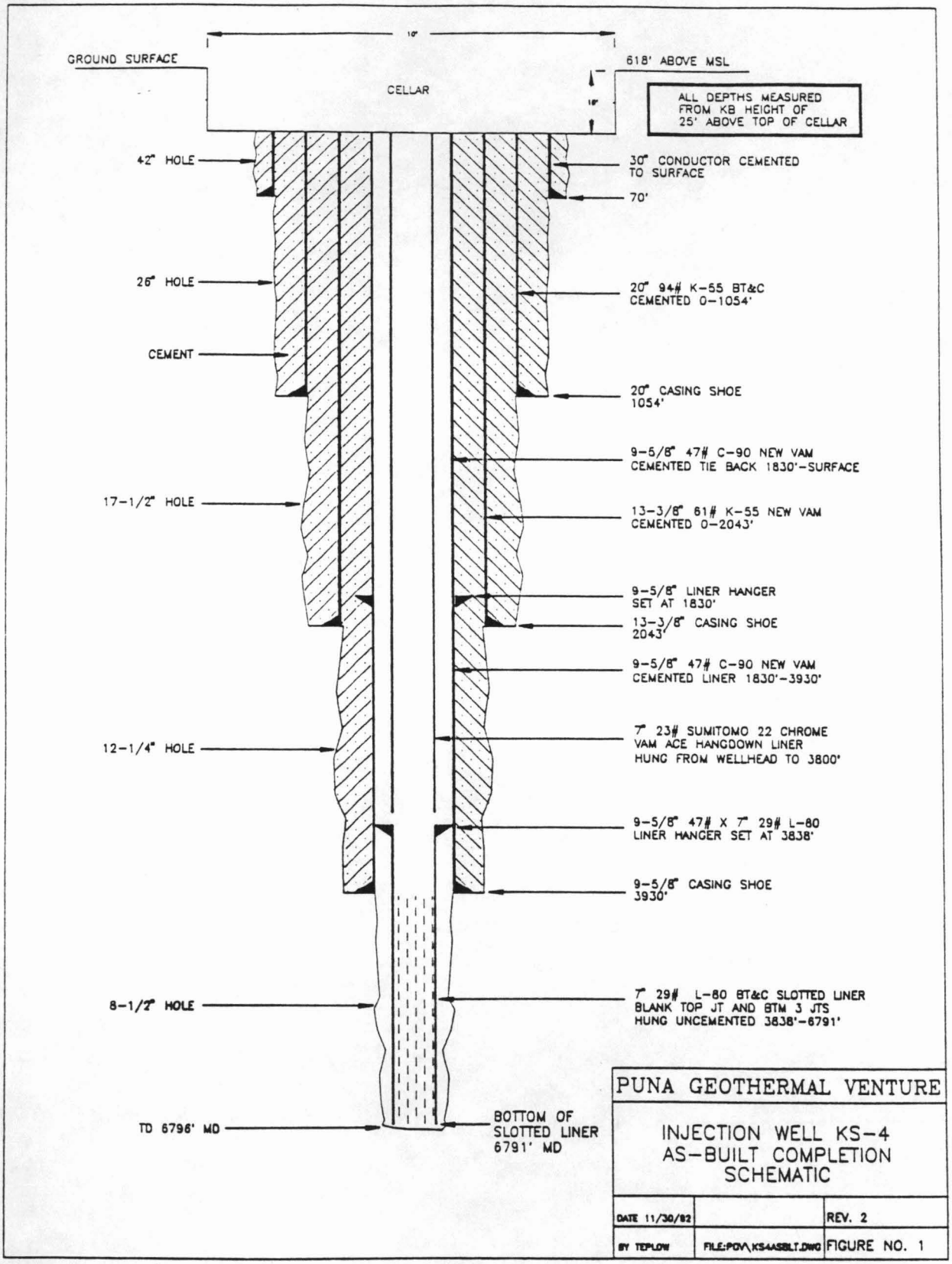
TABLE 2

SUMMARY OF SPINNER LOG CALCULATIONS

WELL KS-4 INJECTION TEST

January 11, 1993

Depth Interval (ft G.L.)	Logging Line Speed (ft/min) Down Run	Up Run	Average Spinner CPS Down Run	Up Run	Fluid Velocity (ft/min)	Hole or Casing I.D. (in.)	Flow Rate (gpm)
3,650-3,750	99.5	-0-	38.70	45.96	530.4	6.366	877
4,775-4,875	99.0	103.0	15.24	31.24	291.9	8.50	860
6,000-6,100	100.0	101.0	15.35	31.25	294.0	8.50	867


10'
GROUND SURFACE
618' ABOVE MSL
CELLAR
10'
ALL DEPTHS MEASURED FROM KB HEIGHT OF 25' ABOVE TOP OF CELLAR
42" HOLE
30" CONDUCTOR CEMENTED TO SURFACE
70'
26" HOLE
20" 94# K-55 BT&C CEMENTED 0-1054'
CEMENT
20" CASING SHOE 1054'
9-5/8" 47# C-90 NEW VAM CEMENTED TIE BACK 1830'-SURFACE
17-1/2" HOLE
13-3/8" 61# K-55 NEW VAM CEMENTED 0-2043'
9-5/8" LINER HANGER SET AT 1830'
13-3/8" CASING SHOE 2043'
9-5/8" 47# C-90 NEW VAM CEMENTED LINER 1830'-3930'
7" 23# SUMITOMO 22 CHROME VAM ACE HANGDOWN LINER HUNG FROM WELLHEAD TO 3800'
12-1/4" HOLE
9-5/8" 47# X 7" 29# L-80 LINER HANGER SET AT 3838'
9-5/8" CASING SHOE 3930'
7" 29# L-80 BT&C SLOTTED LINER BLANK TOP JT AND BTM 3 JTS HUNG UNCEMENTED 3838'-6791'
8-1/2" HOLE
TD 6796' MD
BOTTOM OF SLOTTED LINER 6791' MD
PUNA GEOTHERMAL VENTURE
INJECTION WELL KS-4
AS-BUILT COMPLETION SCHEMATIC
DATE 11/30/92
REV. 2
BY TEPLOW
FILE:POV\KS4ASBLT.DWG
FIGURE NO. 1

PUNA GEOTHERMAL VENTURE
KS-4 STATIC TEMPERATURE SURVEYS

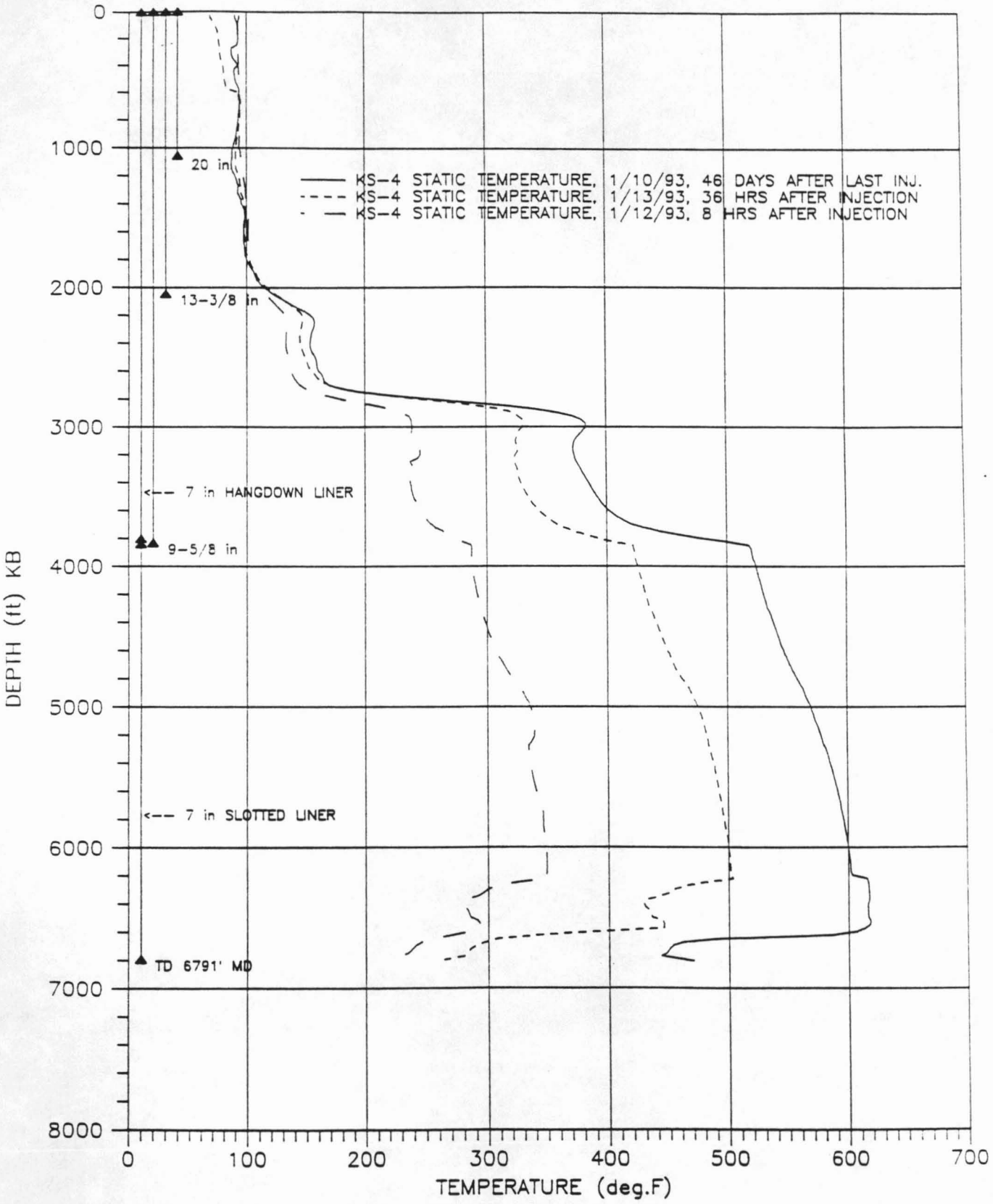


FIGURE 2

PUNA GEOTHERMAL VENTURE
KS-4 PRESSURE FALLOFF AND
TEMPERATURE RECOVERY AT 3750 FT. GL.

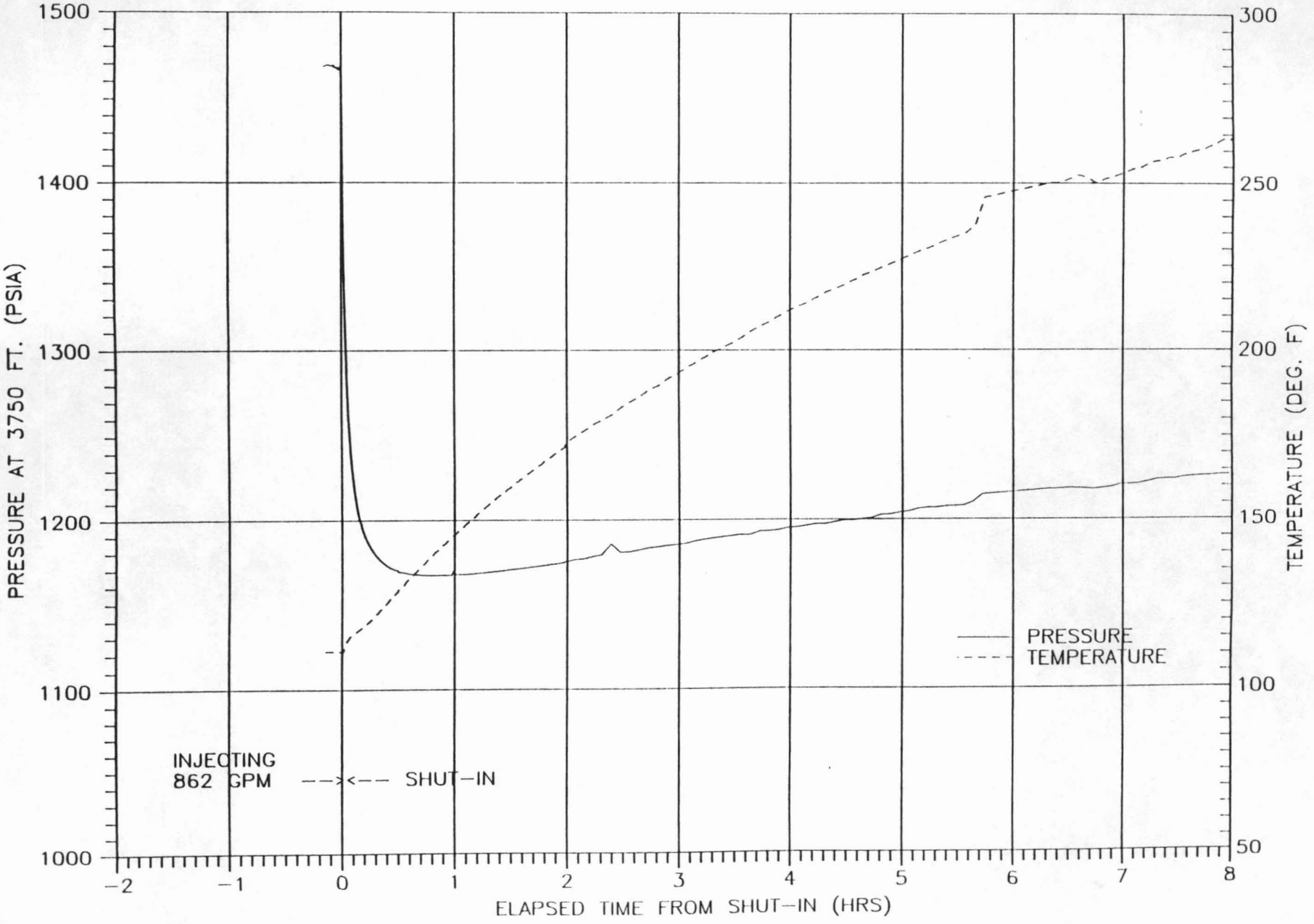


FIGURE 3

APPENDIX A

DAILY DRILLING REPORTS

Puna Geothermal Venture **Well No:** KS-04

REPORT NO. 23 DATE 10-10-92 CHG NO.
CONTRACTOR PDC RIG NO. 231
RIG DAYS 21 DRLD. DAYS 17 + 22
DEPTH @2400 HRS. 1106 FOOTAGE DRLD. 16
HRS. DRILLED 3/4 HRS. TRIPPED 6 1/2
HRS. REPAIR HRS. OTHER 16 3/4

30	" CSG.	70	
20	" CSG.	1064	
	" CSG.		
	"		
	"		
	"		

FORM DRLD Basalt FLOW LINE N/A oF SUCTION oF MAX. oF COOLING TOWER
MUD WT. VIS. W. L. CK. PH CHL YP
P.V. GELS / SAND % SOLIDS % LOST CIR. MTL. C.E.C. LBS/BBL
GALVANIC PRB. CORRATOR SULPHIDE OXY AIR-H2O RATIO /
AIR COMP. NO. CFM PSI TEMP. CHEM. RATIO / G.P.M.

PUMP	LINER	STROKE	SPM	GPM	TOTAL	PSI	NOZZLE VEL.	ANNULUR VEL.
1	6	10	Idle	-0-	-0-	-0-		/
2	6	10	"	"	"			/

BIT#	SIZE	MAKE	TYPE	SER. NO.	JETS	IN	OUT	FT.	HRS.	WT.	RPM	COND.
5	17½	HTC	EP1084	DOLEP	18's	1090	1106	16	3/4	40k	55	/ /
												/ /

BOTTOM HOLE ASSEMBLY: Bit 3 PT 55 Stb Monel Stb 1x10" Stb
STRING WT. PICKUP WT. TORQUE
SURVEYS / STEAM ENTRIES:

REMARKS FOR 24 HOUR PERIOD: Picked up BHA and tripped in to 1023 Filled hole and Pressure tested csg to 600 PSI @ surface Dr Drilled float collar outand 40' cement and shoe @ 1064. Cleaned out cmt. Plug from 1070 - 1090'. Drilled new 17½ hole from 1090 - 1106. Circulated hole clean and performed leak off test. Pump 4 BBL/min @ 270 PSI Tripped out of hole rgn back in hole w/ open ended drill pipe Tagged Bottom @ 1106 and circulated POH to 985' and performed Braden head squeeze Pump 250 FT³ of Class "G" Hawaiian Cmt. w/ 40% SSA-1 and 2% CaCl. Displaced 36 BBLs H2O and CIP at 2400 hrs. W.O.C Held 800 PSI on cmt f/ 15 min. Bled off Pressure and recovered 400 Pressure back up and held 500 PSI f/ 1 hour.

OPERATION @ 0600 FOLLOWING DAY: Released Pressure and POH W.O.C.

PLANNED ACTIVITIES FOLLOWING DAY: Trip in hole & Drill 17½" hole

SUPER & LABOR	2260
LOCATION	
RIG MOVE	
RIG	8475
ABATEMENT	1475
BITS	17000
RMRS. STABS	
RENTALS	1550
FUEL, H2O	
MUD, CHEM.	7788
CMT & SVCS.	10,000
AIR COMPS.	1225
LOGGING	680
DIRECTIONAL	25
FISHING	42
TRANSPORT	
EQUIP. MAINT.	
CASING	
PROD. EQUIP.	
OTHER CUDO	333
DAILY TOTAL	44853
FORWARD	871619
ACCU. TOTAL	916472

D.P. ON LOC., SIZE 5" JTS. 144 SIZE JTS.
FUEL ON HAND USED SUPERVISOR DWW

Puna Geothermal Venture **Well No:** KS-04

REPORT NO. 24 DATE 10-11-92 CHG NO.

CONTRACTOR Parker Drilling RIG NO. 231

RIG DAYS 22 DRLD. DAYS 18+22

DEPTH @2400 HRS. 1106 FOOTAGE DRLD. -0-

HRS. DRILLED 1/2 HRS. TRIPPED 11 1/2

HRS. REPAIR HRS. OTHER 12 1/2

	" CSG.	
30	" CSG.	70
20	" CSG.	1064
	" CSG.	
	"	
	"	
	"	
	"	

FORM DRLD Cmt : Basalt FLOW LINE ___ oF SUCTION ___ oF MAX. ___ oF COOLING TOWER ___

MUD WT. ___ VIS. ___ W. L. ___ CK. ___ PH ___ CHL ___ YP ___

P.V. ___ GELS ___/___ SAND ___ % SOLIDS ___ % LOST CIR. MTL. ___ C.E.C. ___ LBS/BBL

GALVANIC PRB. ___ CORRATOR ___ SULPHIDE ___ OXY ___ AIR–H2O RATIO ___/___

AIR COMP. NO. ___ CFM ___ PSI ___ TEMP. ___ CHEM. ___ RATIO ___/___ G.P.M. ___

PUMP	LINER	STROKE	SPM	GPM	TOTAL	PSI	NOZZLE VEL.	ANNULUR VEL.
1	6	10	107	301	602	1492		/
2	6	10	107	301				/

	BIT#	SIZE	MAKE	TYPE	SER. NO.	JETS	IN	OUT	FT.	HRS.	WT.	RPM	COND.
RR	5	17 1/2	HTC	EP1084	BOLPE	18's	1106		27	1 1/4	50K	50	/ /
													/ /

BOTTOM HOLE ASSEMBLY: Bit 3PT SS Stb Monel Stb DC Stb 4 x 10" D.C. XO 3 x 9" Jars 2 x 9" XO 5 Hwdp BHA = 542.49 STRING WT. ___ PICKUP WT. ___ TORQUE ___

SURVEYS / STEAM ENTRIES:

REMARKS FOR 24 HOUR PERIOD: Tripped in hole to 1013. Drilled cement to 1079 circulated hole and tried to run gradient test. Leaking off @ 2 Bbls/min @ 200 PSI. POH run in hole open ended to 1078' and Pump cement. Pumped 100 Lin. ft. of Hawaiian class "G" cmt. w/ 40% SSA-1 and 3% $CaCl_2$ and .73% CFR3. CIP 21:00 hrs. TOH fill hole and check level. OK W.O.C.

OPERATION @ 0600 FOLLOWING DAY: TIH and tag cmt. @ 958 and drill cmt from 958 to 1106. Continued Drlg 17 1/2 hole from 1106 - 1117

PLANNED ACTIVITIES FOLLOWING DAY: Drlg 17 1/2" hole.

SUPER & LABOR	2460
LOCATION	
RIG MOVE	
RIG	8475
ABATEMENT	1475
BITS	
RMRS. STABS	
RENTALS	1550
FUEL, H2O	
MUD, CHEM.	2258
CMT & SVCS.	10,000
AIR COMPS.	1225
LOGGING	680
DIRECTIONAL	25
FISHING	42
TRANSPORT	900
EQUIP. MAINT.	
CASING	
PROD. EQUIP.	
OTHER Cuso	333
DAILY TOTAL	29423
FORWARD	916472
ACCU. TOTAL	945895

D.P. ON LOC., SIZE 5" JTS. 144 SIZE ___ JTS. ___

FUEL ON HAND ___ USED ___

SUPERVISOR DWW

Puna Geothermal Venture Well No: K S 4

REPORT NO. 24 DATE 10-18-92 CHG NO.
CONTRACTOR Parker Drilg RIG NO. 231
RIG DAYS 28 DRLD. DAYS 3.25+22
DEPTH @2400 HRS. 2055 FOOTAGE DRLD. 0
HRS. DRILLED 0 HRS. TRIPPED 0
HRS. REPAIR 0 HRS. OTHER 24

30	" CSG.	70
20	" CSG.	1064
13 3/8	" CSG.	2043
	"	
	"	
	"	
	"	

FORM DRLD _____ FLOW LINE _____oF SUCTION _____oF MAX. _____oF COOLING TOWER _____
MUD WT. _____ VIS. _____ W. L. _____ CK. _____ PH _____ CHL _____ YP _____
P.V. ____ GELS ___/___ SAND _____ % SOLIDS _____ % LOST CIR. MTL. _____ C.E.C. _____ LBS/BBL
GALVANIC PRB. _____ CORRATOR _____ SULPHIDE _____ OXY _____ AIR-H2O RATIO _____/_____
AIR COMP. NO. ___ CFM _____ PSI _____ TEMP. _____ CHEM. _____ RATIO ___/___ G.P.M. _____

PUMP	LINER	STROKE	SPM	GPM	TOTAL	PSI	NOZZLE VEL.	ANNULUR VEL.
1	6	10						/_____
1	6	10						/_____

BIT#	SIZE	MAKE	TYPE	SER. NO.	JETS	IN	OUT	FT.	HRS.	WT.	RPM	COND.
												/__/__
												/__/__

BOTTOM HOLE ASSEMBLY: _____
STRING WT. _____ PICKUP WT. _____ TORQUE _____
SURVEYS / STEAM ENTRIES: _____

REMARKS FOR 24 HOUR PERIOD:

Rigged up and tested 13 3/8 5M BOE
Tested 13 3/8" Csg to 2500 psi - 10psi press
drop in 30 min Choke line and
manifold 30 min 10 psi press drop
Blind Rams 30 min 10 psi press drop
Variable Rams 2500 psi 10psi press drop
5" Pipe Rams 2500 psi 0 press drop
Hydril 30 min 500 psi 0 press drop
Kelly Cock 30 min 0 press drop
Test witnessed & signed by Eric Franko
Laid down 17 1/2" Tools & 18" DC's

OPERATION @ 0600 FOLLOWING DAY:
L D 10" DC

PLANNED ACTIVITIES FOLLOWING DAY: C/O 13 3/8 Csg
& Perform Bop off test

D.P. ON LOC., SIZE 5 JTS 143 SIZE _____ JTS. _____
FUEL ON HAND _____ USED _____

SUPER & LABOR	2040
LOCATION	
RIG MOVE	
RIG	8475
ABATEMENT	1475
BITS	
RMRS. STABS	
RENTALS	1550
FUEL, H2O	
MUD, CHEM.	365
CMT & SVCS.	1890
AIR COMPS.	1225
LOGGING	680
DIRECTIONAL	230
FISHING	42
TRANSPORT	2500
EQUIP. MAINT.	
CASING	
PROD. EQUIP.	13,000
OTHER Cudd	333
DAILY TOTAL	33 805
FORWARD	1,546,564
ACCU. TOTAL	1,580 369

SUPERVISOR Ward

Puna Geothermal Venture Well No: KS-4

REPORT NO. 25 DATE 10/19/92 CHG NO.

CONTRACTOR Parker Drlg RIG NO. 231

RIG DAYS 29 DRLD. DAYS 26+22

DEPTH @2400 HRS. 2056 FOOTAGE DRLD. 1

HRS. DRILLED 0 HRS. TRIPPED 12 1/2

HRS. REPAIR 0 HRS. OTHER 11 1/2

	CSG.	
30	" CSG.	70
20	" CSG.	1064
13 3/8	" CSG.	2043

FORM DRLD — FLOW LINE 102 oF SUCTION 100 oF MAX. 102 oF COOLING TOWER off

MUD WT. Water W. L. ___ CK. ___ PH ___ CHL ___ YP ___

P.V. ___ GELS ___/___ SAND ___ % SOLIDS ___ % LOST CIR. MTL. ___ C.E.C. ___ LBS/BBL

GALVANIC PRB. ___ CORRATOR ___ SULPHIDE ___ OXY ___ AIR-H2O RATIO ___/___

AIR COMP. NO. ___ CFM ___ PSI ___ TEMP. ___ CHEM. ___ RATIO ___/___ G.P.M. ___

PUMP	LINER	STROKE	SPM	GPM	TOTAL	PSI	NOZZLE VEL.	ANNULUR VEL.
1	6	10						
1	6	10						

BIT#	SIZE	MAKE	TYPE	SER. NO.	JETS	IN	OUT	FT.	HRS.	WT.	RPM	COND.
6	12 1/4	Sec	GMX8	506741	3/16	2055	In	C/o Cement				

BOTTOM HOLE ASSEMBLY: Bit, BS, 3-8" DC's, Drlg Jars, 2-8" DC's, X-O, 5-HWDP

STRING WT. 84 K PICKUP WT. 84 K TORQUE ___

SURVEYS / STEAM ENTRIES:

REMARKS FOR 24 HOUR PERIOD:

L/D 17 1/2" Tools & 10" DCs. RIH w/ 12 1/4" bit #6 on slick drlg assy. C/o cement from 1945' to 2035' w/ FC @ 1961. Press tested csg to 700 psi w/ 1.75 Bbls of water. Drilled out cement to 2055. Drilled 12 1/4" hole from 2055' to 2056. Circulated hole clean. Closed pipe rams. Leak off test. Formation took fluid @ 2 bbls/min w/ .58 frac grad. POH mag flux tools. RIH w/ OEDP to 2056'. Halco pumped 90 ft³ of G cement premixed 40% SSA-1, .75% CFR-2 & 2% CaCl2 displaced w/ 32 bbls of H2O. Pulled 3 stands, closed pipe rams and squeezed 3 bbls cement in formation press built and held @ 2500 psi. POH made up 12 1/4" drlg assy.

SUPER & LABOR	4400
LOCATION	
RIG MOVE	
RIG	8475
ABATEMENT	1475
BITS	#6 12000
RMRS. STABS	3060
RENTALS	1550
FUEL, H2O	
MUD, CHEM.	365
CMT & SVCS.	3821
AIR COMPS.	1225
LOGGING	680
DIRECTIONAL	2522
FISHING	42
TRANSPORT	2000
EQUIP. MAINT.	5680
CASING	
PROD. EQUIP.	
OTHER Cudd	333
DAILY TOTAL	47628
FORWARD	1,580,369
ACCU. TOTAL	1,627,997

OPERATION @ 0600 FOLLOWING DAY: Made up new BHA strap in hole. Tag cement @ 1947' C/O cement to 2053

PLANNED ACTIVITIES FOLLOWING DAY: Rig leak off test. Drill 12 1/4" hole

D.P. ON LOC., SIZE 5" JTS. 143 SIZE ___ JTS. ___

FUEL ON HAND ___ USED ___ SUPERVISOR Ward

Puna Geothermal Venture Well No: KS 4

REPORT NO. 25 DATE 10/20/92 CHG NO. 6162-KS04
CONTRACTOR Parker Drlg RIG NO. 231
RIG DAYS 30 DRLD. DAYS 27 + 22
DEPTH @2400 HRS. 2292 FOOTAGE DRLD. 240
HRS. DRILLED 12 HRS. TRIPPED 7
HRS. REPAIR 0 HRS. OTHER 5

30	" CSG.	70
20	" CSG.	1064
13 3/8	" CSG.	2043
	"	
	"	
	"	

FORM DRLD Fresh FLOW LINE 113 oF SUCTION 102 oF MAX. 114 oF COOLING TOWER off
MUD WT. 8.5 VIS. 36 W. L. 11.5 CK. 2 PH 10.5 CHL 600 YP 8
P.V. 6 GELS 1/2 SAND 1/2 % SOLIDS 1.25 % LOST CIR. MTL. N/A C.E.C. 5.0 LBS/BBL
GALVANIC PRB. _____ CORRATOR _____ SULPHIDE _____ OXY _____ AIR–H2O RATIO _____/_____
AIR COMP. NO. __ CFM _____ PSI _____ TEMP. _____ CHEM. _____ RATIO __/__ G.P.M. _____

PUMP	LINER	STROKE	SPM	GPM	TOTAL	PSI	NOZZLE VEL.	ANNULUR VEL.
1	6	10	95	332	664	1250	359	189 / 129
2	6	10	95	332				/

BIT#	SIZE	MAKE	TYPE	SER. NO.	JETS	IN	OUT	FT.	HRS.	WT.	RPM	COND.
6	12¼	Sec	GM-88	506711	3/16	2052'	Inc.	240	12	15-50	75/100	T/BC
											/	/

BOTTOM HOLE ASSEMBLY: Bit, NMDC, Stab, 1-8" DC, Stab, 7-8" DCS, JARS, 2-8" DC (X), 5-5" HWDP = 72K STRING WT. _____ PICKUP WT. _____ TORQUE _____
SURVEYS / STEAM ENTRIES: 2151' 4 3/4° N 17W

REMARKS FOR 24 HOUR PERIOD:
Made up B/A. Strapped in hole Tagged Cement @ 1947' C/O Cement to 2053' Circulated hole clean. Closed pipe rams & pressure tested to 500 psi: .68 grad C/O Cement to 2056' Drilled 12¼" hole from 2056 to 2292. Twisted off at the top of NMDC. P.O.H. Fish in hole consists of 12¼" Bit & 8" NMDC = 28.92 with top of fish @ 2267'

OPERATION @ 0600 FOLLOWING DAY: Made up 7 3/4" grapple w/ 11 3/4 guide

PLANNED ACTIVITIES FOLLOWING DAY: Retrieve fish Continue drilling 12¼" hole

SUPER & LABOR	2200
LOCATION	
RIG MOVE	
RIG	8475
ABATEMENT	1475
BITS	
RMRS. STABS	
RENTALS	1550
FUEL, H2O	
MUD, CHEM.	5032
CMT & SVCS.	
AIR COMPS.	1225
LOGGING	680
DIRECTIONAL	2522
FISHING	42
TRANSPORT	2000
EQUIP. MAINT.	
CASING	
PROD. EQUIP.	
OTHER Cudd	333
DAILY TOTAL	25,534
FORWARD	1,627,997
ACCU. TOTAL	1,653,531

D.P. ON LOC., SIZE 5 JTS. 145 SIZE _____ JTS. _____
FUEL ON HAND _____ USED _____
SUPERVISOR Ward

Puna Geothermal Venture **Well No:** KS-04

REPORT NO. 42 DATE 10-29-92 CHG NO. ______
CONTRACTOR Parker Drlg. RIG NO. 231
RIG DAYS 39 DRLD. DAYS 36 + 22
DEPTH @2400 HRS. 3930 FOOTAGE DRLD. - 0 -
HRS. DRILLED ______ HRS. TRIPPED ______
HRS. REPAIR ______ HRS. OTHER 24

30	" CSG.	70
20	" CSG.	1064
13 3/8	" CSG.	2043
9 5/8	" Liner	1830-3930
	"	
	"	

FORM DRLD ______ FLOW LINE ______ oF SUCTION ______ oF MAX. ______ oF COOLING TOWER ______
MUD WT. ______ VIS. ______ W. L. ______ CK. ______ PH ______ CHL ______ YP ______
P.V. ______ GELS ___/___ SAND ______ % SOLIDS ______ % LOST CIR. MTL. ______ C.E.C. ______ LBS/BBL
GALVANIC PRB. ______ CORRATOR ______ SULPHIDE ______ OXY ______ AIR-H2O RATIO ___/___
AIR COMP. NO. ___ CFM ______ PSI ______ TEMP. ______ CHEM. ______ RATIO ___/___ G.P.M. ______

PUMP	LINER	STROKE	SPM	GPM	TOTAL	PSI	NOZZLE VEL.	ANNULUR VEL.
1	6	10	Idle					/
2	6	10						/

BIT#	SIZE	MAKE	TYPE	SER. NO.	JETS	IN	OUT	FT.	HRS.	WT.	RPM	COND.
8	8½	HTC	ATC 44C	N21HN	3x16	3930		Inc.				/ /
												/ /

BOTTOM HOLE ASSEMBLY: Bit Bit Sub 3PT DC Stb D.C Stb 10 x 6½ DC. JARS XO 5 Jts HWDP
BHA= 674.61 STRING WT. ______ PICKUP WT. ______ TORQUE ______
SURVEYS / STEAM ENTRIES: ______

REMARKS FOR 24 HOUR PERIOD: W.O.C. Picked up new 8½ Drlg. Assm. and tripped in hole to 2000'. Circulated bottoms up and Shut Pipe Rams Performed Liner LAP test to a .9 GRAdient liner LAP didn't hold Established pump rate @ 1 Bbl /minute @ 900 PSI. Tripped out of hole and stood back 8½ Drlg Assm. RAN in hole to 1817' with open-ended Drill Pipe fill hole and rigged up Halliburton. Mixed and Pumped 100 FT³ of Class G Hawaiian cmt w/ 40% SSA+1 and .75 % CFR³ Mixed 1st 50 FT³ of cmt w/ 2% CaCl₂ Displaced 30 Bbls H2O and Pulled 180' of D.P. CIP @ 1615 hrs Shut Pipe rams and squeezed 75 FT³ cmt in LAP annulus with 1500 PSI final Pressure. Left 25 FT³ cmt in 13 3/8 csg Held 1500 PSI f/ 1 hour Released Pressure Flowed back 4 Bbls. Pumped back 4 Bbls and hold 1500 PSI for 1 hour. Opened Rams + tripped out of hole W O C Tripped in hole w/ 12¼ Bit to 1830 no cmt

SUPER & LABOR	3500
LOCATION	
RIG MOVE	
RIG	8500
ABATEMENT	1475
BITS	2700
RMRS. STABS	
RENTALS	1550
FUEL. H2O	
MUD. CHEM.	365
CMT & SVCS.	10000
AIR COMPS.	1025
LOGGING	680
DIRECTIONAL	
FISHING	1194
TRANSPORT	
EQUIP. MAINT.	
CASING Crew	3520
PROD. EQUIP.	
OTHER Cuop	333
DAILY TOTAL	34,842
FORWARD	2,091,175
ACCU. TOTAL	2,126,017

OPERATION @ 0600 FOLLOWING DAY: Pressure test Lap 900 Surface Pressure 30 min OK TOH & Picked up 8½ Assm TIH

PLANNED ACTIVITIES FOLLOWING DAY: Drill Float Test csg Perform Leak off test & Drill new 8½ hole

D.P. ON LOC., SIZE 5" JTS. 145 SIZE ______ JTS. ______
FUEL ON HAND ______ USED ______ SUPERVISOR DWW

Puna Geothermal Venture **Well No:** KS-04

REPORT NO. 42 DATE 10-30-92 CHG NO.
CONTRACTOR Parker Drilling RIG NO. 231
RIG DAYS 40 DRLD. DAYS 37+22
DEPTH @2400 HRS. 4271 FOOTAGE DRLD. 341
HRS. DRILLED 8 1/4 HRS. TRIPPED 6 1/4
HRS. REPAIR -0- HRS. OTHER 9.5

Size		Depth
30	" CSG.	70
20	" CSG.	1064
13 3/8	" CSG.	2043
9 5/8	" Liner	1830-3930
	"	
	"	

FORM DRLD Basalt FLOW LINE 146 oF SUCTION 132 oF MAX. 134 oF COOLING TOWER ON
MUD WT. 8.6 VIS. 35 W. L. 12.7 CK. 2 PH 10.8 CHL 1200 YP 6
P.V. 7 GELS 1 / 2 SAND 1/4 % SOLIDS 2.3 % LOST CIR. MTL. — C.E.C. LBS/BBL
GALVANIC PRB. CORRATOR SULPHIDE OXY AIR-H2O RATIO /
AIR COMP. NO. -0- CFM PSI TEMP. CHEM. RATIO / G.P.M.

PUMP	LINER	STROKE	SPM	GPM	TOTAL	PSI	NOZZLE VEL.	ANNULUR VEL.
1	6	10	82	285	571	1450	245 LP	290 - 8 1/2 hole; ~~283~~ - 9 5/8 csg
2	6	10	82	285				112 - 13 3/8 csg

BIT#	SIZE	MAKE	TYPE	SER. NO.	JETS	IN	OUT	FT.	HRS.	WT.	RPM	COND.
9	8 1/2	HTC	ATC 44C	N21HN	3x18	3930		341	8 1/4	50K	80-90	INC. /
												/ /

BOTTOM HOLE ASSEMBLY: Same
STRING WT. 160 K PICKUP WT. 170 K TORQUE 200/214
SURVEYS / STEAM ENTRIES: 2764 310° 4057 8 1/4° 190° 4207 7 1/2° 204°
4360 7° 196°

REMARKS FOR 24 HOUR PERIOD: C/O to Liner Hanger. Performed Lap test held 900 PSI for 30 min POH for 8 1/2 Assm. RIH to 3734'. Ran Temp Survey @ 2764 = 310° DRilled Float collar and 20' cmt to 3907. Tested csg to 800 surface Pressure held 30 min. OK Drilled cmt. and shoe @ 3930 Drilled from 3930-3937 and performed Leak off test to a .65 Gradient 775 surface PSI Drilled 8 1/2" Hole F/3937 to 4118' Survey @ 4088'. DRilled 8 1/2" Hole F/4118 - 4271 Survey @ 4207.

OPERATION @ 0600 FOLLOWING DAY: Drilled 8 1/2" Hole f/ 4436

PLANNED ACTIVITIES FOLLOWING DAY: Drill 8 1/2 hole

Item	Cost
SUPER & LABOR	3500
LOCATION	
RIG MOVE	
RIG	8500
ABATEMENT	
BITS	
RMRS. STABS	1800
RENTALS	1550
FUEL, H2O	4728
MUD, CHEM.	9008
CMT & SVCS.	24120
AIR COMPS.	1025
LOGGING	680
DIRECTIONAL	
FISHING	42
TRANSPORT	
EQUIP. MAINT.	
CASING	
PROD. EQUIP.	
OTHER Cuod	333
DAILY TOTAL	55,286
FORWARD	2,126,017
ACCU. TOTAL	2,181,303

D.P. ON LOC., SIZE 5 JTS. 181 SIZE JTS.
FUEL ON HAND USED SUPERVISOR DWW

Puna Geothermal Venture **Well No:** KS-04

REPORT NO. 49 DATE 11-6-92 CHG NO. _____
CONTRACTOR PDC RIG NO. 231
RIG DAYS 47 DRLD. DAYS 44+22
DEPTH @2400 HRS. 4579 FOOTAGE DRLD. -0-
HRS. DRILLED _____ HRS. TRIPPED _____
HRS. REPAIR _____ HRS. OTHER _____

30	" CSG.	70
20	" CSG.	1034
13 3/8	" CSG.	2043
9 5/8	" Liner	1830-3930
9 5/8	" Tie Back	1830 - Surface
	"	

FORM DRLD _____ FLOW LINE _____ oF SUCTION _____ oF MAX. _____ oF COOLING TOWER _____
MUD WT. 9.5 VIS. 43 W. L. 16.4 CK. 2-3 PH 9.6 CHL 1000 YP 18
P.V. 22 GELS 4/11 SAND .12 % SOLIDS 10 % LOST CIR. MTL. _____ C.E.C. _____ LBS/BBL
GALVANIC PRB. _____ CORRATOR _____ SULPHIDE _____ OXY _____ AIR-H2O RATIO _____/_____
AIR COMP. NO. __ CFM _____ PSI _____ TEMP. _____ CHEM. _____ RATIO __/__ G.P.M. _____

PUMP	LINER	STROKE	SPM	GPM	TOTAL	PSI	NOZZLE VEL.	ANNULUR VEL.
1	6	10						/_____
2	6	10						/_____

BIT#	SIZE	MAKE	TYPE	SER. NO.	JETS	IN	OUT	FT.	HRS.	WT.	RPM	COND.
												/__/__
												/__/__

BOTTOM HOLE ASSEMBLY: _____
STRING WT. _____ PICKUP WT. _____ TORQUE _____
SURVEYS / STEAM ENTRIES: _____

REMARKS FOR 24 HOUR PERIOD: Nippled up BOP's. Changed out Hydril rubber. Tested asy. to 2500 PSI. Tested Rams 2500 PSI Master Valve 2500 PSI and Hydril to 1500 PSI, all OK. TIH and tagged at @ 1788 C/O, Float collar and cmt to 1843'. C/O to top of Packer @ 2059

SUPER & LABOR	3500
LOCATION	
RIG MOVE	
RIG	8500
ABATEMENT	
BITS	
RMRS. STABS	
RENTALS	1550
FUEL, H2O	
MUD, CHEM.	365
CMT & SVCS.	2500
AIR COMPS.	1025
LOGGING	680
DIRECTIONAL	712
FISHING	42
TRANSPORT	
EQUIP. MAINT.	
CASING	
PROD. EQUIP.	
OTHER (LIND)	3500
DAILY TOTAL	22,374
FORWARD	2,442,271
ACCU. TOTAL	2,464,645

OPERATION @ 0600 FOLLOWING DAY: Circ and TOH f/ Packer retrieving Tool.

PLANNED ACTIVITIES FOLLOWING DAY: Pick up additional BOP and Drill.

D.P. ON LOC., SIZE 5 JTS. 219 SIZE _____ JTS. _____
FUEL ON HAND _____ USED _____

SUPERVISOR DWW