HGP-A WELLHEAD GENERATOR FEASIBILITY PROJECT

WELL WORKOVER COMPLETION REPORT

February 1981

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I. INTRODUCTION

INTRODUCTION

The HGP-A Well on the Big Island of Hawaii was drilled by the University of Hawaii's Hawaii Geothermal Project in 1976. After setting the 20" surface casing and the 13-3/8" anchor casing, the 9-5/8" production casing was set from the surface to about 2200 ft below surface, and a 7" slotted liner was set off bottom from a total depth of about 6400 ft to 2100 ft below surface.

Prior to the well workover, the wellhead pressure during shut-in periods was approximately 140 psig and the temperature profile inside the casing (see Fig. 1) was low until it reached the 9-5/8" casing shoe at about 2200 ft below surface. However, after the well flow test in November, 1978, the static wellhead pressure began to increase gradually and by January 1979, the well had to be vented daily in order to keep the pressure below 500 psig, and the temperature profile in the casing showed a dramatic rise, especially in the section from 1450 ft to the bottom of the 9-5/8" casing shoe. Furthermore, a gas cap formed in the well-bore during static condition, which was not observed prior to November 1978. These phenomena led to the speculation that there was either a break in the casing which permitted hot fluids to circulate inside of the wellbore, or that the cement anchoring of the casing to the formation had deteriorated, allowing well fluids to migrate upward on the outside of the casing.

After consultation with Mr. Anthony Adduci, Mr. Martin Scheve and Dr. Bennie DiBonna of the Department of Energy (DOE), a casing caliper log and a cement bond log were run in May, 1979 to determine whether there was a break in the casing and/or that the cement bond had deteriorated. No apparent break in the casing was detected, however, substantial deterioration of the cemend bond was confirmed, and the fact that high temperature cement had not been used in the original cementing program prompted the project to propose to U.S. DOE that a casing perforation and cement squeeze job be performed to insure the integrity of the HGP-A Well. Subsequently, DOE approved the proposal in June, 1969, and a geothermal well modification permit was issued by the State Department of Land and Natural Resources in September, 1979.

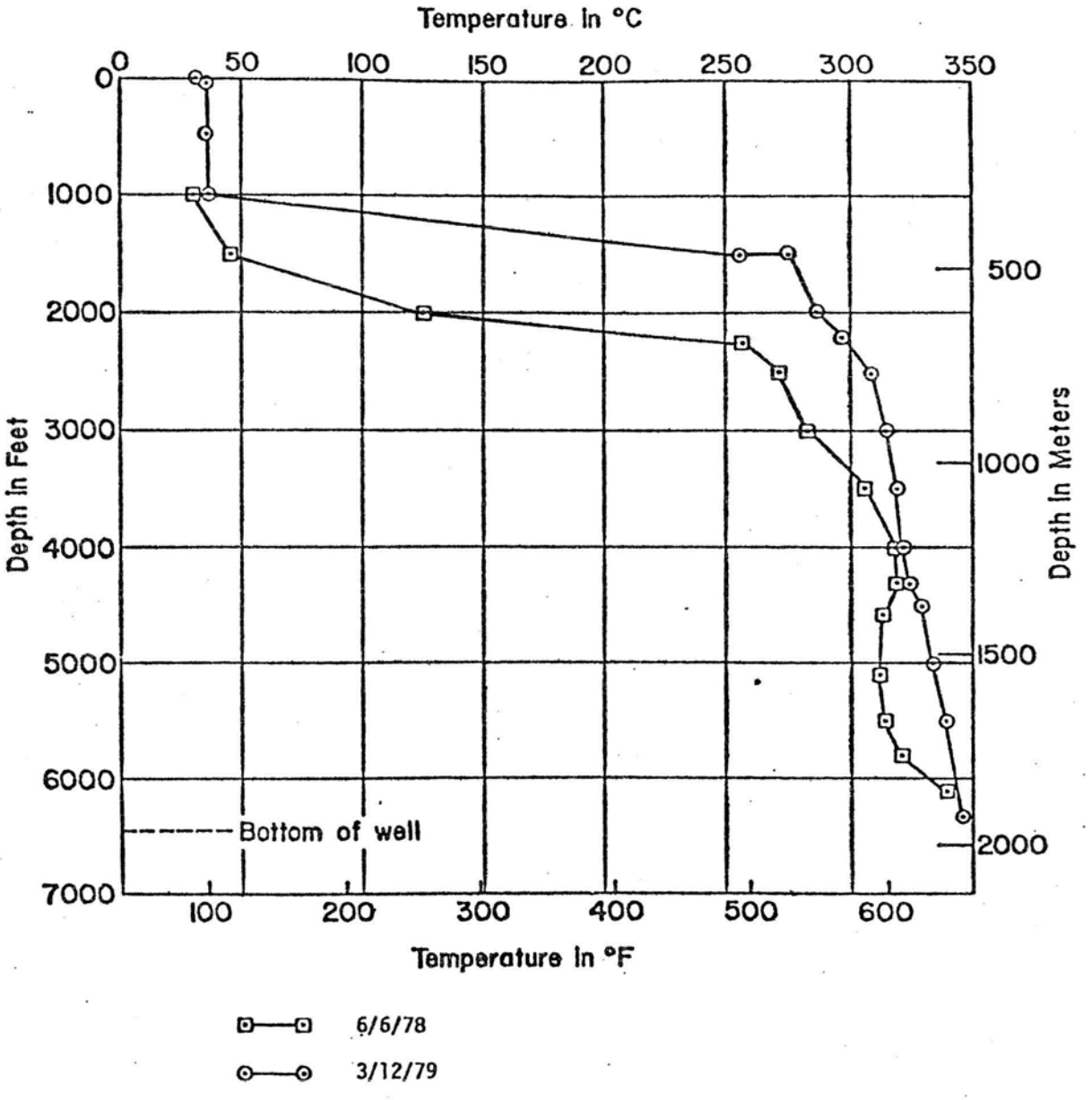


Figure 1 Temperature Profiles of HGP-A Well

II. WORKOVER PLAN

Rogers Engineering Inc., of San Francisco was retained as the drilling consultant to the project and Mr. James Kuwada of Rogers was designated as the technical consultant. Specifications for the workover were prepared by Rogers and invitations to bid were sent to potential drilling companies, in addition to general advertising in June. Two bids were received in July and after evaluation of the bids, Water Resources International, Inc. was selected. To further assist the project, Mr. Sheldon Hopkins of Global Geothermal was hired to serve as the drilling supervisor to supervise the daily workover operations. Mr. Anthony Adduci of DOE/SAN was the technical director for all technical decisions.

Several meetings were held among the drilling manager, the drilling supervisor and the drilling contractor regarding tools, services and workover program in August. The rig was moved to the site in early September and the workover program commenced on September 15, 1979. This report describes the procedures followed and equipment used in the completion of the workover.

Workover Plan

In the contract with DOE, the project was directed to perform the following tasks:

1. Acquire a workover rig to be placed at HGP-A with necessary blow-out preventing devices.
2. Pressure test the casing for leakage.
3. Perforate, cement and restore cement bond.

3a. Cut off 7" liner at 3000 ft and remove.

4. Tie back 7" casing from 3000 ft to surface and cement to block off cool water production zone between 2200-3000 ft and to anchor 7" tie back string if deemed necessary.
5. Run cement bond logs to insure competency.
6. Cement the upper portion of the 7" slotted liner to tie down the liner and to block off the cold water zone.
7. Perform mechanical caliper run inside the 7" slotted liner.
8. Ream out the inside of the slotted liner and obtain samples for analysis.
9. Remove or pound to the bottom of the hole the junk accumulated in the hole and restore the hole to 6455 feet.
10. Obtain all permits, waivers, and inspections required by governmental agencies having jurisdiction.
11. Report all efforts as part of the reporting requirements presently provided on the original contract and the revisions thereto.

After several meetings among the project staff, the drilling manager and the technical consultant, the following program was tentatively agreed upon subject to change as the workover progressed.

1. Kill well by pumping in cold water.
2. Keeping well dead, rotate master valve to desired position to accommodate set up of drilling rig, blow-out-preventer stack-mastergate, cross over spool, double gate, Hydrill and rotating head.
3. Keeping well dead run temperature survey & caliper log (Otis).

4. Run in hole with 7" casing scraper & jars to 3200 ft.
5. Run and set HOWCO 7" 23# EZSV #1 @ ± 3150 ft.
6. Unsting from EZSV and spot spearhead of flow check fill at bottom of slotted section.
7. Pullout of hole and pick up EZSV #2.
8. Run in hole and set @ ± 2950 ft.
9. Pump spear head of "Flochek-II" and cement as follows: Mix 20 ft^3 1-1-1 "G" cement + 1 ft^3 perlite + 1 ft^3 sand + 0.5% CFR-2 + retarders as needed.
10. Pull out of hole with stinger and wait on cement.
11. Run in hole with stinger and stab into EZSV #2.
12. Pressure test with 1000 psig.
13. Resqueeze if necessary as many times as necessary.
14. After bridge is established, run in hole with 9-5/8" scraper. Then 9-5/8" RTTS and retrieve bridge plug combined or separately if necessary.
15. Set bridge plug at ± 2100 ft.
16. Set RTTS at ± 1000 ft. and test both sides. Isolate any leaks.
17. If no leaks are found run cement bond log on top 400 ft of hole, perforate and squeeze to surface is possible.
18. Clean out, cement, recover retrievable Bridge plug in top part of hole.
19. Decision may be made to cut 7" slotted liner and recover same, as follows:
20. Run in hole OE and change over to mud and loss circulation material.
21. Run in hole with casing cutter and cut casing below collar at ± 2925 ft.
22. Run in hole with casing spear and jars and recover casing.
23. Underream 8-1/2" hole to 10".
24. Run in hole with 7" casing and casing bowl.
25. Cement to surface.
26. Install 10" x 7" casing head and new master gate.
27. Run casing bond log.

28. If decision is made to cement existing slotted 7" liner proceed as follows:

29. Set RTTS Packer (with 2 joints tailpipe) above each section of slotted liner and cement. Wait on cement between jobs as needed.

30. Drill out cement and pressure test 7" liner above bridge plug.

31. If OK drill out EZSV Bridge Plugs and continue to top of junk and push to bottom.

32. Flow well (supervised by University staff).

33. Rig down.

It is further agreed upon between the project and DOE that Mr. Anthony Adduci shall be the technical director in DOE for all technical decisions.

III. WORKOVER SUMMARY

Workover Summary

Approximately three weeks prior to the commencement of the workover, large amounts of cold water at approximately 150 gpm were pumped into the HGP-A well to kill the well pressure. Subsequently, about 80 gpm of cold water was pumped into the well continuously to maintain the static water level in the wellbore at approximately 400 ft. below ground level. The drilling rig and its supporting equipment were mobilized and ready to go by September 15, 1979 with all necessary blowout preventing equipment installed.

Repeated pressure testing of the 9-5/8" casing with retrievable plug at approximately 2000 ft. below rotary table (BRT) and RTTS tool at different depths above the plug failed to reveal any significant leaks in the casing. A decision was made then to set a cement plug at approximately 3000 ft. BRT to prevent well fluids from producing into the wellbore so that the casing perforation and cement squeeze job can be performed. The top section of the original 7" liner was also removed from 2161 to 2921 ft. BRT.

A HOWCO retrievable bridge plug was set at about 2000 ft BRT and a series of perforation and cement squeeze job were performed at intervals 2150 to 2152, 2110 to 2112, 1650 to 1652, 1250 to 1252 and 970 to 972 ft. BRT. (See Appendix D). It is evident from the formation breakdown pressure that the cement outside of the casing has deteriorated so that well fluids have migrated upward on the outside of the casing. After the hole was cleaned to the HOWCO plug, the casing was pressure tested for apparent leaks and no leaks were found.

Difficulty was experienced in retrieving the HOWCO plug at about 2200 ft. It appeared that the 9-5/8" casing has come apart and gone out of alignment at about 2147 ft. BRT. After considerable amount of drilling, milling and rolling efforts, the plug was retrieved.

A cement bond log was run to check on the effectiveness of the squeeze job. It was discovered that all of the squeeze operations have improved the bonding substantially except at about 1650 ft. A decision was made to perforate and squeeze again at

1420 to 1422 ft. which was approximately half way between the two previous squeeze operations at 1250 and 1650 ft BRT. This squeeze operation has improved the bonding substantially between 1200 and 1500 ft. as evidenced from later cement bond log.

A decision was made to tie back the 7" casing from the 7" liner stub at 2921 ft. BRT to the surface. 70 joints of 26-16 K55 buttress casing with stage-cementing tools was run in and was stage-cemented to the surface and the rig was shut down for the Discoverer's Day weekend to wait on cement.

After the break, cement bond logs were run to check the cementing job. It was discovered that from 2500 to 2900 ft. the cement bond was not competent. Squeeze jobs were then performed at 2963 to 2975 ft and at 2530 to 2533 ft. A final cement bond log was run from surface to 2990 ft and over 80% bonding was shown on almost the entire string.

A new wellhead was completed on the 7" casing and cement plug was drilled out, cleaned out hole to 6430 ft. and drove junk to 6343 ft BRT. A banjo box was installed and flow test equipment was attached to prepare for a brief flow test. The well was flowed for 4-1/2 hours on October 17th and the production was approximately the same as before the workover. The rig was subsequently released on October 18, 1979.

IV. DAILY DRILLING REPORTS

DAILY DRILLING REPORTS

Sept. 15, 1979 — Start rig time at 12:00 noon. Install blowout preventing equipment (BOE) and Grant rotating head. Pressure test BOE to 1000 psi.

Sept. 16, 1979 — Scrape 7" liner to 3225 ft. below rotary table (BRT). Scrape 9-5/8" casing to top of liner at 2161 ft BRT. Tight spots at 1996 - 2034 ft. and 2150 ft. BRT. Set 9-5/8" RTTS at 360 ft. BRT, pressurize between 360 ft. and surface to 1000 psi. Pressure declined 500 psi in 2 minutes. Pull RTTS out of hole.

Sept. 17, 1979 — Set HOWCO retrievable bridge plug at 1958 ft BRT. Set RTTS at 175 ft. BRT. Pressurize between RTTS and plug. Pressure declined 500 psi in 3 minutes. Reset RTTS at 865 ft BRT. Pressurize between RTTS and plug again to 1000 psi. Pressure declined 350 psi in 15 minutes. Retrieve RTTS and run cement bond log from 500 ft to 20 ft BRT. Retrieve HOWCO bridge plug. Set 7" EZSV at 3140 ft BRT. Prepare for cementing.

Sept. 18, 1979 — With drill pipe at 3136 ft BRT. Inject 10 bbls of 10% calcium chloride brine, 2 bbls water, 5 bbls "Flochek-II" and 2 bbls water. Follow immediately with 32 cu. ft. of API Class G cement with 40% silica flour and 0.5% CFR-2. Displace cement with 24 bbls of water. Wait on cement (WOC) 13 hours. Run in hole to tag cement. No cement. With drill pipe at 3136 ft BRT, re-inject 10 bbls of calcium chloride brine, 1 bbl water, 5 bbls of "Flochek-II" and 1 bbl water. Follow immediately with 24 cu ft API class G cement with 40% silica flour and 0.5 % CFR-2. Displace cement with 19 bbls of water. WOC 6-1/2 hrs. Run in hole and tag top of cement at 3088 ft BRT at midnight.

Sept. 19, 1979 — With drill pipe above the top of cement plug, inject 10 bbls water, follow by 32 cu ft of API class G cement with 40% silica flour and 0.5% CFR-2 and displace with 17 bbls of water. WOC 2 hrs. Cut 7" slotted liner at 2921 ft. BRT. Spear liner at 2161 ft. BRT and recover and lay down 7" casing.

Sept. 20, 1979 — Scrape casing to 2190 BRT. Pick up 8-1/2 " bit to clean out fill with mud to 2898 ft BRT. Circulate to clean out fill.

Sept. 21, 1979 — Set HOWCO retrievable bridge plug at 2196 ft BRT. Dump 10 sacks of sand on plug with drill pipe. Wait on sand 2-1/2 hrs. Tag sand at 2179 ft BRT. Perforate casing from 2150 to 2152 ft BRT with 8 1/2"-holes. Set RTTS at 2165 ft BRT. Pressurize to 1000 psi. No leaks. Set RTTS at 2075 ft BRT. Pump 20 cu ft per minute water at 200 psi. Squeeze with 52 cu ft of API class G cement with 40% silica flour and 0.5% CFR-2. Displace cement with 117 cu ft of water. W.O.C.

Sept. 22, 1979 — W.O.C. till 10:00 am. Perforate casing at 2110 to 2112 ft BRT with 8 1/2"-holes. Set RTTS at 2015 ft BRT. Pressurize to 1500 psi and obtain breakdown with 20 cu ft/min water rate. Squeeze with 178 cu ft of API class G cement with 40% silica flour and 0.5% CFR-2. Displace with 21 bbls of water. W.O.C. 6 hrs. Perforate casing from 1650 to 1652 ft BRT with 8 1/2" holes. Set RTTS at 1545 ft BRT. Obtain breakdown pressure at 200 psi with 20 ft^3/min water rate. Squeeze with 162 cu ft of API class G cement with 40% silica flour and 0.5% CFR-2. Displace with 22 cu ft water. W.O.C.

Sept. 23, 1979 — W.O.C. till 6:00 am. Perforate casing from 1250 to 1252 ft BRT with 8 1/2-inch holes. Set RTTS at 1167 ft BRT. Breakdown at 200 psi with 20 cu ft/min water rate. Squeeze with 87 cu ft

of API class G cement with 40% silica flour and 0.5% CFR-2. Displace with 15 bbls of water. W.O.C. 6 hrs. Perforate casing from 970 to 972 ft. BRT with 8 1/2"-holes. Set RTTS at 880 ft. BRT. Breakdown at 2500 psi with 20 cu. ft./min. water rate. Squeeze with 87 cu. ft. of API Class G cement with 40% silica flour and 0.5% CFR-2 displaced with 11 bbls of water. W.O.C. till midnight.

Sept. 24, 1979 — W.O.C. till 5:00 am. With 8-1/2" bit drill out cement and clean hole to 2147 ft. BRT. Bad spot in casing at 2147 ft. Trip out of hole and change bit.

Sept. 25, 1979 — Drill on bad spot in casing at 2147 ft. BRT. Continue to drill out cement and sand to 2186 ft. BRT. Pressure test 9-5/8" casing. Pressure declined 600 lb in 3 minutes. Trip out and return in hole with retriever tool to retrieve HOWCO bridge plug. Succeed in latching on the plug after three tries. Unsuccessful in pulling through the casing bad spot at 2147 ft. BRT. Reset bridge plug at 2172 ft. BRT. Return with 8-1/2" in casing roller to work on the bad spot. Unable to pull out of hole.

Sept. 26, 1979 — Try to pull casing roller out. Stuck at 1794 ft. BRT. Run two back-off shots at 1793 ft. BRT and backed off at 1793 ft. BRT. Return in hole with drill collar, bumper sub and jars. Screw into fish and retrieved the casing roller. Return in hole with 8-1/2" casing swedge to drive through bad spot to 2151 ft. BRT. Pull out of hole and build tungston carbide face on bottom of swedge.

Sept. 27, 1979 — With the rebuilt swedge, mill through bad spot in 9-5/8" casing at 2147 ft. BRT. Retrieve the HOWCO bridge plug after two tries. With 8-1/2" casing scraper, scrape to 2205 ft. BRT. Run cement bond log.

Sept. 28, 1979 — Continue with cement bond log. Drill out cement and fill, condition hole and clean out to 3000 ft. BRT.

Sept. 29, 1979 Attempt to run inside 7" slotted liner stub at 2920 ft. BRT was unsuccessful. Run in with 6" tapered mill and mill out top of 7" to 2931 ft. BRT. Attempt to run inside 7" slotted liner stub at 2920 ft. BRT was again unsuccessful. Run in with 6" tapered mill and tagged fill at 2987 BRT.

Sept. 30, 1979 Attempt to run inside 7" slotted liner with perforation gun failed. Pick up 7" sizing tool and bumper sub to dress up 7" liner. Tools can not pass 2147 ft. BRT.

Oct. 1, 1979 With hard facing 8-5/8" swedge and two 8-1/4" stubs, mill out bad spots from 2145 to 2155 ft. BRT. Attempt to dress up 7" slotted liner with 7" dressing tool failed again. Set 9-5/8" retrievable bridge plug at 1563 ft. BRT.

Oct. 2, 1979 Place 10 cu ft of sand on plug. Perforate casing from 1420 to 1422 ft. BRT with 8 1/2-inch holes. Set RTTS at 1458 ft. BRT and pressure test to 1000 psi. Pull up and reset RTTS at 1260 ft. BRT and pumped 20 cu ft of water per min. at 200 psi. Cemented with 162 cu ft of API class G cement with 40% silica flour, 0.5% CFR-2. Displaced with 76 cu ft of water. W.O.C. 10 hours. Drill out cement and retrieve bridge plug.

Oct. 3, 1979 Mill on 7" slotted liner stub with 8-1/2" pilot mill to 2921 ft. BRT. Clean out fill from 2990 to 3000 ft. BRT with 6" tapered mill. With perforating gun and sinker bar shot 10 1/2-inch holes from 2963 to 2975 ft. BRT. Set 7" RTTS at 2930 ft. BRT and break down formation at 2000 psi.

Oct. 4, 1979 Dress up 7" stub with dressing tool at 2921 ft. BRT. Change BOP blind ram to 7". Run cement bond log inside 9-5/8" casing. Run in 70 joints 26 16 K55 buttress casing with stage-cementing tools (See Appendix C).

Oct. 5, 1979 Attempt to circulate at 7" stub failed. Dropped D.V. opening plug and circulate at 2492 ft. BRT with 200 psi. Pumped 50 cu ft

mud flush, 25 cu ft water, 147 cu ft "Flowchek-II" and 25 cu ft water. Cemented with 162 cu ft of API class G cement with 40% silica flour, 0.5% CFR-Z and 0.3% HR7. Displaced with 536 cu ft of water. Dropped DV opening plug and circulated DV collar at 2163 ft and got good cement. WOC till midnight.

Oct. 6, 1979 — Circulate through top DV collar at 2163 ft BRT. Pumped 50 cu ft mud flush and 25 cu ft water. Cemented with 446 cu ft of API Class G cement with 40% silica flour, 0.5% CFR-2 and 0.3% HR7. Displaced with 476 cu ft water. W.O.C. and shut rig down at 4:00 pm.

Oct. 7 & 8 — Rig shut down

Oct. 9, 1979 — Start up rig. Run bond log to find top of cement at 19 ft below surface. Flush and fill cement with 1" pipe until good return to surface. Cut off 7" casing and weld on 7" casing head.

Oct. 10, 1979 — Dug out cement inside 30" conductor, cut off 20" pipe 14" below cellar floor, 13-3/8" pipe 10" below cellar floor and 9-5/8" pipe 4" below cellar floor. Bottom of 7" well head is flush with cellar floor.

Oct. 11, 1979 — Drill out cement and DV collars to 2877 ft BRT. Pressure up on 7" weld. small leak on upper weld.

Oct. 12, 1979 — Continue to drill out float collar and clean out to 3000 ft BRT. Run cement bond log from 2968 ft to 2000 ft BRT. Perforate 6 1/2-inch holes from 2530 to 2533 ft BRT. Set 6" RTTS at 2576 ft BRT. Pumped 20 cu ft/min at 1200 psi into perforations at 2963 to 2975 ft. Opened circulation collar and pumped 20 cu ft/min into 2530 to 2533 ft. No communications established. Reset RTTS at 2510 ft BRT and tested casing to 500 psi with no leakage.

Oct. 13, 1979	Set 6" EZSV at 2573 ft. Pumped 20 cu ft/min water into perforations at 2963 to 2975 ft at 1200 psi. Cemented with 162 cu ft of API class G cement with 40% silica flour, 0.5% CFR-2 and 0.3% HR7. Displaced with 185 cu ft of water. Set RTTS at 2385 ft and pumped 20 cu ft/min of water at 1500 psi in perforations at 2530 to 2533 ft BRT. Cemented with 81 cu ft of API Class G cement with 40% silica flour, 0.5% CFR-2 and 0.3% HR7. Displaced with 125 cu ft of water. W.O.C. Reweld 7" casing head and X-rayed.
Oct. 14, 1979	Drill out cement from 2348 ft to 2552 ft BRT. Test casing to 500 psi with no leakage. Drill out EZSV and cement from 2765 to 2993 ft BRT. Test casing to 500 psi with no leakage. Run cement bond log on entire 7" casing.
Oct. 15, 1979	Drill out cement and EZSV and clean out hole to 6340 ft BRT.
Oct. 16, 1979	With 6" flat bottom mill, mill and drive junk to 6343 ft BRT. Install banjo box and build flow test line to muffler. Run Kuster temperature survey.
Oct. 17, 1979	Bail out water till well flashed and flowed well for 4-1/2 hours. Shut in and run Kuster temperature survey.
Oct. 18, 1979	Lay down drill collars and drill pipes. Release rig at midnight.

V. CONCLUSION

V. Conclusion

The HGP-A workover effort accomplished all of the objectives as planned. It secured the cement bonding of the casing and prevented the geothermal fluids from migrating up the annulus of the 9-5/8" casing.

Currently, after almost a year after the workover, the wellhead pressure has stabilized to approximately 140 psig which was the same as the shut-in pressure prior to November 1978. This further demonstrated that the workover effort was successful.

VI. ACKNOWLEDGEMENTS

VI. Acknowledgements

The well workover is performed under the Department of Energy Contract DE-AC03-78ET28420, and fundings from the State and County of Hawaii and Hawaii Electric Light Company.

The Hawaii Natural Energy Institute and the Hawaii Institute of Geophysics have also provided help in performing temperature survey, well flashing and chemistry sampling.

APPENDIX A

HGP-A Casing Record
Hole Size 8-1/2 inch
Casing Size 7 inch OD 26 lbs/ft
Grade K55 Buttress Thread

Joint No.	Measured Length (ft)	Cumulative Length (ft)
1	41.06	41.06
2	43.44	84.50
3	43.51	128.01
4	42.24	170.25
5	43.81	214.06
6	43.01	257.07
7	40.61	297.68
8	43.35	341.03
9	40.06	381.09
10	42.00	423.09
11	42.43	465.52
12	36.84	502.36
13	39.25	541.61
14	42.62	584.23
15	42.75	626.98
16	42.36	669.34
17	38.12	707.46
18	40.96	748.42
19	40.01	788.43
20	41.36	829.79
21	42.94	872.73
22	41.48	914.21
23	43.01	957.22
24	42.48	999.70
25	36.84	1036.54
26	43.72	1080.26
27	43.62	1123.88
28	42.96	1166.84
29	43.38	1210.22
30	41.12	1251.34
31	40.04	1291.38
32	42.94	1334.32
33	43.29	1377.61
34	43.38	1420.99
35	43.04	1464.03
36	43.18	1507.21
37	42.81	1550.02
38	41.02	1591.04
39	43.05	1634.09
40	42.07	1676.16
41	42.60	1718.76
42	40.28	1759.04
43	42.70	1801.74
44	40.20	1841.94
45	29.04	1870.98
46	43.35	1914.33
47	41.38	1955.71
48	43.31	1999.02
49	43.32	2042.34
50	43.23	2085.57

Joint No.	Measured Length (ft)	Cumulative Length (ft)
51	42.86	2128.43
52	43.68	2172.17
53	43.26	2215.37
54	40.98	2256.35
55	41.98	2298.33
56	40.57	2338.90
57	40.91	2379.81
58	43.52	2423.33
59	41.15	2464.48
60	38.72	2503.20
61	42.42	2545.62
62	41.66	2587.28
63	43.18	2630.46
64	35.98	2666.44
65	42.15	2708.59
66	39.16	2747.75
67	41.16	2788.91
68	44.02	2832.93
69	42.31	2875.24
70	43.60	2918.84

APPENDIX B

BIT RECORD

Bit No.	Size	Type	Serial	Purpose
1	8 1/2"	S4TJ	555280	Clean out fill
2	8 1/2"	S4TJ	881474	" " cement
3	6"	SEC	596581	" " cement
4	6"	S4J	828136	Drill out EZSV & cement
5	6"	S4J	827063	" " " " "
6	6"	S4J		" " " " "

APPENDIX C

RECORD OF

HGP-A CASING CEMENTING EQUIPMENT

Casing Bowl = 1.20	Top @ 2919.80
Float Collar = 1.73	Top @ 2877.01
Bottom DV Collar = 3.21	Top @ 2491.77
Top DV Collar = 3.10	Top @ 2163.34

Cement Basket #1	2537
Cement Basket #2	2453
Cement Basket #3	2207
Cement Basket #4	2086

APPENDIX D

Record of Perforation and Testing

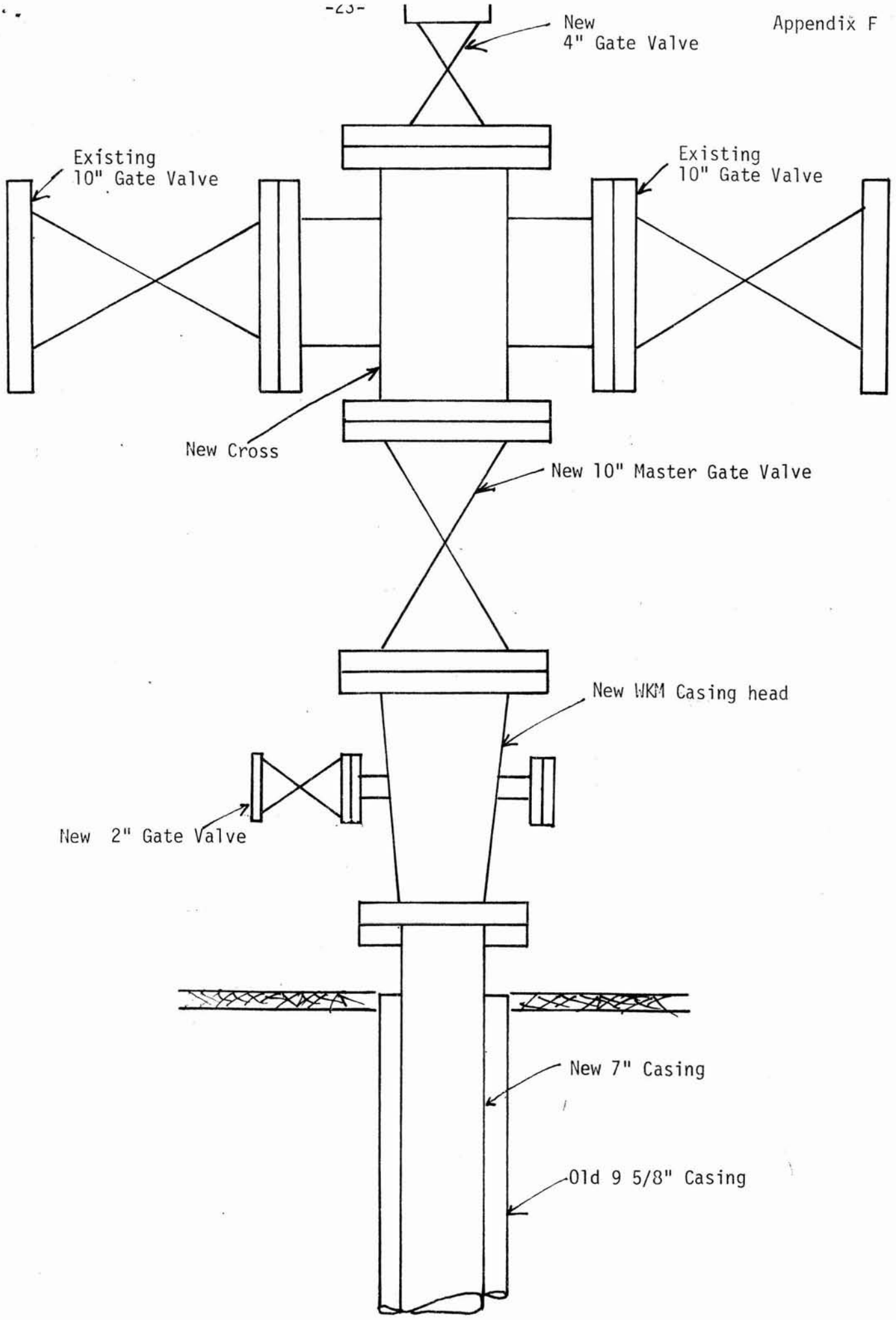
Date	Perforated at (ft BRT)	RTTS at (ft. BRT)	Formation Breakdown Pressure (psig.)
9/21/79	2150 to 2152	2165	1000/no leaks
		2075	200
9/22/79	2110 to 2112	2015	1500
	1650 to 1652	1545	200
9/23/79	1250 to 1252	1167	200
	970 to 972	880	2500
10/ 2/79	1420 to 1422	1260	200
10/ 3/79	2963 to 2975	2930	2000
10/12/79	2530 to 2533	2576	1200

APPENDIX E

Record of Logging Operations

Date	Type of Log	Interval	Comments
4/25/76	Cement Bond	0 - 2200 ft.	Original bond record
5/20/79	Temperature	100 - 2400 ft.	
5/20/79	Casing Caliper	0 - 2100 ft.	No apparent breaks
5/20/79	Cement Bond	350 - 2106 ft.	Substantial deterioration
9/17/79	Cement Bond	20 - 500 ft.	
9/28/79	Cement Bond	100 - 2200 ft.	
9/29/79	3-arm Caliper	2100 - 2914 ft.	
10/ 3/79	Temperature	200 - 2906 ft.	
10/ 4/79	Cement Bond	100 - 2200 ft.	
10/12/79	Cement Bond	2000 - 2968 ft.	
10/14/79	Cement Bond	20 - 2990 ft.	

APPENDIX F


New
4" Gate Valve
Existing
10" Gate Valve
Existing
10" Gate Valve
New Cross
New 10" Master Gate Valve
New WKM Casing head
New 2" Gate Valve
New 7" Casing
Old 9 5/8" Casing