

HAWAII GEOTHERMAL PROJECT, WELL A

HGP-A

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Chronology and Tables Used as Background
for Presentation to the:

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CHRONOLOGY OF THE HAWAII GEOTHERMAL PROJECT (HGP):

- The 1972 Hawaii State Legislature allocated \$200,000 for geothermal research, contingent on Federal matching funds, with \$100,000 of these funds to be administered by the County of Hawaii.
- May 1973 -- The National Science Foundation provided its initial grant of \$252,000 to the HGP and Phase I got underway.

Phase I -- The two-year period from May 1, 1973 through April 30, 1975 was the exploratory geophysical survey phase, with support from the Engineering, Environmental and Socioeconomic Programs.

- May 1975 -- Based on geological and geophysical data, the Site Selection Committee chose the location for the first research hole near the Puna rift zone of Kilauea Volcano, three miles ESE of Pahoa, at an elevation of approximately 600 feet above sea level.

Phase II -- The research drilling program began on May 1, 1975, initially with \$1,064,000 from ERDA, \$500,000 from the State, and \$45,000 from the Hawaiian Electric Company.

- July 31, 1975 -- Marked the death of Dr. Agatin T. Abbott, Co-P.I. and Chairman of the Site Selection Committee -- a great personal and professional loss to the Project. Dr. Gordon A. Macdonald, Senior Professor of Geology, replaced Ag as Director of the Drilling Program.
- November 22, 1975 -- The drillsite was given the traditional Hawaiian dedication and blessing.
- December 10, 1975 -- The well was spudded in and drilling commenced.
- April 27, 1976 -- Drilling of HGP-A was completed to a depth of 6450 feet and preliminary well testing with the rig in place was conducted.

Phase III -- July 1976 through April 1978 involved well testing, analysis, and planning for development of the resource.

- July 2, 1976 -- Utilizing airlifting to evacuate the cold water from the wellbore, initial flashing of HGP-A was achieved and sustained briefly before shutting in the well.
- July 22, 1976 -- A four-hour flow test was conducted during which extensive measurements were taken of various reservoir parameters.
- October 1976 - January 1977 -- A silencer/separator was installed and periodic flow tests conducted of up to two weeks duration.

CHRONOLOGY (continued)

- March 28 to May 9, 1977 -- A 1000-hour (42 day) flow test was conducted; the test was terminated when it appeared that the pressure time curve for the well had stabilized.
- April 1977 -- The HGP-A/DG (Development Group) was organized with the State (lead agency), County and University, and a preliminary proposal for a wellhead generator was submitted to ERDA.
- March 10, 1978 -- The Geothermal Regulations for the State of Hawaii were approved by the Department of Land and Natural Resources.
- April 12, 1978 -- Governor Ariyoshi accepted the Environmental Impact Statement for a Geothermal Research Station utilizing HGP-A as adequate for assessing the proposed project.

Phase IV -- May 1978 through 1980 will include installation of the wellhead generator and assessment of the Kapoho geothermal reservoir.

- May 15, 1978 -- Negotiations between DOE and HGP-A/DG were completed and a wellhead generator contract signed for \$6,268,256--including \$525,000 of local funding and agreement by the utility to purchase up to 3.5 MWe of power.

BUDGET SUMMARY FOR HGP-A

Phase I -- Exploratory Surveys & Related Research (May 1973 through April 1975)

Figures in \$1000

State of Hawaii	FY 72	100	
County of Hawaii	FY 72	100	
National Science Foundation	FY 73-74	469	
ERDA	FY 75	119	
Other Public & Private Funds	FY 72-75	<u>39</u>	
	Subtotal		\$ 827

Phase II -- Experimental Drilling, Initial Well Testing, & Related Research (May 1975 through June 1976)

ERDA	FY 75-76	1,472	
State of Hawaii	FY 74	500	
Water Resources International	FY 76	60	
Hawaiian Electric Company	FY 75	<u>45</u>	
	Subtotal		\$2,077

Phase III -- Well Testing & Analysis (July 1976 through April 1978)

ERDA	Transition Period	147	
ERDA - DOE	FY 77	270	
State of Hawaii	FY 77	<u>66</u>	
	Subtotal		483

Phase IV -- Installation of Wellhead Generator & Assessment of Kapoho Reservoir (May 1978 through Dec. 1980--Initial Funding)

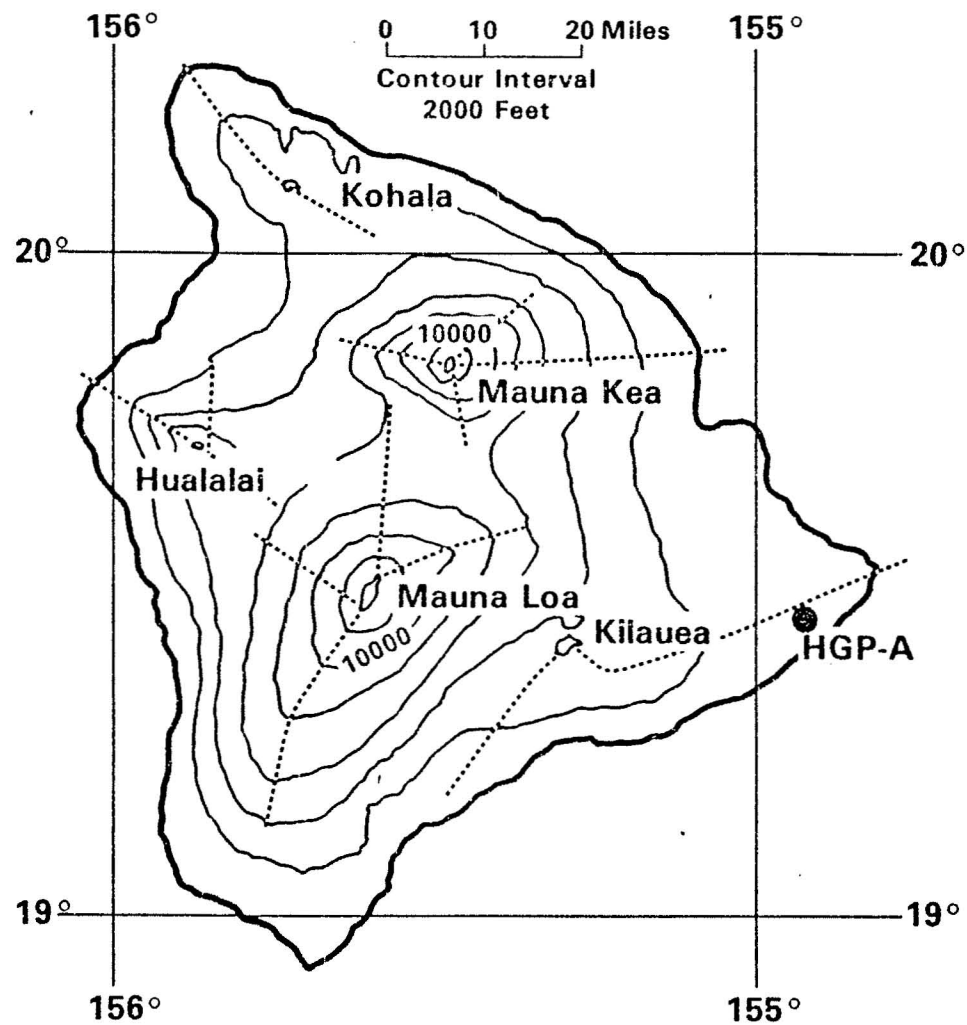
DOE	FY 78-80	5,743	
State of Hawaii	FY 78	400	
County of Hawaii	FY 78	100	
Helco	FY 78	<u>25</u>	
	Subtotal		<u>6,268</u>

Total Funding to Date: 9,655

A Breakdown of This Funding by Category Follows:

Federal Support (NSF, ERDA, DOE)	\$8,220,000
State & County Support	1,272,000
Utility and Private Funding	<u>163,000</u>
Total	\$9,655,000

Locations of HGP-A, Volcanoes and Rift Zones on the Island of Hawaii

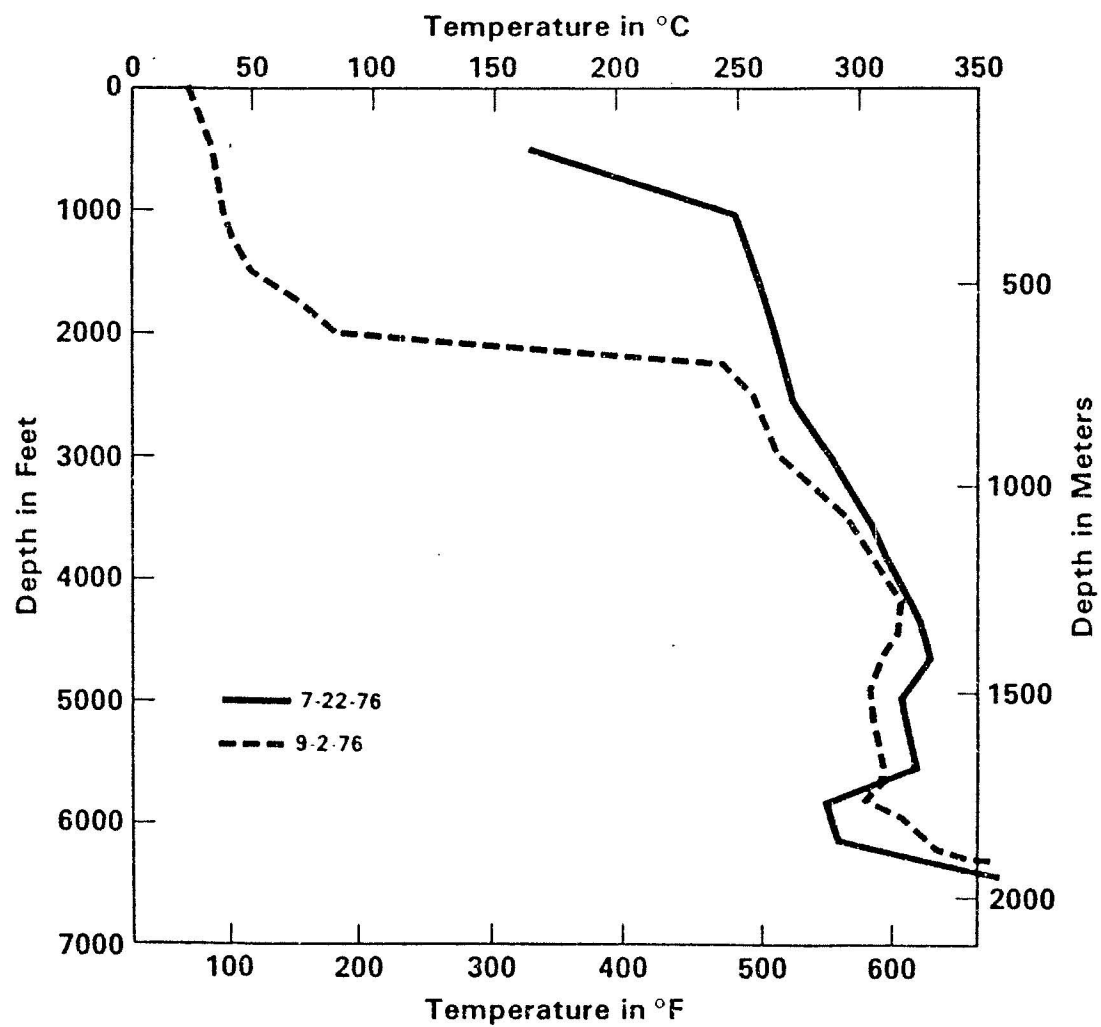


HGP-A

COST OF SITE PREPARATION, DRILLING,
AND RIG ASSISTED WELL TESTING

Site Preparation, Water Reservoir, and Cellar	\$ 45,496
Mobilization	120,192
Labor and Rig Time	733,830
Consumable Materials and Misc. Services	673,995
Electric Logging	16,486
Demobilization	<u>9,615</u>
SUBTOTAL	\$ 1,599,614
Less Credit for Returned Consumables	<u>96,143</u>
NET COST OF HGP-A	\$ 1,503,471
Less Rig Rental Time Donated by WRI	<u>60,000</u>
TOTAL COST OF HGP-A TO THE PROJECT	\$ 1,443,471

Temperature vs Depth for HGP-A



Discharge Rates After Flow Tests

	Nov.	Dec.	Jan.	Mar.
Mass Flow Rate (KLB/HR)	88	103	114	120
Steam Flow Rate (KLB/HR)	60	64	72	75
Steam Quality, %	68	62	63	62
Electric Power Potential, MWe	3.4	3.8	4.3	4.5

Throttled Flow Data:

Orifice (Inches)	Steam Flow (KLB/HR)	W.H. Pressure (PSIG)	W.H. Temp. (°F)	Potential Power (MWe)
8	64	51	295	3.3
6	65	54	300	3.4
4	57	100	338	3.5
3	54	165	372	3.5
2	43	293	419	3.1

Long-Range Power Projections, HGP-A

Time (Years)	Wellhead Pressure (PSIG)	Steam Flow Rate (KLB/HR)	Enthalpy (BTU/LB)	Power MWe
1	153	59	900	3.2
15	142	58	904	3.0
30	140	57	906	3.0

HGP-A Geothermal Well

Has Severe Skin Damage

Flashing Occurs in Formation

Producing Regions at 4300

Feet and Near Bottomhole

Wellhead Pressure 160 PSI at Flow

Rate of 60 KLB/HR of Steam

Potential Power Output, 3.5 MWe

Kapoho Geothermal Reservoir

Liquid Dominated, Tight Formation

Very High Temperatures, 350°C

High Formation Pressures, 2000 PSI

Slightly Brackish, High Silica

**Potentially Large Reservoir
(<1000 MWe)**

