RESPONSE OF THE
HGP-A DEVELOPMENT GROUP
TO THE
COUNTY OF HAWAII PLANNING DEPARTMENT
REGARDING ISSUES RELATING TO SPECIAL PERMIT NO. 392

HGP-A Development Group

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I. RESPONSE TO THE COMPLAINTS OR CONCERNS OF RESIDENTS

A. Previous responses

Since the HGP-A plant started operations in June, 1981, the HGP-A has received 22 complaints logged by the environmental monitoring contractor, Environmental Analysis Laboratory (EAL) (see Appendix A). The original plan was to have one of EAL's employees respond to the complaints and take air or water samples if necessary. However, the contract with EAL did not provide for immediate response on a 24-hour basis, with the result that when the responder arrived at the complaint site, weather conditions had already changed. Most of the complaints have been in regard to odor nuisance.

B. The new telephone/paging system

The HGP-A Development Group has now implemented an around-the-clock complaint response system. By calling the number 961-0046, a telephone/paging system will be triggered to alert the responder to contact the complainant as soon as possible. The responder will call and inform the complainant of his arrival time. Upon arrival, the responder will determine the nature of the complaint and take air, water and/or noise measurements as required. A record of the response will be prepared and signed and dated by both the complainant and the responder. One copy of the response record will be left with the complainant and one copy will be maintained on file by HGP-A.

Results of any analysis made on the samples will be sent to the complainant. If no one is at home at the time of the response, noise and air sampling will be done as required and a response form will be left at the residence.

Mr. Robert Kochy has agreed to serve as the responder. He lives near Leilani Estates, and is thus near the well and can respond quickly to the calls of residents.

II. STEAM PLUMES CROSSING THE ROAD NEXT TO THE ROCK MUFFLER

A. Brief history

When HGP-A opened the well in June, 1981, the steam was vented through the old rock muffler, where the enclosure is approximately 3 feet above ground. HGP-A staff discovered that when tradewinds are blowing, the steam drifts across the road. After the well was shut down in September, 1981, and prior to the start-up in December, 1981, HGP-A rebuilt the muffler box and extended the enclosure around the rock muffler to a height of 10 feet. Although conditions improved, there were still times when heavy tradewinds depressed the steam so that it drifted across the road. Before the April 15, 1982 public meeting, designs were drawn up to further heighten the stack to 17 feet.

B. Construction of a new stack

The HGP-A Development Group has asked the County Public Works Department to erect signs cautioning motorists of possible steam drifts on both Pohoiki Bay Road and Leilani Road. Furthermore, the Development Group has authorized the construction of a stack/hood for the muffler box to vent the steam at 17 feet above ground. The design has been completed (see Figure 1) and the construction of the stack/hood will begin soon. The Development Group believes that this stack/hood will eliminate the problem of steam drifting across the road. If it does not, the height of the stack can be increased.

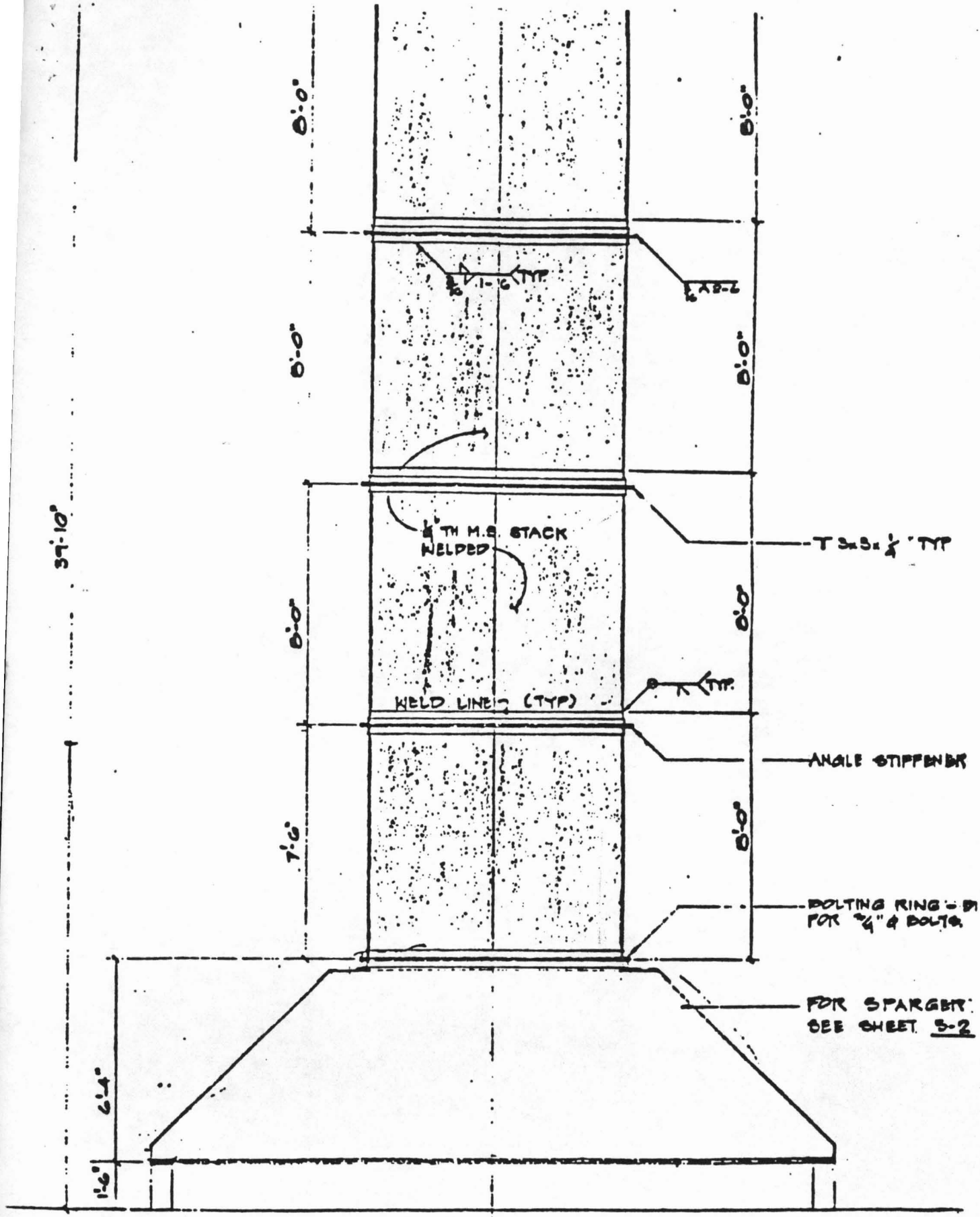

Figure 1.

STACK GENERAL ARRANGEMENT

III. THE MONITORING PROGRAM NEAR THE HGP-A WELL

A. A brief history

Since the onset of the University's geothermal exploration in 1973, an environmental program has always been an integral part of the project. A comprehensive environmental baseline study was conducted and culminated in a report entitled, Environmental Baseline Study for Geothermal Development in Puna, Hawaii[1/]

After the HGP-A Wellhead Generator Project started in 1978, an environmental plan for the project was developed.[2/] In this document all emission standards and environmental monitoring efforts are thoroughly planned out. This document was approved by the U.S. Department of Energy and thoroughly scrutinized by the State Department of Health, University of Hawaii Environmental Center, and the State Office of Environmental Quality Control.

In the meantime, an environmental monitoring program based on the environmental plan was implemented. This program is now carried out by EAL of Richmond, California. EAL monitors hydrogen sulfide and trace elements at emission points in the plant. Hydrogen sulfide levels in ambient air are also measured at the property line, at Mr. Schroeder's house in Leilani Estates and at surrounding areas. Monitoring during October, 1981 when the well was shut down indicated that the average H_2S was .003 ppm (parts per million), and the maximum was .013 ppm. Monitoring during January, 1982 when steam was

being emitted to the atmosphere indicated that the average H_2S was .005 ppm, and the maximum H_2S was .04 ppm (see Appendix B). The ambient air monitor indicates that the average hydrogen sulfide level in the surrounding area is substantially less than .03 ppm, the California standard. Well and spring waters around HGP-A are collected to monitor the effect of water disposal, if any. To date, no impact has been observed at any of the wells around HGP-A. Catchment water is monitored for its sulfur and trace elements. No sulfur or trace element increases have been detected in the water catchment systems monitored. These monitoring efforts will continue.

B. Relocation of monitoring equipment to residential areas

A concern expressed at the public meeting on April 15, 1982 was that monitoring should take place at more residential sites. The Development Group has thus approved the relocation of two existing environmental monitoring stations from the plant site to residential areas. The expected cost of relocation is approximately $10,000.

IV. THE PERCEPTION OF HEALTH PROBLEMS

A. Experience in other parts of the world

The geothermal industry is now operating in many different countries--Japan, the United States, the Soviet Union, Italy, Hungary, Iceland, New Zealand, Mexico, and the Philippines. As of 1975, the commercial industry amounted to 3400 thermal megawatts (MW), of which 21.9 percent was used for agricultural purposes; 28.7 percent for balneology/tourism; 33.2 percent for electrical generation; 4.4 percent for industrial applications; and 11.8 percent for space heating.[3/]

The perception of health in regard to geothermal discharges seems to vary in an extraordinary way. At the public meeting on April 15, 1982 at Pahoa, residents stated that the geothermal well was making them sick. In other parts of the world, however, people flock to geothermal hot springs to smell the discharges, drink the sulfur water, and bathe in geothermal effluent in order to become healthy. Balneology--the therapeutic use of baths--is a major aspect of geothermal use in Japan, the Soviet Union, and Hungary, accounting for the use of 977 MW or 28.7 percent of the world geothermal industry in 1975.[4/]

> ...There were 100 million overnight visitors in 1968 to 1,590 hot spring locations in Japan who spent 2-3,000 yen ($6.67-$10.00) a day ($834,000,000) and another 50 million day-time visitors ("one-day trippers") who spent about 1,000 yen ($3.33) per person ($166,650,000). Total annual expenditure was $1,000,650,000 at the 13,553 lodging

> facilities with average capacity of 57 people per facility and average occupancy rate of 35.6 percent. These hot springs provide curing and recreational facilities as well as lodging and food. If 50 percent of the revenues are allocated to lodging and the remainder divided equally between geothermal and food, the geothermal share of these revenues is $250,162,500. The balneology/tourism for the rest of the world (348.91 MW) is 55.5 percent that of Japan and, if these areas have 50 percent as much utilization as does Japan, their geothermal revenues are $69,420,093. The worldwide balneology/tourism sector is then a billion dollar industry ($1,278,330,373) with a geothermal component valued at $319,582,593.[5]

It may be that the geothermal resources themselves vary; it may also be that psychological attitudes toward the resource vary. Still, it is difficult to believe that geothermal hot springs are popular as health spas in three countries and also believe that in Puna, the geothermal well is a source of illness. World experience does not point toward illness.

B. Hydrogen sulfide (H_2S)

The release of hydrogen sulfide may be the most frequently-cited environmental concern related to geothermal development. In 1978, the U.S. Environmental Protection Agency published a report entitled Pollution Control Guidance for Geothermal Energy Development.[6] The report provided the following guidance regarding limitations on hydrogen sulfide:

> Hydrogen sulfide is the only air pollutant for which limitations are suggested at this time. Hydrogen sulfide emissions from initial demonstration facilities and existing commercial facilities should be limited to an average of no more than 10% of the loading in the raw fluid. For most electric power generation facilities it is expected that this will be equivalent to an average between 0.2 and 0.4 kilograms per megawatt-hour (MWH) of normal power generation (rated capacity X plant factor). Facilities producing raw loads less than 0.2 kg/MWH probably will not require treatment.[7]

The EPA guidance for a 3-MW plant such as HGP-A is 1.32 to 2.64 lbs/hr. As Dr. Chen testified at the public meeting on April 15, 1982, the H_2S emission level at the HGP-A site is now approximately 1.5 lbs/hr, which is at the low end of the EPA guidance range.

Further action will be taken by the HGP-A Development Group to keep the H_2S emissions as close as possible to the EPA guidance level during the venting of the well, in addition to meeting standards during normal operating hours. The well is likely to be vented through the muffler box four weeks per year; there may also be "upsets" or periods during which venting is necessary due to mechanical problems. Hydrogen sulfide emissions during venting have been reduced by 90 percent, but this leaves the emission level at approximately 5.5 lbs/hr, which is above EPA guidance levels. By doubling the caustic injection, the efficiency of removal may rise to 95 percent, with a resulting emission level of 3.5 lbs/hr.

The exposure of workers at geothermal plants to H_2S is a specific concern. According to the EPA guidance report:

> Hydrogen sulfide in the facility work environment (e.g. power plant) is likely to be of greater health significance than in relatively distant areas. The Occupational Safety and Health Administration regulations (29 CFR 1910.1000) list an acceptable ceiling concentration, without respiratory protection, of 20 ppm, with a maximum peak of 50 ppm for a 10-minute exposure. The American Conference of Governmental Industrial Hygienists currently recommends a time-weighted average limit over the work day or week of 10 ppm, with a short-term (15 minute) exposure limit of 15 ppm. Conformance with these criteria may obviate human health concerns outside the work environment.[8/]

The National Institute for Occupational Safety and Health (NIOSH) issued a report on hydrogen sulfide in 1977.[9] It established a standard designed to protect the health and safety of employees working up to a 10-hour work shift in a 40-hour workweek, over a lifetime. The standard is:

> Exposure to hydrogen sulfide shall be controlled so that no employee is exposed to hydrogen sulfide at a ceiling concentration greater than 15 mg of hydrogen sulfide per cubic meter of air (15 mg/cu m or approximately 10 ppm), as determined with a sampling period of 10 minutes, for up to a 10-hour work shift in a 40-hour workweek. Evacuation of the area shall be required if the concentration of hydrogen sulfide equals or exceeds 70 mg/cu m.[10]

Thus, the Occupational Saftey and Health Administration has set an acceptable ceiling, without respiratory protection, of 20 ppm, and the NIOSH standard for safety throughout a lifetime of work is approximately 10 ppm. Industrial toxicologists believe that "the currently accepted threshold limit value for H_2S is 10 ppm."[11]

Environmental data collection down wind from the HGP-A well has yielded an ambient air level of .005 to .010 ppm H_2S, with occasional peaks of up to .04 ppm. This is between 1/4000th and 1/2000th of the 20 ppm OSHA standard, and between 1/2000th and 1/1000th of the 10 ppm lifetime NIOSH standard. The peak of .04 ppm is 1/500th the OSHA standard and 1/250th the NIOSH standard. It should be emphasized that the peak levels of H_2S were measured during periods of venting through the muffler box. Under normal plant operations, the ambient H_2S levels down wind of the plant are substantially below the peak values. Also, the OSHA monitor at the plant site has indicated a high level on only one occasion, which was caused by maintenance requirements. There have been no complaints from the HELCO operators and other project personnel at the site regarding discomfort or health problems.

The EPA guidance report summarizes the effects of H_2S on humans in the following table, taken from a literature review by the U.S. Public Health Service.[12/]

TABLE I. HYDROGEN SULFIDE EFFECTS ON HUMANS

Concentration (ppm)	Effects
.0007-.030	odor threshold
0.33	distinct odor; can cause nausea, headaches
2.7 - 5.3	odor offensive and moderately intense
20 - 33.	odor strong but not intolerable
100	can cause loss of sense of smell in few minutes
210	smell not as pungent, probably due to olfactory paralysis
667	can cause death quickly due to respiratory paralysis
750	virtually no odor sensation; death can occur rapidly, upon very short exposure

Based on this table, it can be seen that the HGP-A level of .005 ppm to .010 ppm H_2S is well within the first category, or the "odor threshold." The occasional peaks of .04 ppm are above the "odor threshold," but are still only 1/8 of the amount which can cause nausea and headaches.

This is supported by the information presented in another EPA publication, Western Energy Resources and the Environment: Geothermal Energy.[13/] This report sets forth the physiological effects at increasing levels, presented in Table II below. A column has been added at the right to compare the ppm of

the physiological effects with the occasional peak of .04 ppm for the HGP-A well. For example, the odor nuisance level of .067 ppm is 1.67 times greater than the .04 ppm peak level at the HGP-A well.

TABLE II. PHYSIOLOGICAL EFFECTS OF HYDROGEN SULFIDE COMPARED TO HGP-A EMISSIONS

Effect	PPM (H_2S) =	X's Greater than HGP-A (.04 ppm)
odor nuisance	0.067	1.67
loss of sense of smell	0.067 - 0.67	1.67 - 16.75
eye irritation, fatigue	0.67 - 6.7	16.75 - 167.5
eye irritation, photophobia after several hours	6.7 - 100	167.5 - 2,500
eye and respiratory irritation within 1 hour; possible death within 43 hours	100 - 200	2,500 - 5,000
eye and respiratory irritation within 30 minutes; slight systematic effects within 4-8 hours; dyspnea, hemmorage, and death within 48 hours	200 - 334	5,000 - 8,350
slight systemic effects within 4 hours, hemorrage and death within 8 hours	334 - 467	8,350 - 11,675
slight systemic symptoms within 1 hour, death within 4-8 hours	467 - 600	11,675 - 15,000
death within 1 hour	600 - 934	15,000 - 23,350

Citizens at the public meeting in Pahoa on April 15, 1982 described a number of ailments. One asserted that he has respiratory problems which may or may not have to do with the geothermal well; the doctors don't know. Another citizen stated that her children had ear infections, and her baby no longer responds to antibiotics. Another said he has sinus problems, and his

wife has migraine headaches. Another said that when the well was being drilled his wife couldn't breathe, and had to go to the hospital. Another said her baby is congested in the lungs; she has experienced dizziness; and she has had a cold for two months. Another cited thickening of the throat. Another stated that people were dying, and that the children were suffering terribly. Several said that when they leave Puna, they are all right; when they come back, they get sick. One man said he had eye irritation and pulmonary problems. Another said he had a cold and coughing for six months. One woman said that she has irreversible lung damage. Another woman said that her throat swelled shut; she had trouble with her bronchial tubes; and she was almost incapacitated for a week. And a woman who works at the HGP-A well, and has worked there since December, 1981, said that she has experienced no health problems that appear to be related to her increased exposure to H_2S.

In evaluating these statements, there are a number of considerations:

(1) Assuming that all those who testified are describing facts--that they or their family members are indeed sick--there was no evidence offered to connect the sickness with the HGP-A well. The ailments may exist, but the HGP-A well may not be the cause.

(2) According to available data, such as provided in Tables I and II, nausea and headaches should not occur until the H_2S emissions are 8.25 times the peak ambient down wind HGP-A level of .04 ppm. Eye irritation and fatigue should not occur until the H_2S level is between 16 times and 167 times the HGP-A level. Respiratory irritation could occur within an hour if H_2S emissions were between 2,500 and 5,000 times the peak HGP-A level.

While individuals may vary, the data takes those variations into account. Residents are asserting far greater effects at far lower emission levels than the data would suggest. It is thus unlikely that HGP-A is the cause of the ailments reported by residents.

(3) The Puna District includes a volcanic rift zone with outgassing at a number of points other than the HGP-A well. Kilauea itself discharges aerosols and gases which can affect Puna residents. Puna is rich in pollens which cause allergies. In addition, Puna is an area of high rainfall and has much higher than average concentrations of mold and fungi which are frequently associated with respiratory and pulmonary allergic reactions. The ailments may thus be due to the environment of the entire region. This is consistent with the statements made to the effect that "when I leave Puna I am all right; when I come back, I get sick." It is also consistent with assertions of ailments by new arrivals, people who were rarely sick where they lived on the mainland.

(4) A final consideration is that more than 11,000 people live in Puna; there are 150 residences in Leilani Estates; and less than 10 percent of the residents at Leilani Estates testified at the public meeting regarding health problems, ascribing them to the HGP-A well. There may be residents with ailments they didn't report, but the percentage of those who did report illnesses is consistent with the number of people statewide who have such illnesses.

The State of Hawaii Data Book 1981 reports that the population in the Puna District was 11,751 on April 1, 1980. The Data Book also provides tables on acute conditions and chronic conditions in 1979 on a statewide basis, as compiled by the Hawaii State Department of Health. The table on acute conditions is as follows:[14/]

TABLE III. ACUTE CONDITIONS: 1979

Condition	Incidences of condition	Incidence per 100 persons
All acute conditions	1,840,801	209.2
Infective parasitic diseases	124,208	14.1
Respiratory condition	1,221,329	138.7
Upper respiratory	824,385	93.7
Influenza	346,947	39.4
Other respiratory condition	49,997	5.7
Digestive system condition	32,894	3.7
Injuries	244,357	27.7
All other acute conditions	218,013	24.7

This table shows that respiratory conditions were above all the most common, occurring 138.7 times per 100--or the equivalent of more than once per person. Chronic conditions, occurring repetitively, are far lower. The table on chronic conditions is as follows:[15/]

TABLE IV. CHRONIC CONDITIONS: 1979

Selected chronic conditions	Incidences of condition	Incidence per 1,000 persons
Heart condition	18,437	20.9
Impairments of back or spine	30,453	34.6
Hypertension without heart involvement	58,783	66.8
Arthritis/rheumatism	23,028	26.2
Hearing impairment	22,960	26.1
Asthma with or without hayfever	32,149	36.5
Diabetes	19,408	22.1
Mental and nervous condition	8,459	9.6
Visual impairment	9,201	10.5
Malignant neoplasms	5,380	6.1
Chronic and allergic skin conditions	21,057	23.9
Chronic sinusitis	17,629	20.0
Hayfever without asthma	47,890	54.4
Stomach ulcer	7,288	8.3
Bronchitis/emphysema	8,068	9.2
Benign and unspecified neoplasms	6,005	6.8
Hemorrhoids	10,859	12.3
Thyroid/goiter	4,564	5.2
Varicose veins	3,679	4.2
Gout	9,984	11.3

Based on Table III, regarding acute conditions, one would expect each resident of Puna to have a respiratory problem at least once each year, or many but not all residents to have respiratory problems several times per year. The data only reflects the number of incidences of the condition, so we do not know how many were experienced by specific individuals, nor whether the incidences in Puna are comparable to the statewide average. It is not unusual, however, that residents at the public meeting on April 15, 1982 testified that they had respiratory problems. Such problems are statistically widespread.

As for chronic conditions, the testimony mentioned asthma, sinusitis, and bronchitis. Table IV shows that asthma occurred 36.5 times per thousand people in 1979, which would mean 401 cases for a population of 11,000, roughly the population of Puna. Chronic sinusitis occurred 20 times per thousand people, or 220 cases for a population of 11,000. Bronchitis/emphysema occurred 9.2 times per thousand people, or 101 cases for a population the size of Puna's. Many of the symptoms reported are consistent with hay fever, the second highest chronic condition reported in Table IV, 54.4 per thousand, or 598 people for a population of 11,000. Again, the data only reflect the number of incidences of the condition, so we do not know how many were experienced by specific individuals, nor whether the incidences in Puna are comparable to the statewide average.

In light of this data, the testimony at the public meeting is to be expected. It is consistent with health problems experienced throughout the State, not just near the HGP-A site, and not just in Puna. A public meeting at <u>any</u> location in the State could reveal significant health problems of the type asserted by Puna residents, without there being any relationship to geothermal development. Some people may live near freeways; some near airports; some near areas with large amounts of dust; some in areas with large amounts of pollen; some near volcanic discharges. The HGP-A Development Group believes that health problems in Puna are typical of locations which do <u>not</u> have a geothermal generator. There is thus no reason to believe that the HGP-A well has caused the health problems which were reported.

Based on the existing data and the above considerations, the HGP-A Development Group concludes that there is at present no convincing evidence to indicate that the health problems experienced by the residents can be attributed to the emissions of H_2S from the HGP-A plant.

C. Mercury (Hg)

A significant amount of environmental baseline data collection has focused on mercury emissions. This work established as early as 1977 that the HGP-A well is a low mercury emitter, and that high levels of mercury in the environs of the HGP-A well are due to natural events and processes in Kilauea and the East Rift Zone. This was the conclusion of Drs. B.Z. Siegel and S.M. Siegel, who have been conducting monitoring work in the rift zone for 13 years. The Siegels observed in 1978:

> It is virtually impossible to be familiar with the Island of Hawaii yet unaware of the proximity to HGP-A of a host of natural thermal sites...On 31 October, prior to warmup, HGP-A ambient air yielded 16 $ug.m^{-3}$, of Hg. During the warmup phase, 1-2 November, levels of 16-18 $ug.m^{-3}$ were found, but on 3 November, after 4 hours flashing, the level had fallen to 7 $ug.m^{-3}$, yet during the two weeks after the well was shutdown, values of 13-29 $ug.m^{-3}$ were recorded.[16]

The Siegels have concluded that "Increases in Hg (mercury) [at the well site] are independent of well activity reflecting instead natural thermal emissions [in the area]. A level of about one $ug.m^{-3}$ (microgram per cubic meter of air) reflects general atmospheric norm but East Rift activity can elevate this figure 10-fold at HGP-A and 50-200 fold on the Kilauea East Rift."[17] The HGP-A incinerator-absorber system that works on hydrogen sulfide scrubs out almost all of the mercury that comes out of the well.

The levels at issue are far below the EPA emission standards for coal-fired electric and incinerator facilities, which are 2300 g or 1600 g in 24 hour periods, compared with the expected maximum emission rate of 10 g for mercury at HGP-A.[18/]

Dr. Donald Thomas testified at the public meeting on April 15, 1982 that he had run some tests that day, and mercury levels were below detection, they were so small. The HGP-A Development Group has concluded that mercury emitted from the HGP-A well is not a hazard to public health or safety.

D. Radon

The EPA report, Western Energy Resources and the Environment: Geothermal Energy, describes the concern over radon as follows:

> Radon-222, the only radioactive gas, is found in trace amounts in the noncondensable gas portion of geothermal steam. It is produced by the decay of uranium in the rocks of the geothermal reservoir.
>
> Although only a minute amount of radon is present in geothermal effluents, its very presence has caused considerable concern. Once introduced to the atmosphere, radon acts as a source of highly toxic decay products. While radon itself does not accumulate in human beings, it has a relatively short half-life of 3.82 days, and breaks down into 'daughter products' that readily attach to other particles in the atmosphere. These particles can, in turn, attach to human tissue. Increases in lung cancer at industrial sites have been associated with exposure to radon and its daughter products. A concentration standard of three picocuries per liter has been set by the state of California for the radon-222 concentration in the air.[19/]

Radon gas is present as a trace constituent in all geothermal steam. Radon is a natural emission in fumarolic gases as well as from rocks in non-thermal areas in all parts of the world. The radon released by HGP-A, at

a distance of only 100 meters downwind of the well, is about .026 picocuries per liter. This produces an increase in the normal ambient concentration equivalent to 1/100th of the California recommended limit of 3 picocuries per liter for ambient air and 1/1000th of the EPA recommended limit of 30 picocuries for habitable dwellings. This increase is also equivalent to about one-tenth of the normal daily variation in the local ambient radon concentrations. For purposes of comparison, in continental areas (where naturally occuring levels of uranium are higher than in Hawaii), the typical ambient radon concentrations are about twice that found locally.

Due to the low levels, the HGP-A Development Group has concluded that radon emitted by the HGP-A well is not a hazard to public health or safety.

E. Noise

Noise is caused by geothermal drilling, the venting of wells, and the operation of a generating station using geothermal energy. The EPA guidance document states:

> In all industrial operations noise is a pollutant that must be accepted to some degree. In geothermal operations noise may be particularly annoying, in part because the areas of operation will be generally remote and otherwise relatively quiet. The most significant potential sources are drilling (particularly with air) and steam flashing and venting.
>
> ...In general, noise level decreases from 3 to 6 dBA with every doubling of distance. The expression of dBA means 'A-weighted' sound level measured in decibels above a reference sound pressure of 0.0002 microbars (20 micropascals). 'A-weighting' weights the contributions of sounds of different frequency so that the response of the human ear is simulated.[20/]

For reference, the EPA guidance document sets forth ranges for "well-known" sources of sound. Some of these ranges are:[21/]

• quiet wilderness area	20 - 30 dBA
• quiet suburban residence	48 - 52 dBA
• business office	50 - 60 dBA
• noisy urban area	80 - 90 dBA
• adjacent to freeway	90 dBA
• jet airplane at 100 feet	120 - 130 dBA

Occupational Safety and Health Administration requirements for the workplace specify that no worker should be exposed to 115 dBA for more than 15 minutes, or to 90 dBA for more than eight hours.[22/] The recommendation in the EPA guidance document is as follows:

> Noise limitations should conform, as an initial minimum, to the regulations issued by the U.S. Geological Survey for geothermal operations on Federal lands; i.e. not to exceed 65 dBA at the lease boundary or one-half mile from the source, whichever is greater.[23/]

Noise levels at the HGP-A well are set forth in Appendix C. During October, 1981 when the well was shut down, the noise level at nine stations near the well ranged from 38 to 52 dBA. During January, 1982, when steam was being vented, the noise level ranged from 38 to 51 dBA. No appreciative increase was found to occur due to HGP-A operations. The noise level was within the "quiet suburban residence" category above. Also, it was far under the EPA recommendation of 65 dBA.

F. Odor

While emissions from the HGP-A well do not constitute a health hazard, even very small amounts of H_2S can be detected by smell, and the odor is

considered by many to be unpleasant. According to Table I above, the odor threshold can be as low as .0007 ppm, which is far below the HGP-A level. The EPA data in Table II classified the odor as a "nuisance" at .067 ppm, which is 1.6 times higher than the HGP-A level.

Testimony at the public meeting on April 15, 1982 was that "the smell is the problem." Odor is a problem in daily life. The odor of sewage systems, departing airplanes, sugar mills, pineapple canneries, auto fumes, and volcanic discharges are all difficult to control. For the most part, we learn to live with them, because the cost of eliminating them is far too high to be worthwhile. The HGP-A Development Group intends to increase the efficiency of H_2S reduction measures in hopes of curtailing the odor problem. It is unlikely, however, that the odor can be absolutely eliminated. A few individuals, at certain times, are still likely to smell the hydrogen sulfide.

V. THE TERMS OF SPECIAL PERMIT NO. 392

The notice of the public meeting on April 15, 1982 stated the purpose of the meeting as follows:

PURPOSE

The Hawaii Geothermal Generator Project was originally permitted under Special Permit No. 392, by the County Planning Commission and State Land Use Commission on July 18, 1978. Condition No. 6 of this Special Permit required:

> That the petitioner or its authorized representative shall be responsible in assuring that every precaution is taken to reduce any nuisances, whether it be noise or fumes, which may affect the residents and properties in the immediate area. Should it be determined by the Planning Director that these precautionary measures are not being applied, he will prepare and present a written report to the Planning Commission for its appropriate action which may involve the termination of the Special Permit.

The purpose of this meeting is to provide the Planning Director with an opportunity to gather and evaluate information with respect to the geothermal emissions of the HGP-A generating plant and the problems related thereto in accordance with the responsibilities of Condition No. 6 of Special Permit No. 392.

What the County Planning Commission and State Land Use Commission required in Condition No. 6 was that "the petitioner or its authorized representative shall be responsible in assuring that every precaution is taken to reduce any nuisances, whether it be noise or fumes, which may affect the residents and properties in the immediate area." The first key phrase is "responsible in assuring that every precaution be taken." The HGP-A Development Group has developed the geothermal well in a responsible manner, taking every precaution that it can. Staff has been on the site working continuously to improve

conditions and reduce emissions. The situation has steadily improved, and will improve even more. Within two weeks after the public meeting on April 15, 1982, the HGP-A Development Group took action to respond to community concerns.

Condition No. 6 does not require that there be no impacts and no nuisances. The second key phrase is the requirement that every precaution be taken "to reduce any nuisances." This is the question before the Planning Department in its deliberations: whether the HGP-A Development Group has been responsible in assuring that every precaution is taken to reduce any nuisances.

As this document shows, the answer is yes: every precaution has been taken. Emissions are within recommended limits, and far below health hazard levels. Noise has been reduced to below the recommended level. While not required by Condition No. 6, the Development Group has conducted an extensive environmental monitoring program. In response to community concerns, it has established a telephone/paging service, authorized the construction of a hood/stack, and agreed to relocate monitoring equipment, all at an approximate total expense of $95,000 above current operating expenses. The Development Group will continue to respond, as appropriate, to any problems and legitimate community concerns which may arise in the future.

NOTES

1/ Robert M. Kamins et al, Environmental Baseline Study for Geothermal Development in Puna, Hawaii (Honolulu: Hawaii Geothermal Project, University of Hawaii, 1976).

2/ S.M. Siegel and B.Z. Siegel, "Environmental Plan Proposed for the HGP-A Generator Project - A Model" (unpublished manuscript submitted to the Research Corporation of the University of Hawaii, 1978).

3/ Richard E. Peterson and Nabil El-Ramly, The Worldwide Electric and Nonelectric Geothermal Industry (Honolulu: The Hawaii Geothermal Project, University of Hawaii, 1975), p. 16.

4/ Ibid.

5/ Ibid., p. 17.

6/ Robert P. Hartley, Pollution Control Guidance for Geothermal Energy Development (Cincinnati: U.S. Environmental Protection Agency, 1978).

7/ Ibid., p. 11.

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10/ Ibid., p. 2.

11/ Alice Hamilton and Harriet L. Hardy, Industrial Toxicology (Acton, Mass.: Publishing Sciences Group, Inc., 1974), p. 233.

12/ Robert P. Hartley, Pollution Control Guidance for Geothermal Energy Development (Cincinnati: U.S. Environmental Protection Agency, 1978), p. 39.

13/ Western Energy Resources and the Environment: Geothermal Energy (Washington, D.C.: U.S. Environmental Protection Agency, 1977).

14/ State of Hawaii Data Book 1981 (Honolulu: State of Hawaii Department of Planning and Economic Development, 1981), p. 65.

15/ Ibid., p. 66.

16/ B.Z. Siegel, and S.M. Siegel, "The Hawaii Geothermal Project: An Aerometric Study of Mercury and Sulfur Emissions," Geothermal Energy A Novelty Becomes Resource Vol. 2, Section 2 (Davis, Calif.: Geothermal Resources Council, 1978), p. 597.

17/ S.M. Siegel and B.Z. Siegel, "Environmental Plan Proposed for the HGP-A Generator Project - A Model" (unpublished manuscript submitted to the Research Corporation of the University of Hawaii, 1978).

18/ B.Z. Siegel and S.M. Siegel, "The Hawaii Geothermal Project: An Aeromatic Study of Mercury and Sulfide Emissions," Geothermal Energy: A Novelty Becomes Resource, Vol. 2, Section 2 (Davis, Calif.: Geothermal Resources Council, 1978), p. 597.

19/ Western Energy Resources and the Environment: Geothermal Energy (Washington, D.C.: U.S. Environmental Protection Agency, 1977), p. 71.

20/ Robert P. Hartley, Pollution Control Guidance for Geothermal Energy Development (Cincinnati: U.S. Environmental Protection Agency, 1978), p. 27.

21/ Ibid.

22/ Ibid., p. 40.

23/ Ibid., p. 12.

APPENDIX A

COMPLAINT LOG

Date	Resident	Location	Nature of Complaint and EAL Response
6/12/81	Bear	Kumukahi	Noise, mercury, sulfur compounds, effect on baby complaint. Measured noise at 41 db, no detectable odors.
6/12/81	Gutierrez	Nohea	Noise complaint. Measured noise at 35-51 db, no odor.
6/12/81	Zoepeway	Hookupu	H_2S odor complaint. Rotorod measured < 15 ppb over 20 minutes, noise at 46 db, no odor.
6/12/81	Rueckheim	Moku	Noise, H_2S complaint. Rotorod-< 15 ppb over 20 minutes, noise at 42 db, no odor.
6/15/81	Davids	Panioki	H_2S odor complaint. Rotorod < 15 ppb over 20 minutes.
6/17/81	Zoepeway	Hookupu	H_2S caused wife to "black out" complaint. Left three colortec cards, no odor.
6/22/81	Bear	Kumukahi	H_2S odor complaint. L. Lopez responded.
6/26/81	---	3 miles from HGP-A	Occasional H_2S complaint.
6/26/81	---	---	H_2S complaint. B. Burkard and L. Lopez responded, left three colortec cards.
6/30/81	---	---	Odor complaint. B. Burkard and S. Casalina responded.
6/30/81	---	---	Odor complaint. B. Burkard and S. Casalina responded.
7/1 through 7/30, 1981		---	No complaints logged.

-COMPLAINT LOG-

DATE	COMPLAINANT	ADDRESS	COMPLAINT	RESPONSE
8/8/81	Kakara	Leilani Estates	Stomach Cramps	D. Thomas, B. Burkard collected samples. nothing was found in the water.
8/11/81	Fubaty	Leilani Estates	H_2S odor	

COMPLAINTS REGARDING
HGP-A OPERATIONS

DATE	COMPLAINANT	ADDRESS	COMPLAINT	RESPONSE
12/11	Heather Carrol	---	Received by Health Dept.	B.B. Contacted Health Dept.
12/15	Heather Carrol	---	Received by Health Dept.	B.B. called Mrs. Carrol
12/19	Amasa Gilman	Kaupili & Kahukai St.	Rotten Egg Odor	---
12/22	Amasa Gilman	Kaupili & Kahukai St.	Terrible Sound	---
12/23	Amasa Gilman	Kaupili & Kahukai St.	Terrible Smell	Installed Telephone answering Service
2/11	Greg Pommerenk	---	H_2S & Noise	B.B. to monitor @ this residence

COMPLAINTS REGARDING
HGP-A OPERATIONS

DATE	COMPLAINANT	ADDRESS	COMPLAINT	RESPONSE
3-14*	Amasa Gilman	Kaupili & Kahukai St.	Terrible noise and smell.	Field Engineer visited 3-15; noticed slight H_2S odor.
3-14*	Unidentified		Noise and smell.	
4-14*	Warren Bennett	---	Headaches; H_2S suspected.	---

* Logged by telephone answering device.

H2S CHART REDUCTION -- Schroeders Station

From 10-1-81 to 10-31-81

JULIAN DATE / HOUR:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	AVG	MAX
274	0	0	0	0	0	0	0	0	0	0	0	*	*	*	0	0	0	0	0	0	0	0	0	0	0	1
275	0	0	0	0	0	0	0	T	0	0	*	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3
276	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
277	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
278	0	0	0	0	0	0	0	0	*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
279	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
280	0	0	0	0	0	0	0	0	0	0	0	0	*	0	0	T	0	0	0	T	T	T	6	T	2	6
281	T	T	6	6	8	6	7	T	T	T	T	T	T	T	T	T	T	T	T	**	**	**	**	**	5	8
282	**	**	**	**	**	**	**	**	**	**	**	**	**	*	T	T	T	6	8	12	10	9	9	9	8	12
283	10	8	7	8	8	7	7	8	7	7	8	6	6	7	8	9	11	9	8	9	9	8	8	8	8	11
284	9	9	8	9	10	10	11	13	12	12	13	12	10	9	9	7	7	T	6	8	7	9	7	9	9	13
285	10	11	11	10	11	13	11	10	9	*	*	*	**	**	**	**	**	**	**	**	**	**	**	**	11	13
286	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	0	0
287	**	**	**	**	**	**	**	**	**	**	**	**	**	*	*	T	T	T	0	T	T	T	T	T	4	5
288	T	T	T	T	T	T	T	T	T	T	0	0	0	0	0	0	0	0	0	0	0	T	T	T	3	5
289	T	T	T	T	T	T	T	0	0	*	T	0	0	0	0	0	T	T	T	T	T	T	T	T	3	5
290	T	T	0	T	T	T	T	T	T	T	T	T	0	T	0	0	0	T	0	T	T	T	0	0	3	5
291	0	0	0	0	0	T	T	T	0	T	T	T	T	T	T	T	T	0	T	T	T	0	0	0	3	4
292	0	0	0	0	0	0	T	T	T	T	T	*	T	0	0	0	0	0	0	0	0	0	0	0	2	4
293	0	0	0	0	0	0	0	0	T	T	T	0	T	0	0	0	0	0	0	0	0	0	0	0	2	4
294	0	0	0	T	T	0	T	0	*	*	T	T	T	0	0	0	0	0	0	0	0	0	0	0	1	4
295	0	0	0	0	0	0	0	0	0	T	T	T	0	0	0	0	0	0	0	0	0	0	0	0	1	3
296	0	0	0	0	0	0	0	*	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	1	2
297	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	0	0
298	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	0	0
299	**	**	**	**	**	**	**	**	**	**	*	7	T	6	T	T	0	0	0	0	0	T	T	T	3	7
300	0	0	0	0	T	T	T	0	T	T	T	T	T	T	T	0	0	0	0	0	0	0	0	0	2	5
301	T	0	0	T	0	0	T	*	*	*	0	**	**	*	*	**	**	**	**	**	**	**	**	**	2	3
302	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	0	0
303	**	**	**	**	**	**	**	**	**	**	**	**	**	**	*	T	T	0	0	0	T	0	T	0	2	3
304	T	T	T	0	T	T	T	T	T	T	T	T	T	0	T	6	0	0	0	0	0	0	0	0	3	6
AVE.	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	3	2	3	3	2	3	
MAX.	10	11	11	10	11	13	11	13	12	12	13	12	10	9	9	9	11	9	8	12	10	9	9	9		13

**=Power or Equip. failure: *=Calibration: 0=0,1,or2: T=3,4 or 5:

H2S CHART REDUCTION — Schroeders Station

From 1-1-82 to 1-31-82

HOUR:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	AVG	MAX
0101	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	T	0	1	3
0102	T	T	T	T	T	0	T	0	T	T	T	T	0	0	0	0	0	0	0	0	0	0	0	0	2	5
0103	0	0	0	0	T	T	T	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3
0104	T	T	T	T	T	T	T	T	T	T	T	0	0	0	0	0	0	0	0	0	0	0	T	T	2	4
0105	T	T	T	T	T	T	0	0	T	T	T	T	T	T	T	0	0	0	0	0	0	0	0	0	2	5
0106	0	0	0	T	T	T	T	T	T	T	*	*	6	T	6	7	7	8	T	T	T	T	T	7	5	8
0107	6	T	T	T	T	6	6	7	7	7	T	T	T	7	7	7	6	T	6	8	T	T	T	T	6	8
0108	7	6	T	T	T	T	T	T	T	T	*	*	0	0	T	0	0	0	0	0	T	0	0	0	3	7
0109	0	0	0	0	0	T	T	T	7	6	6	8	6	T	7	7	T	T	0	0	0	0	0	T	3	8
0110	T	T	T	T	T	T	6	7	6	7	6	6	7	6	8	6	7	6	T	T	T	T	T	T	5	8
0111	T	0	T	T	T	T	6	6	7	7	7	*	7	6	T	T	T	T	T	0	0	0	0	0	4	7
0112	0	T	T	9	8	7	T	T	T	T	T	T	6	6	8	T	0	0	0	0	0	0	0	0	4	9
0113	T	T	T	T	T	T	T	T	T	T	T	T	T	*	T	T	T	T	0	0	T	T	T	T	3	4
0114	T	6	T	T	T	T	6	6	6	6	7	7	6	T	T	T	T	T	T	6	7	6	T	0	5	7
0115	0	0	T	T	T	T	T	T	T	6	7	7	*	T	T	T	T	0	0	0	0	0	0	0	3	7
0116	0	0	T	26	24	19	9	16	27	23	16	10	9	8	7	6	T	T	T	T	T	T	T	19	11	27
0117	21	40	13	7	7	8	7	6	6	6	6	6	6	6	7	6	T	6	8	6	T	T	T	6	8	40
0118	6	T	6	8	7	6	6	8	7	7	6	6	T	*	*	7	8	11	7	T	T	T	T	T	6	11
0119	T	T	6	7	6	6	6	6	6	7	6	6	6	T	T	T	T	T	T	T	T	6	6	7	5	7
0120	**	**	**	**	**	**	**	**	**	**	**	**	**	*	*	T	T	T	T	T	T	T	6	6	5	6
0121	7	7	6	T	6	6	T	T	6	7	9	13	8	T	6	6	6	7	7	6	6	7	8	8	7	13
0122	10	8	7	7	8	6	7	7	8	8	9	*	*	9	9	8	9	20	32	11	9	10	8	8	10	32
0123	10	8	12	10	9	0	9	10	12	10	13	11	11	10	12	9	8	6	6	6	T	6	7	7	9	13
0124	8	8	8	8	8	9	10	10	11	12	12	11	12	11	10	9	8	7	7	7	8	8	8	8	9	12
0125	7	21	9	10	10	9	11	11	10	14	*	19	27	11	10	10	9	10	10	11	11	11	10	11	12	27
0126	10	11	10	10	10	10	10	11	12	11	10	9	10	10	9	9	9	8	7	8	10	11	10	10	10	12
0127	11	10	10	9	9	9	9	8	9	9	10	*	*	11	10	9	10	8	7	6	6	7	7	8	9	11
0128	9	16	9	8	8	8	9	10	10	10	11	19	12	12	10	9	10	8	7	7	6	7	9	10	10	19
0129	10	11	11	13	12	12	13	11	12	10	11	11	12	11	10	11	9	10	8	7	6	8	7	8	10	13
0130	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	0	0
0131	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	0	0
AVE.	6	7	6	7	7	6	6	7	7	7	7	8	7	6	6	5	5	5	5	4	4	5	5	5	5	
MAX.	21	40	13	26	24	19	13	16	27	23	16	19	27	12	12	11	10	20	32	11	11	11	10	19		40

**=Power or Equip. failure: *=Calibration: 0=0,1,or2: T=3,4 or 5:

Date: Month/Day

APPENDIX C

Noise Level Stations are located in reference to HGP-A Well Site.

Station #1	Rift	.5 mi.	E	of HGP-A
2	Schroeders Hill	1.1 mi.	SW	"
3	Fire Hydrant	.5 mi.	SE	"
4	Colortec #25	.6 mi.	NE	"
5	Colortec #35	.4 mi.	NW	"
6	Pomerencks	1.1 mi.	ENE	"
7	Visitors Center			on site
8	Colortec #38	.7 mi.	NNW	of HGP-A
9	Colortec #13	1.0 mi.	W	"

Noise Levels recorded during Month of October, 1981

Date	1	2	3	4	5	6	7	8	9
1981									
10-2	44 R,W6	-	43 R,W5	50	-	-	-	46R,W5	-
10-5	<35 W5	43 W5	37 P	<35	35	37 W4	53 P5	35	38 W4
10-7	42 W5	-	43 W6	40W6	-	-	51 P, W5	-	-
10-9	40	-	43	38	41	-	-	-	-
10-12	43 W6	42	35	35	36	42 W5	54 P,W6	35	<35
10-14	41 W5	-	38 W3	40W6	-	-	-	39 W4	-
10-16	39 R,W4	36	36 W2	40R,W4	38 R,W2	-	52 P,R,W4	-	-
10-19	35	37 W7	40 P,W6	<35	<35	43 W5	50 P	35	46W7
10-20*	48 TV,W6	52 TV,W4	64 TV,W5	-	54 TV,W5	-	49	41 W4	44TV,W
10-23	43 W9	-	41 W6	45W12	46 W10	-	-	-	-
10-26	45 T,W5	45W10	42 T,W5	35P	42 W5	46 W5	52 P,W7	<35	<35
10-29	38 R,W4	36R,W2	36 P,W2	-	<35	-	53 P,R,W4	37 R,W5	-
10-30	<35	-	38 W2	41D,W3	38 W4	-	-	-	-
AVERAGE	41	42	41	39	40	42	52	38	40

* N.E. corner of HGP-A had noise level of 72 db during Thermal Power venting (directly downwind).

NOTE: The symbols and/or numbers alongside the noise level readings indicate

W = Wind source - numbers indicate wind speed.
D = Drilling rig noise
T = Tractor
H = Helicoptor or Airplane
B = Birds
P = HGP-A Plant Activity
R = Rain
C = Construction Equipment
X = Craddock Operations
CT = Construction work at Thermal Drill Site
TV = Thermal Power well venting.

NOISE LEVELS DURING MONTH OF JANUARY, 1982

Noise Level Stations are located in reference to HGP-A Well Site.

Station #1	Rift	.5 mi.	E	of HGP-A
2	Schroeders Hill	1.1 mi.	SW	"
3	Fire Hydrant	.5 mi.	SE	"
4	Colortec #25	.6 mi.	NE	"
5	Colortec #35	.4 mi.	NW	"
6	Pomerencks	1.1 mi.	ENE	"
7	Visitors Center			on Site
8	Colortec #38	.7 mi.	NNW	of HGP-A
9	Colortec #13	1.0 mi.	W	"

Station Number / DATE	1	2	3	4	5	6	7	8	9
1/4	43 CT	<35	35	65 CT	<35	<35	48P	<35	35 B
1/6	<35	-	-	59 CT,W8	--	-	50P	37 W4	-
1/8	36 W4	37 W4	-	-	39 W6	-	-	35 W2	-
1/11	35 W3	<35	<35	42 CT,W2	<35	<35	51P,W2	<35	<35
1/13	37 W2	-	37 W3	-	35 W2	-	-	<35	-
1/15	38 W4	35 W3	41 T,W5	-	-	-	51P,W5	-	-
1/18	35 W2	<35 W2	<35 W2	44 CT,W3	35 W4	43 T,W2	52P,W3	<35	35 W2
1/20	-	-	46 R,W16	44 R,W15	42 R,W15	-	-	52 T,W10	-
1/22	41 R,W11	38 W10	-	-	-	-	52P,W14	-	38 W8
1/25	36 W4	<35 W4	49 R,P,W6	46 R,CT,W3	46 R,W4	50 R,W7	52P,W4	40 R,W5	35 W3
1/27	43 R,CT,W7	-	39 R,W8	-	38 W5	-	-	37 W5	-
1/29*	<35 W2	-	37 P,W3	-	35 W2	-	51P,W3	-	35 CT,T
Average	38	36	39	50	38	41	51	38	36

* Readings taken at 2300 hours.

Note: The symbols and/or numbers alongside the noise level readings indicate:

W = Wind source - numbers indicate wind speed.
D = Drilling rig noise
T = Tractor
H = Helicoptor or Airplane
X = Craddock Operations
R = Rain
P = HGP-A Plant Activity
C = Construction Equipment
CT = Construction work at Thermal Drill Site
TV = Thermal Power well venting
B = Birds

APPENDIX D

II. RECOMMENDATIONS

The following recommendations should be considered as initial pollution control guidance with respect to discharge and emission limits, pollutant monitoring, and control technology and regulatory development needs.

SUGGESTED POLLUTANT LIMITATIONS

Air Emissions

Hydrogen sulfide is the only air pollutant for which limitations are suggested at this time. Hydrogen sulfide emissions from initial demonstration facilities and existing commercial facilities should be limited to an average of no more than 10% of the loading in the raw fluid. For most electric power generation facilities it is expected that this will be equivalent to an average between 0.2 and 0.4 kilograms per megawatt-hour (MWH) of normal power generation (rated capacity X plant factor). Facilities producing raw loads less than 0.2 kg/MWH probably will not require treatment.

For non-electric uses where hydrogen sulfide may require control, limits, comparable to those suggested for power generation, are suggested to be within the range of 20 to 40 kg H_2S per million kg of steam used. The basis for such emission limitations is an economically achievable treatment level, rather than environmental effects. However, with the present state of knowledge, it is expected that the suggested emission levels will have little if any measurable environmental effect. The basis for this expectation is The Geysers experience in which the principal known problem caused by unabated emissions is an odor nuisance; a 90% reduction in emissions should essentially eliminate this problem.

Emissions of other gases and particulate materials from geothermal operations may be anticipated, although the evidence of need is currently inadequate to justify their control.

Water Discharges

Where geothermal spent liquids contain pollutants in excess of surface receiving water standards for the area, a no discharge limitation is suggested, unless the liquids are treated to meet those standards at the discharge point. Further, it is suggested that injection to the geothermal reservoir be practiced, and that it be regulated so that other usable ground water aquifers are not changed in chemical or physical properties. In cases where it is not economically feasible to return the spent fluid to the producing reservoir, such as may be the case with geopressured resources,

injection to other aquifers may be allowed if the injected fluid does not degrade those aquifers for other existing or potential uses. It is recognized that spent fluids will in most cases contain higher constituent concentrations than the originally withdrawn fluid. A concentration increase, caused by injected fluids, should be allowable in the geothermal reservoir to the extent that it does not interfere with other legitimate uses of the reservoir waters. In some cases this may require that the state (or EPA where a state declines primacy) designation of certain geothermal reservoirs for geothermal use only.

Land-Disposed Wastes

Suggested limitations for geothermal solid wastes containing hazardous materials (including fluid constituents) are containment and isolation from possible leaching to ground or surface water, or treatment of leachate to remove hazardous materials and any materials that, if discharged, would violate water quality standards.

Noise

Noise limitations should conform, as an initial minimum, to the regulations issued by the U.S. Geological Survey for geothermal operations on Federal lands; i.e. not to exceed 65 dBA at the lease boundary or one-half mile from the source, whichever is greater.

MONITORING

All air emissions, water discharges, and noise should be monitored by the operator on a periodic schedule for all pollutants having a potential harmful effect. In addition, the operator should carry out ambient monitoring at appropriate points at the boundary with other public or private property for the same pollutants, both before (baseline monitoring) and during conversion facility operation, to assure that standards are not violated and harm does not occur, especially where several facilities are co-located.

CONTROL TECHNOLOGY AND REGULATORY DEVELOPMENT NEEDS

It is recommended that all agencies and private industries concerned with geothermal research and development cooperate fully, including the free exchange of information, in developing further the pollution control and monitoring strategies and technologies described briefly herein. Detailed technical and economic analyses should be cooperatively pursued and documented.

It is recommended that increased attention be given to geothermal fluid characterization, to the determination of pollutant effects on the environment, and to the development of reliable injection technologies.

The solutions to many of the conversion technology problems should be evaluated to determine which can simultaneously provide solutions to environmental problems.

STATEMENT OF
Hideto Kono, Director
Department of Planning and Economic Development

before the

Hawaii County Planning Department Public Meeting
Pahoa High School Cafetorium
April 15, 1982

The Department of Planning and Economic Development (DPED) is very pleased with the success of the Hawaii Geothermal Project-Abbott (HGP-A) well in Puna. This project will be remembered in the history of Hawaii as an important step in the opening of a new era of energy independence and economic growth.

The State of Hawaii depends upon imported petroleum for 90 percent of the energy it consumes. This costs the State approximately $1.5 billion per year, which is equivalent to more than ten percent of the Gross State Product. The money which pays for this oil leaves the State, so it is a drain on our economy. Furthermore, being so dependent on oil, the State of Hawaii is vulnerable to disruptions in oil supplies. These disruptions could occur because of war, a decision by OPEC nations to cut back on production, or the accidental collision or sinking of oil tankers. If Hawaii is able to generate its own electricity from natural, indigenous sources, it will greatly improve the State's economy and energy security.

The dawning of every new era is attended by uncertainty, and success requires bold action. We congratulate the University of Hawaii, the County of Hawaii, and the people of the Island of Hawaii for their support toward developing what we believe is the State's largest near-term baseload electricity potential. While the capacity of the geothermal reservoir in the Puna District has not yet been established, it is reasonable to expect that the reservoir may be able to support the generation of 500 megawatts of electricity. This could account for one-third of the State's total electricity generating capacity, and could save the State $250 million in imported oil per year. By spending this money within the State, the multiplier effect could yield an estimated economic benefit of $500 million.

The State of Hawaii needs to develop new industries to replace or supplement old ones. The geothermal industry itself is expected to provide up to 900 construction jobs if 500 megawatts of generating capacity is developed. It is likely to support 300 jobs during subsequent operation. In addition, the availability of geothermal power may stimulate new local industries involving agriculture and aquaculture which will provide further jobs and expand the tax base. Part or all of the electricity could be transported to major population centers. We are studying the feasibility of a deep water electrical transmission cable, which could transmit electricity to a ready market on the Island of Oahu.

In developing a major new opportunity of this kind, the State must look to the good of all its people. We believe that geothermal development will directly or indirectly benefit all our people on all our islands. The expansion of the tax base can result in more money for necessary government services, and savings in the purchase of oil can result in a healthier statewide economy and a higher quality of life. Depending upon the desires of the citizens and government of the County of Hawaii, many of the new economic opportunities will be available here.

It is not possible to develop a major new opportunity without starting somewhere. Geothermal development in Hawaii started with the drilling of the HGP-A well. As an experimental program, there have been many problems. Project personnel have worked diligently to solve these problems. The whole point of a demonstration is to discover how to do things the right way. If that were known at the beginning, there would be no reason to have a demonstration at all.

The DPED has been concerned from the beginning about the possible negative impacts of the HGP-A well on the surrounding community. Any new development can have negative impacts, even if those impacts are only felt by a few people. The following points are very encouraging to us:

1. The plant was dedicated in July, 1981. After an 8-month shakedown period, the plant is now operating with baseload reliability, providing electricity to the Hawaii Electric Light Company grid.

2. All the major technical and engineering problems at the well have been solved or are being solved.

3. Noise produced by the well is in compliance with regulatory requirements.

4. H_2S discharges have been greatly reduced.

5. Steps are being taken to control the discharge of steam across the roadway.

The HGP-A well has undergone intensive monitoring from the very beginning. The purpose of the monitoring was to detect any immediate problems, as well as to collect data for the development of other wells in other locations. Because of the importance of environmental impacts, we are currently formulating a regional environmental baseline project to determine the natural emissions of the Kilauea volcano and rift zone. This information will be used to understand impacts as well as establish standards for future geothermal exploration and development. The goal is to assure the protection of the environment.

It is important to realize that the objectives of the HGP-A well are now within grasp. We are demonstrating that geothermal energy can produce baseload power, and that it can do so in a manner which is environmentally benign. While there have been problems, the project has progressed in a responsible manner. We are now verging on the commercialization of a resource which can have a major positive effect on all the citizens of our State. We believe this is a time for congratulation. We believe it is a time to look toward the future, to use the information obtained at the HGP-A well to work toward a more diversified economy and greater energy independence.

Thank you for the opportunity to provide these comments.