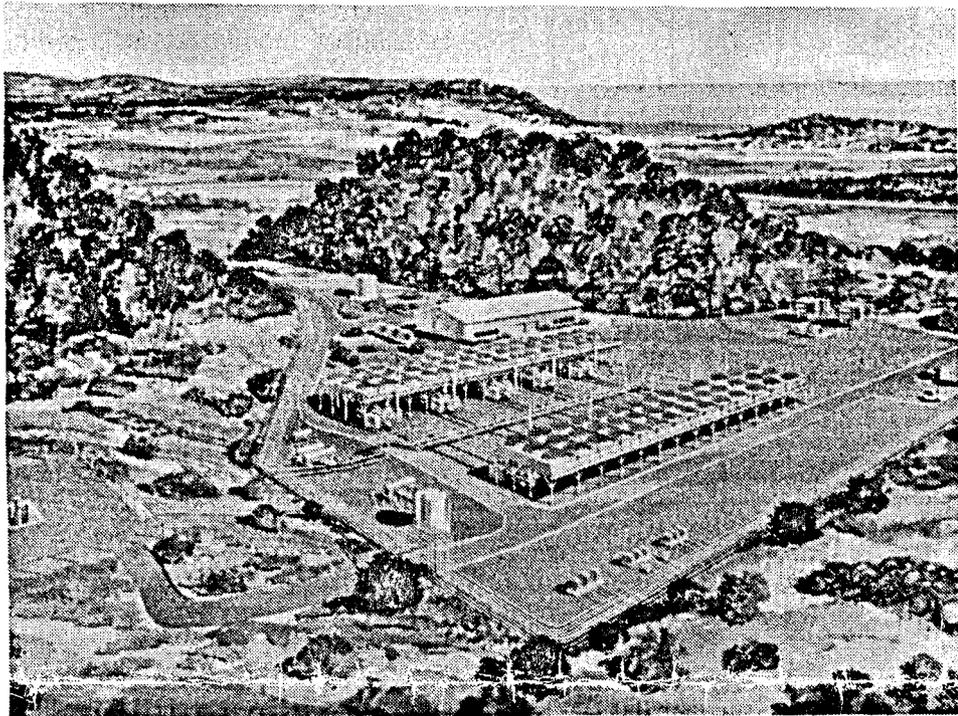


Drilling Resumption at Puna Geothermal Venture

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This sketch shows what will be Hawaii's first commercial geothermal power plant. The facility in Kapoho will deliver 25 megawatts to Hawaii Electric Light Co.

New conditions placed on PGV for start-up operations

Task force bans open venting, tightens drilling requirements, cuts emissions

After meeting the terms and conditions of a major overhaul on drilling, safety requirements and enforcement, Puna Geothermal Venture (PGV) has received permission to complete its 25-megawatt electric power plant in Kapoho.

The new criteria were issued in a Geothermal Management Plan prepared by a joint County-State task force. The plan tightens drilling requirements, improves emergency response procedures, improves emission requirements for hydrogen sulfide and noise, upgrades monitoring equipment and adds staff to ensure enforcement.

"I am advised that the new requirements add up to the stiffest set of safety controls on any geothermal facility anywhere, and that they exceed, by a significant margin, the regulations imposed on any kind of industrial plant in Hawaii," said Mayor Lorraine Inouye.

"Our first priority is to safeguard public health and safety. We are meeting this

priority with the new requirements and the commitment of more than \$1.6 million in State funds to ensure compliance."

The County suspended drilling operations at the facility in June, 1991, after an uncontrolled well blowout. Since then a County-State task force and independent consultants have developed the Geothermal Management Plan to address a wide range of concerns.

The Management Plan includes:

- a ban on the open venting of new or existing wells,
- an upgrade of the air monitoring program to meet the recommendations of independent consultants,
- a stiffening of noise controls.

To reduce future conflicts between PGV and the nearby community, County and State officials have committed to a good-faith effort to compensate or

See New Conditions page 4

\$1.6 million released to staff and equip upgraded health monitoring programs

"As you know, our experience with geothermal development on the Big Island suffered a setback last year. But we have taken sound measures to ensure the safety and health of our citizens. Satisfied, we remain determined and committed to the development of geothermal to fill the critical energy needs of the Big Island."

— Gov. John Waihee
1992 State of the State message

Gov. John Waihee has released \$1.6 million for personnel and upgraded equipment for monitoring and overseeing geothermal activities.

In addition, the State Administration has requested the Legislature set up permanent funding of about \$1.2 million annually to continue the monitoring work.

As part of the Governor's commitment, new personnel include:

- four Department of Health employees (two for air-quality and two for noise monitoring) who will staff shifts 24 hours a day during Puna Geothermal Venture (PGV) drilling. The staffers will be at the State monitoring office in the HGP-A facility next to the PGV plant.
- an air permitting engineer,
- a groundwater engineer,
- a planner to evaluate and update

emergency procedures,

- three State Department of Land and Natural Resources employees, including a geologist, technician and clerk-typist,
- a geothermal coordinator for the County of Hawaii.

In addition, the State Department of Business, Economic Development and Tourism has requested authorization to create a similar position to coordinate State activities.

While hiring is underway to fill these positions, the State has reassigned existing personnel into seven of the slots.

Regarding equipment, the Department of Health has set up four permanent monitoring stations in the PGV area to measure any hydrogen sulfide emissions. Two are to be upgraded to be in compliance with the new Geothermal Management Plan.

In addition, two portable high-grade Jerome monitors are available for use as needed.

The developer has also set up three permanent monitoring stations, bringing the total to nine hydrogen sulfide monitors.

"The PGV facility is the most closely regulated geothermal venture anywhere that we know of," said Dr. Bruce Anderson of the State Department of Health. ♦

Advisory council forms

The State Department of Health is forming an advisory committee made up of residents from communities near the Puna Geothermal Venture (PGV) plant to exchange information and discuss concerns about air quality and noise associated with geothermal development.

Health Department Clean Air Branch Chief Paul Aki, who will chair the meetings, said that community associations have selected persons to sit on the committee and that the first meeting will be scheduled within the next few weeks. Committee meetings will be held monthly.

Discussions will cover the full spectrum of air quality and noise issues. Other State health officials and Hawaii County staff also will attend. ♦

On the inside:

- Big Isle energy profile
- PGV project details
- H₂S levels addressed
- Relocation issues
- Other health concerns
- Changes in emergency plan
- Noise levels
- Complaint hot lines

New criteria set for hydrogen sulfide

Geothermal electric power plants tap natural steam or pressurized hot water inside the earth. Like other underground energy sources, such as oil or coal, natural steam contains unwanted substances.

This mixture of solids, liquids and gases, called geothermal brine, includes carbon dioxide, nitrogen, hydrogen, hydrogen sulfide and trace amounts of radon, mercury, lead and other substances.

Under normal operating conditions at PGV, both the steam and its impurities are injected back into the underground reservoir and practically nothing is emitted into the air. In the event of an upset, however, they can be released into the atmosphere.

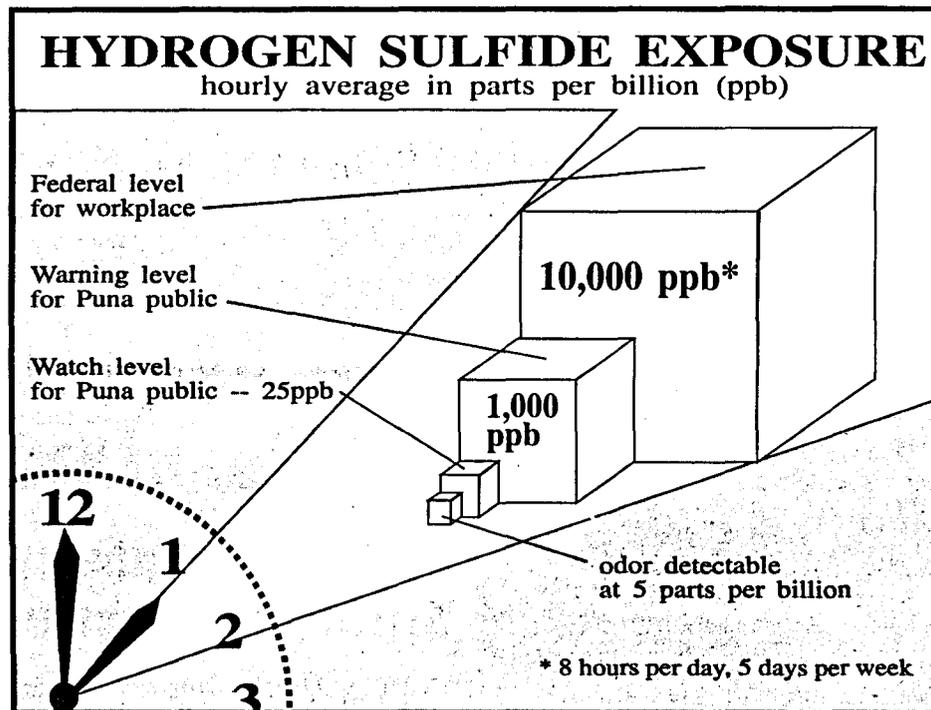
The State's aim is to prevent accidents, hence the Geothermal Management Plan, with its tightened drilling procedures, monitoring requirements and stepped-up agency enforcement.

The byproduct of greatest concern is hydrogen sulfide gas because it can be toxic in very high concentrations. Hydrogen sulfide is colorless, slightly heavier than air, and has a "rotten egg" odor.

Some people can smell it down to a level of about five parts per billion (ppb.) That concentration is equivalent to about three teaspoons of chlorine in an Olympic-size swimming pool.

Concern: Some say the state's permitted limits for hydrogen sulfide are not tough enough; they say some sensitive people, particularly asthmatics and the very young, would have negative reactions at any level. Others say the standards are too stringent, citing communities elsewhere which are exposed to these levels from natural sources without adverse effects.

Response: The Department of Health has set limits of 25 ppb averaged over one hour, which is the same as California's standard, and 10 ppb averaged over 24 hours, after reviewing all the information available about hydrogen sulfide. While you can smell it at levels of 5 ppb, and while



it can cause an odor nuisance at 25 ppb, H₂S is not likely to cause physical health effects at these levels. They were set to prevent odor nuisance problems.

Toxicologists and other experts inside and outside government say the first physical effects have been observed in people when H₂S reaches 10,000 ppb. Exposure to this level of H₂S over an hour or more can cause temporary eye and nose irritation for some persons.

The U.S. Occupational Safety and Health Administration (OSHA) has set an H₂S standard for workers at 10,000 ppb for eight hours per day. That means workers are allowed to be exposed to levels of H₂S all day, five days a week.

At 50,000 ppb, H₂S exposure can cause marked irritation to the eyes and respiratory tract. Higher levels cause more severe respiratory distress.

By setting limits of 25 ppb for one hour and 10 ppb for 24 hours, the State has taken

a conservative approach. The DOH considers the odor of hydrogen sulfide at 25 ppb a serious nuisance and wishes to protect the public from nuisance that affects a person's sense of well-being.

Concern: Can exposure to levels of H₂S below 25 ppb cause lasting problems?

Response: To date, the bulk of scientific evidence does not support the view that H₂S causes chronic long term effects.

Concern: What happens if a geothermal incident sends levels of H₂S greater than 25 ppb into the air?

Response: State health officials have imposed one-hour criteria which require a public watch at 25 ppb, and a public warning at 1,000 ppb. In addition, County Civil Defense has the authority to issue an evacuation order immediately, without waiting an hour to see if the emissions reach these levels.

Concern: Will evacuation procedures prevent people from receiving excessive

exposure to H₂S?

Response: Before the uncontrolled venting at PGV last June, criteria had called for a Civil Defense alert when H₂S reached 100 ppb, a Civil Defense warning at 1,000 ppb and an evacuation at 10,000 ppb. State health officials have simplified and lowered the action levels; PGV has adopted them in its Emergency Response Plan.

The new criteria of 25 ppb for an alert and 1,000 ppb for a warning are four to ten times more stringent than before.

Using computer modeling, scientists have projected various accident scenarios at the PGV facility. In that modeling, the maximum accidental exposure level for one hour under worst-case conditions might be 12,786 ppb at a distance of about a quarter-mile (0.4 kilometer.) That is about the distance to the nearest residence.

New requirements:

Hydrogen sulfide level	Civil Defense response
25 ppb	go on watch
1,000 ppb to public	warning level
any level	evacuation when deemed advisable by Civil Defense

Previous requirements:

100 ppb	go on alert, "serious nuisance"
1,000 ppb	warning level to public
10,000 ppb	evacuation of affected public. ♦

Copies of this information tabloid may be obtained:

In Hilo
Office of Information & Complaints
County of Hawaii
25 Aupuni Street • Hilo, Hawaii 96720
Phone: 961-8223

Governor's Office of Information
75 Aupuni Street • Hilo, Hawaii 96720
Phone: 933-4299

in Kona
West Hawaii Services • County of Hawaii
75-5706 Kuakini Highway, Suite 103
Kailua-Kona, Hawaii 96740
Phone: 329-5226

Governor's Office of Information
75-5706 Kuakini Highway, Suite 112
Kailua-Kona, Hawaii 96740
Phone: 329-9066

and in Honolulu
DBED Library
220 S. King Street, 4th Floor
Honolulu, Hawaii 96813

- a land exchange program in which the State would explore the availability of non-ceded State-owned lands,
- a transfer of development rights, or TDR's, where owners could transfer development rights to a designated receiving area in lieu of building residences on their present property.

For resident owners who elect to retain their present properties, various compensation options are under study. These include direct monthly compensation linked to average residential electricity bills in the County of Hawaii and real property tax relief.

After further preliminary development, the initiatives will undergo a process of public review and comment and would require County or State legislation or agency rules. ♦

Ways sought to reduce conflicts

Relocation, compensation options undergo review for nearby Puna area

County and State officials are working on several concepts to provide relocation or compensation opportunities for nearby residents of the Puna Geothermal (PGV) facility.

The various proposals reflect a recognition by officials that a community conflict with PGV must be addressed and that despite safety and health regulations, there may be some nuisance effects the nearer one resides to the development.

Options now being drafted seek to provide residents and property owners an opportunity to relocate without incurring

economic loss, or to receive some compensation if they choose to remain.

For nearby residents wishing to relocate temporarily during drilling operations, proposed rules for the County of Hawaii's Geothermal Asset Fund may allow compensation to be paid.

For affected owner-occupants who may wish to relocate permanently, options under study include:

- a proposal at the Legislature by State Senator Richard Matsuura for a buy-out plan with the State guaranteeing a fair market price,

Evaluation of radon turns up no problem, health officer says

State health officials have reevaluated the possible health hazards associated with exposure to natural constituents in geothermal emissions. These include radon, mercury, lead and other substances found in geothermal wells in Kapoho and other areas.

During normal power plant operations at Puna Geothermal Venture (PGV), all geothermal gases and fluids will be reinjected back into the ground where they originated. Since there are practically no emissions, there is no hazard associated with normal operations.

However, health officials are concerned about unplanned releases, which are addressed in the Emergency Response Plan. Plans are in place to assure that the public is protected from potential hazards should an upset condition occur.

Reevaluation

"Hydrogen sulfide (H₂S) is still the most important public health concern associated with geothermal development in Hawaii," said Bruce Anderson, Ph.D., deputy director for environmental health. "Based on a thorough reevaluation of existing data by our toxicologist and consultants, we do not anticipate an unacceptable health threat to nearby residents."

Dr. Anderson continued, "To be sure that we have good data to reevaluate hazards in the future, geothermal developers will be required to run periodic tests. Additional measurements will begin as soon as PGV resumes drilling and flow testing."

Scientists have carried out tests on radon in particular for years along the rift zone where the PGV plant is located. Radon is a radioactive gas found naturally in the air, ground and in groundwater. Exposure to high levels over a long period of time has been associated with an increased risk of lung cancer.

Homeowner exposure

On the Mainland, where radon is more of a problem, the U.S. Environmental Protection Agency says a homeowner should avoid an exposure of four or more picocuries per cubic liter in the house, based on 24 hours a day over 70 years.

In Hawaii, where homes are built with more natural ventilation and fewer weather-proofing materials, the average, sustained level of radon in homes is less than one picocurie.

After a PGV well blowout in June, 1991, State health officials ordered PGV to do an in-depth study on all other contaminants, then linked those results to worst-case accident scenarios recently developed for the PGV plant.

H₂S serves as a reliable yardstick for overall safety because other contaminants found with it are proportionally much smaller. "We are confident that protecting for H₂S will also protect against other potential hazards, including radon," Dr. Anderson said.

"Radon is indeed in geothermal emissions and long-term exposure, over a lifetime, would be unacceptable. However, the short-term exposures that would possibly result from an unplanned steam release would not significantly increase risk."

Underground steam

State health officials said the precise amount of radioactive radon in Puna's underground steam is uncertain, but agree with PGV geochemical consultant Paul Hertz that the numbers are most likely less than 2 picocuries per cubic liter of uncondensed steam.

It is because more precise numbers have not yet been pinned down for new wells that the Department of Health will require developers to carry out well-specific testing. ♦

How the revised Emergency Response Plan operates

As one of the conditions for Puna Geothermal Venture (PGV) to resume operations, the joint County-State task force has required the plant to upgrade its Emergency Response Plan (ERP).

In the event of an accident, the Hawaii County Civil Defense Agency will determine whether to issue a watch or a warning notice to the surrounding community.

The key for Civil Defense authorities to decide whether to take action is based on the projected exposure of nearby residents to hydrogen sulfide (H₂S) emissions from an accident at the PGV plant.

The basic principle is that Civil Defense will issue an alert, or a warning, to the public depending on the possible exposure level to H₂S emissions caused by an accident. Civil Defense may also issue an evacuation notice at any time.

In order to help Civil Defense to determine those possible exposure levels, the plant's ERP spells out 12 accident scenarios based on computer modeling.

The 12 scenarios cover the range of situations where outside consultants and State health officials believe that contaminants could be released into the air

What is the newly revised Emergency Response Plan?

Part of the Geothermal Management Plan prepared by a joint County-State task force has required improvements in the emergency response plan for Puna Geothermal Venture (PGV) to better respond to conditions which may threaten the health, safety or welfare of employees and nearby residents.

The County suspended drilling operations last June shortly after an uncontrolled, 30-hour well blowout.

The Geothermal Management Plan requires more monitoring equipment and staff. The plan has reduced the levels of allowable hydrogen sulfide (H₂S) emissions and noise, and has set up two levels for action by Civil Defense authorities to replace a previous three-tiered plan.

All decisions about notifying nearby residents of emergencies at the plant, and evacuating them if necessary, will rest with the Hawaii County Civil Defense Agency and the Department of Health.

In this regard, any uncertainties will be resolved in favor of protecting public health and safety.

Among other matters, the ERP:

- spells out procedures to identify and notify all residents within the affected area of possible emergencies and warnings,
- describes potential problems and gives technical data on the nature of them,
- identifies how the wells and plant facilities

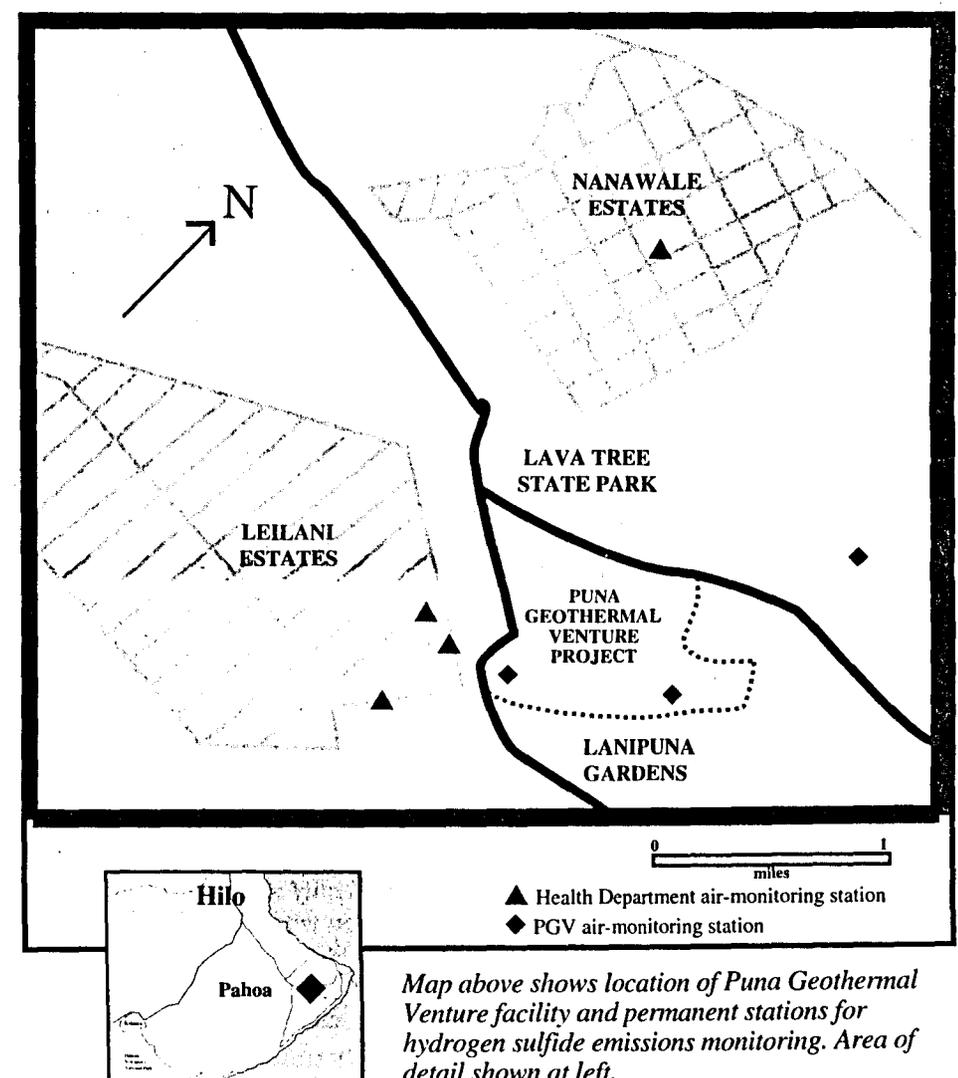
are inspected and monitored to prevent emergency situations,

- describes the warning and monitoring systems in place to alert personnel and the nearby community about an accident,
- explains training requirements for plant personnel, including shutting down the plant, handling emergency equipment, spill prevention, first aid and rescue, fire fighting and evacuation,
- details procedures PGV will follow to coordinate with county, state and federal personnel during and after an emergency,
- requires frequent, unannounced emergency preparedness drills for personnel,
- addresses responses, notices and procedures in the event of natural hazards such as lava flows, earthquakes and storms.

For PGV employees, the ERP requires at least three persons trained in handling hydrogen sulfide (H₂S) emergencies to be present during drilling work shifts.

It also requires, before the start of operations, training by a certified H₂S safety instructor for all drill workers and contractors.

The ERP requires PGV's drilling superintendent to be certified in H₂S safety, and for the superintendent to carry out one or more unannounced emergency response drills monthly. ♦



Map above shows location of Puna Geothermal Venture facility and permanent stations for hydrogen sulfide emissions monitoring. Area of detail shown at left.

See How ERP works page 4

Why is the power plant important?

The Island of Hawaii's total electric generating capacity is 160 megawatts. The electric utility is relying on PGV to add another 25 megawatts in the next month or two — roughly enough to service 25,000 households. That will boost capacity by about 15 percent to meet demand and ease rolling brownouts and blackouts which now occur when other power plants either break down or are closed for maintenance.

In the bigger picture, PGV will help reduce the Big Island's dependence on imported oil to generate electricity. All power plants require a source of energy. The most common source for the island today is oil, providing 73 percent of Hawaii Island's electricity.

Oil deposits do not exist anywhere in Hawaii. All oil used here is imported from the West Coast or Indonesia. Those supplies will become less available during the 1990's and at some point, probably in this decade, Hawaii may have to begin importing oil from the Middle East.

Oil is an international commodity. Its price and supply fluctuate greatly according to real or perceived shortages in its production and delivery, whether caused by natural or man-made disasters or by political strife.

The more a community relies on oil for electricity, the more external events affect its price and supply. Yet the reliable production of electricity at stable and reasonable rates is essential, not optional, for an orderly, healthy economy.

What is the PGV project?

The Puna Geothermal Venture (PGV) project is an electrical power plant that will generate 25 megawatts of electricity for use on the Island of Hawaii. It is the Big Island's first commercial geothermal plant. No other electricity is generated from geothermal energy in the state at this time. PGV, a partnership of OESI Power Corporation and Constellation Energy, Inc., will sell the power to the Hawaii Electric Light Company.

The PGV plant is located about 21 miles southeast of Hilo in a rural area of the Puna district near Lava Tree State Park. There are about sixty houses within a 2/3-mile perimeter of the project, in the sub-divisions of Lanipuna Gardens, Leilani Estates and Nanawale Estates. The nearest residents are about a quarter-mile from the project.

PGV's facilities occupy about 45 surface acres on a 500-acre project site in the Kapoho section of Puna. The site is within a Geothermal Resource Subzone established in 1984. County and State agencies issued the required permits to PGV in 1989, construction began in 1990, and the plant is nearly completed. ♦

Given the problems of oil prices and supplies since the 1970's, all levels of government around the world have moved to reduce their use of oil for electricity. For example, ten years ago California relied on oil for about 50 percent of its electricity and decided such reliance posed an unacceptable risk.

California turned to alternate energy sources and oil here today provides just six percent of its electricity. By comparison, the new PGV plant will push the Big Island's present oil dependence of 73 percent down to 50 percent — to where California was a decade ago.

Critics of the plant say that it will not reduce overall oil imports to Hawaii because refineries on Oahu still must bring in about the same amount of crude oil and distill it into lighter jet fuels, gasoline and diesel for transportation.

While debate continues on total oil imports, the PGV plant will most definitely reduce the Big Island's dependence on oil to generate electricity. The island will become more independent from oil for electricity because PGV's energy source is the local steam reservoir within the earth at Kapoho.

The PGV plant has drawn criticism because of hydrogen sulfide emissions and other contaminants in the event of some kinds of accidents. There are, however, major environmental gains which cannot be discounted. Each year, the plant will eliminate 173,000 tons of carbon dioxide that a comparable oil-fired plant would put into the atmosphere. The plant will also reduce oil shipments into Hilo Bay by 450,000 barrels a year. ♦

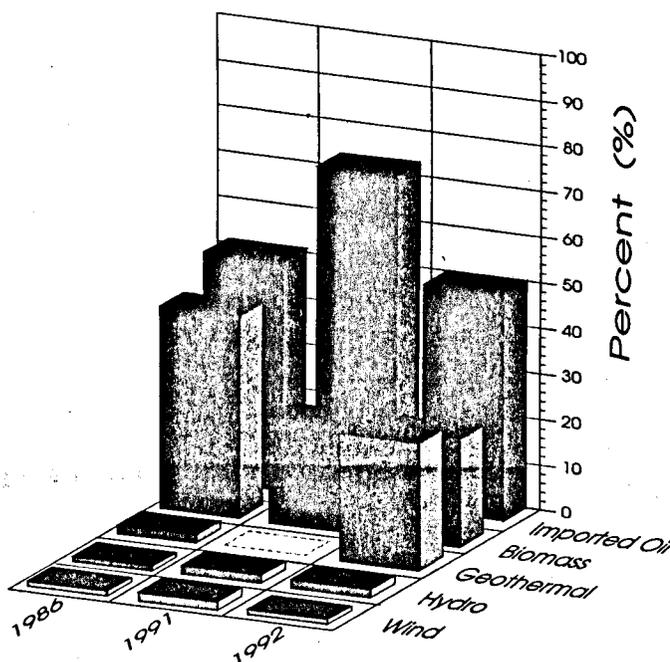
...new conditions

Continued from page 1

relocate residents near the plant who may wish to move.

The present physical size of the plant and well field will be limited to 45 acres of surface disturbance.

If Civil Defense issues an evacuation notice, PGV has agreed to pay up to \$200 per day per family and \$150 per day for business owners who live within 3,500 feet of the project. PGV has also agreed to enter arbitration for any residents beyond 3,500 feet who may submit claims. ♦



Energy sources for electricity for island of Hawaii, with 1992 extrapolation.

Graphic concept courtesy of Hawaiian Electric Co.

...how ERP works

Continued from page 3

from any of PGV's wells, its power plant or other facilities.

The scenarios include worst cases, both singly and in those combinations which experts deem possible.

The County has required PGV to set up two new criteria, or action levels, for Civil Defense to determine whether an accident requires a response.

The new levels replace an earlier three-tiered emergency response plan. They also now follow standard Civil Defense terms instead of State Health Department terms.

The first new action level will help Civil Defense decide whether to issue a watch if hydrogen sulfide (H₂S) emissions reach 25 parts per billion (ppb). The second action level will help Civil Defense determine whether to issue a warning. This action level is based on scenarios where H₂S can reach 1,000 ppb (or one part per million).

The 12 scenarios assume that H₂S emissions will be sustained at 25 or 1,000 ppb over a period of one hour.

The revised ERP allows Civil Defense to issue a watch or a warning notice right away, without waiting 60 minutes, and without waiting for results from monitoring equipment, no matter what the accident scenarios project.

PGV's emergency response procedures assign each of the 12 scenarios an automatic Type One (watch) or Type Two (warning) designation. PGV employees must relate an upset condition to one of the 12 scenarios and immediately notify Civil Defense that it is a Type One or Type Two emergency. ♦

Copies of the Geothermal Management Plan and the Emergency Response Plan are available for public inspection at the addresses listed on page 2.

Noise levels vary

Noise levels from Puna Geothermal Venture, as heard at the boundary of the property, are limited to 55 decibels during the day and 45 decibels at night during drilling or other regular operations.

One drilling site, wellpad E, is limited to 47 decibels at night.

Noise from the power plant is limited to 53 decibels during the day and 44 at night at the property line. These limits are intended to protect nearby residents from noise nuisance associated with geothermal development activities. They will be monitored 24 hours a day by DOH staff.

The workplace limit set by the Occupational Safety and Health Administration is 90 decibels for an eight-hour day. ♦

Common questions

Q: Does the facility pose a risk to public health and safety?

A: Stringent controls have been placed on drilling and plant operations to eliminate as much risk as possible. In an unlikely worst-case situation, residents would be evacuated to avoid exposure to health nuisances or hazards.

Q: Will air and noise monitoring equipment be in place before drilling resumes?

A: Yes. In addition, new equipment will be added later. Monitoring procedures will continue to be updated and improved as needed.

Q: Will criteria for PGV be used for other geothermal developers?

A: Geothermal sites have different terrain, meteorological conditions and other considerations. Sites may need different criteria to ensure safe operations. PGV's criteria may prove helpful to regulate future projects. ♦

For inquiries or complaints

A geothermal hot line telephone number is set up on the Island of Hawaii for the public to call with an inquiry or complaint at any time, any day, if they believe there is an emergency at the power plant.

The State Department of Health staffs this number: **933-4683**. A health official on standby will handle the inquiry or complaint related to air and noise quality as soon as possible and usually within an hour after the complaint.

In the event of an unplanned release of hydrogen sulfide, PGV must immediately notify Civil Defense authorities, who may then notify the public. ♦