Tapping into a subterranean furnace

Elsewhere in the world, pace of geothermal development accelerates

Second of four parts

By Jim Borg 5/14/90
Advertiser Science Writer

Don Thomas enjoys getting into hot water.

A research geochemist with the University of Hawaii, Thomas has studied the lava-rock bowels and subterranean caldrons of Kilauea Volcano since 1972.

Testifying in an unofficial capacity before the Legislature last month, he was clearly annoyed.

At issue was a resolution calling for a deceleration in the state's plans for development of geothermal wells and power plants on the Big Island.

"It is difficult for me to conceive how geothermal development in Hawaii could be much slower without a complete halt and abandonment of the program," Thomas said.

"In the nearly 15 years since the geothermal resource was discovered on the Kilauea East Rift Zone, we have managed to develop one 3-megawatt demonstration power plant," he said. "During this same period, California has added approximately 800 megawatts in The Geysers field and more than 100 megawatts in the Salton Sea . . .

"The Philippines have developed more than 800 megawatts in fields that were identified after that on the East Rift Zone in an even shorter time period."

Thomas was right that geothermal development has been slow here, but in most areas the pace is picking up.

Hawaiian Electric Co., facing a December deadline, is negotiating in private with two competing groups of companies that have offered proposals for a state-backed 500-megawatt geothermal project. The power would be carried from the Puna District to Honolulu by an undersea transmission cable, the deepest in the world, beginning in 1995.

Former Gov. William Quinn, chairman of Gov. John Waihee's geothermal advisory board, has called it "far and away the largest project ever contemplated in the state of Hawaii."

Meanwhile, after long delays from legal challenges and contested permits, two smaller geothermal enterprises are figuratively, if not literally, gathering steam.

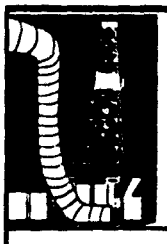
One partnership, True/Mid-Pacific, has completed its first well in the Puna rain forest, while the second company, Ormat Energy Systems, known as Puna Geothermal Venture, although still without a well, has promised to deliver 7 to 10 megawatts to Hawaii Electric Light Co. by year's end.

Opponents of geothermal power here have been eager to point out that steam production at The Geysers in northern California has declined unexpectedly over the last three years.

But scientists agree the geology of the two fields is completely different.

While The Geysers is a tightly enclosed subterranean sandstone reservoir containing almost pure steam,

See Geothermal, Page A4



KILAUEA RIFT:
The Geothermal Power Struggle

Today: To tap a deep caldron
On Page A3:
120,000 leagues under the sea
Losing steam at the Geysers

Tomorrow in The Advertiser:
Fumes of burning stone
Lake County's growing pains

Wednesday in The Advertiser:
In the ahupua'a
High tech in the high desert
Invasion of the mud volcanoes

5/14/90

Geothermal: Development pace is issue

FROM PAGE ONE

Kilauea, they say, is built on permeable lava-rock formations through which hot water circulates quickly and is replenished easily by rain.

"Virtually every water-dominated geothermal system has recharge," says Thomas. "It has to."

This rapid circulation has led some critics to suggest that seawater or rainwater would effectively dissipate the heat. Anti-geothermal groups also point to a drop in production at the state's defunct HGP-A geothermal plant, from 3 megawatts to 2.4 megawatts over its lifetime.

"The claim that seawater will lead to quenching of geothermal wells is speculation that is unsupported by eight years of production of fluids from the HGP-A well, during which time the temperature of the fluids remained virtually constant and the chemistry indicated no appreciable cooling in the vicinity of the well bore," Thomas responded.

"Individual wells may have a finite lifetime — 10 years, 20 years or longer, depending on the nature of the resource," he said. "To declare the resource as being non-renewable because wells have to be replaced is the same as saying that solar is non-renewable because solar cells have to be replaced periodically."

Based on scientific test drilling, Thomas estimates that Kilauea's geothermal zone holds the equivalent of 1,400 megawatts of electricity.

By geothermal or "earth heat" energy, scientists mean the underground soup of water and minerals that magma creates in two basic forms:

- dry steam — that is, nearly all steam with no water.
- superheated water, which may have a temperature of nearly 700 degrees Fahrenheit — well above its normal boiling point of 212 degrees — because of the immense gravitational pressure exerted by the rock and water above.

Although the flanks of Kilauea are believed to house some dry steam, the prime resource is believed to be brackish water that lies about a mile below sea level. Tapping these reservoirs can produce energy in a variety of ways.

Dry steam is pumped more or less directly into a generating turbine, which is tailored to the specific pressures and temperatures of the resource.

In a so-called "flash steam" power plant, hot water is brought to the surface

Don Thomas
Says Hawaii is snoozing

by pipes and fed into a container called a separator, where steam rises from the water or brine. The brine is pumped back into the ground through an injector well. (The troublesome HGP-A plant put the brine into holding ponds.)

The steam goes to the generating turbine, then is condensed and also reinjected. The cooling tower emits air and water vapor.

So-called non-condensable gases — hydrogen sulfide, chiefly — are either scrubbed out during the cooling process or, in the case of California's Coso Geothermal Project, reinjected into the ground.

In a "double flash" plant, steam is separated from the brine a second time at a lower pressure.

In a binary cycle plant, a less efficient and more expensive system, the hot water passes though a heat exchanger, then back into the ground. The heat is picked up by another fluid, commonly isobutane, which turns a turbine as part of a closed cycle.

Unlike HGP-A, modern geothermal plants have turbine-bypass systems that run the steam through the normal abatement systems when the turbine, for one reason or another, must be shut down.

What about the integrity of the well pipes? Could they crack open during earthquakes, spewing brackish, chemical-laden geothermal brine into fresh ground water?

Could the reinjection process cause its own ruptures?

HGP-A's steel well pipes, separated from the surrounding earth by concrete, sustained earthquakes of 6.1 and 6.6 magnitude without cracking, Thomas says. Those natural quakes are far larger than any disturbances generated by reinjection, he adds.

Second, breaks in well pipes can be detected and repaired.

Third, the ground water along Kilauea's East Rift Zone is naturally salty and warm.

"You have to recognize that groundwater in that area is not considered to be potable," Thomas said in an interview. "It has natural geothermal discharge in it."

The Hawaii Legislature this month approved $3 million for research drilling and assessment of the Puna area's geothermal resources to determine if and where 500 megawatts of geothermal energy exists.

The research, conducted through a series of UH "scientific observation holes," received $2.6 million this fiscal year.

Along with the size, extent, temperature and composition of Kilauea's geothermal fluids, the question of cost remains troublesome.

Estimates have ranged from $1.7 billion from HECO and the state to $4 billion from Mainland consultants hired by anti-geothermal camps. Thomas says the costs will "remain speculative" until many more wells have been drilled.

But some critics have already heard enough.

"In all my years of experience, I have never seen the development of a major generation plant treated in such a cavalier and unplanned manner as this geothermal project," says Maui resident James Williamson, a former Seattle civil engineer, now retired, who is familiar with geothermal plants in California and Iceland. "When I first became aware of this 500-megawatt geothermal installation in the most active volcano in the world — and an unprecedented high-voltage submarine cable to Oahu, I did not believe it to be a serious proposal.

"Inherently it has to be more expensive than conventional oil- or coal-fired generation," says Williamson. "And there is no question that its environmental impacts will be far greater."

Tomorrow in The Advertiser: The Sound and the Sulfur