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Dear Tak:

As a result of our meetings with you, some of the Department of Health staff, the other developers and Hawaiian Electric staff, we have put together some comments from the Puna Geothermal Venture related to the informal draft for geothermal air emission rules distributed several months ago through the Geothermal Advisory Committee.

I have been slow to gather these comments, for which I apologize, but I can assure you it is not because we lack interest in seeing some reasonable rules to guide the development of geothermal electricity. With the new year well under way, I would like to see the hearings on the rule changes, which were discussed last fall, begin in earnest so that the new rules can be adopted.

The comments below deal primarily with the Dames & Moore report and its relationship to the rulemaking process. I hope you find them useful, and that you will pass them on to the Department of Health.

It is our understanding that the report by Dames and Moore entitled, "Evaluation of BACT and Air Quality Impact of Potential Development in Hawaii," EPA contract 68-02-3508, served as the primary basis for the air quality regulations governing geothermal development being proposed by the State of Hawaii Department of Health. A review of this report by Thermal Power Company, and its consultants, Bechtel Group Inc., (summarized in Attachment A) indicates that the report is generally well done and internally consistent.

The stated objectives of the report were to: 1) predict the most probable geothermal development scenario in the Puna District of Hawaii County; 2) provide information regarding emission control technology applicable to this scenario that could be used to determine Best Available Control Technology (BACT); and 3) estimate ambient air quality impacts resulting from the predicted development. The focus of the report was not the establishment of a fixed H_2S emission standard per se.

The report approaches the objectives above based upon a single set of assumptions regarding resource chemistry, while acknowledging that "...little information is available on the geothermal resource in Hawaii," and that "...changing the assumptions regarding the geothermal resources in Hawaii could impact the ...recommended emission control systems and subsequent H_2S emission rates." The air quality analysis is based only on the Puna District of Hawaii and

does not address the implications of geothermal development in parts of the State outside the Puna District. Thus, the report's conclusion that "the most cost effective, efficient and demonstrated method to control H_2S emissions is the combined Stretford, HPCC secondary system" can apply only to the set of assumptions regarding geothermal resources chemistry that are given in the report. Additionally, it should be realized that the report's statement that the "overall efficiency of this combination should achieve 98.6% control" can only apply to the single set of resource assumptions made in the report. Even if it were concluded through detailed analyses that BACT for a given different set of resource conditions were the same combined Stretford, HPCC system technology, the overall efficiency of abatement achievable by this combination of abatement techniques might be significantly higher or significantly lower than the 98.6% calculated by Dames and Moore for the assumptions used in the report.

Our experience in California in The Geysers, plus calculations for that area (Attachment B) also indicate that the H_2S abatement system performance and economic analyses in the Dames and Moore report are based on questionable numbers. The estimated cost of the Stretford system in Table 7.0-9 is equivalent to approximately $1.2 million. We have received quotes from three vendors for a similar system that ranged from $3.0 to $3.7 million, excluding foundations, site work, and connecting utilities. Review of the enclosed paper by Pacific Gas and Electric (PG&E) (Attachment C), and recent filings with the California Energy Commission by PG&E and others indicates that the cost for the Stretford system is considerably higher than that indicated by Dames and Moore. Changes in cost assumptions would alter the judgements made by Dames and Moore regarding the appropriate technology representing BACT.

Further, the partitioning values identified in the Dames and Moore report for recent PG&E units appear to be overly optimistic. The report notes that the latest PG&E units are achieving up to 95% partitioning. But, in recent communication with PG&E's Department of Engineering Research, we learned that these plants generally operate in the 80% to 90% partitioning range rather than the 90% to 95% range.

Lastly, the Dames & Moore report does not evaluate the impact of a given emission rate on ambient air quality at potential geothermal project sites. No attempt is made to tie the cost of achieving a given level of control to its corresponding impact upon the environment. Without evaluating the cost of the system as related to the corresponding environmental impact, a 98% standard could make a geothermal power plant economically infeasible, while achieving little in terms of incremental improvement of the environmental quality at a given site. Or, for a different set of resource conditions, 98% abatement might not be a sufficiently high level of control to protect the ambient environment at the desired level, while the incremental cost of achieving additional environmental protection might be reasonable.

We thus believe that, rather than requiring a fixed abatement percentage or a fixed emission rate for all projects, the proper regulatory approach at the early stages of geothermal development, when little resource data is available, is to require BACT. There are tremendous uncertainties associated with development of new geothermal resources. These uncertainties include:

- **Resource chemistry**
- **Anticipated levels of partitioning of noncondensible gases in the condenser**
- **The effect of a given emission rate on ambient air quality at different locations**
- The cost of alternative abatement technologies for different design emission rates

These uncertainties argue against a fixed emission limit or percentage abatement standard, especially for geothermal fields such as Puna where little data regarding resource chemistry is available. We believe that the resource uncertainties must be addressed on a site-by-site basis with site-specific BACT analyses.

As indicated by the Dames and Moore report, page 7-1, "...The determination of BACT is made on a case-by-case basis. Individual projects having different energy, environmental and economic impacts can have different emission control technologies defined as BACT. In addition, BACT will change with time as more emission control data becomes available." As a result, a requirement for projects in Hawaii to use BACT would ensure that project developers use the most up-to-date and most cost effective emission control technologies available as each new project is proposed. In addition, the proposed maximum allowable increase in H_2S concentration in the ambient air of 25 ppb above natural background level would ensure that the ambient air quality is protected to the extent deemed appropriate by the Department of Health. A point that may not be clear is that a BACT requirement will probably provide tighter emission control than a fixed percentage emission rate (lb/hr) requirement under some circumstances. For instance, a requirement of 98% abatement has very high economic cost in example 2 in Attachment B, since partitioning is 80%. Under these circumstances, the 98% level of control is difficult to justify economically and more stringent control requirements would most certainly make projects uneconomical. However, if no ammonia were present in the geothermal resource, 99% partitioning might be achieved rather than 80% and no secondary abatement would be required. The total H_2S abatement costs would be significantly less than for 80% partitioning since Stretford system costs would change relatively little. The overall plant emission rate would be 13 lb/hr. If BACT were required for a project utilizing such a resource, an assessment of the

impacts of the 13 lb/hr emission versus the costs of reducing this emission rate would be required and a lower emission rate (e.g., higher than 98% abatement) might be required.

One additional area of concern is that BACT analysis under a different set of circumstances may show that technological and economic limitations result in an emission control requirement that provides both a low percentage abatement and a relatively high emissions rate. However, because the project could not receive permits to operate under the proposed rules, if it caused the ambient air quality emission increment of 25 ppb to be exceeded, the scenario of the abatement and relatively high emissions rate would not occur. Thus, BACT provides a more rational basis for protecting the environment than a fixed percentage abatement requirement.

I must apologive for being tardy in getting this information, and our comments to you; a great many other tasks have interfered. We remain vitally interested in the proposed air quality standards and would hope that the DOH can proceed to hold public hearings, and adopt the rules, in the very near future. If I can be any help in the matter, please give me a call.

Sincerely yours,

Ralph A. Patterson

RAP/crn

attachments

cc: R. T. Pittenger
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