

**PUNA GEOTHERMAL VENTURE'S
RESPONSE TO THE INDEPENDENT TECHNICAL REPORTS
ELEMENTS I, II AND III (PARTS I AND II)**

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SUMMARY

Puna Geothermal Venture (PGV) has reviewed each of the four Element Reports prepared under the State of Hawaii Geothermal Action Plan for the PGV KS-8 geothermal well uncontrolled flow event. The following is an executive summary of PGV comments and responses to the four reports.

PGV agrees with the conclusion of the Element I Report ("Independent Technical Investigation of the Puna Geothermal Venture Unplanned Steam Release, June 12 and 13, 1991, Puna, Hawaii") that the geothermal resource encountered in the KS-8 well, although quite hot, is manageable through the use of modern well drilling and production technology. Further, PGV generally accepts the recommendations of the Element I Report. Attachment 1 of the Element I Report contains a discussion of the actions already taken, or planned to be taken, in response to these recommendations and the results of PGV's own internal investigation. ~~However, PGV believes that none of the Element I Report findings or recommended equipment or procedural changes would have prevented the kick of well KS-8.~~

~~PGV does not agree with the Element I Report that the KS-8 well uncontrolled flow event occurred because of inadequacies in PGV's drilling plan and procedures.~~ PGV believes that it occurred because the drilling encountered a high temperature and high pressure geothermal resource at a depth that was more shallow than anticipated. PGV's previous experiences with the KS-7 well caused PGV to make significant changes to the drilling program implemented for KS-8, and the KS-8 well drilling program was prepared to handle any resource of similar characteristics. However, the temperatures and pressures of the geothermal resource encountered by the KS-8 well were substantially higher than those encountered in the KS-7 well.

PGV concurs that there were a number of indicators preceding the KS-8 "kick" (defined by the Element I Report as "the intrusion of formation liquids or gas into a well bore which results in an increase in pit volume which, without corrective measures, can result in an uncontrolled flow from the well") and "uncontrolled flow event" (defined as "the uncontrolled flow of well fluids and/or well fluids from the well bore to the surface, or into lower-pressured subsurface zones") which could have led PGV to make certain decisions which would have substantially reduced the possibility that the KS-8 well kick would have turned into an uncontrolled flow event. However, there were also a significant number of additional indicators which led PGV to evaluate the situation differently.

PGV concurs with the Element I Report that the kick resulted from the drill bit encountering a substantially over-pressured geothermal resource, with bottom hole pressures sufficient to lift the entire column of moderately weighted drilling mud. However, PGV believes that all currently available information demonstrates that the kick, and subsequent uncontrolled flow event, of well KS-8 were not created by the condition, assumed by the Element I Report, of heavy drilling mud entering the fracture and thus leaving the well bore partially void of confining drilling fluid. Accordingly, PGV believes that the proper course for future drilling in the Kilauea East Rift Zone will be to drill with mud that is sufficiently heavy in weight to overcome these relatively shallow high-pressure geothermal fractures.

In retrospect, PGV also agrees that the 9-5/8" casing should have been set somewhere near the 3,177-foot depth. However, at the time the decision was made not to run the casing at 3,177 feet, numerous geologic indicators did not show that PGV would encounter the type of geothermal resource that was, in fact, encountered. PGV was clearly recognizing, as the events were unfolding, the numerous conflicting indicators of the status of the geothermal well. These conflicting indicators did not, in PGV's evaluation, show the need for setting the casing at 3,177 feet. In addition, this casing was not necessary to ensure proper anchoring of the blowout prevention equipment (BOPE), nor would setting any casing at any depth have prevented the kick.

Finally, PGV believes that the Element I Report statement that sufficient cold water pumped down the well bore would certainly be able to completely kill the well during the uncontrolled flow event is too limited. Rather, PGV believes that, in addition to the use of water, the use of heavy drilling mud and/or cement may be necessary to completely kill the KS-8 well.

Based upon PGV's review of the Element II Report ("Review of Emergency Plan and Response to the 12 June 1991 Uncontrolled Venting of the Puna Geothermal Venture (PGV) KS8 Geothermal Well"), PGV's own internal review of the information available regarding the emergency response to the KS-8 uncontrolled flow event and its consequences, and PGV's review of the actions taken by all parties during the emergency, PGV believes that its approved Emergency Response Plan (ERP), specifically Section 8.2.1. of the PGV ERP, adequately anticipated the possible occurrence of such an uncontrolled flow event. The PGV ERP provided PGV, emergency response personnel and the public with generally accurate information regarding the possible consequences of such an event. PGV concurs with the principal finding of the Element II Report that "The actual implementation of the PGV Emergency Response Plan (ERP) went reasonably well."

PGV generally concurs with the recommendations of the Element II Report, and has cooperated and will continue to fully cooperate with representatives of the Hawaii State Department of Health, Hawaii State Emergency Response Commission, and the Hawaii County Local Emergency Response Commission in these matters. PGV concurs with the recommendation that the Hawaii State Department of Health (DOH) conduct a review of the "action levels" for hydrogen sulfide, although PGV believes that the "action levels" already proposed by DOH are appropriate and should be accepted as the "action levels" for hydrogen sulfide. PGV also generally agrees with the intent of the recommendation to review the PGV ERP, since the PGV ERP provides that it "will be updated as appropriate when necessary".

PGV also agrees with the Element II Report that there appears to have been some confusion on the part of emergency response personnel and the public during and after the uncontrolled flow event regarding how to proceed, the applicability of the temporary housing cost reimbursement, and the PGV employee alarm system. This apparent public and agency confusion regarding the emergency episode underscores the need for the Hawaii County Civil Defense Agency (HCD), other government agencies, and PGV to work harder to educate the community regarding the PGV ERP. PGV believes that everyone involved must recognize that the PGV ERP is not designed to direct the response actions of either the agencies or the communities in the event of any emergency at the PGV facility. This is the responsibility of the HCD and the HCD's emergency implementation plan. Accordingly, PGV believes it also necessary that the public and other government agencies be educated concerning the HCD's implementation plan for any emergency which may arise on the PGV facility site.

PGV believes that the extensive information provided in the Element III-I Report ("Independent Air and Noise Program Review Concerning the June 1991 Uncontrolled Venting of the Puna Geothermal Ventures KS-8 Geothermal Well") can be categorized into two areas. First, the Element III-I Report contains a review of the air and noise monitoring programs in the Puna area and a "precursory appraisal" of the issued permits regarding air and noise. Both of these have only a peripheral applicability to the KS-8 well uncontrolled flow event. Second, the Element III-I Report discusses the KS-8 well uncontrolled flow event emission scenario and suggests how to anticipate, mitigate and manage any possible similar future events. Both of these latter topics bear more directly on the KS-8 well uncontrolled flow event.

PGV agrees with the Element III-I Report recommendation that unifying, or at least coordinating, the air monitoring efforts would enhance the regional coverage and the consistency of the collected data. However, PGV believes that the Element III-I Report summary review of the Hawaii Department of Health (DOH) air permits is, as

the Element III-I Report itself indicates, only a "precursory" review, and one which PGV believes unfairly and superficially criticizes the DOH and the extensive permit conditions which includes many restrictive limitations on the allowable increases in ambient hydrogen sulfide concentrations.

PGV believes that the Element III-I Report is misleading when it states that "ambient measurements of noise and H₂S indicated levels markedly above those anticipated in the issued permits as limits or believed to be acceptable," because the uncontrolled flow event was obviously not a "permitted" emission, but one covered by the emergency event conditions of the permits and the PGV ERP. Further, PGV does not believe that the uncontrolled flow event demonstrates that the County of Hawaii Geothermal Resource Permit noise limitations should or must be changed.

The Element III-I Report points out that no noise or hydrogen sulfide mitigation systems were installed on the "choke" line. This is because discharge of geothermal steam or fluid through the horizontal choke line was not a permitted action, nor was it ever considered as an emergency event. PGV's noise abatement consultant was on-site during the uncontrolled flow event, and prepared a noise abatement plan. However, the plan was not immediately implemented because of safety considerations. Attachment 1 to the PGV Response to the Element I Report contains additional information about the systems which have now been installed, and will be installed, to abate noise and hydrogen sulfide emissions if such an event were to occur again.

While emissions estimates discussed in the Element III-I Report may have helped the emergency response personnel during the uncontrolled flow event, sampling of the KS-8 well was not possible during the uncontrolled flow event for safety reasons. PGV also does not disagree with the desirability of characterizing the components of drift emissions. However, given the substantial differences between the operation of geothermal projects which have continuous drift emissions (e.g., those projects operating in The Geysers) and the PGV project (with no normal emissions), PGV does not believe that the expense and effort required for ambient monitoring of components of the drift are justified.

PGV cannot accept the basic premise of the entire Element III-II Report ("Micrometeorological Aerometric and Health Effects Analysis Contribution to the Independent Air and Noise Monitoring Program Review Concerning the June 12, 13 and 14, 1991 Uncontrolled Venting of the Puna Geothermal Ventures KS8 Geothermal Well"), as expressed in the second sentence of the Executive Summary: "The purpose of this study is to provide independent verification of monitoring and spot measurements of ambient concentrations of hydrogen sulfide (H₂S) as well as provide estimates of plume concentration and plume transport paths in areas where

documented health effects occurred." PGV finds that the author of the Element III-II Report does not provide verification of the hydrogen sulfide monitoring data. Instead, the measured field data is manipulated to fit the author's own model of the uncontrolled flow event. The estimates of plume concentration and plume transport presented in the Element III-II Report are principally based on the undocumented, randomly sampled, unsubstantiated health complaints collected by members of the community, and no attempt is made to determine the statistical relevance of the "sampling" or any linkage to the KS-8 uncontrolled flow event.

PGV strongly disagrees that the "independent estimates of hydrogen sulfide (H₂S) ambient concentrations" prepared as a part of this Element III-II Report were "in substantial agreement with local monitoring station and mobile spot measurements throughout the venting period." In fact, PGV believes that the Element III-II Report Figures 3-1 through 3-16 show exactly the opposite. The Element III-II Report provides absolutely no statistically-based cause-and-effect relationship between health complaints and ambient hydrogen sulfide concentrations to justify the extremely subjective "finding" that "Local H₂S concentration were elevated above health significance levels and correlated with health complaints."

The regional wind flow analysis presented in the Element III-II Report does not employ a technically sound approach for estimating plume transport over the two-day period in question, and the author of the Element III-II Report has developed no statistically-based cause-and-effect relationship between the health complaints and the presumed ambient hydrogen sulfide concentrations.

PGV believes the Element III-II Report "finding" that the emission of "other" air toxics were of significant health concern is extremely subjective and without any reasonable basis for establishing a cause-and-effect relationship. PGV also does not agree with the "finding" that it did not utilize Best Available Control Technologies and did not utilize equipment described in the Authority to Construct. This finding also appears to be beyond the scope of the Element III-II Report's stated purpose.

Finally, the recommendations presented in the Element III-II Report are simply a restated presentation of the recommendations presented in the Element III-I Report, and have very little, if anything, to do with the KS-8 well uncontrolled flow event or its aftermath.