MEMORANDUM

TO: The Honorable Susumu Ono  
Chairman, Department of Land and Natural Resources

FROM: Kent M. Keith


The U.S. Navy is in the early planning stages of drilling a geothermal well and developing a hybrid GEOTEC (Geothermal and Ocean Thermal Energy Conversion [OTEC]) demonstration electric generating plant on Navy owned land in Lualualei on the Waianae Coast of Oahu. The land is classified Agricultural.

Would you please advise which State permits, licenses and leases that the Navy would have to obtain before proceeding? A specific concern is the applicability of Act 296, SLH 1983, regarding geothermal resource subzones.

KMK/GOL:rnk
Department of Navy
Continental Scientific Drilling Program

1.0 Objective
The interest of the Department of Navy in Continental Scientific Drilling Activities is to define, develop, and implement scientific and technical programs having a prime objective to improve Navy capabilities and mission requirements. This interest includes: (1) research in geology, geophysics, geochemistry, hydrology, mineral resources, and seismic activity, (2) the assessment of the geothermal potential on Navy and Marine Corps controlled lands whereby the Navy can utilize these resources as an alternate energy source.

2.0 Background
It is necessary for the Department of the Navy (DON) to understand the physical properties and structure of the earth's crust for a number of operationally important reasons. As a corollary, it is important, in order to develop efficient, cost-effective techniques for evaluating crustal properties from geophysical data observed at the surface, that methods be developed to infer the deep physical properties of the crustal rocks from the characteristics of the surface-recorded geophysical data. To develop such techniques requires actual samples of the deep crust in order to determine the lithology, porosity, fluid content, and other physical properties of the deep crust. Such data, combined with laboratory studies of the physical behavior and characteristics of rocks at crustal pressures and temperatures, constitute the fundamental building blocks upon which such a system for remotely sensing otherwise unmeasureable crustal properties can be developed.

3.0 Fundamental Investigation
A broad range of fundamental physical properties of the earth's crust either directly affect DON or have a potential impact, some of which should be developed to become operationally useful. These include the porosity, fluid content, stress concentration, strength, electromagnetic and seismic propagation characteristics, and the distribution of surface
conductivity which affects very low frequency (VLF) propagation signal patterns. Such information is applicable to an evaluation of: the volume, temperature, and fluid content of geothermal reservoirs; stress concentrations in seismically active areas (earthquake risk evaluation); the strength of subsurface layers; the distribution of surface conductivity patterns (which cause the refraction of electromagnetic navigation signals); and the possibility for electromagnetic or seismic crustal communication through the earth.

4.0 Specific Applications
The Department of Navy Energy Office is responsible for planning and monitoring the efficient use of energy throughout the Navy and for implementing DOD priorities and policies. The DON energy resource management priorities are:

- To ensure that adequate energy supplies are available to sustain peacetime and combat operations
- To improve the energy efficiency of the shore establishment operating forces
- To substitute energy sources for fossil fuels where cost effective

As an integral part of this effort, the Geothermal Energy R&D Program is established to verify geothermal resources on Navy and Marine Corps lands and to evaluate the risks and benefits associated with its development. Deep test drilling is the only way to confirm the presence of the resource. All drilling programs will ensure the obtaining of information about the size and value of the resource so as to reduce the risk and establish value to the Navy.

5.0 General Applications
The applications for DON for a knowledge of crustal properties are numerous. In order to discharge its mission for the defense of the nation, DON is obligated to develop facilities and techniques which can ensure its continued ability to function in the case of attack by foreign powers. The concept of invulnerable naval underground facilities protected from enemy action has a certain appeal for defense purposes.
However, an understanding of earth properties immediately becomes essential for evaluating techniques of communication, power supply, environmental control, strength to withstand bombing over pressures, and vulnerability of surface access links (i.e., for personnel, power, water, ventilation, communication, and waste disposal).

5.1 Earthquake Risk Reduction at Naval Facilities
The need for deep drill holes for developing methods to evaluate stress buildup in seismically active areas is of prime importance. The possible destruction of DON bases by earthquakes is a matter of valid concern. The Navy has a clear responsibility to protect its shore bases against damage from any source, including natural hazards. The threat from earthquake damage is especially critical for naval bases since they are often located in coastal areas on unstable marine soils and filled land. Buildings in such an area are subject to distortion or collapse, either of which renders a building operationally useless. Because this can affect hospitals, power stations, communication stations, command headquarters, harbor ingress and egress, and the support of the Fleet by naval bases in general, this knowledge is critical to the Navy and vital to the security of the nation.

5.2 Military/Civil Projects
Many holes are being drilled into crystalline basement at military installations for logistical support, including water supply wells, waste disposal wells, foundation investigations, and other civil work projects.

6.0 Current Status of Navy Cooperative Efforts
Interagency Agreement between Navy Energy R&D Offices and Department of Energy, Ocean Energy Technology Division (Hybrid Geothermal/Ocean Thermal Energy Conversion System).

Cooperative Program Agreement between Navy Energy R&D Office and Department of Energy, Geothermal and Hydropower Technologies Division on Geothermal energy investigation.

Interagency Accord on Continental Scientific Drilling (Proposed).
8.0 Recommendations
Currently, we are unable to determine deep physical properties of the continental crust with any certainty by geoscientific observations at the earth's surface, although DOD research organizations are currently supporting investigations aimed toward achieving this goal. A continental scientific drilling program is needed to provide ground truth to test the geological, geochemical, geophysical techniques being developed. This is critically important to the achievement of this goal. Such an objective will have direct scientific (academic, state and federal agencies, and professional societies) and industrial benefits in addition to its criticality for achieving DON objectives.

For the reasons outlined above, DON has a vital interest directly involved with national security to ensure the progress and implementation of a continental scientific drilling program. We wish to emphasize the importance of such a program and to lend the weight of our responsibilities and needs to the argument that such a program should be funded in the national interest.
Supplement B
Continental Scientific Drilling of
Lualualei, Oahu, Hawaii

Objective:
To develop a drilling program with the capability to provide the required information on the geothermal resource beneath the Island of Oahu and the applicability of using geothermal fluids to provide power and cooling for the Navy.

Approach:
If the resource proves to be viable for production, the next objective will be to develop the geothermal resource which is authorized under 10 USC 2689. Also, 10 USC 2394 authorizes the Navy to contract with terms up to 30 years appropriate for the amortization of costs if the development is done at contractors expense.\(^1\) The contract (venture capital type) calls for the firm to complete the evaluation of the resource, develop the geothermal field, construct the power plant and operate the plant at no capital cost to the Navy. The developer recovers the capital investment through sales of energy services (steam, electricity).

Because the electrical load at Lualualei does not exceed 1MWe, one scenario would be to wheel the excess power by HECO to other military installations on Oahu.

The results of the drilling program and the data compiled will provide the collateral that venture capital requires for the investment portfolio. Such collateral includes geothermal resource temperature, geofluid flow rate and well drawdown, and geofluid reinjection temperature and injectivity.

Impact:
The Lualualei Drilling Program is designed to not only satisfy Navy requirements, but also support scientific interests of the State of Hawaii (Department of Planning and Economic Development) and participating agencies under the Interagency Accord on Continental Scientific Drilling.

\(^1\) The Navy has two such geothermal contracts in existence at this time; the Coso Development at the Naval Weapons Center, China Lake, CA, and Fallon Development at the Naval Air Warfare Training Center, Fallon, NV.
Site Description:
The Island of Oahu, third largest of the Hawaiian Chain has an area of 1,569 square kilometers. The island was formed from two, originally independent, volcanic systems: Waianae volcano, the older of the two, in the central western part of the island, and Koolau volcano, which formed eastern Oahu. Part of the Waianae volcano caldera is located in what is now Lualualei Valley.

The Naval Magazine Lualualei occupies about 8,182 acres plus a three mile access road. The Naval Transmitter Facility occupies about 1,750 acres adjoining the Naval Magazine, Figure 1. Legal and institutional land matters are satisfied by the Navy.

Geoscientific Information:
Geologic mapping identifies several caldera and rift zone structures in the Valley and provide a tentative outline of their boundaries. Clay mineralogy studies indicate that minor geothermal alteration of near-surface rocks has occurred at some period in the history of the area. Schlumberger resistivity soundings indicate the presence of a low resistivity layer beneath the valley floor, which has been tentatively attributed to warm water-saturated basalt. Soil and groundwater chemistry studies outline several geochemical anomalies around the perimeter and within the inferred caldera boundaries. The observed anomalies strongly suggest a subsurface heat source.

Other research opportunities beyond that of the thermal regime could include: (1) downhole seismic studies of the structure of the Waianae Caldera complex and nearby submarine flanks; (2) geochemical analyses and modeling of low temperature fluid compositions from a moribund basaltic island hydrothermal system; (3) geological, geophysical petrological, and geochemical analysis of cores and cuttings of late stage subaerial caldera filling lavas intrusive formations and hydrothermal and retrograde alteration mineral suites; and (4) modeling of thermal and mechanical processes associated with an extinct basaltic island volcanic system.

Scientific Drilling Program:
The Navy Scientific Drilling Program will have three elements.²

A. The first element comes before drilling and that is entitled problem definition which will involve investigations of many types ranging

from analysis of existing drill hole data to advanced geological/geochanical/geophysical surveys, environmental assessment, and Navy mission operational requirements.

B. The second element is the commencement of drilling operations in which coring, sample collections, and downhole measurements will be made. The Navy will include in their drill plans the monitoring of Geothermal Resources Operations Orders.3

C. The third element is postdrilling investigations which include the various studies of cores, analysis, interpretations, and the reporting of results of the program.

Drilling Program Management:
The Navy has defined roles and responsibilities to accommodate a program of this magnitude, see Figure 2.

Outside assistance from the scientific community is encouraged by utilizing such expertise from the Deep Observation and Sampling of the Earth's Continental Crust (DOSECC), Inc., Science Advisory Committee and the Board of Earth Sciences through their Continental Scientific Drilling Committee.

The envisioned drilling program at Lualualei, Oahu, is being offered as a hole(s) of opportunity to the scientific community for cooperative efforts. The Navy process will be to announce our plans in the DEW (Drilling Early Warning) Newsletter sponsored by the Continental Scientific Drilling Committee.

Request for Funds:
The envisioned Navy Continental Scientific Drilling Program under the responsibility of the U.S. Navy Energy R&D Program is to drill one 6,000 foot exploratory hole. The cost of this program without add-on opportunities will be approximately $3M.

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3 Geothermal Resources Operational Orders are issued under the Geothermal Steam Act of 1970 and administered by DOI (Bureau of Land Management). Each operational order sets forth provisions to conduct various geothermal operations from exploration through field closures.
Department of the Navy
Drilling Projects Management Plan

Figure 2.
By Mr. PRESSLER:
S. 1026. A bill to direct the cooperation of certain Federal entities in the implementation of the Continental Scientific Drilling Program; to the Committee on Energy and Natural Resources.

Mr. PRESSLER. Mr. President, I am extremely pleased today to introduce into the Senate a bill entitled the "Continental Scientific Drilling and Exploration Act of 1985." This legislation represents an early step in a scientific program which I believe parallels in importance our efforts in space over the past three decades—but at a fraction of the cost. In short, an effort to understand the scientific value and potential for resolving heretofore unanswered questions about the origin, evolution, and management of the planet on which we live is inestimable.

By increasing our basic understanding of the Earth, an effective Continental Scientific Drilling Program joint effort between the Department of the Interior and the National Science Foundation (CSDP) has practical day-to-day applications in areas dealing with energy and mineral development, natural hazards such as earthquakes and volcanic eruptions, disposal of hazardous waste, water resource management, and a host of other areas.

Mr. President, this legislation calls for the implementation of the Continental Scientific Drilling Program known as the Interagency Coordination Group (ICG), and calls on the Interagency Coordinating Group to prepare and submit to the Committees on Energy and Natural Resources and the Appropriations Committee an Interim Report on the progress of the program.

I believe that the time is ripe to enhance fundamental understanding of the crustal evolution of the earth and the mountain building processes. The development of improved techniques for evaluating the crustal evolution will be key to a liveable, prosperous future for generations to come.

Mr. President, this legislation is an important piece of legislation and represents an early step in cooperation and cooperative spirit of the individuals and Government agencies involved in this program. It is the beginning to witness people and agencies so closely devoted to a worthy common goal.

The legislation represents an early step in our efforts to understand our nation's vital natural resources and to strengthen the scientific community's basic research and development efforts in this area. The legislation is critical to our understanding of the earth and the mountain building processes, and has already gone forward. Indeed, the National Science Foundation has already gone forward. Indeed, the National Science Foundation has already provided $12 million to date toward the execution of the program.

Mr. President, this legislation is an extremely important element in gaining a better understanding of and insight into our Earth. Space is not the final frontier. Much closer, just as mysterious, and probably more beneficial is the interior of our own planet. A thorough exploration of this important frontier I am certain, will reap great rewards. I would like to ask you to join me in support of this important legislation and support passage of this legislation.

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appropriate cooperation from any Federal agency that can contribute to the objectives of such program, without adversely affecting any program or activity of such agency; and

(5) acting through the Interagency Coordinating Group, preparing and submitting to the Congress, within one hundred and eighty days after the enactment of this Act a report describing—

(A) long and short-term policy objectives and goals of the United States Continental Scientific Drilling Program;

(B) projected schedules of desirable scientific and engineering events that would advance United States objectives in the Continental Scientific Drilling Program;

(C) to the extent and for the duration that the Interagency Coordinating Group deems practicable, maximum, minimum, and intermediate levels of resources and funding that would be required by each participating Federal agency to carry out events pursuant to subparagraphs (A) and (B) at the various levels of effort;

(D) the scientific, economic, technological, and social benefits expected to be realized through the implementation of such program at each level described in subparagraph (C);

(E) a recommended course for interaction with the international community in a cooperative effort to achieve the goals and purposes of the Act;

(F) the extent of participation or interest shown to date in the Continental Scientific Drilling Program by—

(i) any other governmental agency;

(ii) any academic institution;

(iii) any organization in the private sector; and

(iv) any governmental or other entity in the international community;

(G) a plan to develop beneficial cooperative relationships among the entities mentioned in subparagraph (F), to the extent that the Interagency Coordinating Group deems practicable; and

(H) any other information or recommendations that the Interagency Coordinating Group deems appropriate.