



**CALENERGY COMPANY, INC.**

January 18, 1999

Jeffrey B. Hulen  
University of Utah  
Energy & Geoscience Institute  
423 Wakara Way Suite 300  
Salt Lake City, Utah 84108-1242

Dear Jeff:

CalEnergy has reviewed your proposal dated December 04, 1997, titled "Proposal for Geologic Reservoir Characterization of the Telephone Flat Geothermal System, Medicine Lake, CA" and the accompanying letter of understanding. We understand that this proposal is for DOE-funded work.

Attached you will find the signed approval of your proposal and we understand that your proposal is within the terms of the CalEnergy - University of Utah Technical Data Gathering Agreement of June 1998. This agreement provides for confidentiality and publication guidelines.

We will provide you initial access to our confidential data and information regarding the Telephone Flat reservoir during the period of January 20 - 22, 1999 at our Ridgecrest office. Please contact Mark Walters at 760-499-2336 to work out the scheduling details. We are hopeful that the information that EGI gains from your visit will also allow you to work with Colin Williams of the USGS in his publication of his temperature logging work at Telephone Flat, as well as assisting John Finger at Sandia National Laboratory who is developing a proposal for the drilling of a slimhole.

Sincerely,

Alex Schriener, Jr.  
Geothermal Manager, CalEnergy

c.: Mark Walters



Energy & Geoscience Institute

MEMORANDUM OF UNDERSTANDING  
between CalEnergy Company (CEC) and the Energy & Geoscience Institute (EGI)

December 4, 1998

**Proposal for Geologic Reservoir Characterization  
of the Telephone Flat Geothermal System, Medicine Lake, California**

*Jeffrey B. Hulen, Senior Geologist, EGI*

**Executive Summary** – EGI proposes to carry out a program of geoscientific research, in cooperation with CEC, aimed at characterizing reservoir controls in CEC's Telephone Flat geothermal system in the Medicine Lake volcano, Siskiyou County, California. The project would involve (1) careful analysis and synthesis of the existing Telephone Flat geological, geochemical, geophysical, and hydrological database; (2) new studies (e.g. petrographic; fluid-inclusion) based on existing cores and cuttings obtained by CEC and its predecessors at Telephone Flat; (3) collaboration with CEC, should it obtain the requisite internal and Department of Energy (DOE) funding, in the design and optimum implementation of a spot-coring program to retrieve representative, 3-10 m-long cores from the geothermal reservoir; and (4) detailed study of those cores, in the full light of insight gained from [1] above, and with the same goal -- better understanding and more cost-effective development of one of the Nation's most promising and untapped geothermal resources. The knowledge gained from this investigation should greatly benefit not only the long-term development and maintenance of this resource, but the understanding of other high-temperature geothermal systems in the western U.S.A. and globally.

**Background** – The Telephone Flat geothermal prospect occurs in the heart of the Medicine Lake volcano, a feature of particular geological complexity. On the eastern flank of the High Cascade mountain range near Mt. Shasta, the principally andesitic, late Quaternary volcano is surmounted by a large depression whose rim appears to be a constructional feature. Flows of Recent dacite and rhyolite point to the presence of a sizable and perhaps still partially molten felsic magma chamber at depth beneath the modern volcanic edifice.

The Medicine Lake volcano and geothermal system have been extensively explored with encouraging results; several wells are capable of commercial production. It is EGI's understanding that cuttings and supporting logs from these wells, along with continuous core from at least three deep thermal-gradient boreholes, would be made available in support of the proposed investigation (subject to provisions of a recently-signed EGI-CEC comprehensive, non-

**EGI**

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site-specific research agreement). As a DOE-funded investigation, the proposed project's research results would be published, but with prior review by CEC, if requested, to safeguard CEC's proprietary and confidential interests.

**Approach** – The proposed investigation would involve the following tasks, each of which would be subject to modification contingent upon newly available information and significant research results to date.

1. Evaluation of the existing Medicine Lake geologic and geophysical database, including (A) information obtained directly by CEC as well as that collected by its predecessors at the site; (B) published accounts, particularly those of the U.S. Geological Survey. Part [A] of this step would involve focused perusal of the Medicine Lake files (again, subject to the restraints of confidentiality) at CEC's Ridgecrest, California, headquarters. Armed with this information, EGI scientists, in collaboration with CEC, would begin to build a conceptual model portraying possible 3-D geologic configurations for the explored and outlying portions of the Telephone Flat system.

2. Proceeding apace with [1], task 2 would involve retrieval, observation and evaluation of cores and cuttings thus far obtained from the system. These materials would be donated by CEC to the newly relocated and upgraded EGI Geothermal Sample Library, where they would first be examined along with their existing documentation (mud logs, e-logs, imagery, petrographic descriptions, etc) in order to determine, to EGI's satisfaction, what further characterization might be beneficial. At this point, additional samples would be taken and submitted for whole-rock geochemistry, X-ray diffraction, stable-isotopic analysis, fluid-inclusion microthermometry, or other appropriate analytical techniques. Results would be incorporated with those previously obtained to refine the geologic reservoir characterization discussed in [1] above.

3. It is EGI's understanding that CEC will seek DOE co-funding for a comprehensive spot-coring and logging program at Medicine Lake, to be carried out in conjunction with planned, CEC production-well drilling during the next two or three years. It is well-documented that such cores can add immeasurably to the understanding of a geothermal resource, where small-diameter drill cuttings are the norm. Should the additional DOE support to CEC be forthcoming, EGI, in addition to the tasks outlined above, would undertake to collaborate with CEC, and other parties (e.g.; USGS, Sandia National Laboratories) to be determined, to help design and carry out this coring effort.

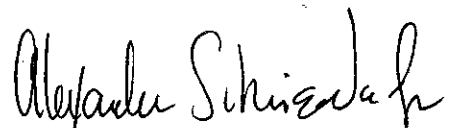
EGI's contribution to the conceptual CEC coring and logging program is envisioned as follows: (1) select the best portions of the system and its host rocks for spot-coring and corresponding downhole logging and imaging; (2) design a coring protocol (such as, for example, the one utilized for The Geysers, CA, and Awibengkok, Indonesia, coring projects) appropriate for Medicine Lake, to ensure that the retrieved specimens preserve the maximum amount of useful information to be gleaned from the penetrated system; (3) be on site during coring operations to help supervise the collection and preservation of the core; (4) see that the core is properly and timely transported to and curated at the EGI Geothermal Sample Library; (5) design, in collaboration with a team of scientists from National Laboratories, the U.S. Geological Survey,


universities, and various other institutions, a research plan to optimize the cores' and corresponding logs' full scientific yield; (6) oversee the ongoing collaborative research effort, to ensure timely intercommunication of results among all project participants, including CEC.; (7) Apply results of the coring project to refine the geologic and reservoir model discussed in [1] above. As part of this effort, EGI would carry out detailed petrographic, paragenetic, isotopic, and mineralogic study of the spot cores, in a fashion similar to its core characterization at The Geysers and Awibengkok. Additionally, contingent on necessary additional DOE funding, EGI anticipates that its Center for Industrial Imaging (CII) will undertake unique porosity and permeability measurement and image processing for the Medicine Lake cores; the CII's studies have frequently pointed to new petroleum reserves in areas thought to have been fully produced.

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The level of effort directed toward a pre-coring evaluation of the Telephone Flat system (utilizing available samples and information) would depend in part on CEC's production-well drilling schedule during 1999. The more time available to EGI to learn about the system in advance of spot coring, the better able it will be to select with confidence the optimum coring and logging depths and locations. EGI would welcome the opportunity to work with CEC in this exciting venture.

  
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Jeffrey B. Hulén

  
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CEC authorized representative  
Manager, Geothermal Resources

  
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Rick Allis  
Chief Scientist, EGI

cc: Phillip M. Wright; Marshall J. Reed