UCRL 15891
S/C 7768303

MASTER

FINAL REPORT
SUBCONTRACT 7768303
LAWRENCE LIVERMORE LABORATORY

BASELINE HEALTH EFFECTS DATA APPLICABLE TO
ANTICIPATED GEOTHERMAL RESOURCE DEVELOPMENT
IN IMPERIAL COUNTY

Report Submitted By:

Margaret Deane, M.P.H.
Co-Principal Investigator
Epidemiological Studies Section
State Department of Health Services
2151 Berkeley Way, Berkeley, CA 94704

June, 1981

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

FINAL REPORT
SUBCONTRACT 7768303
LAWRENCE LIVERMORE LABORATORY

BASELINE HEALTH EFFECTS DATA APPLICABLE TO
ANTICIPATED GEOTHERMAL RESOURCE DEVELOPMENT
IN IMPERIAL COUNTY

DISCLAIMER

This book was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Report Submitted By:

Margaret Deane, M.P.H.
Co-Principal Investigator
Epidemiological Studies Section
State Department of Health Services
2151 Berkeley Way, Berkeley, CA 94704

June, 1981

cd
DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

PROJECT STAFF

Margaret Deane, Co-Principal Investigator
Jeffrey L. Hahn, Co-Principal Investigator

Professional and Technical Staff

John R. Goldsmith
Lawrence B. Perry
Madeline Thresh
Elaine D. Williams
Charles Wolff

Clerical Staff

Florence Baeza
Arlene B. Campos
Dianne Carraway

Introduction

The gradual development of geothermal energy in Imperial County has offered an unusual opportunity to collect baseline health and environmental data against which the results of future studies can be compared. Because of budget cuts in the Department of Energy, several components of the work as set forth in the original contract could not be undertaken or completed. These include the design and execution of a health and annoyance survey in Lake County which was to have provided background for designing a similar survey in Imperial County. The Lake County experience would have been particularly useful in developing a questionnaire since Lake County residents are already experiencing exposure to geothermal development. In addition, residents of the area, unlike those of Imperial County, have for many years been exposed to naturally escaping gases from geothermal resources.

A second component of the study which was eliminated because of lack of funds was the assessment of existing health data, the recommendation of new data to be collected, and the recommendation of methods of compiling, analyzing, and interpreting the data so that long-term health effects could be monitored. A pilot study was to have been implemented based on these recommendations.

The third component eliminated for financial reasons was the planning and pilot testing of methods for determining the earliest possible biological indicators of environmental health hazards, and the recommendation of health surveillance procedures.

On the positive side, a health and annoyance survey in Imperial County was completed and a report produced, and reports were prepared on the location and components of present odor sources in the Imperial Valley and on the occupational hazards associated with geothermal energy. In addition, the availability of data from geothermal sites in New Zealand was explored. A trip to New Zealand by Jeffrey Hahn provided valuable first-hand information on the operation of geothermal plants and possible health hazards associated with these.

The remainder of this report describes the specific outcomes related to each task in the Scope of Work section of the contract.

TASK A

Develop a questionnaire to measure health and annoyance reactions to noise and odor from geothermal sources. Select locations and sampling frame information for a survey in Lake County.

Output: Copy of questionnaire, sampling frame and list of locations in Lake County.

Outcome: Copies of English and Spanish versions of the questionnaire are in the survey report, "Imperial County Baseline Health Survey".

The Lake County Survey was eliminated from the contract following budget cuts. Some preliminary work was done to select appropriate locations for the survey. One problem is the relatively small population living near the areas of principal geothermal activity and development. Population density is relatively low, and as a consequence a personal interview survey might be relatively expensive. Discussions were held with survey research experts and the Pacific Telephone Company on the feasibility of doing a random digit dialing telephone interview survey.

Selection of an appropriate control area might require using a different county, Sonoma or Napa, since much of Lake County is exposed to geothermal emissions.

Recently the California Energy Commission has contacted one of us (M.D.) to act as consultants to them on the feasibility of doing a health interview survey in Lake County similar to that conducted in Imperial County. The Commission is apparently

considering funding and conducting such a study itself.

TASK B

Conduct an annoyance and health survey in selected households in three locations in Lake County representing three different levels of exposure to odor from geothermal sources: Compile, analyze and interpret the results.

Output: Report.

Outcome: The Lake County Survey was eliminated from the contract following budget cuts.

TASK C

Determine the sites and select the sampling frames to be used for the health and annoyance surveys in Imperial County.

Output: List of sites for Imperial County survey and copy of sampling frame.

Outcome: The sites and sampling frame are described in the survey report. A copy of the sampling frame will be prepared following consultation with Lawrence Livermore Laboratory on what format this should take.

TASK D

Use the results of the Lake County health surveys to develop a procedure for the Imperial County Surveys.

Output: Report.

Outcome: Since the Lake County survey was eliminated from the contract, the procedures for the Imperial County survey were developed independently and are described in the survey report.

TASK E

Perform health and annoyance surveys in the Imperial Valley under various meteorological conditions using the methods developed and modified in Lake County. Compile, analyze and interpret the results.

Output: Report.

Outcome: The health and annoyance survey in Imperial Valley was completed and is reported in "Imperial County Baseline Health Survey" by Margaret Deane. Since a single survey was done, it was not performed under various meteorological condition. A computer tape of the data is available.

TASK F

Examine the health data presently being collected as well as that available from local facilities for medical care. Assess the data for suitability for long-term monitoring of health effects. Make recommendations concerning its compilation, analysis, and interpretation. Make recommendations on the collection of new data and its use for health monitoring. Implement recommendations on a pilot basis and interpret the results.

Output: Report.

Outcome: Budget cuts led to the elimination of this task after some preliminary work had been done.

This consisted of contacts with the three local hospitals: Callexico Hospital, El Centro Community Hospital, and Pioneer Memorial Hospital. Either the hospital administrator or his assistant was contacted, and in some cases the medical records librarian. Each hospital subscribes to a different hospital audit organization, and all three were agreeable to the possibility of three-way

contracts between the Department of Health Services, the hospital, and the audit organization, which would provide for the audit organization to supply the Department with data from individual case abstracts. Information identifying the individual would be removed before the Department received these data. Staff members of the respective audit firms were also contacted to discuss the feasibility of obtaining the data. Perhaps the main drawback to data from these sources is the time lapse between the medical event and the receipt of the data by the Department.

Alternatives would be 1) for the hospital to provide copies of the abstracts directly to the Department, 2) for the hospital to permit access directly to hospital records, or 3) for the hospital to abstract the required information or a special form provided by the Department.

Recently, other possibilities for obtaining health data have developed. Starting in 1982, hospitals will be required to submit case abstracts to the State on a uniform hospital discharge form. Such

forms will contain a meager amount of information, but this could change in the future. In addition, several projects in the Department are now obtaining copies of hospital case abstracts from one or more audit organizations and the possibility might exist of extending these agreements to include Imperial County data. Easier access to vital statistics computer tapes is also rapidly being developed.

Further work on this task was outside the scope of the revised contract.

TASK G

Using University-supplied Imperial Valley meteorological data (i.e., typical wind patterns, average temperatures) identify location of odor sources and possible components causing the odor (i.e., fertilizer, pesticides, chemicals or animal fecal matter).

Output: Data.

Outcome: The outcome of Task G has been reported in a report previously submitted by Jeffrey L. Hahn titled "Location of Odor Sources and the Affected Population in Imperial County, California", dated January 1979. The report catalogues the many

odor sources already present in Imperial County and maps the areas affected by them.

TASK H

Compile available health data from other geothermal sites, including those in New Zealand and Finland. Where possible, compare health data from these areas with data from Imperial County.

Output: Report.

Outcome: The outcome of Task H is represented by information in letters from health officials in New Zealand and reports made by Jeffrey Hahn on a trip to New Zealand. In the course of this trip he observed the operation of geothermal plants, gained first-hand information concerning potential occupational and community health problems associated with geothermal energy, and discussed such problems with local and national officials in New Zealand. A synopsis of two of the letters follows:

1. Letter from R.J. Flight, Medical Officer of Health, Department of Health District

Officer, Rotorua, to Mr. F. Foster, Chief Health Statistician, National Health Statistics Center, Wellington, February 22, 1977.

No figures are available relevant to the possible effects of hydrogen sulfide on pregnancy outcome, status of infants or children, or on respiratory or central nervous system disease. He had hoped but was unable to do a study on effects on respiratory disease using data on admissions and mortality rates for Rotorua Hospital to be compared with data for Tauranga Hospital as a control. If such a study can be done in the future it could be extended to include central nervous system diseases and incidence of congenital malformations.

There have been instances of fatalities in Rotorua among workmen in trenches, children falling into shallow depressions, and people taking geothermal baths in improperly ventilated bath houses. However, local practitioners and hospital staff do not in general feel that there is any effect on general health, other than acute or chronic poisoning.

2. Letter from R.T. Douglass, Chief Air Pollution Control Officer, Department of Health, Wellington, to Dr. John R. Goldsmith of this Department.

Deaths have occurred from geothermal emissions due to scalding or entrapment of gases in confined places. Many people react strongly to the odor, which is not only hydrogen sulfide, and complaints of eye irritation were common in some old buildings.

There appears to be a need for community health studies, and with appropriate funding these could be carried out. Such studies might be of three types:

1. Systematic collection and analysis of data on workers in the geothermal industry. Both existing health records and special health interview and health examination surveys could be used.
2. Compilation and analysis of data from existing records, such as birth and death certificates and hospital records. If the numbers of events are sufficient these could be analyzed by small geographic areas. Particular attention should be paid to pregnancy outcome, as well as to respiratory and central nervous system diseases and general health status.
3. Special health surveys as well as physiological testing and health examination surveys. Such studies might contrast the

health status of populations living close to geothermal activities and geothermal plants with that of comparable populations living elsewhere. Annoyance reactions should also be measured using standardized techniques.

One of the outcomes of Jeffrey Hahn's trip has been encouragement of New Zealand authorities to seek funding to conduct epidemiological health studies as well as to compile and analyze data from health information systems currently in operation in New Zealand. To this end officials from New Zealand have visited the United States and have made presentations and held discussions with this Department, the California Energy Commission, and Lawrence Livermore Laboratory. A detailed draft report of Jeffrey Hahn's trip is available.

TASK I

Collect and analyze existing data on occupational hazards such as hydrogen sulfide gas, radon, mercury, and noise and thermal exposure likely or known to be associated with geothermal development.

Output: Report.

Outcome: The outcome of Task I has been reported in a report previously submitted by Jeffrey L. Hahn titled "Occupational Hazards Associated with Geothermal Energy".

This paper was presented at the Geothermal Resources Council's 1979 Annual Meeting in Reno, Nevada, September 24-27, 1979 and was subsequently published in the Proceedings. A more comprehensive report on potential occupational hazards is available in draft form.

TASK J

Plan and pilot test methods for determining the earliest possible indicators of environmental hazards, such as the estimation of the body burden of such pollutants as radon, mercury, arsenic, etc. in expired air (radon) or hair. Take account of the potential role of pollution and noise exposure in producing injury, recommend health surveillance procedures, and methods for evaluating the results.

Output: Report.

Outcome: Budget cuts led to the elimination of this task.