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METREK DIVISION

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Vol III.

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Site-Specific Analysis of Geothermal Development-Data Files of Prospective Sites

F. Williams
A. Cohen
R. Pfundstein
S. Pond

October 1977

Prepared for
Energy Research and Development Administration
Division of Geothermal Energy

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MTR-7586

Vol. III

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Prepared for
Energy Research and Development Administration
Division of Geothermal Energy

THE MITRE CORPORATION
METREK DIVISION

McLean, Virginia 22101

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Department Approval: *MM Schup*

MITRE Project Approval: *Steven N. Goldstein*

ABSTRACT

MITRE/METREK is analyzing development scenarios for 37 hydrothermal and geopressed prospects in the United States to assist ERDA's Division of Geothermal Energy in mission-oriented planning of geothermal resource development.

This volume presents site-specific data and sample development schedules for the first plant on line at each of the 37 prospects.

PREFACE

The Federal Inter-Agency Geothermal Coordinating Council, chaired by the Energy Research and Development Administration (ERDA), has decided to plan the Federal Geothermal Program in a mission-oriented fashion on the basis of postulated geothermal resource development.

Towards this end, the ERDA Division of Geothermal Energy has postulated development scenarios for 37 geothermal (hydrothermal and geopressured) resource areas or prospects envisioned for electric power generation starting prior to 1990. In general, these scenarios postulate an initial generating capacity of approximately 50 MW_e, followed by incremental additions of 50 to 200 MW_e at a pace believed to be likely for the prospect. The pace of development at each prospect was based on many factors, including electrical power demand, transmission capabilities, and estimated resource characteristics.

An analysis of development at the 37 hydrothermal and geopressured prospects aimed towards definition of Federal initiatives that may be needed to realize the postulated development (and to evaluate the present initiatives) is documented in these three volumes.

Volume I contains a summary of the site-specific analysis with particular emphasis on possible recommendations for the Federal Geothermal Program.

Volume II contains the detailed site-specific analysis in terms of technological, economic, and other requirements for meeting the postulated schedules.

Volume III contains detailed descriptive data files for each of the 37 prospects. These data files were used for the analysis contained in Volume II and should be useful for other geothermal resource studies.

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INTRODUCTION

This document presents site-specific data and sample development schedules for the first plant on line at 30 hydrothermal and 7 geopressured prospective sites (prospects) that are believed to be suited for supporting the geothermal generation of electricity.

This report includes many prospects from an earlier METREK report on geothermal development scenarios.* The list has been augmented with other sites chosen as development prospects by the Division of Geothermal Energy (DGE) of the Energy Research and Development Administration (ERDA). The DGE additions included a general area called "Cascade Range". METREK has chosen the following specific Cascade Range Sites in place of that general area: Baker Hot Springs, Mount Hood, Lassen and Glass Mountain/Diablo.

All of the prospects have been selected on the basis of current knowledge of hydrothermal and geopressured resources. The selection is intended for program planning purposes. Neither METREK nor the Federal government warrants that any of these sites will necessarily be developed, nor does their selection necessarily imply any commitment on the part of the Federal government to their development.

The Division of Geothermal Energy has grouped the geothermal prospect areas into five regions (Figure 1). The grouping is based on a relative similarity of geothermal characteristics of

*R.K. Trehan et al, Analysis of Geothermal Energy Development Scenarios, MTR-7220, November 1976.

FIGURE 1

GEOHERMAL ENERGY OPERATIONS RESEARCH REGIONAL BOUNDARIES*

*Regional boundaries based on rough estimates of near future development activities as deduced by ERDA from the USGS Circular 726, Assessment of Geothermal Resources of the United States - 1975. The regions were established such that roughly equivalent levels of activity are expected to occur in each region.

prospects within each region as well as on an expectedly similar amount of development activity in each region. Regions 1, 3 and 4 contain hydrothermal systems believed capable of supporting significant electric power generation. Region 2 contains geopressured systems which are potentially economic sources of dissolved methane (natural gas) as well as of geothermal energy which could be used to generate electricity economically if credit is given for the methane recovery. Region 5, the eastern half of the U.S., contains many lower temperature systems which are currently believed to be best suited for direct (non-electric) applications. Prospective development sites for non-electric applications in Region 5, as well as in the other regions, are currently under study, and background data on them will be reported later.

FORMAT FOR THE GEOTHERMAL PROSPECT FILES

The information about each prospect has been organized into a file of data which are relevant to its development. The prospects are arranged by region, and alphabetically by site name within each region. Much of the information has been taken from previous publications and has been appropriately referenced. The information has been augmented by personal communications between METREK staff and members of the geothermal community*.

All distances to the geothermal prospects have been calculated using a straight-line measurement to the point represented by the longitude and latitude shown on the pages entitled "Site Location and Physical Description." (Site locations are as defined in the USGS Circular 726, Assessment of Geothermal Resources in the United States--1975.)

Contents of the Hydrothermal Prospect Files

The information file for each hydrothermal prospect contains the following pages:

- Postulated Site Development
- Summary
- Map of Site
- Site Location and Physical Description

*The contributions of staff members of the Division of Geothermal Energy, especially the mission team leaders for each region, are acknowledged. Future updates of the prospectuses are expected to benefit from information assembled by the operations research and systems analysis contractors in each of the regions.

- Reservoir Characteristics and Geological/Geophysical Description
- Land Ownership and Leasing
- Geothermal Development Status
- Institutional Considerations
- Description of the Environment
- Population, Transportation, and Utilities
- Geothermal Resources File ("Geotherm," not available for all Sites)

Contents of the Geopressured Prospect Files

The information for each geopressured prospect contains the following pages:

- Postulated Site Development Schedule
- Summary
- Map of Site
- Site Location and Physical Description
- Geopressured Reservoir Characteristics by Subarea
- Geothermal Development Status
- Institutional Considerations
- Description of the Environment
- Population, Transportation, and Utilities

The geopressured subareas which are mapped and discussed in the geopressured files are as defined in the USGS Circular 726, Assessment of Geothermal Resources of the United States--1975.

The characteristics of the subareas were identified in oil and gas drilling logs, with subarea boundaries selected on the basis of geologic history and structure of the study area.⁽⁷⁾

Geopressured fairways (areas where geopressured resources have been identified) defined for the Frio geologic formation in Texas have been identified. The maps of Texas counties have these fairways indicated in addition to the USGS subareas. It is expected that as geopressured development progresses many more fairways will be identified.

REGION 1 - CALIFORNIA, HAWAII

SITE: BRAWLEY, CA

SITE: BRAWLEY, CA (STATE/PRIVATE LAND)
POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
SLC, Owner	Issue Prospecting/Exploration Permits	Developer	} ASSUMED COMPLETED										
County Gov't	Issue Land Use Permits	Developer											
DOG	Issue Drilling Permits	Developer											
SLC, Owner	Acquire Leases	Developer											
SLC, County	Process EIR	State DEQ											
Developer	Preliminary Geophysical Exploration												
Developer	Exploratory Drilling & Reservoir Evaluation												
Developer	Develop Utility Interest												
Developer & Utility	Feasibility Study												
Producer (Developer) & Utility	Financial Negotiations												
Producer	Site Selection												
Utility	Prepare Environmental Data Statement	CPUC, CERCDC County											
Producer & Utility	Design												
Producer/Utility	Commitment to Development				Δ								
CERCDC, CPUC	Certify Plant, & Site, Issue Permits	Producer & Utility											
County, DOG	Process EIR (Drilling)	State DEQ											
CPUC	Process EIR (Plant >50MW)	State DEQ											
CPUC	Process EIR (Transmission Line)	State DEQ											
Producer	Development Drilling												
Utility	Plant Construction												
Utility	Install Transmission Line (16km)												

Possible Subsequent Additions (MWe) and On Line Date: 50 - 1985, 100 - 1987, 100 - 1988, 100 - 1989, 100 - 1990, 100 - 1991, 100 - 1992, 100 - 1993, 100 - 1994, 100 - 1995

SITE: BRAWLEY, CA (REGION 1)

SUMMARY

TEMPERATURE °C

Surface:

Subsurface: 200⁽⁷⁾ 300⁽²⁰⁾ 260⁽³¹⁾

TOTAL DISSOLVED SOLIDS (PPM):

Low-to-moderate⁽¹⁾ 100,000⁽³¹⁾

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS):

333⁽⁷⁾ 1000⁽²⁰⁾ 1,700 to 2,000 (USGS)⁽⁴⁷⁾

TYPE OF OVERLAYING ROCK:

Soft

ESTIMATED DEPTH TO TOP OF RESERVOIR (METERS):

1,500

DESCRIPTION OF KGRA

Total KGRA Acres: 28,885

Total Federal Acres: 0

Federal Acres Leased: 0

Total State and Private Acres: 28,885

State and Private Acres Leased:

GEOHERMAL DEVELOPMENT STATUS:

As of August 1975, 3 successful wells were drilled and 10 more wells were planned.

Testing was to take place after drilling an injection well and constructing field pipeline.⁽¹⁾

By February 1977, 5 wells had been drilled.⁽²⁰⁾ Geothermal non-electric use was being considered for a sugar refinery.⁽²³⁾ There is a possibility of 10MW pilot plant construction ^(20,31).

LOCAL AND STATE ATTITUDE TOWARD GEOHERMAL DEVELOPMENTS:

Numerous state and local regulations.^(1A)

LAND USE AND POPULATION:

Flat, irrigated land is used for agriculture. Town of Brawley has a population of 14,467.⁽⁶⁾

COMMENTS AND CRITICAL ISSUES:

Brawley is competing with Salton Sea, Heber and East Mesa for local market. Resource is considered similar to Salton Sea but is less saline.⁽²⁰⁾ ERDA has received loan guarantee application for exploration at Brawley.⁽²⁵⁾

SITE: BRAWLEY, CA

SITE: BRAWLEY, CA

SITE LOCATION AND PHYSICAL DESCRIPTION

LATITUDE: 33° 01' 00" N

LONGITUDE: 115° 31' 00" W

COUNTY: Imperial

ADJACENT COUNTIES: San Diego, Riverside; Yuma, Az., Mexico

LAND OWNERSHIP:

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
Desert in gently sloping area.	Irrigated land used for agriculture(6)			

SITE: BRAWLEY, CA

RESERVOIR CHARACTERISTICS AND GEOLOGICAL/GEOPHYSICAL DESCRIPTION

RESERVOIR TEMPERATURE

Surface:
Subsurface: 200°C (7) 300°C (20) 260°C (31)

Geochemical
SiO₂:
Na-K-Ca:

TOTAL DISSOLVED SOLIDS (TDS): Low-to-Moderate⁽¹⁾ 100,000 ppm (31)

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS): 333⁽⁷⁾ 1000⁽²⁰⁾ 1,700 to 2,000 (USGS)⁽⁴⁷⁾

TYPE OF OVERLAYING ROCK: Sediment, siltstone and sandstone

ESTIMATED DEPTH TO TOP OF RESERVOIR: 1500m (4921 ft)

SEISMIC ACTIVITY: The area is in an active tectonic region and has experienced significant earthquakes many times since the late 1940's.⁽⁶⁾

SITE: BRAWLEY, CA

LAND OWNERSHIP AND LEASING

		TOTAL AREA (ACRES)	FEDERAL (ACRES)	STATE (ACRES)	PRIVATE (ACRES)
KGRA: Brawley		28,885		28,885 (1) (state and private)	
LAND LEASED IN KGRA			N/A		
HIGHEST-PRICED LEASES (BY DOLLARS/ACRE)					
\$/ACRE	LESSEE				
TENTATIVE LEASE SALE DATES					
NUMBER OF SALES OFFERED BUT NO BIDS:					
NUMBER OF BIDS REJECTED (RESULTING IN NO LEASE):					
SUBSURFACE AREA OF RESERVOIR		4,448 ⁽⁸⁾			

SUMMARY OF LEASING STATUS AND NEEDS:

SITE: BRAWLEY, CA

GEOHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
<p>As of August 1975, Union Oil Company of California had drilled three successful wells and filed notices to drill another ten. It was projected that testing would start after an injection well was drilled and a field pipeline constructed. After testing, Union was to decide how many of the proposed ten wells would actually be drilled. Depths were 1,219 to 1,524 meters (4,000 to 5,000 feet).</p> <p>By February 1977, five wells had been drilled by Union. (20) It was reported that four wells were drilled by January 1977, and of the four wells, two were being used for tests.(22) Results from the five wells drilled by Union indicate temperature of 260°C (500°F) with 100,000 ppm.(31) By June 1977, one well was drilled by Standard Oil of California.(47)</p> <p>TRW, Inc. and Holly Sugar are testing the use of geothermal energy for heating operation at Holly's sugar refinery.(23)</p>	<p>In March 1977, a loan guarantee application for \$6.326 million was received by ERDA for the exploration of Brawley and Beryl and Lund, Utah. The exploration would be a joint venture by Geothermal Kinetics, Inc., and McCullah Oil Co. The total project cost would be \$10.326 million with the expectation that the best of the three sites would be chosen to power a 55 MW power plant.(25)</p> <p>By the end of 1977, Union Oil expects to announce plans to construct a 10 MW pilot facility.(31)</p>

SITE: BRAWLEY, CA

INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)
<p>Production Permit must be issued by Imperial County (requires compliance with all other permits and regulations such as building, plumbing, electrical and construction permits). The most important and time-consuming requirement of the Production Permit is the Environmental Impact Report (EIR) which may require at least 10 months of lead time for data collection and report preparation.</p> <p>The State's District Air Pollution Control Board requires construction and operation permits.</p> <p>Imperial County requires underground installation of collection and reinjection pipes at geothermal sites. Air pollution standards are set by the Occupational Safety and Health Administration (OSHA) and by the California Air Resources Board. California Division of Oil and Gas (DOG) is responsible for determining that potable groundwater supplies are protected during oil-, gas-, and geothermal-field operations, and for assuring that subsidence will not occur.(13)</p>		<p>A loan guarantee application has been received to explore Brawley, CA., and Beryl and Lund, Utah.(25)</p>

SITE: BRAWLEY, CA

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds
Precipitation (Annual): 5.8 cm (2.3 inches)
Average Temperature
Minimum: 12.2°C (54°F)
Maximum: 33.9°C (93°F)

Relative Humidity
(Seasonal Peaks)
Summer: 20% - 30%
Winter: 40%

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
			Creosote bush, bur sage, saltbush, greasewood ⁽⁶⁾		

SITE: BRAWLEY, CA

POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR:

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES NEAR SITE	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
Brawley	< 16 km (10 miles)	14,467	There is one 161 kv line east of Brawley and a 161 kv capacity line operating at 92 kv west of Brawley. There is a 13.3 MW internal combustion and a 22.5 combustion turbine plant 13 km (8 mi.) east of Brawley. There is a 187.6 MW steam plant 19 km (12 mi.) south of Brawley (at El Centro). The lines and plants are owned by the Imperial Irrigation District (municipal). (33-II)	State Highway 86 runs through Brawley	Rail service in Brawley. 56 cm (22") or smaller gas pipeline within a few miles. 25 cm (10") or larger oil products pipeline ~ 17 miles to north. (6)

RECORD 00001

GEOHERMAL RESOURCES FILE (GEOHERM) REVISION 8

SECTION A.- GEOHERMAL FIELD-AREA

RECORD IDENTIFICATION

RECORD NO..... 0000296
CROSS INDEX NO.. CF00481
RECORD TYPE..... A
NAME..... J. P. CALZIA, J. RENNER
DATE..... 75/01
ORGANIZATION.. U.S.G.S.

GEOGRAPHIC LOCALITY

GEOHERMAL FIELD-AREA.. BRAWLEY
COUNTRY CODE..... US
STATE/PROVINCE..... CALIFORNIA
LATITUDE..... 33-01-00N
COUNTRY NAME..... UNITED STATES
COUNTY..... IMPERIAL
LONGITUDE..... 115-31-00W

TOWNSHIP RANGE SECTION 1/4 1/4
13S 14E 15 SW

BASE & MERIDIAN..... SAN BERNARDINO
AVAILABLE MAPS OF AREA: WESTMORLAND 1:24,000

GENERAL DESCRIPTION

ELEVATION..... -4.5720E+01M -150. FT
RESOURCE CATEGORY..... 6
PRESENT USE & DEVELOPMENTS: 1 OIL WELL TO 2400M; FOUR GEOHERMAL LOCATIONS BY UNION OIL.
NO. OF HOT SPRINGS..... NONE

GEOHERMAL CHARACTERISTICS

WELL INFORMATION

BOTTOM-HOLE TEMPERATURE..... 139.0 C TO 2588.00 M

RESERVOIR PROPERTIES

RESERVOIR TEMPERATURES..... 150. C TO 300. C ASSUMED
BEST ESTIMATE..... 200.0 C
SUBSURFACE AREA..... 13.0 KM**2 TO 31.0 KM**2
BEST ESTIMATE..... 18.0 KM**2
BASED ON: 8 F/100 FT. BUR. RECLAMATION TEMP GRADIENT CONTOUR
DEPTH TO TOP OF RESERVOIR..... 1000.00 M 1.000 KM TO 2000.00 M 2.000 KM
BEST ESTIMATE..... 1500.00 M 1.500 KM
DEPTH TO BOTTOM OF RESERVOIR.. 3000.00 M 3.000 KM TO 3000.00 M 3.000 KM
BEST ESTIMATE..... 3000.00 M 3.000 KM
THICKNESS OF RESERVOIR..... 1000.00 M 1.000 KM TO 2000.00 M 2.000 KM
BEST ESTIMATE..... 1500.00 M 1.500 KM
VOLUME OF RESERVOIR..... 13.000 KM**3 TO 62.000 KM**3
BEST ESTIMATE..... 27.000 KM**3
COMMENTS: DEPTHS TO TOP & BOTTOM OF RESERVOIR ARE ASSUMED.

RESERVES

TOTAL STORED HEAT..... 4.1860E+18 J 9.9999E+17 CAL TO 4.6042E+19 J 1.0999E+19 CAL
BEST ESTIMATE..... 1.2558E+19 J 2.9999E+18 CAL ABOVE 15. C

GEOLOGY

GENERAL ROCK TYPES: DELTAIC SEDIMENTS, SILTSTONE & SANDSTONE

GEOPHYSICS

OTHER GEOPHYSICAL INFORMATION: TEMPERATURE GRADIENT

PRIMARY REFERENCE:

AUTHOR..... D.E. WHITE & D.L. WILLIAMS, EDITORS

DATE..... 1975

TITLE..... ASSESSMENT OF GEOTHERMAL RESOURCES OF THE UNITED STATES - 1975

REFERENCE... U.S.G.S. CIRCULAR 726

RELATED REFERENCES:

- 1) DUTCHER, L.C. AND OTHERS, 1972, PRELIMINARY APPRAISAL OF GROUND WATER IN STORAGE WITH REFERENCE TO GEOTHERMAL RESOURCES IN THE IMPERIAL VALLEY AREA, CALIFORNIA: U.S.G.S. CIRC. 649, 57 P.
- 2) MOYLE, W.R., JR., 1974, TEMPERATURE & CHEMICAL DATA FOR SELECTED THERMAL WELLS & SPRINGS IN SOUTHEASTERN CALIF: U.S.G.S. WATER RES. INVS. 33-73
- 3) U.S. BUREAU OF RECLAMATION, 1972, GEOTHERMAL RESOURCE INVESTIGATION, IMPERIAL VALLEY, CALIFORNIA DEVELOPMENTAL CONCEPTS: U.S. DEPT. INT. BUR. RECLAMATION, 58P.
- 4) MUNGER'S DAILY OILGRAM 12-74

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 8

SECTION A.- GEOTHERMAL FIELD-AREA

RECORD IDENTIFICATION

RECORD NO..... 0000390
 CROSS INDEX NO.. CF00951
 RECORD TYPE..... A

NAME..... J. RENNER, J. P. CALZIA
 DATE..... 75/01
 ORGANIZATION.. U.S.G.S.

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. GLAMIS OR EAST BRAWLEY
 COUNTRY CODE..... US
 STATE/PROVINCE..... CALIFORNIA
 LATITUDE..... 32-53-00N

COUNTRY NAME..... UNITED STATES
 COUNTY..... IMPERIAL
 LONGITUDE..... 115-11-00W

TOWNSHIP RANGE SECTION 1/4 1/4
 14S 17E 2 NE

BASE & MERIDIAN..... SAN BERNARDINO
 AVAILABLE MAPS OF AREA: GLAMIS NW 1:2400

GENERAL DESCRIPTION

ELEVATION..... 36.56 M 120. FT
 RESOURCE CATEGORY..... C
 SURFACE THERMAL ACTIVITY..... NO VISIBLE MANIFESTATION, FOUND BY HEAT FLOW ANOMALY,

RESERVOIR PROPERTIES

RESERVOIR TEMPERATURES.....	100.	C	TO 150.	C	ASSUMED			
BEST ESTIMATE.....	135.0	C						
SUBSURFACE AREA.....	0.6	KM**2			TO 5.0	KM**2		
BEST ESTIMATE.....	2.0	KM**2						
BASED ON: TEMP. GRADIENT ANOMALY								
DEPTH TO TOP OF RESERVOIR.....	1000.00	M	1.000	KM	TO 2000.00	M	2.000	KM
BEST ESTIMATE.....	1500.00	M	1.500	KM				
DEPTH TO BOTTOM OF RESERVOIR..	3000.00	M	3.000	KM	TO 3000.00	M	3.000	KM
BEST ESTIMATE.....	3000.00	M	3.000	KM				
THICKNESS OF RESERVOIR.....	1000.00	M	1.000	KM	TO 2000.00	M	2.000	KM
BEST ESTIMATE.....	1500.00	M	1.500	KM				
VOLUME OF RESERVOIR.....	0.600	KM**3			TO 10.000	KM**3		
BEST ESTIMATE.....	3.000	KM**3						

COMMENTS: DEPTHS TO TOP & BOTTOM OF RESERVOIR ARE ASSUMED.

RESERVES

TOTAL STORED HEAT.....	1.2558E+17 J	2.9999E+16 CAL	TO 3.3468E+18 J	7.9999E+17 CAL
BEST ESTIMATE.....	8.3716E+17 J	1.9999E+17 CAL	ABOVE 15.	C

GEOLOGY

GENERAL ROCK TYPES: SANDY DELTAIC DEPOSITS

PRIMARY REFERENCE:

AUTHOR..... D.E. WHITE & D.L. WILLIAMS, EDITORS
 DATE..... 1975
 TITLE..... ASSESSMENT OF GEOTHERMAL RESOURCES OF THE UNITED STATES - 1975

REFERENCE... U.S.G.S. CIRCULAR 726

RELATED REFERENCES:

- 1) U.S. BUREAU OF RECLAMATION, 1972, GEOTHERMAL RESOURCE INVESTIGATION, IMPERIAL VALLEY, CALIFORNIA DEVELOPMENTAL CONCEPTS: U.S. DEPT. INT. BUR. RECLAMATION, 58 P.

SITE: COSO HOT SPRINGS, CA

SITE: COSO H.S., CA (FEDERAL/NAVY LAND)
POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Navy	Process EIS	CEQ	_____	_____	_____								
USGS	Issue Drilling Permit	Developer			_____								
Developer	Preliminary Geophysical Exploration				_____								
Developer	Exploratory Drilling & Reservoir Evaluation				_____	_____	_____						
Developer	Develop Utility Interest					_____	_____						
Developer & Utility	Feasibility Study						_____						
Producer (Developer) & Utility	Financial Negotiations						_____						
Producer	Site Selection						_____						
Navy, Producer, Utility	Commitment to Development						_____Δ						
Producer & Utility	Design (Preliminary Final)						_____	_____					
Producer & Utility	Prepare Master Development Plan	Navy, USGS					_____	_____					
Utility	Prepare Environmental Data Statement	Navy, FPC, County, CPUC, CERCDC					_____	_____					
BLM, FPC, CPUC, CERCDC, USGS	Certify Plant & Site, Issue Permits	Producer & Utility					_____	_____	_____				
USGS	Process EIS (Drilling)	CEQ						_____	_____				
FPC	Process EIS (Plant)	CEQ						_____	_____				
FPC	Process EIS (Transmission Line)	CEQ						_____	_____				
Producer	Development Drilling									_____	_____	_____	
Utility	Plant Construction									_____	_____	_____	_____
Utility	Install Transmission Line									_____	_____	_____	_____

Possible Subsequent Additions (MWe) and On Line Date: 50 - 1987, 150 - 1988, 150 - 1989, 150 - 1990

SITE: COST HOT SPRINGS, CA (REGION 1)

SUMMARY

TEMPERATURE °C
Surface: 95⁽⁷⁾

Subsurface: 220⁽⁷⁾

TOTAL DISSOLVED SOLIDS (PPM): 2,000
ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS): 4,533⁽¹⁾ 2,000⁽²⁰⁾
TYPE OF OVERLAYING ROCK: Medium-Hard
ESTIMATED DEPTH TO TOP OF RESERVOIR (METERS): 1,000

DESCRIPTION OF KGRA

Total KGRA Acres: 51,760⁽⁹⁾

Total Federal Acres: 43,330⁽¹⁾ (16,690 BLM, 26,640 Navy)⁽²⁰⁾ Total State and Private Acres: 8,430
State and Private Acres Leased:
Federal Acres Leased:

GEOHERMAL DEVELOPMENT STATUS:

As of February 1977, 18 shallow temperature gradient wells had been drilled,⁽¹⁷⁾ and one deep well was being drilled.⁽²⁰⁾ The Navy, Bureau of Reclamation (BuRec), and USGS are involved in development.⁽¹⁸⁾ A study of heat flow and microearthquake activity was done for the site.^(1A) Test drilling on Navy land is scheduled to begin in July 1977.⁽⁴⁷⁾

LOCAL AND STATE ATTITUDE TOWARD GEOHERMAL DEVELOPMENTS:

Administrative constraints are stringent and may cause long delays.^(1A) Significant public opposition is not expected.⁽⁴⁾

LAND USE AND POPULATION:

Desert area. Recreation, military and agricultural use. Agriculture declining because of lack of irrigation water.⁽⁴⁾ Rural population. A general land-use plan exists for the area.⁽⁴⁾

COMMENTS AND CRITICAL ISSUES:

Environmental study has been completed by the Navy.⁽⁴⁾ Coso is surrounded by faults and may be seismically active.⁽⁴⁾ Tentative lease sale is scheduled for November 1978.⁽¹⁴⁾ There are indications that dry steam may be available.^(1A)

SITE: COSO HOT SPRINGS, CA

SITE: COSO HOT SPRINGS, CA

SITE LOCATION AND PHYSICAL DESCRIPTION

LATITUDE: 36° 03' 00" N

LONGITUDE: 117° 47' 00" W

COUNTY: Inyo

ADJACENT COUNTIES: San Bernardino, Kern, Tulare, Fresno, Mono, NV - Esmeralda, Nye, Clark

LAND OWNERSHIP: 92% Federally owned in county, primarily BLM
8% Privately owned, primarily by LA Dept. of Water and Power⁽⁴⁾

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
Typical desert. The site is in the Mojave Desert east of the Sierra Nevada Range.	Recreation, military and agriculture. ⁽⁴⁾	Future growth is expected in recreation and tourism. Agricul- ture has been declin- ing because of a lack of irrigation water. All future development must occur outside the military reservation. ⁽⁴⁾ A general plan for land use exists for the area. ⁽⁴⁾	No outstand- ing aesthetic qualities. ⁽⁴⁾ Remote scenic beauty. ⁽¹⁰⁾	Area has been inhabited by the Piute Indians & many landmarks remain from the Goldrush of the mid-1800s. ⁽⁴⁾

SITE: COSO HOT SPRINGS, CA

RESERVOIR CHARACTERISTICS AND GEOLOGICAL/GEOPHYSICAL DESCRIPTION

RESERVOIR TEMPERATURE

Surface: 95°C
Subsurface: 220°C

Geochemical

SiO₂: 161°C
Na-K-Ca: 238°C

TOTAL DISSOLVED SOLIDS (TDS): 2,000 ppm⁽⁴⁾

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS): 4533⁽¹⁾ 2000⁽²⁰⁾

TYPE OF OVERLAYING ROCK: 56.4 m (185 ft) of hematite-stained alluvium.
Granitic Basement (?) to top of reservoir.
Rhyolite volcanics.⁽⁴⁾

ESTIMATED DEPTH TO TOP OF RESERVOIR: 1000 m (3281 ft)

SEISMIC ACTIVITY: Microearthquake activity is of swarm type indicating that tectonic forces are currently active. Much of Coso Range is enclosed by an arcuate faulting system that forms a rough oval. This structure is broken by a set of northeast and northwest trending, steeply dipping faults. The ring faulting along with structural subsidence suggests a caldera in the early stage of collapse.⁽⁴⁾

SITE: COSO HOT SPRINGS, CA

LAND OWNERSHIP AND LEASING

		TOTAL AREA (ACRES)	FEDERAL (ACRES)	STATE (ACRES)	PRIVATE (ACRES)
KGRA: Coso Hot Springs		51,760 ⁽⁹⁾	43,330 (16,690 BLM (48) 26,640 USN)	8,430 ⁽¹⁾ (State & Private)	
LAND LEASED IN KGRA			None		
HIGHEST-PRICED LEASES (BY DOLLARS/ACRE)					
\$/ACRE	LESSEE				
TENTATIVE LEASE SALE DATES 11/78 BLM ⁽⁴⁷⁾					
NUMBER OF SALES OFFERED BUT NO BIDS:					
NUMBER OF BIDS REJECTED (RESULTING IN NO LEASE):					
SUBSURFACE AREA OF RESERVOIR		41,514			

SUMMARY OF LEASING STATUS AND NEEDS:

SITE: COSO HOT SPRINGS, CA
GEOHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
<p>Twenty-five shallow wells drilled in the 1920s and 1930s for a resort.(4)</p> <p>Navy drilled a shallow well in 1967 to 112.5 m (375 ft). A bottom-hole temperature of 143°C (288°F) was measured. The water recovered from the well was neutral to alkaline and rich in chloride. The well produced at 40 GPM with an indicated downhole pressure greater than 20 psig.(4) There are possible indications that dry steam may be available.(1A)</p> <p>In August of 1975, the University of Texas at Dallas was studying heat flow and microearthquake activity at the site.(1A)</p> <p>The Navy, BuRec and USGS are currently engaged in development activity.(18)</p> <p>As of February 1977, 18 shallow temperature gradient wells have been drilled,(17) and 1 deep well was being drilled.(20)</p>	<p>Test drilling on Navy land is scheduled to begin in July 1977.(47)</p> <p>Since cooling water is an important consideration at the site, it is hoped that condensate would be used for geothermal power plants.(47)</p>

SITE: COSO HOT SPRINGS, CA

INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)
<p>On a local level, definitive procedures have been enacted to control geothermal activities. An environmental assessment is required prior to development and production. Administrative constraints on development are stringent and may cause long delays.(1A)</p> <p>Although the Navy is generally in favor of geothermal development, its land use stipulations are stringent and Congressional action may be needed to offer land for leasing.(47)</p>	<p>The public is relatively uninformed about geothermal energy, but significant public opposition to development is not expected.(4) However, the local administration has adopted a very cautious approach to all outside interference.(1A) It is predicted that one of the greatest difficulties will be overcoming court battles brought on by environmentalist due to remote scenic beauty of the area.(10) In June 1977, an Indian tribe was trying to return to the land (taken by the Navy) to build a village.(47)</p>	<p>An environmental study of the area has been done by the Navy.(4) A master contract (RFP) for an environmental study was being negotiated by the BLM and Navy in June 1977. The contract which may not be signed until January 1978 is to perform all the work that will be required by an EIS--assuming the Navy's legislative hurdles are overcome. Project completion is scheduled for mid-1978. (47)</p>

SITE: COSO HOT SPRINGS, CA

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds Prevailing westerly winds
 Precipitation (Annual): 15.11 cm (5.95 in.)
 Average Temperature
 Minimum: 3.89°C (39°F)
 Maximum: 27.2°C (81°F)

Relative Humidity
 (Seasonal Peaks)
 Summer: 10% - 20%
 Winter: 30% - 50%

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
Good but has deteriorated recently because of flow from the Los Angeles Basin.(4)	TDS of 1000-2000 ppm including silicate content of 200-300 ppm. Spring water is highly acidic and lacks chloride. Though surface water is scarce,(1A) some cooling water may be available from either the Los Angeles Aqueduct, which passes a few miles from site, or from ground water.(4)	Data on ambient noise is unavailable but it is probably very low.(4)	Desert scrub brush.(4)	Coyote, fox, rabbit, rat, squirrel, sparrow, lark, raven and various species of lizards.(4)	Owens Chub, Owen Pufffish, and the Mohave Ground Squirrel.(4)

SITE: COSO HOT SPRINGS, CA

POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR:

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES NEAR SITE	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
China Lake	56 km (35 miles) south of site	13,500 ⁽⁶⁾	Within 13 km (8 mi.) west of Coso there are two 230 kv lines owned by Los Angeles (municipal) and two 138 kv capacity lines operating at 115 kv owned by the Southern California Edison Company (private). All 4 lines run N-S. (33-II)	US Highway 395 ~ 7 1/2 miles away (12 km)	8 km (5 miles) from secondary railroad no gas and oil pipe- lines within 161 km (100 miles)

RECORD 00002

GEOHERMAL RESOURCES FILE (GEOTHERM) REVISION 6

SECTION A.- GEOTHERMAL FIELD-AREA

RECORD IDENTIFICATION

RECORD NO..... 0000290
CROSS INDEX NO.. CF00451
RECORD TYPE..... A

NAME..... J. A. CROWLEY, J. RENNER, D. WILLIAMS, D
ORGANIZATION.. U.S.G.S.

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. CUSD HOT SPRINGS
WARNING FIGURE..... 8
COUNTRY CODE..... US
STATE/PROVINCE..... CALIFORNIA
LATITUDE..... 36-03-00N

WARNING NUMBER..... 141-143
COUNTRY NAME..... UNITED STATES
COUNTY..... INYO
LONGITUDE..... 117-47-00W

TOWNSHIP RANGE SECTION 1/4 1/4
22S 38E 4

BASE & MERIDIAN..... MT. DIABLO
AVAILABLE MAPS OF AREA: HAIWEE RESERVOIR 1:62,500

GENERAL DESCRIPTION

SIZE OF SURFACE EXPRESSION.... 1.0 KM**2
ELEVATION..... 1097.26 M 2600. FT
RESOURCE CATEGORY..... B
PRESENT USE & DEVELOPMENTS: 1 SHALLOW WELL FLOWING TEMPERATURE 116C
SURFACE THERMAL ACTIVITY..... HOT SPRINGS, FUMAROLE OR WARM VAPOR
ASSOCIATED DEPOSITS..... SINTER
NO. OF HOT SPRINGS..... 10

GEOTHERMAL CHARACTERISTICS

SPRING TEMPERATURES..... 60. C TO 95. C

RESERVOIR PROPERTIES

RESERVOIR TEMPERATURES..... 150. C TO 240. C ASSUMED
BEST ESTIMATE..... 220.0 C
SUBSURFACE AREA..... 114.0 KM**2 TO 1264.0 KM**2
BEST ESTIMATE..... 168.0 KM**2
BASED ON: GEOLOGY, GEOPHYSICS
DEPTH TO TOP OF RESERVOIR..... 500.00 M 0.500 KM TO 1500.00 M 1.500 KM
BEST ESTIMATE..... 1000.00 M 1.000 KM
DEPTH TO BOTTOM OF RESERVOIR.. 3000.00 M 3.000 KM TO 3000.00 M 3.000 KM
BEST ESTIMATE..... 3000.00 M 3.000 KM
THICKNESS OF RESERVOIR..... 1500.00 M 1.500 KM TO 2500.00 M 2.500 KM
BEST ESTIMATE..... 2000.00 M 2.000 KM
VOLUME OF RESERVOIR..... 171.000 KM**3 TO 3160.000 KM**3
BEST ESTIMATE..... 336.000 KM**3
COMMENTS: DEPTHS TO TOP & BOTTOM OF RESERVOIR ARE ASSUMED.

RESERVES

TOTAL STORED HEAT..... 5.8181E+19 J 1.3899E+19 CAL TO 1.7999E+21 J 4.2999E+20 CAL
BEST ESTIMATE..... 1.7288E+20 J 4.1299E+19 CAL ABOVE 15. C

GEOLOGY

GENERAL ROCK TYPES: RHYOLITE VOLCANICS, GRANITE

GEOPHYSICS

GRAVITY SURVEY INFORMATION: TEST MADE
MAGNETIC SURVEY INFORMATION: TEST MADE
SEISMIC SURVEY INFORMATION: MICROEARTHQUAKES
ELECTRICAL RESISTIVITY: DC RESISTIVITY TEST MADE

PRIMARY REFERENCE:

AUTHOR..... D.E. WHITE & D.L. WILLIAMS, EDITORS
DATE..... 1975
TITLE..... ASSESSMENT OF GEOTHERMAL RESOURCES OF THE UNITED STATES - 1975
REFERENCE... U.S.G.S. CIRCULAR 726

RELATED REFERENCES:

- 1) COMBS, JAMES, 1947A; HEAT FLOW STUDIES, COSO GEOTHERMAL AREA, CHINA LAKE, CALIF.: TEXAS UNIV. INST. GEOSCIENCES TECH. REPORT 1 & 2.
- 2) MOYLE, W.R., JR., 1974, TEMPERATURE & CHEMICAL DATA FOR SELECTED THERMAL WELLS & SPRINGS IN SOUTHEASTERN CALIF: U.S.G.S. WATER RES. INVS. 33-73
- 3) ROSS, C.P., & VATES, R.G., 1943, THE COSO QUICKSILVER DISTRICT, INYO COUNTY, CALIF: U.S.G.S. BULL. 936-Q P. Q395-Q416

RECORD 00003

GEOHERMAL RESOURCES FILE (GEOHERM) REVISION 8

SECTION B.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000291

CROSS INDEX NO.. CF00451

RECORD TYPE..... B

SAMPLE TYPE..... SURFACE

NAME..... J. A. CROWLEY, J. RENNER, D. WILLIAMS, D

DATE..... 00/00

ORGANIZATION.. U.S.G.S.

GEOGRAPHIC LOCALITY

GEOHERMAL FIELD-ARLA.. COSO HOT SPRINGS

COUNTRY CODE..... US

STATE/PROVINCE..... CALIFORNIA

LATITUDE..... 36-03.00 N

COUNTRY NAME..... UNITED STATES

COUNTY..... INYO

LONGITUDE..... 117-47.00 W

SAMPLE INFORMATION

SOURCE TYPE..... SPRING

WATER ANALYSIS

PH 1)..... 8.50

SOLUTE ANALYSIS (WATER)

LI	NA	K	RB	CS	NA+K
	1630.00	244.00			
MG	CA	SR	BA	CA+MG	
	74.00				
F	CL	BR	I		
	3040.00				
NH4	NO3	PO4	SIO2	SO4	CO3
			150.00	53.00	HCO3

REFERENCES: WHITE & OTHERS, ASSESSMENT OF GEOHERMAL RESOURCES OF THE U.S. - 1975, U.S.G.S. CIRCULAR 726
MOYLE, 1974

RECORD 00004

GEO THERMAL RESOURCES FILE (GEO THERM) REVISION 8

SECTION B.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0002247
CROSS INDEX NO..
RECORD TYPE..... B
SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.
DATE..... 76/06
ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEO THERMAL FIELD-AREA.. COSO HOT SPRINGS
NAME OF SAMPLE SOURCE.. MAIN SPRING
COUNTRY CODE..... US
STATE/PROVINCE..... CALIFORNIA

COUNTRY NAME..... UNITED STATES
COUNTY..... INYO

SAMPLE INFORMATION

SOURCE TYPE..... SPRING
WATER SAMPLING TEMP.... HOT

WATER ANALYSIS

W
ANALYSIS DATE..... 1910
ANALYST(S)..... F. M. EATON
TOTAL DISSOLVED SOLIDS... 2754. PPM

SOLUTE ANALYSIS (WATER)

UNITS USED..... PPM

LI	NA	K	RB	CS	NA+K				
	61	12							
MG	CA	SR	BA	CA+MG					
34	59								
MN+3	MN(TOT)	Fe+2	FE(TOT)	CU					
			83						
ZN	HG	B	HB02	AL	Pb	AS	SB	U	
		G		56					
F	CL	BR	I						
	40								
NH4	NO3	PO4	SI02	SO4	CO3	HC03			
	0	TRACE	411	1400	0				

OTHER SOLUTES & GASES H 12 PPM
REFERENCES: PERSONAL FILE OF DON WHITE, USGS, MENLO PARK
WARING, 1915

RECORD 00005

GEOHERMAL RESOURCES FILE (GEOHERM) REVISION 8

SECTION B.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0002246
CROSS INDEX NO..
RECORD TYPE..... B
SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.
DATE..... 76/06
ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOHERMAL FIELD-AREA.. COSO HOT SPRINGS
COUNTRY CODE..... US
STATE/PROVINCE..... CALIFORNIA
OTHER LOCALITY INFORMATION: 12 MILES EAST OF HAIWEE

COUNTRY NAME..... UNITED STATES
COUNTY..... INYO

SAMPLE INFORMATION

SOURCE TYPE..... SPRING
COLLECTOR(S)..... WARING, USGS
WATER SAMPLING TEMP.... SCALDING
WATER FLOW RATE..... SMALL
OTHER CHEMICAL CHARACTERISTICS: HIGH SULFATE AND SILICA. TINY CRYSTALS OF PYRITE ARE FORMED.

WATER ANALYSIS

W

ANALYSIS DATE..... 1910
ANALYST(S)..... F. M. EATON
TOTAL DISSOLVED SOLIDS... 2188. PPM

SOLUTE ANALYSIS (WATER)

UNITS USED..... PPM

LI	NA	K	RB	CS	NA+K			
	81	12						
MG	CA	SR	BA	CA+MG				
34	59							
MN+3	MN(TOT)	FE+3	FE(TOT)	CU				
			83					
ZN	HG	E	HBO2	AL	PB	AS	SB	U
			0	56				
F	CL	BR	I					
	40							
NH4	NO3	PO4	SiO2	SO4	CO3	HCO3		
	0	TRACE	41	1400	0			

OTHER SOLUTES & GASES H 12 PPM,

COMMENTS: RECENT LAVA, OVER GRANITE

REFERENCES: PERSONAL FILE OF DON WHITE, USGS, MENLO PARK

WARING, 1915

MAIN SPRINGS: EATON ANALYSIS SAME LOCALITY: OSCAR LOEW. ANAL., 1976

RECORD 00006

GEOHERMAL RESOURCES FILE (GEOHERM) REVISION 8

SECTION 8.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0002125
CRUSS INDEX NO..
RECORD TYPE..... B
SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.
DATE..... 76/06
ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOHERMAL FIELD-AREA.. COSO HOT SPRINGS
NAME OF SAMPLE SOURCE.. MAIN SPRING
COUNTRY CODE..... US
STATE/PROVINCE..... CALIFORNIA

COUNTRY NAME..... UNITED STATES
COUNTY..... INYO

SAMPLE INFORMATION

SOURCE TYPE..... SPRING
POINT OF COLLECTION..... MAIN SPRING

WATER ANALYSIS

TOTAL DISSOLVED SOLIDS... 2754. PPM

SOLUTE ANALYSIS (WATER)

UNITS USED..... PPM

LI	NA	K	RB	CS	NA+K			
TRACE	49	11						
MG	CA	SR	BA	CA+MG				
2.4	45							
MN+3	MN(TOT)	FE+3	FE(TOT)	CU				
			122					
ZN	HG	B	HBO2	AL	PB	AS	SB	U
				201				
F	CL	BR	I					
	TRACE							
NH4	NO3	PO4	SIG2	SO4	CO3	HCO3		
TRACE	TRACE			2308	0			

OTHER SOLUTES & GASES TRACE OF P PRESENT.

COMMENTS: TOTAL DISSOLVED SOLIDS RECORDED AS SOLIDS.
REFERENCES: PERSONAL FILE OF DON WHITE, USGS, MENLO PARK

RECORD 00007

GEOHERMAL RESOURCES FILE (GEOTHERM) REVISION 8

SECTION B.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0002248
CROSS INDEX NO..
RECORD TYPE..... B
SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.
DATE..... 76/06
ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOHERMAL FIELD-AREA.. COSO HOT SPRINGS
NAME OF SAMPLE SOURCE.. COSO MINERAL WATER
COUNTRY CODE..... US
STATE/PROVINCE..... CALIFORNIA

COUNTRY NAME..... UNITED STATES
COUNTY..... INYO

SAMPLE INFORMATION

WATER SAMPLING TEMP.... HOT

WATER ANALYSIS

ANALYST(S)..... W E. F. WILLIAMS, MAAS LABORATORIES, LOS ANGELES
TOTAL DISSOLVED SOLIDS... 8362.9 PPM

SOLUTE ANALYSIS (WATER)

UNITS USED..... PPM

LI	NA	K	RB	CS	NA+K			
	579.25	43.48						
MG	CA	SR	BA	CA+MG				
1030.6	66.91							
MN+3	MN(TOT)	FE+3	FE(TOT)	CU				
	1.50		9.52					
ZN	HG	B	HBO2	AL	PB	AS	SB	U
				302.31				
F	CL	BR	I					
	231							
NH4	NO3	PO4	SIO2	SO4	CO3	HCO3		
		1.04	456	6043				

COMMENTS: LAVA AND TUFF OVER GRANITE
REFERENCES: PERSONAL FILE OF DON WHITE, USGS, MENLO PARK
FRASER ET AL., CALIF. JOURNAL MINES & GEOL., V. 38, P. 239, 1942

SITE: EAST MESA, CA

SITE: EAST MESA, CA (FEDERAL LAND)
POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
County Government	Issue Land Use Permit	Developer	} ASSUMED COMPLETED										
BLM	Issue STG Drilling Permit	Developer											
USGS	Issue Drilling Permit	Developer											
BLM	Lease Land	Developer											
Developer	Preliminary Geophysical Exploration												
BLM	Process EIA/EIS	CEQ											
Developer	Exploratory Drilling and Reservoir Evaluation												
Developer	Develop Utility Interest												
Developer and Utility	Feasibility Study												
Producer	Financial Negotiations												
(Developer and Utility)													
Producer	Site Selection												
Producer and Utility	Commitment to Development												
Producer and Utility	Design (Preliminary, Final)												
Producer and Utility	Prepare Master Development Plan	BLM, USGS											
Utility	Prepare Environmental Data Statement	BLM, FPC, CPUC, CERCDO County Government											
BLM, FPC, CPUC, CERCDO	Certify Plant and Site, Issue Permits	Producer and Utility											
USGS	Process EIA/EIS (Drilling)	CEQ											
FPC	Process EIA/EIS (Drilling)	CEQ											
FPC	Process EIA/EIS (Transmission Line)	CEQ											
Producer Utility	Development Drilling												
Utility	Plant Construction												
Utility	Install Transmission Line												

Possible Subsequent Additions (MWe) and On Line Date: 50 - 1988

SITE: EAST MESA, CA (REGION 1)

SUMMARY

TEMPERATURE °C

Surface:

Subsurface: 180°

TOTAL DISSOLVED SOLIDS (PPM): 2,500⁽²⁰⁾

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS): 487⁽¹⁾

TYPE OF OVERLAYING ROCK:

Soft

ESTIMATED DEPTH TO TOP OF RESERVOIR (METERS): 1,000

DESCRIPTION OF KGRA

Total KGRA Acres: 38,365⁽⁹⁾

Total Federal Acres: 32,725 (Bu. Rec.)⁽¹⁾

Federal Acres Leased: 11,770⁽¹⁵⁾

Total State and Private Acres: 4,840⁽¹⁾

State and Private Acres Leased:

GEOHERMAL DEVELOPMENT STATUS:

Nine wells have been drilled.⁽¹⁷⁾ U.S. Bureau of Reclamation is operating a multiple flashed-steam water desalination plant.⁽¹⁾ One application to construct a 10 MWe plant has been filed recently.⁽¹⁴⁾ It is hoped that the 10 MWe pilot plant will be on line by 1978.⁽²³⁾ Numerous tests and studies are taking place.⁽²³⁾ ERDA has granted a loan guarantee for drilling at the site.⁽³⁷⁾ Environmental work has been completed, with more work underway.⁽⁴⁷⁾

LOCAL AND STATE ATTITUDE TOWARD GEOHERMAL DEVELOPMENTS:

Numerous state and local regulations.^(1A)

LAND USE AND POPULATION:

Flat irrigated land and desert shrubland. Rural area near population centers.⁽⁶⁾

COMMENTS AND CRITICAL ISSUES:

Natural water shortage exists in area. More Federal leasing appears to be needed within the KGRA.⁽⁴⁷⁾

SITE: EAST MESA, CA

SITE: EAST MESA, CA

SITE LOCATION AND PHYSICAL DESCRIPTION

LATITUDE: 32° 47' 00" N

LONGITUDE: 115° 15' 00" W

COUNTY: Imperial

ADJACENT COUNTIES: San Diego, Riverside; Yuma, AZ; Mexico

LAND OWNERSHIP:

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
Flat. (6)	Irrigated land and desert shrubland mostly ungrazed. (6)			

SITE: EAST MESA, CA

RESERVOIR CHARACTERISTICS AND GEOLOGICAL/GEOPHYSICAL DESCRIPTION

RESERVOIR TEMPERATURE

Surface:
Subsurface: 180°C⁽⁷⁾

Geochemical
SiO₂:
Na-K-Ca:

TOTAL DISSOLVED SOLIDS (TDS): 2500 PPM

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS): 487⁽¹⁾

TYPE OF OVERLAYING ROCK: Deltaic river sediments (soft).

ESTIMATED DEPTH TO TOP OF RESERVOIR: 1000 m (3281 ft)

SEISMIC ACTIVITY:

SITE: EAST MESA, CA

LAND OWNERSHIP AND LEASING

		TOTAL AREA (ACRES)	FEDERAL (ACRES)	STATE (ACRES)	PRIVATE (ACRES)
KGRA: East Mesa		38,365	32,725 ⁽¹⁾ (Bu. Rec.)		4,840 ⁽¹⁾⁽²⁰⁾
LAND LEASED IN KGRA			11,770 ⁽¹⁵⁾		
HIGHEST-PRICED LEASES (BY DOLLARS/ACRE) (15)			2,549		
\$/ACRE	LESSEE				
169.80	Republic Geothermal				
130.91	Republic Geothermal & City of Burbank				
3.27	Republic Geothermal				
2.25	Magma Power Co.		1,596 2,560 1,868		
TENTATIVE LEASE SALE DATES 9/21/78 - USFS & BLM ⁽¹⁴⁾					
NUMBER OF SALES OFFERED BUT NO BIDS: 8 ⁽¹⁵⁾					
NUMBER OF BIDS REJECTED (RESULTING IN NO LEASE): 0 ⁽¹⁵⁾			18,399		
SUBSURFACE AREA OF RESERVOIR		6,919 ⁽⁸⁾			

SUMMARY OF LEASING STATUS AND NEEDS: The center of the KGRA, where land is being held for the ERDA test facility, has the greatest resource potential. Land surrounding the test facility has been withheld from leasing for possible water development. Leased land is at the north and south portions of the KGRA. Land held by Republic in the north may not be adequate to sustain a 50 MWe plant without additional leasing. Land that was reoffered and not bid upon is in a less desirable location than the land withheld by the BuRec.(47)

SITE: EAST MESA, CA

GEOHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
<p>U.S. Bureau of Reclamation is operating a multiple flashed-steam water desalination pilot plant to investigate the potential of using geothermal waters as a source of fresh water for the Colorado River. Two desalting plants, a multistage flash distillation unit, and a vertical tube evaporator distillation unit are being used. Each unit is designed to produce 151,416 to 378,541 liters (20,000 to 50,000 gallons) of distilled water per day.(1)</p> <p>The City of Burbank exploratory drilling of 1975 failed to produce water hot enough for electric power.(1)</p> <p>Five deep test wells more than 1,800 meters (5,500 feet) in depth were completed by August 1975. Included were 3 wells drilled by Republic Geothermal on their Federal leases (with reservoir evaluation expected to continue beyond 1975).(1)</p> <p>As of February 1977, a total of 9 wells had been drilled.(17)</p> <p>Bureau of Reclamation tests of the desalination facility indicate that it is technically feasible. The BuRec will continue to collect reservoir information through 1977, and will conduct production and reinjection tests. They have a seismic net in operation and EPA is monitoring air quality. The BuRec is monitoring pressures in the formation and pressures to reinject, and is experimenting with an evaporative spray system.(23)</p> <p>The University of California, Riverside, is studying the geology, geochemistry, and geophysics of a portion of East Mesa. The Lawrence Berkeley Laboratory (LBL) is involved in the component test facility for experiments in brine utilization and in reservoir testing. LBL is actively working on educating the private sector about geothermal development and specifically about the component test facility.(23)</p>	<p>As of August 1975, an ERDA field test facility to evaluate development components was planned for the Bureau of Reclamation East Mesa site.(1)</p> <p>Magma Power Co. has applied for a permit to construct a 10 MWe geothermal power plant for research and development at East Mesa on Federal land.(14) The San Diego Gas and Electric Co. is working with Magma Power on the proposed 10 MWe pilot plant. The Imperial Magma Co. is planning the 10 MWe pilot plant with the Magmamax design, which has 2 turbine generators (1 with an isobutane loop and 1 with a propane loop), and cooling by use of a spray pond. Imperial Magma Co. hopes that the plant will be operating in 1978.(23)</p> <p>Republic Geothermal has indicated that it intends to build a 36 MWe power plant which could be operating by the early 1980s.(37)</p>

SITE: EAST MESA, CA

GEOTHERMAL DEVELOPMENT STATUS (CONTINUED)

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
<p>In May 1977, ERDA issued its first loan guarantee under the Geothermal Corp. of Santa Fe Springs, CA. The loan guarantee is to be used for drilling wells and is for \$9.03 million (75% of the \$12 million total cost of the drilling project). Each well drilled by Republic Geothermal must produce 2 MW to be considered a viable well by ERDA.⁽³⁷⁾</p> <p>By June 1977, a 50 MWe power plant application from Magma was received by the BLM for land in the southern portion of the KGRA.⁽⁴⁷⁾</p>	

SITE: EAST MESA, CA

INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)
		Environmental work that has been completed or is currently underway includes an EIS, power plant and Lawrence Livermore studies.(47)

SITE: EAST MESA, CA

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds
 Precipitation (Annual): 20.3 cm (< 8 inches)⁽⁶⁾
 Average Temperature
 Minimum: 10.0 to 15.6°C (50-60°F)
 Maximum: 32.2 to 37.8°C (90-100°F)

Relative Humidity
 (Seasonal Peaks)
 Summer: 30%
 Winter: 40-50%

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
	Available water used primarily for irrigation. ⁽⁶⁾		Creosote, bush- bur sage. ⁽⁶⁾		

SITE: EAST MESA, CA

POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR:

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES NEAR SITE	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
Holtville	11 km (7 miles)	3,686 ⁽⁶⁾	A 161 kv line running east-west is located 8 km (5 miles) south of the site, terminating at the 187.6 MW steam plant at El Centro (<32 km or <20 miles west of East Mesa). The line and plant are owned by the Imperial Irrigation District (municipal).(33-II)	Interstate 8, 8 km (5 miles) from the site.(6)	None.(6)
El Centro	26 km (16 miles)	19,280			
Heber	26 km (16 miles)	800			

RECORD 00008

GEO THERMAL RESOURCES FILE (GEOTHERM) REVISION E

SECTION A-- GEO THERMAL FIELD-AREA

RECORD IDENTIFICATION

RECORD NO..... 0000300

CROSS INDEX NO.. CF00501

RECORD TYPE..... A

NAME..... J. RENNER, J. P. CALZIA

DATE..... 74/12

ORGANIZATION.. U.S.G.S.

GEOGRAPHIC LOCALITY

GEO THERMAL FIELD-AREA.. EAST MESA

COUNTRY CODE..... US

STATE/PROVINCE..... CALIFORNIA

LATITUDE..... 32-47-00N

COUNTRY NAME..... UNITED STATES

COUNTY..... IMPERIAL

LONGITUDE..... 115-15-00W

TOWNSHIP RANGE SECTION 1/4 1/4
16S 17E 6 SE

BASE & MERIDIAN..... SAN BERNARDINO

AVAILABLE MAPS OF AREA: HOLTVILLE EAST, 124000

GENERAL DESCRIPTION

ELEVATION..... 7.62 M 25. FT

RESOURCE CATEGORY..... B

PRESENT USE & DEVELOPMENTS: 5 DEEP WELLS 1500 TO 2450M

SURFACE THERMAL ACTIVITY..... NO VISIBLE MANIFESTATION, FOUND BY HEAT FLOW ANOMALY, FOUND BY RESISOMALY, FOUND BY DRILLING

GEO THERMAL CHARACTERISTICS

WELL INFORMATION

MAXIMUM WELL TEMPERATURE..... 200. C TO 2450. M

BOTTOM-HOLE TEMPERATURE..... 200.0 C TO 2450.00 M

RESERVOIR PROPERTIES

RESERVOIR TEMPERATURES..... 150. C TO 225. C ASSUMED

BEST ESTIMATE..... 180.0 C

SUBSURFACE AREA..... 5.0 KM**2 TO 56.0 KM**2

BEST ESTIMATE..... 28.0 KM**2

BASED ON: 8 F/100 FT. GRAD. BUR REC. 1972

DEPTH TO TOP OF RESERVOIR..... 700.00 M 0.700 KM TO 1500.00 M 1.500 KM

BEST ESTIMATE..... 1000.00 M 1.000 KM TO 3000.00 M 3.000 KM

DEPTH TO BOTTOM OF RESERVOIR.. 3000.00 M 3.000 KM TO 3000.00 M 3.000 KM

BEST ESTIMATE..... 3000.00 M 3.000 KM TO 2300.00 M 2.300 KM

THICKNESS OF RESERVOIR..... 1500.00 M 1.500 KM TO 2300.00 M 2.300 KM

BEST ESTIMATE..... 2000.00 M 2.000 KM TO 128.000 KM**3

VOLUME OF RESERVOIR..... 7.500 KM**3 TO 128.000 KM**3

BEST ESTIMATE..... 56.000 KM**3

COMMENTS: DEPTHS TO TOP & BOTTOM OF RESERVOIR ARE ASSUMED.

RESERVES

TOTAL STORED HEAT..... 2.5116E+18 J 5.9999E+17 CAL TO 6.7390E+19 J 1.6099E+19 CAL

BEST ESTIMATE..... 2.3023E+19 J 5.4999E+18 CAL ABOVE 15. C

GEOLOGY

GENERAL ROCK TYPES: COLORADO RIVER DELTAIC DEPOSITS

GEOPHYSICS

GRAVITY SURVEY INFORMATION: TEST MADE
SEISMIC SURVEY INFORMATION: SEISMIC NOISE, MICROEARTHQUAKES
ELECTRICAL RESISTIVITY: DC RESISTIVITY TEST MADE
OTHER GEOPHYSICAL INFORMATION: HEAT FLOW, TEMPERATURE GRADIENT

PRIMARY REFERENCE:

AUTHOR..... D.E. WHITE & D.L. WILLIAMS, EDITORS
DATE..... 1975
TITLE..... ASSESSMENT OF GEOTHERMAL RESOURCES OF THE UNITED STATES - 1975
REFERENCE... U.S.G.S. CIRCULAR 726

RELATED REFERENCES:

- 1) DUTCHER, L.C. AND OTHERS, 1972, PRELIMINARY APPRAISAL OF GROUND WATER IN STORAGE WITH REFERENCE TO GEOTHERMAL RESOURCES IN THE IMPERIAL VALLEY AREA, CALIFORNIA: U.S.G.S. CIRC. 649, 57 P.
- 2) U.S. BUREAU OF RECLAMATION, 1972, GEOTHERMAL RESOURCE INVESTIGATION, IMPERIAL VALLEY, CALIFORNIA DEVELOPMENTAL CONCEPTS: U.S. DEPT. INT. BUR. RECLAMATION, 58P.
- 3) U.S. BUREAU OF RECLAMATION, 1973, GEOTHERMAL RESOURCE INVESTIGATIONS, IMPERIAL VALLEY, CALIF., SPECIAL REPORT, TEST WELL MESA 6-1: U.S. DEPT. INT., BUR. RECLAMATION

SITE: THE GEYSERS, CA (LIQUID-DOMINATED)

SITE: THE GEYSERS (HYDRO), CA (STATE/PRIVATE LAND)
POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
SLC, County	Process Environmental Reports (EIR)	State DEQ	_____										
SLC, Owner	Lease Land	Developer		_____									
DOG	Issue Drilling Permits	Developer		_____									
Developer	Preliminary Geophysical Exploration				_____								
Developer	Exploratory Drilling and Reservoir Evaluation			_____	_____								
Developer	Develop Utility Interest				_____								
Developer and Utility	Feasibility Study				_____								
Producer (Developer) and Utility	Financial Negotiations					_____							
Producer	Site Selection						_____						
Producer and Utility	Commitment to Development						_____ Δ						
Producer and Utility	Design						_____	_____					
Utility	Prepare Environmental Data Statement	CPUC, County, CERCDC					_____						
CERCDC, CPUC	Certify Plant and Site, Issue Permits	Producer and Utility					_____	_____					
County, DOG	Process EIR (Drilling)	State DEQ						_____					
CPUC	Process EIR (Plant)	State DEQ						_____					
CPUC	Process EIR (Transmission Line)	State DEQ											
Producer	Development Drilling									_____	_____		
Utility	Plant Construction									_____	_____		
Utility	Install Transmission Line									_____	_____		

Possible Subsequent Additions (MWe) and On Line Date: 100 - 1986, 100 - 1987, 100 - 1988, 100 - 1989, 100 - 1990, 100 - 1991, 100 - 1992, 100 - 1993, 100 - 1994

SITE: GEYSERS, CA (LIQUID-DOMINATED)

(REGION 1)

Liquid-dominated resources may be found at the periphery of the Geysers KGRA. Although numerous steam-producing wells have been drilled at the Geysers, only one hot water well (near Clear Lake) has been drilled. It was drilled and abandoned in the early 1960's.⁽⁴⁷⁾

Detailed information on the Geysers resource is contained in the following "GEYSERS, CA (STEAM)" data file.

SITE: THE GEYSERS, CA (STEAM)

SITE: GEYSERS, CA (STEAM) (REGION 1)

SUMMARY

TEMPERATURE °C
Surface: 101°C⁽⁷⁾ Subsurface: ~240°C⁽⁷⁾

TOTAL DISSOLVED SOLIDS (PPM):
ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS): 1722⁽¹⁾ 1574⁽⁷⁾
TYPE OF OVERLAYING ROCK: Medium
ESTIMATED DEPTH TO TOP OF RESERVOIR (METERS):

DESCRIPTION OF KGRA

Total KGRA Acres:	
Total Federal Acres:	Total State and Private Acres:
Federal Acres Leased:	State and Private Acres Leased:

GEOHERMAL DEVELOPMENT STATUS: Extensive development of vapor-dominated source. 500 MWe currently being produced,⁽²⁾ with an additional 400 MWe projected by 1979.⁽²³⁾

LOCAL AND STATE ATTITUDE TOWARD GEOTHERMAL DEVELOPMENTS:

LAND USE AND POPULATION: Extensive geothermal development at the site. Outlying area is open woodland, grazed, with rural population.

COMMENTS AND CRITICAL ISSUES: The resource is vapor-dominated, although hydrothermal domination may occur at the periphery of the resource.⁽²⁷⁾ Pending the Supreme Court ruling on homestead land, little additional Federal land is leasable.⁽⁴⁷⁾

SITE: THE GEYSERS, CA

SITE: GEYSERS, CA (STEAM)

SITE LOCATION AND PHYSICAL DESCRIPTION

LATITUDE: 38° 48' N

LONGITUDE: 122° 48' W

COUNTY: Sonoma

ADJACENT COUNTIES: Mendocino, Lake, Napa, Marin

LAND OWNERSHIP: A portion of the 50,000 acre Mendocino National Forest is in the KGRA.(47)

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
	Extensive geothermal development at the site. Outlying area is open woodland, grazed.(6)			Fort Ross and Luther Burbank House and Garden Historical Landmarks within 97 km (60 miles) of the site.(6)

SITE: GEYSERS, CA (STEAM)

RESERVOIR CHARACTERISTICS AND GEOLOGICAL/GEOPHYSICAL DESCRIPTION

RESERVOIR TEMPERATURE

Surface: 101°C⁽⁷⁾
Subsurface: ~240°C⁽⁷⁾ System is vapor-dominated; periphery may be liquid-dominated.⁽²⁷⁾
Well temperatures are consistently within the range of 230-250°C.⁽²⁸⁾

Geochemical

SiO₂: (Not applicable)⁽⁷⁾
Na-K-Ca:

TOTAL DISSOLVED SOLIDS (TDS):

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe, 30 YEARS): 1722⁽¹⁾ 1574⁽⁷⁾

2000 steam, 1000 hot water--USGS estimate.⁽⁴⁷⁾

TYPE OF OVERLAYING ROCK: Jurassic--Cretaceous graywackes and shales, basalt.⁽²⁸⁾

ESTIMATED DEPTH TO TOP OF RESERVOIR: .

SEISMIC ACTIVITY:

SITE: GEYSERS, CA (STEAM)

LAND OWNERSHIP AND LEASING

		TOTAL AREA (ACRES)	FEDERAL (ACRES)	STATE (ACRES)	PRIVATE (ACRES)
KGRA: Geysers-Calistoga		374,910 ⁽⁹⁾			
LAND LEASED IN KGRA			8,755 ⁽¹⁵⁾		
HIGHEST-PRICED LEASES (BY DOLLARS/ACRE) ⁽¹⁵⁾					
\$/ACRE	LESSEE				
1367.52	Shell Oil Co.				
1021.00	Occidental Petroleum				
847.46	Shell Oil Co.				
508.18	Union Oil Co.				
TENTATIVE LEASE SALE DATES 6/21/77 - BLM ⁽⁴⁷⁾ 3/9/78 - (Indian Valley) ⁽⁴⁷⁾					
NUMBER OF SALES OFFERED BUT NO BIDS:					
NUMBER OF BIDS REJECTED (RESULTING IN NO LEASE): 2 ⁽¹⁵⁾					
SUBSURFACE AREA OF RESERVOIR 70 km ²		17,290 ⁽⁷⁾			

SUMMARY OF LEASING STATUS AND NEEDS: A total of approximately 140,000 acres of Federal and private land have been leased in and around the KGRA. Little additional Federal leasing can occur unless the Supreme Court rules that the Federal Government has the mineral rights to homestead land.⁽⁴⁷⁾

SITE: GEYSERS, CA (STEAM)
GEOHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
<p>By February 1973, wells up to 2,743 (9,000 feet) had been drilled. One well had a flow of 172,365 kg/hr (380,000 lb/hr) although a flow of 90,178 kg/hr (2000,000 lb/hr) was more typical.(29)</p> <p>More than 100 wells drilled by 1975.(7)</p> <p>By June 1976, Pacific Gas and Electric (PG&E) had 500 MWe of plant installation in 11 units. Over 150 holes were drilled across 18 mi², of which 2 in 3 encountered steam. Most of the other wells are hot but non-productive.(2)</p> <p>The largest generating unit at Geysers produces 106 MWe.(28)</p> <p>In March 1977, Pacific Gas and Electric (PG&E) was in the process of building additional power units at Geysers. PG&E expects to add another 406 MW of power by 1979.(23)</p> <p>Other industry involvement includes Shell Oil Co., Amin Oil, Union Oil, Magma Power,(24) Thermal Power, Pacific Energy Co., Burmah Oil, and Sun Oil.(2)</p>	<p>By 1985, development is projected to exceed 1500 MWe, and field limits and dimensions should be known.(2)</p>

SITE: GEYSERS, CA (STEAM)

INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)

SITE: GEYSERS, CA (STEAM)

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds
 Precipitation (Annual): 81.3 to 121.9 cm (32 to 48 inches)⁽⁶⁾
 Average Temperature
 Minimum: 4.4 to 10.0°C (40-50°F)⁽⁶⁾
 Maximum: 15.6 to 21.1°C (60-70°F)

Relative Humidity
 (Seasonal Peaks)
 Summer: 70-80%⁽⁶⁾
 Winter: 60-70%

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
	Russian River 5 km (3 miles) from site. Numerous lakes and reservoirs in area. (6)		California mixed evergreen forest. ⁽⁶⁾		

SITE: GEYSERS, CA (STEAM)

POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR:

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES NEAR SITE	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
Geyserville	5 km (3 miles)	750 ⁽⁶⁾	One 115 kv line from the North and two 115 kv lines from the South converge at the 559.4 MW geothermal steam plant at Geysers. The lines and plant are owned by the Pacific Gas and Electric Co. (private). (33-II)	Federal Hwy. 101 5 km (3 miles) from site.(6)	Rail line, airport and natural gas pipelines near site. (6)
Lytton	10 km (6 miles)	160 ⁽⁶⁾			
Middletown	13 km (8 miles)	750 ⁽⁶⁾			
Calistoga	15 km (9 miles)	1,875 ⁽⁶⁾			
Healdsburg	12 km (7 miles)	4,816 ⁽⁶⁾			

RECORD 00006

GEOHERMAL RESOURCES FILE (GEOHERM) REVISION 8

SECTION A.- GEOHERMAL FIELD-AREA

RECORD IDENTIFICATION

RECORD NO..... 0000272
CROSS INDEX NO.. CFC0301
RECORD TYPE..... A

NAME..... D. E. WHITE AND D. L. WILLIAMS
DATE..... 75/04
ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOHERMAL FIELD-AREA.. THE GEYSERS
WARNING FIGURE..... 8
COUNTRY CODE..... US
STATE/PROVINCE..... CALIFORNIA
LATITUDE..... 38-46- N

WARNING NUMBER..... 72, 73, 74, 62, 63
COUNTRY NAME..... UNITED STATES
COUNTY..... SONOMA & LAKE
LONGITUDE..... 122-48- W

TOWNSHIP RANGE SECTION 1/4 1/4
11N 09W 13 NE

BASE L MERIDIAN..... MT. DIABLO
AVAILABLE MAPS OF AREA: THE GEYSERS 1:24000

GENERAL DESCRIPTION

SIZE OF SURFACE EXPRESSION.... 1.0 KM**2
ELEVATION..... 548.64 M 1800. FT
RESOURCE CATEGORY..... A
PRESENT USE & DEVELOPMENTS: GENERATION OF ELECTRIC POWER
SURFACE THERMAL ACTIVITY..... HOT SPRINGS, FUMARoles
NO. OF HOT SPRINGS..... 20
ELECTRIC POWER CAPACITY..... 5.0000E+08 J/S 500. MW
NUMBER OF WELLS: NO. WELLS TOTAL.. GT 100

GEOHERMAL CHARACTERISTICS

NATURAL SURFACE DISCHARGE..... 1.67 L/S 100. L/MIN ESTIMATED
SPRING TEMPERATURES..... 20. C TO 101. C
WELL INFORMATION
MAXIMUM WELL TEMPERATURE..... 240. C TO 2000. M
BOTTOM-HOLE TEMPERATURE..... 240. C TO 3000. M

RESERVOIR PROPERTIES

RESERVOIR TEMPERATURES..... 170. C TO 240. C ASSUMED
BEST ESTIMATE..... 240. C
SUBSURFACE AREA..... 80. KM**2 TO 90. KM**2
BEST ESTIMATE..... 70. KM**2
BASED ON: DRILLING, LEASING, AND GEOPHYSICS
DEPTH TO TOP OF RESERVOIR..... 100.00 M .10 KM TO 1500.00 M 1.5 KM
BEST ESTIMATE..... 1000.00 M 1. KM
DEPTH TO BOTTOM OF RESERVOIR.. 3000.00 M 3.0 KM TO 3000.00 M 3.0 KM
BEST ESTIMATE..... 3000.00 M 3.0 KM
THICKNESS OF RESERVOIR.....
BEST ESTIMATE..... 2000.00 M 2.0 KM
VOLUME OF RESERVOIR..... 120.0 KM**3 TO 180.0 KM**3
BEST ESTIMATE..... 140.0 KM**3
PEROSITY..... .01 TO .10

BEST ESTIMATE..... .05
 AVERAGE WELL FLOW..... 12.50 KG/S 45000. KG/HR TO 70000. KG/HR
 COMMENTS: RESERVOIR PROBABLY CONTINUES TO 4 KM DEPTH? ESTIMATED PRESENT CONDUCTIVE HEAT FLOW FROM TOP OF RESERVOIR
 10.560 CAL/SEC FROM ASSUMED 70 KM**2. THIS WOULD REQUIRE ABOUT 57000 YEARS TO SUPPLY EST. STORED HEAT. PRESENT
 PRODUCTION OF HEAT IN STEAM, 500 MW, 9 KG/KWHR, 670 CAL/GM IS 3.04E12 CAL/HR OR ABOUT 80 TIMES ESTIMATED NATURAL
 HEAT FLOW.

RESERVES
 TOTAL STORED HEAT..... 6.7781E+19 J 16.2E18 CAL TO 1.0167E+20 J 24.3E18 CAL
 BEST ESTIMATE..... 7.9676E+19 J 18.9E18 CAL ABOVE 15. C

GEOLOGY
 GENERAL ROCK TYPES: FRANCISCAN GRAYWACKE, GREENSTONE, SERPENTINE

GEOPHYSICS
 GRAVITY SURVEY INFORMATION: TEST MADE
 MAGNETIC SURVEY INFORMATION: TEST MADE
 SEISMIC SURVEY INFORMATION: SEISMIC NOISE, MICROEARTHQUAKES
 ELECTRICAL RESISTIVITY: DC RESISTIVITY TEST MADE

PRIMARY REFERENCE:
 AUTHOR..... D. E. WHITE AND D. L. WILLIAMS, ED.
 DATE..... 1975
 TITLE..... ASSESSMENT OF GEOTHERMAL RESOURCES OF THE UNITED STATES - 1975
 REFERENCE... USGS CIRCULAR 726

RELATED REFERENCES:
 1) ALLEN, E. T., AND DAY, A. L., 1927, STEAM WELLS AND OTHER THERMAL ACTIVITY AT THE GEYSERS, CALIF.: CARNEGIE
 INST. WASHINGTON PUB. 376
 2) MC NITT, J. R., 1963, EXPLORATION & DEVELOPMENT OF GEOTHERMAL POWER IN CALIFORNIA: CALIF. DIV. OF MINES AND
 GEOLOGY, SPEC. REPORT 75
 3) RAMEY, H. J., JR., 1970, A RESERVOIR ENGINEERING STUDY OF THE GEYSERS GEOTHERMAL FIELD: EVIDENCE REICH AND
 REICH, PETITIONERS VS. COMMISSIONER OF INTERNAL REVENUE, 1969, TAX COURT OF THE UNITED STATES, 52. T. C. NO. 74,
 36 P.

SITE: GLASS MOUNTAIN/DIABLO, CA

SITE: GLASS MOUNTAIN/DIABLO, CA (FEDERAL LAND)
POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
USFS	Process Environmental Reports (EIS)	CEQ											
USFS	Lease Land	Developer											
USGS	Issue Drilling Permits	Developer											
Developer	Preliminary Geophysical Exploration												
Developer	Exploratory Drilling and Reservoir Evaluation												
Developer	Develop Utility Interest												
Developer and Utility	Feasibility Study												
Producer (Developer) and Utility	Financial Negotiations												
Producer and Utility	Site Selection												
Producer and Utility	Commitment to Development												
Producer and Utility	Design												
Producer and Utility	Prepare Master Development Plan	USFS, USGS											
Producer and Utility	Prepare Environmental Data Statement	USFS, FPC, CPUC, CERCDC, County											
USFS, FPC, USGS, CPUC, CERCDC	Certify Plant and Site, Issue Permits	Producer and Utility											
USGS	Process EIA/EIS (Drilling)	CEQ											
FPC	Process EIA/EIS (Plant)	CEQ											
FPC	Process EIA/EIS (Transmission Line)	CEQ											
Producer	Development Drilling												
Utility	Plant Construction												
Utility	Install Transmission Line												

SITE: GLASS MOUNTAIN/DIABLO, CA (REGION 1)

SUMMARY

TEMPERATURE °C

Surface:

Subsurface: >200°C⁽²⁰⁾

TOTAL DISSOLVED SOLIDS (PPM):

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS): 50-2000⁽²⁰⁾

TYPE OF OVERLAYING ROCK:

ESTIMATED DEPTH TO TOP OF RESERVOIR (METERS):

DESCRIPTION OF KGRA

Total KGRA Acres: 33,287⁽⁹⁾ 33,502⁽¹⁾

Total Federal Acres:

Federal Acres Leased:

Total State and Private Acres:

State and Private Acres Leased:

GEOTHERMAL DEVELOPMENT STATUS: Preliminary exploration had taken place by March 1976, and considerable commercial interest was expressed through noncompetitive lease applications.⁽¹⁾

LOCAL AND STATE ATTITUDE TOWARD GEOTHERMAL DEVELOPMENTS:

LAND USE AND POPULATION: Site is in a heavily populated area, 2 km (1 mile) from State Park and Game Reserve,⁽⁶⁾ in open low mountains.

COMMENTS AND CRITICAL ISSUES: Seismically active area.⁽⁶⁾ In Cascade Mountain Range (see Baker H.S., WA, Lassen and Mount Hood, CA). One moist air vent is the only surface indication of geothermal activity. Noncompetitive leasing interest has been expressed outside of the KGRA. The Forest Service general land use plan should be complete by March 1978.⁽⁴⁷⁾

SITE: GLASS MOUNTAIN/DIABLO, CA

SITE: GLASS MOUNTAIN/DIABLO, CA

SITE LOCATION AND PHYSICAL DESCRIPTION

LATITUDE: 37° 50' 06" N

LONGITUDE: 121° 58' 30" W

COUNTY: Contra Costa

ADJACENT COUNTIES: San Joaquin, Alameda

LAND OWNERSHIP: The KGRA is mostly in the Modoc National Forest, and is south of the National Mountain (owned by the Department of the Interior). Klamath and Shasta Trinity Forest are outside the KGRA.(47)
The National Forest is currently interested in annexing part of Glass Mountain.(47)

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
Open low (6) mountains.	2 km (1 mile) from Mt. Diablo State Park and Game Refuge. In a built- up area.(6)			

SITE: GLASS MOUNTAIN/DIABLO, CA

RESERVOIR CHARACTERISTICS AND GEOLOGICAL/GEOPHYSICAL DESCRIPTION

RESERVOIR TEMPERATURE

Surface:
Subsurface: >200°C⁽²⁰⁾

Geochemical
SiO₂:
Na-K-Ca:

TOTAL DISSOLVED SOLIDS (TDS):

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe, 30 YEARS): 50-2000⁽²⁰⁾

TYPE OF OVERLAYING ROCK: At lower end of Cascade Mountain Range which continues to Canadian border. (See Baker H.S., WA; Lassen, CA; and Mount Hood, OR).
One moist air vent at ~ 38°C (100° F) is the only surface indication of hydrothermal activity.(47)

ESTIMATED DEPTH TO TOP OF RESERVOIR:

SEISMIC ACTIVITY: Area is seismically very active.⁽⁶⁾

SITE: GLASS MOUNTAIN/DIABLO, CA

LAND OWNERSHIP AND LEASING

		TOTAL AREA (ACRES)	FEDERAL (ACRES)	STATE (ACRES)	PRIVATE (ACRES)
KGRA: Glass Mountain and Addition		33,287 ⁽⁹⁾	32,601 (F.S.) ⁽¹⁾	901 (State and Private) ⁽¹⁾	
LAND LEASED IN KGRA					
HIGHEST-PRICED LEASES (BY DOLLARS/ACRE)					
\$/ACRE	LESSEE				
TENTATIVE LEASE SALE DATES					
NUMBER OF SALES OFFERED BUT NO BIDS:					
NUMBER OF BIDS REJECTED (RESULTING IN NO LEASE):					
SUBSURFACE AREA OF RESERVOIR					

SUMMARY OF LEASING STATUS AND NEEDS: Noncompetitive interest has been expressed for Klamath, Shasta Trinity and Modoc Forests (outside the KGRA). Leasing decisions for Klamath Forest are expected sometime in 1977.⁽⁴⁷⁾

SITE: GLASS MOUNTAIN/DIABLO, CA

GEOHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
<p>As of March 1976, preliminary exploration had taken place. Considerable commercial interest was expressed (through noncompetitive lease applications).(1)</p>	

SITE: GLASS MOUNTAIN/DIABLO, CA

INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)
There is an anticipated need for an EAR which would specifically address geothermal activity. ⁽⁴⁷⁾		By March 1978, it is expected that a general land management plan which includes the KGRA will be completed by the Forest Service. ⁽⁴⁷⁾

SITE: GLASS MOUNTAIN/DIABLO, CA

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds
 Precipitation (Annual): 40.6 to 61.0 cm (16-24 in.)
 Average Temperature
 Minimum: 4.4°C to 10.0°C (40-50°F)
 Maximum: 15.6°C to 21.1°C (60-70°F)

Relative Humidity
 (Seasonal Peaks)
 Summer: 70-80%
 Winter: 70-80%

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
	Numerous waterways in area. 25 km (16 miles) from San Francisco Bay.		California steppe and California oakwoods. ⁽⁶⁾		

SITE: GLASS MOUNTAIN/DIABLO, CA

POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR: Dense population in an urban area
(as defined by the U.S. Bureau of the Census) (6)

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES NEAR SITE	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
Diablo	0	800 ⁽⁶⁾	Within 32 km (20 miles) of the site there are 40, 80, 1253.6 and 2,028.9 MWe steam plants owned by the Pacific Gas and Electric Co. (private), and a 48.0 combustion turbine plant owned by the Dow Chemical Co., (industrial). There are numerous transmission lines in the area. (33-II)	Interstate 680 ⁽⁶⁾ near the site.	Rail line 2 km (1-1/2 miles) from site. Air service in area. Crude oil and natural gas pipelines near site. (6)
Oakland	17 km (10 miles)	378,000 ⁽⁶⁾			
Walnut Creek	9km (6 miles)	23,368 ⁽⁶⁾			

SITE: HEBER, CA

SITE: HEBER, CA (STATE/PRIVATE LAND)

POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
SLC, Owner	Issue Prospecting/Exploration Permits	Developer											
SLC, County Government	Process EIR	State DEQ											
SLC, Owner	Lease Land	Developer											
County Government	Issue Land Use Permits												
DOG	Issue Drilling Permits												
Developer	Preliminary Geophysical Exploration												
Developer	Utility Identified												
Developer	Exploratory Drilling and Reservoir Evaluation												
Developer	Site Selection												
Developer and Utility Producer (Developer) and Utility	Feasibility Study												
	Financial Negotiations												
Producer and Utility	Process Notice of Interest												
Producer and Utility	Commit to Development												
Utility	Prepare Environmental Data Statement	CPUC, CERCDC											
CERCDC, CPUC	Certify Plant and Site, Issue Permits	County Government											
Producer and Utility	Design (Preliminary, Final)	Producer and Utility											
County, CPUC, DOG	Process EIR												
Producer	Development Drilling												
Utility	Plant Construction												
Utility	Install Transmission Line												

Possible Subsequent Additions (MWe) and On line Date: 50 - 1987, 100 - 1989, 100 - 1990, 100 - 1991, 100 - 1992, 100 - 1993, 100 - 1994, 100 - 1995, 100 - 1996, 100 - 1997

SITE: HEBER, CA (REGION 1)

SUMMARY

TEMPERATURE °C

Surface:

Subsurface: 190

TOTAL DISSOLVED SOLIDS (PPM):

14,000⁽¹³⁾ up to 25,000⁽²³⁾

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS):

973⁽¹⁾

TYPE OF OVERLAYING ROCK:

Soft

ESTIMATED DEPTH TO TOP OF RESERVOIR (METERS):

1,000

DESCRIPTION OF KGRA

Total KGRA Acres: 58,568

Total Federal Acres: 0

Federal Acres Leased: 0

Total State and Private Acres: 58,568

State and Private Acres Leased:

GEOHERMAL DEVELOPMENT STATUS:

In April 1977 tentative plans for a 65 MWe binary cycle generating unit were underway.⁽³⁸⁾ EPRI agreed to contribute \$4.5 million to the project.⁽¹⁶⁾ Numerous tests are underway, and environmental baseline data have been collected.⁽²²⁾

LOCAL AND STATE ATTITUDE TOWARD GEOTHERMAL DEVELOPMENTS:

Numerous state and local regulations.^(1A)

LAND USE AND POPULATION:

Irrigated agricultural land. Generally sparse population. Heber population is 800.⁽⁶⁾

COMMENTS AND CRITICAL ISSUES:

Extremely flat topography sensitive to disturbance of runoff patterns.⁽¹³⁾ In seismically active area.⁽¹³⁾

SITE: HEBER, CA

SITE: HEBER, CA

SITE LOCATION AND PHYSICAL DESCRIPTION

LATITUDE: 32° 43' 00" N

LONGITUDE: 115° 31' 42" W

COUNTY: Imperial

ADJACENT COUNTIES: San Diego, Riverside, Yuma, Az., Mexico

LAND OWNERSHIP:

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
Extremely flat region lying mostly below sea level.(13)	Irrigated land used for agriculture.(6)			

SITE: HEBER, CA

RESERVOIR CHARACTERISTICS AND GEOLOGICAL/GEOPHYSICAL DESCRIPTION

RESERVOIR TEMPERATURE

Surface:
Subsurface: 190° C

Geochemical
SiO₂:
Na-K-Ca:

TOTAL DISSOLVED SOLIDS (TDS): 14,000 ppm, includes significant quantities of barium, calcium, strontium, sulfate and bicarbonate ions.⁽¹³⁾ TDS up to 250,000 ppm⁽²³⁾

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS): 973⁽¹⁾

TYPE OF OVERLAYING ROCK: Sandy Deltaic Sediments (soft).⁽⁸⁾

ESTIMATED DEPTH TO TOP OF RESERVOIR: 1000 M (3281 ft).⁽⁸⁾

SEISMIC ACTIVITY: Heber is in one of the most seismically active regions of North America. Numerous low-magnitude earthquakes have been recorded near Heber. It is projected that an earthquake of approximate magnitude 7.5 on the Richter Scale might occur once per century.⁽¹³⁾

SITE: HEBER, CA

LAND OWNERSHIP AND LEASING

		TOTAL AREA (ACRES)	FEDERAL (ACRES)	STATE (ACRES)	PRIVATE (ACRES)
KGRA: Heber		58,568 ⁽¹⁾	N/A		58,568 ⁽¹⁾ (20)
LAND LEASED IN KGRA			N/A		
HIGHEST-PRICED LEASES (BY DOLLARS/ACRE)					
\$/ACRE	LESSEE				
TENTATIVE LEASE SALE DATES					
NUMBER OF SALES OFFERED BUT NO BIDS:					
NUMBER OF BIDS REJECTED (RESULTING IN NO LEASE):					
SUBSURFACE AREA OF RESERVOIR		12,355 ⁽⁸⁾			

SUMMARY OF LEASING STATUS AND NEEDS:

SITE: HEBER, CA

GEOTHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
<p>In the Heber KGRA, Chevron Oil Company is performing hardware studies and resource assessment aimed at having a plant on line in the Heber area by early 1979. They are working with Magma Power Company and New Albion Resource Company and have nine wells drilled. As of August 1975, they were involved in resource assessment, brine tests, and heat exchanger tests.(1)</p> <p>Maximum flow rate of free-flowing wells drilled in the area is 198,000 kg/hr (440,000 lbs/hr).(13)</p> <p>Leaseholders at Heber have indicated an ability to supply hot brine and reinject cooled brine and cooling tower blowdown (waste-water) simultaneously at rates required for a power plant.(13)</p> <p>As of January 1977, the San Diego Gas and Electric Co. has invited the California Energy Resources Conservation and Development Commission (ERCDC) to participate in a proposed power plant project (65 MW binary cycle generating unit).(16)</p> <p>By February 1977, 8 wells were drilled;(20) Union Oil Co. drilled 5 of the wells.(22)</p> <p>The California Energy Resources Conservation and Development Commission in conjunction with the Ben Holt Co. is conducting heat exchanger tests (funded by the State and EPRI) at Heber. By January 1977, a 2,000 hour heat exchanger test was proven to be technically feasible. The brines had 13,000 to 14,000 ppm total dissolved salts at 175°C (346°F) and a pressure of 9.24 kg/cm² (130 psi).</p> <p>The San Diego Gas and Electric Co. has acquired environmental baseline data for the environmental impact report on the Heber anomaly.(22)</p>	<p>In April 1977, the San Diego Gas and Electric Co. was planning to construct a \$42 million 65 MWe binary cycle demonstration facility at a site one mile south of Heber. Construction was expected to start in mid 1978 with completion by mid 1980. Twenty of the 65 MWe would be used for on-site power. The remaining 45 MWe may be sold to the Imperial Irrigation District. It was planned that the proposed power plant would be designed, constructed, and operated by a consortium of utilities and the Electric Power Institute (EPRI) with SDG&E as project manager and holding majority ownership in the plant.(38)</p> <p>It is possible that Chevron, San Diego Gas and Electric, EPRI, ERDA, The Los Angeles Department of Water and Power, Southern California Edison Co. may all be involved in the development of the demonstration plant at Heber.(15,16) The Electric Power Research Institute has already agreed to contribute \$4.5 million to the project.(16)</p> <p>Ben Holt Co. and Bechtel have been working on plans for a commercial-scale demonstration plant at Heber.(22)</p>

SITE: HEBER, CA

INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF PROCEDURES (i.e., EIA/EIS WRITTEN)
<p>A Production Permit must be issued by Imperial County (it requires compliance with all other permits and regulations such as building, plumbing, electrical and construction permits). The most important and time-consuming requirement of the Production Permit is the Environmental Impact Report (EIR) which may require at least 10 months of lead time for data collection and report preparation.</p> <p>The State's District Air Pollution Control Board requires construction and operation permits.</p> <p>Imperial County requires underground installation of collection and reinjection pipes at geothermal sites. Air pollution standards are set by the Occupational Safety and Health Administration (OSHA) and by the California Air Resources Board. California Division of Oil and Gas (DOG) is responsible for determining that potable groundwater supplies are protected during oil-, gas-, and geothermal-field operations, and for assuring that subsidence will not occur.(13)</p>		<p>Environmental baseline data for the environmental impact report has been collected.(22)</p>

SITE: HEBER, CA

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds Summer from S.E. at 13.7 Kph (8.5 mph); winter from North at 11.3 Kph (7 mph).⁽¹³⁾
Precipitation (Annual): 6.73 cm (2.65 inches)
Average Temperature
Minimum: 12.2°C (54°F)
Maximum: 33.3°C (92°F)

Relative Humidity
(Seasonal Peaks)
Summer: 20% - 30%
Winter: 40%

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
	Water table of only 1.5 meters (5 feet). Series of irrigation canals from Colorado River. ⁽¹³⁾		Cresote bush, bur sage, salt- bush, grease- wood. ⁽⁶⁾		

SITE: HEBER, CA

POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR:

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES NEAR SITE	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
Heber	< 16 km (10 miles)	800	Heber is located 10 km (6 miles) south of the 187.6 MW steam plant at El Centro. The plant, which is owned by the Imperial Irriga- tion District (municipal), has two 161 kv lines and a 161 kv ca- pacity line opera- ting at 92 kv. (33-II)	State Highway 86 goes through town of Heber.(6)	Rail service in Heber. 56 cm (22") or smaller gas pipe- line within a few miles.(6) Good air service accessibility (13)
El Centro (County Seat)	10 km (6 miles)				

RECORD 00010

GEOHERMAL RESOURCES FILE (GEOHERM) REVISION 8

SECTION A.- GEOHERMAL FIELD-AREA

RECORD IDENTIFICATION

RECORD NO..... 0000298
CROSS INDEX NO.. CF00491
RECORD TYPE..... A

NAME..... . RENNER, J. P. CALZIA
DATE..... 74/12
ORGANIZATION.. U.S.G.S.

GEOGRAPHIC LOCALITY

GEOHERMAL FIELD-AREA.. HEBER
COUNTRY CODE..... US
STATE/PROVINCE..... CALIFORNIA
LATITUDE..... 32-43-00N

COUNTRY NAME..... UNITED STATES
COUNTRY..... IMPERIAL
LONGITUDE..... 115-31-42W

TOWNSHIP RANGE SECTION 1/4 1/4
16S 14E 29 SE

BASE & MERIDIAN..... SAN BERNARDINO
AVAILABLE MAPS OF AREA: HEBER 1:24,000

GENERAL DESCRIPTION

SIZE OF SURFACE EXPRESSION.... 0.0 KM**2
ELEVATION..... -1.5240E+00M -5. FT
RESOURCE CATEGORY..... B
PRESENT USE & DEVELOPMENTS: 8 WELLS DRILLED. HOLTZ #1 168C AT 1560 M (PERS. COM. BILL HARDT,
SURFACE THERMAL ACTIVITY..... NO VISIBLE MANIFESTATION, FOUND BY HEAT FLOW ANOMALY,

GEOHERMAL CHARACTERISTICS

WELL INFORMATION

BOTTOM-HOLE TEMPERATURE..... 168.0 C TO 1560.00 M

RESERVOIR PROPERTIES

RESERVOIR TEMPERATURES..... 150. C TO 225. C ASSUMED
BEST ESTIMATE..... 190.0 C
SUBSURFACE AREA..... 10.0 KM**2 TO 95.0 KM**2
BEST ESTIMATE..... 50.0 KM**2
BASED ON: 2 F/100 FT. CONTOUR
DEPTH TO TOP OF RESERVOIR..... 700.00 M 0.700 KM TO 1500.00 M 1.500 KM
BEST ESTIMATE..... 1000.00 M 1.000 KM
DEPTH TO BOTTOM OF RESERVOIR.. 3000.00 M 3.000 KM TO 3000.00 M 3.000 KM
BEST ESTIMATE..... 3000.00 M 3.000 KM
THICKNESS OF RESERVOIR..... 1500.00 M 1.500 KM TO 2300.00 M 2.300 KM
BEST ESTIMATE..... 2000.00 M 2.000 KM
VOLUME OF RESERVOIR..... 15.000 KM**3 TO 195.000 KM**3
BEST ESTIMATE..... 100.000 KM**3
COMMENTS: DEPTHS TO TOP & BOTTOM OF RESERVOIR ARE ASSUMED.

RESERVES

TOTAL STORED HEAT..... 5.0228E+18 J 1.1999E+18 CAL TO 1.0465E+20 J 2.4999E+19 CAL
BEST ESTIMATE..... 4.6042E+19 J 1.0799E+19 CAL ABOVE 15. C

GEOLOGY

GENERAL ROCK TYPES: SANDY DELTAIC SEDIMENTS

GEOPHYSICS

GRAVITY SURVEY INFORMATION: TEST MADE
ELECTRICAL RESISTIVITY: DC RESISTIVITY TEST MADE
OTHER GEOPHYSICAL INFORMATION: TEMPERATURE GRADIENT

PRIMARY REFERENCE:

AUTHOR..... D.E. WHITE & D.L. WILLIAMS, EDITORS
DATE..... 1975
TITLE..... ASSESSMENT OF GEOTHERMAL RESOURCES OF THE UNITED STATES - 1975
REFERENCE... U.S.G.S. CIRCULAR 726

RELATED REFERENCES:

- 1) DUTCHER, L.C. AND OTHERS, 1972, PRELIMINARY APPRAISAL OF GROUND WATER IN STORAGE WITH REFERENCE TO GEOTHERMAL RESOURCES IN THE IMPERIAL VALLEY AREA, CALIFORNIA: U.S.G.S. CIRC. 649, 57 P.
- 2) U.S. BUREAU OF RECLAMATION, 1972, GEOTHERMAL RESOURCE INVESTIGATION, IMPERIAL VALLEY, CALIFORNIA DEVELOPMENTAL CONCEPTS: U.S. DEPT. INT. BUR. RECLAMATION, 58P.

SITE: LASSEN, CA

SITE: LASSEN, CA (FEDERAL/STATE LAND)
POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
BLM,USFS,St. County	Process Environmental Reports (EIS, EIR)	CEQ											
BLM, FS,St.	Lease Land	Developer											
USGS, DOG	Issue Drilling Permits	Developer											
Developer	Preliminary Geophysical Exploration												
Developer	Exploratory Drilling and Reservoir Evaluation												
Developer	Develop Utility Interest												
Developer and Utility	Feasibility Study												
Producer (Developer) and Utility	Financial Negotiations												
Producer and Utility	Site Selection												
Producer and Utility	Commitment to Development												
Producer and Utility	Design												
Producer and Utility	Prepare Master Development Plan	BLM, USGS											
Utility	Prepare Environmental Data Statement	BLM, FPC, State, County											
BLM, FPC, State, USGS	Certify Plant and Site, Issue Permits	Producer and Utility											
USGS,DOG,Cty	Process EIA/EIS (Drilling)	CEQ,St.DEQ											
FPC,CPUC	Process EIA/EIS (Plant)	CEQ,St.DEQ											
FPC,CPUC	Process EIA/EIS (Transmission Line)	CEQ,St.DEQ											
Producer	Development Drilling												
Utility	Plant Construction												
Utility	Install Transmission Line												

Possible Subsequent Additions (MWe) and On Line Date: 50 - 1990

SITE: LASSEN, CA (REGION 1)

SUMMARY

TEMPERATURE °C
Surface: 95.5°C⁽⁷⁾ Subsurface: ~240°C⁽⁷⁾

TOTAL DISSOLVED SOLIDS (PPM):
ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS): 133 ⁽¹⁾
TYPE OF OVERLAYING ROCK: Quaternary volcanic rocks; some andesites and basalts. ⁽⁸⁾ Medium-hard.
ESTIMATED DEPTH TO TOP OF RESERVOIR (METERS): 1,000 ⁽⁸⁾

DESCRIPTION OF KGRA

Total KGRA Acres: 78,642	
Total Federal Acres: 54,640	Total State and Private Acres: 24,002
Federal Acres Leased:	State and Private Acres Leased:

GEOHERMAL DEVELOPMENT STATUS: As of March, 1976, preliminary exploration had taken place. ⁽¹⁾

LOCAL AND STATE ATTITUDE TOWARD GEOTHERMAL DEVELOPMENTS: Public opposition may occur due to scenic quality of the land. ⁽¹⁾

LAND USE AND POPULATION: Forest and woodland, grazed. ⁽⁶⁾

COMMENTS AND CRITICAL ISSUES: No defined utility or industry interest in geothermal development of the site. ⁽²⁰⁾ Located in Cascade Mountain Range. May be sensitive to development because site is in national forest.

SITE: LASSEN, CA

SITE: LASSEN, CA

SITE LOCATION AND PHYSICAL DESCRIPTION

LATITUDE: 40° 26' 00" N

LONGITUDE: 121° 26' 00" W

COUNTY: Tehama⁽⁶⁾

ADJACENT COUNTIES: Mendocino, Trinity, Shasta, Plumas, Butte, Glenn⁽⁶⁾

LAND OWNERSHIP: Federal--National Forest

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
Low and high mountains with more than 75% of gentle slope. (6)	Forest and woodland, some grazing, in Lassen National Forest which is adjacent to Lassen National Park. (6)		High scenic value. ⁽¹⁾	

SITE: LASSEN, CA

RESERVOIR CHARACTERISTICS AND GEOLOGICAL/GEOPHYSICAL DESCRIPTION

RESERVOIR TEMPERATURE

Surface: 95°C
Subsurface: ~240°C

Geochemical
SiO₂:
Na-K-Ca:

TOTAL DISSOLVED SOLIDS (TDS):

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe, 30 YEARS): 133⁽¹⁾

TYPE OF OVERLAYING ROCK: Quaternary volcanic rocks, mostly dacites and rhyodacites, some andesites and basalts.⁽⁸⁾ Located in the Cascades Mountain Range which extends from Canadian border into California. (Lassen is considered one of the most promising of the geothermal sites in the range. (See Mount Hood, OR; Glass Mountain/Diablo, CA; and Baker H.S., WA.) (27)

ESTIMATED DEPTH TO TOP OF RESERVOIR: 1000 m (3,281 feet)⁽⁸⁾

SEISMIC ACTIVITY:

SITE: LASSEN, CA

LAND OWNERSHIP AND LEASING

		TOTAL AREA (ACRES)	FEDERAL (ACRES)	STATE (ACRES)	PRIVATE (ACRES)
KGRA: Lassen		78,642	54,640 ⁽¹⁾ (F.S.)	24,002 ⁽¹⁾ (State and Private Land)	
LAND LEASED IN KGRA					
HIGHEST-PRICED LEASES (BY DOLLARS/ACRE)					
\$/ACRE	LESSEE				
TENTATIVE LEASE SALE DATES 1979 - May: F.S. and BLM land ⁽⁴⁷⁾ June: BLM(20)					
NUMBER OF SALES OFFERED BUT NO BIDS:					
NUMBER OF BIDS REJECTED (RESULTING IN NO LEASE):					
SUBSURFACE AREA OF RESERVOIR		11,609 ⁽⁸⁾			

SUMMARY OF LEASING STATUS AND NEEDS:

SITE: LASSEN, CA

GEOHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
<p>As of March, 1976, preliminary exploration had taken place. (1)</p> <p>As of March, 1977, there was no defined utility or industry interest. Geothermal development growth was expected to be slow. Two wells were drilled at Kelly Hot Springs. (20)</p>	

SITE: LASSEN, CA

INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)
	<p>Public opposition may occur due to the scenic quality of the land. (1)</p> <p>There is some concern (which may or may not be valid) that geothermal development at the KGRA could drain the National Park geothermal system. (47)</p>	

SITE: LASSEN, CA

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds
 Precipitation (Annual): 130.8 cm (51.5 inches) (5)
 Average Temperature
 Minimum: -1.1°C (30°F)
 Maximum: 17.2°C (60°F) (5)

Relative Humidity
 (Seasonal Peaks)
 Summer: 40-50%
 Winter: 60-70% (6)

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
			Mixed conifer forest. (6)		

SITE: LASSEN, CA

POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR:

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES NEAR SITE	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
Mineral (6)	8-16 km (5-10 mi.) (6)	125 (6)	There are two 500 kv lines owned by the Pacific Gas and Electric Co. (private) running N-S, within 32 km (20 miles) W. of the site. (33-II)	State Highway No. 36 <16 km (10 miles) (6)	Approximately 48 km (30 miles) to major 61 cm (24") gas pipeline. 80 km (50 miles) to minor 20-25 cm (8"-10") crude oil and products pipeline. 40-48 km (25-30 miles) from primary railroad. (6)

RECORD 00002

GEOHERMAL RESOURCES FILE (GEOHERM) REVISION 8

SECTION A.- GEOHERMAL FIELD-AREA

RECORD IDENTIFICATION

RECORD NO..... 0000274
CROSS INDEX NO.. LF00371
RECORD TYPE..... A

NAME..... D.E.WHITE
DATE..... 75/03
ORGANIZATION.. U.S.G.S.

GEOGRAPHIC LOCALITY

GEOHERMAL FIELD-AREA.. LASSEN
WARNING FIGURE..... 8
COUNTRY CODE..... US
STATE/PROVINCE..... CALIFORNIA
LATITUDE..... 40-26-00N

WARNING NUMBER..... 25-27, 34-
COUNTRY NAME..... UNITED STATES
COUNTY..... SHASTA-PLUMAS-TEHAMA
LONGITUDE..... 121-26-00W

TOWNSHIP RANGE SECTION 1/4 1/4
30N 05E 21 SW

BASE & MERIDIAN..... MT. DIABLO

AVAILABLE MAPS OF AREA: (SPECIAL MAP) LASSEN VOLCANIC NATIONAL PARK & VICINITY, CALIF. 1

GENERAL DESCRIPTION

SIZE OF SURFACE EXPRESSION.... 2.0 KM**2
ELEVATION..... 1628.80 M 6000. FT
RESOURCE CATEGORY..... A
SURFACE THERMAL ACTIVITY..... HOT SPRING(S), FUMAROLE OR WARM VAPOR,
NO. OF HOT SPRINGS..... ABOUT 75

GEOHERMAL CHARACTERISTICS

SPRING TEMPERATURES..... 50. C TO 95. C

RESERVOIR PROPERTIES

RESERVOIR TEMPERATURES..... 0. C TO 240. C ASSUMED
BEST ESTIMATE..... 240.0 C
SUBSURFACE AREA..... 10.0 KM**2 TO 70.0 KM**2
BEST ESTIMATE..... 47.0 KM**2
BASED ON: DISTRIBUTION OF VENT AREAS & ASSUMED COMPARABILITY TO THE GEYSERS SYST
DEPTH TO TOP OF RESERVOIR..... 100.00 M 0.100 KM TO 2000.00 M 2.000 KM
BEST ESTIMATE..... 1000.00 M 1.000 KM
DEPTH TO BOTTOM OF RESERVOIR.. 1500.00 M 1.500 KM TO 3000.00 M 3.000 KM
BEST ESTIMATE..... 2000.00 M 2.000 KM
THICKNESS OF RESERVOIR..... 500.00 M 0.500 KM TO 2900.00 M 2.900 KM
BEST ESTIMATE..... 1000.00 M 1.000 KM
VOLUME OF RESERVOIR.....
BEST ESTIMATE..... 47.000 KM**3
POROSITY..... 0.05 TO 0.10
BEST ESTIMATE..... 0.07

RESERVES

TOTAL STORED HEAT.....
BEST ESTIMATE..... 2.6371E+19 J 6.2999E+18 CAL ABOVE 15.

GEOLOGY

GENERAL ROCK TYPES: QUATERNARY VOLCANIC ROCKS, MOSTLY DACITES AND RHYODACITES NEAR LASSEN ACTIVE 1912-19; SOME
ANDESITES & BASALTS. FIELD POSSIBLY CONTROLLED BY NORTH PART OF PRE-CALDERA (?) RING FRACTURE SYST

PRIMARY REFERENCE:

AUTHOR..... D.L. WHITE & D.L. WILLIAMS, EDITORS
DATE..... 1975
TITLE..... ASSESSMENT OF GEOTHERMAL RESOURCES OF THE UNITED STATES - 1975
REFERENCE... U.S.G.S. CIRCULAR 726

RELATED REFERENCES:

- 1) DAY, A.L., AND ALLEN, E.T., 1924, THE SOURCE OF THE HEAT AND THE SOURCE OF THE WATER IN THE HOT SPRINGS OF LASSEN
NATIONAL PARK: JOUR. GEOL., V.32, NO.3, P.178-190.
- 2) WILLIAMS, HOWELL, 1952, GEOLOGY OF THE LASSEN VOLCANIC NATIONAL PARK, CALIFORNIA: CALIF. UNIV. PUBS. GEOL.
SCI., V.21, NO.8, P.195-386
- 3) UNPUBLISHED DATA

RECORD 00022

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 8

SECTION A.- GEOTHERMAL FIELD-AREA

RECORD IDENTIFICATION

RECORD NU..... 0000278

CROSS INDEX NU.. CF00391

RECORD TYPE..... A

NAME..... D. E. WHITE

DATE..... 75/03

ORGANIZATION.. U.S.G.S.

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. MORGAN SPRINGS

WARNING FIGURE..... 8

COUNTRY CODE..... US

STATE/PROVINCE..... CALIFORNIA

LATITUDE..... 40-23-60N

WARNING NUMBER..... 33

COUNTRY NAME..... UNITED STATES

COUNTY..... TEHAMA

LONGITUDE..... 121-31-00W

TOWNSHIP RANGE SECTION 1/4 1/4
29N 04E 11

BASE & MERIDIAN..... MT. DIABLO

AVAILABLE MAPS OF AREA: LASSEN VOLC. NAT. PARK SPECIAL 1:62,500

GENERAL DESCRIPTION

SIZE OF SURFACE EXPRESSION.... 3.0 KM**2

ELEVATION..... 1554.48 M 5100. FT

RESOURCE CATEGORY..... B

SURFACE THERMAL ACTIVITY..... HOT SPRINGS, GEYSERS

ASSOCIATED DEPOSITS..... SINTER

NO. OF HOT SPRINGS..... 25

GEOTHERMAL CHARACTERISTICS

NATURAL SURFACE DISCHARGE..... 5.83 L/S 3.5000E+02 L/MIN ESTIMATED

SPRING TEMPERATURES..... TO 95. C

SPRING DESCRIPTION..... WARM

RESERVOIR PROPERTIES

RESERVOIR TEMPERATURES..... 180. C TO 220. C ASSUMED

BEST ESTIMATE..... 210.0 C

SUBSURFACE AREA..... 2.0 KM**2 TO 50.0 KM**2

BEST ESTIMATE..... 5.0 KM**2

BASED ON: SURFACE ACTIVITY, MAY BE MUCH LARGER

DEPTH TO TOP OF RESERVOIR..... 500.00 M 0.500 KM TO 1500.00 M 1.500 KM

BEST ESTIMATE..... 1000.00 M 1.000 KM

DEPTH TO BOTTOM OF RESERVOIR.. 3000.00 M 3.000 KM TO 3000.00 M 3.000 KM

BEST ESTIMATE..... 3000.00 M 3.000 KM

THICKNESS OF RESERVOIR..... 1500.00 M 1.500 KM TO 2500.00 M 2.500 KM

BEST ESTIMATE..... 2000.00 M 2.000 KM

VOLUME OF RESERVOIR..... 3.000 KM**3 TO 125.000 KM**3

BEST ESTIMATE..... 10.000 KM**3

COMMENTS: DEPTHS TO TOP & BOTTOM OF RESERVOIR ARE ASSUMED.

RESERVES

TOTAL STORED HEAT..... 1.2558E+18 J 2.9999E+17 CAL TO 6.4460E+19 J 1.5399E+19 CAL

BEST ESTIMATE..... 5.0228E+18 J 1.1999E+18 CAL ABOVE 15. C

GEOLOGY

GENERAL ROCK TYPES: QUATERNARY VOLCANIC ROCKS, MOSTLY DACITES, ANDESITES

PRIMARY REFERENCE:

AUTHOR..... D.E. WHITE & D.L. WILLIAMS, EDITORS

DATE..... 1975

TITLE..... ASSESSMENT OF GEOTHERMAL RESOURCES OF THE UNITED STATES - 1975

REFERENCE... U.S.G.S. CIRCULAR 726

RELATED REFERENCES:

1) WARING, G.A., 1965, VIOLENT MUD-VOLCANIC ERUPTION OF LAKE CITY HOT SPRINGS, NORTHEASTERN CALIFORNIA: GEOL. SOC.

AMERICA BULL., V-66, NO-9, P.1109-1130

2) D.E. WHITE, UNPUBLISHED DATA

RECORD 00023

GEGTHERMAL RESOURCES FILE (GEGTHERM) REVISION E

SECTION B.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000279

CROSS INDEX NO.. CF00391

RECORD TYPE..... E

SAMPLE TYPE..... SURFACE

NAME..... D. E. WHITE

DATE..... 75/03

ORGANIZATION.. U.S.G.S.

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. MORGAN SPRINGS

COUNTRY CODE..... US

STATE/PROVINCE..... CALIFORNIA

LATITUDE..... 40-23.00 N

COUNTRY NAME..... UNITED STATES

COUNTY..... TEHAMA

LONGITUDE..... 121-31.00 W

SAMPLE INFORMATION

SOURCE TYPE..... SPRING

WATER FLOW RATE..... 1.59 L/S 95.4 L/MIN

WATER ANALYSIS

PH 1)..... 30.00

SOLUTE ANALYSIS (WATER)

LI	NA	K	RE	CS	NA+K
	1398.00	196.00			

MC	CA	SR	BA	CA+MG
	79.00			

F	CL	BR	I
	2430.00		

NH4	NO3	PO4	SiO2	SO4	CO3	HCO3
			233.00	79.00		52.00

REFERENCES: WHITE & OTHERS, ASSESSMENT OF GEOTHERMAL RESOURCES OF THE U.S. - 1975, U.S.G.S. CIRCULAR 726
WHITE, UNPUBLISHED DATA

SITE: MONO-LONG VALLEY, CA

SITE: MONO-LONG VALLEY, CA (FEDERAL LAND)

POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
BLM/USFS	Process EIS	CEQ	} ASSUMED COMPLETED										
BLM/USFS	Lease Land												
BLM/USFS	Issue STG Drilling Permit	Developer											
County	Issue Land Use Permit	Developer											
Government	Issue Drilling Permit	Developer											
USGS	Preliminary Geophysical Exploration												
Developer	Utility Interest Identified												
Developer	Exploratory Drilling and Reservoir Evaluation			_____									
Developer and Utility	Feasibility Study			_____									
Producer (Developer) and Utility	Financial Negotiations				_____								
Producer and Utility	Site Selection					Δ							
Producer and Utility	Commitment to Development												
Producer and Utility	Design (Preliminary, Final)					_____	_____						
Producer and Utility	Prepare Master Development Plan	BLM, USGS				_____							
Utility	Prepare Environmental Data Statement	BLM, FPC, CPUC, CERCDC				_____							
BLM, FPC, USGS, CPUC, CERCDC	Certify Plant and Site, Issue Permits	County Government Producer and Utility					_____	_____					
USGS	Process EIS (Drilling)	CEQ					_____						
FPC	Process EIS (Plant)	CEQ					_____						
FPC	Process EIS (Transmission Line)	CEQ					_____						
Producer	Development Drilling							_____	_____				
Utility	Plant Construction								_____	_____			
Utility	Install Transmission Line									_____	_____		

Possible Subsequent Additions (MWe) and On Line Date: 100 - 1987, 100 - 1990

SITE: MONO-LONG VALLEY, CA (REGION 1)

SUMMARY

TEMPERATURE °C

Surface: 94

Subsurface: 220

TOTAL DISSOLVED SOLIDS (PPM):

1-2,000⁽⁴⁾

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS):

4,923⁽⁷⁾ 2000⁽²⁰⁾

TYPE OF OVERLAYING ROCK:

Medium/Hard

ESTIMATED DEPTH TO TOP OF RESERVOIR (METERS):

1,000

DESCRIPTION OF KGRA

Total KGRA Acres: 455,256

Total Federal Acres: 392,096 (103,690 BLM; 288,406 Total State and Private Acres: 63,160

Federal Acres Leased: 5,483 Forest Serv.) State and Private Acres Leased:

GEOHERMAL DEVELOPMENT STATUS:

Numerous wells drilled. Comprehensive investigation of resource by USGS.⁽⁴⁾ City of Burbank to start exploratory drilling in April 1976. If successful, installation of a 50 MWe plant is planned.⁽¹⁾ Litigation over Grandfather Rights to land is currently underway. Environmental studies are being done. ⁽⁴⁷⁾

LOCAL AND STATE ATTITUDE TOWARD GEOHERMAL DEVELOPMENTS:

Administrative constraints are stringent. Lengthy delays have occurred.^(1A,2) Public reaction generally negative, although county official reaction is positive.^(1A) There is a great deal of environmental concern in the area.⁽⁴⁷⁾

LAND USE AND POPULATION:

Rural area, low population. Primarily recreation and tourism with some mining and agriculture. Focus on increasing recreation and tourism.⁽⁴⁾

COMMENTS AND CRITICAL ISSUES:

Sample air quality ppm exceeded state standards.⁽⁴⁾ Highly scenic area. Southern California Edison concerned that projected peak loads will exceed existing transmission capabilities and wants to transfer part of load to geothermal space heating.⁽¹⁾ Development could accelerate with availability of transmission lines.⁽²⁰⁾

SITE: MONO-LONG VALLEY, CA

SITE: MONO-LONG VALLEY, CA

SITE LOCATION AND PHYSICAL DESCRIPTION

LATITUDE: 37° 40' 00" N

LONGITUDE: 118° 52' 00" W

COUNTY: Mono

ADJACENT COUNTIES: Inyo, Fresno, Madera, Mariposa, Tuolumne, Alpine; NV: Douglas, Lyon, Mineral, Esmerelda

LAND OWNERSHIP:

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
Site is east of the Sierra Nevada Mountains. Long Valley is a major, well-recognized collapse structure (caldera). 16 km (10 miles) wide by 32 km (20 miles) long, little slope.(4)	Primarily recreation, with some timbering, mining and agriculture. (4)	Focus on increasing recreation and tourism. Conservation is prime concern. Geothermal land is zoned as "general purpose". (4)	Highly scenic. (4)	Old Indian habitation sites and petroglyphs. (4)

SITE: MONO-LONG VALLEY, CA

RESERVOIR CHARACTERISTICS AND GEOLOGICAL/GEOPHYSICAL DESCRIPTION

RESERVOIR TEMPERATURE

Surface: 94°C
Subsurface: 220°C

Geochemical

SiO₂: 219°C
Na-K-Ca: 238°C

TOTAL DISSOLVED SOLIDS (TDS): TDS of 1-2,000 ppm. Silicate content of 1-300 ppm⁽⁴⁾

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS): 4923⁽⁷⁾ 2000⁽²⁰⁾

TYPE OF OVERLAYING ROCK: Rhyolitic volcanics (medium-hard).

ESTIMATED DEPTH TO TOP OF RESERVOIR: 1000m (3281 ft)

SEISMIC ACTIVITY: Seismic noise and microearthquake studies indicate a relatively constant and relatively minor level of seismicity.⁽⁴⁾

SITE: MONO-LONG VALLEY, CA

LAND OWNERSHIP AND LEASING

	TOTAL AREA (ACRES)	FEDERAL (ACRES)	STATE (ACRES)	PRIVATE (ACRES)
KGRA: Mono-Long Valley	455,256 ⁽⁹⁾	392,096 (BLM and F.S.)	63,160 (state and private)	
LAND LEASED IN KGRA		5,483 ⁽¹⁵⁾		
HIGHEST-PRICED LEASES (BY DOLLARS/ACRE) (15)				
\$/ACRE	LESSEE			
290.90	Republic Geothermal	1,773		
52.02	Geothermal Resources Intl.	1,895		
10.17	Geothermal Resources Intl.	1,815		
TENTATIVE LEASE SALE DATES 7/21/77 (BLM and USGS) ⁽¹⁴⁾ 11/8/77 FS ⁽⁴⁷⁾				
NUMBER OF SALES OFFERED BUT NO BIDS: 4 ⁽¹⁵⁾		8,232		
NUMBER OF BIDS REJECTED (RESULTING IN NO LEASE): 0 ⁽¹⁵⁾				
SUBSURFACE AREA OF RESERVOIR	55,599 ⁽⁸⁾			

SUMMARY OF LEASING STATUS AND NEEDS: The two lease tracts held by Geothermal Resources International are involved in litigation; Getty Oil claims to have Grandfather Rights to the land. Grandfather Clauses reverting to mining claims cover approximately 28,000 acres (mostly owned by the Forest Service) in the KGRA. Although the entire KGRA seems geologically promising, the island in Mono Lake and the Grandfather Rights land are the only KGRA areas with known hydrothermal activity.⁽⁴⁷⁾

SITE: MONO-LONG VALLEY, CA

GEOHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
<p>Approximately 20 shallow (less than 1000 ft. deep) wells were drilled in early 1960's, primarily in Casa Diablo area. Max. Temp. of 177°C (350°F); and flow rates of 500 GPM were encountered. Development was halted by the difficulties with disposal of arsenic/boron laden water and by the implementation of new environmental requirements.⁽⁴⁾</p> <p>Long Valley has been the scene of intensive, comprehensive geotechnical investigation by USGS. Data available does not indicate a significant thermal anomaly; if one exists, it is probably limited to the immediate vicinity of the caldera.⁽⁴⁾</p> <p>Electrical/electromagnetic surveys, seismic noise and microearthquake studies have been made.⁽⁴⁾</p> <p>By 1975, approximately 10 holes were drilled in a limited area by Magma Power, surface exploration was continuing; although drilling was delayed because of environmental and leasing questions.⁽²⁾</p> <p>Aeromagnetic survey has been done.^(1A)</p> <p>Several wells ≥ 300 meters (1000 feet) have been drilled with temperature, flow and chemical information acquired.^(1A) One deep well was drilled by Republic Geothermal.⁽²⁴⁾</p> <p>Union Oil holds a drilling permit for unleased land in the KGRA. By June 1977 they had not started to drill. ⁽⁴⁷⁾</p>	<p>In June 1976, probable continued drilling and testing of wells was projected through 1979. A possible decision to construct a power plant was projected for 1980-1985; if so, further drilling and testing of wells.⁽²⁾</p> <p>Southern California Edison Co. interested in Long Valley area where they may be partnered with Magma Energy Corp. Southern Cal. is concerned that projected peak-loads will exceed existing transmission capabilities, and wants to transfer part of load to geothermal space-heating (Mammoth Lakes Village).⁽¹⁾</p> <p>The City of Burbank was to start exploratory drilling in April 1976. If successful, installation of 50 MWe plant is planned.⁽¹⁾</p> <p>Development could accelerate with availability of transmission lines.⁽²⁰⁾</p>

SITE: MONO-LONG VALLEY, CA

INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)
<p>The local administration has enacted definitive procedures for geothermal activity. An EIS is required for exploration with review by several state agencies to obtain a land use permit.(1A)</p> <p>Administrative constraints on geothermal development are stringent. Requirements pose significant constraints and delays.(1A)</p>	<p>Public reaction to geothermal development is generally negative, although county officials are encouraging development for taxation purposes and because it represents a good example of an optimum means of using a resource.(4) The local private interest groups and the Sierra Club pose the most significant constraints.(1A)</p> <p>The Friends of Mammoth (an environmental group) have expressed their concern for the area.(47)</p>	<p>Two EIS's have been prepared.(4)</p> <p>An environmental study by the Forest Service for the Grandfather Rights land is underway with a December 1978 completion scheduled. Land use plans and environmental studies for the remainder of the Forest Service land are scheduled for completion by November 1978. If these dates are met, Forest Service land could be available for leasing by March 1979 at the earliest. (47)</p>

SITE: MONO-LONG VALLEY, CA

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds

Precipitation (Annual): 81.3 to 121.9 cm (32-48 in.)

Average Temperature

Minimum: -12.2 to -6.7 °C (10-20°F)

Maximum: 15.6 to 21.1°C (60-70°F)

Relative Humidity

(Seasonal Peaks)

Summer: 30 - 40%

Winter: 60-70%

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
In each of 3 samples, particulates exceeded the standards of the State Air Resources Board. From a 3 week sample, oxidant content exceeded the standards for 11 hours, and hydro-carbon content exceeded standards for 7 days. Particulate source unknown, possibly motor vehicles. ⁽⁴⁾	Crowley Lake, Mono Lake, Owens River and other permanent streams in area (potential sources of cooling water). ⁽⁴⁾	May be as high as 90-95 dbA (from trucks) ⁽⁴⁾	Sage, bitter and rabbit brush, pinon and juniper. ⁽⁴⁾	Sage grouse, mule deer, black bear, pine martin, ground squirrel and owl. Hot Creek has brown, rainbow and brook trout. ⁽⁴⁾	Four plants and Bighorn Sheep, Wolverine, Spotted Bat, Bald Eagle, Owens Chub and Prairie and Peregrine Falcon. (Only the chub might be affected by geothermal development.) ⁽⁴⁾

SITE: MONO-LONG VALLEY, CA

POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR:

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES NEAR SITE	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
Bishop	48 km (30 miles)	3,500 ⁽⁴⁾	Within 8-32 km (5-20 miles) of the site there are three 37.5 MW hydro-electric plants and a 230 kv N-S line owned by Los Angeles (municipal). Within 16 km (10 miles) west of the site there is one 115 kv line and a 138 kv capacity line operating at 115 kv owned by the Southern California Edison Co. (private). Eight km (5 miles) east of the site there is a N-S 800 kv DC line owned by Southern California Edison (private), Los Angeles, Glendale, Pasadena and Burbank (municipalities).(33-II)	Interstate 395 5 km (3 miles) from site.(6)	
Mammoth Lakes	8 km (5 miles)	900 (500 in winter season) ⁽⁴⁾			
Tom's Place	24 km (15 miles)	150			

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 6

SECTION A.- GEOTHERMAL FIELD-AREA

RECORD IDENTIFICATION

RECORD NO..... 0000286
 CROSS INDEX NO.. 0600431
 RECORD TYPE..... A

NAME..... J. RENNER, J. A. CROWLEY
 DATE..... 75/05
 ORGANIZATION.. U.S.G.S.

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. LONG VALLEY
 WARNING FIGURE..... 8
 COUNTRY CODE..... US
 STATE/PROVINCE..... CALIFORNIA
 LATITUDE..... 37-40-00N

WARNING NUMBER..... 123-126
 COUNTRY NAME..... UNITED STATES
 COUNTY..... MONTE
 LONGITUDE..... 118-52-00W

TOWNSHIP RANGE SECTION 1/4 1/4
 03S 28E 35

BASE & MERIDIAN..... MT. DIABLO
 AVAILABLE MAPS OF AREA: MT. MORRISON 1:62,500

GENERAL DESCRIPTION

SIZE OF SURFACE EXPRESSION.... 10.0 KM**2
 ELEVATION..... 2164.06 M 7100. FT
 RESOURCE CATEGORY..... 6
 PRESENT USE & DEVELOPMENTS: ABOUT 10 WELLS DRILLED
 SURFACE THERMAL ACTIVITY..... HOT SPRINGS, FUMAROLE OR WARM VAPOR
 ASSOCIATED DEPOSITS..... SINTER
 NO. OF HOT SPRINGS..... 40

GEOTHERMAL CHARACTERISTICS

SPRING TEMPERATURES..... 60. C TO 94. C
 WELL INFORMATION
 MAXIMUM WELL TEMPERATURE..... 181. C TO 300. M

RESERVOIR PROPERTIES

RESERVOIR TEMPERATURES..... 200. C TO 250. C ASSUMED
 BEST ESTIMATE..... 220.0 C
 SUBSURFACE AREA..... 40.0 KM**2 TO 230.0 KM**2
 BEST ESTIMATE..... 225.0 KM**2
 BASED ON: GEOLOGY, GEOPHYSICS
 DEPTH TO TOP OF RESERVOIR..... 500.00 M 0.500 KM TO 1500.00 M 1.500 KM
 BEST ESTIMATE..... 1000.00 M 1.000 KM
 DEPTH TO BOTTOM OF RESERVOIR.. 3000.00 M 3.000 KM TO 3000.00 M 3.000 KM
 BEST ESTIMATE..... 3000.00 M 3.000 KM
 THICKNESS OF RESERVOIR..... 1500.00 M 1.500 KM TO 2500.00 M 2.500 KM
 BEST ESTIMATE..... 2000.00 M 2.000 KM
 VOLUME OF RESERVOIR..... 60.000 KM**3 TO 575.000 KM**3
 BEST ESTIMATE..... 450.000 KM**3
 POROSITY..... 0.07 TO 0.23
 BEST ESTIMATE..... 0.15
 COMMENTS: DEPTHS TO TOP & BOTTOM OF RESERVOIR ARE ASSUMED.

RESERVES

TOTAL STORED HEAT.....	2.8046E+19 J	6.6999E+18 CAL	TC 3.3906E+20 J	8.0999E+19 CAL
BEST ESTIMATE.....	2.3023E+20 J	5.4999E+19 CAL	ABOVE 15. C	

GEOLOGY

GENERAL ROCK TYPES: PLEISTOCENE RHYOLITIC VOLCANICS

GEOPHYSICS

MAGNETIC SURVEY INFORMATION: TEST MADE
SEISMIC SURVEY INFORMATION: SEISMIC NOISE, P-DELAY, MICROEARTHQUAKES
ELECTRICAL RESISTIVITY: TEST MADE
OTHER GEOPHYSICAL INFORMATION: AMT, HEAT FLOW, TEMPERATURE GRADIENT

PRIMARY REFERENCE:

AUTHOR..... D.E. WHITE & D.L. WILLIAMS, EDITORS
DATE..... 1975
TITLE..... ASSESSMENT OF GEOTHERMAL RESOURCES OF THE UNITED STATES - 1975
REFERENCE... U.S.G.S. CIRCULAR 726

RELATED REFERENCES:

- 1) BAILEY, R.A., 1974, PRELIMINARY GEOLOGIC MAP AND CROSSSECTIONS OF THE CASA DIABLO GEOTHERMAL AREA, LONG VALLEY CALDERA, MONO COUNTY, CALIFORNIA: U.S.GEOL.SURVEY OPEN-FILE REPORT.
 - 2) HOOVER, D.B., AND OTHERS, 1974, EVALUATION OF AUDIO-MAGNETOTELLURIC TECHNIQUES AS A RECONNAISSANCE EXPLORATION TOOL IN LONG VALLEY, MONO AND INYO COUNTIES, CALIF.: U.S.G.S. OPEN-FILE REPORT
 - 3) LEWIS, R.E., 1974, DATA ON WELLS, SPRINGS, & THERMAL SPRINGS IN LONG VALLEY, MONO COUNTY, CALIF: U.S.G.S. OPEN-FILE REPORT
 - 4) STANLEY, W.D., & OTHERS, 1974, PRELIMINARY RESULTS OF DEEP ELECTRICAL STUDIES IN THE LONG VALLEY CALDERA, MONO & INYO COUNTIES, CALIF.: USGS OPEN-FILE REPORT
- WILLEY, L.M., & OTHERS, 1973, GEOCHEMISTRY OF THERMAL WATERS IN LONG VALLEY, CALIF.(ABS): EOS (AM. GEOPHYS. UNION TRANS.) V.54, NO.11, P. 1212

RECORD 00012

GEO THERMAL RESOURCES FILE (GEO THERM) REVISION E

SECTION D.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000287
CROSS INDEX NO.. CF00431
RECORD TYPE..... F
SAMPLE TYPE..... SURFACE

NAME..... J. RENNER, J. A. CROWLEY
DATE..... 75/05
ORGANIZATION.. U.S.G.S.

GEOGRAPHIC LOCALITY

GEO THERMAL FIELD-AREA.. LONG VALLEY
COUNTRY CODE..... US
STATE/PROVINCE..... CALIFORNIA
LATITUDE..... 37-40.00 N

COUNTRY NAME..... UNITED STATES
COUNTY..... MONO
LONGITUDE..... 118-52.00 W

SAMPLE INFORMATION

SOURCE TYPE..... SPRING
WATER SAMPLING TEMP.... 94.0 C

WATER ANALYSIS

PH 1)..... W 9.20

SOLUTE ANALYSIS (WATER)

LI	NA	K	RB	CS	NA+K				
2.8	390.00	45.00							
MG	CA	SR	BA	CA+MC					
	0.90								
ZN	HG	B	HCO2	AL	PB	AS	SB	U	
		15							
F	CL	BR	I						
	280.00								
NH4	NO3	PO4	SIO2	SO4	CO3	HCO3			
			340.00	130.00		450.00			

REFERENCES: WHITE & OTHERS, ASSESSMENT OF GEO THERMAL RESOURCES OF THE U.S. - 1975, U.S.G.S. CIRCULAR 726
WILLEY ETAL 1974 (MAGMA RITCHIE #5)

RECORD 00013

GEOHERMAL RESOURCES FILE (GEOHERM) REVISION 8

SECTION 8.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0002422
CROSS INDEX NO..
RECORD TYPE..... 8
SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.
DATE..... 78/06
ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOHERMAL FIELD-AREA.. LONG VALLEY
COUNTRY CODE..... US
STATE/PROVINCE..... CALIFORNIA

COUNTRY NAME..... UNITED STATES
COUNTY..... MENDEOCINO

TOWNSHIP RANGE SECTION 1/4 1/4
ZON 14W 7 NE

OTHER LOCALITY INFORMATION: EAST SIDE OF BRANCH OF EEL RIVER, 6.8 MILES SOUTH OF LAYTONVILLE

SAMPLE INFORMATION

SOURCE TYPE..... SPRING
COLLECTION DATE..... 1957/03/22
COLLECTOR(S)..... E. H. BAILEY
WATER SAMPLING TEMP..... 16.75 C
WATER FLOW RATE..... 0.035224 L/S 8. GAL/MIN
OTHER CHEMICAL CHARACTERISTICS: CARBONATED, SCANT OIL FILM.

WATER ANALYSIS

ANALYSIS DATE..... 1958/05/28
ANALYST(S)..... H. C. WHITEHEAD
PH 1)..... 6.5
SPECIFIC CONDUCTANCE..... 3980. UMHC/CM AT 25. C
ALKALINITY..... 1040. PPM AS CaCO3

SOLUTE ANALYSIS (WATER)

UNITS USED..... PPM

L1	NA	K	RB	CS	NA+K			
0	552	5.0						
KL	CA	SR	BA	CA+MG				
44	344							
ZN	HG	B	HB02	AL	PB	AS	SF	U
		120						
F	CL	BR	I					
	842							
NH4	NO3	FO4	SI02	SO4	CO3	HCO3		
			97	0	0	1160		

REFERENCES: PERSONAL FILE OF DON WHITE, USGS, MENLO PARK

RECORD 00014

GEOHERMAL RESOURCES FILE (GEOHERM) REVISION 8

SECTION 8.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0002451
CROSS INDEX NO..
RECORD TYPE..... 1
SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.
DATE..... 76/07
ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOHERMAL FIELD-AREA.. LONG VALLEY
NAME OF SAMPLE SOURCE.. HOT SPRING # 7422
COUNTRY CODE..... US
STATE/PROVINCE..... CALIFORNIA
OTHER LOCALITY INFORMATION: MAMMOTH

COUNTRY NAME..... UNITED STATES
COUNTY..... MONG

SAMPLE INFORMATION

SOURCE TYPE..... SPRING
WATER SAMPLING TEMP.... 80. C
WATER FLOW RATE..... 0.000353 L/S .01 CFS

WATER ANALYSIS

SOLUTE ANALYSIS (WATER)

UNITS USED..... PPM

LI	NA	K	RB	CS	NA+K			
	354.6							
MG	CA	SR	BA	CA+MG				
0.6	18.4							
ZN	HG	B	HBO2	AL	PB	AS	SE	U
		10.18						
F	CL	BR	I					
11.5	211.6							
NH4	NO3	PO4	SIO2	SO4	CO3	HCO3		
			92	67.25		633.6		

REFERENCES: PERSONAL FILE OF DON WHITE, USGS, MENLO PARK

RECORD 00015

GEOHERMAL RESOURCES FILE (GEOHERM) REVISION 8

SECTION B.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0002450
 CROSS INDEX NO..
 RECORD TYPE..... B
 SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.
 DATE..... 76/07
 ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOHERMAL FIELD-AREA.. LONG VALLEY
 NAME OF SAMPLE SOURCE.. GEYSER #3180
 COUNTRY CODE..... US
 STATE/PROVINCE..... CALIFORNIA

COUNTRY NAME..... UNITED STATES
 COUNTY..... MONO

TOWNSHIP RANGE SECTION 1/4 1/4
 3S 28E 25 SE W

SAMPLE INFORMATION

WATER SAMPLING TEMP.... 91. C
 WATER FLOW RATE..... 0.000071 L/S .002 CFS

WATER ANALYSIS W

PH 1)..... 8.4

SOLUTE ANALYSIS (WATER)

UNITS USED..... PPM

LI	NA	K	RE	CS	NA+K			
	368.7							
MG	CA	SR	BA	CA+MG				
0.9	19.0							
ZN	HG	B	HBO2	AL	PB	AS	SE	U
		11.3						
F	CL	BR	I					
	226.9							
NH4	NO3	PO4	SIO2	SC4	CO3	HC03		
				46.1		497.2		

COMMENTS: WHAT METHOD FOR PH?
 REFERENCES: PERSONAL FILE OF DON WHITE, USGS, MENLO PARK

RECORD 00016

GEOHERMAL RESOURCES FILE (GEOHERM) REVISION 8

SECTION 8.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0002459
CROSS INDEX NO..
RECORD TYPE..... B
SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.
DATE..... 76/07
ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOHERMAL FIELD-AREA.. LONG VALLEY
NAME OF SAMPLE SOURCE.. MONO HOT SPRING
COUNTRY CODE..... US
STATE/PROVINCE..... CALIFORNIA

COUNTRY NAME..... UNITED STATES
COUNTY..... MONO

OTHER LOCALITY INFORMATION: NE OF LEE VINING, EAST OF BLACK POINT, NW SHORE OF MONO LAKE

SAMPLE INFORMATION

SOURCE TYPE..... SPRING
COLLECTION DATE..... 1957/09/20
COLLECTOR(S)..... J. FETH
POINT OF COLLECTION..... AT CONCRETE TROUGH WITH PIPE DISCHARGE
WATER SAMPLING TEMP.... 62.2 C
DEPOSITS OR ALTERATION: VOLCANIC CINDER FLAT
OTHER CHEMICAL CHARACTERISTICS: CHLORIDE CORRELATION FOR BR PLUS I

WATER ANALYSIS

W

ANALYSIS DATE..... 1957/12/27
ANALYST(S)..... J. P. SCHUCH
PH 1)..... 8.0
SPECIFIC CONDUCTANCE..... 1960. UMHO/CM
ALKALINITY..... 54. PPM AS CaCO3
TOTAL DISSOLVED SOLIDS... 1190. PPM SOLIDS

AT 25. C

SOLUTE ANALYSIS (WATER)

UNITS USED..... PPM

LI	NA	K	RB	CS	NA+K				
	450	6.7							
MG	CA	SR	BA	CA+MG					
4.6	14								
MN+3	MN(TOT)	FE+3	FE(TOT)	CU					
			0						
ZN	HG	6	HGO2	AL	PB	AS	SE	U	
		7.4							
F	CL	ER	1						
13	324	2.1	.4						
NH4	NO3	PO4	SIO2	SO4	CO3	HCO3			
1.9	2.0		73	92	0	430			

REFERENCES: PERSONAL FILE OF DON WHITE, USGS, MENLO PARK

RECORD 00017

GEO THERMAL RESOURCES FILE (GEOTHERM) REVISION 6

SECTION 6.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0002458

CROSS INDEX NO..

RECORD TYPE..... 6

SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.

DATE..... 76/07

ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. LONG VALLEY

NAME OF SAMPLE SOURCE.. HOT CREEK SPRINGS

COUNTRY CODE..... US

STATE/PROVINCE..... CALIFORNIA

COUNTRY NAME..... UNITED STATES

COUNTY..... MENDO

TOWNSHIP RANGE SECTION 1/4 1/4
3S 29E 31 NE

OTHER LOCALITY INFORMATION: 1 MI. SE OF GEYSER

SAMPLE INFORMATION

SOURCE TYPE..... SPRING

COLLECTION DATE..... 1957/05/07

COLLECTOR(S)..... DON E. WHITE

WATER SAMPLING TEMP.... HOT

WATER FLOW RATE..... 0.008806 L/S 2. GAL/MIN

OTHER CHEMICAL CHARACTERISTICS: SO4 DETERMINATION IS TURBIDIMETRIC

WATER ANALYSIS W

ANALYSIS DATE..... 1958/05/28

ANALYST(S)..... J. P. SCHUCH

PH 1)..... 8.6

SPECIFIC CONDUCTANCE..... 1490.

ALKALINITY..... 4E.

UMHO/CM
PPM AS CaCO3

AT 25. C

SOLUTE ANALYSIS (WATER)

UNITS USED..... PPM

LI	NA	K	RB	CS	NA+K				
2.0	317	14							
MG	CA	SR	BA	CA+MG					
.5	18								
ZN	MG	B	HB02	AL	PB	AS	SB	U	
		0.2							
F	CL	BR	1						
	172								
NH4	NO3	PO4	SiO2	SO4	CO3	HCO3			
			118	80	0	497			

COMMENTS: FROM ALLUVIUM, PROBABLY IN RHYOLITE.
REFERENCES: PERSONAL FILE OF DON WHITE, USGS, MENLO PARK

RECCRD 00018

GEO THERMAL RESOURCES FILE (GEO THERM) REVISION B

SECTION B.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0002455

CROSS INDEX NO..

RECORD TYPE..... B

SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.

DATE..... 76/07

ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEO THERMAL FIELD-AREA.. LONG VALLEY

NAME OF SAMPLE SOURCE.. HOT CREEK SPRINGS

COUNTRY CODE..... US

STATE/PROVINCE..... CALIFORNIA

COUNTRY NAME..... UNITED STATES

COUNTY..... MCNO

TOWNSHIP RANGE SECTION 1/4 1/4
35 28E 25

OTHER LOCALITY INFORMATION: BIG NW POOL IN HOT CREEK

SAMPLE INFORMATION

SOURCE TYPE..... PUGL

COLLECTION DATE..... 1957/05/07

COLLECTOR(S)..... DON WHITE

POINT OF COLLECTION..... SE CORNER OF 20 FT X 40 FT. POOL

WATER SAMPLING TEMP.... 85-93. C

WATER FLOW RATE..... NO DISCHARGE

DEPOSITS OR ALTERATION: SINTER AND TRAVERTINE ON RHYOLITE.

OTHER CHEMICAL CHARACTERISTICS: NO EVIDENCE OF H₂S IN FIELD.

WATER ANALYSIS

ANALYSIS DATE..... 1958/03/24

ANALYST(S)..... WHITEHEAD AND SCHUCH

PH 1)..... 6.1

SPECIFIC CONDUCTANCE..... 1760.

ALKALINITY..... 20. PPM AS CaCO₃

TOTAL DISSOLVED SOLIDS... 1100. PPM SUM

AT 25. C

SOLUTE ANALYSIS (WATER)

UNITS USED..... PPM

LI NA K RB CS NA+K
2.6 363 22

MG CA SR BA CA+MG
.2 7.6

ZN HG B HCO₂ AL PB AS SB U
11

F CL BR 1
11 245

NH₄ NO₃ PO₄ SiO₂ SO₄ CO₃ HCO₃
.2 110 107 0 454

REFERENCES: PERSONAL FILE OF DON WHITE, USGS, MENLO PARK

RECORD 00019

GEOHERMAL RESOURCES FILE (GEOHERM) REVISION 8

SECTION 5.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0002454
CROSS INDEX NO..
RECORD TYPE..... E
SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.
DATE..... 76/07
ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOHERMAL FIELD-AREA.. LONG VALLEY
NAME OF SAMPLE SOURCE.. HOT CREEK SPRINGS
COUNTRY CODE..... US
STATE/PROVINCE..... CALIFORNIA

COUNTRY NAME..... UNITED STATES
COUNTY..... MONO

TOWNSHIP RANGE SECTION 1/4 1/4
3S 28E 35 NW

MAP REFERENCE: MT. MORRISON SHEET

OTHER LOCALITY INFORMATION: NORTH OF FISH HATCHERY

SAMPLE INFORMATION

SOURCE TYPE..... POOL
COLLECTION DATE..... 1954/09/05
COLLECTOR(S)..... D. F. HEWETT, USGS

WATER ANALYSIS

ANALYSIS DATE..... 1954/11/22
ANALYST(S)..... HENRY KRAMER
PH 1)..... 7.35
SPECIFIC CONDUCTANCE..... 1815. UMHO/CM

AT 25. C

SOLUTE ANALYSIS (WATER)

UNITS USED..... PPM

L1	NA	K	RB	CS	NA+K			
2.2	376.	23.2						
MG	CA	SR	BA	CA+MG				
0	8.0	.48						
ZN	HG	E	HBO2	AL	PB	AS	SB	U
		11.1						
F	CL	BR	I					
5.0	258.							
NH4	NO3	FL4	SI02	SO4	CO3	HC03		
	.80		126.	118.	0	475.		

REFERENCES: PERSONAL FILE LF DON WHITE, USGS, MENLO PARK

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 8

SECTION B.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0002453

CROSS INDEX NO..

RECORD TYPE..... E

SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.

DATE..... 76/07

ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. LONG VALLEY

NAME OF SAMPLE SOURCE.. HOT CREEK SPRINGS

COUNTRY CODE..... US

STATE/PROVINCE..... CALIFORNIA

COUNTRY NAME..... UNITED STATES

COUNTY..... MONG

TOWNSHIP RANGE SECTION 1/4 1/4
3S 28E 25 NW

OTHER LOCALITY INFORMATION: SOUTH BANK OF CREEK IN CANYON

SAMPLE INFORMATION

SOURCE TYPE..... GEYSER

COLLECTION DATE..... 1957/05/17

COLLECTOR(S)..... D. WHITE

WATER SAMPLING TEMP.... 93.

WATER FLOW RATE..... .32-.63 L/S 5-10. GAL/MIN

OTHER CHEMICAL CHARACTERISTICS: COLORIMETRIC CHECKED GRAVIMETRICALLY

WATER ANALYSIS

ANALYSIS DATE..... 1958/01/31

ANALYST(S)..... C. WHITEHEAD

PH 1)..... 8.3

SPECIFIC CONDUCTANCE..... 1620.

ALKALINITY..... 12.

TOTAL DISSOLVED SOLIDS... 1110.

UMHO/CM

PPM AS CaCO3

PPM SOLIDS

AT 25. C

SOLUTE ANALYSIS (WATER)

UNITS USED..... PPM

L1	NA	K	RB	CS	NA+K			
1.7	350	20						
MG	CA	SR	BA	CA+MG				
0.2	4.4							
MN+3	MN(TOT)	FE+3	FE(TOT)	CU				
	0		.04	0				
ZN	HG	B	HBO2	AL	Pb	AS	SB	U
.01		10		0	0			
F	CL	BR	1					
10	200	.7	.4					
NH4	NO3	PO4	S102	SO4	CO3	HCO3		
.1	0		131	90	7.9	497		

REFERENCES: PERSONAL FILE OF DON WHITE, USGS, MENLO PARK

RECORD 00021

GEOHERMAL RESOURCES FILE (GEOHERM) REVISION 8

SECTION 6.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0002452
CROSS INDEX NO..
RECORD TYPE..... 6
SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.
DATE..... 76/07
ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOHERMAL FIELD-AREA.. LONG VALLEY
NAME OF SAMPLE SOURCE.. GEYSER SPRING
COUNTRY CODE..... US
STATE/PROVINCE..... CALIFORNIA

COUNTRY NAME..... UNITED STATES
COUNTY..... MONO

TOWNSHIP RANGE SECTION 1/4 1/4
3S 28E 25 NE

OTHER LOCALITY INFORMATION: SOUTH SIDE OF HOT CREEK, ADJOINING STREAM

SAMPLE INFORMATION

SOURCE TYPE..... POOL AT GEYSER
COLLECTION DATE..... 1954/09/05
COLLECTOR(S)..... D. F. HEWETT
POINT OF COLLECTION..... AT THE POOL
WATER SAMPLING TEMP.... BOILING
DEPOSITS OR ALTERATION: NO SINTER
OTHER CHEMICAL CHARACTERISTICS: PERPETUAL SPRINGER

WATER ANALYSIS

ANALYSIS DATE..... 1954/11/22
ANALYST(S)..... HENRY KRAMER
PH. 1)..... 7.75
SPECIFIC CONDUCTANCE..... 1665. UMHO/CM AT 25. C

SOLUTE ANALYSIS (WATER)

UNITS USED..... PPM

LI	NA	K	RB	CS	NA+K			
1.8	352.	21						
MG	CA	SR	BA	CA+MG				
0	8.6	.6						
ZN	HG	B	HBO2	AL	PR	AS	SB	U
		9.0						
F	CL	BR	1					
5.0	205.							
NH4	NO3	PO4	SI02	SO4	CO3	HC03		
	.70		137	86.	6	532.		

REFERENCES: PERSONAL FILE OF DON WHITE, USGS, MENLO PARK

SITE: PUNA, HI

SITE: PUNA, HI (FEDERAL/STATE/PRIVATE LAND)
POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
USFS, State, County	Process Environmental Reports (EIS - Start 1979)	CEQ, State DEQ											
USFS, Owner	Lease Land	Developer											
USGS, State	Issue Drilling Permits	Developer											
Developer	Preliminary Geophysical Exploration												
Developer	Exploratory Drilling and Reservoir Evaluation												
Developer	Develop Utility Interest												
Developer and Utility	Feasibility Study												
Producer (Developer) and Utility	Financial Negotiations												
Producer and Utility	Site Selection												
Producer and Utility	Commitment to Development												
Producer and Utility	Design												
Producer and Utility	Prepare Master Development Plan	BLM, USGS											
Utility	Prepare Environmental Data Statement	BLM, FPC, State, County											
BLM, FPC, State, USGS	Certify Plant and Site, Issue Permits	Producer and Utility											
USGS, St., Cty	Process EIA/EIS (Drilling)	CEQ, St. DEQ											
FPC, St. PUC	Process EIA/EIS (Plant)	CEQ, St. DEQ											
FPC, St. PUC	Process EIA/EIS (Transmission Line)	CEQ, St. DEQ											
Producer	Development Drilling												
Utility	Plant Construction												
Utility	Install Transmission Line												

Possible Subsequent Additions (MWe) and On Line Date: 100 - 1990, 200 - 1991, 200 - 1992, 200 - 1993,
200 - 1994, 100 - 1995

SITE: PUNA, HI (REGION 1)

SUMMARY

TEMPERATURE °C

Surface:

Subsurface: 356°C⁽²⁰⁾

TOTAL DISSOLVED SOLIDS (PPM): 2,000 ⁽³⁹⁾

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS): 1,000 MW (for Hawaii County) ⁽²⁰⁾

TYPE OF OVERLAYING ROCK: Hard

ESTIMATED DEPTH TO TOP OF RESERVOIR (METERS):

DESCRIPTION OF KGRA

Total KGRA Acres:

Total Federal Acres:

Federal Acres Leased:

Total State and Private Acres:

State and Private Acres Leased:

GEOHERMAL DEVELOPMENT STATUS: By February 1977, one successful well was drilled,⁽¹⁹⁾ and the Geothermal Exploration and Development Corporation of Hawaii and Thermal Power Company were planning a joint project to drill on Hawaii County island.

LOCAL AND STATE ATTITUDE TOWARD GEOTHERMAL DEVELOPMENTS:

LAND USE AND POPULATION: Forested plains with low mountains, small population. ⁽⁶⁾

COMMENTS AND CRITICAL ISSUES: Extremely active seismic area. ⁽⁶⁾

SITE: PUNA, HI

SITE: PUNA, HI

SITE LOCATION AND PHYSICAL DESCRIPTION

LATITUDE: ~19° 30' 00" N (6)

LONGITUDE: ~154° 54' 23" W (6)

COUNTY: Hawaii County

ADJACENT COUNTIES: None

LAND OWNERSHIP:

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
Plains with low mountains. (6) Site elevation is ~183 M (600 ft) above sea level. (26)	Puna is a district on the eastern- most point of Hawaii Island (Hawaii Co.). The Nanawale Forest Reserve is adjacent to the current drilling site. Hawaii Volcanoes National Park is in the southern portion of the Puna district, and the Puna Forest Reserve is in the center. (34) Forest and woodland are mostly ungrazed. A granite and other crystalline and/or igneous rock quarry is near the site. (6)			

SITE: PUNA, HI

RESERVOIR CHARACTERISTICS AND GEOLOGICAL/GEOPHYSICAL DESCRIPTION

RESERVOIR TEMPERATURE

Surface:

Subsurface: 356°C (bottomhole temperature)⁽²⁰⁾ Expected range of 250-300°C.⁽³⁹⁾

Geochemical

SiO₂:

Na-K-Ca :

TOTAL DISSOLVED SOLIDS (TDS): 2,000 (primarily silica and chloride)⁽³⁹⁾

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS): 1,000 MW (for Hawaii County)⁽²⁰⁾

TYPE OF OVERLAYING ROCK: Quaternary and tertiary volcanic rock.⁽⁶⁾

Olivine-bearing tholeiitic basalt of Kilauea, of both aa and pahoehoe types.⁽⁴⁰⁾

ESTIMATED DEPTH TO TOP OF RESERVOIR:

SEISMIC ACTIVITY: Island is extremely active. ⁽⁶⁾

SITE: PUNA, HI

LAND OWNERSHIP AND LEASING

		TOTAL AREA (ACRES)	FEDERAL (ACRES)	STATE (ACRES)	PRIVATE (ACRES)
KGRA: No KGRA defined.					
LAND LEASED IN KGRA					
HIGHEST-PRICED LEASES (BY DOLLARS/ACRE)					
\$/ACRE	LESSEE				
TENTATIVE LEASE SALE DATES					
NUMBER OF SALES OFFERED BUT NO BIDS:					
NUMBER OF BIDS REJECTED (RESULTING IN NO LEASE):					
SUBSURFACE AREA OF RESERVOIR					

SUMMARY OF LEASING STATUS AND NEEDS:

SITE: PUNA, HI

GEOHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
<p>Unsuccessful drilling was done in the early 1960s by a New Zealand firm.⁽³⁵⁾</p> <p>Drilling occurred near the Kilauea summit in the early 1970s in a research program conducted by Dr. George Keller of the Colorado School of Mines.⁽³⁵⁾</p> <p>More recently, a two-phase geothermal project took place 5 km (3 miles) east of Pahoa. The project was directed by the University of Hawaii School of Engineering,⁽³⁵⁾ and was funded by the State of Hawaii, the County of Hawaii, NSF, ERDA, and other public and private sources.⁽²⁶⁾</p> <p>The first phase of the project involved infrared aerial photographic mapping (of Hawaii Co.) which identified the southeast rift zone of Kilauea Volcano as the most promising point for the drilling effort.⁽³⁵⁾</p> <p>By July 1976,⁽⁴⁰⁾ a 1,966 m (6,450 feet)⁽³⁹⁾ well was drilled as Phase 2 of the project. Drilling began November 22, 1975, with 744 m (2,440 feet) drilled by April 1976. Drilling was slowed by the irregular pahoe-hoe rock formation that caused the drill stem to go off course.⁽³⁵⁾</p> <p>The completed well had a 6.35 cm (2.5 inch) orifice at ground level, and flowed 916 MT/day (84,000 lb/hr) brine of which 589 MT/day (54,000 lb/hr) was steam. The well-head temperature was 205°C with pressure of 16.66 kg/cm² (237 psia). The TDS was 2,000 ppm but highly variable in terms of content (which was primarily silica and chloride). A maximum of 4 MWe is expected from the well. ERDA is investigating a proposal to install a wellhead generator.⁽³⁹⁾</p>	

SITE: PUNA, HI (CONTINUED)

GEOHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
<p>By February 1977, the Geothermal Exploration and Development Corp. of Hawaii (GEDCO, a subsidiary of Water Resources International of Honolulu which drilled the successful well under contract to the University of Hawaii) and the Thermal Power Co. (a subsidiary of Natomas) jointly planned to conduct an exploration and development program on both the Hilo and Kona site of the Hawaii County island "with plans to probe the other side in the near future."(36)</p> <p>GEDCO and the Thermal Power Co. are currently seeking permission to drill 6 wells. The companies are considering applying for loan guarantees for these wells.(39)</p>	

SITE: PUNA, HI

INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)

SITE: PUNA, HI

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds
Precipitation (Annual): 40.6 to 762.0 cm (16 to 300 in.) (6)

Average Temperature
Minimum: 21.1 to 26.7°C (70 to 80°F) (6)
Maximum: 21.1 to 26.7°C (70 to 80°F) (6)

Relative Humidity
(Seasonal Peaks)
Summer: 80-90% (6)
Winter: 80-90%

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
	Site is within 10 km (6 mi.) of the Pa- cific Ocean.		Guava mixed forest. (6)		

SITE: PUNA, HI

POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR:

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES NEAR SITE	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
Pahoa	5 km (3 mi.) (26)	1,046 (6)	There is a 69 kv line crossing the NW Corner of the Puna District. The line is owned by Hawaii Electric Light Co. (private). A 69 kv line and a 150 MW steam plant owned by Puna Sugar Co. (industrial) is located in the N.E. Corner of the Puna District (near Keaau). (33IV)	State Highway 132 is located at the current drilling site. State Highways 11 and 13 are in the District (34)	
Opihikao	5 km (3 mi.) (6)	116 (6)			
Kalapana	12 km (7 mi.) (6)	60 (6)			

SITE: SALTON SEA, CA

SITE: SALTON SEA, CA (STATE/PRIVATE)

POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
SLC, Owner	Issue Prospecting/Exploration Permits	Developer	}	ASSUMED COMPLETED									
County Gov't	Issue Land Use Permits	Developer											
DOG	Issue Drilling Permits	Developer											
SLC, Owner	Acquire Leases	Developer											
Developer	Preliminary Geophysical Exploration	Developer											
Developer	Develop Utility Interest												
SLC, County Developer	Process EIR	State DEQ											
Developer & Utility	Exploratory Drilling & Reservoir Evaluation												
Developer & Utility	Feasibility Study												
Producer (Developer) & Utility	Financial Negotiations												
Producer & Utility	Site Selection												
Producer & Utility	Prepare Environmental Data Statement	CPUC/ CERDC, County											
Producer & Utility	Design												
Producer & Utility	Commitment to Development												
CERDC, CPUC	Certify Plant & Site, Issue Permits	Producer & Utility											
County, DOG	Process EIR (Drilling)	State DEQ											
CPUC	Process EIR (Plant >50 MW)	State DEQ											
CPUC	Process EIR (Transmission Line)	State DEQ											
Producer & Utility	Development Drilling												
Utility	Plant Construction												
Utility	Install Transmission Line (16km)												

Possible Subsequent Additions (MWe) and On Line Date: 100 - 1985, 75 - 1986, 75 - 1987, 100 - 1988,
 100 - 1989, 100 - 1990, 100 - 1991, 100 - 1992, 100 - 1993, 100 - 1994, 100 - 1995, 100 - 1996, 100 - 1997,
 100 - 1998, 100 - 1999

SITE: SALTON SEA, CA (REGION 1)

SUMMARY

TEMPERATURE °C

Surface: 101

Subsurface: 340

TOTAL DISSOLVED SOLIDS (PPM):

250,000 Av.; 330,000 Max. (13)

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS):

2,759 (7)

TYPE OF OVERLAYING ROCK:

Soft

ESTIMATED DEPTH TO TOP OF RESERVOIR (METERS):

1,000

DESCRIPTION OF KGRA

Total KGRA Acres: 95,824 (2)

Total Federal Acres: 18,644 (1) (Bu.Rec.)

Federal Acres Leased:

Total State and Private Acres: 76,370 (1)

State and Private Acres Leased:

GEOHERMAL DEVELOPMENT STATUS:

Numerous productive wells have been drilled. An experimental facility has been constructed to test geothermal fluids. (16) A 10 MWe thermal loop is under operation. (3) As of June 1976, 650 MWe is planned for 1986-95, predicated upon direct flash technology for hypersaline brines. (2) There is extensive industry involvement. (13, 20, 22)

LOCAL AND STATE ATTITUDE TOWARD GEOHERMAL DEVELOPMENTS:

Numerous state and local regulations. (1A)

LAND USE AND POPULATION:

Irrigated land used for agriculture. Relatively sparse population with small population centers nearby. (6)

COMMENTS AND CRITICAL ISSUES:

Extremely flat topography sensitive to disturbance of runoff patterns. In seismically active area. (6) Economics and market favorable if brine handling and injection problems are solved. (20)

SITE: SALTON SEA, CA

SITE: SALTON SEA, CA

SITE LOCATION AND PHYSICAL DESCRIPTION

LATITUDE: 33° 12' 00" N

LONGITUDE: 115° 36' 00" W

COUNTY: Imperial

ADJACENT COUNTIES: San Diego, Riverside, Yuma, AZ. Mexico is south of Imperial County.

LAND OWNERSHIP:

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
Extremely flat area with average grade of .93-1.86 m/km (5-10 ft/ mile)(13)	Irrigated land used for agricul- ture.(6) Approximately 19,000 acres are bird refuge and Naval Test Base.(20)			

SITE: SALTON SEA, CA

RESERVOIR CHARACTERISTICS AND GEOLOGICAL/GEOPHYSICAL DESCRIPTION

RESERVOIR TEMPERATURE

Surface: 101°C
Subsurface: 340°C

Geochemical
SiO₂:
Na-K-Ca:

TOTAL DISSOLVED SOLIDS (TDS): 250,000 ppm, average; 330,000 ppm maximum.⁽¹³⁾

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS): 2759⁽⁷⁾

TYPE OF OVERLAYING ROCK: Shale-siltstone caprock underlain by arbosic sand (soft).

ESTIMATED DEPTH TO TOP OF RESERVOIR: 1000 m (3281 ft)

SEISMIC ACTIVITY:

In seismically active area.⁽⁶⁾

SITE: SALTON SEA, CA

LAND OWNERSHIP AND LEASING

		TOTAL AREA (ACRES)	FEDERAL (ACRES)	STATE (ACRES)	PRIVATE (ACRES)
KGRA: Salton Sea		95,824	18,644 ⁽¹⁾ (Bu. Rec.)	76,370 ⁽¹⁾ (State & Private)	
LAND LEASED IN KGRA			None (approx- imately 19,000 withdrawn for		
HIGHEST-PRICED LEASES (BY DOLLARS/ACRE)			bird refuge and Naval Test Base) ⁽²⁰⁾		
\$/ACRE	LESSEE				
TENTATIVE LEASE SALE DATES					
NUMBER OF SALES OFFERED BUT NO BIDS:					
NUMBER OF BIDS REJECTED (RESULTING IN NO LEASE):					
SUBSURFACE AREA OF RESERVOIR		13,344 ⁽⁸⁾			

SUMMARY OF LEASING STATUS AND NEEDS:

SITE: SALTON SEA, CA

GEOHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
<p>By July 1976, 24 wells of which 15 are operative were drilled within 17 square miles. Wells range in depth from 177 m - 2,240 m (590 - 8,100 feet) with average being 1,110 m (3,700 feet), and average flow rate of 207,000 kg/hr. (460,000 lbs./hr.). The shallow wells produce brines generally low in TDS, while the TDS in deeper holes goes to 330,000 ppm. (13)</p> <p>San Diego Gas and Electric Co. (SDG&E) is researching geothermal deposits in the Salton Sea area, where the SDG&E and ERDA have constructed an experimental facility to study high temperature, high brine geothermal fluids. In May 1977, a 10 MW binary test loop using flashed steam as the intermediate heat transfer medium was operating. The loop, which had operated 3,000 hours, has four stages of flashing with the last being below atmospheric pressure. Water, rather than isobutane, was being used at the output end (isobutane is to be used by November 1977). (31)</p> <p>Scaling (primarily of silica and some carbonate) in the primary side of the loop is substantial, with the greatest scaling in the injection pump and the return line into the injection well. The longest time the loop had operated (by May 1977) was 934 hours and the 330 mm (10 in.) output line was choked to 25 mm (1 in.) in this period. Hydroblasting and acid treatment removed the scale satisfactorily. A Teflon lining in the return line may be used to limit scaling. (31)</p> <p>The steam scrubbers in the loop have been successful with only 10-12 ppm remaining in the steam. (31)</p>	<p>As of June 1976, Southern California Edison (SCE) was planning for 650 MWe of geothermal capacity between 1986-1995. This was to be predicated upon the successful development/ test program of direct flash technology for hypersaline brines in the Salton Sea area. (2)</p>

SITE: SALTON SEA, CA (CONTINUED)

GEOHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
<p>The University of California, Riverside, has been studying gravity models, performing active seismic programs, doing shallow temperature studies using magnetotelluric investigations, and studying the lithology of the Salton Sea anomalie. The Lawrence Livermore Lab has been monitoring subsidence and seismic activity. (22)</p> <p>Other industry involvement includes SCE and SP Land Corp.;(20) and the Imperial Magma Co., Westec Services, and Woodward-Clyde Consultants working with Phillips Petroleum. (22)</p> <p>Most of the geothermal development at Salton Sea has been on the southeast shore. (47)</p> <p>Shallow wells were drilled at Salton Sea between 1927 and 1952 to obtain CO₂, which was used to manufacture dry ice. (47)</p>	

SITE: SALTON SEA, CA
INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)
<p>Production Permit must be issued by Imperial County (requires compliance with all other permits and regulations such as building, plumbing, electrical and construction permits). The most important and time-consuming requirement of the Production Permit is the Environmental Impact Report (EIR) which may require at least 10 months of lead time for data collection and report preparation.</p> <p>The State's District Air Pollution Control Board requires construction and operations permits.</p> <p>Imperial County requires underground installation of collection and reinjection pipes at geothermal sites. Air pollution standards are set by the Occupational Safety and Health Administration (OSHA) and by the California Air Resources Board.</p> <p>California Division of Oil and Gas (DOG) is responsible for determining that potable groundwater supplies are protected during oil-, gas-, and geothermal-field operations, and for ensuring that subsidence will not occur.⁽¹³⁾</p> <p>In addition, the State Division of Industrial Safety requires a permit for liquid petroleum.⁽¹³⁾</p>		

SITE: SALTON SEA, CA

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds Summer: from SE at 13.7 kph (8.5 mph); Winter: from N at 11.3 kph (7 mph)⁽¹³⁾

Precipitation (Annual): 5.8 cm (2.3 inches)

Average Temperature

Minimum: 12.2°C (54°F)

Maximum: 33.3°C (92°F)

Relative Humidity

(Seasonal Peaks)

Summer: 20%-30%

Winter: 40%

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
	Alamo River is 5 km (3 miles) east of the site. Water table is only 2 meters (5 feet) deep. There are irrigation canals throughout the area.		Creosote bush, bur sage, saltbush, greasewood		

SITE: SALTON SEA, CA

POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR:

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES NEAR SITE	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
Niland	<16 km (10 miles)	800	One 161 kv N-S line and one 161 kv E-W line owned by the Imperial Irrigation District (municipal) intersect within 16 kv (10 mi.) east of Niland. (33-II)	Niland has a high- way running through it. (6)	Few miles from Rail- road (rail service in Niland)
El Centro (County Seat)	48 km (30 miles)			Nearest railroad access is approx- imate 6 miles. (6)	56 cm (22") or smaller gas pipeline within a few miles. 25 cm (10") or larger oil products pipeline within a few miles. (6)

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 8

SECTION A.- GEOTHERMAL FIELD-AREA

RECORD IDENTIFICATION

RECORD NO..... 0000294
 CROSS INDEX NO.. CF00471
 RECORD TYPE..... A

NAME..... J. RENNER
 DATE..... 74/12
 ORGANIZATION.. U.S.G.S.

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. SALTON SEA
 WARING FIGURE..... 8
 COUNTRY CODE..... US
 STATE/PROVINCE..... CALIFORNIA
 LATITUDE..... 33-12-00N

WARING NUMBER..... 162A
 COUNTRY NAME..... UNITED STATES
 COUNTY..... IMPERIAL
 LONGITUDE..... 115-36-00W

TOWNSHIP RANGE SECTION 1/4 1/4
 11S 13E 22

BASE & MERIDIAN..... SAN BERNARDINO
 AVAILABLE MAPS OF AREA: N1LAND 1:24000, OBSIDIAN BUTTE 1:24000

GENERAL DESCRIPTION

SIZE OF SURFACE EXPRESSION.... 2.5 KM**2
 ELEVATION..... -7.0104E+01M -230. FT
 RESOURCE CATEGORY..... 6
 PRESENT USE & DEVELOPMENTS: ABOUT 20 WELLS, 700 TO 2400 M. DEPTH, TEMPERATURES TO 360C IN HYP
 SURFACE THERMAL ACTIVITY..... HOT SPRING(S), FUMAROLE OR WARM VAPOR,
 NO. OF HOT SPRINGS..... 5

GEOTHERMAL CHARACTERISTICS

SPRING TEMPERATURES..... 72. C TO 101. C
 SPRING DESCRIPTION..... BOILING
 WELL INFORMATION
 MAXIMUM WELL TEMPERATURE..... 360. C TO 2100. M
 BOTTOM-HOLE TEMPERATURE..... 360.0 C TO 2100.00 M

RESERVOIR PROPERTIES

RESERVOIR TEMPERATURES..... 300. C TO 360. C MEASURED
 BEST ESTIMATE..... 340.0 C
 SUBSURFACE AREA..... 23.0 KM**2 TO 104.0 KM**2
 BEST ESTIMATE..... 54.0 KM**2
 BASED ON: GEOLOGY, GEOPHYSICS, DRILLING
 DEPTH TO TOP OF RESERVOIR..... 700.00 M 0.700 KM TO 1500.00 M 1.500 KM
 BEST ESTIMATE..... 1000.00 M 1.000 KM
 DEPTH TO BOTTOM OF RESERVOIR.. 3000.00 M 3.000 KM TO 3000.00 M 3.000 KM
 BEST ESTIMATE..... 3000.00 M 3.000 KM
 THICKNESS OF RESERVOIR..... 1500.00 M 1.500 KM TO 2300.00 M 2.300 KM
 BEST ESTIMATE..... 2000.00 M 2.000 KM
 VOLUME OF RESERVOIR..... 34.500 KM**3 TO 240.000 KM**3
 BEST ESTIMATE..... 108.000 KM**3
 POROSITY..... 0.15 TO 0.20

COMMENTS: DEPTHS TO TOP & BOTTOM OF RESERVOIR ARE ASSUMED.

RESERVES
 TOTAL STORED HEAT..... 2.4697E+19 J 5.8999E+18 CAL TO 2.0930E+20 J 4.9999E+19 CAL
 BEST ESTIMATE..... 8.7902E+19 J 2.0999E+19 CAL ABOVE 15. C

GEOLOGY
 GENERAL ROCK TYPES: SHALE -SILTSTONE CAPROCK UNDERLAIN BY ARKOSIC SAND

GEOPHYSICS
 GRAVITY SURVEY INFORMATION: TEST MADE
 MAGNETIC SURVEY INFORMATION: TEST MADE
 OTHER GEOPHYSICAL INFORMATION: TEMPERATURE GRADIENT

PRIMARY REFERENCE:
 AUTHOR..... D.E. WHITE & D.L. WILLIAMS, EDITORS
 DATE..... 1975
 TITLE..... ASSESSMENT OF GEOTHERMAL RESOURCES OF THE UNITED STATES - 1975
 REFERENCE... U.S.G.S. CIRCULAR 726

RELATED REFERENCES:
 1) HELGESON, H.C., 1968, GEOLOGIC AND THERMODYNAMIC CHARACTERISTICS OF THE SALTON SEA GEOTHERMAL SYSTEM:
 AM. JOUR. SCI., V. 266, NO. 3, P. 129-166.
 2) MUFFLER, L.J.P., & WHITE, D.E., 1969, ACTIVE METAMORPHISM OF UPPER CENOZOIC SEDIMENTS IN SALTON SEA GEOTHERMAL
 FIELD & THE SALTON TROUGH, SOUTHEASTERN CALIFORNIA: GEOL. SOC. AMERICA BULL., V. 80, P. 157-182
 3) WHITE, D.E., 1965, GEOTHERMAL ENERGY: U.S.G.S. CIRC. 519, 19 P.
 4) MUNGER WELL HISTORIES

RECORD 00025

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 2

SECTION B.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0002072
 CROSS INDEX NO..
 RECORD TYPE..... 0
 SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.
 DATE..... 76/06
 ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. SALTON SEA
 NAME OF SAMPLE SOURCE.. FIELD #1
 COUNTRY CODE..... US COUNTRY NAME..... UNITED STATES
 STATE/PROVINCE..... CALIFORNIA COUNTY..... IMPERIAL
 OTHER LOCALITY INFORMATION: SANDY BEACH, AEC. 1000 FT. OFFSHORE

SAMPLE INFORMATION

COLLECTION DATE..... 1968/09/10
 WATER SAMPLING TEMP.... 32.4 C
 OTHER CHEMICAL CHARACTERISTICS: SMALL AMOUNT. PRECIPITATE IN SAMPLE WHEN RECEIVED.

WATER ANALYSIS

W

ANALYST(S)..... R. BARNES
 PH 1)..... 8.11
 SPECIFIC CONDUCTANCE..... 44200. UMHO/CM AT 25. C

SOLUTE ANALYSIS (WATER)

UNITS USED..... MG/L

LI	NA	K	RB	CS	NA+K			
	10800	185						
MG	CA	SR	BA	CA+MG				
1050	890							
ZN	HG	B	HB02	AL	PB	AS	SB	U
		9.3						
F	CL	ER	I					
2.0	15300							
NH4	NO3	PO4	SiO2	SO4	CO3	HCO3		
	.4		3.6	8140		191		

REFERENCES: PERSONAL FILE OF DON WHITE, USGS, MENLO PARK

RECORD 00026

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 8

SECTION 6.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0002071

CROSS INDEX NO..

RECORD TYPE..... 6

SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.

DATE..... 76/06

ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. SALTON SEA

NAME OF SAMPLE SOURCE.. FIELD #2

COUNTRY CODE..... US

STATE/PROVINCE..... CALIFORNIA

COUNTRY NAME..... UNITED STATES

COUNTY..... IMPERIAL

OTHER LOCALITY INFORMATION: SALTON SEA BEACH, 3 MI. SOUTH OF COUNTY LINE, 1000 FT. OFFSHORE

SAMPLE INFORMATION

COLLECTION DATE..... 1968/09/10

WATER SAMPLING TEMP.... 32.1 C

OTHER CHEMICAL CHARACTERISTICS: PRECIPITATE IN SAMPLE WHEN RECEIVED.

WATER ANALYSIS

W

ANALYST(S)..... R. BARNES

PH 1)..... 7.49

SPECIFIC CONDUCTANCE..... 44100. UMHO/CM

AT 25. C

SOLUTE ANALYSIS (WATER)

UNITS USED..... MG/L

LI	NA 10700	K 195	RB	CS	NA+K			
MG 1050	CA 845	SR	BA	CA+MG				
ZN	HG	B 9.0	HB02	AL	PB	AS	SB	U
F 2.2	CL 15100	BR	I					
NH4	NO3 .4	PO4	SIC2 4.0	SO4 8110	CO3	HCO3 197		

REFERENCES: PERSONAL FILE OF DON WHITE, USGS, MENLO PARK

SITE: SURPRISE VALLEY, CA

SITE: SURPRISE VALLEY, CA (FEDERAL/STATE/PRIVATE LAND)

POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
SLC, Owner, BLM	Issue Prospecting/ Exploration	Developer	ASSUMED COMPLETED										
County Government	Issue Land Use Permit	Developer											
BLM	Issue STG Drilling Permit	Developer											
USGS, DOG, BLM, SLC, Owner	Issue Drilling Permit	Developer											
Developer	Lease Land	Developer											
	Preliminary Geophysical Exploration												
BLM, SLC, County	Process EIA/EIS/EIR	CEQ, State DEQ											
Developer	Exploratory Drilling and Reservoir Evaluation												
Developer	Develop Utility Interest												
Developer and Utility	Feasibility Study												
Producer (Developer) and Utility	Financial Negotiations												
Producer and Utility	Site Selection												
Producer and Utility	Commitment to Development												
Producer and Utility	Design (Preliminary, Final)												
Producer and Utility	Prepare Master Development Plan	BLM, USGS											
Utility	Prepare Environmental Data Statement	BLM, FPC, CPUC, CERCDC											
County Government													
BLM, FPC, USGS, CPUC, CERCDC	Certify Plant and Site, Issue Permits	Producer and Utility											
USGS, County, DOG	Process EIA/EIS/EIR (Drilling)	CEQ, State DEQ											
FPC, CPUC	Process EIA/EIS/EIR (Plant & Transmission Line)	CEQ, State DEQ											
Producer	Development Drilling												
Utility	Plant Construction												
Utility	Install Transmission Line												

Possible Subsequent Additions (MWe) and On Line Date: 50 - 1988, 100 - 1989, 100 - 1990, 100 - 1991, 100 - 1992, 100 - 1993, 100 - 1994, 100 - 1995, 100 - 1996, 100 - 1997, 100 - 1998, 100 - 1999

SITE: SURPRISE VALLEY, CA (REGION 1)

SUMMARY

TEMPERATURE °C

Surface: 174

Subsurface: 175

TOTAL DISSOLVED SOLIDS (PPM): 1,500^(1A)
ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS): 2,102⁽⁷⁾ 150-200 (USGS)⁽⁴⁷⁾
TYPE OF OVERLAYING ROCK: Medium/Hard
ESTIMATED DEPTH TO TOP OF RESERVOIR (METERS): 1,000

DESCRIPTION OF KGRA

Total KGRA Acres: 72,446⁽⁹⁾
Total Federal Acres: 33,852⁽¹⁾ (31,972 BLM: 1,880 Total State and Private Acres: 32,399⁽¹⁾
Federal Acres Leased: 10,584⁽¹⁾ USFS) State and Private Acres Leased:

GEO THERMAL DEVELOPMENT STATUS:

Numerous wells drilled.^(4,2,20)

LOCAL AND STATE ATTITUDE TOWARD GEO THERMAL DEVELOPMENTS:

Stringent administrative constraints cause delays.^(1A) Public opinion is mixed.⁽⁴⁾ There may be a conflict between BLM and the County for control of activities on Federal lands.^(1A)

LAND USE AND POPULATION:

Mountain valley with grazing, farming and lumbering. Sparsely populated with several small towns nearby.

COMMENTS AND CRITICAL ISSUES:

As of August 1975, all exploration has occurred on private lands.^(1A) Environmental Impact Report is completed.⁽⁴⁾ Water supply is limited.⁽⁴⁾

SITE: SURPRISE VALLEY, CA

SITE: SURPRISE VALLEY, CA

SITE LOCATION AND PHYSICAL DESCRIPTION

LATITUDE: 41° 40' 00" N.

LONGITUDE: 120° 12' 00" W

COUNTY: Modoc

ADJACENT COUNTIES: Lassen, Shasta, Siskiyou; OR-Klamath, Lake; NV-Washoe

LAND OWNERSHIP OF COUNTY: 70% Federal (USFS & BLM)
25% Private
5% State⁽⁴⁾

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
Mountain valley generally north- south ⁽⁴⁾	Grazing, farming, lumbering on mountain sides. ⁽⁴⁾		The area is not of high aesthetic quality. ⁽⁴⁾	Historical sites (e.g., Fort Bidwell, the Applegate Trail) exist in area. ⁽⁴⁾

SITE: SURPRISE VALLEY, CA

RESERVOIR CHARACTERISTICS AND GEOLOGICAL/GEOPHYSICAL DESCRIPTION

RESERVOIR TEMPERATURE

Surface: 174°C
Subsurface: 175°C

Geochemical

SiO₂: 174°C
Na-k-Ca: 159°C

TOTAL DISSOLVED SOLIDS (TDS): 1500^(1A)

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS): 2102⁽⁷⁾ 150-200 (USGS)⁽⁴⁷⁾

TYPE OF OVER LAYING ROCK: The Surprise Valley fault is a major structural feature paralleling the western side of the valley. The vertical displacement of this fault may be as much as 3658 m (12,000 ft), and the valley fill is at least 2134 m (7000 ft) in thickness. There are also young rhyolite flows and plugs in the northern half of the valley in association with further hot spring occurrence.⁽⁴⁾

ESTIMATED DEPTH TO TOP OF RESERVOIR: 100 m (3281 ft)

SEISMIC ACTIVITY: Geologically, Surprise Valley is a down-dropped fault block (graben) with uplifted fault blocks (horsts) forming the mountain ranges to the east and west. Structure such as this is typical of the Basin and Range province to the east; however, the sedimentary and volcanic stratigraphic section is typical of the Modoc Plateau to the west. Surprise Valley, then, lies in a transition zone between provinces.⁽⁴⁾

The lack of erosion on the fault scarp and the existence of uneroded landslide scars suggest recent (perhaps within 10,000 years) major movement.⁽⁴⁾

SITE: SURPRISE VALLEY, CA

LAND OWNERSHIP AND LEASING

		TOTAL AREA (ACRES)	FEDERAL (ACRES)	STATE (ACRES)	PRIVATE (ACRES)
KGRA: Lake City - Surprise Valley		72,446 ⁽⁹⁾	33,852	32,339 (state & private)	
LAND LEASED IN KGRA			10,584 ⁽¹⁵⁾		
HIGHEST-PRICED LEASES (BY DOLLARS/ACRE) (15)					
\$/ACRE	LESSEE				
21.53	So. Union Prod. Co.				
18.74	Getty Oil Co.				
12.75	Getty Oil Co.				
7.75	Getty Oil Co.		2,586 1,587 1,800 2,528		
TENTATIVE LEASE SALE DATES					
NUMBER OF SALES OFFERED BUT NO BIDS:					
NUMBER OF BIDS REJECTED (RESULTING IN NO LEASE):					
SUBSURFACE AREA OF RESERVOIR		30,888 ⁽⁸⁾			

SUMMARY OF LEASING STATUS AND NEEDS: Dow Chemical Co. held a geothermal lease which was terminated.(47)
The most promising part of the resource appears to be on private rather than Federal land.(47)

SITE: SURPRISE VALLEY, CA

GEOHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
<p>By August 1975, Gulf Oil had drilled three wells in area with the greatest well depth at 1371 m (4,500 ft).⁽⁴⁾</p> <p>By early 1976, approximately seven holes were drilled across several square miles by Magma Power and Gulf Oil, and sites were approved for three additional holes.⁽²⁾</p> <p>By February 1977, eight wells were drilled on private land.⁽²⁰⁾</p> <p>By June 1977, Gulf had drilled two 2,134 m (7,000 foot) holes.⁽⁴⁷⁾</p> <p>Magma's drilling was in the northern part of the KGRA.⁽⁴⁷⁾</p>	

SITE: SURPRISE VALLEY, CA

INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)
<p>The local administration has adopted definitive procedures for geothermal activity. An Environmental Assessment (EA) or possibly an EIS (if required) must be done to obtain a land use permit. An EIS is required for development and production.(1A)</p> <p>Administrative constraints are stringent, causing delays in development.(1A)</p>	<p>Public opinion is mixed but no significant opposition is expected.(4) However, the disposition of the county administration has been described as "cautious". The county is anticipating a potential conflict with BLM for control of geothermal activities on federal lands.(1A)</p>	<p>Environmental Impact Report pertaining to geothermal exploration is available.(4)</p>

SITE: SURPRISE VALLEY, CA

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds

Precipitation (Annual): 32.7 cm (12.88 inches)

Average Temperature

Minimum: -1.7°C (29°F)

Maximum: 22.8°C (73°F)

Relative Humidity

(Seasonal Peaks)

Summer: 30% - 40%

Winter: 70%

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
Very good. (4)	Poor. Limited supply. Three lakes exist but are alkaline; there are several seasonal saline lakes on Valley floor. (4)		Sagebrush, bitterbush, juniper and (4) various grasses.	deer, antelope, rabbit, dove, quail, pheasant, grouse, eagle, and duck. (4)	8 varieties of plants, 4 birds (bald eagle, Osprey, Peregrine & Prairie Falcons), 2 fish (Shortnose and Modoc (4) Suckers).

SITE: SURPRISE VALLEY, CA
POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR:

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES NEAR SITE	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
Cedarville	~32 km (20 miles)	800	Within 90 km (25 miles) east of the site (in Nevada) there is one 800 kv DC N-S line owned by the Southern California Edison Co. (private), and the Los Angeles, Glendale, Burbank, and Pasadena municipalities. (33-II)	State Highway 299 <16 km (10 miles) from site. (6)	~40 km (25 miles) from primary rail- road. (6)
Lake City	~16 km (10 miles)	100			
Reno	~322 km (200 miles)	70,000			

RECORD 00027

GEOHERMAL RESOURCES FILE (GEOHERM) REVISION 8

SECTION A.- GEOHERMAL FIELD-AREA

RECORD IDENTIFICATION

RECORD NO..... 0000276
 CROSS INDEX NO.. CF00361
 RECORD TYPE..... A

NAME..... J. RENNER, C. BROOK, D. WILLIAMS
 DATE..... 75/02
 ORGANIZATION.. U.S.G.S.

GEOGRAPHIC LOCALITY

GEOHERMAL FIELD-AREA.. SURPRISE VALLEY
 WARNING FIGURE..... 8
 COUNTRY CODE..... US
 STATE/PROVINCE..... CALIFORNIA
 LATITUDE..... 41-40-00N

WARNING NUMBER..... 14
 COUNTRY NAME..... UNITED STATES
 COUNTY..... MODOC
 LONGITUDE..... 120-12-00W

TOWNSHIP RANGE SECTION 1/4 1/4
 44N 15E 24 NW SE

BASE & MERIDIAN..... MT. DIABLO
 AVAILABLE MAPS OF AREA: CEDARVILLE 1:62,500

GENERAL DESCRIPTION

SIZE OF SURFACE EXPRESSION.... 1.0 KM**2
 ELEVATION..... 1365.50 M 4480. FT
 RESOURCE CATEGORY..... B
 PRESENT USE & DEVELOPMENTS: 4 WELLS DEEPEST 1370M
 SURFACE THERMAL ACTIVITY..... HOT SPRINGS
 ASSOCIATED DEPOSITS..... SINTER
 NO. OF HOT SPRINGS..... 7

GEOHERMAL CHARACTERISTICS

SPRING TEMPERATURES..... 49. C TO 97. C
 WELL INFORMATION
 MAXIMUM WELL TEMPERATURE..... 160. C TO 1155. M
 BOTTOM-HOLE TEMPERATURE..... TO 1370.00 M

RESERVOIR PROPERTIES

RESERVOIR TEMPERATURES..... 110. C TO 225. C ASSUMED
 BEST ESTIMATE..... 175.0 C
 SUBSURFACE AREA..... 40.6 KM**2 TO 250.0 KM**2
 BEST ESTIMATE..... 125.0 KM**2
 BASED ON: GEOLOGY, GEOPHYSICS
 DEPTH TO TOP OF RESERVOIR..... 500.00 M 0.500 KM TO 1500.00 M 1.500 KM
 BEST ESTIMATE..... 1000.00 M 1.000 KM
 DEPTH TO BOTTOM OF RESERVOIR.. 3000.00 M 3.000 KM TO 3000.00 M 3.000 KM
 BEST ESTIMATE..... 3000.00 M 3.000 KM
 THICKNESS OF RESERVOIR..... 1500.00 M 1.500 KM TO 2500.00 M 2.500 KM
 BEST ESTIMATE..... 2000.00 M 2.000 KM
 VOLUME OF RESERVOIR..... 60.000 KM**3 TO 625.000 KM**3
 BEST ESTIMATE..... 250.000 KM**3

COMMENTS: DEPTHS TO TOP & BOTTOM OF RESERVOIR ARE ASSUMED.

RESERVES

TOTAL STORED HEAT.....	1.4232E+19 J	3.3999E+18 CAL	TO 3.6836E+20 J	8.7999E+19 CAL
BEST ESTIMATE.....	1.0046E+20 J	2.3999E+19 CAL	ABOVE 15. C	

GEOLOGY

GENERAL ROCK TYPES: QUATERNARY ALLUVIUM, TERTIARY OR POSSIBLY PLEISTOCENE VOLCANICS

GEOPHYSICS

GRAVITY SURVEY INFORMATION: TEST MADE
 MAGNETIC SURVEY INFORMATION: TEST MADE
 ELECTRICAL RESISTIVITY: DC RESISTIVITY TEST MADE
 OTHER GEOPHYSICAL INFORMATION: AMT

PRIMARY REFERENCE:

AUTHOR..... D.E. WHITE & D.L. WILLIAMS, EDITORS
 DATE..... 1975
 TITLE..... ASSESSMENT OF GEOTHERMAL RESOURCES OF THE UNITED STATES - 1975
 REFERENCE... U.S.G.S. CIRCULAR 726

RELATED REFERENCES:

- 1) CHAPMAN, R.H., AND BISHOP, C.C., 1968, ALTURAS SHEET: CALIFORNIA DIV. MINES & GEOLOGY, BOUGUER GRAVITY MAP OF CALIFORNIA
- 2) DUFFIELD, W.A., & FOURNIER, R.O., 1974, RECONNAISSANCE STUDY OF THE GEOTHERMAL RESOURCES OF MODOC COUNTY, CALIF.: U.S.G.S. OPEN-FILE REPORT.
- 3) GAY, T.E., JR., & AUNE, W.A., COMPILERS, 1958, GEOLOGIC MAP OF CALIFORNIA, ALTURAS SHEET: CALIF. DIV. MINES & GEOLOGY
- 4) WARING, G.A., 1965, THERMAL SPRINGS OF THE U.S. AND OTHER COUNTRIES OF THE WORLD - A SUMMARY: USGS PROF. PAPER 492

WHITE & OTHERS, 1963, CHEMICAL COMPOSITION OF SUBSURFACE WATERS, IN FLEISCHER, M., ED., DATA OF GEOCHEMISTRY:
 USGS PROF. PAPER 440-F

RECORD 00028

GEO THERMAL RESOURCES FILE (GEOTHERM) REVISION 8

SECTION B.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000852
 CROSS INDEX NO.. REE00P1
 RECORD TYPE..... 8
 SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.
 DATE..... 76/04
 ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEO THERMAL FIELD-AREA.. SURPRISE VALLEY
 NAME OF SAMPLE SOURCE.. LEONARDS HOT SPRINGS
 COUNTRY CODE..... US
 STATE/PROVINCE..... CALIFORNIA
 LATITUDE..... 41-35.9 N

COUNTRY NAME..... UNITED STATES
 COUNTY..... MODOC
 LONGITUDE..... 120-05.5 W

TOWNSHIP RANGE SECTION 1/4 1/4
 43N 10E 13 NE NE

SAMPLE INFORMATION

SOURCE TYPE..... SPRING
 SAMPLE NO..... 4
 COLLECTION DATE..... 1973/07/25
 COLLECTOR(S)..... MARSHALL J. REED
 WATER FLOW RATE..... 2.50 L/S 150. L/MIN
 WATER TREATMENT DATA: PRESSURE-FILTERED THROUGH A .45 MICROMETRE MEMBRANE, PORTION ACIDIFIED, DILUTED
 OTHER CHEMICAL CHARACTERISTICS: ALTITUDE 1390 M

WATER ANALYSIS

ANALYST(S)..... W
 REED, RAPP, PRESSER, WILLEY
 PH 1)..... 7.82
 SPECIFIC CONDUCTANCE..... 2.59 UMHO/CM
 TOTAL DISSOLVED SOLIDS... 1180 MG/L

SOLUTE ANALYSIS (WATER)

UNITS USED..... MG/L

LI	NA	K	Rb	CS	NA+K			
.13	330	8.5	.03					
MG	CA	SR	BA	CA+MG				
.6	26							
MN+3	MN(TOT)	FE+3	FE(TOT)	CU				
	.09							
ZN	HG	B	HBO2	AL	Pb	AS	SE	U
LT .005		7.6						
F	CL	BR	I					
5.2	220							
NH4	NO3	PO4	SIO2	SO4	CO3	HCO3		
			110	390	1	82		

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COMMENTS: SURPRISE VALLEY IS A GRABEN WITH ACCUMULATED SEDIMENTS AND VOLCANIC DEBRIS
REFERENCES: REED, MARSHALL J., THE CHEMISTRY OF THERMAL WATER IN SELECTED GEOTHERMAL AREAS OF CALIFORNIA, REPORT
NO. TR15

RECORD 00029

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 8

SECTION 6.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000853
 CROSS INDEX NO.. REEDUP1
 RECORD TYPE..... 8
 SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.
 DATE..... 76/04
 ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. SURPRISE VALLEY
 NAME OF SAMPLE SOURCE.. SEYFERTH HOT SPRINGS
 COUNTRY CODE..... US
 STATE/PROVINCE..... CALIFORNIA
 LATITUDE..... 41-36.9 N

COUNTRY NAME..... UNITED STATES
 COUNTY..... MOHOC
 LONGITUDE..... 120-06.1 W

TOWNSHIP	RANGE	SECTION	1/4	1/4
43N	16E	12	NW	NW

SAMPLE INFORMATION

SOURCE TYPE..... SPRING
 SAMPLE NO..... 3
 COLLECTION DATE..... 1973/07/26
 COLLECTOR(S)..... MARSHALL J. REED
 WATER SAMPLING TEMP.... 85.4 C
 WATER FLOW RATE..... 8.33 L/S 500. L/MIN
 WATER TREATMENT DATA: PRESSURE-FILTERED THROUGH A .45 MICROMETRE MEMBRANE, PORTION ACIDIFIED, DILUTED
 OTHER CHEMICAL CHARACTERISTICS: ALTITUDE 1417 M.

WATER ANALYSIS

ANALYST(S)..... W M. J. REED, RAPP, PRESSER, WILLEY
 PH 1)..... 7.66
 SPECIFIC CONDUCTANCE..... 3.28 UMHO/CM
 TOTAL DISSOLVED SOLIDS... 1110. MG/L

ISOTOPIC DATA

DEL C(18) OF WATER..... -14.05 0/00
 DEL D OF WATER..... -121.2 0/00

SOLUTE ANALYSIS (WATER)

UNITS USED..... MG/L

LI	NA	K	RB	CS	NA+K
.15	300	9.0	.04		
MG	CA	SR	BA	CA+MG	
LT .1	28				
MN+3	MN(TOT)	FE+3	FE(TOT)	CU	
	.01				
ZN	HG	B	HRG2	AL	PB
LT .005		7.6			AS
					SB
					U

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F	CL	BR	I			
5.4	220					
NH4	NO3	PO4	SI02	SO4	CO3	HCO3
			110	370	0	63

COMMENTS: SURPRISE VALLEY IS A GRABEN WITH ACCUMULATED SEDIMENTS AND VOLCANIC DEBRIS
REFERENCES: REED, MARSHALL J., THE CHEMISTRY OF THERMAL WATER IN SELECTED GEOTHERMAL AREAS OF CALIFORNIA, REPORT
NO. TR15.

RECORD 00030

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION B

SECTION B.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000851
 CROSS INDEX NO.. REEDUP1
 RECORD TYPE..... L
 SAMPLE TYPE..... WELL

NAME..... SANFORD, LINDA J.
 DATE..... 76/04
 ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. SURPRISE VALLEY
 NAME OF SAMPLE SOURCE.. HUT SPRINGS MOTEL
 COUNTRY CODE..... US
 STATE/PROVINCE..... CALIFORNIA
 LATITUDE..... 41-31.9 N

COUNTRY NAME..... UNITED STATES
 COUNTY..... MODOC
 LONGITUDE..... 120-04.5 W

TOWNSHIP	RANGE	SECTION	1/4	1/4
42N	17E	6	NE	SW

SAMPLE INFORMATION

SAMPLE NO..... 5
 COLLECTION DATE..... 1973/07/27
 COLLECTOR(S)..... MARSHALL J. REED
 WATER SAMPLING TEMP.... 96.1 C
 WATER FLOW RATE..... 5.00 L/S 300. L/MIN
 WATER TREATMENT DATA: PRESSURE-FILTERED THROUGH A .45 MICROMETRE MEMBRANE, PORTION ACIDIFIED, DILUTED
 OTHER CHEMICAL CHARACTERISTICS: DEPTH 27 M., ALTITUDE 1372 M

WATER ANALYSIS

ANALYST(S)..... MARSHALL J. REED
 PH 1)..... 8.40
 SPECIFIC CONDUCTANCE..... 2.66 UMHO/CM

ISOTOPIC DATA

DEL D(18) OF WATER..... -13.81 0/00
 DEL D OF WATER..... -117.0 0/00

SOLUTE ANALYSIS (WATER)

UNITS USED..... MG/L

L1	NA	K	Rb	CS	NA+K
.10	280	5.5	.03		
MG	CA	SR	BA	CA+MG	
LT .1	16				
MN+3	MN(TOT)	FE+3	FE(TOT)	CU	
	LT .01				
ZN	HG	B	HCU2	AL	PB AS SB U
.014		5.7			
F	CL	BR	I		
5.1	200				

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NH4	NO3	PO4	SiO2	SO4	CO3	HCO3
			100	320	2	57

COMMENTS: SURPRISE VALLEY IS A GRABEN WITH ACCUMULATED SEDIMENTS AND VOLCANIC DEBRIS
REFERENCES: REED, MARSHALL J., THE CHEMISTRY OF THERMAL WATER IN SELECTED GEOTHERMAL AREAS OF CALIFORNIA, REPORT
NO. TR15

RECORD 00031

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 8

SECTION B.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000850
 CROSS INDEX NO.. REED0P1
 RECORD TYPE..... 6
 SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.
 DATE..... 76/04
 ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. SURPRISE VALLEY
 NAME OF SAMPLE SOURCE.. MENLO HOT SPRINGS
 COUNTRY CODE..... US
 STATE/PROVINCE..... CALIFORNIA
 LATITUDE..... 41-16.0 N

COUNTRY NAME..... UNITED STATES
 COUNTY..... MODOC
 LONGITUDE..... 120-04.5 W

TOWNSHIP RANGE SECTION 1/4 1/4
 39N 17E 7 NE NE

SAMPLE INFORMATION

SOURCE TYPE..... SPRING
 SAMPLE NO..... 6
 COLLECTION DATE..... 1973/08/23
 COLLECTOR(S)..... MARSHALL J. REED
 WATER SAMPLING TEMP.... 57.4 C
 WATER FLOW RATE..... 8.33 L/S 500. L/MIN
 WATER TREATMENT DATA: PRESSURE-FILTERED THROUGH A .45 MICROMETRE MEMBRANE, PORTION ACIDIFIED, DILUTED
 OTHER CHEMICAL CHARACTERISTICS: ALTITUDE 1384 M.

WATER ANALYSIS

ANALYST(S)..... W REED, RAPP, PRESSER, WILLEY
 PH 1)..... 8.91
 SPECIFIC CONDUCTANCE..... .808 UMHO/CM
 TOTAL DISSOLVED SOLIDS... 370. MG/L

ISOTOPIC DATA

DEL O(18) OF WATER..... -15.30 0/00
 DEL D OF WATER..... -112.3 0/00

SOLUTE ANALYSIS (WATER)

UNITS USED..... MG/L

LI	NA	K	Rb	CS	NA+K				
LT .02	100	1.4	LT .01						
MG	CA	SR	BA	CA+MG					
LT .1	5.1								
MN+3	MN(TOT)	FE+3	FE(TOT)	CU					
	LT .01								
ZN	HG	B	H602	AL	FB	AS	SE	U	
LT .05		.93							

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F	CL	BR	I			
3.8	25					
NH4	NO3	PO4	SiO2	SO4	CO3	HCO3
			53	120	34	27

COMMENTS: SURPRISE VALLEY IS A GRABEN WITH ACCUMULATED SEDIMENTS AND VOLCANIC DEBRIS.
REFERENCES: REED, MARSHALL J., THE CHEMISTRY OF THERMAL WATER IN SELECTED GEOTHERMAL AREAS OF CALIFORNIA, REPORT
NO. TR15.

RECORD 00032

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 8

SECTION 8.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... G000277
 CROSS INDEX NO.. CF00381
 RECORD TYPE..... B
 SAMPLE TYPE..... SURFACE

NAME..... J. RENNER, C. BROOK, D. WILLIAMS
 DATE..... 75/02
 ORGANIZATION.. U.S.G.S.

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. SURPRISE VALLEY
 COUNTRY CODE..... US
 STATE/PROVINCE..... CALIFORNIA
 LATITUDE..... 41-40.00 N

COUNTRY NAME..... UNITED STATES
 COUNTY..... MODOC
 LONGITUDE..... 120-12.00 W

SAMPLE INFORMATION

SOURCE TYPE..... SPRING
 WATER SAMPLING TEMP.... 86.0 C
 WATER FLOW RATE..... 0.049998 L/S 3.0 L/MIN

WATER ANALYSIS W

ANALYSIS DATE..... 1973

SOLUTE ANALYSIS (WATER)

LI	NA	K	Rb	CS	NA+K
	343.00	16.30			
MG	CA	SR	BA	CA+MG	
	11.00				
F	CL	BR	I		
	223.00				
NH4	NO3	PO4	SiO2	SO4	CO3
			182.00	330.00	HCO3
					124.00

REFERENCES: WHITE & OTHERS, ASSESSMENT OF GEOTHERMAL RESOURCES OF THE U.S. - 1975, U.S.G.S. CIRCULAR 726
 DUFFIELD & FOURNIER 1974 (MUD VOLCANO AREA)

RECORD 00033

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 8

SECTION 8.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000829
 CROSS INDEX NO.. REEDOP1
 RECORD TYPE..... B
 SAMPLE TYPE..... WELL

NAME..... SANFORD, LINDA J.
 DATE..... 76/04
 ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. SURPRISE VALLEY

NAME OF SAMPLE SOURCE.. WELL AT FORT BOWWELL RESERVATION

COUNTRY CODE..... US

COUNTRY NAME..... UNITED STATES

STATE/PROVINCE..... CALIFORNIA

COUNTY..... MODOC

LATITUDE..... 41-51.7 N

LONGITUDE..... 120-09.5 W

TOWNSHIP RANGE SECTION 1/4 1/4
 46N 16E 17 NW NE

SAMPLE INFORMATION

SAMPLE NO..... 1
 COLLECTION DATE..... 1973/07/26
 COLLECTOR(S)..... MARSHALL J. REED
 WATER SAMPLING TEMP.... 45.1 C

WATER FLOW RATE..... 0.07 L/S 400. L/MIN

WATER TREATMENT DATA: PRESSURE - FILTERED THROUGH A .45 MICROMETRE MEMBRANE, PORTION ACIDIFIED, DILUTED

OTHER CHEMICAL CHARACTERISTICS: ALTITUDE 1414 M.

WATER ANALYSIS

W

ANALYST(S)..... M. J. REED, RAPP, PRESSER, WILLEY
 PH 1)..... 7.85
 SPECIFIC CONDUCTANCE..... .733 UMHC/CM
 TOTAL DISSOLVED SOLIDS... 458. MG/L

SOLUTE ANALYSIS (WATER)

UNITS USED..... MG/L

LI	NA	K	RB	CS	NA+K			
.03	110	9.5	.01					
MG	CA	SR	EA	CA+MG				
	4.2							
MN+3	MY(TOT)	FE+3	FE(TOT)	CU				
	LT .01							
ZN	HG	B	HBO2	AL	PB	AS	SB	U
LT .005		.61						
F	CL	BR	I					
2.2	31							
LiH4	NO3	PO4	SIC2	SC4	CO3	HCO3		
			82	86	1	131		

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COMMENTS: SURPRISE VALLEY IS A CRABEN WITH ACCUMULATED SEDIMENTS AND VOLCANIC DEBRIS
REFERENCES: REED, MARSHALL J., THE CHEMISTRY OF THERMAL WATER IN SELECTED GEOTHERMAL AREAS OF CALIFORNIA, REPORT
NO. TR15

RECORD 00034

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 1

SECTION B.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000826
 CROSS INDEX NO.. REEDOP1
 RECORD TYPE..... B
 SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.
 DATE..... 76/04
 ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. SURPRISE VALLEY
 NAME OF SAMPLE SOURCE.. POOL AT LAKE CITY MUD EXPLOSION
 COUNTRY CODE..... US
 STATE/PROVINCE..... CALIFORNIA

COUNTRY NAME..... UNITED STATES
 COUNTY..... MODOC

TOWNSHIP	RANGE	SECTION	1/4	1/4
44N	15E	24	SW	NE

SAMPLE INFORMATION

SOURCE TYPE..... POOL
 SAMPLE NO..... 2
 COLLECTION DATE..... 1973/08/16
 COLLECTOR(S)..... MARSHALL J. REED
 WATER SAMPLING TEMP.... 96.5 C
 WATER FLOW RATE..... 0.0000E+00 L/S 0. L/MIN
 WATER TREATMENT DATA: PRESSURE-FILTERED THROUGH .45 MICROMETRE MEMBRANE, PORTION ACIDIFIED, DILUTED
 OTHER CHEMICAL CHARACTERISTICS: ALTITUDE 1366 M.

WATER ANALYSIS

ANALYST(S)..... W REED, RAPP, PRESSER, WILLEY
 PH 1)..... 7.44
 SPECIFIC CONDUCTANCE.... 5.74 UMHO/CM
 TOTAL DISSOLVED SOLIDS... 1210 MG/L

ISOTOPIIC DATA

DEL O(18) OF WATER..... -14.79 0/00
 DEL D OF WATER..... -113.0 0/00

SOLUTE ANALYSIS (WATER)

UNITS USED..... MG/L

LI	NA	K	RB	CS	NA+K				
.24	320	15	.00						
MG	CA	SR	BA	CA+MG					
LT .1	7.7								
MG+3	MN(TOT)	FE+3	FE(TOT)	CU					
	LT .01								
ZN	HG	P	HB02	AL	PB	AS	SE	U	
LT .005		.61							
F	CL	BR	I						

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7.6 220

NH4	NO3	PO4	S102	SO4	CO3	HCO3
			200	320	0	112

COMMENTS: SURPRISE VALLEY IS A GRABEN WITH ACCUMULATED SEDIMENTS AND VOLCANIC DEBRIS.
REFERENCES: REED, MARSHALL J., THE CHEMISTRY OF THERMAL WATER IN SELECTED GEOTHERMAL AREAS OF CALIFORNIA, REPORT
NO. TR 15

REGION 3 - NORTHWEST

SITE: ALVORD, OR

SITE: ALVORD, OR (Federal Land)

POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
BLM	Process EIA/EIS	CEQ	} ASSUMED	COMPLETED									
BLM	Lease Land	Developer											
BLM	Issue STC Drilling Permit	Developer		—	—								
USGS	Issue Drilling Permit	Developer			—								
Developer	Preliminary Geophysical Exploration				—								
Developer	Exploratory Drilling and Reservoir Evaluation					—	—						
Developer	Develop Utility Interest					—							
Developer and Utility	Feasibility Study						—						
Producer (Developer) and Utility	Financial Negotiations							—					
Producer and Utility	Site Selection							—					
Producer and Utility	Commitment to Development							Δ					
Producer and Utility	Design (Preliminary, Final)							—	—				
Producer and Utility	Prepare Master Development Plan	BLM, USGS						—					
Utility	Prepare Environmental Data Statement	BLM, FPC, State, County						—					
BLM, FPC, State, USGS	Certify Plant and Site, Issue Permits	Producer, Utility							—	—			
USGS	Process EIA/EIS (Drilling)	CEQ							—	—			
FPC	Process EIA/EIS (Plant)	CEQ							—	—			
FPC	Process EIA/EIS (Transmission Line)	CEQ							—	—			
Producer	Development Drilling										—	—	—
Utility	Plant Construction										—	—	—
Utility	Install Transmission Line										—	—	—

Possible Subsequent Additions (MWe) and On Line Date: 50 - 1990, 50 - 1991, 50 - 1992, 50 - 1993, 50 - 1994

SITE: ALVORD, OR (REGION 3)

SUMMARY

TEMPERATURE °C
Surface: 76°C⁽⁷⁾

Subsurface: 200°C⁽⁷⁾ 210°C⁽²⁰⁾

TOTAL DISSOLVED SOLIDS (PPM):

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS): 56 MWe⁽⁷⁾ 310 MWe⁽²⁰⁾

TYPE OF OVERLAYING ROCK: Rhyodacite, Andesite, Basalt⁽⁸⁾ Hard

ESTIMATED DEPTH TO TOP OF RESERVOIR (METERS): 1,500⁽⁸⁾

DESCRIPTION OF KGRA

Total KGRA Acres: 176,835⁽⁹⁾

Total Federal Acres:

Federal Acres Leased: 31,182⁽¹⁵⁾

Total State and Private Acres:

State and Private Acres Leased:

GEOTHERMAL DEVELOPMENT STATUS: Only shallow temperature wells have been drilled. Three hot springs have been found in the KGRA.⁽⁴⁷⁾

LOCAL AND STATE ATTITUDE TOWARD GEOTHERMAL DEVELOPMENTS:

LAND USE AND POPULATION: Remote area.⁽⁶⁾

COMMENTS AND CRITICAL ISSUES: Lawsuits concerning rejected landlease bids and environmental concerns are pending. Additional leasing may not occur until the cases are resolved.⁽⁴⁷⁾

The area is remote with rough terrain.

SITE: ALVORD, OR

SITE: ALVORD, OR

SITE LOCATION AND PHYSICAL DESCRIPTION

LATITUDE: 42° 32' 36" N

LONGITUDE: 118° 31' 36" W

COUNTY: Harney

ADJACENT COUNTIES: Malheur, Grant, Crook, Lake, and Humboldt, NV.

LAND OWNERSHIP:

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
Plains with high mountains. ⁽⁶⁾ Alvord is in a basin and range area. The north-south mountain range has very steep faults. The western boundary fault has a sheer escarpment of several thousand feet. ⁽⁴⁷⁾	Desert shrubland with some grazing. ⁽⁶⁾			

SITE: ALVORD, OR

RESERVOIR CHARACTERISTICS AND GEOLOGICAL/GEOPHYSICAL DESCRIPTION

RESERVOIR TEMPERATURE

Surface: 70°C (7)
Subsurface: 200°C

Geochemical

SiO₂: 148°C (7)
Na-K-Ca: 199°C

TOTAL DISSOLVED SOLIDS (TDS):

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe, 30 YEARS): 56⁽⁷⁾ 310⁽²⁰⁾

TYPE OF OVERLAYING ROCK: Rhyodacite, Andesite, Basalt⁽⁸⁾

ESTIMATED DEPTH TO TOP OF RESERVOIR: 1500 m (4,921 feet)⁽⁸⁾

SEISMIC ACTIVITY:

SITE: ALVORD, OR

LAND OWNERSHIP AND LEASING

		TOTAL AREA (ACRES)	FEDERAL (ACRES)	STATE (ACRES)	PRIVATE (ACRES)
KGRA: Alvord		176,835 ⁽⁹⁾			
LAND LEASED IN KGRA			31,182 ⁽¹⁵⁾		
HIGHEST-PRICED LEASES (BY DOLLARS/ACRE) ⁽¹⁵⁾					
\$/ACRE	LESSEE				
17.90	Chevron Oil Co.		2,561		
10.56	Republic Geothermal		2,560		
7.17	Al-Aquitaine Exploration		2,560		
6.51	Al-Aquitaine Exploration		2,560		
6.03	Mapco		2,016		
TENTATIVE LEASE SALE DATES					
NUMBER OF SALES OFFERED BUT NO BIDS: 24 ⁽¹⁵⁾					
NUMBER OF BIDS REJECTED (RESULTING IN NO LEASE): 6 ⁽¹⁵⁾					
SUBSURFACE AREA OF RESERVOIR 3.0 km ²		741 ⁽⁸⁾			

SUMMARY OF LEASING STATUS AND NEEDS: There have been 3 competitive lease sales where a total of 44 tracts were offered and 14 were leased. Getty and Union bids were rejected for being too low. Both companies appealed to the DOI Board of Land Appeals. Getty's appeal was denied, Union's is pending. No reoffering of land seems likely until these cases and the environmental suits are resolved. An attempt to reoffer land in December 1976 was halted by the U.S. Attorney.⁽⁴⁷⁾

SITE: ALVORD, OR
GEOTHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
<p>One well was drilled by March 1977. (20)</p> <p>Only shallow temperature wells have been drilled in the area. Three hot springs have been found in the KGRA. (47)</p>	<p>It was predicted that exploratory test drilling may take place between 1975 and 1977. (2)</p>

SITE: ALVORD, OR

INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)
		<p>Appeals concerning Union land leases are pending at the DOI Board of Land Appeals.(47)</p> <p>The Sierra Club is suing the Forest Service by claiming that the completed Environmental Analysis was not sufficient. Of particular concern to the Club are archaeological artifacts and the ring-necked lizard (which is not an Endangered Species).(47)</p> <p>It is estimated that the above cases may be in court until 1979-1980.(47)</p> <p>The Forest Service is currently required to send a monthly report to the judge that lists details of all access to the Alvord land including time of day, purpose, method of transport, and wildlife encountered.(47)</p> <p>A 1976 Chevron drilling application was not approved.(47)</p>

SITE: ALVORD, OR

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds

Precipitation (Annual): 20.3 to 40.6 cm (8-16 inches)

Average Temperature

Minimum: -12.2 to -6.7°C (10-20°F)

Maximum: 26.7 to 32.2°C (80-90°F) (6)

Relative Humidity

(Seasonal Peaks)

Summer: 30-40% (6)

Winter: 70-80%

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
	~20 km (17 miles) from Alvord Lake (6)		Saltbrush, greasewood (6)		

SITE: ALVORD, OR

POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR:

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES NEAR SITE	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
Frenchglen	~40 km (25 mi.) (6)	20 ⁽⁶⁾	Alvord is within 24 km (15 mi.) east of a 115 kv N-S line owned by the Harney Electric Coop. (33-I)	~60 km (37 mi.) from State Rt. 78.	
Princeton	~80 km (50 mi.) (6)	10 ⁽⁶⁾		~55 km (34 mi.) from I-95. (6)	

RECORD 00001

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 8

SECTION A.- GEOTHERMAL FIELD-AREA

RECORD IDENTIFICATION

RECORD NO..... 0000000
 CROSS INDEX NO.. CF02401
 RECORD TYPE..... A

NAME..... F. SMITH, J. RENNER
 DATE..... 75/01
 ORGANIZATION.. U.S.G.S.

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. ALVORD HOT SPRING
 WARNING FIGURE..... 6
 COUNTRY CODE..... US
 STATE/PROVINCE..... OREGON
 LATITUDE..... 42-32-34N

WARNING NUMBER..... 068
 COUNTRY NAME..... UNITED STATES
 COUNTY..... HARNEY
 LONGITUDE..... 118-31-38W

TOWNSHIP RANGE SECTION 1/4 1/4
 34S 34E 33

BASE & MERIDIAN..... WILLAMETTE
 AVAILABLE MAPS OF AREA: ADEL 1:250,000

GENERAL DESCRIPTION

SIZE OF SURFACE EXPRESSION.... 0.5 KM**2
 ELEVATION..... 1249.68 M 4100. FT
 RESOURCE CATEGORY..... 6
 PRESENT USE & DEVELOPMENTS: WATER USED LOCALLY
 SURFACE THERMAL ACTIVITY..... HOT SPRING(S),
 NO. OF HOT SPRINGS..... SEVERAL

GEOTHERMAL CHARACTERISTICS

NATURAL SURFACE DISCHARGE..... 8.33 L/S 5.0000E+02 L/MIN ESTIMATED
 SPRING TEMPERATURES..... 76. C

RESERVOIR PROPERTIES

RESERVOIR TEMPERATURES..... 150. C TO 240. C ASSUMED
 BEST ESTIMATE..... 200.0 C
 SUBSURFACE AREA..... TO 31.0 KM**2
 BEST ESTIMATE..... 3.0 KM**2
 BASED ON: GEOLOGY, GEOPHYSICS
 DEPTH TO TOP OF RESERVOIR..... 1000.00 M 1.000 KM TO 2500.00 M 2.500 KM
 BEST ESTIMATE..... 1500.00 M 1.500 KM TO 3000.00 M 3.000 KM
 DEPTH TO BOTTOM OF RESERVOIR.. 3000.00 M 3.000 KM TO 2000.00 M 2.000 KM
 BEST ESTIMATE..... 3000.00 M 3.000 KM
 THICKNESS OF RESERVOIR..... 500.00 M 0.500 KM
 BEST ESTIMATE..... 1500.00 M 1.500 KM
 VOLUME OF RESERVOIR..... 0.025 KM**3 TO 62.000 KM**3
 BEST ESTIMATE..... 4.500 KM**3
 COMMENTS: DEPTHS TO TOP & BOTTOM OF RESERVOIR ARE ASSUMED.

RESERVES

TOTAL STORED HEAT..... 1.1302E+16 J 2.6999E+15 CAL TO 2.8799E+19 J 6.8799E+18 CAL
 BEST ESTIMATE..... 2.0930E+18 J 4.9999E+17 CAL ABOVE 15. C

GEOLOGY

GENERAL ROCK TYPES: RHYODACITE, ANDESITE, BASALT

GEOPHYSICS

GRAVITY SURVEY INFORMATION: TEST MADE

MAGNETIC SURVEY INFORMATION: TEST MADE

OTHER GEOPHYSICAL INFORMATION: HEAT FLOW, TEMPERATURE GRADIENT, AMT

PRIMARY REFERENCE:

AUTHOR..... D.E. WHITE & D.L. WILLIAMS, EDITORS

DATE..... 1975

TITLE..... ASSESSMENT OF GEOTHERMAL RESOURCES OF THE UNITED STATES - 1975

REFERENCE... U.S.G.S. CIRCULAR 726

RELATED REFERENCES:

- 1) MARINER, R.H., AND OTHERS, 1974, THE CHEMICAL COMPOSITION AND ESTIMATED MINIMUM THERMAL RESERVOIR TEMPERATURES OF SELECTED HOT SPRINGS IN OREGON: U.S.G.S. OPEN-FILE REPORT
- 2) WALKER, G.W. & REPENNING, C.A., 1965, RECONNAISSANCE GEOLOGIC MAP OF THE ADEL QUAD., LAKE, HARNEY, & MALHEUR COUNTIES, ORE.: USGS MISC. GEOL. INV. MAP I-446
- 3) WARING, G.A., 1965, THERMAL SPRINGS OF THE UNITED STATES AND OTHER COUNTRIES OF THE WORLD—A SUMMARY: U.S.G.S. PROF. PAPER 492, 383P.

SITE: BAKER HOT SPRINGS, WA

SITE: BAKER H.S., WA, (FEDERAL/STATE/PRIVATE LAND)

POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
BLM, State	Process Environmental Reports	CEQ, State DEQ											
BLM, ST, Owner	Lease Land	Developer											
State, USGS	Issue Drilling Permits	Developer											
Developer	Preliminary Geophysical Exploration												
Developer	Exploratory Drilling and Reservoir Evaluation												
Developer	Develop Utility Interest												
Developer and Utility	Feasibility Study												
Producer (Developer) and Utility	Financial Negotiations												
Producer and Utility	Site Selection												
Producer and Utility	Commitment to Development												
Producer and Utility	Design (Preliminary, Final)												
Producer and Utility	Prepare Master Development Plan	BLM, USGS											
Utility	Prepare Environmental Data Statement	BLM, FPC, State, County											
BLM, FPC, USGS	Certify Plant and Site, Issue Permits	Producer and Utility											
USGS, State	Process EIA/EIS (Drilling)	CEQ, State DEQ											
FPC, State PUC	Process EIA/EIS (Plant)	CEQ, State DEQ											
FPC, State PUC	Process EIA/EIS (Transmission Line)	CEQ, State DEQ											
Producer	Development Drilling												
Utility	Plant Construction												
Utility	Install Transmission Line												

SITE: BAKER HOT SPRINGS, WA (REGION 3)

SUMMARY

TEMPERATURE °C
Surface: 42°C (7) Subsurface: 165°C (7)

TOTAL DISSOLVED SOLIDS (PPM):
ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS):
TYPE OF OVERLAYING ROCK:
ESTIMATED DEPTH TO TOP OF RESERVOIR (METERS):

DESCRIPTION OF KGRA

Total KGRA Acres:	
Total Federal Acres:	Total State and Private Acres:
Federal Acres Leased:	State and Private Acres Leased:

GEOHERMAL DEVELOPMENT STATUS:

The USGS monitored thermal activity at Baker H.S. in 1975. (42)

LOCAL AND STATE ATTITUDE TOWARD GEOTHERMAL DEVELOPMENTS:

LAND USE AND POPULATION: In National Forest, in high mountains. Sparse population. (6)

COMMENTS AND CRITICAL ISSUES: Site is at Northern end of the Cascades Mountain Range, and is the most active volcanic system in the range. (27)

SITE: BAKER H. S., WA

SITE: BAKER HOT SPRINGS, WA

SITE LOCATION AND PHYSICAL DESCRIPTION

LATITUDE: 48° 45' 54" N

LONGITUDE: 121° 40' 12" W

COUNTY: Whatcom

ADJACENT COUNTIES: Skagit, Okanogan; Canada

LAND OWNERSHIP: Federal

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
High mountains ⁽⁶⁾	Forest and woodland, mostly un- grazed. ⁽⁶⁾ In Mount Baker National Forest, adjacent to North Cascades National Park. ⁽⁶⁾			

SITE: BAKER HOT SPRINGS, WA

RESERVOIR CHARACTERISTICS AND GEOLOGICAL/GEOPHYSICAL DESCRIPTION

RESERVOIR TEMPERATURE

Surface: 42°C⁽⁷⁾
Subsurface: 165°C

Geochemical
SiO₂: 151°C⁽⁷⁾
Na-K-Ca: 162°C

TOTAL DISSOLVED SOLIDS (TDS):

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe, 30 YEARS):

TYPE OF OVERLAYING ROCK: This is the most active volcanic area in the Cascades Range.⁽²⁷⁾ Site is at northern end of Cascades Mountain Range (see Mount Hood, OR; Lassen and Glass Mountain/Diablo, CA).

ESTIMATED DEPTH TO TOP OF RESERVOIR:

SEISMIC ACTIVITY:

SITE: BAKER HOT SPRINGS, WA

LAND OWNERSHIP AND LEASING

		TOTAL AREA (ACRES)	FEDERAL (ACRES)	STATE (ACRES)	PRIVATE (ACRES)
KGRA: No KGRA defined.					
LAND LEASED IN KGRA					
HIGHEST-PRICED LEASES (BY DOLLARS/ACRE)					
\$/ACRE	LESSEE				
TENTATIVE LEASE SALE DATES					
NUMBER OF SALES OFFERED BUT NO BIDS:					
NUMBER OF BIDS REJECTED (RESULTING IN NO LEASE):					
SUBSURFACE AREA OF RESERVOIR					

SUMMARY OF LEASING STATUS AND NEEDS:

SITE: BAKER HOT SPRINGS, WA
GEOTHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
<p>In 1975, the U.S. Geological Survey monitored the thermal activity at Baker H.S.(42)</p>	

SITE: BAKER HOT SPRINGS, WA

INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)

SITE: BAKER HOT SPRINGS, WA

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds

Precipitation (Annual): 121.9 to 162.6 cm (48 to 64 inches)⁽⁶⁾

Average Temperature

Minimum: -1.1 to 4.4°C (30 to 40°F)⁽⁶⁾

Maximum: 15.6 to 21.1°C (60 to 70°F)

Relative Humidity

(Seasonal Peaks)

Summer: 60-70%⁽⁶⁾

Winter: 80-90%

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
	Site is at Baker Lake. Numerous reservoirs in area ⁽⁶⁾ .		Western spruce- fir forest. ⁽⁶⁾		

SITE: BAKER HOT SPRINGS, WA

POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR:

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES NEAR SITE	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
Newhalen	30 km (17 miles)	400 ⁽⁶⁾	Within 16 km (10 miles) SE of the site there are a 94.4 MW and a 64.0 MW hydroelectric plants on the Baker River and 115 kv lines. The plants and lines are owned by the Puget Sound Power and Light Co. (private). (33-I) Other lines and plants within 64 km (40 miles) of the site are owned by the Seattle City Light Co. (municipal). (33-I)	25 km (16 miles) to nearest major roadway. ⁽⁶⁾	
Diablo	40 km (25 miles)	200 ⁽⁶⁾			
Glacier	25 km (16 miles)	50 ⁽⁶⁾			
Bellingham	65 km (40 miles)	35,200 ⁽⁶⁾			

SITE: BRUNEAU /GRANDVIEW, ID

SITE: BRUNEAU/GRAVVIEW (CASTLE CREEK), ID (FEDERAL/STATE/PRIVATE LAND)
POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
BLM, State County	Process Environmental Reports (EIA)	CEQ											
BLM, Owner	Lease Land	Developer											
USGS, State Developer	Issue Drilling Permits	Developer											
Developer	Preliminary Geophysical Exploration												
Developer	Exploratory Drilling and Reservoir Evaluation												
Developer	Develop Utility Interest												
Developer and Utility	Feasibility Study												
Producer (Developer) and Utility	Financial Negotiations												
Producer and Utility	Site Selection												
Producer and Utility	Commitment to Development												
Producer and Utility	Design												
Producer and Utility	Prepare Master Development Plan	BLM, USGS											
Utility	Prepare Environmental Data Statement	BLM, FPC, State, County											
BLM, FPC State, USGS	Certify Plant and Site, Issue Permits	Producer and Utility											
USGS, St., Cty.	Process EIA/EIS (Drilling)	CEQ, St. DEQ											
FPC, St. PUC	Process EIA/EIS (Plant)	CEQ St. DEQ											
FPC, St. PUC	Process EIA/EIS (Transmission Line)	CEQ St. DEQ											
Producer	Development Drilling												
Utility	Plant Construction												
Utility	Install Transmission Line												

Possible Subsequent Additions (MWe) and On Line Date: 100 - 1990, 100 - 1991, 100 - 1992, 100 - 1993, 100 - 1994, 100 - 1995, 100 - 1996, 100 - 1997, 100 - 1998, 100 - 1999

SITE: BRUNEAU/GRANDVIEW (CASTLE CREEK), ID (REGION 3)*

SUMMARY

TEMPERATURE °C

Surface:

Subsurface: >200°C⁽¹⁹⁾

TOTAL DISSOLVED SOLIDS (PPM):

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS):

TYPE OF OVERLAYING ROCK:

ESTIMATED DEPTH TO TOP OF RESERVOIR (METERS):

DESCRIPTION OF KGRA

Total KGRA Acres: 79,722⁽⁹⁾

Total Federal Acres:

Federal Acres Leased:

Total State and Private Acres:

State and Private Acres Leased:

GEOTHERMAL DEVELOPMENT STATUS: One nonproducing well which encountered temperatures >200°C was drilled to 3,353 m (11,000 feet). Irrigation wells drilled to 305 m (1,000 feet) have had temperatures of 77°C. The resource seems to be most promising for nonelectric agricultural use.

LOCAL AND STATE ATTITUDE TOWARD GEOTHERMAL DEVELOPMENTS:

LAND USE AND POPULATION:

Grazed desert shrubland and irrigated land of considerable relief. Sparse population.⁽⁶⁾

COMMENTS AND CRITICAL ISSUES: Some KGRA land has been withheld from leasing for a BLM raptor study.

*Although ERDA/DGE planning for this site is done for an area called Bruneau-Grandview, ID, descriptive data in this document is limited to Castle Creek, ID. Castle Creek is a 324 km² (800,000 acre) KGRA⁽⁹⁾ located within the Bruneau-Grandview prospective geothermal area whose subsurface reservoir area has been estimated at 2,250 km² (555,975 acres).⁽⁷⁾

SITE: BRUNEAU/GRANDVIEW (CASTLE CREEK), ID

SITE: BRUNEAU/GRANDVIEW (CASTLE CREEK), ID

SITE LOCATION AND PHYSICAL DESCRIPTION

LATITUDE: 116° 15' 00" N

LONGITUDE: 43° 00' 00" W

COUNTY: Owyhee and Elmore⁽⁶⁾

ADJACENT COUNTIES: Twin Falls, Gooding, Camas, Boise, Boise City⁽⁶⁾.

LAND OWNERSHIP:

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
Tablelands, considerable relief. ⁽⁶⁾	Grazed desert shrubland and irrigated land. ⁽⁶⁾			

SITE: BRUNEAU/GRANDVIEW (CASTLE CREEK), ID

RESERVOIR CHARACTERISTICS AND GEOLOGICAL/GEOPHYSICAL DESCRIPTION

RESERVOIR TEMPERATURE

Surface:
Subsurface: $>200^{\circ} \text{C}^{(19)}$

Geochemical
SiO₂:
Na-K-Ca:

TOTAL DISSOLVED SOLIDS (TDS):

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS):

TYPE OF OVERLAYING ROCK:

ESTIMATED DEPTH TO TOP OF RESERVOIR:

SEISMIC ACTIVITY:

SITE: BRUNEAU/GRANDVIEW (CASTLE CREEK), ID

LAND OWNERSHIP AND LEASING

		TOTAL AREA (ACRES)	FEDERAL (ACRES)	STATE (ACRES)	PRIVATE (ACRES)
KGRA: Castle Creek		79,722 ⁽⁹⁾			
LAND LEASED IN KGRA			20,623 ⁽¹⁵⁾		
HIGHEST-PRICED LEASES (BY DOLLARS/ACRE) ⁽¹⁵⁾					
\$/ACRE	LESSEE				
35.6	The Anschutz Corp.		1,720		
12.47	Phillips Petroleum Co.		2,480		
8.09	Nancy P. Anschutz		2,475		
8.09	Nancy P. Anschutz		2,218		
TENTATIVE LEASE SALE DATES					
NUMBER OF SALES OFFERED BUT NO BIDS:					
NUMBER OF BIDS REJECTED (RESULTING IN NO LEASE):					
SUBSURFACE AREA OF RESERVOIR					

SUMMARY OF LEASING STATUS AND NEEDS: Anschutz transferred land to Occidental Petroleum and the Louisiana Land Corp. in a 75/25 ratio.(47)

There is a continued interest in leasing at Castle Creek. In June 1977, 15 to 20 lease applications were received by BLM.(47) Some of the KGRA land has been withheld from leasing for the BLM raptor study.(47)

SITE: BRUNEAU/GRANDVIEW (CASTLE CREEK), ID

GEOHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
<p>Anchutz drilled one 3,353 m (11,000 foot) well under an oil and gas permit before the KGRA was formed. Although the well went through 3,353 m (11,000 feet) of volcanic rock, it still was not near the bottom of the Snake River Valley. The drilling went through permeability zones that carried hot water at 1,524 - 2,134 m (5,000 - 7,000 feet). The remaining well depth was not hot. Although the temperatures were encouraging ($>200^{\circ}\text{C}$) the well was not producing. It is suspected that the greatest producing potential is southwest of the well.⁽⁴⁷⁾</p> <p>The Anchutz well is on land that was later transported to Occidental.^(47,19)</p> <p>Irrigation wells in the area have been drilled to 305 m (1,000 feet) and have had temperatures of 77°C (170°F).⁽⁴⁷⁾</p>	<p>Although the number of potential users is limited, the Castle Creek area appears to be most promising for nonelectric agricultural use of the geothermal resource. A 610 m (2,000 foot) hole on private land northwest of the KGRA may be drilled during the summer of 1977. The developer (Chapman?) is looking for process water at $\sim 150^{\circ}\text{C}$.⁽⁴⁷⁾</p>

SITE: BRUNEAU/GRANDVIEW (CASTLE CREEK), ID

INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)
		<p>Much of the land in the KGRA along the Snake River is not available for leasing because it is reserved for the BLM Birds of Prey raptor study. As part of the study, the BLM has introduced 3 peregrine falcons into the area. (The falcons are listed as Endangered Species.) The land reserved for the raptor study is not regarded as being critical to geothermal development at Castle Creek. (47)</p>

SITE: BRUNEAU/GRANDVIEW (CASTLE CREEK), ID

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds
 Precipitation (Annual): 18.4 cm (7.26 inches)
 Average Temperature
 Minimum: -1.7°C (29.4°F) (5)
 Maximum: 24.6°C (76.5°F)

Relative Humidity
 (Seasonal Peaks)
 Summer: 30%
 Winter: 70% (6)

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
	Site is within 16 km (10 mi.) SW of the Snake River. (6)		Saltbush, grease wood, sagebrush. (6)		Peregrine Falcon. (See "Status of Administrative Procedures"). (47)

SITE: BRUNEAU/GRANDVIEW (CASTLE CREEK), ID

POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR:

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES NEAR SITE	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
Grand View	<16 km (10 miles)	200 ⁽⁶⁾	Castle Creek is 16 km (10 miles) S. of the Sinter Creek substation and 138 kv line; and 40 km (25 miles) W. of the C. J. Strike 62.8 MW hydrothermal plant and 138 kv line. The lines and plant are owned by the Idaho Power Co. (private).(33-1)	<19 km (12 miles) from U.S. Rte. 30. (6)	<40 km (25 miles) from primary rail line.(6) <40-48 km (25-30 miles) from major (>25.4 cm or 10 inches) petroleum products pipeline. <16 km (10 miles) from minor (<55.9 cm or 22 inch) natural gas pipeline.(6)
Mountain Home	~40 km (25 miles)	50			

SITE: MOUNT HOOD, OR

SITE: MT. HOOD, OR (FEDERAL/STATE/PRIVATE LAND)
POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
BLM, State	Process Environmental Reports	CEQ, State DEQ		—									
BLM, ST, Owner	Lease Land	Developer		—									
State, USGS	Issue Drilling Permits	Developer		—	—								
Developer	Preliminary Geophysical Exploration				—	—							
Developer	Exploratory Drilling and Reservoir Evaluation				—	—	—						
Developer	Develop Utility Interest				—	—	—						
Developer and Utility	Feasibility Study				—	—	—						
Producer (Developer) and Utility	Financial Negotiations						—	—					
Producer and Utility	Site Selection						—	—					
Producer and Utility	Commitment to Development						—	—					
Producer and Utility	Design (Preliminary, Final)							—	—	—			
Producer and Utility	Prepare Master Development Plan	BLM, USGS						—	—				
Utility	Prepare Environmental Data Statement	BLM, FPC, State, County						—	—				
BLM, FPC, USGS	Certify Plant and Site, Issue Permits	Producer and Utility						—	—	—			
State	Process EIA/EIS (Drilling)	CEQ, State DEQ						—	—	—			
USGS, State	Process EIA/EIS (Plant)	CEQ, State DEQ						—	—	—			
FPC, State PUC	Process EIA/EIS (Transmission Line)	CEQ, State DEQ						—	—	—			
FPC, State PUC	Development Drilling										—	—	—
Producer Utility	Plant Construction										—	—	—
Utility	Install Transmission Line										—	—	—

SITE: MOUNT HOOD, OR (REGION 3)

SUMMARY

TEMPERATURE °C
Surface: 90°C⁽⁷⁾ Subsurface: 125°C⁽⁷⁾

TOTAL DISSOLVED SOLIDS (PPM):
ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS):
TYPE OF OVERLAYING ROCK: Lava (quaternary)⁽⁸⁾ - medium to hard
ESTIMATED DEPTH TO TOP OF RESERVOIR (METERS): 1,000⁽⁸⁾

DESCRIPTION OF KGRA

Total KGRA Acres: 8,671⁽⁹⁾
Total Federal Acres:
Federal Acres Leased:

Total State and Private Acres:
State and Private Acres Leased:

GEOHERMAL DEVELOPMENT STATUS:

Non-electric use proposed. Only 1 well has been drilled but it collapsed.⁽⁴⁷⁾

Development at the site is currently severely limited due to pending legal and legislative issues based on environmental concerns.⁽⁴⁷⁾

LOCAL AND STATE ATTITUDE TOWARD GEOHERMAL DEVELOPMENTS:

LAND USE AND POPULATION: Open high mountains, forest and woodland (sparsely populated).⁽⁶⁾
Recreation center.⁽²⁷⁾

COMMENTS AND CRITICAL ISSUES: Site is in a National Forest in Cascades Mountain Range.⁽⁶⁾ Site may also be sensitive to geothermal development because of its recreational use.⁽²⁷⁾

SITE: MOUNT HOOD, OR

SITE: MOUNT HOOD, OR

SITE LOCATION AND PHYSICAL DESCRIPTION

LATITUDE: 45° 22' 30" N

LONGITUDE: 121° 42' 30" W

COUNTY: Hood River and Clackamas Counties

ADJACENT COUNTIES: Wasco and Multnomah, Oregon; Skamania and Klickitat, Washington⁽⁶⁾

LAND OWNERSHIP: Site in Mount Hood National Forest.⁽⁶⁾

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
Open high mountains ⁽⁶⁾	Forest and woodland in Mount Hood National Forest. ⁽⁶⁾ Mount Hood is a very active recreation spot (primarily skiing). ⁽²⁷⁾			Mount Hood is a National Historical site. (43)

SITE: MOUNT HOOD, OR

RESERVOIR CHARACTERISTICS AND GEOLOGICAL/GEOPHYSICAL DESCRIPTION

RESERVOIR TEMPERATURE

Surface: 90°C
Subsurface: 125°C⁽⁷⁾

Geochemical
SiO₂:
Na-K-Ca:

TOTAL DISSOLVED SOLIDS (TDS):

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe, 30 YEARS):

TYPE OF OVERLAYING ROCK: Lava (quaternary)⁽⁸⁾ In the Cascades Mountain Range, which extends from the Canadian border into California. (See Lassen and Glass Mountain/Diablo, CA and Mount Baker H.S., WS).⁽²⁷⁾

ESTIMATED DEPTH TO TOP OF RESERVOIR: 1,000⁽⁸⁾

SEISMIC ACTIVITY:

Because Mount Hood is of structurally competent rock in which water moves through fracture zones in the lava flows, and mudflows and glacial deposits contain permeable zones, subsidence is not considered a potential problem.⁽⁴³⁾ There is no seismic activity in the area.⁽²⁷⁾

SITE: MOUNT HOOD, OR

LAND OWNERSHIP AND LEASING

		TOTAL AREA (ACRES)	FEDERAL (ACRES)	STATE (ACRES)	PRIVATE (ACRES)
KGRA: Mount Hood		8,671 ⁽⁹⁾	8,671 (mostly F.S.)(47)		
LAND LEASED IN KGRA					
HIGHEST-PRICED LEASES (BY DOLLARS/ACRE)					
\$/ACRE	LESSEE				
TENTATIVE LEASE SALE DATES					
NUMBER OF SALES OFFERED BUT NO BIDS:					
NUMBER OF BIDS REJECTED (RESULTING IN NO LEASE):					
SUBSURFACE AREA OF RESERVOIR		497 ⁽⁸⁾			

SUMMARY OF LEASING STATUS AND NEEDS: The top of Mount Hood is classified as a Forest Service Wilderness Area, where no geothermal leasing can be allowed. Noncompetitive leases have been let for the Old Maid Flats (outside the KGRA).(47)

SITE: MOUNT HOOD, OR

GEOHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
<p>One geothermal well was drilled on private land near the Timberline Lodge, but it caved in.⁽⁴⁷⁾</p>	<p>An exploration program has been proposed to locate geothermal water near the Timberline Lodge by a combined geological-geophysical study and drilling program. It was proposed that preliminary magnetic, gravity, and electrical resistivity surveys be made prior to drilling. Drilling was expected to be within 610 m (2,000 ft), and a geo-heating system would be installed at the Lodge. It was also proposed that the geothermal waters be used to melt snow on roads and parking lots at the Lodge.⁽⁴³⁾</p> <p>The Timberline Lodge, which uses ~38,000 gallons of oil per month, is the largest single-building consumer of oil in Oregon.⁽⁴⁷⁾</p>

SITE: MOUNT HOOD, OR

INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)
	<p>The public may be sensitive to development because Mount Hood is an active recreation area.(27)</p>	<p>Most of the lease applications at Mount Hood are for land covered by 2 land use planning units. The first unit includes Bull Run, which is closed to all entry pending legal resolutions. The Courts have ordered that all future timber sales in the Bull Run watershed cease in order to protect the municipal water supply. The Forest Service contends that although timbering has occurred in the watershed since the 1940's, the only changes in the water quality have been due to natural occurrences (e.g., land slips in uncut areas). An EIS for Mount Hood (including Bull Run) is scheduled for completion by August 1977.(47)</p> <p>The second land use planning unit in the KGRA area is for Clackamas, just south of Mount Hood. The EIS for this area should be completed by November 1978.(47)</p> <p>At the present time, the only location where geothermal exploration may be allowed on Federal land is at the Old Maid Flats area where there is active timbering and numerous roads.(47)</p> <p>The Hatfield Amendment, which proposes to reserve more land as Wilderness Study Areas (a prerequisite to determining if land should be officially declared a Wilderness Area), includes many acres on the east side of Mount Hood.(47)</p>

SITE: MOUNT HOOD, OR

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds
Precipitation (Annual): 203.2 to 243.8 cm (80-96 inches) (6)
Average Temperature
Minimum: -7 to -1°C (20 to 30°F) (6)
Maximum: 10 to 16°C (50 to 60°F) (6)

Relative Humidity
(Seasonal Peaks)
Summer: 50-60% (6)
Winter: 70-80%

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
	Columbia River 30 km (19 miles) from site. Numerous rivers and creeks in area. (6)		Fir-hemlock forest. (6)		

SITE: MOUNT HOOD, OR
POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR:

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES NEAR SITE	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
Rhododendron	~ 16 km (10 miles) (6)	200 ⁽⁶⁾	At the Mount Hood site there is one 230 kv line, one 500 kv line, one 287 kv capacity line operating at 230 kv, and one 345 kv line operating at 230 kv. The four lines are owned by the Bonneville Power Administration (BPA, Federal) and go west into Portland, OR from the Dalles, WA 1,807.0 hydro-thermal power plant, owned by the U.S. Army, 45 km (28 miles) north-east of the site.	U.S. Route 26 <16 km (10 miles) from site. ⁽⁶⁾	Primary railroad <16 km (10 miles) from site. ⁽⁶⁾
Parkdale	~ 16 km (10 miles) (6)	400 ⁽⁶⁾			Major gas line <30 cm (24 inches) within 16 km (10 miles) of site. ⁽⁶⁾
Portland	~ 88 km (55 miles) (6)	380,000 ⁽⁶⁾			

SITE: MOUNT HOOD, OR (CONTINUED)

POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR:

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES NEAR SITE	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
			There are numerous other lines and power plants in the Mount Hood-Portland area. Most of the lines are owned by the Pacific Power and Light Co. (PAPL, private). Power plants in Portland are owned by the USAR, PAPL and the Portland General Electric Co. (private). (33-I)		

RECORD 00004

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 8

SECTION A - GEOTHERMAL FIELD-AREA
RECORD IDENTIFICATION

RECORD NO..... 000004
 CROSS INDEX NO.. 001471
 RECORD TYPE..... A

NAME..... F. SMITH, J. RENNER
 DATE..... 7/4/12
 ORGANIZATION.. U.S.G.S.

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. M1 HOOB
 WARING FIGURE..... 0
 COUNTRY CODE..... US
 STATE/PROVINCE..... OREGON
 LATITUDE..... 45-21-30N

WARING NUMBER..... 001
 COUNTRY NAME..... UNITED STATES
 COUNTY..... WASCO/CLACKAMAS
 LONGITUDE..... 121-42-30W

TOWNSHIP RANGE SECTION 1/4 1/4
 02S 09E 29

BASE & MERIDIAN..... WILLAMETTE

AVAILABLE MAPS OF AREA: CALNEURAL RIDGE, ORE 1:24,000; TIMBERLINE LODGE, ORE 1:24,000

GENERAL DESCRIPTION

ELEVATION..... 3042.00 M 10000. FT
 RESOURCE CATEGORY..... C
 SURFACE THERMAL ACTIVITY..... FUMAROLE OR WARM VAPOR,

GEOTHERMAL CHARACTERISTICS

SPRING TEMPERATURES..... 49. C TO 90. C

RESERVOIR PROPERTIES

RESERVOIR TEMPERATURES..... 90. C TO 150. C ASSUMED
 BEST ESTIMATE..... 125.0 C
 SURFACE AREA..... 1.0 KM**2 TO 45.0 KM**2
 BEST ESTIMATE..... 2.0 KM**2
 DEPTH TO TOP OF RESERVOIR..... 500.00 M 0.500 KM TO 2000.00 M 2.000 KM
 BEST ESTIMATE..... 1000.00 M 1.000 KM
 DEPTH TO BOTTOM OF RESERVOIR..... 5000.00 M 5.000 KM TO 3000.00 M 3.000 KM
 BEST ESTIMATE..... 3000.00 M 3.000 KM
 THICKNESS OF RESERVOIR..... 1000.00 M 1.000 KM TO 2500.00 M 2.500 KM
 BEST ESTIMATE..... 2000.00 M 2.000 KM
 VOLUME OF RESERVOIR..... 1.000 KM**3 TO 112.500 KM**3
 BEST ESTIMATE..... 4.000 KM**3

COMMENTS: DEPTHS TO TOP & BOTTOM OF RESERVOIR ARE ASSUMED.

RESERVOIR

TOTAL STORAGE HEAT..... 1.7027E+17 J 6.5999E+16 CAL TO 3.1001E+19 J 7.4249E+18 CAL
 BEST ESTIMATE..... 1.0003E+16 J 2.5999E+16 CAL ABOVE IS. C

GEOLOGY

GENERAL ROCK TYPES: LAVA (QUATERNARY)

PRIMARY REFERENCE:

PAGE 0008

AUTHOR..... D.L. WHITE & D.L. WILLIAMS, EDITORS
DATE..... 1975
TITLE..... ASSESSMENT OF GEOTHERMAL RESOURCES OF THE UNITED STATES - 1975
REFERENCE.... U.S.G.S. CIRCULAR 726

RELATED REFERENCES:

- 1) PECK, D.L. & THURKS, 1964, GEOLOGY OF THE CENTRAL AND NORTHERN PART OF THE WESTERN CASCADE RANGE IN OREGON:
U.S.G.S. PROF. PAPER 445
- 2) HARTIG, L.A., 1968, THERMAL SPRINGS OF THE UNITED STATES AND OTHER COUNTRIES OF THE WORLD--A SUMMARY: U.S.G.S.
PROF. PAPER 452, 363P.
- 3) WATERS, A.C., 1968, RECONNAISSANCE GEOLOGIC MAP OF THE DUFUR QUADRANGLE, HOOD RIVER, SHERMAN AND WASCO COUNTIES,
OREGON: U.S.G.S. DISC. GEOL. INV. MAP I-556

SITE: RAFT RIVER, ID

SITE: RAFT RIVER, ID (FEDERAL/STATE/PRIVATE LAND)
POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
State, County BLM Owner	Process Environmental Reports	CEQ, State											
State, Developer	Lease Land	Developer											
Developer	Issue Drilling Permits	Developer											
Developer	Preliminary Geophysical Exploration												
Developer	Exploratory Drilling and Reservoir Evaluation												
Developer	Develop Utility Interest												
Developer and Utility	Feasibility Study												
Producer (Developer) and Utility	Financial Negotiations												
Producer	Site Selection												
Producer and Utility	Commitment to Development												
Producer and Utility	Design												
Producer and Utility	Prepare Master Development Plan	BLM, USGS											
Utility	Prepare Environmental Data Statement	BLM, FPC, State, County											
BLM, FPC, State, USGS	Certify Plant and Site, Issue Permits	Producer and Utility											
USGS, St., Cty.	Process EIA/EIS (Drilling)	CEQ, St. DEQ											
FPC, St. PUC	Process EIA/EIS (Plant)	CEQ, St. DEQ											
FPC, St. PUC	Process EIA/EIS (Transmission Line)	CEQ, St. DEQ											
Producer	Development Drilling												
Utility	Plant Construction												
Utility	Install Transmission Line												

Possible Subsequent Additions (MWe) and On Line Date: 50 - 1990

SITE: RAFT RIVER, ID (REGION 3)

SUMMARY

TEMPERATURE °C

Surface: 96°C (205°F)⁽⁷⁾ Subsurface: 140°C (284°C)⁽⁷⁾; 150°C⁽²⁰⁾; 147°C⁽⁴²⁾

TOTAL DISSOLVED SOLIDS (PPM): <2000⁽⁴⁾

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS): 100 MWe⁽²⁰⁾

TYPE OF OVERLAYING ROCK: Alluvium (sediments and tuffs), schists and quartzites with aquartz monzanite basement.

ESTIMATED DEPTH TO TOP OF RESERVOIR (METERS): 1,500⁽⁸⁾ Hard

DESCRIPTION OF KGRA

Total KGRA Acres: 30,209⁽⁴⁷⁾

Total Federal Acres: 25,110⁽⁴⁸⁾

Federal Acres Leased:

Total State and Private Acres:

State and Private Acres Leased:

GEOHERMAL DEVELOPMENT STATUS: ERDA has drilled 3 wells.⁽¹⁷⁾ A project is underway to use waste energy from geothermal electric generation for food processing.⁽²³⁾ Geothermal water has been successfully used for crop irrigation.⁽⁴⁵⁾ ERDA is considering Raft River for a binary experimental facility.⁽⁴⁷⁾

LOCAL AND STATE ATTITUDE TOWARD GEOTHERMAL DEVELOPMENTS: There is no public opposition to geothermal development although development could cause a "boom and bust" cycle.⁽⁴⁾

LAND USE AND POPULATION: The area is almost exclusively agricultural with a population density of less than one per square mile.⁽⁴⁾

COMMENTS AND CRITICAL ISSUES:

SITE: RAFT RIVER, ID

SITE: RAFT RIVER, ID

SITE LOCATION AND PHYSICAL DESCRIPTION

LATITUDE: 42° 06' 06" N
113° 22' 48" W

COUNTY: Cassia⁽⁴⁾

ADJACENT COUNTIES: Idaho: Twin Falls, Jerome, Minidoka, Blaine, Power and Oneida
Nevada: Elko
Utah, Box Elder⁽⁶⁾

LAND OWNERSHIP:

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
The landscape is generally flat with small gullies and ridges. The natural environment has been altered extensively by farm activities. (4)	Area is almost exclusively agricultural with some light industry focusing on potato processing. ⁽⁴⁾		The area is not extraordinarily aesthetic. ⁽⁴⁾	There may be artifacts at this site. ^(3III)

SITE: RAFT RIVER, ID

RESERVOIR CHARACTERISTICS AND GEOLOGICAL/GEOPHYSICAL DESCRIPTION

RESERVOIR TEMPERATURE

Surface: 96°C (205°F)⁽⁷⁾
Subsurface: 140°C (284°F)⁽⁷⁾ 150°C⁽²⁰⁾

Geochemical

SiO₂: 136°C (276°F)⁽⁷⁾
Na-K-Ca: 139°C (282°F)⁽⁷⁾

TOTAL DISSOLVED SOLIDS (TDS): <2000 ppm⁽⁴⁾

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe, 30 YEARS): 100 MWe⁽²⁰⁾

TYPE OF OVERLAYING ROCK: Alluvium (sediments and tuffs), schists and quartzites with a quartz monzonite basement.⁽⁸⁾ The Raft River geothermal resource has a fault-controlled circulation of warm water. The KGRA includes what was once named the Frazier KGRA, which was created because of geologic geothermal indications.⁽⁴⁷⁾

ESTIMATED DEPTH TO TOP OF RESERVOIR: 1,500 m (4,921 feet)⁽⁸⁾

SEISMIC ACTIVITY:

SITE: RAFT RIVER, ID

LAND OWNERSHIP AND LEASING

		TOTAL AREA (ACRES)	FEDERAL (ACRES)	STATE (ACRES)	PRIVATE (ACRES)
KGRA: Raft River (includes what was once named the Frazier KGRA) (47)		30,209 ⁽⁴⁷⁾	25,110 ⁽⁴⁸⁾		
LAND LEASED IN KGRA					
HIGHEST-PRICED LEASES (BY DOLLARS/ACRE)					
\$/ACRE	LESSEE				
TENTATIVE LEASE SALE DATES 11/17/77 ⁽⁴⁷⁾					
NUMBER OF SALES OFFERED BUT NO BIDS:			4,000 (offered by BLM) ⁽⁴⁷⁾		
NUMBER OF BIDS REJECTED (RESULTING IN NO LEASE):					
SUBSURFACE AREA OF RESERVOIR		4,940 ⁽⁸⁾			

SUMMARY OF LEASING STATUS AND NEEDS: ERDA withdrew 8,000 acres to construct a 10 MWe power facility, but has since released 3,800 acres. Along with the 3,800 acres, 2 leasing units will be reoffered in November 1977.⁽⁴⁷⁾ 31 noncompetitive lease applications for land outside the KGRA have been received and approximately one half have been approved. Leases have been granted or are being considered for Sunoco, Delta Funds, the Raft River Rural Coop, Phillips, and a number of individuals.⁽⁴⁷⁾

SITE: RAFT RIVER, ID

GEOHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
<p>ERDA has drilled 3 wells.⁽¹⁷⁾ One well had a bottomhole temperature of 146°C at a total depth of 1,368 m (4,489 ft) with an average flow of 2,460 lpm (650 gpm). Another hole drilled to 1,825 m (5,988 ft) had a bottomhole temperature of 147°C with an average flow of 3,028 lpm (800 gpm).⁽⁴²⁾</p> <p>By 1975, testing and evaluating of the aquifer for possible application of binary-cycle heat exchanging was taking place.⁽²⁾ An interest in constructing a turbine generator has been expressed by the Raft River Geothermal Project which is associated with the Raft River Rural Electric Cooperative⁽³⁰⁾ (whose members are principal private landowners at Raft River).⁽⁴²⁾ The project has received financial support from several NW electric utilities.⁽³⁰⁾</p> <p>By February 1977, ERDA's Idaho National Engineering Laboratory (INEL) had successfully completed the first phase of an experiment using geothermal water for irrigation at the Raft River site.⁽⁴⁵⁾</p> <p>Approximately 12.5 previously uncultivated acres were subdivided by crops and irrigation practices to compare the irrigation use of geothermal water with that of the relatively pure Raft River (the experiment's control). Crops successfully grown included wheat, barley, oats, grasses, alfalfa, potatoes and garden vegetables. Preliminary test results indicate that there are no adverse effects on crops due to the mineral content of the geothermal water.⁽⁴⁵⁾</p> <p>The experiment was expected to last for two more years.⁽⁴⁵⁾</p> <p>In March 1977, Terra Tek (of Salt Lake City, Utah) was working on a project to use waste energy from geothermal electric generation for the food processing industry (mostly sugar beets and potatoes).⁽²³⁾</p>	<p>ERDA is considering Raft River for a binary experimental facility. It is believed that 30-40 percent more power output at the same wellhead temperature could be obtained with a binary rather than flash unit at Raft River. (Binary power generation reduces the outlift temperature from the turbine in colder weather because a smaller turbine than that required for flashed steam is needed.)⁽⁴⁷⁾</p>

SITE: RAFT RIVER, ID

INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)
<p>As of August 1975, no legislation or regulations for geothermal development existed. No constraints existed at the county level.^(3III)</p>	<p>Noncommittal as of August 1975. County had no experience with geothermal development.^(3III)</p> <p>There is no public opposition to geothermal development although development could cause a "boom or bust" cycle.⁽⁴⁾</p>	

SITE: RAFT RIVER, ID

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds
Precipitation (Annual): 20.3 to 40.6 cm (8-16 inches)
Average Temperature
Minimum: -12 to -1°C (10-30°F)⁽⁶⁾
Maximum: 21 to 27°C (70-80°F)
Relative Humidity
(Seasonal Peaks)
Summer: 30%⁽⁶⁾
Winter: 70%⁽⁶⁾

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
Air quality is generally excellent although dust can often be a pollutant. ⁽⁴⁾	Water shortage exists in area. ^(3III)	Ambient noise is very low. ⁽⁴⁾	Sage subclimax type with sagebrush, greasewood and juniper being dominant. ⁽⁴⁾	Rabbit, deer, coyote, squirrels, snakes and many birds. Trout, suckers, and minnows found in streams. ⁽⁴⁾	A few species may inhabit the general area of proposed development. ^(3III) These include four birds: Greater Sandhill Crane, Prairie Falcon, Peregrine Falcon, and the Ferrigenous Hawk. ⁽⁴⁾

SITE: RAFT RIVER, ID

POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR:

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES NEAR SITE	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
Burley ⁽⁴⁾	64 km (40 miles) (4)	8,300 ⁽⁴⁾	The Bridge substation is at the Raft River site. The substation has one 138 kv capacity line operating at 34 kv from the north, owned by the U.S. Bureau of Reclamation. 64 m (40 miles) N of the site are E-W lines owned by the Idaho Power Co. (private). There are no other lines and no plants within 80 km (50 miles) of the site. (33-I)	Minor highway goes to Oakley. ⁽⁶⁾	Railroad in Oakley. ⁽⁶⁾ Major oil products pipeline >25.4 cm (10 inches) within 40 km (25 miles) of site. ⁽⁶⁾
Oaklay ⁽⁴⁾	45 km (28 miles)	650 ⁽⁴⁾			
Bridge	12 km (7 miles)	10 ⁽⁶⁾			

RECORD 00005

GEOTHERMAL RESOURCES FILE (GEOTERM) REVISION 3

SECTION A- GEOTHERMAL FIELD-AREA

RECORD IDENTIFICATION

RECORD NO..... 000050

CROSS INDEX NO.. 001701

RECORD TYPE..... A

NAME..... PETER OBERLINDACHER, J. KENNER, D. WILLI

DATE..... 75/04

ORGANIZATION.. U.S.G.S.

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. KAT RIVER

WARNING FIGURE..... 4

COUNTRY CODE..... US

STATE/PROVINCE..... IDAH

LATITUDE..... 42°00'00"N

WARNING NUMBER..... 184

COUNTRY NAME..... UNITED STATES

COUNTY..... CASSIA

LONGITUDE..... 113-22-48W

TOWNSHIP RANGE SECTION 174 174
120 201 20

BASE & MERIDIAN..... NAD83

AVAILABLE MAPS OF AREA: CORNERCHERRY 1:25,000; "WELL (NOT)"

GENERAL DESCRIPTION

ELEVATION..... 1470.00 M +850. FT

RESOURCE CATEGORY..... C

SURFACE THERMAL ACTIVITY..... HOT SPRINGS

ASSOCIATED DEPOSITS..... TRAVERTINE

GEOTHERMAL CHARACTERISTICS

NATURAL SURFACE DISCHARGE..... 3.78 L/S 2.2700E+02 L/MIN MEASURED

WELL INFORMATION

MAXIMUM WELL TEMPERATURE..... 140. C TO 140. M

BOTH-HOLE TEMPERATURE..... 140.0 C TO 400.00 M

RESERVOIR PROPERTIES

RESERVOIR TEMPERATURES..... 150. C TO 170. C MEASURED

BEST ESTIMATE..... 150.00 C

SUBSURFACE AREA..... 4.0 KM**2 TO 44.0 KM**2

BEST ESTIMATE..... 20.0 KM**2

BASED ON: GEOPHYSICS, GEOLOGY

DEPTH TO TOP OF RESERVOIR..... 1000.00 M 1.000 KM TO 2000.00 M 2.000 KM

BEST ESTIMATE..... 1500.00 M 1.500 KM

DEPTH TO BOTTOM OF RESERVOIR..... 3000.00 M 3.000 KM TO 3000.00 M 3.000 KM

BEST ESTIMATE..... 3000.00 M 3.000 KM

THICKNESS OF RESERVOIR..... 1000.00 M 1.000 KM TO 2000.00 M 2.000 KM

BEST ESTIMATE..... 1500.00 M 1.500 KM

VOLUME OF RESERVOIR..... 4.000 KM**3 TO 68.000 KM**3

BEST ESTIMATE..... 10.000 KM**3

AVERAGE WELL FLOW..... 05.00 M3/S 220000.00 M3/HR

COMMENT: DEPTH TO TOP & BOTTOM OF RESERVOIR ARE ASSUMED.

RESERVOIR

TOTAL STORAGE..... 3.571E+17 J 1.9979E+17 CAL TO 3.4325E+19 J 8.1999E+18 CAL

BEST ESTIMATE..... 3.027E+16 J 2.2999E+16 CAL ABOVE 15. C

GEOLOGY

GENERAL ROCK TYPES: EOCENE-PLIOCENE RIVER & FAN DEP.; MIOCENE-PLIOCENE INTRUSIVES & LAVAS, SILICIC

PRIMARY REFERENCES:

AUTHOR..... D.W. HEFL & D.L. WILLIAMS, EDITORS
 DATE..... 1975
 TITLE..... ASSESSMENT OF GEOTHERMAL RESOURCES OF THE UNITED STATES - 1975
 REFERENCE.... U.S.G.S. CIRCULAR 726

RELATED REFERENCES:

- 1) HOOVER, J.I., 1974, AERIAL-MAGNETOTELLURIC APPARENT RESISTIVITY MAPS, SOUTHERN RAFT RIVER AREA, CASSIA COUNTY, IDAHO: U.S.G.S. OPEN-FILE REPORT
- 2) MAREY, D.R., AND WILSON, C.W., 1974, BOGGER GRAVITY ANOMALY MAP OF THE SOUTHERN RAFT RIVER AREA, CASSIA COUNTY, IDAHO: U.S.G.S. OPEN-FILE REPORT
- 3) NACEY, L. & OTHERS, 1961, WATER RESOURCES OF THE RAFT RIVER BASIN, IDAHO-UTAH: U.S.G.S. WATER-SUPPLY PAPER 1567
- 4) U.S. GEOLOGICAL SURVEY, 1974, RESIDUAL MAGNETIC INTENSITY MAP OF THE SOUTHERN RAFT RIVER AREA, CASSIA COUNTY, IDAHO: U.S.G.S. OPEN-FILE REPORT

WILLIAMS, D.L., & OTHERS, 1974, PRELIMINARY GEOLOGIC MAP OF THE SOUTHERN RAFT RIVER AREA, CASSIA COUNTY, IDAHO: U.S.G.S. OPEN-FILE REPORT

WILSON, C.W. & MAREY, D.R., 1974, PRINCIPAL FACTS FOR GRAVITY STATIONS IN THE SOUTHERN RAFT RIVER AREA, CASSIA COUNTY, IDAHO: U.S.G.S. OPEN-FILE REPORT

YOUNG, J.W. & MITCHELL, J.C., 1973, GEOTHERMAL INVESTIGATIONS IN IDAHO, PART 1, GEOCHEMISTRY & GEOLOGIC SETTING OF SELECTED THERMAL WATERS: IDAHO DEPT. OF WATER ADMIN. WATER INFO. BULL. 30

SITE: VALE HOT SPRINGS, OR

SITE: VALE H.S., OR (FEDERAL LAND)
POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
BLM	Process Environmental Reports	CEQ	ASSUMED COMPLETED										
BLM	Lease Land	Developer											
USGS	Issue Drilling Permits	Developer											
Developer	Preliminary Geophysical Exploration												
Developer	Exploratory Drilling and Reservoir Evaluation												
Developer	Develop Utility Interest												
Developer and Utility	Feasibility Study												
Producer	Financial Negotiations												
(Developer) and Utility	Site Selection												
Producer	Commitment to Development												
Producer and Utility	Design												
Producer and Utility	Prepare Master Development Plan	BLM, USGS											
Producer and Utility	Prepare Environmental Data Statement	BLM, FPC, State, County											
BLM, FPC State, USGS	Certify Plant and Site, Issue Permits	Producer and Utility											
USGS	Process EIA/EIS (Drilling)	CEQ											
FPC	Process EIA/EIS (Plant)	CEQ											
FPC	Process EIA/EIS (Transmission Line)	CEQ											
Producer	Development Drilling												
Utility	Plant Construction												
Utility	Install Transmission Line												

Possible Subsequent Additions (MWe) and On Line Date: 50 - 1990, 50 - 1991, 50 - 1992, 50 - 1993, 50 - 1994, 50 - 1995, 50 - 1996, 50 - 1997, 50 - 1998, 50 - 1999

SITE: VALE HOT SPRINGS, OR (REGION 3)

SUMMARY

TEMPERATURE °C
Surface: 73°C⁽⁷⁾

Subsurface: 160°C⁽⁷⁾ 180°C⁽²⁰⁾

TOTAL DISSOLVED SOLIDS (PPM):

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS): 810 MWe⁽²⁰⁾ 500 (USGS)⁽⁴⁷⁾

TYPE OF OVERLAYING ROCK: loosely consolidated sandstone, siltstone, some freshwater limestone.⁽⁸⁾ soft

ESTIMATED DEPTH TO TOP OF RESERVOIR (METERS): 1000⁽⁸⁾

DESCRIPTION OF KGRA

Total KGRA Acres: 22,998⁽⁹⁾

Total Federal Acres:

Federal Acres Leased: ~14,000⁽⁴⁷⁾

Total State and Private Acres:

State and Private Acres Leased:

GEOTHERMAL DEVELOPMENT STATUS: No wells drilled by March 1977. The USGS is planning to do reservoir reconnaissance. Direct use of resource for agribusiness and residential heating is possible. Oregon State has completed a heat flow study in the Vale area.⁽⁴²⁾

LOCAL AND STATE ATTITUDE TOWARD GEOTHERMAL DEVELOPMENTS:

LAND USE AND POPULATION: Grazed desert shrubland and some irrigated land. Rural⁽⁶⁾

COMMENTS AND CRITICAL ISSUES:

SITE: VALE H. S., OR

SITE: VALE HOT SPRINGS, OR

SITE LOCATION AND PHYSICAL DESCRIPTION

LATITUDE: 43° 59' 23" N

LONGITUDE: 117° 14' 04" W

COUNTY: Malheur

ADJACENT COUNTIES: Harney, Grant, Baker, OR; Washington, Payette, Canyon, Owyhee, ID;
Humboldt, NV.

LAND OWNERSHIP:

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
	Grazed desert shrubland and some irrigated land.(6)			

SITE: VALE HOT SPRINGS, OR

RESERVOIR CHARACTERISTICS AND GEOLOGICAL/GEOPHYSICAL DESCRIPTION

RESERVOIR TEMPERATURE

Surface: 73°C
Subsurface: 160°C⁽⁷⁾ 180°C⁽²⁰⁾

Geochemical
SiO₂: 153°C⁽⁷⁾
Na-K-Ca: 158°C

TOTAL DISSOLVED SOLIDS (TDS):

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe, 30 YEARS): 762⁽⁷⁾ 810⁽²⁰⁾ 500 (USGS)⁽⁴⁷⁾

TYPE OF OVERLAYING ROCK: Loosely consolidated sandstone, siltstone, some freshwater limestone, occasionally interbedded.⁽⁸⁾ The geothermal resource is in a north-south fault controlled area.⁽⁴⁷⁾

ESTIMATED DEPTH TO TOP OF RESERVOIR: 1,000 m (3,281 feet)⁽⁸⁾

SEISMIC ACTIVITY:

SITE: VALE HOT SPRINGS, OR

LAND OWNERSHIP AND LEASING

		TOTAL AREA (ACRES)	FEDERAL (ACRES)	STATE (ACRES)	PRIVATE (ACRES)
KGRA: Vale Hot Springs and Additions		22,998 ⁽⁹⁾			
LAND LEASED IN KGRA			~14,000 ⁽⁴⁷⁾		
HIGHEST-PRICED LEASES (BY DOLLARS/ACRE) (15)					
\$/ACRE	LESSEE				
16.16	Union Oil Co.				
10.27	Republic Geothermal Inc.				
3.00	Geothermal Resources Intl.		4,486 1,347 2,560		
TENTATIVE LEASE SALE DATES					
NUMBER OF SALES OFFERED BUT NO BIDS: 3 ⁽¹⁵⁾					
NUMBER OF BIDS REJECTED (RESULTING IN NO LEASE):					
SUBSURFACE AREA OF RESERVOIR		12,350 ⁽⁸⁾			

SUMMARY OF LEASING STATUS AND NEEDS: The Republic Geothermal Corporation has expressed an interest in stock-raising homestead land (which includes 9,000 acres within the KGRA). Ownership of mineral rights has not been resolved, but this land is considered necessary for continued geothermal development at the KGRA.⁽⁴⁷⁾

SITE: VALE HOT SPRINGS, OR
GEOTHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
<p>By March 1977, no geothermal wells had been drilled. (20)</p> <p>As part of a long-term program to prepare a comprehensive heat flow map of Oregon, Oregon's State Department of Geology and Mineral Industries has completed a heat-flow hole drilling program in the Vale area. (42)</p>	<p>The USGS plans to do reservoir reconnaissance in 1978-1979. (20)</p> <p>There has been some interest expressed in nonelectric geothermal application at Vale, particularly for sugar beet plants and residential heating. (47)</p>

SITE: VALE HOT SPRINGS, OR

INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)

SITE: VALE HOT SPRINGS, OR

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds

Precipitation (Annual): 20.3 to 40.6 cm (8-16 inches) ⁽⁶⁾

Average Temperature

Minimum: -6.7 to -1.1°C (20 to 30°F) ⁽⁶⁾

Maximum: 15.6 to 21.1°C (60 to 70°F)

Relative Humidity

(Seasonal Peaks)

Summer: 30-40% ⁽⁶⁾

Winter: 70-80%

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
	On Malheur River. 15 km (9 mi.) from Bully Creek reser- voir. Some irrigation. ⁽⁶⁾		Saltbrush, greasewood and sagebrush steppe. ⁽⁶⁾		

SITE: VALE HOT SPRINGS, OR
POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR:

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES NEAR SITE	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
Vale	0	1806 (6)	The Ontario sub- station is 19km (12 miles) NE of the site. Two 138 kv lines, owned by the Idaho Power Co. (private) intersect at the substation.(33-I)	At junction of Interstates 20 and 26. (6)	Primary railroad, natural gas and oil products pipelines within 35 km (22 mi) of site. (6)

RECORD 00191

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 6

SECTION A.- GEOTHERMAL FIELD-AREA

RECORD IDENTIFICATION

RECORD NO..... 0000684
 CROSS INDEX NO.. CF02421
 RECORD TYPE..... A

NAME..... F. SMITH, J. RENNER, D. WILLIAMS
 DATE..... 75/05
 ORGANIZATION.. U.S.G.S.

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. VALE HOT SPRINGS
 WARNING FIGURE..... 6
 COUNTRY CODE..... US
 STATE/PROVINCE..... OREGON
 LATITUDE..... 43-59-23N

WARNING NUMBER..... 77
 COUNTRY NAME..... UNITED STATES
 COUNTY..... MALHEUR
 LONGITUDE..... 117-14-04W

TOWNSHIP RANGE SECTION 1/4 1/4
 18S 45E 20

BASE & MERIDIAN..... WILLAMETTE

AVAILABLE MAPS OF AREA: VALE EAST QUAD, ORE (1:24,000) BOISE, IDAHO. ORE. 1:250,000

GENERAL DESCRIPTION

ELEVATION..... 670.56 M 2200. FT
 RESOURCE CATEGORY..... B
 SURFACE THERMAL ACTIVITY..... HOT SPRING(S),
 NO. OF HOT SPRINGS..... SEVERAL

GEOTHERMAL CHARACTERISTICS

NATURAL SURFACE DISCHARGE..... 1.26 L/S 7.5599E+01 L/MIN ESTIMATED
 SPRING TEMPERATURES..... 97. C

RESERVOIR PROPERTIES

RESERVOIR TEMPERATURES..... 145. C TO 175. C ASSUMED
 BEST ESTIMATE..... 180.0 C
 SUBSURFACE AREA..... 10.0 KM**2 TO 150.0 KM**2
 BEST ESTIMATE..... 50.0 KM**2
 BASED ON: AMT, HEATFLOW, GEOLOGY
 DEPTH TO TOP OF RESERVOIR..... 750.00 M 0.750 KM TO 2000.00 M 2.000 KM
 BEST ESTIMATE..... 1000.00 M 1.000 KM
 DEPTH TO BOTTOM OF RESERVOIR.. 3000.00 M 3.000 KM TO 3000.00 M 3.000 KM
 BEST ESTIMATE..... 3000.00 M 3.000 KM
 THICKNESS OF RESERVOIR..... 1000.00 M 1.000 KM TO 2250.00 M 2.250 KM
 BEST ESTIMATE..... 2000.00 M 2.000 KM
 VOLUME OF RESERVOIR..... 10.000 KM**3 TO 337.500 KM**3
 BEST ESTIMATE..... 100.000 KM**3
 COMMENTS: DEPTHS TO TOP & BOTTOM OF RESERVOIR ARE ASSUMED.

RESERVES

TOTAL STORED HEAT..... 3.6418E+18 J 8.6999E+17 CAL TO 1.2290E+20 J 2.9359E+19 CAL
 BEST ESTIMATE..... 3.6418E+19 J 8.6999E+18 CAL ABOVE 15. C

GEOLOGY

GENERAL ROCK TYPES: LOOSELY CONSOLIDATED SANDSTONE, SILTSTONE, SOME FRESHWATER LIMESTONE, OCCASIONALLY, INTERBEDDED

W/BASALT FLOWS

GEOPHYSICS

GRAVITY SURVEY INFORMATION: TEST MADE
OTHER GEOPHYSICAL INFORMATION: HEAT FLOW, AMT

PRIMARY REFERENCE:

AUTHOR..... D.E. WHITE & D.L. WILLIAMS, EDITORS
DATE..... 1975
TITLE..... ASSESSMENT OF GEOTHERMAL RESOURCES OF THE UNITED STATES - 1975
REFERENCE... U.S.G.S. CIRCULAR 726

RELATED REFERENCES:

- 1) CONCORAN, R.E., & OTHERS, 1962, GEOLOGY OF THE MITCHELL BUTTE QUADRANGLE, OREGON: OREGON DEPT. GEOLOGY AND MINERAL INDUSTRIES GEOL. MAP SER. 2
- 2) WALKER, C.W., COMPILER, 1973, PRELIMINARY GEOLOGIC AND TECTONIC MAPS OF OREGON EAST OF THE 121ST MERIDIAN: U.S.G.S. MISC. FIELD STUDIES MAP MF-495
- 3) WARING, G.A., 1965, THERMAL SPRINGS OF THE UNITED STATES AND OTHER COUNTRIES OF THE WORLD--A SUMMARY: U.S.G.S. PROF. PAPER 452, 383P.

RECORD 00192

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION E

SECTION B.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000665
 CROSS INDEX NO.. CF02421 MAR00P4
 RECORD TYPE..... R
 SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.
 DATE..... 76/04
 ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. VALE HOT SPRINGS
 COUNTRY CODE..... US
 STATE/PROVINCE..... OREGON

COUNTRY NAME..... UNITED STATES
 COUNTY..... MALHEUR

TOWNSHIP RANGE SECTION 1/4 1/4
 18S 45E 20 SE

MAP REFERENCE: VALE EAST, ORE. (7 1/2'); BOISE, ID-ORE. (2 DEG)

SAMPLE INFORMATION

SOURCE TYPE..... SPRING
 COLLECTION DATE..... 1974
 COLLECTOR(S)..... BARNES GROUP
 POINT OF COLLECTION..... NEAR ORIFICE OF SPRING
 WATER SAMPLING TEMP.... 73. C

WATER TREATMENT DATA: PRESSURE-FILTERED THROUGH A .45 MICROMETRE MEMBRANE, PORTION ACIDIFIED, DILUTED
 OTHER CHEMICAL CHARACTERISTICS: ALKALINITY AS REPORTED AS BICARBONATE.

WATER ANALYSIS

ANALYSIS DATE..... 1974
 ANALYST(S)..... EARNES GROUP
 PH 1)..... 7.47
 SPECIFIC CONDUCTANCE.... 1530. UMHO/CM
 ALKALINITY..... 143. MG/L

ISOTOPIC DATA

DEL C(18) OF WATER..... -15.18 0/00
 DEL D OF WATER..... -135.0 0/00

SCLUTE ANALYSIS (WATER)

UNITS USED..... MG/L

L1	NA	K	RB	CS	NA+K			
.28	310	16	.09	LT .1				
MG	CA	SR	BA	CA+MG				
.8	19							
MN+3	MN(TOT)	FE+3	FE(TOT)	CU				
	.04		LT .02	LT .01				
ZN	HG	E	HGB2	AL	PB	AS	SB	U
		9.4		.017				
F	CL	BR	I					

PAGE 0250

6.1 360

NH ₄	NO ₃	PO ₄	SiO ₂	SO ₄	CO ₃	HCO ₃
1.03			130	100		

REFERENCES: MARINER, PRESSER, RAPP, WILLEY, THE MINOR AND TRACE ELEMENTS, GAS, AND ISOTOPE COMPOSITIONS OF THE
PRINCIPAL HOT SPRINGS OF NEVADA AND OREGON.

SITE: WEISER-CRANE CREEK, ID

SITE: WEISER/CRAVE CREEK, ID (FEDERAL/STATE/PRIVATE LAND)
POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
BLM, State, County	Process Environmental Reports (EIA)	CEQ, State DEQ	_____										
BLM, Owner	Lease Land	Developer		_____									
USGS, State	Issue Drilling Permits	Developer		_____									
Developer	Preliminary Geophysical Exploration				_____								
Developer	Exploratory Drilling and Reservoir Evaluation				_____	_____							
Developer	Develop Utility Interest					_____							
Developer	Feasibility Study					_____							
and Utility	Financial Negotiations						_____						
Producer (Developer)	Site Selection							_____					
and Utility	Commitment to Development							_____ Δ					
Producer	Design								_____				
Producer and Utility	Prepare Master Development Plan	BLM, USGS							_____				
and Utility	Prepare Environmental Data Statement	BLM, FPC, State, County							_____				
Utility	Certify Plant and Site, Issue Permits	Producer and Utility							_____	_____			
BLM, FPC, State, USGS	Process EIA/EIS (Drilling)	CEQ, St. DEQ							_____	_____			
USGS, St., Cty.	Process EIA/EIS (Plant)	CEQ, St. DEQ							_____	_____			
FPC, ST. PUC	Process EIA/EIS (Transmission Line)	CEQ, St. DEQ							_____	_____			
FPC, ST. PUC	Development Drilling										_____	_____	
Producer	Plant Construction										_____	_____	
Utility	Install Transmission Line										_____	_____	
Utility													

Possible Subsequent Additions (MWe) and On Line Date: 100 - 1990, 100 - 1991, 100 - 1992, 100 - 1993, 100 - 1994, 100 - 1995, 100 - 1996, 100 - 1997, 100 - 1998, 100 - 1999

SITE: WEISER-CRANE CREEK, ID (REGION 3)

SUMMARY

TEMPERATURE °C

Surface: 77°C⁽⁷⁾ Subsurface: 160°C⁽⁷⁾ 180°C⁽²⁰⁾

TOTAL DISSOLVED SOLIDS (PPM):

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS): 535 MW⁽⁷⁾ 1000⁽²⁰⁾

TYPE OF OVERLAYING ROCK: Alluvium and the Idaho group⁽⁸⁾ Medium-Hard

ESTIMATED DEPTH TO TOP OF RESERVOIR (METERS): 1000 m (3,281 feet)⁽⁸⁾

DESCRIPTION OF KGRA

Total KGRA Acres: 4,342⁽⁹⁾

Total Federal Acres:

Federal Acres Leased: 1,381⁽¹⁵⁾

Total State and Private Acres:

State and Private Acres Leased:

GEOHERMAL DEVELOPMENT STATUS: 610 m (2,000 feet) stratigraphic test holes are currently being drilled.⁽⁴⁷⁾ Test drilling is projected through 1977.⁽²⁾ USGS work on reservoir confirmation may continue until 1979.⁽²⁰⁾

LOCAL AND STATE ATTITUDE TOWARD GEOTHERMAL DEVELOPMENTS:

LAND USE AND POPULATION:

Subhumid grassland and semiarid grazing land. Some irrigation.⁽⁶⁾

COMMENTS AND CRITICAL ISSUES:

SITE: WEISER-CRANE CREEK, ID

SITE: WEISER-CRANE CREEK, ID

SITE LOCATION AND PHYSICAL DESCRIPTION

LATITUDE: 44° 17' 54" N

LONGITUDE: 117° 02' 54" W⁽⁸⁾

COUNTY: Washington⁽⁸⁾

ADJACENT COUNTIES: ID: Payette, Gem and Adams; OR: Baker and Malheur⁽⁶⁾

LAND OWNERSHIP:

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
Low open mountains ⁽⁶⁾	Subhumid grassland and semiarid grazing land. Some irrigated land. ⁽⁶⁾			

SITE: WEISER-CRANE CREEK, ID

RESERVOIR CHARACTERISTICS AND GEOLOGICAL/GEOPHYSICAL DESCRIPTION

RESERVOIR TEMPERATURE

Surface: 77°C
Subsurface: 160°C⁽⁶⁾ 180°C⁽²⁰⁾

Geochemical

SiO₂: 157°C
Na-K-Ca: 142°C

TOTAL DISSOLVED SOLIDS (TDS):

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe, 30 YEARS): 535⁽⁷⁾ 1000⁽²⁰⁾

TYPE OF OVERLAYING ROCK: alluvium and the Idaho group.⁽⁸⁾

ESTIMATED DEPTH TO TOP OF RESERVOIR: 1000 m (3,281 feet)⁽⁸⁾

SEISMIC ACTIVITY:

SITE: WEISER-CRANE CREEK, ID

LAND OWNERSHIP AND LEASING

		TOTAL AREA (ACRES)	FEDERAL (ACRES)	STATE (ACRES)	PRIVATE (ACRES)
KGRA: Crane Creek		4,342 ⁽⁹⁾	3,240 ⁽⁴⁸⁾	1,102 ⁽⁴⁸⁾ (state and private)	
LAND LEASED IN KGRA			1,381 ⁽¹⁵⁾		
HIGHEST-PRICED LEASES (BY DOLLARS/ACRE) ⁽¹⁵⁾			1,381		
\$/ACRE	LESSEE				
17.28	Southern Union Production Co.				
TENTATIVE LEASE SALE DATES					
NUMBER OF SALES OFFERED BUT NO BIDS: 0 ⁽¹⁵⁾					
NUMBER OF BIDS REJECTED (RESULTING IN NO LEASE): 0 ⁽¹⁵⁾					
SUBSURFACE AREA OF RESERVOIR		8,645 ⁽⁸⁾			

SUMMARY OF LEASING STATUS AND NEEDS: Because of environmental concerns, the BLM rejected noncompetitive lease applications from Arco and Union. No Federal land has been leased for geothermal activity outside the KGRA.⁽⁴⁷⁾

SITE: WEISER-CRANE CREEK, ID

GEOHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
<p>Phillips has been and is currently drilling 610 m (2,000 foot) stratigraphic test holes on private land.(47)</p>	<p>It was projected that exploratory test drilling may take place 1975-77.(2) USGS may be working on reservoir confirmation until 1979.(20)</p>

SITE: WEISER-CRANE CREEK, ID

INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)
		Some environmental work has been done.(47)

SITE: WEISER-CRANE CREEK, ID

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds
 Precipitation (Annual): 40.6 to 61.0 cm (16-24 inches)⁽⁶⁾
 Average Temperature
 Minimum: -7 to -1°C (20-30°F)⁽⁶⁾
 Maximum: 21°C (70°F)

Relative Humidity
 (Seasonal Peaks)
 Summer: 40-50%⁽⁶⁾
 Winter: 70-80%

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
	Site is on the Weiser River, near the Crane Creek reservoir. ⁽⁶⁾		Sagebrush steppe. ⁽⁶⁾		

SITE: WEISER-CRANE CREEK, ID

POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR:

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES NEAR SITE	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
Weiser		4,208(6)	There is a substation and a 138 kv line owned by the Idaho Power Co. (private) at Weiser.(33-1)	I-95 within 8 km (5 miles) of site. (6)	Primary rail line within 8 km (5 miles) of site. Major >25.4 cm (10 inches) oil products pipeline within 16 km (10 miles) of site. Minor <56 cm (22 inches) natural gas line within 24 km (15 miles) of site.(6)
Midvale	32 km (20 miles)	5,802(6)			

RECORD 00039

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 6

SECTION A.- GEOTHERMAL FIELD-AREA

RECORD IDENTIFICATION

RECORD NO..... 0000436
 CROSS INDEX NO.. CFG1181
 RECORD TYPE..... A

NAME..... PETER OBERLINDACHER, J. RENNER, D. WILLI
 DATE..... 75/04
 ORGANIZATION.. U.S.G.S.

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. WEISER
 WARNING FIGURE..... 4
 COUNTRY CODE..... US
 STATE/PROVINCE..... IDAHO
 LATITUDE..... 44-17-54N

WARNING NUMBER..... 021
 COUNTRY NAME..... UNITED STATES
 COUNTY..... WASHINGTON
 LONGITUDE..... 117-02-54W

TOWNSHIP RANGE SECTION 1/4 1/4
 11N 06W 14

BASE & MERIDIAN..... BOISE
 AVAILABLE MAPS OF AREA: OLDS FERRY SE 1:62,500

GENERAL DESCRIPTION

ELEVATION..... 670.56 M 2200. FT
 RESOURCE CATEGORY..... B
 SURFACE THERMAL ACTIVITY..... HOT SPRING(S),
 NO. OF HOT SPRINGS..... NUMEROUS

GEOTHERMAL CHARACTERISTICS

NATURAL SURFACE DISCHARGE..... 0.33 L/S 2.0000E+01 L/MIN ESTIMATED
 SPRING TEMPERATURES..... 25. C TO 77. C
 WELL INFORMATION
 MAXIMUM WELL TEMPERATURE..... 77. C

RESERVOIR PROPERTIES

RESERVOIR TEMPERATURES..... 130. C TO 250. C ASSUMED
 BEST ESTIMATE..... 160.0 C
 SUBSURFACE AREA..... 9.0 KM**2 TO 120.0 KM**2
 BEST ESTIMATE..... 35.0 KM**2
 BASED ON: AMT., GEOLOGY
 DEPTH TO TOP OF RESERVOIR..... 500.00 M 0.500 KM TO 2000.00 M 2.000 KM
 BEST ESTIMATE..... 1000.00 M 1.000 KM
 DEPTH TO BOTTOM OF RESERVOIR.. 3000.00 M 3.000 KM TO 3000.00 M 3.000 KM
 BEST ESTIMATE..... 3000.00 M 3.000 KM
 THICKNESS OF RESERVOIR..... 1000.00 M 1.000 KM TO 2500.00 M 2.500 KM
 BEST ESTIMATE..... 2000.00 M 2.000 KM
 VOLUME OF RESERVOIR..... 9.000 KM**3 TO 300.000 KM**3
 BEST ESTIMATE..... 70.000 KM**3
 COMMENTS: DEPTHS TO TOP & BOTTOM OF RESERVOIR ARE ASSUMED.

RESERVES

TOTAL STORED HEAT..... 2.5116E+18 J 5.9999E+17 CAL TO 1.7581E+20 J 4.1999E+19 CAL
 BEST ESTIMATE..... 2.5534E+19 J 6.0999E+18 CAL ABOVE 15. C

GEOLOGY

GENERAL ROCK TYPES: QUATERNARY ALLUVIUM, IDAHO GROUP (PLEISTOCENE & PLIOCENE)

GEOPHYSICS

GRAVITY SURVEY INFORMATION: TEST MADE

MAGNETIC SURVEY INFORMATION: TEST MADE

OTHER GEOPHYSICAL INFORMATION: AMT, TEMPERATURE GRADIENT

PRIMARY REFERENCE:

AUTHOR..... D.E. WHITE & D.L. WILLIAMS, EDITORS

DATE..... 1975

TITLE..... ASSESSMENT OF GEOTHERMAL RESOURCES OF THE UNITED STATES - 1975

REFERENCE... U.S.G.S. CIRCULAR 726

RELATED REFERENCES:

- 1) NEWCOMB, R.C., 1970, TECTONIC STRUCTURE OF THE MAIN PART OF THE BASALT OF THE COLUMBIA RIVER GROUP, WASHINGTON, OREGON, AND IDAHO: U.S.G.S. MISC. GEOL. INV. MAP 1-567
- 2) YOUNG, H.W., AND WHITEHEAD, R.L., 1974, GEOTHERMAL INVESTIGATIONS IN IDAHO, PART 3, AN EVALUATION OF THERMAL WATER IN THE WEISER AREA, IDAHO: U.S.G.S. OPEN-FILE REPORT 74-249

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RECORD 00046

GEOHERMAL RESOURCES FILE (GEOHERM) REVISION: 8

SECTION B.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000437
CROSS INDEX NO.. CF01181
RECORD TYPE..... B
SAMPLE TYPE..... SURFACE

NAME..... PETER OBERLINDACHER, J. RENNER, D. WILLI
DATE..... 7/5/04
ORGANIZATION.. U.S.G.S.

GEOGRAPHIC LOCALITY

GEOHERMAL FIELD-AREA.. WEISER
COUNTRY CODE..... US
STATE/PROVINCE..... IDAHO
LATITUDE..... 44-17.90 N

COUNTRY NAME..... UNITED STATES
COUNTY..... WASHINGTON
LONGITUDE..... 117-02.90 W

SAMPLE INFORMATION

SOURCE TYPE..... SPRING

WATER ANALYSIS

PH 1)..... 9.30

SOLUTE ANALYSIS (WATER)

LI	NA 140.00	K 5.00	RB	CS	NA+K
MG	CA 2.90	SR	BA	CA+MG	
F	CL 56.00	BR	I		
NH4	NO3	PO4	SiO2 140.00	SO4 150.00	CO3 35.00

REFERENCES: WHITE & OTHERS, ASSESSMENT OF GEOHERMAL RESOURCES OF THE U.S. - 1975, U.S.G.S. CIRCULAR 726
YOUNG AND WHITEHEAD, 1974b

SITE: WEST YELLOWSTONE, MT

SITE: W. YELLOWSTONE, MT. (FEDERAL/STATE/PRIVATE LAND)
POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 Mw PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
BLM, State	Process Environmental Reports	CEQ, State DEQ											
BLM, ST, Owner	Lease Land	Developer											
State, USGS	Issue Drilling Permits	Developer											
Developer	Preliminary Geophysical Exploration												
Developer	Exploratory Drilling and Reservoir Evaluation												
Developer	Develop Utility Interest												
Developer and Utility	Feasibility Study												
Producer (Developer) and Utility	Financial Negotiations												
Producer and Utility	Site Selection												
Producer and Utility	Commitment to Development												
Producer and Utility	Design (Preliminary, Final)												
Producer and Utility	Prepare Master Development Plan	BLM, USGS											
Utility	Prepare Environmental Data Statement	BLM, FPC, State, County											
BLM, FPC, USGS	Certify Plant and Site, Issue Permits	Producer and Utility											
USGS, State	Process EIA/EIS (Drilling)	CEQ, State DEQ											
FPC, State PUC	Process EIA/EIS (Plant)	CEQ, State DEQ											
FPC, State PUC	Process EIA/EIS (Transmission Line)	CEQ, State DEQ											
Producer	Development Drilling												
Utility	Plant Construction												
Utility	Install Transmission Line												

SITE: WEST YELLOWSTONE, MT (REGION 3)

SUMMARY

TEMPERATURE °C
Surface:

Subsurface:

TOTAL DISSOLVED SOLIDS (PPM):
ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS):
TYPE OF OVERLAYING ROCK:
ESTIMATED DEPTH TO TOP OF RESERVOIR (METERS):

DESCRIPTION OF KGRA

Total KGRA Acres: 12,763⁽⁹⁾
Total Federal Acres:
Federal Acres Leased:

Total State and Private Acres:
State and Private Acres Leased:

GEOHERMAL DEVELOPMENT STATUS:

LOCAL AND STATE ATTITUDE TOWARD GEOHERMAL DEVELOPMENTS:

LAND USE AND POPULATION: Open high mountains in a National Forest adjacent to Yellowstone National Park. Sparse population.⁽⁶⁾

COMMENTS AND CRITICAL ISSUES: In a very seismically active area.⁽⁶⁾

SITE: WEST YELLOWSTONE, MT

SITE: WEST YELLOWSTONE, MT

SITE LOCATION AND PHYSICAL DESCRIPTION

LATITUDE: 44° 39' 03" N

LONGITUDE: 111° 05' 05" W

COUNTY: Gallatin

ADJACENT COUNTIES: MT: Madison, Jefferson, Broadwater, Meagher, Park; WY: Park, Teton; ID: Fremont.⁽⁶⁾

LAND OWNERSHIP:

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
Open high mountains ⁽⁶⁾	Forest and woodland mostly ungrazed Adjacent to Yellowstone National Park, in Gallatin National Forest. ⁽⁶⁾			

SITE: WEST YELLOWSTONE, MT

RESERVOIR CHARACTERISTICS AND GEOLOGICAL/GEOPHYSICAL DESCRIPTION

RESERVOIR TEMPERATURE

Surface:
Subsurface:

Geochemical
SiO₂:
Na-K-Ca:

TOTAL DISSOLVED SOLIDS (TDS):

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe, 30 YEARS):

TYPE OF OVERLAYING ROCK:

ESTIMATED DEPTH TO TOP OF RESERVOIR:

SEISMIC ACTIVITY: In a very seismically active area.⁽⁶⁾

SITE: WEST YELLOWSTONE, MT

LAND OWNERSHIP AND LEASING

		TOTAL AREA (ACRES)	FEDERAL (ACRES)	STATE (ACRES)	PRIVATE (ACRES)
KGRA: Yellowstone		12,763 ⁽⁹⁾	12,763 ⁽⁴⁷⁾ (F.S.)		
LAND LEASED IN KGRA					
HIGHEST-PRICED LEASES (BY DOLLARS/ACRE)					
\$/ACRE	LESSEE				
TENTATIVE LEASE SALE DATES Feb. 1979 - F.S. lands only ⁽¹⁴⁾					
NUMBER OF SALES OFFERED BUT NO BIDS:					
NUMBER OF BIDS REJECTED (RESULTING IN NO LEASE):					
SUBSURFACE AREA OF RESERVOIR					

SUMMARY OF LEASING STATUS AND NEEDS: Some BLM, state and private land leased outside the KGRA. Numerous noncompetitive leases are pending. KGRA leasing will depend on outcome of the EIS⁽⁴⁷⁾.

SITE: WEST YELLOWSTONE, MT
GEOTHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT

SITE: WEST YELLOWSTONE, MT

INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)
		<p>The Forest Service is currently working on an EIS which is scheduled for completion in early 1979. Work on the EIS is currently proceeding on schedule.⁽⁴⁷⁾</p> <p>The first draft of an Island Park (Yellowstone) Land Use Plan was being reviewed by the Regional Forest Service Office in June 1977. The plan was expected to be finalized in 1977.⁽⁴⁷⁾</p>

SITE: WEST YELLOWSTONE, MT

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds

Precipitation (Annual): 40.6 to 61.0 cm (16-24 inches)

Average Temperature

Minimum: -12°C (10°F)

Maximum: 16°C (60°F)

Relative Humidity
(Seasonal Peaks)

Summer: 50%

Winter: 80%

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
	Within 5 km (3 miles) of Hebgen Lake, and within 16 km (10 miles) of Henrys Lake (6)		Douglas Fir Western Spruce (6)		The grizzly bear and wolves are of particular environmental concern. (47)

SITE: WEST YELLOWSTONE, MT

POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR:

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES NEAR SITE	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
West Yellowstone	0	150 ⁽⁶⁾	Macks Inn, ID, substation is 32 km (20 mi.) S.W. of the site. There is a 115 kv line from the south terminating at the sub- station. The line is owned by the Bonneville Power Administra- tion (Federal). There are no other power plants or lines within 80 km (50 mi.) of the site.(33-1)	On interstate 191.(6)	Primary Railroad in West Yellowstone.(6)
Bigsprings	21 km (13 miles)	30 ⁽⁶⁾			
Grayling	16 km (10 miles)	10 ⁽⁶⁾			

REGION 4 - SOUTHWEST

SITE: BEOWAWE, NV

SITE: BEOWAWE, NV (FEDERAL LAND, POSSIBLY SOME PRIVATE)

POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
BLM	Issue STG Drilling Permit	Developer	} ASSUMED COMPLETED										
USGS	Issue Drilling Permit	Developer											
BLM/Owner	Lease Land	Developer											
BLM	Process EIA/EIS	CEQ											
County	Issue Land Use Permits	Developer											
Developer	Exploratory Drilling & Reservoir Evaluation		_____	_____									
Developer	Develop Utility Interest		_____										
Developer & Utility	Feasibility Study		_____	_____									
Producer (Developer) & Utility	Financial Negotiations			_____									
Producer & Utility	Site Selection			_____									
Producer & Utility	Design			_____	_____	_____							
Producer & Utility	Commitment to Development			_____	_____								
Producer & Utility	Prepare Master Development Plan	BLM, USGS		_____	_____								
Utility	Prepare Environmental Data Statement	BLM, FPC, STATE, County		_____	_____								
BLM, FPC	Certify Plant & Site, Issue Permits	Producer & Utility			_____	_____	_____						
USGS	Process EIA/EIS (Drilling)	CEQ			_____	_____	_____						
FPC	Process EIA/EIS (Plant)	CEQ			_____	_____	_____						
FPC	Process EIA/EIS (Transmission Line)	CEQ			_____	_____	_____						
Producer	Development Drilling						_____	_____	_____				
Utility	Plant Construction						_____	_____	_____	_____			
Utility	Install Transmission Line (40km)							_____	_____	_____			

Possible Subsequent Additions (MWe) and On Line Date: 50 - 1986, 50 - 1988, 100 - 1990, 100 - 1991, 100 - 1992, 100 - 1993, 100 - 1994, 100 - 1995, 100 - 1996, 100 - 1997, 50 - 1998

SITE: DEOWAWE, NV (REGION 4)

SUMMARY

TEMPERATURE °C

Surface: 226

Subsurface: 240

TOTAL DISSOLVED SOLIDS (PPM):

1,200⁽⁴⁾

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS):

624⁽⁷⁾

500-1000⁽²⁰⁾

TYPE OF OVERLAYING ROCK:

Hard

ESTIMATED DEPTH TO TOP OF RESERVOIR (METERS):

1,000

DESCRIPTION OF KGRA

Total KGRA Acres: 33,225⁽⁴⁹⁾

Total Federal Acres: ~ 16,530⁽⁴⁹⁾

Federal Acres Leased:

Total State and Private Acres: ~ 1/2^(1A)

State and Private Acres Leased:

GEOHERMAL DEVELOPMENT STATUS:

As of February 1977, 13 deep wells have been drilled.⁽²⁰⁾

LOCAL AND STATE ATTITUDE TOWARD GEOTHERMAL DEVELOPMENTS:

Development is generally welcome. A use permit for land is required. Mild constraints and brief delays may be expected.^(1A) Development has been delayed by legal problems.⁽²⁰⁾

LAND USE AND POPULATION:

Sparsely populated desert. Mining, grazing and irrigated agriculture.⁽⁴⁾

COMMENTS AND CRITICAL ISSUES:

A water shortage exists.^(1A) BLM has prepared a regional environmental analysis.⁽⁴⁾

SITE: BEOWAWE, NV

SITE: BEOWAWE, NV

SITE LOCATION AND PHYSICAL DESCRIPTION

LATITUDE: 40° 34' 12" N

LONGITUDE: 116° 34' 48" W

COUNTY: Eureka and Lander Counties⁽⁸⁾

ADJACENT COUNTIES: Elko, White Pine, Nye, Churchill, Pershing, Humboldt

LAND OWNERSHIP: Federal and Private ownership.⁽⁶⁾ Stanford University owns property in the area.⁽²⁰⁾

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
Desert	Sparsely populated. Principally mining, grazing, irrigation, agriculture. ⁽⁴⁾		Bold, stark beauty and isolation of site would be substantially altered by construction of roads, power lines, mines. ⁽⁴⁾	Immigrant Trail north of site, Pony Express route south of site. Shoshone and Piute Indians inhabited area. ⁽⁴⁾

SITE: BEOWAWE, NV

RESERVOIR CHARACTERISTICS AND GEOLOGICAL/GEOPHYSICAL DESCRIPTION

RESERVOIR TEMPERATURE

Surface: 226°C
Subsurface: 240°C

Geochemical

SiO₂: 226°C
Na-K-Ca: 242°C

TOTAL DISSOLVED SOLIDS (TDS): 1200 ppm⁽⁴⁾ The fluids are high in silica, but they are potable.⁽⁴⁷⁾

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS): 624⁽⁷⁾ 500-1000⁽²⁰⁾ 500 (USGS)⁽⁴⁷⁾

TYPE OF OVERLAYING ROCK: Tertiary Basalt, Quarternary Alluvium. The geothermal system is fault-controlled.⁽⁴⁷⁾

ESTIMATED DEPTH TO TOP OF RESERVOIR: 1000 M (3281 ft)

SEISMIC ACTIVITY:

SITE: BEOWAWE, NV

LAND OWNERSHIP AND LEASING

		TOTAL AREA (ACRES)	FEDERAL (ACRES)	STATE (ACRES)	PRIVATE (ACRES)
KGRA: Beowawe		33,225 ⁽⁴⁹⁾	16,530 ⁽⁴⁹⁾	approximately 1/2 (1A)	
LAND LEASED IN KGRA			13,768 ⁽¹⁵⁾		
HIGHEST-PRICED LEASES (BY DOLLARS/ACRE) (15)					
\$/ACRE	LESSEE				
203.75	Chevron Oil Co.				
30.59	Chevron Oil Co.				
18.00	Getty Oil Co.				
12.91	So. Union Prod. Co.		2,479 2,468 2,521 1,938		
TENTATIVE LEASE SALE DATES					
NUMBER OF SALES OFFERED BUT NO BIDS: 5			5,047 ⁽¹⁵⁾		
NUMBER OF BIDS REJECTED (RESULTING IN NO LEASE): 0 ⁽¹⁵⁾					
SUBSURFACE AREA OF RESERVOIR		5,189 ⁽⁸⁾			

SUMMARY OF LEASING STATUS AND NEEDS:

SITE: BEOWAWE, NV

GEOHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
<p>As of August 1975, the deepest well drilled was 2915 m (9,563 feet).⁽⁴⁾ By June 1976, more than 12 holes were drilled, with Magma Power (Chevron) planning additional holes.⁽²⁾ By February 1977, 1 well had been drilled by Standard Oil of California.⁽¹⁷⁾ (As of February 1977, 13 deep wells were drilled).⁽²⁰⁾</p> <p>Phillips has also been involved in development.⁽²⁰⁾</p> <p>By June 1977, the deepest well (which was drilled by Chevron) had a downhole temperature of ~214°C. A 213 m (700 foot) well drilled by Magma had the same downhole temperature.⁽⁴⁷⁾</p> <p>Vandalized Magma wells have been running wild for the past 2 to 3 years.⁽⁴⁷⁾</p> <p>Chevron has drilled one dry hole.⁽⁴⁷⁾</p>	

SITE: BEOWAWE, NV

INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)
<p>Eureka County requires a use permit for land, and geothermal activity must comply with county zoning. Mild constraints and brief delays may be expected.(1A)</p>	<p>Residents would be concerned about demands on services if population increases significantly; however geothermal development is generally welcome.(4)</p>	<p>By June 1977, an EAR was completed by BLM(49).</p> <p>Development has been delayed by legal problems.(20)</p>

SITE: BEOWAWE, NV

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds

Precipitation (Annual): 23 cm (9.13 inches)

Average Temperature

Minimum: -5.5°C (22°F)

Maximum: 21°C (70°F)

Relative Humidity

(Seasonal Peaks)

Summer: 30 - 40%

Winter: 60 - 70%

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
ppm undetermined. ⁽⁴⁾ Principal pollutant is wind-borne dust, with some sulphur dioxide and hydrogen sulfide from hot springs.	Surface water is available from the Humbolt River. Shal- low ground water of good quality is also available. ⁽⁴⁾ How- ever, a water short- age exists. ^(1A)	Ambient noise level is low.	greasewood, shadscale, rabbit brush, big sage, winter fat, wild-rye, squirreltail, cheat grass. Aquatic plant life found in thermal springs. (4)	wild horse, fox, weasel, bat, coyote, bobcat, rabbit, mule deer, prong-horn antelope. Springwater heavily used by wildlife and livestock. (4)	Spotted Bat and a relict fish found in Carico Lake Valley. ⁽⁴⁾

SITE: BEOWAWE, NV

POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR:

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES NEAR SITE	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
Battle Mountain	32 km (20 miles)	1850 ⁽⁶⁾	<p>No transmission lines > 115 kv within 64 km (40 miles) of site. (33-II)</p> <p>40 km (25 miles) to distribution line. (4)</p> <p>A transmission line is planned for within 33 km (20 miles) of Beowawe. (20)</p>	Interstate Highway 80 a few miles north of site. (6)	<p>Railroad few miles north of site (primary railroad)</p> <p>Minor gas pipeline few miles north of site. (6)</p>

RECORD 00045

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 8

SECTION A.- GEOTHERMAL FIELD-AREA

RECORD IDENTIFICATION

RECORD NO..... 0000588
 CROSS INDEX NO.. CF01941
 RECORD TYPE..... A

NAME..... E. A. JOHNSON, J. RENNER
 DATE..... 75/01
 ORGANIZATION.. U.S.G.S.

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. BEOWAWE
 WARNING FIGURE..... 8
 COUNTRY CODE..... US
 STATE/PROVINCE..... NEVADA
 LATITUDE..... 40-34-12N

WARNING NUMBER..... 77A
 COUNTRY NAME..... UNITED STATES
 COUNTY..... EUREKA
 LONGITUDE..... 116-34-48W

TOWNSHIP RANGE SECTION 1/4 1/4
 31N 48E 17 NW

BASE & MERIDIAN..... MT. DIABLO
 AVAILABLE MAPS OF AREA: DUNPHY 1:62,500; WINNEMUCCA 1:250,000

GENERAL DESCRIPTION

SIZE OF SURFACE EXPRESSION.... 1.6 KM**2
 ELEVATION..... 1524.00 M 5000. FT
 RESOURCE CATEGORY..... B
 PRESENT USE & DEVELOPMENTS: 9 WELLS 131M TO 3000M; TEMPS TO 212C
 SURFACE THERMAL ACTIVITY..... HOT SPRINGS, GEYSERS, FUMAROLE OR WARM VAPOR
 ASSOCIATED DEPOSITS..... SINTER
 NO. OF HOT SPRINGS..... 15

GEOTHERMAL CHARACTERISTICS

SPRING TEMPERATURES..... 50. C TO 98. C
 WELL INFORMATION
 MAXIMUM WELL TEMPERATURE..... 212. C TO 220. M
 BOTTOM-HOLE TEMPERATURE..... 212.0 C TO 220.00 M

RESERVOIR PROPERTIES

RESERVOIR TEMPERATURES..... 165. C TO 240. C ASSUMED
 BEST ESTIMATE..... 240.0 C
 SUBSURFACE AREA..... 0.6 KM**2 TO 31.0 KM**2
 BEST ESTIMATE..... 21.0 KM**2
 BASED ON: GEOLOGY, GEOPHYSICS, EXPLORATION
 DEPTH TO TOP OF RESERVOIR..... 500.00 M 0.500 KM TO 1500.00 M 1.500 KM
 BEST ESTIMATE..... 1000.00 M 1.000 KM
 DEPTH TO BOTTOM OF RESERVOIR.. 3000.00 M 3.000 KM TO 3000.00 M 3.000 KM
 BEST ESTIMATE..... 3000.00 M 3.000 KM
 THICKNESS OF RESERVOIR..... 1500.00 M 1.500 KM TO 2500.00 M 2.500 KM
 BEST ESTIMATE..... 2000.00 M 2.000 KM
 VOLUME OF RESERVOIR..... 0.900 KM**3 TO 77.500 KM**3
 BEST ESTIMATE..... 42.000 KM**3
 COMMENTS: DEPTHS TO TOP & BOTTOM OF RESERVOIR ARE ASSUMED.

RESERVES

TOTAL STORED HEAT.....	4.1860E+17 J	9.9999E+16 CAL	TO 5.1484E+19 J	1.2299E+19 CAL
BEST ESTIMATE.....	2.3860E+19 J	5.6999E+18 CAL	ABOVE 15. C	

GEOLOGY

GENERAL ROCK TYPES: TERTIARY BASALT, QUATERNARY ALLUVIUM

GEOPHYSICS

GRAVITY SURVEY INFORMATION: TEST MADE

MAGNETIC SURVEY INFORMATION: TEST MADE

PRIMARY REFERENCE:

AUTHOR..... D.E. WHITE & D.L. WILLIAMS, EDITORS

DATE..... 1975

TITLE..... ASSESSMENT OF GEOTHERMAL RESOURCES OF THE UNITED STATES - 1975

REFERENCE... U.S.G.S. CIRCULAR 726

RELATED REFERENCES:

- 1) GILLULY, JAMES, AND GATES, OLCOTT, 1965, TECTONIC AND IGNEOUS GEOLOGY OF THE NORTHERN SHOSHONE RANGE, NEVADA: U.S.G.S. PROF. PAPER 465
- 2) HUSE, R.K., AND TAYLOR, B.E., 1974, GEOTHERMAL SYSTEMS OF NORTHERN NEVADA: U.S.G.S., OPEN-FILE REPORT 74-271
- 3) MABEY, D.R., 1964, GRAVITY MAP OF EUREKA COUNTY AND ADJOINING AREAS, NEVADA: U.S.G.S. GEOPHYS. INV. MAP GP-415
- 4) MARINER, R.H., & OTHERS, 1974, THE CHEMICAL COMPOSITION AND ESTIMATED MINIMUM THERMAL RESERVOIR TEMPERATURE OF THE PRINCIPAL HOT SPRINGS OF NORTHERN AND CENTRAL NEVADA: USGS OPEN-FILE REPORT

ROBINSON, E.S., 1970, RELATIONS BETWEEN GEOLOGIC STRUCTURE AND AEROMAGNETIC ANOMALIES IN CENTRAL NEVADA: GEOL. SOC. AMERICA BULL. V. 81, NO. 7, P. 2045-2060

STEWART, J.H. & MCKEE, E.H., 1970, GEOLOGIC MAP OF LANDER COUNTY, NEVADA: USGS OPEN-FILE REPORT

ZOBACK, M.L., 1974, A GEOLOGICAL AND GEOPHYSICAL INVESTIGATION OF THE BEOWAWE GEOTHERMAL AREA, NORTH-CENTRAL NEVADA: STANFORD UNIV., M.S. REPORT

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RECORD 00046

GEOHERMAL RESOURCES FILE (GEOHERM) REVISION 8

SECTION B.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000819
CROSS INDEX NO..
RECORD TYPE..... E
SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.
DATE..... 76/04
ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOHERMAL FIELD-AREA.. BEGWANE
NAME OF SAMPLE SOURCE.. SPRING #3
COUNTRY CODE..... US
STATE/PROVINCE..... NEVADA
LATITUDE..... 40-33. N

COUNTRY NAME..... UNITED STATES
COUNTY..... EUREKA
LONGITUDE..... 116-35. W

OTHER LOCALITY INFORMATION: SAME AS #423

SAMPLE INFORMATION

SOURCE TYPE..... SPRING
COLLECTION DATE..... 1958/09/01
COLLECTOR(S)..... D. E. WHITE
WATER FLOW RATE..... 0.026418 L/S 6. GAL/MIN
WATER TREATMENT DATA: OPALINE S102 ADDED WHEN COLLECTED

WATER ANALYSIS

ANALYSIS DATE..... 1958/07/11
ANALYST(S)..... H. C. WHITEHEAD
PH 1)..... 9.3
SPECIFIC CONDUCTANCE..... 1200. UMHO/CM

AT

SOLUTE ANALYSIS (WATER)

UNITS USED..... PPM

MG	CA	SR	BA	CA+MG		
U	.8					
F	CL	BR	I			
	70					
NH4	NO3	PO4	SIC2	SO4	CO3	HCO3
			236		183	150

REFERENCES: FROM PERSONAL FILE OF DON WHITE, USGS, MENLO PARK

RECORD 00047

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 8

SECTION B.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000788
 CROSS INDEX NO..
 RECORD TYPE..... 6
 SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.
 DATE..... 76/04
 ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. BEDWAVE
 NAME OF SAMPLE SOURCE.. MAIN GEYSER
 COUNTRY CODE..... US
 STATE/PROVINCE..... NEVADA
 LATITUDE..... 40-33. N

COUNTRY NAME..... UNITED STATES
 COUNTY..... EUREKA
 LONGITUDE..... 116-35. W

SAMPLE INFORMATION

WATER SAMPLING TEMP.... BOILING

WATER ANALYSIS W

ANALYST(S)..... S. C. DINSMORE, UNIV. NEV.
 TOTAL DISSOLVED SOLIDS... 1307. PPM

SOLUTE ANALYSIS (WATER)

UNITS USED..... PPM

MG	CA	SR	BA	CA+MG				
U	TRACE							
MN+3	MN(TOT)	FE+3	FE(TOT)	CU				
			TRACE					
ZN	HG	B	HBD2	AL	PB	AS	SB	U
				TRACE				
F	CL	BR	I					
	70							
NH4	NO3	PO4	SI02	SO4	CO3	HCO3		
			418	91	TRACE	512		

OTHER SOLUTES & GASES NA + K 262 PPM.

COMMENTS: LAVA, FAULTED.

REFERENCES: NOLAN AND ANDERSON, 1934, AM. J. SCI. 5 SER., V. 27, P. 215.

RECORD 00048

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 6

SECTION B.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000810
 CROSS INDEX NO..
 RECORD TYPE..... B
 SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.
 DATE..... 76/C4
 ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. BEOWAWE
 COUNTRY CODE..... US
 STATE/PROVINCE..... NEVADA
 LATITUDE..... 40-33. N

COUNTRY NAME..... UNITED STATES
 COUNTY..... EUREKA
 LONGITUDE..... 116-35. W

TOWNSHIP RANGE SECTION 1/4 1/4
 31N 48E 17

OTHER LOCALITY INFORMATION: NORTHERLY OF 2 POOLS ON FLATS

SAMPLE INFORMATION

COLLECTION DATE..... 1952/09/16
 COLLECTOR(S)..... G. S. SIMMONS
 POINT OF COLLECTION..... NORTHERLY OF 2 POOLS AS FLATS
 WATER SAMPLING TEMP.... 87. C
 OTHER CHEMICAL CHARACTERISTICS: CLEAR WHEN COLLECTED AND ANALYZED.

WATER ANALYSIS

ANALYSIS DATE..... 1955/04/13 ?
 SPECIFIC CONDUCTANCE..... 1040. UMHO/CM
 ALKALINITY..... 6. PPM
 TOTAL DISSOLVED SOLIDS... 1030 PPM

AT

SOLUTE ANALYSIS (WATER)

UNITS USED..... PPM

L1	NA	K	RB	CS	NA+K			
1.2	239	19						
MG	CA	SR	BA	CA+MG				
.9	1.2							
MN+3	MN(TOT)	FE+3	FE(TOT)	CU				
	0		.02					
ZN	HG	B	HbO2	AL	PB	AS	SR	U
		.93						
F	CL	BR	I					
16	60							
NH4	NO3	PO4	SI02	SO4	CO3	HC03		
	0	0	392	93	157	96		

REFERENCES: FROM PERSONAL FILE OF DON WHITE, USGS

RECORD 00049

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 8

SECTION 6.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000811
 CROSS INDEX NO..
 RECORD TYPE..... B
 SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.
 DATE..... 76/04
 ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. BEOWAWE
 NAME OF SAMPLE SOURCE.. SMALL GEYSER
 COUNTRY CODE..... US
 STATE/PROVINCE..... NEVADA
 LATITUDE..... 40-33 N

COUNTRY NAME..... UNITED STATES
 COUNTY..... LANDER
 LONGITUDE..... 116-35 W

SAMPLE INFORMATION

WATER SAMPLING TEMP.... BOILING
 OTHER CHEMICAL CHARACTERISTICS: LUVA, FAULTED.

WATER ANALYSIS

ANALYST(S)..... W
 TOTAL DISSOLVED SOLIDS... 1208 PPM
 CARNEGIE GEOPHYS. LAB

SOLUTE ANALYSIS (WATER)

UNITS USED..... PPM

LI	NA	K	RE	CS	NA+K			
	239	33						
MG	CA	SR	BA	CA+MG				
0	2							
MN+3	MN(TOT)	FE+3	FE(TOT)	CU				
			TRACE					
ZN	HG	B	HGO2	AL	PB	AS	SR	U
		7.2		0		0		
F	CL	BR	I					
11	47							
O2	N2	CO2	SU2	H2S	H2	CH4		
				0				
NH4	NO3	PO4	SIG2	SO4	CO3	HCO3		
42			449	97	173	129		

OTHER SOLUTES & GASES S2 03 1 PPM.

REFERENCES: NOLAN AND ANDERSON, 1934, AM. J. SCI., 5 SER., V. 27, P. 215.

RECORD 00050

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 8

SECTION 6.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000790
 CROSS INDEX NO.. MARP1P4
 RECORD TYPE..... B
 SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.
 DATE..... 76/03
 ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. BEOWAWE
 NAME OF SAMPLE SOURCE.. BEOWAWE HOT SPRING
 COUNTRY CODE..... US
 STATE/PROVINCE..... NEVADA
 LATITUDE..... 40-34. N

COUNTRY NAME..... UNITED STATES
 COUNTY..... EUREKA
 LONGITUDE..... 116-34. W

TOWNSHIP RANGE SECTION 1/4 1/4
 31N 48E 8 SE

MAP REFERENCE: DUNPHY, NEV. (15'); WINNEMUCCA. NEV. (2 DEG.)

SAMPLE INFORMATION

SOURCE TYPE..... SPRING
 COLLECTION DATE..... 1972-73
 COLLECTOR(S)..... MARINER'S GROUP
 POINT OF COLLECTION..... NEAR ORIFICE OF SPRING
 WATER SAMPLING TEMP.... 98. C
 WATER FLOW RATE..... 1.67 L/S 100. L/MIN

DEPOSITS OR ALTERATION: SILICA APRON DEPOSITED.

WATER TREATMENT DATA: PRESSURE FILTERED THROUGH A .45 MICROMETRE MEMBRANE FILTER, DILUTED.

OTHER CHEMICAL CHARACTERISTICS: BOILING, VERY LOW CALCIUM, SUPERHEATED. ALKALINITY REPORTED AS CARBONATE AND BICARBONATE.

WATER ANALYSIS

ANALYSIS DATE..... 1972-73
 ANALYST(S)..... BARNES GROUP
 PH 1)..... 8.98
 SPECIFIC CONDUCTANCE..... 1020. UMHO/CM2
 ALKALINITY..... 385. MG/L

ISOTOPIC DATA

DEL O(18) OF WATER..... -14.76 0/00
 DEL D OF WATER..... -130.6 0/00

SOLUTE ANALYSIS (WATER)

UNITS USED..... MG/L

LI	NA	K	RB	CS	NA+K
1.3	250	16	.20		
MG	CA	SR	EA	CA+MG	
LT .1	1.0	.05			
MN+3	MN(TOT)	FE+3	FE(TOT)	CU	
	LT .02		LT .02	LT .01	

ZN	HG	B	HB02	AL	PB	AS	SB	U
	.0017	2.1		.082		.03		
F	CL	BR	I					
17	69	.2	.02					
NH4	NO3	PO4	SI02	SC4	CO3	HC03		
.64		.15	320	130				

COMMENTS: BASALT AND ANDESITE FLOWS SURROUND THE SPRING
 REFERENCES: MARINER, R. H., RAPP, PRESSER, WILLEY, THE CHEMICAL COMPOSITION & ESTIMATED MINIMUM THERMAL RESERVOIR
 TEMPERATURES OF PRINCIPAL HOT SPRINGS OF NORTHERN & CENTRAL NEVADA. MARINER, PRESSER, RAPP, WILLEY, THE MINOR AND
 TRACE ELEMENTS, GAS, AND ISOTOPE COMPOSITIONS OF THE PRINCIPAL HOT SPRINGS OF NEVADA AND OREGON.

RECORD 00051

GEOHERMAL RESOURCES FILE (GEOHERM) REVISION 8

SECTION B.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000589
 CROSS INDEX NO.. CF01941 MARPIP4
 RECORD TYPE..... B
 SAMPLE TYPE..... WELL

NAME..... SANFORD, LINDA J.
 DATE..... 76/03
 ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOHERMAL FIELD-AREA.. BEOWAWE
 NAME OF SAMPLE SOURCE.. "STEAM" WELL
 COUNTRY CODE..... US
 STATE/PROVINCE..... NEVADA
 LATITUDE..... 40-33. N

COUNTRY NAME..... UNITED STATES
 COUNTY..... EUREKA
 LONGITUDE..... 116-35. W

TOWNSHIP RANGE SECTION 1/4 1/4
 31N 48E 17 NW

MAP REFERENCE: DUNPHY, NEV. (15 MIN.), WINNEMUCCA, NEV. (2 DEG)

SAMPLE INFORMATION

COLLECTION DATE..... 1972-73
 COLLECTOR(S)..... MARINER'S GROUP
 POINT OF COLLECTION..... NEAR ORIFICE OF WELL
 WATER SAMPLING TEMP.....

WATER TREATMENT DATA: - PRESSURE - FILTERED THROUGH A .45 MICROMETRE MEMBRANE, DILUTED

OTHER CHEMICAL CHARACTERISTICS: SILICA APRON DEPOSITED; BOILING, VERY LOW CALCIUM ALKALINITY REPORTED AS CARBONATE AND BICARBONATE.

WATER ANALYSIS

W

ANALYSIS DATE..... 1972-73
 ANALYST(S)..... BARNES GROUP
 PH 1)..... 9.38
 SPECIFIC CONDUCTANCE..... 1490. UMHO/CM
 ALKALINITY..... 667. MG/L

ISOTOPIC DATA

DEL O(18) OF WATER..... -11.07 0/00
 DEL D OF WATER..... -113.6 0/00

SOLUTE ANALYSIS (WATER)

UNITS USED..... MG/L

LI	NA	K	RB	CS	NA+K
2.1	250	3E	.46	.3	

MG	CA	SR	BA	CA+MG
.2	1.3	.07		

MN+3	MN(TOT)	FE+3	FE(TOT)	CU
	LT .02		LT .02	LT .01

ZN	HG	B	HBO2	AL	PB	AS	Sb	U
		2.5				.05		

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F	CL	BR	I			
LT .05	70	.1	.02			
NH4	NO3	PO4	SiO2	SO4	CO3	HCO3
.15		.31	500	64		

COMMENTS: BASALT AND ANDESITE FLOWS SURROUND THE WELL.
REFERENCES: MARINER, R. H., RAPP, PRESSER, WILLEY, THE CHEMICAL COMPOSITION & ESTIMATED MINIMUM THERMAL RESERVOIR TEMPERATURES OF PRINCIPAL HOT SPRINGS OF NORTHERN & CENTRAL NEVADA. MARINER, PRESSER, RAPP, WILLEY, THE MINOR AND TRACE ELEMENTS, GAS, AND ISOTOPE COMPOSITIONS OF THE PRINCIPAL HOT SPRINGS OF NEVADA AND OREGON.

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RECORD 00052

GEOHERMAL RESOURCES FILE (GEOHERM) REVISION 8

SECTION 8.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000938
CROSS INDEX NO..
RECORD TYPE..... 8
SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.
DATE..... 76/04
ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOHERMAL FIELD-AREA.. BEUWAVE
NAME OF SAMPLE SOURCE.. SPRING #3
COUNTRY CODE..... US
STATE/PROVINCE..... NEVADA
LATITUDE..... 40-33. N

COUNTRY NAME..... UNITED STATES
COUNTY..... FUREKA
LONGITUDE..... 116-35. W

SAMPLE INFORMATION

SOURCE TYPE..... STREAM
COLLECTION DATE..... 1957/09/01
COLLECTOR(S)..... D. E. WHITE
POINT OF COLLECTION..... NEAR END OF DISCHARGE STREAM
OTHER CHEMICAL CHARACTERISTICS: COLLECTED AFTER WATER HAS FLOWED 70' VERTICALLY AND 260' HORIZONTALLY OVER SINTER SAND, CEMENTING IT AND COOLING

WATER ANALYSIS

W

ANALYSIS DATE..... 1958/07/09
ANALYST(S)..... H. C. WHITEHEAD
PH 1)..... 9.4
SPECIFIC CONDUCTANCE..... 1250. UMHO/CM
ALKALINITY..... 8.0 PPM

SOLUTE ANALYSIS (WATER)

UNITS USED..... PPM

MG	CA	SR	BA	CA+MG		
1.0	1.6					
F	CL	ER	I			
	55					
NH4	NO3	PO4	SI02	SO4	CO3	HCO3
			219		165	120

OTHER SOLUTES & GASES SI02--COLORIMETRIC 219 PPM; SI02--NAOH METHOD 340 PPM; SI02--GRAVIMETRIC 353 PPM.
REFERENCES: FROM PERSONAL FILE OF DON WHITE, USGS, MENLO PARK.

RECORD 00053

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 6

SECTION B.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000936

CROSS INDEX NO..

RECORD TYPE..... E

SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.

DATE..... 76/04

ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. BEGWAVE

NAME OF SAMPLE SOURCE.. LARGE GEYSER POOL IN FLAT BELOW TERRACE

COUNTRY CODE..... US

COUNTRY NAME..... UNITED STATES

STATE/PROVINCE..... NEVADA

COUNTY..... EUREKA

LATITUDE..... 40-33. N

LONGITUDE..... 116-35. W

SAMPLE INFORMATION

SOURCE TYPE..... POOL

COLLECTION DATE..... 1957/09/01

COLLECTOR(S)..... U. WHITE

POINT OF COLLECTION..... LARGE GEYSER POOL IN FLAT BELOW TERRACE

WATER SAMPLING TEMP.... 96. C

WATER FLOW RATE..... 0.33 L/S 75. GAL/MIN

DEPOSITS OR ALTERATION: H2S FROM BASE OF SINTER TERRACE ON ENE FAULT, ADJACENT TO TERTIARY ANDESITE.

WATER ANALYSIS W

ANALYSIS DATE..... 1958/01/31

ANALYST(S)..... H. C. WHITEHEAD

SPECIFIC CONDUCTANCE.... 1050.

UMHO/CM

AT

ALKALINITY..... 2.

PPM TOTAL

TOTAL DISSOLVED SOLIDS... 1000.

PPM

SOLUTE ANALYSIS (WATER)

UNITS USED..... PPM

LI	NA	K	RB	CS	NA+K			
1.3	230	16						
MG	CA	SR	BA	CA+MG				
0	.8	0						
MN+3	MN(TOT)	FE+3	FE(TOT)	CU				
	0		.04					
ZN	HG	B	HBO2	AL	PR	AS	Sb	U
0		2.0		0	0	.02		
F	CL	BR	I					
15	30	.4	0					
NH4	NO3	PO4	SIO2	SO4	CO3	HCO3		
.5	.4	.07	373	89	149	116		

REFERENCES: FROM PERSONAL FILE OF DON WHITE, USGS, MENLO PARK.

RECORD 00054

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 8

SECTION B.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000935
 CROSS INDEX NO..
 RECORD TYPE..... 6
 SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.
 DATE..... 76/04
 ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. BEOWAWE
 NAME OF SAMPLE SOURCE.. POOL IN TERRACES
 COUNTRY CODE..... US
 STATE/PROVINCE..... NEVADA
 LATITUDE..... 40-33. N

COUNTRY NAME..... UNITED STATES
 COUNTY..... EUREKA
 LONGITUDE..... 116-35. W

TOWNSHIP RANGE SECTION 1/4 1/4
 31N 48E 17

SAMPLE INFORMATION

SOURCE TYPE..... POOL IN TERRACES
 COLLECTION DATE..... 1952/09/16
 WATER SAMPLING TEMP.... 89. C

WATER ANALYSIS

W
 ANALYSIS DATE..... 1955/04/04
 ANALYST(S)..... MITCHELL
 PH 1)..... 9.5
 SPECIFIC CONDUCTANCE.... 1120. UMHO/CM
 ALKALINITY..... 7. PPM TOTAL
 TOTAL DISSOLVED SOLIDS... 1090. PPM

AT

SOLUTE ANALYSIS (WATER)

UNITS USED..... PPM

L1	NA	K	RB	CS	NA+K			
1.2	235	26						
MG	CA	SR	BA	CA+MG				
1.2	.8							
MN+3	MN(TOT)	FE+3	FE(TOT)	CU				
	0		.04					
ZN	HG	B	HBO2	AL	PB	AS	SB	U
		1.1						
F	CL	BR	I					
14	40							
NH4	NO3	PO4	SIO2	SO4	CO3	HCO3		
	.1	0	450	90	114	234		

COMMENTS: CLEAR WHEN COLLECTED.

REFERENCES: FROM PERSONAL FILE OF DON WHITE, USGS, MENLO PARK

RECORD 00055

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 8

SECTION B.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000934

CROSS INDEX NO..

RECORD TYPE..... 6

SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.

DATE..... 76/04

ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. BEOWAWE

NAME OF SAMPLE SOURCE.. ACTIVE GEYSER, SOUTH END OF TERRACE

COUNTRY CODE..... US

STATE/PROVINCE..... NEVADA

LATITUDE..... 40-33. N

COUNTRY NAME..... UNITED STATES

COUNTY..... EUREKA

LONGITUDE..... 116-35. W

TOWNSHIP RANGE SECTION 1/4 1/4
31N 48E 17

OTHER LOCALITY INFORMATION: SOUTH END OF TERRACE

SAMPLE INFORMATION

SOURCE TYPE..... GEYSER

COLLECTION DATE..... 1952/09/16

COLLECTOR(S)..... G. S. SIMMONS

WATER SAMPLING TEMP.... 95-99. C

OTHER CHEMICAL CHARACTERISTICS: CLEAR WHEN COLLECTED.

WATER ANALYSIS W

ANALYSIS DATE..... 1955/04/13

ANALYST(S)..... MITCHELL

PH 1)..... 9.8

SPECIFIC CONDUCTANCE..... 1160. UMHC/CM

ALKALINITY..... 9. PPM

TOTAL DISSOLVED SOLIDS... 1180. PPM

AT

SOLUTE ANALYSIS (WATER)

UNITS USED..... MG/L

LI	NA	K	RB	CS	NA+K			
1.2	257	30						
MG	CA	SR	BA	CA+MG				
1.4	1.2							
MN+3	MN(TOT)	FE+3	FE(TOT)	CU				
	G		.02					
ZN	HG	B	HBO2	AL	PB	AS	SB	U
		2.2			0			
F	CL	BR	I					
14	50							
NH4	NO3	PO4	SIC2	SO4	CO3	HC03		

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.2

448

83

199

100

COMMENTS: 91% OF TOTAL DISSOLVED SOLIDS IS NA.
REFERENCES: PERSONAL FILE OF DON WHITE, USGS, MENLO PARK

RECORD 00056

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 8

SECTION B.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000933
 CROSS INDEX NO..
 RECORD TYPE..... R
 SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.
 DATE..... 76/04
 ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. BEUWAVE
 NAME OF SAMPLE SOURCE.. SPRING #40
 COUNTRY CODE..... US
 STATE/PROVINCE..... NEVADA
 LATITUDE..... 40-33. N

COUNTRY NAME..... UNITED STATES
 COUNTY..... EUREKA
 LONGITUDE..... 116-35. W

SAMPLE INFORMATION

SOURCE TYPE..... SPRING
 COLLECTION DATE..... 1957/09/01
 WATER SAMPLING TEMP.... 94. C
 WATER FLOW RATE..... SEEPING

OTHER CHEMICAL CHARACTERISTICS: SEEPING DISCHARGE MILKY WHITE WITH SUSPENDED CLAY AND DIATOMS (?)

WATER ANALYSIS

W
 ANALYSIS DATE..... 1958/03/07
 ANALYST(S)..... H. C. WHITEHEAD
 PH 1)..... 2.6
 SPECIFIC CONDUCTANCE.... 1840. UMHO/CM
 ALKALINITY..... 10. PPM
 TOTAL DISSOLVED SOLIDS... 1060. PPM

SOLUTE ANALYSIS (WATER)

UNITS USED..... PPM

LI	NA	K	RB	CS	NA+K				
.2	27	8.8							
MG	CA	SR	BA	CA+MG					
1.5	1.0								
MN+3	MN(TOT)	FE+3	FE(TOT)	CU					
	.05								
ZN	HG	B	HBO2	AL	PB	AS	SB	U	
		.12		13					
F	CL	BR	I						
.9	2								
NH4	NO3	PO4	SIO2	SO4	CO3	HC03			
41	1.8		210	738	0	0			

OTHER SOLUTES & GASES FF + 2 9.8

COMMENTS: SOME SAMPLES DETERMINED IN SOLUTION.

REFERENCES: PERSONAL FILE OF DON WHITE, USGS, MENLO PARK

RECORD 00057

GEO THERMAL RESOURCES FILE (GEO THERM) REVISION 8

SECTION 5.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000920

CROSS INDEX NO..

RECORD TYPE..... E

SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.

DATE..... 76/04

ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEO THERMAL FIELD-AREA.. BEOWAWE

COUNTRY CODE..... US

STATE/PROVINCE..... NEVADA

LATITUDE..... 40-33. N

OTHER LOCALITY INFORMATION: EUREKA CO., NEVADA

COUNTRY NAME..... UNITED STATES

COUNTY..... EUREKA

LONGITUDE..... 116-35. W

SAMPLE INFORMATION

SOURCE TYPE..... SPRING

COLLECTION DATE..... 1958/05/25

COLLECTOR(S)..... J. FETH

POINT OF COLLECTION..... 50 - 75 FT. DOWNSLOPE FROM ORIFICE

WATER SAMPLING TEMP.... 93. C

OTHER CHEMICAL CHARACTERISTICS: TEMPERATURE DATA FROM ORIFICE. SAMPLE TAKEN AT SOUTHERMOST VENT.

WATER ANALYSIS

W

ANALYSIS DATE..... 1958/12/18

ANALYST(S)..... J. P. SCHUCH

PH 1)..... 9.7

SPECIFIC CONDUCTANCE..... 1070.

TOTAL DISSOLVED SOLIDS... 617. UMHO/CM

AT

PPM

SOLUTE ANALYSIS (WATER)

UNITS USED..... PPM

LI	NA	K	RB	CS	NA+K			
1.5	232	22						
MG	CA	SR	BA	CA+MG				
0	0							
MN+3	MN(TOT)	FE+3	FE(TOT)	CU				
	0		.01					
ZN	MG	B	H602	AL	PB	AS	SB	U
		.57		0		.63		
F	CL	BR	I					
14	46	.3	0					
CO2	N2	CO2	SO2	H2S	H2	CH4		
				6.0				
NH4	NO3	PO4	SIO2	SO4	CO3	HCO3		
	0	.15	212	101	120	122		

REFERENCES: PERSONAL FILE OF DON WHITE, USGS, MENLO PARK

RECORD 00058

GEOHERMAL RESOURCES FILE (GEOHERM) REVISION 8

SECTION B.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000921

CROSS INDEX NO..

RECORD TYPE..... F

SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.

DATE..... 76/04

ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOHERMAL FIELD-AREA.. BEOWAWE

COUNTRY CODE..... US

STATE/PROVINCE..... NEVADA

LATITUDE..... 40-33. N

COUNTRY NAME..... UNITED STATES

COUNTY..... EUREKA

LONGITUDE..... 116-35. W

SAMPLE INFORMATION

SOURCE TYPE..... HOT SPRING

COLLECTION DATE..... 1958/03/25

COLLECTOR(S)..... J. FETH

POINT OF COLLECTION..... 4' BELOW ORIFICE

WATER SAMPLING TEMP..... 97. C

WATER ANALYSIS

W

ANALYSIS DATE..... 1958/12/18

ANALYST(S)..... J. B. SCHUCH

PH 1)..... 9.3

SPECIFIC CONDUCTANCE..... 1090.

ALKALINITY..... 2.

TOTAL DISSOLVED SOLIDS... 681.

UMHO/CM

PPM AS CaCO3

PPM

AT

SOLUTE ANALYSIS (WATER)

UNITS USED..... PPM

LI	NA	K	RB	CS	NA+K			
1.3	225	27						
MG	CA	SR	BA	CA+MG				
0	.3							
MN+3	MN(TOT)	FE+3	FE(TOT)	CU				
0	0		.02					
ZN	HG	B	HBO2	AL	PR	AS	SB	U
		1.2		.64		0		
F	CL	BR	I					
14	40	.2	.1					
O2	N2	CO2	SO2	H2S	H2	CH4		
				2.3				
NH4	NO3	PO4	SiO2	SO4	CO3	HCO3		
.8	0	.40	49	106	74	132		

REFERENCES: FROM PERSONAL FILE OF DON WHITE, USGS, MENLO PARK

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 8

SECTION B.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000919
 CROSS INDEX NO..
 RECORD TYPE..... B
 SAMPLE TYPE..... WELL

NAME..... SANFORD, LINDA J.
 DATE..... 76/04
 ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. BEOWAWE
 NAME OF SAMPLE SOURCE.. NEVADA THERMAL WELL NO. 2
 COUNTRY CODE..... US COUNTRY NAME..... UNITED STATES
 STATE/PROVINCE..... NEVADA COUNTY..... EUREKA
 LATITUDE..... 40-33. N LONGITUDE..... 116-35. W
 OTHER LOCALITY INFORMATION: WELL 6 MI. WSW BEOWAWE, EUREKA

SAMPLE INFORMATION

COLLECTION DATE..... 1960/09/09
 COLLECTOR(S)..... C. WHITE AND G. SIGYALDASON
 WATER
 POINT OF COLLECTION.... CREST OF SINTER TERRACE 30 FT. S OF SPRING
 WATER SAMPLING TEMP.... 96.7 C
 WATER FLOW RATE..... 0.55 L/S 125. GAL/MIN

WATER ANALYSIS W

ANALYSIS DATE..... 1960/12/09
 ANALYST(S)..... S. M. ROGERS
 PH 1)..... 9.7
 SPECIFIC CONDUCTANCE.... 1130. UMHO/CM
 ALKALINITY..... 3. PPM AS CaCO3
 TOTAL DISSOLVED SOLIDS... 1200. PPM

AT

SOLUTE ANALYSIS (WATER)

UNITS USED..... PPM

LI	NA	K	RB	CS	NA+K			
1.6	232	30						
MG	CA	SR	BA	CA+MG				
.2	.8	.21						
MN+3	MN(TGT)	FE+3	FE(TOT)	CU				
	0		0					
ZN	HG	B	HBO2	AL	PB	AS	SE	U
		2.4		.66		0		
F	CL	BR	I					
15	49	0	0					
L2	N2	CO2	SU2	H2S	H2	CH4		
				11				

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NH4	NO3	PO4	SiO2	SO4	CO3	HCO3
.4	0	.06	534	90	224	39

COMMENTS: SOME SAMPLES FIXED IN FIELD WITH H2SO4.
REFERENCES: PERSONAL FILE OF DON WHITE, USGS, MENLO PARK

RECORD 00060

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION B

SECTION B.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000918
 CROSS INDEX NO..
 RECORD TYPE..... B
 SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.
 DATE..... 76/04
 ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. BEDWAVE

COUNTRY CODE..... US

STATE/PROVINCE..... NEVADA

LATITUDE..... 40-33. N

OTHER LOCALITY INFORMATION: NO. 29 OF WHITE

COUNTRY NAME..... UNITED STATES
 COUNTY..... EUREKA
 LONGITUDE..... 116-35. W

SAMPLE INFORMATION

SOURCE TYPE..... POOL
 COLLECTION DATE..... 1949/09/08
 COLLECTOR(S)..... D. E. WHITE
 POINT OF COLLECTION..... RELATED POOL ADJACENT TO GEYSER
 WATER SAMPLING TEMP.... 96. C

WATER ANALYSIS

W

ANALYSIS DATE..... 1950/04/26
 ANALYST(S)..... W. W. BRANNOCK
 PH 1)..... 9.54
 SPECIFIC CONDUCTANCE..... 1015-1109 UMHC/CM

AT

SOLUTE ANALYSIS (WATER)

UNITS USED..... PPM

LI	NA	K	RB	CS	NA+K			
1.6	241	29						
MG	CA	SR	BA	CA+MG				
LT 1	LT 1							
ZN	HG	B	H6O2	AL	PB	AS	SB	U
		2.2				.1	0	
F	CL	BR	I					
13	44							
NH4	NO3	PO4	SI02	SO4	CO3	HC03		
			444	78	161	148		

OTHER SOLUTES & GASES S 6.0 PPM B = 0.06% OF EQ.
 REFERENCES: FROM PERSONAL FILE OF DON WHITE, USGS, MENLO PARK

SITE: BRADY HOT SPRINGS, NV

SITE: BRADY H.S., NV (FEDERAL LAND)

POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
BLM County USGS BLM BLM	Issue STG Drilling Permit Issue Land Use Permit Issue Drilling Permit Lease Land Process EIA/EIS	Developer Developer Developer Developer CEQ	} ASSUMED COMPLETED										
Developer	Exploratory Drilling & Reservoir Evaluation		_____										
Developer	Develop Utility Interest		_____										
Developer & Utility	Feasibility Study		_____										
Producer (Developer) & Utility	Financial Negotiations			_____									
Producer	Site Selection			_____									
Producer & Utility	Design			_____	_____								
Producer & Utility	Commitment to Development				▲								
Producer & Utility	Prepare Master Development Plan	BLM USGS			_____								
Producer & Utility	Prepare Environmental Data Statement	BLM FPC State County			_____								
BLM, FPC, State USGS	Certify Plant & Site, Issue Permits	Producer & Utility			_____	_____							
USGS	Process EIA/EIS (Drilling)	CEQ			_____	_____							
FPC	Process EIA/EIS (Plant)	CEQ			_____	_____							
FPC	Process EIA/EIS (Transmission Line)	CEQ			_____	_____							
Producer	Development Drilling						_____	_____					
Utility	Plant Construction						_____	_____	_____				
Utility	Install Transmission Line (16km)							_____	_____				

Possible Subsequent Additons (MWe) and One Line Date: 50 - 1986, 100 - 1988, 100 - 1990, 100 - 1991, 100 - 1992, 100 - 1993, 100 - 1994, 100 - 1995, 100 - 1996, 100 - 1997

SITE: BRADY HOT SPRINGS, NV (REGION 4)

SUMMARY

TEMPERATURE °C

Surface: 98

Subsurface: 214

TOTAL DISSOLVED SOLIDS (PPM):

2,450⁽⁴⁾
393⁽⁷⁾ 1000⁽²⁰⁾

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS):

TYPE OF OVERLAYING ROCK:

Hard

ESTIMATED DEPTH TO TOP OF RESERVOIR (METERS):

500

DESCRIPTION OF KGRA

Total KGRA Acres: 98,508

Total Federal Acres: 59,358⁽⁴⁹⁾

Federal Acres Leased: 26,049

Total State and Private Acres: 39,150⁽⁴⁹⁾
State and Private Acres Leased:

GEOHERMAL DEVELOPMENT STATUS:

Numerous wells have been drilled.^(4,17) The wells have high flow rates.⁽²⁰⁾ ERDA has received an application for a loan guarantee to build a dehydration plant which would use geothermally-derived electricity to dehydrate products.⁽²⁵⁾ Philips has drilled one ~2,133 m (~7,000 foot) liquid and steam producing well which had temperatures >250°C.⁽⁴⁷⁾

LOCAL AND STATE ATTITUDE TOWARD GEOHERMAL DEVELOPMENTS:

County concerned with maintaining open areas in natural state, but receptive to controlled development.⁽⁴⁾ Mild constraints and brief delays can be expected. Special use permit required.^(1A)

LAND USE AND POPULATION:

Rural population, agriculture, some recreation and mining.

COMMENTS AND CRITICAL ISSUES:

Surface water not available.⁽⁴⁾ As of August 1975, all exploration occurred on private property.^(1A) BLM has prepared an environmental analysis of the area.⁽⁴⁾ There is some evidence of recent seismic activity.⁽⁶⁾

SITE: BRADY H.S., NV

SITE: BRADY HOT SPRINGS, NV

SITE LOCATION AND PHYSICAL DESCRIPTION

LATITUDE: 39° 47' 13" N

LONGITUDE: 119° 00' 00" W

COUNTY: Churchill and Lyon⁽⁶⁾

ADJACENT COUNTIES: Douglas, Carson City, Storey, Washoe, Pershing, Lander, Nye, Mineral

LAND OWNERSHIP: Federal (BLM and Bureau of Reclamation)⁽⁴⁾ and Private⁽¹⁴⁾

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
Alkali flats, dry washes, buttes. ⁽⁴⁾	Rural, agriculture, recreation, some mining. ⁽⁴⁾	County concerned with maintaining open areas in natural state, but receptive to controlled geothermal development. ⁽⁴⁾	Little scenic or aesthetic quality. ⁽⁴⁾	History includes numerous mining camps. ⁽⁴⁾

SITE: BRADY HOT SPRINGS, NV

RESERVOIR CHARACTERISTICS AND GEOLOGICAL/GEOPHYSICAL DESCRIPTION

RESERVOIR TEMPERATURE

Surface: 98°C
Subsurface: 214°C

Geochemical
SiO₂: 179°C
Na-K-Ca:

TOTAL DISSOLVED SOLIDS (TDS): 2450 ppm⁽⁴⁾

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS): 393⁽⁷⁾ 1000⁽²⁰⁾

TYPE OF OVERLAYING ROCK: Basalt and alluvium

ESTIMATED DEPTH TO TOP OF RESERVOIR: 500 m (1640 ft)

SEISMIC ACTIVITY: Thermal activity lies along Brady Thermal Fault which runs North-South for approximately six miles. The movement is probably strike-slip but it can't be ascertained because the scarp is covered by alluvium. There is some evidence of recent activity.(4)

SITE: BRADY HOT SPRINGS, NV

LAND OWNERSHIP AND LEASING

		TOTAL AREA (ACRES)	FEDERAL (ACRES)	STATE (ACRES)	PRIVATE (ACRES)
KGRA: Brady-Hazen		98,508 ⁽⁴⁹⁾	59,358 ⁽⁴⁷⁾	39,150 ⁽⁴⁹⁾ (state and private)	
LAND LEASED IN KGRA			26,049 ⁽⁴⁹⁾		
HIGHEST-PRICED LEASES (BY DOLLARS/ACRE) (15)					
\$/ACRE	LESSEE				
20.00	Natomas Co.				
15.00	Natomas Co.				
10.16	Geo Resources Intl.				
7.93	So. Union Prod. Co.				
TENTATIVE LEASE SALE DATES					
NUMBER OF SALES OFFERED BUT NO BIDS: 18 ⁽¹⁵⁾			39,650		
NUMBER OF BIDS REJECTED (RESULTING IN NO LEASE): 1 ⁽¹⁵⁾			2,561		
SUBSURFACE AREA OF RESERVOIR		2,965 ⁽⁸⁾			

SUMMARY OF LEASING STATUS AND NEEDS: Land ownership at Brady-Hazen is checkerboarded with the Southern Pacific Railroad owning the alternate patterns of land.(47) Phillips Petroleum has currently reached its acreage limitation.(47)

SITE: BRADY HOT SPRINGS, NV

GEOHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
<p>Several companies have been drilling in the area since 1959. Magma Power Company drilled several shallow wells between 1959 and 1961. Earth Energy, Inc. drilled a well to 1,519 m (5,062 feet) in 1964. By August 1975, Phillips and Union drilled deeper than 2,100 m (7,000 feet) and Magma had drilled 2 wells to 1,050 m (3,500 feet) and 1,350 m (4,500 feet) near the old holes.(4)</p> <p>By February 1977, Southern Union Products Co. suspended operations, and Standard Oil of California had drilled a producing well.(17)</p> <p>One 1,500 m (4,921 foot) well had a temperature of 214°C and a high flow rate.(20)</p> <p>Phillips has new high flow rate wells east of the old Brady Magma wells.(20)</p> <p>In March 1977, ERDA received an application for \$3,046,000 million in loan guarantees by Geothermal Food Processors, Los Angeles, CA to build a dehydration plant at the site. Geothermal energy would be used to dehydrate food products and to operate a 490 kw binary cycle power plant for the food processing plant.(38) Total project cost would be \$4.96 million. The loan would be granted by the Nevada National Bank.(25)</p> <p>The USGS reports that the flow rate of Brady Hot Springs is low. A downhole temperature of 200°C has been recorded. However, when the well was flowed the fluid temperature was less than 200°C.(47)</p> <p>At Desert Peak which is southeast of Brady Hot Springs, Phillips has reported that temperatures from the deepest well, which was 2,133 m (7,000 feet), were >250°C. There was some steam from the well. The USGS assumes that the Desert Peak geothermal system is separate from the Brady Hot Springs System.(47)</p>	

SITE: BRADY HOT SPRINGS, NV

INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)
<p>A special use permit is required for all geothermal activity. Mild constraints and brief delays can be expected. (1A) The county general plan includes a partial EIS. (4)</p>	<p>The county administration is in favor of geothermal development at a rate that can be planned and controlled. (4) (The administration perceives geothermal as a means to growth and improvements.) (1A)</p>	<p>BLM has proposed an Environmental Analysis Report (EAR) of the thermal area. (4)</p> <p>Nevada Geothermal Processors, (Los Angeles, CA) has applied to ERDA for \$3.46 million in loan guarantees. (25)</p>

SITE: BRADY HOT SPRINGS, NV

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds

Precipitation (Annual): 0-20.3 cm (0-8 inches)⁽⁶⁾

Average Temperature

Minimum: -6°C (31°F)

Maximum: 21.1°C (70°F)

Relative Humidity
(Seasonal Peaks)

Summer: 20% - 30%

Winter: 50% - 60%

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
Not measured, but quality is good. ⁽⁴⁾	No permanent streams; shallow groundwater available. ⁽⁴⁾	Ambient noise levels not measured but may be high because of proximity of Inter- state 80. ⁽⁴⁾	desert scrub including greasewood, sage, salt grass, squirrel tail. ⁽⁴⁾	coyote, bob- cat, rabbit, porcupine, mule deer, many birds. ⁽⁴⁾	No data existing. ⁽⁴⁾

SITE: BRADY HOT SPRINGS, NV

POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR:

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES NEAR SITE	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
Reno	80 km (50 miles)	70,000	<p>Within 16 km (10 miles) west of the site there is one 800 kv DC N-S line owned by the Southern California Edison Co. (private), and Los Angeles, Glendale, Burbank and Pasadena municipalities.</p> <p>There is a 120 kv NE-SW line owned by the Sierra Pacific Power Co. (private), 24 km (15 miles) NW of the site which connects with an 81.6 MW steam and a 69.4 MW combustion turbine plant at Sunrise, NV, owned by the Nevada Power Co. (private), located 32 km (20 miles) NW of the site. 40 km (25 miles) south of the site there is a 230 kv NE-SW line and the Fort Churchill 210.0 MW steam plant owned by the Sierra Pacific Power Co. (33-II)</p>	1.6 km (1 mile) from Interstate Highway 80 (4)	<p>Minor 15-20 cm (6-8 inches) oil products pipeline 16 km < (10 miles).</p> <p>Primary rail line within 16 km (10 miles).</p> <p>Minor 56 cm (22 inches) gas pipeline 16 km < (10 miles) (6)</p>
Fernley	32 km (20 miles)	900			

RECORD 00061

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 8

SECTION A.- GEOTHERMAL FIELD-AREA

RECORD IDENTIFICATION

RECORD NO..... 0000602
 CROSS INDEX NO.. C02011
 RECORD TYPE..... A

NAME..... E. A. JOHNSON, J. RENNER
 DATE..... 75/01
 ORGANIZATION.. U.S.G.S.

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. BRADY HOT SPRINGS
 WARNING FIGURE..... 8
 COUNTRY CODE..... US
 STATE/PROVINCE..... NEVADA
 LATITUDE..... 39-47-13N

WARNING NUMBER..... 72
 COUNTRY NAME..... UNITED STATES
 COUNTY..... CHURCHILL
 LONGITUDE..... 119-00-00W

TOWNSHIP RANGE SECTION 1/4 1/4
 22N 26E 12 SW

BASE & MERIDIAN..... MT. DIABLO
 AVAILABLE MAPS OF AREA: FIRE BALL RIDGE 1:62,500; RENO 1:250,000

GENERAL DESCRIPTION

SIZE OF SURFACE EXPRESSION.... 0.6 KM**2
 ELEVATION..... 1255.78 M 4120. FT
 RESOURCE CATEGORY..... B
 SURFACE THERMAL ACTIVITY..... HOT SPRINGS, FUMAROLE OR WARM VAPOR
 ASSOCIATED DEPOSITS..... SINTER
 NO. OF HOT SPRINGS..... SEVERAL

GEOTHERMAL CHARACTERISTICS

TOTAL CALCULATED DISCHARGE OF DEEP WATERS: 45.00 L/S 2700.00 L/MIN
 TOTAL NATURAL HEAT FLUX..... 33.91 J/S 8.0999E+00 CAL/S
 SPRING TEMPERATURES..... 70. C TO 98. C
 WELL INFORMATION
 MAXIMUM WELL TEMPERATURE..... 214. C

RESERVOIR PROPERTIES

RESERVOIR TEMPERATURES..... 200. C TO 230. C ASSUMED
 BEST ESTIMATE..... 214.0 C
 SUBSURFACE AREA..... 5.0 KM**2 TO 30.0 KM**2
 BEST ESTIMATE..... 12.0 KM**2
 BASED ON: GEOLOGY, TEMP GRADIENT, EXPLORATION, SURFACE EXPRESSION
 DEPTH TO TOP OF RESERVOIR..... 500.00 M 0.500 KM TO 1500.00 M 1.500 KM
 BEST ESTIMATE..... 500.00 M 0.500 KM
 DEPTH TO BOTTOM OF RESERVOIR.. 3000.00 M 3.000 KM TO 3000.00 M 3.000 KM
 BEST ESTIMATE..... 3000.00 M 3.000 KM
 THICKNESS OF RESERVOIR..... 1500.00 M 1.500 KM TO 2500.00 M 2.500 KM
 BEST ESTIMATE..... 2500.00 M 2.500 KM
 VOLUME OF RESERVOIR..... 7.500 KM**3 TO 75.000 KM**3
 BEST ESTIMATE..... 30.000 KM**3
 COMMENTS: DEPTH TO BOTTOM OF RESERVOIR IS ASSUMED.

RESERVES

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TOTAL STORED HEAT.....	2.4743E+18 J	8.2599E+17 CAL	TO 4.0604E+19 J	9.6999E+18 CAL
BEST ESTIMATE.....	1.5069E+19 J	3.5999E+18 CAL	ABOVE 15.	C

GEOLOGY

GENERAL ROCK TYPES: PLIOCENE-PLEISTOCENE BASALT; QUATERNARY ALLUVIUM

PRIMARY REFERENCE:

AUTHOR..... D.E. WHITE & D.L. WILLIAMS, EDITORS
DATE..... 1975
TITLE..... ASSESSMENT OF GEOTHERMAL RESOURCES OF THE UNITED STATES - 1975
REFERENCE... U.S.G.S. CIRCULAR 726

RELATED REFERENCES:

- 1) GAKSIDE, L.J., 1974, GEOTHERMAL EXPLORATION & DEVELOPMENT IN NEVADA THROUGH 1973: NEVADA BUR. MINES AND GEOLOGY REPORT 21
- 2) KOENIG, J.B., 1970, GEOTHERMAL EXPLORATION IN THE WESTERN UNITED STATES: GEOTHERMICS SPEC. ISSUE 2, V.2, PT.1, P.1-13
- 3) OLMSTED, F.H., AND OTHERS, 1975, PRELIMINARY HYDROGEOLOGIC APPRAISAL OF SELECTED HYDROTHERMAL SYSTEMS IN NORTHERN & CENTRAL NEVADA: U.S.G.S. OPEN-FILE REPORT 75-56
- 4) WAKING, G.A., 1965, THERMAL SPRINGS OF THE UNITED STATES AND OTHER COUNTRIES OF THE WORLD-A SUMMARY: U.S.G.S. PROF. PAPER 492

RECORD 00062

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 8

SECTION B.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000894
 CROSS INDEX NO..
 RECORD TYPE..... B
 SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.
 DATE..... 76/03
 ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. BRADY HUT SPRINGS

NAME OF SAMPLE SOURCE.. MUD VOLCANO #2

COUNTRY CODE..... US

STATE/PROVINCE..... NEVADA

LATITUDE..... 39-47. N

COUNTRY NAME..... UNITED STATES

COUNTY..... CHURCHILL

LONGITUDE..... 119-01. W

OTHER LOCALITY INFORMATION: 15 MILES NE OF BRADY'S STATION NEAR BRADY'S HUT SPRINGS

SAMPLE INFORMATION

COLLECTION DATE..... 1960/09/08

COLLECTOR(S)..... D. E. WHITE

WATER SAMPLING TEMP.... BOILING

OTHER CHEMICAL CHARACTERISTICS: SI02

WATER ANALYSIS

ANALYSIS DATE..... 1961/04/11

ANALYST(S)..... H. C. WHITEHEAD

PH 1)..... 4.7

SPECIFIC CONDUCTANCE..... 7290.

ALKALINITY..... 1150.

TOTAL DISSOLVED SOLIDS... 5930.

UMHO/CM

PPM AS CaCO3

PPM

AT

SOLUTE ANALYSIS (WATER)

UNITS USED..... PPM

LI	NA	K	RB	CS	NA+K			
3.3	1360	114						
MC	CA	SR	BA	CA+MG				
28	412							
ZN	HG	B	H602	AL	PB	AS	SB	U
		7.1						
F	CL	BR	1					
2.4	1070							
NH4	NO3	PO4	SI02	SO4	CO3	HCO3		
	.3	2.0	149	2760	0	2		

OTHER SOLUTES & GASES TOTAL CATIONS IN EPM 86.29. TOTAL ANIONS IN EPM 87.79.
 REFERENCES: PERSONAL FILE OF DON WHITE, USGS, MENLO PARK.

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 8

SECTION D.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 000693

NAME..... SANFORD, LINDA J.

CROSS INDEX NO..

DATE..... 76/04

RECORD TYPE..... 6

ORGANIZATION.. USGS

SAMPLE TYPE..... SURFACE

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. BRADY HOT SPRINGS

NAME OF SAMPLE SOURCE.. MUD VOLCANO, NEW VENT, AT U.S. HIGHWAY 50 1+ MILE N. OF BRADY'S HOT SPRINGS

COUNTRY CODE..... US

COUNTRY NAME..... UNITED STATES

STATE/PROVINCE..... NEVADA

COUNTY..... CHURCHILL

TOWNSHIP RANGE SECTION 1/4 1/4

22N 26E 1 SE

MAP REFERENCE: FIREBALL RIDGE, NEVADA QUAD

SAMPLE INFORMATION

SOURCE TYPE..... NEW VENT IN MUD VOLCANO

COLLECTION DATE..... 1960/09/07

COLLECTOR(S)..... J. H. FETH

POINT OF COLLECTION..... SMALL GREEN MUD - SPATTER CONE OUT FLOW, W. EDGE OF HIGHWAY, SOUTH OF CULVERT

WATER FLOW RATE..... LT .06 L/S LT 1. GAL/MIN

WATER TREATMENT DATA: SAMPLES UNFIXED, FILTERED THRU MILLIPORE OR FIXED, ACETIFORM

OTHER CHEMICAL CHARACTERISTICS: BASIN DRAINED OF STANDING WATER AND NEW FLOW COLLECTED. VERY MUDDY

WATER ANALYSIS

W

ANALYSIS DATE..... 1961/07/25

ANALYST(S)..... H. C. WHITEHEAD, CHECKED BY W. L. POLZER

PH 1)..... 7.3

SPECIFIC CONDUCTANCE..... 1210. UMHO/CM

ALKALINITY..... 120. PPM AS CaCO3

TOTAL DISSOLVED SOLIDS... 1050. PPM

SOLUTE ANALYSIS (WATER)

UNITS USED..... PPM

LI	NA	K	RB	CS	NA+K			
.19	200	31						
MG	CA	SR	BA	CA+MG				
2.6	44	1.1						
MN+2	MN(TOT)	FE+2	FE(TOT)	CU				
	.5							
ZN	HG	E	HBO2	AL	PB	AS	SE	U
		2.4		.09		.35		
F	CL	BR	I					
5.6	43	0	.6					

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NH4	NO3	PO4	SiO2	SO4	CO3	HCO3
6	6	2.1	106	341	0	204

OTHER SOLUTES & GASES TOTAL CATION IN EPM 11.96, TOTAL ANION IN EPM 11.94.
REFERENCES: PERSONAL FILE OF DON WHITE, USGS, MENLO PARK

RECORD 00064

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 8

SECTION B.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000889

CROSS INDEX NO..

RECORD TYPE..... 6

SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.

DATE..... 76/03

ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. BRADY HOT SPRINGS (SPRINGERS HOT SPRINGS)

COUNTRY CODE..... US

STATE/PROVINCE..... NEVADA

LATITUDE..... 39-47. N

COUNTRY NAME..... UNITED STATES

COUNTY..... CHURCHILL

LONGITUDE..... 119-01. W

OTHER LOCALITY INFORMATION: HOT SPRING STATION ON SOUTHERN PACIFIC RAILROAD (BRADY'S OR SPRINGER'S HOT SPRING)

SAMPLE INFORMATION

COLLECTION DATE..... 1882?

WATER ANALYSIS

TOTAL DISSOLVED SOLIDS... 2495. PPM

SOLUTE ANALYSIS (WATER)

UNITS USED..... PPM

LI	NA	K	RB	CS	NA+K			
TRACE	774.3	66.9						
MG	CA	SR	BA	CA+MG				
1.0	30							
ZN	HG	F	HED2	AL	PB	AS	SB	U
				1				
F	CL	ER	I					
	967.9							
NH4	NO3	PO4	SiO2	SO4	CO3	HCO3		
			278.8			335.5		

REFERENCES: RUSSELL, ISRAEL COOK, U.S. GEOL. SURVEY MON. 11, P. 49, GEOLOGIC HISTORY OF LAKE LAHONTAN, A QUATERNARY LAKE OF NORTHWESTERN NEVADA.

RECORD 00065

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 8

SECTION B.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000892
 CROSS INDEX NO..
 RECORD TYPE..... E
 SAMPLE TYPE..... WELL

NAME..... SANFORD, LINDA J.
 DATE..... 76/04
 ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. BRADY HOT SPRINGS
 NAME OF SAMPLE SOURCE.. STEAM WELL
 COUNTRY CODE..... US
 STATE/PROVINCE..... NEVADA
 LATITUDE..... 39-47. N
 OTHER LOCALITY INFORMATION: 18 MILES NE OF FERNLEY, NEV.

COUNTRY NAME..... UNITED STATES
 COUNTY..... CHURCHILL
 LONGITUDE..... 119-01. W

SAMPLE INFORMATION

COLLECTION DATE..... 1960/06/10
 COLLECTOR(S)..... UMAR LOELTZ
 WATER SAMPLING TEMP.... EQUILING

WATER ANALYSIS

ANALYSIS DATE..... W 1960/06/10
 ANALYST(S)..... H. C. WHITEHEAD CHECKED BY A. S. VAN DENEURGH
 PH 1)..... 7.3
 SPECIFIC CONDUCTANCE..... 4050. UMHO/CM AT
 ALKALINITY..... 138. PPM AS CaCO3

SOLUTE ANALYSIS (WATER)

UNITS USED..... PPM

LI	NA	K	RB	CS	NA+K			
1.8	780	65						
MG	CA	SR	BA	CA+MG				
1.2	53	1.9						
MN+3	MN(TOT)	FE+3	FE(TOT)	CU				
	.00		.08	.00				
ZN	HG	B	HR02	AL	PB	AS	SH	U
.00		6.8		.52	.00	.15		
F	CL	ER	I					
7.6	978	2.1	0					
NH4	NO3	PO4	SIO2	SO4	CO3	HCO3		
.00	.4	.22	242	377	0	162		

OTHER SOLUTES & GASES CATION TOTAL IN EPM - 38.59, ANION TOTAL IN EPM - 38.50.

COMMENTS: MINERAL NODULES ON X - RAY SHOW QTZ., TRIDIMITE, AND CRISTOBOLITE.
 REFERENCES: PERSONAL FILE OF DON WHITE, USGS, MENLO PARK

RECORD 00066

GEOHERMAL RESOURCES FILE (GEOHERM) REVISION 8

SECTION 5.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000891
 CROSS INDEX NO..
 RECORD TYPE..... E
 SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.
 DATE..... 76/04
 ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOHERMAL FIELD-AREA.. GRADY HOT SPRINGS
 NAME OF SAMPLE SOURCE.. MUD VOLCANO NO. 1
 COUNTRY CODE..... US
 STATE/PROVINCE..... NEVADA
 LATITUDE..... 39.47.3 N

COUNTRY NAME..... UNITED STATES
 COUNTY..... CHURCHILL
 LONGITUDE..... 119-01.0 W

TOWNSHIP RANGE SECTION 1/4 1/4
 22N 26E 12

SAMPLE INFORMATION

COLLECTION DATE..... 1960/09/08
 COLLECTOR(S)..... D. E. WHITE
 PLANT OF COLLECTION..... 200' NORTH OF NEVADA THERMAL WELL NO. 2
 WATER SAMPLING TEMP..... COLD
 OTHER CHEMICAL CHARACTERISTICS: INACTIVE MUD VOLCANO, 5 FT DIAMETER CONE 12-18 FT. ABOVE GROUND. SIO2 DATA IS
 COLORIMETRIC, MAYNOT REPRESENT TOTAL

WATER ANALYSIS

W

ANALYSIS DATE..... 1961/02/06
 ANALYST(S)..... H. C. WHITEHEAD, CHECKED BY C. E. ROBERSON
 PH 1)..... 7.3
 SPECIFIC CONDUCTANCE..... 6240. UMHO/CM
 ALKALINITY..... 298. PPM AS CaCO3

SOLUTE ANALYSIS (WATER)

UNITS USED..... PPM

LI	NA	K	RB	CS	NA+K				
2.5	1170	91							
MG	CA	SR	BA	CA+MG					
1.5	117								
MN+3	MN(TOT)	FE+3	FE(TOT)	CU					
	0		0						
ZN	HC	B	HBO2	AL	PB	AS	SB	U	
		8.2		0					
F	CL	BR	I						
0.6	1510								
HF4	NO3	PO4	SIO2	SD4	CO3	HC03			
	0	.72	169	694	0	269			

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OTHER SOLUTES & GASES CATION TOTALS IN EPM 59.55, ANION TOTALS IN EPM 61.79
REFERENCES: PERSONAL FILE OF DON WHITE, USGS, MENLO PARK.

RECORD 00067

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 8

SECTION B.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000890
 CROSS INDEX NO..
 RECORD TYPE..... b
 SAMPLE TYPE..... SURFACE

NAME..... SANFORD, LINDA J.
 DATE..... 76/04
 ORGANIZATION.. USGS

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. BRADY HOT SPRINGS
 COUNTRY CODE..... US
 STATE/PROVINCE..... NEVADA
 LATITUDE..... 36-47.3 N

COUNTRY NAME..... UNITED STATES
 COUNTY..... CHURCHILL
 LONGITUDE..... 119-01.0 W

TOWNSHIP RANGE SECTION 1/4 1/4
 22N 26E 12 NE

OTHER LOCALITY INFORMATION: 1/3 MILE EAST OF U.S. 40 AT BRADY'S STATION

SAMPLE INFORMATION

COLLECTION DATE..... 1957/05/22
 COLLECTOR(S)..... D. E. WHITE
 WATER SAMPLING TEMP.... 94. C
 WATER FLOW RATE..... 4.4030E-26 L/S 10-20 GAL/MIN
 DEPOSITS OR ALTERATION: H2S .3 PPM FROM SILICEOUS SINTER ON ALLUVIUM

WATER ANALYSIS W

ANALYSIS DATE..... 1958/01/31
 ANALYST(S)..... H. C. WHITEHEAD, CHECKED BY C. ROBERSON
 PH 1)..... 7.1
 SPECIFIC CONDUCTANCE.... 3640. UMHC/CM
 ALKALINITY..... 5+. PPM AS CaCO3
 TOTAL DISSOLVED SOLIDS... 2360 PPM

SOLUTE ANALYSIS (WATER)

UNITS USED..... PPM

LI	NA	K	RB	CS	NA+K			
1.3	730	62						
MG	CA	SR	BA	CA+MG				
0	22	0						
MN+3	MN(TOT)	FE+3	FE(TOT)	CU				
	0		0					
ZN	HG	B	HBO2	AL	PB	AS	SB	U
.01		4.7		0	0	.11		
F	CL	BR	I					
7.3	910	2.2	.1					
NH4	NH3	PO4	SiO2	SO4	CO3	HCO3		
.5	0	.26	226	315	0	67		

PAGE 0101

OTHER SOLUTES & GASES ANION TOTALS IN EPM - 33.74.
REFERENCES: PERSONAL FILE OF DON WHITE, USGS, MENLO PARK.

RECORD 00068

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 8

SECTION B.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000603
CROSS INDEX NO.. CF02011
RECORD TYPE..... B
SAMPLE TYPE..... SURFACE

NAME..... E. A. JOHNSON, J. RENNER
DATE..... 75/01
ORGANIZATION.. U.S.G.S.

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. BRADY HOT SPRINGS
COUNTRY CODE..... US
STATE/PROVINCE..... NEVADA
LATITUDE..... 39-47.21 N

COUNTRY NAME..... UNITED STATES
COUNTY..... CHURCHILL
LONGITUDE..... 119-00.00 W

SAMPLE INFORMATION

SOURCE TYPE..... SPRING

WATER ANALYSIS

PH 1)..... 9.00

SOLUTE ANALYSIS (WATER)

NH4	NO3	PO4	SIO2	SO4	CO3	HCO3
			242.00			

REFERENCES: WHITE & OTHERS, ASSESSMENT OF GEOTHERMAL RESOURCES OF THE U.S. - 1975, U.S.G.S. CIRCULAR 726
OLMSTED AND OTHERS, 1975

SITE: CHANDLER, AZ

SITE: CHANDLER, AZ (FEDERAL/STATE/PRIVATE LAND)
POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
BLM, State Owner	Process Environmental Reports	CEQ, State, DEQ	Assumed	Completed									
USGS, State Developer	Lease Land	Developer											
Developer	Issue Drilling Permits												
Developer	Preliminary Geophysical Exploration												
Developer	Exploratory Drilling and Reservoir Evaluation												
Developer	Develop Utility Interest												
Developer and Utility Producer (Developer)	Feasibility Study												
Producer and Utility Producer	Financial Negotiations												
Producer and Utility Producer	Site Selection												
Producer and Utility Producer	Commitment to Development												
Producer and Utility Producer	Design												
Producer and Utility Producer	Prepare Master Development Plan	BLM, USGS											
Utility	Prepare Environmental Data Statement	BLM, FPC, State, County											
BLM, FPC, State, USGS	Certify Plant and Site, Issue Permits	Producer and Utility											
USGS, St. Cty.	Process EIA/EIS (Drilling)	CEQ, St. DEQ											
FPC, St. PUC	Process EIA/EIS (Plant)	CEQ, St. DEQ											
FPC, St. PUC	Process EIA/EIS (Transmission Line)	CEQ, St. DEQ											
Producer	Development Drilling												
Utility	Plant Construction												
Utility	Install Transmission Line												

Possible Subsequent Additions (MWe) and On Line Date: 100 - 1990, 50 - 1991

SITE: CHANDLER, AZ (REGION 4)

SUMMARY

TEMPERATURE °C
Surface:

Subsurface: 178°C (352°F)⁽⁴⁾ 184-200°C⁽²⁰⁾

TOTAL DISSOLVED SOLIDS (PPM): 62,000 (possible contamination from salt based drilling mud)⁽⁴⁾

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS): 200⁽²⁰⁾

TYPE OF OVERLAYING ROCK: Medium to Hard - first 1524 m (5000 feet) soft

ESTIMATED DEPTH TO TOP OF RESERVOIR (METERS):

DESCRIPTION OF KGRA

Total KGRA Acres: No KGRA defined

Total Federal Acres:

Federal Acres Leased:

Total State and Private Acres:

State and Private Acres Leased:

GEOHERMAL DEVELOPMENT STATUS: Two deep wells were drilled. Neither was a good producer when completed with liner and downhole pumps. The deepest well was drilled to 3,186 m (10,450 feet).⁽⁴⁾ No known drilling taking place in June 1976.⁽²⁾

LOCAL AND STATE ATTITUDE TOWARD GEOHERMAL DEVELOPMENTS: Geothermal development not being pursued (little public interest in it.)⁽¹⁾ The local administration is not against development.⁽⁴⁾

LAND USE AND POPULATION: Grazing and farmland. Williams Air Force Base adjoins site.⁽⁴⁾ Rural area outside Phoenix.⁽⁴⁾

COMMENTS AND CRITICAL ISSUES: Water shortage in area. Electric power generated from dams on Salt River.⁽⁴⁾ Possible nonelectric geothermal development.⁽²⁰⁾ Geothermal development at Chandler will depend upon Federal leasing.⁽⁴⁷⁾

SITE: CHANDLER, AZ

SITE: CHANDLER, AZ

SITE LOCATION AND PHYSICAL DESCRIPTION

LATITUDE: 33° 18' 24" N

LONGITUDE: 111° 50' 24" W

COUNTY: Maricopa⁽⁴⁾

ADJACENT COUNTIES: Yuma, Yaupai, Gila, Pinal, Pima⁽⁶⁾

LAND OWNERSHIP: The largest percentage of land in Maricopa County is owned by the Bureau of Land Management. Other land owners are the U.S. Forest Service, the Department of Defense, the Bureau of Indian Affairs, the regional park service, and the State. There is little private land in the County.⁽⁴⁾

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
Flat desert mixed with irrigated farmland, bordered by mountains on west. Dry stream washes and arroyos. ⁽⁴⁾	Grazing and farmland. Williams Air Force Base adjoins site. ⁽⁴⁾		All natural landscape has been altered. Little aesthetic appeal. ⁽⁴⁾	None known. Possibility of discovering new archaeological site remote due to the disturbance of the natural environment. ⁽⁴⁾

SITE: CHANDLER, AZ

RESERVOIR CHARACTERISTICS AND GEOLOGICAL/GEOPHYSICAL DESCRIPTION

RESERVOIR TEMPERATURE

Surface: no surface manifestations⁽⁴⁾
Subsurface: 178°C (352°F)⁽⁴⁾ 184°C-200°C⁽²⁰⁾

Geochemical

SiO₂:
Na-K-Ca: ~149°C (300°F)⁽⁴⁾

TOTAL DISSOLVED SOLIDS (TDS): 62,000 ppm - may be contaminated by salt-based drilling mud.⁽⁴⁾

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe, 30 YEARS): 200⁽²⁰⁾

TYPE OF OVERLAYING ROCK: alluvium, evaporites, other sedimentary rocks, volcanics. About 1524 m (5000 feet) to top of volcanics. Volcanics generally have high porosity but poor permeability.⁽⁴⁾

ESTIMATED DEPTH TO TOP OF RESERVOIR:

SEISMIC ACTIVITY:

SITE: CHANDLER, AZ

LAND OWNERSHIP AND LEASING

		TOTAL AREA (ACRES)	FEDERAL (ACRES)	STATE (ACRES)	PRIVATE (ACRES)
KGRA: No KGRA defined.					
LAND LEASED IN KGRA					
HIGHEST-PRICED LEASES (BY DOLLARS/ACRE)					
\$/ACRE	LESSEE				
TENTATIVE LEASE SALE DATES					
NUMBER OF SALES OFFERED BUT NO BIDS:					
NUMBER OF BIDS REJECTED (RESULTING IN NO LEASE):					
SUBSURFACE AREA OF RESERVOIR					

SUMMARY OF LEASING STATUS AND NEEDS: Drilling has occurred on the privately owned Power Ranch. There is some BLM land and an Indian reservation outside the Ranch. Any geothermal development at Chandler will depend on Federal leasing.(47)

SITE: CHANDLER, AZ
GEOHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
<p>Two deep wells by Geothermal Kinetics were drilled by August 1975. Neither hole was a good producer when completed with a slotted or perforated liner and down-hole pumps.(4) The first well which was drilled to 2,806 m (9,207 feet) had a temperature of 163°C and low permeability. (The flow rate was ~2,000 gal/minute.) The second well was drilled to 3,186 m (10,454 feet) and had less permeability.(47) In June 1976, no known drilling activity was taking place.(2)</p>	<p>Possible nonelectric geothermal development may occur near Phoenix and Tucson.(20)</p>

SITE: CHANDLER, AZ

INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)
No current local legislation and requirements for geothermal, no constraints at county level. (1)	Geothermal development is not being pursued (little public interest). However, the local administration does not seem opposed to geothermal development. (1)	

SITE: CHANDLER, AZ

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds

Precipitation (Annual): 20.3-40.6 cm (8-16 inches)⁽⁶⁾

Average Temperature

Minimum: 10.0 to 15.6°C (50-60°F)⁽⁶⁾

Maximum: 32.2 to 37.8°C (90-100°F)

Relative Humidity

(Seasonal Peaks)

Summer: 30-40%⁽⁶⁾

Winter: 40-50%

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
Quality is good with ordinary visibility of 48-64 km (30-40 miles) ⁽⁴⁾	Two major river systems, Salt River and Verde River, flow in the region. Phoenix imposes great demands on Salt River; and the river and its tributaries can become dry south of the city. ⁽⁴⁾ There is a water shortage in the area. (1A)	Ambient noise level, generated by air traffic at the Air Base, auto traffic, and farm machinery, is relatively high. (4)	Planted in cot- ton and citrus. Nearly all natural vegeta- tion altered. Remaining plants include creosote, burrobush, and mesquite. ⁽⁴⁾	Reptiles, birds small burrowing rodents. Aquatic life confined to irrigation canals (algae, bivalves and snails). ⁽⁴⁾	None ⁽⁴⁾

SITE: CHANDLER, AZ

POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR:

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES NEAR SITE	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
Phoenix ⁽⁴⁾	40 km (25 miles) ⁽⁴⁾	505,666 ⁽⁶⁾	There are numerous power plants and transmission lines in the Phoenix-Chandler area. The closest line to the site is a 230 kv E-W line 6.5 km (4 miles) N of the site, owned by the Salt River Project Agriculture Improvement and Power District (SARV, state-owned). The line connects the 310.5 MW combined cycle and the 72.0 MW combined cycle (under construction) Santan plants which are 9.6 km (6 miles) E of Chandler with the 108.9 MW steam and 226.9 MW combustion turbine Kyrene plants which are 11 km (7 miles) NW of the site. The plants at Santan and Kyrene are owned by SARV. Other lines in the area are owned by the Arizona Public Service Co. (private) and the U.S. Bureau of Reclamation (Federal). (33-II)	State Routes 87 and 93 ⁽⁶⁾ at the site. ~16 km (10 miles) ⁽⁶⁾ from U.S. 80 and 89.	Oil product pipeline <16 km (10 miles) from site. ⁽⁶⁾ Major 61 cm (24 inches) natural gas pipeline <16 km (10 miles) from site. ⁽⁶⁾ Primary railroad <16 km (10 miles) from site. ⁽⁶⁾
Chandler	0	12,181 ⁽⁶⁾			

SITE: COVE FORT/SULPHURDALE, UT

SITE: COVE FORT/SULPHURDALE, UT (FEDERAL LANDS)

POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
BLM BLM BLM Developer	Process EIA/EIS Issue STG Drilling Permit Lease Land Preliminary Geophysical Exploration	CEQ Developer Developer	} ASSUMED COMPLETED										
USGS Developer	Issue Drilling Permit	Developer	—										
Developer	Exploratory Drilling and Reservoir Evaluation		—	—	—								
Developer	Develop Utility Interest			—	—								
Developer and Utility	Feasibility Study				—								
Developer and Utility	Financial Negotiations				—								
Producer (Developer) and Utility	Site Selection				—								
Producer and Utility	Commitment to Development					Δ							
Producer and Utility	Design (Preliminary, Final)					—	—						
Producer and Utility	Prepare Master Development Plan	BLM, USGS				—	—						
Producer and Utility	Prepare Environmental Data Statement	BLM, FPC State, County				—	—						
BLM, FPC State, USGS	Certify Plant and Site, Issue Permits	Producer and Utility				—	—	—					
USGS	Process EIA/EIS (Drilling)	CEQ				—	—	—					
FPC	Process EIA/EIS (Plant)	CEQ				—	—	—					
FPC	Process EIA/EIS (Transmission Line)	CEQ				—	—	—					
Producer Utility	Development Drilling							—	—	—			
Utility	Plant Construction							—	—	—	—		
Utility	Install Transmission Line							—	—	—	—		

Possible Subsequent Additions (MWe) and On Line Date: 50 - 1987, 50 - 1989, 50 - 1990, 100 - 1991, 100 - 1992, 100 - 1993, 100 - 1994, 100 - 1995, 100 - 1996, 100 - 1997, 100 - 1998, 100 - 1999

SITE: COVE FORT/SULPHURDALE, UT (REGION 4)

SUMMARY

TEMPERATURE °C

Surface:

Subsurface: 200

TOTAL DISSOLVED SOLIDS (PPM):

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS): 274⁽⁷⁾ 500-1500⁽²⁰⁾

TYPE OF OVERLAYING ROCK:

Medium/Hard

ESTIMATED DEPTH TO TOP OF RESERVOIR (METERS):

1,500

DESCRIPTION OF KGRA

Total KGRA Acres: 24,874⁽⁸⁾

Total Federal Acres:

Federal Acres Leased: 19,409

Total State and Private Acres:

State and Private Acres Leased:

GEOHERMAL DEVELOPMENT STATUS:

In the summer of 1976, Union Oil drilled a 3,352 m (11,000 foot) well that caved in. They are expected to begin drilling another well in September 1977.⁽⁵⁰⁾ Other geothermal industry involvement in the area has been identified.⁽⁵⁰⁾

LOCAL AND STATE ATTITUDE TOWARD GEOTHERMAL DEVELOPMENTS:

Beaver County: Positive administrative attitude. As of August 1975, no regulations or constraints.^(1A)

LAND USE AND POPULATION:

Forest and open woodland with some grazing, in area of low and high mountains.⁽⁶⁾ Adjacent to National Forest. Sparse population.⁽⁶⁾

COMMENTS AND CRITICAL ISSUES:

May be a vapor-dominated geothermal system^(7,20) or it may be an extension of the Roosevelt Hot Springs System.⁽²⁰⁾

SITE: COVE FORT-SULPHURDALE, UT

SITE: COVE FORT/SULPHURDALE, UT

SITE LOCATION AND PHYSICAL DESCRIPTION

LATITUDE: 38° 36' 00" N

LONGITUDE: 112° 33' 00" W

COUNTY: Millard and Beaver

ADJACENT COUNTIES: Iron, Garfield, Piute, Seiver, Sanpete, Jaub; Nevada: White Pine and Lincoln

LAND OWNERSHIP:

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
Plains with low and high mountains	Adjacent to Fishlake National Forest. Forest and open woodland, some grazing. (6)			

SITE: COVE FORT/SULPHURDALE, UT

RESERVOIR CHARACTERISTICS AND GEOLOGICAL/GEOPHYSICAL DESCRIPTION

RESERVOIR TEMPERATURE

Surface:
Subsurface: 200°C⁽⁷⁾ (>200°C)⁽²⁰⁾

Geochemical
SiO₂:
Na-k-Ca:

TOTAL DISSOLVED SOLIDS (TDS):

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS): 274⁽⁷⁾ (500-1,500)⁽²⁰⁾

TYPE OF OVER LAYING ROCK: Sediments and recent volcanics. (Medium-hard).⁽⁸⁾ May be a vapor-dominated geothermal system⁽⁷⁾ as suggested by large sulfur deposits.⁽²⁰⁾ Might be an extension of the Roosevelt Hot Springs System.⁽²⁰⁾

ESTIMATED DEPTH TO TOP OF RESERVOIR: 1,500 m (4,921 ft)⁽⁸⁾

SEISMIC ACTIVITY: There has been some seismic activity in the area.⁽⁶⁾

SITE: COVE FORT/SULPHURDALE, UT

LAND OWNERSHIP AND LEASING

		TOTAL AREA (ACRES)	FEDERAL (ACRES)	STATE (ACRES)	PRIVATE (ACRES)
KGRA: Cove Fort - Sulphurdale		24,874 ⁽⁴⁷⁾			
LAND LEASED IN KGRA			19,409 ⁽¹⁵⁾		
HIGHEST-PRICED LEASES (BY DOLLARS/ACRE) (15)					
\$/ACRE	LESSEE				
361.87	Union Oil Co.				
361.85	Union Oil Co.				
325.68	Union Oil Co.				
171.45	Union Oil Co.				
TENTATIVE LEASE SALE DATES					
NUMBER OF SALES OFFERED BUT NO BIDS: 1 ⁽⁴⁷⁾			1,600 ⁽⁴⁷⁾		
NUMBER OF BIDS REJECTED (RESULTING IN NO LEASE):					
SUBSURFACE AREA OF RESERVOIR		3,707 ⁽⁸⁾			

SUMMARY OF LEASING STATUS AND NEEDS: An estimated one third of the KGRA is owned by the Forest. Noncompetitive leases may be granted in October or November 1977 if the Forest Service completes its EAR as scheduled.⁽⁴⁷⁾

In March 1975, 21,000 acres were offered for lease and 19,000 acres were taken. Sixteen thousand of the remaining acres were reoffered but received no bids. Phillips and Union hold leases.⁽⁴⁷⁾

SITE: COVE FORT/SULPHURDALE, UT

GEOHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
<p>Surface exploration underway,⁽²⁾ with exploratory drilling likely to begin in early 1977.⁽¹⁸⁾</p> <p>During the summer of 1976, Union Oil drilled an 3,352 m (11,000 foot) well that caved in. In June 1977, the USGS approved an environmental analysis and granted a drilling permit to Union Oil.⁽⁴⁷⁾ Drilling is expected to begin in September 1977.⁽⁵⁰⁾ (By February 1977, Union and Phillips had filed for permits to drill up to 33 deep wells.)⁽²⁰⁾</p> <p>Other industry involvement in the area includes O'Brien, Chevron, Hunt, Thermal, Gillette and others.⁽²⁰⁾</p>	

SITE: COVE FORT/SULPHURDALE, UT

INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)
<p>As of August 1975, there were no local regulations or legislation for geothermal. There were virtually no constraints at the county level.^(1A)</p> <p>The State groundwater laws require a permit for geothermal development.⁽⁴⁷⁾</p>	<p>Beaver Co.: Administration is very pro-geothermal.^(1A)</p>	<p>One Environmental Analysis has been completed. An additional EAR which is being done by the Forest Service prior to granting noncompetitive leases is expected to be completed by October 1977. Negotiations to perform a soil survey are underway between ERDA and the Forest Service.⁽⁴⁷⁾</p>

SITE: COVE FORT/SULPHURDALE, UT

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds
 Precipitation (Annual): (6) 20.3 to 40.6 cm (8-16 inches)
 Average Temperature
 Minimum: -6.7 to -1.1°C (20-30°F)
 Maximum: 21.1 to 26.7°C (70-80°F)

Relative Humidity
 (Seasonal Peaks)
 Summer: 40-50%
 Winter: 70-80%

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
	Surface and ground- water available.(6)		Juniper-pinyon woodland and great basin sagebrush.(6)		

SITE: COVE FORT/SULPHURDALE, UT

POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR:

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES NEAR SITE	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
Manderfield	24 km (15 miles)	70	Within 3 km (2 miles) of the site, there is one 138 kv N-S line owned by the Utah Power and Light Co. (private).(33-II)	Interstate Routes 70 and 15 at the site.(6)	Primary railroad within 24 km (15 miles) of site. (6)
Beaver	40 km (25 miles)	1,548			
Kanosh	19 km (12 miles)	12,499			

RECORD 00193

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 8

SECTION A.- GEOTHERMAL FIELD-AREA

RECORD IDENTIFICATION

RECORD NO..... 0000736
 CROSS INDEX NO.. CF02681
 RECORD TYPE..... A

NAME..... J. RENNER
 DATE..... 75/06
 ORGANIZATION.. U.S.G.S.

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. COVE FORT - SULPHURDALE
 COUNTRY CODE..... US
 STATE/PROVINCE..... UTAH
 LATITUDE..... 38-36-UON

COUNTRY NAME..... UNITED STATES
 COUNTY..... MILLARD (& BEAVER)
 LONGITUDE..... 112-33-00W

TOWNSHIP RANGE SECTION 1/4 1/4
 25S 06W 32

BASE & MERIDIAN..... SALT LAKE
 AVAILABLE MAPS OF AREA: COVE FORT 1:62,500

GENERAL DESCRIPTION

ELEVATION..... 1950.72 M 6400. FT
 RESOURCE CATEGORY..... B
 SURFACE THERMAL ACTIVITY..... FUMAROLE OR WARM VAPOR,
 NO. OF HOT SPRINGS..... NONE

RESERVOIR PROPERTIES

RESERVOIR TEMPERATURES..... 100. C TO 240. C ASSUMED
 BEST ESTIMATE..... 200.0 C
 SUBSURFACE AREA..... 12.0 KM**2 TO 75.0 KM**2
 BEST ESTIMATE..... 15.0 KM**2
 BASED ON: OCCURRENCE OF SULFUR DEPOSITS
 DEPTH TO TOP OF RESERVOIR.....
 BEST ESTIMATE..... 1500.00 M 1.500 KM
 DEPTH TO BOTTOM OF RESERVOIR..
 BEST ESTIMATE..... 3000.00 M 3.000 KM TO 3000.00 M 3.000 KM
 THICKNESS OF RESERVOIR.....
 BEST ESTIMATE..... 1500.00 M 1.500 KM
 VOLUME OF RESERVOIR..... 18.000 KM**3 TO 112.500 KM**3
 BEST ESTIMATE..... 22.500 KM**3
 COMMENTS: DEPTHS TO TOP & BOTTOM OF RESERVOIR ARE ASSUMED.

RESERVES

TOTAL STORED HEAT..... 4.1860E+16 J 9.9999E+17 CAL TO 6.2786E+19 J 1.4999E+19 CAL
 BEST ESTIMATE..... 1.0465E+19 J 2.4999E+18 CAL ABOVE 15. C

GEOLOGY

GENERAL ROCK TYPES: PALEOZOIC SEDIMENTS, TERTIARY VOLCANICS

PRIMARY REFERENCE:

AUTHOR..... D.E. WHITE & D.L. WILLIAMS, EDITORS
 DATE..... 1975

PAGE 0252

TITLE..... ASSESSMENT OF GEOTHERMAL RESOURCES OF THE UNITED STATES - 1975
REFERENCE... U.S.G.S. CIRCULAR 726

RELATED REFERENCES:

- 1) HINTZE, L.F., 1963, GEOLOGIC MAP OF SOUTHWESTERN UTAH: UTAH STATE LAND BOARD
- 2) LEE, W.T., 1907, SULPHUR AND PYRITE-THE COVE CREEK SULPHUR BEDS, UTAH: U.S.G.S. BULL. 13
- 3) RODRIGUEZ, E.L., 1960, ECONOMIC GEOLOGY OF THE SULPHURDALE, UTAH: UTAH UNIV., M.S. THESIS

RECORD 00194

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 8

SECTION B.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000737

CROSS INDEX NO.. CF02681

RECORD TYPE..... 6

SAMPLE TYPE..... SURFACE

NAME..... J. RENNER

DATE..... 75/06

ORGANIZATION.. U.S.G.S.

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. COVE FORT - SULPHURDALE

COUNTRY CODE..... US

STATE/PROVINCE..... UTAH

LATITUDE..... 36-36.00 N

COUNTRY NAME..... UNITED STATES

COUNTY..... MILLARD (& BEAVER)

LONGITUDE..... 112-33.00 W

SAMPLE INFORMATION

SOURCE TYPE..... SPRING

WATER ANALYSIS

W

SOLUTE ANALYSIS (WATER)

LI	NA	K	RB	CS	NA+K	
					144	
MG	CA	SR	BA	CA+MG		
	158.00					
F	CL	BR	I			
	79.00					
NH4	NO3	PO4	SiO2	SO4	CO3	HCO3
			124.00	7602.00		

OTHER SOLUTES & GASES FREE S=3.6

REFERENCES: WHITE & OTHERS, ASSESSMENT OF GEOTHERMAL RESOURCES OF THE U.S. - 1975, U.S.G.S. CIRCULAR 726
LEE, 1967

SITE: LEACH, NV

SITE: LEACH, NV (FEDERAL LAND)
POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
BLM	Process Environmental Reports	CEQ	ASSUMED COMPLETED										
BLM	Lease Land	Developer											
Developer	Issue Drilling Permits	Developer											
Developer	Preliminary Geophysical Exploration												
Developer	Exploratory Drilling and Reservoir Evaluation												
Developer	Develop Utility Interest												
Developer and Utility	Feasibility Study												
Producer (Developer) and Utility	Financial Negotiations												
Producer and Utility	Site Selection												
Producer and Utility	Commitment to Development												
Producer and Utility	Design												
Producer and Utility	Prepare Master Development Plan	BLM, USGS											
Utility	Prepare Environmental Data Statement	BLM, FPC, State, County											
BLM, FPC, State, USGS	Certify Plant and Site, Issue Permits	Producer and Utility											
USGS	Process EIA/EIS (Drilling)	CEQ											
FPC	Process EIA/EIS (Plant)	CEQ											
FPC	Process EIA/EIS (Transmission Line)	CEQ											
Producer Utility	Development Drilling												
Utility	Plant Construction												
Utility	Install Transmission Line												

Possible Subsequent Additions (MWe) and On Line Date: 50 - 1990, 100 - 1991, 100 - 1992, 100 - 1993, 100 - 1994, 100 - 1995, 100 - 1996, 100 - 1997, 100 - 1998, 100 - 1999

SITE: LEACH, NV (REGION 4)

SUMMARY

TEMPERATURE °C

Surface: 96

Subsurface: 170⁽⁷⁾ (170-200°)⁽²⁰⁾

TOTAL DISSOLVED SOLIDS (PPM):

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS): 79⁽⁷⁾ 100⁽⁴⁷⁾

TYPE OF OVERLAYING ROCK:

ESTIMATED DEPTH TO TOP OF RESERVOIR (METERS):

DESCRIPTION OF KGRA

Total KGRA Acres: 8,957⁽⁹⁾

Total Federal Acres:

Federal Acres Leased: 12,246

Total State and Private Acres:

State and Private Acres Leased:

GEOHERMAL DEVELOPMENT STATUS:

Surface exploration has occurred.⁽²⁾ Industries which may become involved in development have been identified.⁽²⁰⁾ Leach may be a good prospect for non-electric agricultural use.⁽⁴⁷⁾

LOCAL AND STATE ATTITUDE TOWARD GEOTHERMAL DEVELOPMENTS:

LAND USE AND POPULATION:

Sparsely populated open woodland and grazed desert shrubland.⁽⁶⁾

COMMENTS AND CRITICAL ISSUES:

In seismically active area.⁽⁶⁾

SITE: LEACH, NV

SITE: LEACH, NV

SITE LOCATION AND PHYSICAL DESCRIPTION

LATITUDE: 40° 36' 12" N

LONGITUDE: 117° 38' 42" W

COUNTY: Pershing

ADJACENT COUNTIES: Humboldt, Lander, Churchill, Washoe

LAND OWNERSHIP:

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
Plains with high mountains.(6)	Open woodland and grazed desert shrubland.(6)			

SITE: LEACH, NV

RESERVOIR CHARACTERISTICS AND GEOLOGICAL/GEOPHYSICAL DESCRIPTION

RESERVOIR TEMPERATURE

Surface: 96°C
Subsurface: 170°C⁽⁷⁾ (170-200°C)⁽²⁰⁾

Geochemical

SiO₂: 155°C
Na-k-Ca: 176°C

TOTAL DISSOLVED SOLIDS (TDS):

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS): 79⁽⁷⁾ (1000-1500 MWe Leach, Kyle and Rye Patch)⁽²⁰⁾
100 (USGS)⁽⁴⁷⁾

TYPE OF OVER LAYING ROCK:

ESTIMATED DEPTH TO TOP OF RESERVOIR:

SEISMIC ACTIVITY: In area of seismic activity. In early 1900's, one earthquake near the site registered IX-X on Mercalli Intensity Scale (considerable damage).⁽⁶⁾

SITE: LEACH, NV

LAND OWNERSHIP AND LEASING

		TOTAL AREA (ACRES)	FEDERAL (ACRES)	STATE (ACRES)	PRIVATE (ACRES)
KGRA: Leach Hot Springs		12,797 ⁽⁹⁾	12,246 ⁽⁴⁷⁾		
LAND LEASED IN KGRA			12,246 ⁽¹⁵⁾		
HIGHEST-PRICED LEASES (BY DOLLARS/ACRE) (15)					
\$/ACRE	LESSEE				
7.69	Amin Oil USA, Inc.				
1.76	Amin Oil USA, Inc.				
1.64	Amin Oil USA, Inc.		4,635 5,002 2,809		
TENTATIVE LEASE SALE DATES					
NUMBER OF SALES OFFERED BUT NO BIDS: 0 ⁽¹⁵⁾					
NUMBER OF BIDS REJECTED (RESULTING IN NO LEASE): 0 ⁽¹⁵⁾					
SUBSURFACE AREA OF RESERVOIR					

SUMMARY OF LEASING STATUS AND NEEDS: The Leach Hot Springs are on private land that is surrounded by Federal land. All of the Federal land was leased by Amin Oil (who had no competing bids) in October 1976. ⁽⁴⁷⁾

SITE: LEACH, NV

GEOHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
<p>As of June 1976, significant surface exploration was underway.⁽²⁾</p> <p>(Possible industry involvement by Sun, Chevron, and Magma)⁽²⁰⁾</p> <p>LBL tested a superconducting magnetometer at Leach. The magnetometer successfully demonstrated the existence of a geothermal anomaly including its position, size, and depth.⁽²⁵⁾</p>	<p>Leach may be a good prospect for non-electric agricultural use. The area has a short growing season because the temperature gradient between day and night is so great.⁽⁴⁷⁾</p>

SITE: LEACH, NV

INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)

SITE: LEACH, NV

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds
 Precipitation (Annual): 0-40.6 cm (0-16 inches)⁽⁶⁾
 Average Temperature
 Minimum: -6.7 to -1.1°C (20-30°F)
 Maximum: 21.1 to 26.7°C (70-80°F)⁽⁶⁾

Relative Humidity
 (Seasonal Peaks)
 Summer: 20-30%⁽⁶⁾
 Winter: 60-70%

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
	Humboldt River 40 km (25 miles) from site (used for irrigation) (6)		Great Basin Sagebrush, Chaparral ⁽⁶⁾		

SITE: LEACH, NV

POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR:

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES NEAR SITE	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
Humboldt	44 km (28 miles)	20 ⁽⁶⁾	Within 40 km (25 miles) N of the site, there is a 120 kv NE-SW capacity line operating at 60 kv owned by the Sierra Pacific Power Co. (private).(33-II)	Interstate 80, 38 km (24 miles).	Rail line 38 km (24 miles). Natural gas pipeline within 10 kv (6 miles).(6)
Valmy	44 km (28 miles)	30 ⁽⁶⁾			

SITE: ROOSEVELT HOT SPRINGS, UT

SITE: ROOSEVELT H.S., UT (FEDERAL LAND)
POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
BLM	Issue STG Permit	Developer	} ASSUMED COMPLETED										
USGS	Issue Drilling Permits	Developer											
BLM	Process EIA/EIS	CEQ											
County Gov't	Issue Land Use Permit	Developer											
Developer	Preliminary Geophysical Exploration												
Developer	Exploratory Drilling and Reservoir Assessment												
Developer	Develop Utility Interest												
Developer	Feasibility Study												
Utility													
Producer/Developer and Utility	Financial Negotiations			—									
Producer/Utility	Site Selection			—									
Producer/Utility	Design			—	—								
Producer/Utility	Prepare Master Development Plan	BLM, USGS		—	—								
Utility	Prepare Environmental Data Statement	BLM, FPC, State, County		—	—								
Producer/Utility	Commitment to Development			Δ									
BLM, FPC, State, USGS	Certify Plant and Site, Issue Permits	Producer & Utility			—	—	—	—					
USGS	Process EIA/EIS (Drilling)	CEQ			—	—	—	—					
FPC	Process EIA/EIS (Plant)	CEQ			—	—	—	—					
FPC	Process EIA/EIS (Transmission Line)	CEQ			—	—	—	—					
Producer/Utility	Development Drilling					—	—	—	—				
Utility	Plant Construction						—	—	—	—			
Utility	Install Transmission Line (96.5km)							—	—	—			

Possible Subsequent Additions (MWe) and On Line Date: 50 - 1986, 50 - 1988, 100 - 1990, 100 - 1991
100 - 1992, 100 - 1993, 100 - 1994, 100 - 1995, 100 - 1996, 100 - 1997, 50 - 1998

SITE: ROOSEVELT HOT SPRINGS, UT (REGION 4)

SUMMARY

TEMPERATURE °C

Surface: 88

Subsurface: 230⁽⁷⁾ 260⁽²⁰⁾

TOTAL DISSOLVED SOLIDS (PPM):

7,800⁽⁴⁾

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS):

100⁽⁷⁾ 500 to 1,000⁽²⁰⁾

TYPE OF OVERLAYING ROCK:

Medium/Hard

ESTIMATED DEPTH TO TOP OF RESERVOIR (METERS):

830

DESCRIPTION OF KGRA

Total KGRA Acres: 29,791⁽⁹⁾

Total Federal Acres:

Total State and Private Acres:

Federal Acres Leased: 24,592

State and Private Acres Leased:

GEOHERMAL DEVELOPMENT STATUS:

Numerous wells drilled. Projected total mass flow capacity of well is 1 million lbs/hr of steam and hot water.(14) Reservoir exploration completed. Industry involvement has been identified.(20) Testing of helical screw expander may occur at the site.(31) A geothermal preheat of coal has been proposed.(47)

LOCAL AND STATE ATTITUDE TOWARD GEOTHERMAL DEVELOPMENTS:

Positive public attitude. As of August 1975, no regulations or constraints.(1A)

LAND USE AND POPULATION:

Rural, bordered by mountains. Mining, agriculture and tourism in county.(4)

COMMENTS AND CRITICAL ISSUES:

Cooling water is probably not available. Withdrawal from the aquifer has caused up to 183 cm (6 feet) of subsidence.(4) Zoning at the resource restricts only salvage yards, dumps, and gravel pits.(4) Resource may be a part of the Cove Fort/Sulphurdale system.(20) Geophysics indicates a fault zone extends for 20 km (12 miles).(20) Much of the KGRA has been unitized.(47)

SITE: ROOSEVELT H.S., UT

SITE: ROOSEVELT HOT SPRINGS, UT

SITE LOCATION AND PHYSICAL DESCRIPTION

LATITUDE: 38° 30' 00" N

LONGITUDE: 112° 50' 00" W

COUNTY: Beaver

ADJACENT COUNTIES: Iron, Piute Sevier, Millard; Lincoln, NV.

LAND OWNERSHIP: of Beaver County Land BLM & National Forest = 78.0%
State = 9.4%
Private = 12.6%

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
Desert type - grazing, bordered by mountains. ⁽⁴⁾	Mining, agriculture and tourism in County. Land proposed for geo- thermal usage is zoned so that use restrictions apply only to salvage yards, dumps and gravel pits. ⁽⁴⁾		Mountainous & Southeast area are moderately to highly scenic. ⁽⁴⁾	12 historic & pre-historic inhabited sites are known in the area. Increased activity could pose a threat to archeological values. ⁽⁴⁾

SITE: ROOSEVELT HOT SPRINGS, UT

RESERVOIR CHARACTERISTICS AND GEOLOGICAL/GEOPHYSICAL DESCRIPTION

RESERVOIR TEMPERATURE

Surface: 88°C (190°F)⁽⁷⁾
Subsurface: 230°C (446°F)⁽⁷⁾ 260°C⁽²⁰⁾

Geochemical
SiO₂: 213°C
Na-K-Ca: 283°C

TOTAL DISSOLVED SOLIDS (TDS): 7,800 ppm (including a silica content of 313 ppm).⁽⁴⁾

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe, 30 YEARS): 100⁽⁷⁾ 500-1,000⁽²⁰⁾

TYPE OF OVERLAYING ROCK: Tertiary and Quaternary unconsolidated sediments. Precambrian (?) metamorphics and Tertiary volcanics outcropping to east.⁽⁴⁾ Roosevelt H.S. may be a part of a series of geothermal resources occurring along a line from the southwestern corner of Utah to Salt Lake City and just to the west of the mountain range running in that general direction.⁽¹⁰⁾ (May be a part of the Cove Fort/Sulphurdale System.)⁽²⁾

ESTIMATED DEPTH TO TOP OF RESERVOIR: Top of altered volcanic pay zone = 830 m (2,724 ft).⁽⁴⁾

SEISMIC ACTIVITY: Geophysics indicates a fault zone extends for 20 km (12 miles).⁽²⁰⁾

SITE: ROOSEVELT HOT SPRINGS, UT

LAND OWNERSHIP AND LEASING

		TOTAL AREA (ACRES)	FEDERAL (ACRES)	STATE (ACRES)	PRIVATE (ACRES)
KGRA: Roosevelt H. S.		29,791 ⁽⁹⁾	83% - all BLM (47)	(Present, but acreage unknown)	
LAND LEASED IN KGRA			24,592 ⁽¹⁵⁾ (BLM)	(Some has been leased, but acreage unknown)	
HIGHEST-PRICED LEASES (BY DOLLARS/ACRE) (15)					
\$/ACRE	LESSEE				
128.04	Phillips Petroleum Co.				
128.04	Phillips Petroleum Co.				
58.38	A.L. & W.L. McDonald				
53.38	Phillips Petroleum Co.		2,454 1,940 40 1,640		
TENTATIVE LEASE SALE DATES					
NUMBER OF SALES OFFERED BUT NO BIDS: 0					
NUMBER OF BIDS REJECTED (RESULTING IN NO LEASE): 0					
SUBSURFACE AREA OF RESERVOIR		988			

SUMMARY OF LEASING STATUS AND NEEDS: There have been 2 lease sales. The first was in July 1974 when 23,000 acres were offered and taken. Phillips later relinquished 12,000 of these acres, which were reoffered and taken in 1975.(47) Most of the KGRA has been unitized by Phillips, Union, and possibly Getty. Thermal Power, which has leased State land, has not participated in the unitizing.(47) Any additional leasing in the foreseeable future would probably be noncompetitive.(47)

SITE: ROOSEVELT HOT SPRINGS, UT

GEOHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
<p>Thermal Power Company, subsidiary of Natomas Co., completed a joint-venture well which was drilled to 382 m (1,254 ft). Preliminary testing demonstrated a well-head pressure of 25 kg/cm² (355 lbs/sq inch) gravity and temperature of 222°C (132°F). Projected total mass flow capability of well is 1 million lbs/hr of steam and hot water.(14)</p> <p>Phillips Petroleum reports that from 823-840 m (2,700-2,800 ft) the test well had an initial flow rate of 90,700 kg/hr (200,000 lb/hr) of steam at 204°C (400°F) equivalent to a water flow rate of 1,514 lpm (400 gpm).(14) Tests indicate that the well could produce sufficient steam to generate 12.5 MW.(41) Phillips has completed reservoir exploration.(20)</p> <p>The first well drilled by Phillips (in 1975) struck steam but the well casing collapsed due to overheating. When the pipe got too hot, the weight of a concrete platform built over the pipe caused it to collapse.(41)</p> <p>In January of 1977, Phillips was drilling additional wells at Roosevelt to determine how large the field may be. It was estimated that 2,200 to 8,000 acres could be productive.(41)</p> <p>S. Ward University of Utah is doing a case study of the area. Other industry involvement includes Getty, O'Brien, Chevron, Arco and Union.(20)</p> <p>Of the 6 wells that have been drilled in the KGRA, the best well is producing >1,000,000 lbs/hr of water and steam at 250°C.(47)</p>	<p>Thermal Power Company plans to build a larger test facility to determine more precisely the electric generating capability potential being considered.(14)</p> <p>Thermal Power holds options to drill on an additional 3 sections of geothermal leaseholds in the Roosevelt fields.(14)</p> <p>A 1 MW helical screw expander device, built by Hydrothermal Power, should be ready for integration testing in June 1977, and is awaiting field test approval by the USGS for testing at Roosevelt. The device is 6 m (21 ft) long, 2.5 m (8 ft) wide, weights 3,629 kg (8,000 lbs) and should be on line in September 1977. (31)</p> <p>ERDA/DGE has proposed a geothermal preheat for coal generation at Roosevelt. (Coal is the major energy competitor in the area.)(47)</p>

SITE: ROOSEVELT HOT SPRINGS, UT

INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)
As of August 1975, there were no local legislation, regulations or planning agencies to deal with geothermal energy development, and no constraints existed at the county level.(3III)	Local residents generally welcome geothermal development. (4)	As of February 1977, EIA/EIS was in progress.(20)

SITE: ROOSEVELT HOT SPRINGS, UT

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds
 Precipitation (Annual): 29.9 cm (11.77 inches)
 Average Temperature
 Minimum: -3°C (26.2°F)
 Maximum: 21°C (69.2°F)

Relative Humidity
 (Seasonal Peaks)
 Summer: 30%
 Winter: 60% - 70%

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
No measurements made; air relatively free of pollutants except dust. (4)		Ambient noise of site is minimal from State Hwy. #257	Shadscale, greasewood, great basin sage, cheat grass, halo- geton, rabbit brush, blue- bunch, wheat grass, ponderosa pine, mountain mahogany	mule deer, bob cat, coyote, golden & bald eagle, great basin rattle- snake, great basin spadefoot toad.	prairie and peregrine falcon.

SITE: ROOSEVELT HOT SPRINGS, UT

POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR:

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES NEAR SITE	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
Milford ⁽⁴⁾	19 km (12 miles)	1,471 ⁽⁶⁾	Within 32 km (20 miles) east of the site there is one 138 kv north-south line owned by the Utah Power and Light Company (private).(33-II) Another transmission line is being planned near the site.(20)	Within view of State Highway #257.(4)	Primary railroad main 16 to 32 km (10 to 20 miles) from resource. No major pipelines near resource area.(6)
Beaver ⁽⁴⁾	32 km (20 miles)	1,548 ⁽⁶⁾			

RECORD 00195

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 8

SECTION A.- GEOTHERMAL FIELD-AREA

RECORD IDENTIFICATION

RECORD NO..... 0000734
 CROSS INDEX NO.. CF02671
 RECORD TYPE..... A

NAME..... J. RENNER
 DATE..... 75/04
 ORGANIZATION.. U.S.G.S.

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. ROOSEVELT HOT SPRING
 WARING FIGURE..... 7
 COUNTRY CODE..... US
 STATE/PROVINCE..... UTAH
 LATITUDE..... 38-30-00N

WARING NUMBER..... 51
 COUNTRY NAME..... UNITED STATES
 COUNTY..... BEAVER
 LONGITUDE..... 112-50-00W

TOWNSHIP RANGE SECTION 1/4 1/4
 27S 09W 3 NW

BASE & MERIDIAN..... SALT LAKE
 AVAILABLE MAPS OF AREA: RICHFIELD 1:250,000

GENERAL DESCRIPTION

ELEVATION..... 1584.96 M 5200. FT
 RESOURCE CATEGORY..... b
 PRESENT USE & DEVELOPMENTS: ONE SHALLOW WELL ABANDONED BECAUSE OF PROBLEMS; PHILLIPS CURRENTL
 SURFACE THERMAL ACTIVITY..... DEPOSITS
 ASSOCIATED DEPOSITS..... SINTER
 NO. OF HOT SPRINGS..... NONE

GEOTHERMAL CHARACTERISTICS

SPRING TEMPERATURES..... 55. C TO 88. C
 WELL INFORMATION
 MAXIMUM WELL TEMPERATURE..... 132. C
 BOTTOM-HOLE TEMPERATURE..... TO 85.00 M

RESERVOIR PROPERTIES

RESERVOIR TEMPERATURES..... 0. C TO 0. C ASSUMED
 BEST ESTIMATE..... 230.0 C
 SUBSURFACE AREA.....
 BEST ESTIMATE..... 4.0 KM**2
 DEPTH TO TOP OF RESERVOIR.....
 BEST ESTIMATE..... 1000.00 M 1.000 KM
 DEPTH TO BOTTOM OF RESERVOIR.. TO 3000.00 M 3.000 KM
 BEST ESTIMATE..... 3000.00 M 3.000 KM
 THICKNESS OF RESERVOIR.....
 BEST ESTIMATE..... 2000.00 M 2.000 KM
 VOLUME OF RESERVOIR.....
 BEST ESTIMATE..... 8.000 KM**3
 COMMENTS: DEPTHS TO TOP & BOTTOM OF RESERVOIR ARE ASSUMED.

RESERVES

TOTAL STORED HEAT.....
 BEST ESTIMATE..... 4.1860E+18 J 9.9999E+17 CAL ABOVE 15. C

GEOLOGY

GENERAL ROCK TYPES: PRECAMERIAN GRANITE AND PLIOCENE OR PLEISTOCENE VOLCANICS.

PRIMARY REFERENCE:

AUTHOR..... D.E. WHITE & D.L. WILLIAMS, EDITORS
DATE..... 1975
TITLE..... ASSESSMENT OF GEOTHERMAL RESOURCES OF THE UNITED STATES - 1975
REFERENCE... U.S.G.S. CIRCULAR 726

RELATED REFERENCES:

- 1) MUNDORFF, J.C., 1970, MAJOR THERMAL SPRINGS OF UTAH: UTAH GEOL. AND MINERALOG. SURVEY WATER-RESOURCES BULL. 13
- 2) PETERSEN, C.A., 1973, ROOSEVELT AND THERMO HOT SPRINGS, BEAVER COUNTY, UTAH, IN GEOLOGY OF THE MILFORD AREA, 1973: UTAH GEOL. ASSOC. PUB. 3, P. 73-74
- 3) PETERSON, C.A., 1974, GEOLOGY (AND GEOTHERMAL POTENTIAL) OF THE ROOSEVELT HOT SPRINGS AREA, BEAVER COUNTY, UTAH: UTAH UNIV., M.S. THESIS, 52P.
- 4) WARING, C.A., 1965, THERMAL SPRINGS OF THE UNITED STATES AND OTHER COUNTRIES OF THE WORLD--A SUMMARY: U.S.G.S. PROF. PAPER 492

RECORD 00196

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 8

SECTION B.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000735
 CROSS INDEX NO.. CF02671
 RECORD TYPE..... B
 SAMPLE TYPE..... SURFACE

NAME..... J. RENNER
 DATE..... 75/04
 ORGANIZATION.. U.S.G.S.

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. ROOSEVELT HOT SPRING
 COUNTRY CODE..... US
 STATE/PROVINCE..... UTAH
 LATITUDE..... 38-30.00 N

COUNTRY NAME..... UNITED STATES
 COUNTY..... BEAVER
 LONGITUDE..... 112-50.00 W

SAMPLE INFORMATION

SOURCE TYPE..... SPRING
 WATER SAMPLING TEMP.... 55.0 C

WATER ANALYSIS

ANALYSIS DATE..... 57/09

SOLUTE ANALYSIS (WATER)

LI	NA	K	RB	CS	NA+K
	2500.00	488.00			
MG	CA	SR	BA	CA+MG	
	22.00				
F	CL	BR	I		
	4240.00				
NH4	NO3	PO4	SiO2	SO4	CO3
			313.00	73.00	HCO3
					156.00

REFERENCES: WHITE & OTHERS, ASSESSMENT OF GEOTHERMAL RESOURCES OF THE U.S. - 1975, U.S.G.S. CIRCULAR 726
 MUNDORFF, 1970

SITE: SAFFORD, AZ

SITE: SAFFORD, AZ (FEDERAL/STATE/PRIVATE LAND)

POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
BLM/BIA, St. County	Process Environmental Reports	CEQ, State DEQ	_____										
BLM/BIA	Lease Land	Developer		_____									
USGS State Developer	Issue Drilling Permits	Developer		_____									
Developer	Preliminary Geophysical Exploration				_____								
Developer	Exploratory Drilling and Reservoir Evaluation				_____	_____							
Developer	Develop Utility Interest					_____							
Developer and Utility Producer (Developer) and Utility Producer	Feasibility Study						_____						
Producer and Utility Producer	Financial Negotiations							_____					
Producer and Utility Producer	Site Selection							_____					
Producer and Utility Producer	Commitment to Development							_____ Δ					
Producer and Utility Producer	Design								_____	_____			
Producer and Utility Producer	Prepare Master Development Plan	BLM, USGS							_____				
Utility	Prepare Environmental Data Statement	BLM, FPC, State, County							_____				
BLM, FPC, State, USGS	Certify Plant and Site, Issue Permits	Producer and Utility							_____	_____			
USGS, St., Cty.	Process EIA/EIS (Drilling)	CEQ, St. DEQ							_____	_____			
FPC, St. PUC	Process EIA/EIS (Plant)	CEQ, St. DEQ							_____	_____			
FPC, St. PUC	Process EIA/EIS (Transmission Line)	CEQ, St. DEQ							_____	_____			
Producer	Development Drilling										_____	_____	
Utility	Plant Construction										_____	_____	_____
Utility	Install Transmission Line										_____	_____	_____

Possible Subsequent Additions (MWe) and On Line Date: 50 - 1995

SITE: SAFFORD, AZ (REGION 4)

SUMMARY

TEMPERATURE °C

Surface:

Subsurface: 100°C measured, > 200°C estimated⁽²⁰⁾

TOTAL DISSOLVED SOLIDS (PPM):

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS): 200 MWe⁽²⁰⁾

TYPE OF OVERLAYING ROCK:

ESTIMATED DEPTH TO TOP OF RESERVOIR (METERS):

DESCRIPTION OF KGRA

Total KGRA Acres:

Total Federal Acres:

Federal Acres Leased:

Total State and Private Acres:

State and Private Acres Leased:

GEOHERMAL DEVELOPMENT STATUS:

Mineral exploration wells drilled. Indian tribe and industry interested in geothermal development.⁽²⁰⁾

LOCAL AND STATE ATTITUDE TOWARD GEOTHERMAL DEVELOPMENTS:

LAND USE AND POPULATION:

Grazed desert shrubland and irrigated land.⁽⁶⁾

COMMENTS AND CRITICAL ISSUES:

SITE: SAFFORD, AZ

SITE: SAFFORD, AZ

SITE LOCATION AND PHYSICAL DESCRIPTION

LATITUDE: 32° 49' 36" N

LONGITUDE: 109° 42' 48" W

COUNTY: Graham

ADJACENT COUNTIES: Gila, Navajo, Apache, Greenlee, Cochise, Pima, Pinal

LAND OWNERSHIP:

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
Open low mountains and plains with high mountains.(6)	Grazed desert shrubland and irrigated land. Coronado National Forest 13 km (8 miles) from the site.(6) Mineral exploration is taking place.(20)			Rio Gila Indian wars at the site. (6) Sierra Bonita Ranch National Historic Landmark 30 km (17 miles) from site. (6)

SITE: SAFFORD, AZ

RESERVOIR CHARACTERISTICS AND GEOLOGICAL/GEOPHYSICAL DESCRIPTION

RESERVOIR TEMPERATURE

Surface:
Subsurface: 100°C measured, > 200°C estimated⁽²⁰⁾

Geochemical

SiO₂:

Na-K-Ca:

TOTAL DISSOLVED SOLIDS (TDS):

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS): 200 MWe⁽²⁰⁾

TYPE OF OVERLAYING ROCK:

ESTIMATED DEPTH TO TOP OF RESERVOIR:

SEISMIC ACTIVITY:

SITE: SAFFORD, AZ

LAND OWNERSHIP AND LEASING

		TOTAL AREA (ACRES)	FEDERAL (ACRES)	STATE (ACRES)	PRIVATE (ACRES)
KGRA: No KGRA defined.					
LAND LEASED IN KGRA					
HIGHEST-PRICED LEASES (BY DOLLARS/ACRE)					
\$/ACRE	LESSEE				
TENTATIVE LEASE SALE DATES					
NUMBER OF SALES OFFERED BUT NO BIDS:					
NUMBER OF BIDS REJECTED (RESULTING IN NO LEASE):					
SUBSURFACE AREA OF RESERVOIR					

SUMMARY OF LEASING STATUS AND NEEDS: Safford is a large area which includes the Clifton KGRA, which is one square mile of BLM land created by competitive overlap. When the Clifton KGRA was offered for leasing, there were no bids. There have been several noncompetitive leases issued in the area.(47)

SITE: SAFFORD, AZ

GEOHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
<p>305 m (1,000 feet) mineral exploration wells encountered 100°C. (20)</p> <p>Indian tribes and Sun Oil involved in development. (Sun Oil interested in Springville area). (20)</p>	<p>There is a possibility of direct heat application and electrical potential in Safford-Morenci Copper district. Demo plant needs were not apparent by February 1977. (20)</p> <p>Reservoir assessment is planned for 1977-78. USGS will initiate regional volcanic mapping in 1977. Arizona (ABM) will select sites in 1977 for 1978 work. Market analysis of potential use of heat by copper industry should be initiated in 1977. (20)</p>

SITE: SAFFORD, AZ

INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)
	Indian tribes have asked for geothermal development assistance. (20)	

SITE: SAFFORD, AZ

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds
 Precipitation (Annual): 20.3 to 40.6 cm (8-16 inches) ⁽⁶⁾
 Average Temperature
 Minimum: 4.4 to 10.0°C (40-50°F)
 Maximum: 26.7 to 32.2°C (80-90°F) ⁽²⁰⁾

Relative Humidity
 (Seasonal Peaks)
 Summer: 40-50% ⁽⁶⁾
 Winter: 50-60%

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
	75 km (47 miles) to San Carlos Reservoir. Gila River at site. Withdrawal of ground- water from wells. ⁽²⁰⁾		Creosote bush- bur sage and grama-tobosa shrubsteppe. ⁽²⁰⁾		

SITE: SAFFORD, AZ

POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR: There are Apache Indians in the area. (47)

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES NEAR SITE	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
Safford	0	5,160 (6)	The site is 16 km (10 mi.) east of the Dos Condados sub-station which has a 115 kv line and a 230 kv capacity line operating at 115 kv coming into the substation from the south. The lines are owned by the Arizona Electric Power Cooperative (AREP). The Apache 85.0 MW combined cycle, 63.0 MW and 20.0 MW combustion turbine plants owned by AREP are 80 km (50 mi.) south of the site. (33-II)	Junction of Interstates 70 and 666 at the site. (6)	Rail line, natural gas pipeline at the site. (6)
Solomon	8 km (5 miles)	500			
Thatcher	8 km (5 miles)	1,581			

SITE: STEAMBOAT SPRINGS, NV

SITE: STEAMBOAT SPRINGS, NV (FEDERAL/PRIVATE LAND)

POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
BLM/Owner BLM Developer	Lease Land Process EIA Preliminary Geophysical Exploration	Developer CEQ	ASSUMED COMPLETED										
BLM USGS County Developer	Issue STG Drilling Permit Issue Drilling Permit Issue Use Permit Exploratory Drilling & Reservoir Evaluation	Developer Developer Developer	—	—	—								
Developer Developer & Utility	Develop Utility Interest Feasibility Study			—	—								
Producer (Developer) & Utility	Financial Negotiations				—								
Producer Producer & Utility	Site Selection Design					—	—	—					
Producer & Utility	Commitment to Development					Δ							
Producer & Utility	Prepare Master Development Plan	BLM, USGS				—	—						
Utility	Prepare Environmental Data Statement					—	—						
BLM, FPC, State, USGS	Certify Plant & Site, Issue Permits	BLM, FPC, State, County, Producer & Utility					—	—	—				
USGS	Process EIA (Drilling)	CEQ					—	—	—				
FPC, State PUC	Process EIA (Plant)	CEQ					—	—	—				
FPC, State PUC	Process EIA (Transmission Line)	CEQ					—	—	—				
Producer Utility Utility	Development Drilling Plant Construction Install Transmission Line (16km)								—	—	—	—	—

Possible Subsequent Additions (MWe) and On Line Date: 50 - 1988, 100 - 1990

SITE: STEAMBOAT SPRINGS, NV (REGION 4)

SUMMARY

TEMPERATURE °C
Surface: 96⁽⁷⁾

Subsurface: 210⁽⁷⁾

TOTAL DISSOLVED SOLIDS (PPM): 2,500⁽⁴⁾
ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS): 208⁽⁷⁾
TYPE OF OVERLAYING ROCK: Medium/Hard
ESTIMATED DEPTH TO TOP OF RESERVOIR (METERS): 300

DESCRIPTION OF KGRA

Total KGRA Acres: 8,914
Total Federal Acres: ~ 1/2
Federal Acres Leased: 1,548

Total State and Private Acres: ~ 1/2
State and Private Acres Leased:

GEOHERMAL DEVELOPMENT STATUS:

Numerous wells have been drilled.⁽⁴⁾ By February 1977, no deep wells had been drilled.⁽²⁰⁾
Some geothermal space heating is taking place,⁽²⁾ with significant space heating potential in Reno.⁽²⁰⁾

LOCAL AND STATE ATTITUDE TOWARD GEOTHERMAL DEVELOPMENTS:

Public opinion is mixed. Negative reactions are based on diversion of recreational use or possible additional growth in the community.⁽⁴⁾ Because of regulations, mild constraints and brief delays may be expected. Disposition of the local administration is positive.^(1A)

LAND USE AND POPULATION:

Mountainous with many man-made intrusions. Suburban area with plans for possible residential development. Steamboat Springs is used as a resort. Resource is in a mining district.⁽⁴⁾

COMMENTS AND CRITICAL ISSUES:

Steamboat Springs is a designated historical area.⁽⁴⁾ By August 1975, all exploration was on private land.^(1A)

SITE: STEAMBOAT SPRINGS, NV

SITE: STEAMBOAT SPRINGS, NV

SITE LOCATION AND PHYSICAL DESCRIPTION

LATITUDE: 39° 23' 00" N

LONGITUDE: 119° 45' 00" W

COUNTY: Washoe

ADJACENT COUNTIES: Humboldt, Pershing, Churchill, Lyon, Storey, Ormsby, NV;
Lake, OR; Modoc, Lassen, Sierra, Nevada, Placer, CA.

LAND OWNERSHIP:

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
Basin and Range type. Area is mountainous with many man-made intrusions.	Resource is in Virginia City mining district; Steamboat Springs is being used as a resort. Area is covered with numerous roads, power lines and other construction. ⁽⁴⁾ The KGRA has a trailer park and housing development around it. ⁽⁴⁷⁾	Possible residential development. ⁽⁴⁾		Numerous historical and archeological sites including petroglyphs and open aboriginal camps in area. Steamboat Springs is a designated historical site. (4)

SITE: STEAMBOAT SPRINGS, NV

RESERVOIR CHARACTERISTICS AND GEOLOGICAL/GEOPHYSICAL DESCRIPTION

RESERVOIR TEMPERATURE

Surface: 96°C
Subsurface: 210°C⁽⁷⁾

Geochemical

SiO₂: 207°C
Na-K-Ca: 226°C

TOTAL DISSOLVED SOLIDS (TDS): 2500 ppm⁽⁴⁾

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS): 208⁽⁷⁾

TYPE OF OVER LAYING ROCK: Granite and metamorphic rock type (medium-hard). Volcanic center along Sierra front.⁽²⁰⁾ The resource is part of a complex geological system that appears to be fault controlled. There are mercury and silica deposits and clay pits at the KGRA.⁽⁴⁷⁾

ESTIMATED DEPTH TO TOP OF RESERVOIR: 300 m (984 ft)

SEISMIC ACTIVITY:

SITE: STEAMBOAT SPRINGS, NV

LAND OWNERSHIP AND LEASING

		TOTAL AREA (ACRES)	FEDERAL (ACRES)	STATE (ACRES)	PRIVATE (ACRES)
KGRA: Steamboat Springs, KGRA		8,914	approximately 4,450 (3-III)	approximately 4,450 (3-III) (state & private)	
LAND LEASED IN KGRA			1,548 ⁽¹⁵⁾		
HIGHEST-PRICED LEASES (BY DOLLARS/ACRE) (15)			1,548		
\$/ACRE	LESSEE				
32.30	Phillips Petroleum Co. & Gulf Oil				
TENTATIVE LEASE SALE DATES					
NUMBER OF SALES OFFERED BUT NO BIDS: 0 ⁽¹⁵⁾					
NUMBER OF BIDS REJECTED (RESULTING IN NO LEASE): 0 ⁽¹⁵⁾					
SUBSURFACE AREA OF RESERVOIR		1,483 ⁽⁸⁾			

SUMMARY OF LEASING STATUS AND NEEDS: The USGS recently received an application to exchange leases for land at Steamboat Springs for land leased by someone else at Lake Tahoe.(47)

SITE: STEAMBOAT SPRINGS, NV

GEOHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
<p>In addition to several older wells, 6 wells ranging in depth from 156-549 m (520-1,830 feet), were drilled by Nevada Thermal Power Co. between 1954-1961. Eight diamond drill holes shallower than 1,000 feet were drilled by USGS.⁽⁴⁾</p> <p>One well 217.5 m (725 feet) deep recorded 185°C (365°F). It flowed more than 775 lpm (200 gpm) for over two weeks and then declined (probably due to both decline of pressure and deposition of calcite).⁽⁴⁾</p> <p>Many shallow wells are used for space heating.⁽²⁰⁾</p> <p>Industries involved in development as of February 1977 are Magma and Southern Union Production.⁽²⁰⁾</p> <p>By February 1977, no deep wells had been drilled.⁽²⁰⁾</p>	<p>Possible deep drill hole to test higher enthalpy regime; and possible continued drilling of hot water wells projected through 1977-1979.⁽²⁷⁾</p> <p>Significant space heating potential in Reno.⁽²⁰⁾</p>

SITE: STEAMBOAT SPRINGS, NV

INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIRMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)
<p>A use permit is required for geothermal activity on lands zoned in the county. Mild constraints and brief delays are to be expected. Disposition of the local administration is positive.(1A)</p>	<p>Public opinion on geothermal development is mixed. Negative reactions are based upon possible diverting of recreational land to industrial uses, and possible unwanted growth in the community.(4)</p>	<p>Environmental Analysis Record of general area has been done.(4)</p>

SITE: STEAMBOAT SPRINGS, NV

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds
 Precipitation (Annual): 20.3 to 40.6 cm (8 - 16 inches)⁽⁶⁾
 Average Temperature
 Minimum: -1.1 to 4.4°C (30-40°F)
 Maximum: 15.6 to 21.1°C (60-70°F)

Relative Humidity
 (Seasonal Peaks)
 Summer: 30 - 40%
 Winter: 60 - 70%

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
Good, although particulate matter (dust) is generated by wind over farm- land and natural landscape. Auto- mobile-derived pollution can be severe in Reno area. (4)	Truckee River and Galena Creek are permanent streams. Washoe Lake. Groundwater of relatively poor quality. ⁽⁴⁾	Ambient noise level apt to be relatively high. ⁽⁴⁾	Cropland, riparian, desert scrub, pinon-juniper, grassland and conifer. Most plants in pros- pect area are drought-resis- tant with salt- bush, grease- wood, and shad- scale predominating. ⁽⁴⁾	79 species of mammal, over 250 species of birds and numerous species of fish. (No fish reported in water at Steamboat Springs) ⁽⁴⁾	Peregrine and Prairie Falcon, White-faced Ibis, Ferruginous Hawk, Osprey, and Spotted Bat in region, although none reported to inhabit the immediate Steam- boat Springs area. (4)

SITE: STEAMBOAT SPRINGS, NV
POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR:

Steamboat Springs is in a relatively heavily populated area, although region is basically rural. (4)

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES NEAR SITE	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
Reno	19 km (12 miles)	120,000 (in metropol- itan area)	There are numerous transmission lines in the Steamboat Springs area. The closest is a 120 kv N-S line owned by the Sierra Pacific Power Co. (private) at the site. The Sunrise 81.6 MW steam and 69.4 combustion turbine power plants are 40 km (25 mi.) NE of the site. (33-II)	Numerous	Numerous (includes railroads, airport, crude oil, natural gas) all within 80.5 km (50 miles) (6)
Virginia City	11 km (7 miles)				

RECORD 00035

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 8

SECTION A.- GEOTHERMAL FIELD-AREA

RECORD IDENTIFICATION

RECORD NO..... 0000398

CROSS INDEX NO.. CF00991

RECORD TYPE..... A

NAME..... RENNER, AND GALYARDT

DATE..... 75/04

ORGANIZATION.. U.S.G.S.

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. STEAMBOAT SPRINGS

WARNING FIGURE..... 2

COUNTRY CODE..... US

STATE/PROVINCE..... COLORADO

LATITUDE..... 40-29-06N

WARNING NUMBER..... 2A

COUNTRY NAME..... UNITED STATES

COUNTY..... ROUTT

LONGITUDE..... 106-50-18W

TOWNSHIP	RANGE	SECTION	1/4	1/4
06N	84W	17	NW	NW

BASE & MERIDIAN..... 6TH PRINCIPAL

AVAILABLE MAPS OF AREA: STEAMBOAT SPRINGS 1:24,000

GENERAL DESCRIPTION

SIZE OF SURFACE EXPRESSION.... 0.9 KM**2

ELEVATION..... 2042.16 M 6700. FT

RESOURCE CATEGORY..... C

SURFACE THERMAL ACTIVITY..... HOT SPRINGS

ASSOCIATED DEPOSITS..... TRAVERTINE

NO. OF HOT SPRINGS..... 150 (7 ON TOPO)

GEOTHERMAL CHARACTERISTICS

SPRING TEMPERATURES..... 38. C TO 66. C

RESERVOIR PROPERTIES

RESERVOIR TEMPERATURES..... 100. C TO 200. C

BEST ESTIMATE..... 135.0 C

SUBSURFACE AREA.....

BEST ESTIMATE..... 1.5 KM**2

DEPTH TO TOP OF RESERVOIR.....

BEST ESTIMATE..... 1500.00 M 1.500 KM

DEPTH TO BOTTOM OF RESERVOIR.. TO 3000.00 M 3.000 KM

BEST ESTIMATE..... 3000.00 M 3.000 KM

THICKNESS OF RESERVOIR.....

BEST ESTIMATE..... 1500.00 M 1.500 KM

VOLUME OF RESERVOIR.....

BEST ESTIMATE..... 2.250 KM**3

COMMENTS: SUBSURFACE AREA AND DEPTHS ARE ASSUMED.

RESERVES

TOTAL STORED HEAT.....

BEST ESTIMATE..... 6.7809E+17 J 1.6199E+17 CAL ABOVE 15. C

GEOLOGY

GENERAL ROCK TYPES: DAKOTA SANDSTONE - FAULTED

PRIMARY REFERENCE:

AUTHOR..... D.E. WHITE & D.L. WILLIAMS, EDITORS
DATE..... 1975
TITLE..... ASSESSMENT OF GEOTHERMAL RESOURCES OF THE UNITED STATES - 1975
REFERENCE... U.S.G.S. CIRCULAR 726

RELATED REFERENCES:

- 1) GEORGE, R.D., AND OTHERS, 1920, MINERAL WATERS OF COLORADO: COLORADO GEOL. SURVEY BULL. 11, 474P.
- 2) KULERA, R.E., 1968, GEOMORPHIC RELATIONSHIP OF MIOCENE DEPOSITS IN THE YAMPA DISTRICT, NORTHWEST COLORADO, IN FIELD CONFERENCE GUIDEBOOK FOR THE HIGH ALTITUDE & MOUNTAIN BASIN DEPOSITS OF MIOCENE AGE IN WYOMING & COLORADO: COLORADO UNIVERSITY MUSEUM, P. 116-134
- 3) WAKING, G.A., 1965, THERMAL SPRINGS OF THE UNITED STATES & OTHER COUNTRIES OF THE WORLD--A SUMMARY: U.S.G.S. PROF. PAPER 492

RECORD 00036

GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION E

SECTION B.- CHEMICAL ANALYSIS

RECORD IDENTIFICATION

RECORD NO..... 0000399
 CROSS INDEX NO.. CF00991
 RECORD TYPE..... B
 SAMPLE TYPE..... SURFACE

NAME..... RENNER, AND Galyardt
 DATE..... 75/04
 ORGANIZATION.. U.S.G.S.

GEOGRAPHIC LOCALITY

GEOTHERMAL FIELD-AREA.. STEAMBOAT SPRINGS
 COUNTRY CODE..... US
 STATE/PROVINCE..... COLORADO
 LATITUDE..... 40-29.10 N

COUNTRY NAME..... UNITED STATES
 COUNTY..... ROUTT
 LONGITUDE..... 106-50.30 W

SAMPLE INFORMATION

SOURCE TYPE..... SPRING
 WATER SAMPLING TEMP.... 24.0 C

WATER ANALYSIS W

ANALYSIS DATE..... 1912

SOLUTE ANALYSIS (WATER)

LI	NA 2047.00	K 155.00	RB	CS	NA+K
MG	CA 113.00	SR	BA	CA+MG	
F	CL 1345.00	BR	I		
NH4	NO3	PO4	SiO2 84.80	SO4 486.00	CO3 HCO3 3253.00

COMMENTS: 1912 (GEORGE 1920) AVE. SiO2 IN AREA 23 PPM.

REFERENCES: WHITE & OTHERS, ASSESSMENT OF GEOTHERMAL RESOURCES OF THE U.S. - 1975, U.S.G.S. CIRCULAR 726
 GEORGE, 1920

SITE: THERMO, UT

SITE: THERMO, UT (FEDERAL LAND)
POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
BLM	Process Environmental Reports	CEQ	ASSUMED COMPLETED										
BLM	Lease Land	Developer											
USGS	Issue Drilling Permits	Developer											
Developer	Preliminary Geophysical Exploration	Developer											
Developer	Exploratory Drilling and Reservoir Evaluation												
Developer	Develop Utility Interest												
Developer and Utility	Feasibility Study												
Producer (Developer) and Utility	Financial Negotiations												
Producer	Site Selection												
Producer and Utility	Commitment to Development												
Producer and Utility	Design												
Producer and Utility	Prepare Master Development Plan	BLM, USGS											
Utility	Prepare Environmental Data Statement	BLM, FPC, State, County											
BLM, FPC, State, USGS	Certify Plant and Site, Issue Permits	Producer and Utility											
USGS	Process EIA/EIS (Drilling)	CEQ											
FPC	Process EIA/EIS (Plant)	CEQ											
FPC	Process EIA/EIS (Transmission Line)	CEQ											
Producer	Development Drilling												
Utility	Plant Construction												
Utility	Install Transmission Line												

Possible Subsequent Additions (MWe) and On Line Date: 100 - 1992, 100 - 1993, 100 - 1994, 100 - 1995, 50 - 1996

SITE: THERMO, UT (REGION 4)

SUMMARY

TEMPERATURE °C

Surface: 90

Subsurface: 200°C⁽²⁰⁾

TOTAL DISSOLVED SOLIDS (PPM):

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS): 50-500 MWe⁽²⁰⁾ 0-50 (USGS)⁽⁴⁷⁾

TYPE OF OVERLAYING ROCK: Valley fill, sand dunes apparently cemented by hot springs.⁽⁸⁾ Soft-could be hard if
ESTIMATED DEPTH TO TOP OF RESERVOIR (METERS): 1,500⁽⁸⁾ cemented with SiO₂ sinter

DESCRIPTION OF KGRA

Total KGRA Acres: 26,019⁽⁹⁾

Total Federal Acres:

Federal Acres Leased: 13,450⁽¹⁵⁾

Total State and Private Acres:

State and Private Acres Leased:

GEOHERMAL DEVELOPMENT STATUS: Surface exploration has taken place with drilling expected in 1977.^(2,20)

LOCAL AND STATE ATTITUDE TOWARD GEOHERMAL DEVELOPMENTS: In August 1975, there were no constraints to
geothermal development.^(3III)

LAND USE AND POPULATION:

COMMENTS AND CRITICAL ISSUES: May be part of Roosevelt and Cove Fort-Sulphurdale system.⁽²⁰⁾ In an area
of seismic activity.⁽⁶⁾

SITE: THERMO, UT

SITE: THERMO, UT

SITE LOCATION AND PHYSICAL DESCRIPTION

LATITUDE: 38° 11' 00" N

LONGITUDE: 113° 12' 12" W

COUNTY: Beaver at Iron County line.

ADJACENT COUNTIES: Iron, Millard, Sevier, Piute, UT; Lincoln, NV.

LAND OWNERSHIP:

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
	Desert shrubland, grazed. (6)			

SITE: THERMO, UT

RESERVOIR CHARACTERISTICS AND GEOLOGICAL/GEOPHYSICAL DESCRIPTION

RESERVOIR TEMPERATURE

Surface: 90°C⁽⁷⁾
Subsurface: 200°C

Geochemical
SiO₂: 144°C⁽⁷⁾
Na-K-Ca: 200°C

TOTAL DISSOLVED SOLIDS (TDS):

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe, 30 YEARS): 50-500⁽²⁰⁾ 0-50 (USGS)⁽⁴⁷⁾

TYPE OF OVERLAYING ROCK: Valley fill, sand dunes apparently cemented by hot springs.⁽⁸⁾

ESTIMATED DEPTH TO TOP OF RESERVOIR: 1,500 m (4,921 feet)⁽⁸⁾ May be part of Roosevelt and Cove
Fort-Sulphurdale System.⁽²⁰⁾

SEISMIC ACTIVITY: There has been some low-intensity seismic activity in the area.⁽⁶⁾

SITE: THERMO, UT

LAND OWNERSHIP AND LEASING

		TOTAL AREA (ACRES)	FEDERAL (ACRES)	STATE (ACRES)	PRIVATE (ACRES)
KGRA: Thermo Hot Springs and Addition		26,019 ⁽⁹⁾			
LAND LEASED IN KGRA			13,450 ⁽¹⁵⁾		
HIGHEST-PRICED LEASES (BY DOLLARS/ACRE) (15)					
\$/ACRE	LESSEE				
15.14	Western Geothermal				
7.28	Southern Union Production Co.				
5.28	Southern Union Production Co.		1,002 1,679 1,925		
TENTATIVE LEASE SALE DATES					
NUMBER OF SALES OFFERED BUT NO BIDS:			approximately 3,000 ⁽⁴⁷⁾		
NUMBER OF BIDS REJECTED (RESULTING IN NO LEASE): 0 ⁽¹⁵⁾					
SUBSURFACE AREA OF RESERVOIR		371 ⁽⁸⁾			

SUMMARY OF LEASING STATUS AND NEEDS: Land ownership is checkerboarded Federal vs. state and private.⁽⁴⁷⁾

In June 1975, 17,000 acres were offered for leasing and 5,000 acres were taken. Chevron had the highest bid at \$15/acre (on 1,000 acres) but lost the land to Western Geothermal who held the Grandfather Rights. Thermex also received 2 leases. In February 1976, 12,000 acres were reoffered and 9,000 were taken by Southern Union Production Co., Republic, and Geothermal Resources International.⁽⁴⁷⁾

SITE: THERMO, UT

GEOHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
<p>As of June 1976, surface exploration had taken place and drilling was expected to take place in 1976-77 time frame. Deep drilling was expected by 1979.(2)</p> <p>However, by February 1977, no wells had been drilled. (20)</p> <p>O'Brien industry is involved in the development. (20)</p>	

SITE: THERMO, UT

INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)
<p>In August 1975, there were no local legislation, regulations, or planning agencies to deal with geothermal energy development, and no constraints existed at the Beaver County level.(3III)</p>		

SITE: THERMO, UT

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds
 Precipitation (Annual): 20.3 to 40.6 cm (8-16 inches) ⁽⁶⁾
 Average Temperature ⁽⁶⁾
 Minimum: -6.7 to -1.1°C (20-30° F)
 Maximum: 21.1 to 26.7°C (70-80°F)
 Relative Humidity ⁽⁶⁾
 (Seasonal Peaks)
 Summer: 30-40%
 Winter: 60-70%

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
	Sevier River 80 km (50 mi.) from site. Some use of fresh groundwater for irri- gation near site. ⁽⁶⁾		Saltbush - greasewood. ⁽⁶⁾		

SITE: THERMO, UT

POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR:

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES NEAR SITE	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
Minersville	25 km (16 mi.)	580 (6)	Within 64 km (40 mi.) E of the site there is one 138 kv N-S line owned by the Utah Power and Light Co. (private). (33-II)	State Road 21 25 km (17 mi.) from site. (6)	Railroad tracks at site. (6)
Beaver	50 km (32 mi.)	1,548 (6)			

RECORD 00007

GEO THERMAL RESOURCES FILE (GEO THERM) REVISION 2

SECTION A.- GEO THERMAL FIELD-AREA

RECORD IDENTIFICATION

RECORD NO..... 0000730
 CROSS INDEX NO.. CPG2091
 RECORD TYPE..... A

NAME..... J. RENNER
 DATE..... 75/04
 ORGANIZATION.. U.S.G.S.

GEOGRAPHIC LOCALITY

GEO THERMAL FIELD-AREA.. THERMO HOT SPRINGS
 WARING FIGURE..... 1
 COUNTRY CODE..... US
 STATE/PROVINCE..... UTAH
 LATITUDE..... 38-11-GON

WARING NUMBER..... 52
 COUNTRY NAME..... UNITED STATES
 COUNTY..... BEAVER
 LONGITUDE..... 113-12-12W

TOWNSHIP	RANGE	SECTION	1/4	1/4
30S	12W	20	SW	NE

BASE & MERIDIAN..... SALT LAKE
 AVAILABLE MAPS OF AREA: THERMO 1:62,500

GENERAL DESCRIPTION

SIZE OF SURFACE EXPRESSION.... 1.8 KM**2
 ELEVATION..... 1535.28 M 5037. FT
 RESOURCE CATEGORY..... B
 SURFACE THERMAL ACTIVITY..... HOT SPRINGS
 ASSOCIATED DEPOSITS..... TRAVERTINE
 NO. OF HOT SPRINGS..... 16 SPRINGS

GEO THERMAL CHARACTERISTICS

NATURAL SURFACE DISCHARGE..... 12.87 L/S 7.6000E+02 L/MIN ESTIMATED
 SPRING TEMPERATURES..... 32. C TO 90. C

RESERVOIR PROPERTIES

RESERVOIR TEMPERATURES..... 140. C TO 225. C ASSUMED
 BEST ESTIMATE..... 200.0 C
 SUBSURFACE AREA..... 1.5 KM**2
 BEST ESTIMATE..... 1500.00 M 1.500 KM
 DEPTH TO TOP OF RESERVOIR..... 1500.00 M 1.500 KM
 DEPTH TO BOTTOM OF RESERVOIR.. 3000.00 M 3.000 KM
 THICKNESS OF RESERVOIR..... 1500.00 M 1.500 KM
 VOLUME OF RESERVOIR..... 2.250 KM**3
 BEST ESTIMATE..... 2.250 KM**3
 COMMENTS: SUBSURFACE AREA AND DEPTHS ARE ASSUMED.

RESERVES

TOTAL STORED HEAT.....
 BEST ESTIMATE..... 6.3710E+17 J 1.9999E+17 CAL ABOVE 15. C

CCLCSCY

GENERAL ROCK TYPES: VALLEY FILL, SAND DUNES APPARENTLY CEMENTED BY HOT SPRINGS

PRIMARY REFERENCE:

AUTHOR..... D.E. WHITE & D.L. WILLIAMS, EDITORS
DATE..... 1975
TITLE..... ASSESSMENT OF GEOTHERMAL RESOURCES OF THE UNITED STATES - 1975
REFERENCE... U.S.G.S. CIRCULAR 726

RELATED REFERENCES:

- 1) MUNDURFF, J.C., 1970, MAJOR THERMAL SPRINGS OF UTAH: UTAH GEOL. AND MINERALOG. SURVEY WATER-RESOURCES BULL. 13
- 2) PETERSEN, C.A., 1973, ROOSEVELT AND THERMO HOT SPRINGS, BEAVER COUNTY, UTAH, IN GEOLOGY OF THE MILFORD AREA, 1973: UTAH GEOL. ASSOC. PUE. 3, P. 73-74
- 3) WAKING, C.A., 1965, THERMAL SPRINGS OF THE UNITED STATES AND OTHER COUNTRIES OF THE WORLD—A SUMMARY: U.S.G.S. PROF. PAPER 492

SITE: VALLES CALDERA, NM

SITE: VALLES CALDERA, NM (STATE/PRIVATE LAND)

POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
State,Owner County	Issue Permits -- Prospecting, Exploration, Land Use, Drilling	Developer	}	ASSUMED COMPLETED									
Owner, State	Lease Land	Developer											
Developer	Process Environmental Reports	State DEQ											
Developer	Preliminary Geophysical Exploration												
Developer	Exploratory Drilling and Reservoir Evaluation												
Developer	Develop Utility Interest		}										
Developer & Utility	Feasibility Study												
Producer & Utility	Financial Negotiations												
Producer	Site Selection												
Producer & Utility	Design												
Producer & Utility	Commitment to Development			Δ									
Utility	Prepare Environmental Data Statement	State,County											
State	Certify Plant & Site, Issue Permits	Producer & Utility											
State,County	Process EIR (Drilling)	State DEQ											
State PUC	Process EIR (Plant)	State DEQ											
State PUC	Process EIR (Transmission Line)	State DEQ											
Producer	Development Drilling												
Utility	Plant Construction												
Utility	Initial Power Line (16km)												

Possible Subsequent Additions (MWe) and On Line Date: 100 - 1986, 100 - 1988, 100 - 1990, 100 - 1991,
100 - 1992, 100 - 1993, 100 - 1994, 100 - 1995, 100 - 1996, 100 - 1997, 100 - 1998, 100 - 1999

SITE: VALLES CALDERA, NM (REGION 4)

SUMMARY

TEMPERATURE °C
Surface: 87 Subsurface: 240⁽⁷⁾ 280⁽²⁰⁾

TOTAL DISSOLVED SOLIDS (PPM): 6,000
ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS): 1,870⁽⁷⁾ 1500⁽²⁰⁾
TYPE OF OVERLAYING ROCK: Hard
ESTIMATED DEPTH TO TOP OF RESERVOIR (METERS): 1,000

DESCRIPTION OF KGRA

Total KGRA Acres: 168,761⁽⁹⁾
Total Federal Acres: ≥30,000⁽⁴⁷⁾
Federal Acres Leased: 18,000⁽⁴⁷⁾

Total State and Private Acres:
State and Private Acres Leased:

GEOTHERMAL DEVELOPMENT STATUS: Nine or ten producing wells have been drilled. Flow rates of >50,000 lb/hr and temperatures of ~300°C have been encountered. Negotiations are underway to construct a 50 MWe power plant.

LOCAL AND STATE ATTITUDE TOWARD GEOTHERMAL DEVELOPMENTS:

LAND USE AND POPULATION:

Open grazed woodland in mountains. Population centers within 16 km (10 miles).⁽⁶⁾

COMMENTS AND CRITICAL ISSUES:

Transportation, utilities and water located nearby.⁽⁶⁾

SITE: VALLES CALDERA, NM

SITE: VALLES CALDERA, NM
SITE LOCATION AND PHYSICAL DESCRIPTION

LATITUDE: 35° 45' 00" N

LONGITUDE: 106° 32' 00" W

COUNTY: Sandoval

ADJACENT COUNTIES: San Juan, Rio Arriba, Los Alamos, Santa Fe, Bernalillo, Valencia, McKinley

LAND OWNERSHIP: Area within Caldera is primarily private land (Bacca Ranch).⁽²⁰⁾ The KGRA is bordered by National Forest on 3 sides and the Santa Clara Indian Reserve on the fourth side.⁽⁴⁷⁾

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
Open high mountains.	Open grazed woodland.			Civil War sites in area. ⁽⁶⁾

SITE: VALLES CALDERA, NM

RESERVOIR CHARACTERISTICS AND GEOLOGICAL/GEOPHYSICAL DESCRIPTION

RESERVOIR TEMPERATURE

Surface: 87°C (189°F)⁽⁷⁾
Subsurface: 240°C (464°F) (280°C)⁽²⁰⁾

Geochemical

SiO₂:

Na-K-Ca:

TOTAL DISSOLVED SOLIDS (TDS): 6000 ppm⁽⁴⁾

ESTIMATED ELECTRIC ENERGY POTENTIAL (MWe 30 YEARS): 1870⁽⁷⁾ 1500⁽²⁰⁾

TYPE OF OVERLAYING ROCK: The area has rhyolite domes and two calderas. Igneous rock types.⁽⁴⁷⁾

ESTIMATED DEPTH TO TOP OF RESERVOIR: 1000 m (3280 ft)

SEISMIC ACTIVITY: This is a caldera area which may still be in stage of collapse; many normal faults are in the area.

SITE: VALLES CALDERA, NM

LAND OWNERSHIP AND LEASING

	TOTAL AREA (ACRES)	FEDERAL (ACRES)	STATE (ACRES)	PRIVATE (ACRES)
KGRA: Baca Location No. 1	168,761 ⁽⁹⁾	≥30,000 ⁽⁴⁷⁾		
LAND LEASED IN KGRA (should be completed within Caldera by 3/30/77)(20)		18,000 ⁽⁴⁷⁾ (Forest Service)		
HIGHEST-PRICED LEASES (BY DOLLARS/ACRE)				
\$/ACRE LESSEE				
TENTATIVE LEASE SALE DATES 3/30/77 - (USFS), (14) 6/9(15); 17 leasing units of land totaling 29,375.45 acres were offered by BLM in April 1977 for sealed bids.(38)				
NUMBER OF SALES OFFERED BUT NO BIDS:				
NUMBER OF BIDS REJECTED (RESULTING IN NO LEASE):				
SUBSURFACE AREA OF RESERVOIR	16,062			

SUMMARY OF LEASING STATUS AND NEEDS: Approximately 90,000 acres in the center of the KGRA belong to Bacca Ranch. On May 25, 1977, 30,000 acres were offered for lease: 18,000 acres (all Forest Service land) received bids at \$133 per acre. The acreage which did not receive bids was inventoried roadless with severe development restrictions. Most of this acreage had no-surface occupancy stipulations.(47)

SITE: VALLES CALDERA, NM

GEOTHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
<p>The Union Oil Company has drilled 16 wells of which 9 or 10 are producing wells. The wells that Union drilled along Sulfur Creek were not satisfactory. Of the 6 wells that were drilled at Redondo Peak, 3 had flow rates of separated steam >50,000 lbs/hr and 3 wells had flow rates <50,000 lbs/hr. Maximum temperatures at the Redondo Peak wells were ~300°C. Well costs have been as high as \$1,000,000 per well.⁽⁴⁷⁾</p> <p>In June 1977, negotiations were underway to sell steam to utility companies.⁽⁴⁷⁾</p> <p>By February 1977, the Los Alamos Scientific Lab (LASL) was conducting a hot dry rock experiment at Fenton Hill to the west of the KGRA.⁽²⁰⁾ Wells drilled by LASL prior to June 1977 produced no heat or hot dry rock. ⁽⁴⁷⁾</p>	<p>Union Oil is planning to construct a 50 MWe generator at Redondo Peak. (It is estimated that 8 to 10 additional producing wells are needed.)⁽⁴⁷⁾</p>

SITE: VALLES CALDERA, NM

INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)

SITE: VALLES CALDERA, NM

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds

Precipitation (Annual): 45.72 cm (18 inches)⁽⁶⁾

Average Temperature

Minimum: 0.6°C (33°F)⁽⁶⁾

Maximum: 21°C (70°F)

Relative Humidity

(Seasonal Peaks)

Summer: 50% - 60%⁽⁶⁾

Winter: 50% - 60%

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
	Surface and ground- water available. ⁽⁶⁾ (Fuel-electric power generation using fresh surface water in Sante Fe.) ⁽⁶⁾		pinon, juniper, aspen, chaparral, and brush ⁽⁶⁾		

SITE: VALLES CALDERA, NM

POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR:

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES NEAR SITE	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
Bernalillo	16 km (10 miles)	2,574	The site is within 24 km (15 mi) of two 115 kv lines which intersect each other at the 51.8 MW Algodones steam plant owned by the Plains Electric Generation and Transmission Cooperative, Inc. Other lines in the area are owned by the Public Service Co. of New Mexico (private). (33-II)	State Highway 44 and Interstate I-25 <16 km (10 ⁽⁶⁾ miles) from site	<16 km (10 miles) from minor (22 in. and larger) gas pipeline ⁽⁶⁾
Santa Fe	61 km (38 miles)	40,000			<16 km (10 miles) from major (12 in. and larger) crude oil pipeline ⁽⁶⁾ <16 km (10 miles) from primary railroad line. ⁽⁶⁾

RECORD 00185

GEOHERMAL RESOURCES FILE (GEOHERM) REVISION 8

SECTION A.- GEOHERMAL FIELD-AREA

RECORD IDENTIFICATION

RECORD NO..... C000666
 CROSS INDEX NO.. CF02331
 RECORD TYPE..... A

NAME..... J. RENNER, E. PATTERSON
 DATE..... 75/03
 ORGANIZATION.. U.S.G.S.

GEOGRAPHIC LOCALITY

GEOHERMAL FIELD-AREA.. VALLES CALDERA
 WARNING FIGURE..... 2
 COUNTRY CODE..... US
 STATE/PROVINCE..... NEW MEXICO
 LATITUDE..... 35-43-00N

WARNING NUMBER..... 12
 COUNTRY NAME..... UNITED STATES
 COUNTY..... SANDOVAL
 LONGITUDE..... 106-32-00W

TOWNSHIP RANGE SECTION 1/4 1/4
 20N 02E 35

BASE & MERIDIAN..... NEW MEXICO
 AVAILABLE MAPS OF AREA: VALLE SAN ANTONIO 1:24,000

GENERAL DESCRIPTION

ELEVATION..... 2647.80 M 8687. FT
 RESOURCE CATEGORY..... B
 PRESENT USE & DEVELOPMENTS: MORE THAN 6 GEOHERMAL WELLS DRILLED, DEPTHS REPORTED TO RANGE FR
 SURFACE THERMAL ACTIVITY..... HOT SPRINGS
 ASSOCIATED DEPOSITS..... TRAVERTINE
 NO. OF HOT SPRINGS..... 5 AREAS IN CALDERA

GEOHERMAL CHARACTERISTICS

SPRING TEMPERATURES..... 25. C TO 87. C

RESERVOIR PROPERTIES

RESERVOIR TEMPERATURES..... 100. C TO 300. C ASSUMED
 BEST ESTIMATE..... 240.0 C
 SUBSURFACE AREA..... 45.0 KM**2 TO 300.0 KM**2
 BEST ESTIMATE..... 65.0 KM**2
 DEPTH TO TOP OF RESERVOIR..... 500.00 M 0.500 KM TO 2000.00 M 2.000 KM
 BEST ESTIMATE..... 1000.00 M 1.000 KM
 DEPTH TO BOTTOM OF RESERVOIR.. 3000.00 M 3.000 KM TO 3000.00 M 3.000 KM
 BEST ESTIMATE..... 3000.00 M 3.000 KM
 THICKNESS OF RESERVOIR..... 1000.00 M 1.000 KM TO 2500.00 M 2.500 KM
 BEST ESTIMATE..... 2000.00 M 2.000 KM
 VOLUME OF RESERVOIR..... 45.000 KM**3 TO 750.000 KM**3
 BEST ESTIMATE..... 130.000 KM**3
 COMMENTS: DEPTHS TO TOP & BOTTOM OF RESERVOIR ARE ASSUMED.

RESERVES

TOTAL STORED HEAT..... 9.6274E+18 J 2.2999E+18 CAL TO 5.4414E+20 J 1.2999E+20 CAL
 BEST ESTIMATE..... 7.5344E+19 J 1.7999E+19 CAL ABOVE 15. C

GEOLOGY

GENERAL ROCK TYPES: PLEISTOCENE CALDERA VOLCANICS

PRIMARY REFERENCE:

AUTHOR..... D.E. WHITE & D.L. WILLIAMS, EDITORS
DATE..... 1975
TITLE..... ASSESSMENT OF GEOTHERMAL RESOURCES OF THE UNITED STATES - 1975
REFERENCE... U.S.G.S. CIRCULAR 726

RELATED REFERENCES:

- 1) SMITH, R.L., AND OTHERS, 1970, GEOLOGIC MAP OF THE JEMEZ MOUNTAINS, NEW MEXICO: U.S.G.S. MISC. GEOL. INV. MAP 1-577
- 2) SUMMERS, W.K., 1965A, A PRELIMINARY REPORT ON NEW MEXICO'S GEOTHERMAL ENERGY RESOURCES: NEW MEXICO BUR. MINES AND MINERAL RESOURCES CIRC. 80, 41P.
- 3) SUMMERS, W.K., 1965B, CHEMICAL CHARACTERISTICS OF NEW MEXICO'S THERMAL WATERS--A CRITIQUE: NEW MEXICO BUR. MINES AND MINERAL RESOURCES CIRC. 83, 27P.
- 4) WARING, C.A., 1965, THERMAL SPRINGS OF THE UNITED STATES AND OTHER COUNTRIES OF THE WORLD--A SUMMARY: U.S.G.S. PROF. PAPER 492, 363 P.

REGION 2 - GULF COAST

SITE: ACADIA PARISH, LA

SITE: ACADIA PARISH, LA (STATE/PRIVATE LAND)

POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
State, County	Process Environmental Reports	State DEQ											
Owner	Lease Land	Developer											
State	Issue Drilling Permits	Developer											
Developer	Preliminary Geophysical Exploration												
Developer	Exploratory Drilling and Reservoir Evaluation												
Developer	Develop Utility Interest												
Developer	Feasibility Study												
Developer and Utility	Financial Negotiations												
Producer (Developer) and Utility	Site Selection												
Producer	Commitment to Development												
Producer and Utility	Design (Preliminary, Final)												
Producer and Utility													
Utility	Prepare Environmental Data Statement	County, State											
State	Certify Plant and Site, Issue Permits	Producer and Utility											
State, County	Process EIR (Drilling)	State DEQ											
State PUC	Process EIR (Plant)	State DEQ											
State PUC	Process EIR (Transmission Line)	State DEQ											
Producer	Development Drilling												
Utility	Plant Construction												
Utility	Install Transmission Line												

Possible Subsequent Additions (MWe) and On Line Date: 50 - 1990, 50 - 1991, 50 - 1992, 50 - 1993, 100 - 1994

SITE: ACADIA PARISH, LA

SUMMARY

LARGEST USGS SUBAREA: DL₅⁽⁷⁾

SUBAREA CHARACTERISTICS:

Average Temperature °C: 164

Average Salinity--TDS (g/l): 65

Average Depth to Top of Geopressure (km): 3.01

Average Pressure (MN/m²): 102.0

Methane Content of Water (std. m³/m³): 8.0

GEOPRESSURED DEVELOPMENT STATUS:

Environmental Baseline Study has been done for the Parish.⁽²⁰⁾

LOCAL AND STATE ATTITUDE TOWARD GEOPRESSURED DEVELOPMENT:

LAND USE AND POPULATION:

Cropland with grazing land - some swamp.⁽⁶⁾

COMMENTS AND CRITICAL ISSUES:

SITE: ACADIA PARISH, LA

SITE: ACADIA PARISH, LA
SITE LOCATION AND PHYSICAL DESCRIPTION

COUNTY: Acadia Parish

ADJACENT COUNTIES: Lafayette, Vermillion, Jefferson Davis, Allen, Evangeline, and Saint Landry Parishes. (6)

LAND OWNERSHIP:

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
Flat plains	Cropland with grazing land. Some swamp. (6)			

SITE: ACADIA PARISH, LA

GEOPRESSURED RESERVOIR CHARACTERISTICS BY SUBAREA *

SUBAREA	AVERAGE DEPTH TO TOP OF GEOPRESSURE km	AVERAGE PRESSURE MN/m ²	AVERAGE TEMPERATURE °C
ATL ₂	2.47	78.5	156
DL ₅	3.01	102.0	164
SUBAREA	AVERAGE SALINITY (TDS g/l)	METHANE CONTENT OF WATER** std. m ³ /m ³	SAND AQUIFIER AVERAGE PERMEABILITY md AVERAGE POROSITY %
ATL ₂	20 ⁺	8.4	35 21
DL ₅	65 ⁺⁺	8.0	25 20

* Subareas are defined in the USGS Circular 726, Assessment of Geothermal Resources of the United States--1975. Characterization of the subareas is expected to change as geopressured resource assessment progresses.

Location of the subareas may be found on the site map.

** Based on solubility of methane at average pressure, temperature, and salinity.

+Estimated; samples not available

++Only a few samples from deep zones included

SITE: ACADIA PARISH, LA

GEOHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT

SITE: ACADIA PARISH, LA

INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)
		An Environmental Baseline Study has been done. (20)

SITE: ACADIA PARISH, LA

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds
Precipitation (Annual): 142.2 to 162.6 cm (56-64 inches)⁽⁶⁾
Average Temperature
Minimum: 10.0 to 15.6°C (50 to 60°F)⁽⁶⁾
Maximum: 26.7 to 32.2°C (80 to 90°F)

Relative Humidity
(Seasonal Peaks)
Summer: 70-80%
Winter: 70-80%

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
	Numerous rivers in the Parish.		Bluestem- sachuista prairie. ⁽⁶⁾		

SITE: ACADIA PARISH, LA
POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR:

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES IN PARISH	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
Crowley		16,700 ⁽⁶⁾	There are three 138 kv lines and one 500 kv line owned by Gulf States Utility Company (private) in the Parish.(33-III)	Interstate Highway 10, U.S. Highway 90, and State Hwys. 13 and 35 in the Parish.(34)	Numerous rail lines in the Parish.(34) Crude oil and products, natural gas pipelines in Parish. (6)

SITE: BRAZORIA, TX

SITE: BRAZORIA, TX (STATE/PRIVATE LAND)

POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
State, County	Process Environmental Reports	State DEQ	—										
Owner	Lease Land	Developer		—									
State	Issue Drilling Permits	Developer		—									
Developer	Preliminary Geophysical Exploration				—								
Developer	Exploratory Drilling and Reservoir Evaluation				—								
Developer	Develop Utility Interest				—								
Developer and Utility	Feasibility Study				—								
Producer (Developer) and Utility	Financial Negotiations					—							
Producer and Utility	Site Selection						—						
Producer and Utility	Commitment to Development						Δ						
Producer and Utility	Design (Preliminary, Final)						—						
		BLM, USGS					—						
Utility	Prepare Environmental Data Statement	County, State DEQ											
State	Certify Plant and Site, Issue Permits	Producer and Utility						—					
State, County	Process EIR (Drilling)	State DEQ						—					
State PUC	Process EIR (Plant)	State DEQ						—					
State PUC	Process EIR (Transmission Line)	State DEQ						—					
Producer	Development Drilling									—			
Utility	Plant Construction									—			
Utility	Install Transmission Line									—			

Possible Subsequent Additions (MWe) and On Line Date: 100 - 1988, 100 - 1989, 200 - 1990, 200 - 1991, 200 - 1992, 200 - 1993, 200 - 1994, 500 - 1995, 500 - 1996

SITE: BRAZORIA COUNTY, TX

SUMMARY

LARGEST USGS SUBAREA: ET₃⁽⁷⁾

SUBAREA CHARACTERISTICS:

Average Temperature °C: 146

Average Salinity--TDS (g/l): 27

Average Depth to Top of Geopressure (km): 2.37

Average Pressure (MN/m²): 80.4

Methane Content of Water (std. m³/m³): 7.8

GEOPRESSURED DEVELOPMENT STATUS:

General Crude (oil company) leasing 8,000 acres, and has expressed interest in geopressured development. In May 1977, ERDA budget supplement for drilling of test wells expected to be approved--Work to begin before the end of 1977,⁽³²⁾ with tests taking 1-2 years.⁽⁴⁶⁾

LOCAL AND STATE ATTITUDE TOWARD GEOPRESSURED DEVELOPMENT:

LAND USE AND POPULATION: County is in the Houston SMSA. Relatively dense population.

COMMENTS AND CRITICAL ISSUES:

SITE: BRAZORIA CO., TX

SITE: BRAZORIA COUNTY, TX

SITE LOCATION AND PHYSICAL DESCRIPTION

COUNTY: Brazoria

ADJACENT COUNTIES: Matagorda, Wharton, Fort Bend, Harris, Galveston⁽⁶⁾

LAND OWNERSHIP AND LEASING: National Wildlife Refuge in County. General Crude holds lease for 8000 acres.⁽²⁰⁾

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
Flat plains ⁽⁶⁾	Extensive rice cultivation in the County. ^(21-V) Numerous oil and gas fields in County. ⁽⁶⁾			

SITE: BRAZORIA, TX
GEOPRESSURED RESERVOIR CHARACTERISTICS BY SUBAREA*

SUBAREA	AVERAGE DEPTH TO TOP OF GEOPRESSURE km	AVERAGE PRESSURE MN/m ²	AVERAGE TEMPERATURE °C
DT ₃	2.41	80.4	153
ET ₃	2.37	80.4	146

SUBAREA	AVERAGE SALINITY (TDS g/l)	METHANE CONTENT** OF WATER std. m ³ /m ³	SAND AQUIFIER AVERAGE PERMEABILITY md	AVERAGE POROSITY %
DT ₃	28	8.0	25	20
ET ₃	27	7.8	35	21

* Subareas are defined in the USGS Circular 726, Assessment of Geothermal Resources of the United States--1975. Characterization of the subareas is expected to change as geopressured resource assessment progresses. Location of the subareas may be found on the site map.

** Based on solubility of methane at average pressure, temperature, and salinity.

SITE: BRAZORIA COUNTY, TX

GEOHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
<p>No development at present.</p> <p>General Crude, an intermediate size oil company, has leased 8,000 acres in a prime area for geopressed resources, and has expressed interest in geopressed development.(20)</p>	<p>As of May 2, 1977, a \$10 million ERDA Budget Supplement for the drilling of test wells in Brazoria County was expected to be approved by the President. ERDA received sole source justification for the work, and expected work on the first Brazoria geopressed well to begin before the end of 1977.(32)</p> <p>Well testing is expected to take 1-2 years.(46)</p>

SITE: BRAZORIA COUNTY, TX

INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)
EIA required for drilling and EIS required prior to plant construction.(20)		

SITE: BRAZORIA COUNTY, TX

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds

Precipitation (Annual): 81.3 to 101.6 cm (32 to 40 inches)(6)

Average Temperature

Minimum: 10.0 to 15.6°C (50-60°F)(6)

Maximum: 26.7 to 32.2°C (80-90°F)

Relative Humidity

(Seasonal Peaks)

Summer: 70-80%

Winter: 70-80%(6)

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
	<p>The County has a number of water districts which supply water to fringe areas of Houston.(21-V)</p> <p>There are numerous rivers in the County.(34)</p>		<p>Southern cordgrass prairie along coast, bluestem-sacahuista prairie inland. (6)</p>		

SITE: BRAZORIA COUNTY, TX
POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR:

Brazoria County is in the Houston SMSA. Population of 76 persons per square mile with 61.3% living in urban areas.(21-V)

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES IN COUNTY	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
Brazoria County		92,000 ⁽⁶⁾	Within Brazoria County, there are two 138 kv and two 345 kv lines running north-south and a 138 kv northeast-southwest line. All five lines terminate in Freeport where there are four plants with a total of 899.0 MW steam owned by Dow Chemical Company (industrial).(33-III)	Numerous ⁽⁶⁾	Numerous oil and gas fields, railroads, crude oil and natural gas pipelines. ⁽⁶⁾
Major population centers in County:					
Lake Jackson		10,900			
Freeport		12,000			

SITE: CALCASIEU PARISH, LA

SITE: CALCASIEU PARISH, LA

POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
State, County Owner	Process Environmental Reports	State DEQ											
Developer	Lease Land	Developer											
Developer	Issue Drilling Permits	Developer											
Developer	Preliminary Geophysical Exploration												
Developer	Exploratory Drilling and Reservoir Evaluation												
Developer	Develop Utility Interest												
Developer and Utility Producer (Developer) and Utility Producer and Utility Producer and Utility	Feasibility Study												
Developer and Utility Producer (Developer) and Utility Producer and Utility Producer and Utility	Financial Negotiations												
Developer and Utility Producer (Developer) and Utility Producer and Utility Producer and Utility	Site Selection												
Developer and Utility Producer (Developer) and Utility Producer and Utility Producer and Utility	Commitment to Development												
Developer and Utility Producer (Developer) and Utility Producer and Utility Producer and Utility	Design (Preliminary, Final)												
Utility	Prepare Environmental Data Statement	County, State											
State	Certify Plant and Site, Issue Permits	Producer and Utility											
State, County	Process EIR (Drilling)	State DEQ											
State PUC	Process EIR (Plant)	State DEQ											
State PUC	Process EIR (Transmission Line)	State DEQ											
Producer	Development Drilling												
Utility	Plant Construction												
Utility	Install Transmission Line												

Possible Subsequent Additions (MWe) and On Line Date: 50 - 1990, 50 - 1991, 100 - 1992, 100 - 1993

SITE: CALCASIEU PARISH, LA

SUMMARY

LARGEST USGS SUBAREA: ATL₂

SUBAREA CHARACTERISTICS:

Average Temperature °C: 156

Average Salinity--TDS (g/l): 20 (estimated; samples not available)

Average Depth to Top of Geopressure (km): 2.47

Average Pressure (MN/m²): 78.5

Methane Content of Water (std. m³/m³): 8.4

GEOPRESSURED DEVELOPMENT STATUS:

LOCAL AND STATE ATTITUDE TOWARD GEOPRESSURED DEVELOPMENT:

LAND USE AND POPULATION:

Primarily cropland and grazing, swamp and marshland in south. Calcasieu Parish is a SMSA (relatively dense population).

COMMENTS AND CRITICAL ISSUES:

SITE: CALCASIEU PARISH, LA

SITE: CALCASIEU PARISH, LA
SITE LOCATION AND PHYSICAL DESCRIPTION

COUNTY: Calcasieu Parish

ADJACENT COUNTIES: Louisiana: Cameron, Jefferson Davis and Beauregard Parishes
Texas: Orange and Newton Counties

LAND OWNERSHIP:

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
Flat plains	Primarily cropland with grazing. Some forest and cropland, grazed. Marshland and swamp.(6)			

SITE: CALCASTIEU PARISH, LA

GEOPRESSURED RESERVOIR CHARACTERISTICS BY SUBAREA*

SUBAREA	AVERAGE DEPTH TO TOP OF GEOPRESSURE km	AVERAGE PRESSURE MN/m ²	AVERAGE TEMPERATURE °C
DTL ₄	2.62	83.4	141
DL ₅	3.01	102.0	164
SUBAREA	AVERAGE SALINITY (TDS g/l)	METHANE CONTENT** OF WATER std. m ³ /m ³	SAND AQUIFIER AVERAGE PERMEABILITY md AVERAGE POROSITY %
DTL ₄	46	7.3	30 21
DL ₅	65 ⁺	8.0	25 20

* Subareas are defined in the USGS Circular 726, Assessment of Geothermal Resources of the United States--1975. Characterization of the subareas is expected to change as geopressured resource assessment progresses.

Location of the subareas may be found on the site map.

** Based on solubility of methane at average pressure, temperature, and salinity.

+Only a few samples from deep zones are included.

SITE: CALCASIEU PARISH, LA
GEOTHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT

SITE: CALCASIEU PARISH, LA

INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)

SITE: CALCASIEU PARISH, LA

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds

Precipitation (Annual): 142.2 to 162.6 cm (56 to 64 inches)⁽⁶⁾

Average Temperature

Minimum: 10.0 to 15.6 °C (50 to 60°F)⁽⁶⁾

Maximum: 26.7 to 32.2 °C (80 to 90°F)

Relative Humidity

(Seasonal Peaks)

Summer: 70 to 80%⁽⁶⁾

Winter: 70 to 80%

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
	Numerous rivers in Parish.(34)		Lower half of Parish is marshland with bluestem- sacahuista prairie. Northern part of Parish has southern mixed forest vegeta- tion.(6)		

SITE: CALCASIEU PARISH, LA
POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR: Calcasieu Parish is a SMSA.(6)

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES IN PARISH	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
Goosport Lake Charles Sulphur		18,500 ⁽⁶⁾ 65,000 13,000	<p>There are one 500 kv, one 230 kv, and nine 138 kv lines in the county. An additional 230 kv capacity line is operating at 138 kv, and one 138 kv capacity line is operating at 69 kv.</p> <p>There are 166.2 MW and 90.0 MW steam plants owned by Pittsburgh Plate Glass Co. (industrial) and 982.3 MW steam plant owned by Gulf States Utilities Co. (private).(33-III)</p>	State Hwys. 12 and 109, U.S. Hwys. 90 and 171, and Interstate Hwys. 10 and 210 in the Parish.(34)	<p>Numerous rail lines in the Parish.(34)</p> <p>Numerous crude oil and products, and natural gas pipeline in Parish.(6)</p>

SITE: CAMERON PARISH, LA

SITE: CAMERON PARISH, LA (STATE/PRIVATE LAND)
POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
State, County	Process Environmental Reports	State DEQ		_____									
Owner	Lease Land	Developer			_____								
State	Issue Drilling Permits	Developer			_____								
Developer	Preliminary Geophysical Exploration					_____							
Developer	Exploratory Drilling and Reservoir Evaluation					_____							
Developer	Develop Utility Interest					_____							
Developer and Utility	Feasibility Study						_____						
Producer (Developer) and Utility	Financial Negotiations							_____					
Producer and Utility	Site Selection							_____					
Producer and Utility	Commitment to Development							_____ Δ					
Producer and Utility	Design (Preliminary, Final)							_____					
Utility	Prepare Environmental Data Statement	County						_____					
State	Certify Plant and Site, Issue Permits	State Producer and Utility						_____					
State, County	Process EIR (Drilling)	State DEQ						_____					
State PUC	Process EIR (Plant)	State DEQ						_____					
State PUC	Process EIR (Transmission Line)	State DEQ						_____					
Producer	Development Drilling										_____		
Utility	Plant Construction										_____		
Utility	Install Transmission Line										_____		

Possible Subsequent Additions (MWe) and On Line Date: 50 - 1990, 50 - 1991, 50 - 1992, 50 - 1993, 50 - 1994, 50 - 1995, 50 - 1996, 100 - 1997

SITE: CAMERON PARISH, LA

SUMMARY

LARGEST USGS SUBAREA: ETL₄

SUBAREA CHARACTERISTICS:

Average Temperature °C: 140

Average Salinity--TDS (g/l): 52

Average Depth to Top of Geopressure (km): 2.63

Average Pressure (MN/m²): 87.3

Methane Content of Water (std. m³/m³): 6.7

GEOPRESSURED DEVELOPMENT STATUS:

An Environmental Baseline Study has been done. (20)

LOCAL AND STATE ATTITUDE TOWARD GEOPRESSURED DEVELOPMENT:

LAND USE AND POPULATION:

Sparse population. Marshland and National Wildlife Refuges in Parish.

COMMENTS AND CRITICAL ISSUES:

SITE: CAMERON PARISH, LA

SITE LOCATION AND PHYSICAL DESCRIPTION

COUNTY: Cameron Parish

ADJACENT COUNTIES: Louisiana: Vermillion, Jefferson Davis and Calcasieu Parishes
Texas: Orange and Jefferson Counties

LAND OWNERSHIP: Sabine and Lacassine National Wildlife Refuges in the Parish. (34)

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
Flat marshland. (34)	National wildlife refuges in Parish. (34)			

SITE: CAMERON PARISH, LA

GEOPRESSURED RESERVOIR CHARACTERISTICS BY SUBAREA *

SUBAREA	AVERAGE DEPTH TO TOP OF GEOPRESSURE km	AVERAGE PRESSURE MN/m ²	AVERAGE TEMPERATURE °C
DTL ₄	2.62	83.4	141
ETL ₄	2.63	87.3	140
SUBAREA	AVERAGE SALINITY (TDS g/l)	METHANE CONTENT OF WATER std. m ³ /m ³ **	SAND AQUIFIER AVERAGE PERMEABILITY md AVERAGE POROSITY %
DTL ₄	46	7.3	30 21
ETL ₄	52	6.7	30 21

* Subareas are defined in the USGS Circular 726, Assessment of Geothermal Resources of the United States--1975. Characterization of the subareas is expected to change as geopressured resource assessment progresses.

Location of the subareas may be found on the site map.

** Based on solubility of methane at average pressure, temperature, and salinity.

SITE: CAMERON PARISH, LA

GEOHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
Area developed for oil and gas. No geothermal development at present. ⁽²⁰⁾	

SITE: CAMERON PARISH, LA

INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)
Need EIS for drill sites. (20)		An Environmental Baseline Study has been done. (20)

SITE: CAMERON PARISH, LA

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds

Precipitation (Annual): 142.2 to 162.2 cm (56-64 inches)⁽⁶⁾

Average Temperature

Minimum: 10.0 to 15.6°C (50-60°F)⁽⁶⁾

Maximum: 26.7 to 32.2°C (80-90°F)

Relative Humidity

(Seasonal Peaks)

Summer: 80-90%⁽⁶⁾

Winter: 80-90%

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
	Numerous canals and lakes in the Parish. Parish is on the Gulf of Mexico. ⁽³⁴⁾		Southern cord- grass prairie (spartina). ⁽⁶⁾		

SITE: CAMERON PARISH, LA

POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR:

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES IN PARISH	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
Lake Charles (Calcasieu Parish)	12 km (8 miles) from Cameron Parish. (34)	65,000 ⁽⁶⁾	There is a 138 kv capacity line operating at 69 kv, terminating at Creole. This line is owned by Jefferson Davis Electric Cooperative, Inc. A 230 kv line crosses the upper left corner of the county from a power plant located in TX at the LA border (1543.6 MW steam with 570.0 MW steam under construction by Gulf States Utility Co., private). (33-III)	State Highway 21 in Parish. (34)	Pipelines are available in the Parish. (20)
Cameron (Parish Seat)		950 ⁽⁶⁾			

SITE: CORPUS CHRISTI, TX

SITE: CORPUS CHRISTI, TX (STATE/PRIVATE LAND)
POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
State, County Owner	Process Environmental Reports	State DEQ		_____									
State Developer	Lease Land	Developer			_____								
Developer	Issue Drilling Permits	Developer			_____								
Developer	Preliminary Geophysical Exploration					_____	_____						
Developer	Exploratory Drilling and Reservoir Evaluation					_____	_____						
Developer	Develop Utility Interest					_____	_____						
Developer and Utility Producer (Developer) and Utility Producer	Feasibility Study						_____						
Producer and Utility Producer	Financial Negotiations							_____					
Producer and Utility Producer	Site Selection							_____					
Producer and Utility Producer	Commitment to Development							_____ Δ					
Producer and Utility Producer	Design (Preliminary, Final)							_____	_____				
Utility	Prepare Environmental Data Statement	BLM, FPC, State DEQ						_____					
State	Certify Plant and Site, Issue Permits	Producer and Utility						_____	_____				
State, County	Process EIR (Drilling)	State DEQ						_____	_____				
State PUC	Process EIR (Plant)	State DEQ						_____	_____				
State PUC	Process EIR (Transmission Line)	State DEQ						_____	_____				
Producer	Development Drilling									_____	_____	_____	
Utility	Plant Construction									_____	_____	_____	
Utility	Install Transmission Line									_____	_____	_____	

Possible Subsequent Additions (MWe) and On Line Date: 50 - 1990, 50 - 1991, 50 - 1992, 50 - 1993, 100 - 1994, 100 - 1995, 100 - 1996, 100 - 1997, 100 - 1998, 100 - 1990

SITE: CORPUS CHRISTI, TX

SUMMARY

LARGEST USGS SUBAREA: DT₂⁽⁷⁾

SUBAREA CHARACTERISTICS:

Average Temperature °C: 169

Average Salinity--TDS (g/l): 33

Average Depth to Top of Geopressure (km): 2.68

Average Pressure (MN/m²): 86.3

Methane Content of Water (std. m³/m³): 9.2

GEOPRESSURED DEVELOPMENT STATUS:

LOCAL AND STATE ATTITUDE TOWARD GEOPRESSURED DEVELOPMENT:

LAND USE AND POPULATION:

Site is an urban industrial center located in Neuces Co. Land use outside Corpus Christi is predominantly agricultural.

COMMENTS AND CRITICAL ISSUES:

Corporate offices of Central Power and Light in Corpus Christi.

SITE: CORPUS CHRISTI, TX

SITE: CORPUS CHRISTI, TX

SITE LOCATION AND PHYSICAL DESCRIPTION

COUNTY: Corpus Christi is an urban center located in Neuces County.

ADJACENT COUNTIES: San Patricio, Jim Wells, Kleberg.

LAND OWNERSHIP AND LEASING: Land has been leased by many major and independent oil companies. (20)

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
Flat plains, located on Corpus Christi Bay.	Corpus Christi is an industrial center surrounded by agricultural land use, chemical and petrochemi- cal manufacturing, metals manufac- turing and fabrication, mining, agricultural product processing, shipping, fishing, and tourism. The corporate offices of Central Power and Light Company are in Corpus Christi. (21-V)			

SITE: CORPUS CHRISTI, TX

GEOPRESSURED RESERVOIR CHARACTERISTICS BY SUBAREA *

SUBAREA	AVERAGE DEPTH TO TOP OF GEOPRESSURE km	AVERAGE PRESSURE MN/m ²	AVERAGE TEMPERATURE °C
DT ₂	2.68	86.3	169
CT ₁	2.47	81.4	172

SUBAREA	AVERAGE SALINITY (TDS g/l)	METHANE CONTENT OF WATER std. m ³ /m ³ **	SAND AQUIFIER	
			AVERAGE PERMEABILITY md	AVERAGE POROSITY %
DT ₂	33	9.2	20	20
CT ₁	24 ⁺	8.9	20	19

* Subareas are defined in the USGS Circular 726, Assessment of Geothermal Resources of the United States--1975. Characterization of the subareas is expected to change as geopressured resource assessment progresses.

** Location of the subareas may be found on the site map.

Based on solubility of methane at average pressure, temperature, and salinity.

+Salinity as NaCl calculated from spontaneous potential of well logs.

SITE: CORPUS CHRISTI, TX
GEOTHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT

SITE: CORPUS CHRISTI, TX

INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)
<p>EIA needed for area adjacent to large urban area.(20)</p> <p>Environmental Baseline Study needed for background data on environment.(20)</p>		

SITE: CORPUS CHRISTI, TX

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds
 Precipitation (Annual): 71.1 to 81.3 cm (28 - 32 inches)⁽⁶⁾
 Average Temperature
 Minimum: 10.0 to 15.6°C (50-60°)
 Maximum: 26.7 to 32.2°C (80-90°F)

Relative Humidity
 (Seasonal Peaks)
 Summer: 70-80% (6)
 Winter: 70-80%

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
	Corpus Christi is located on the Corpus Christi Bay, which is fed by the Nueces and Frio Rivers.		Bluestem - Sacahuista prairie. ⁽⁶⁾		

SITE: CORPUS CHRISTI, TX

POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR: Corpus Christi is an urban center located in Neuces County, which has a county population significantly greater than the state average. Out-migration in Neuces County is high. Median earnings and the standard of living for the county are below the state average. The Corpus Christi SMSA includes Neuces and San Patricio Counties. There is a large Mexican-American population in the SMSA.(21-V)

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES IN URBAN AREA	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
Corpus Christi	0	~ 215,000 (1973 estimate) (21-V)	Two 138 kv lines and a 352.8 MW steam plant with an additional 325.0 MW steam under construction owned by Central Power and Light Company (CPL, privately owned) are in Corpus Christi. Within 30 miles of the Corpus Christi urban area, there are numerous 138 kv capacity lines currently operating at 69 kv each. The following generation plants are in the area: 26.7 MW internal combustion owned by Robstown (municipality); 574.2 MW and 595.5 MW steam plants owned by CPL; 135.8 MW internal combustion, 24.0 MW steam and 15.0 MW combustion turbine plants owned by Reynolds Metals Co. (industrial).(33-III)	Numerous highways into the city. (34)	Rail lines into city.(34) Major crude oil and products pipelines in Neuces County (outside the Corpus Christi urban area).(6)

SITE: KENEDY COUNTY, TX

SITE: KENEDY COUNTY, TX (STATE/PRIVATE LAND)
POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
BLM, State, County	Process Environmental Reports	State DEQ		_____									
Owner	Lease Land	Developer		_____									
State	Issue Drilling Permits	Developer		_____									
Developer	Preliminary Geophysical Exploration				_____								
Developer	Exploratory Drilling and Reservoir Evaluation				_____								
Developer	Develop Utility Interest				_____								
Developer and Utility	Feasibility Study				_____								
Producer (Developer) and Utility	Financial Negotiations							_____					
Producer and Utility	Site Selection							_____					
Producer and Utility	Commitment to Development							_____ Δ					
Producer and Utility	Design (Preliminary, Final)							_____					
Utility	Prepare Environmental Data Statement	County State						_____					
State	Certify Plant and Site, Issue Permits	Producer and Utility						_____					
State, County	Process EIR (Drilling)	State DEQ						_____					
State PUC	Process EIR (Plant)	State DEQ						_____					
State PUC	Process EIR (Transmission Line)	State DEQ						_____					
Producer	Development Drilling										_____		
Utility	Plant Construction										_____		
Utility	Install Transmission Line										_____		

Possible Subsequent Additions (MWe) and On Line Date: 50 - 1990, 50 - 1991, 50 - 1992, 50 - 1993, 50 - 1994

SITE: KENEDY COUNTY, TX

SUMMARY

LARGEST USGS SUBAREA: $ET_1^{(7)}$

SUBAREA CHARACTERISTICS:

Average Temperature $^{\circ}C$: 168

Average Salinity--TDS (g/l): 34 (Salinity as NaCl calculated from spontaneous potential of well logs).

Average Depth to Top of Geopressure (km): 2.96

Average Pressure (MN/m^2): 83.4

Methane Content of Water (std. m^3/m^3): 8.8

GEOPRESSURED DEVELOPMENT STATUS:

Exxon has done oil and gas development in the county. ⁽²⁰⁾

LOCAL AND STATE ATTITUDE TOWARD GEOPRESSURED DEVELOPMENT:

LAND USE AND POPULATION:

Extremely sparse population. Large ranches. Few utilities or roads. ^(21-V)

COMMENTS AND CRITICAL ISSUES:

SITE: KENEDY CO., TX

SITE: KENEDY COUNTY, TX

SITE LOCATION AND PHYSICAL DESCRIPTION

COUNTY: Kenedy County

ADJACENT COUNTIES: Willacy, Hidalgo, Brooks, Kleberg⁽⁶⁾

LAND OWNERSHIP AND LEASING: EXXON holds all leases at Kings Ranch.⁽²⁰⁾

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
Flat plains with more than 50% of the area covered by sand. ⁽⁶⁾	Primarily petroleum production and ranching. ^(21-V) Padre Island National Seashore off Kenedy Coast. ⁽³⁴⁾			

SITE: KENEDY COUNTY, TX

GEOPRESSURED RESERVOIR CHARACTERISTICS BY SUBAREA*

SUBAREA	AVERAGE DEPTH TO TOP OF GEOPRESSURE km	AVERAGE PRESSURE MN/m ²	AVERAGE TEMPERATURE °C
DT ₁	2.92	88.3	172
ET ₁	2.96	83.4	168

SUBAREA	AVERAGE SALINITY (TDS g/l)	METHANE CONTENT OF WATER std. m ³ /m ³ **	SAND AQUIFIER	
			AVERAGE PERMEABILITY md	AVERAGE POROSITY %
DT ₁	23	9.1	25	19
ET ₁	34 ⁺	8.8	20	19

* Subareas are defined in the USGS Circular 726, Assessment of Geothermal Resources of the United States--1975. Characterization of the subareas is expected to change as geopressured resource assessment progresses.

** Location of the subareas may be found on the site map.

Based on solubility of methane at average pressure, temperature, and salinity.

+Salinity as NaCl calculated from spontaneous potential of well logs.

SITE: KENEDY COUNTY, TX

GEOHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
<p>No geothermal development. EXXON holds all leases and has developed site for oil and gas only.(20)</p>	

SITE: KENEDY COUNTY, TX

INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)
Need EIA for wells. Remote area-- probably no need for EBS (Environmental Baseline Studies). (20)		

SITE: KENEDY COUNTY, TX

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds

Precipitation (Annual): 61.0 - 71.1 cm (24-28 inches) (6)

Average Temperature

Minimum: 15.6 to 21.1°C (60-70°F) (6)

Maximum: 26.7 to 32.2°C (80-90°F)

Relative Humidity

(Seasonal Peaks)

Summer: 70-80% (6)

Winter: 70-80%

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
	Kenedy County is on the Gulf of Mexico. Numerous small lakes in the County. (6)		Southern cord- grass prairie along the coast, mesquite-live oak savanna inland. (6)		

SITE: KENEDY COUNTY, TX

POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR:

Kenedy County is one of the least populated counties in Texas with a total county population of 699. Most of the population is housed on large ranches.(21-V)

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES IN COUNTY	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
Sarita (largest population center in county)		185(21-V)	There is a 138 kv power line in western half of county, running north-south, owned by Central Power and Light (private). (33-III)	Missouri Pacific RR and U.S. Hwy. 77 bisect the County north- south.(24)	Pipelines in geopressured area.(20)

SITE: MATAGORDA COUNTY, TX

SITE: MATAGORDA COUNTY, TX (STATE/PRIVATE LAND)
POSTULATED SITE DEVELOPMENT SCHEDULE (FOR FIRST 50 MWe PLANT)

OPERATING ENTITIES	ACTIVITY	RECIPIENTS	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
County, State	Process Environmental Reports	State DEQ											
Owner	Lease Land	Developer											
Developer	Issue Drilling Permits	Developer											
Developer	Preliminary Geophysical Exploration												
Developer	Exploratory Drilling and Reservoir Evaluation												
Developer	Develop Utility Interest												
Developer and Utility	Feasibility Study												
Producer (Developer) and Utility	Financial Negotiations												
Producer	Site Selection												
Producer and Utility	Commitment to Development												
Producer and Utility	Design (Preliminary, Final)												
Utility	Prepare Environmental Data Statement	County, State											
State	Certify Plant and Site, Issue Permits	Producer and Utility											
State, County	Process EIR (Drilling)	State DEQ											
State PUC	Process EIR (Plant)	State DEQ											
State PUC	Process EIR (Transmission Line)	State DEQ											
Producer	Development Drilling												
Utility	Plant Construction												
Utility	Install Transmission Line												

Possible Subsequent Additions (MWe) and On Line Date: 50 - 1990, 50 - 1991, 50 - 1992, 50 - 1993, 50 - 1994, 100 - 1995, 100 - 1996

SITE: MATAGORDA COUNTY, TX

SUMMARY

LARGEST USGS SUBAREA: ET₃⁽⁷⁾

SUBAREA CHARACTERISTICS:

Average Temperature °C: 146

Average Salinity--TDS (g/l): 27

Average Depth to Top of Geopressure (km): 2.37

Average Pressure (MN/m²): 80.4

Methane Content of Water (std. m³/m³): 7.8

GEOPRESSURED DEVELOPMENT STATUS:

Environmental Baseline statement completed for the County. (20)

LOCAL AND STATE ATTITUDE TOWARD GEOPRESSURED DEVELOPMENT:

LAND USE AND POPULATION:

Rice farming, and production of petroleum, sulfur, and other mineral resources. (21-V)

COMMENTS AND CRITICAL ISSUES:

SITE: MATAGORDA CO., TX

SITE: MATAGORDA COUNTY, TX

SITE LOCATION AND PHYSICAL DESCRIPTION

COUNTY: Matagorda County

ADJACENT COUNTIES: Calhoun, Jackson, Wharton, Brazoria⁽⁶⁾

LAND OWNERSHIP:

TOPOGRAPHY	PRESENT LAND USE	FUTURE LAND USE PLANS	AESTHETICS	HISTORICAL/ ARCHAEOLOGICAL SIGNIFICANCE
Flat plains	Rice farming, and production of petroleum, sulfur, and other mineral resources.(21V)			

SITE: MATAGORDA COUNTY, TX
GEOPRESSURED RESERVOIR CHARACTERISTICS BY SUBAREA *

SUBAREA	AVERAGE DEPTH TO TOP OF GEOPRESSURE km	AVERAGE PRESSURE MN/m ²	AVERAGE TEMPERATURE °C
DT ₃	2.41	80.4	153
ET ₃	2.37	80.4	146

SUBAREA	AVERAGE SALINITY (TDS g/l)	METHANE CONTENT** OF WATER std. m ³ /m ³	SAND AQUIFIER AVERAGE PERMEABILITY md	AVERAGE POROSITY %
DT ₃	28	8.0	25	20
ET ₃	27	7.8	35	21

* Subareas are defined in the USGS Circular 726, Assessment of Geothermal Resources of the United States--1975. Characterization of the subareas is expected to change as geopressured resource assessment progresses.

** Location of the subareas may be found on the site map.

Based on solubility of methane at average pressure, temperature, and salinity.

SITE: MATAGORDA COUNTY, TX

GEOHERMAL DEVELOPMENT STATUS

PRESENT DEVELOPMENT STATUS	PROJECTED OR PLANNED DEVELOPMENT
Oil and gas development in area. No geothermal development at present.(20)	

SITE: MATAGORDA COUNTY, TX
 INSTITUTIONAL CONSIDERATIONS

INSTITUTIONAL REQUIREMENTS	AGENCY AND PUBLIC ATTITUDES	STATUS OF REQUIREMENTS (i.e., EIA/EIS WRITTEN)
		Environmental Baseline Statement has been completed for Matagorda County. (20)

SITE: MATAGORDA COUNTY, TX

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

Prevailing Winds
 Precipitation (Annual): 81.3 to 121.9 cm (32-40 inches)⁽⁶⁾
 Average Temperature
 Minimum: 10.0 to 15.6°C (50-60°F) ⁽⁶⁾
 Maximum: 26.7 to 32.2°C (80-90°F)

Relative Humidity
 (Seasonal Peaks)
 Summer: 70-80%
 Winter: 70-80% ⁽⁶⁾

AIR QUALITY (Including PPM, Type of Pollutant, Measuring Station)	WATER QUALITY (Quality, Supply, Ownership/Water Rights)	NOISE (Level, Source Measuring Station)	BIOLOGICAL ENVIRONMENT		
			DOMINANT FLORA	DOMINANT FAUNA	ENDANGERED SPECIES (Flora and Fauna)
	Numerous rivers in the County. ⁽³⁴⁾		Southern cord- grass prairie along the coast Bluestem- Sacahuista prairie ⁽⁶⁾ inland.		

SITE: MATAGORDA COUNTY, TX

POPULATION, TRANSPORTATION, AND UTILITIES

GENERAL DESCRIPTION OF POPULATION AT THE RESERVOIR:

Population of 24 persons per square mile in County with 55% of the population in urban areas. Out-migration exceeds in-migration in County. County population ~ 30,000.(21-V)

CLOSEST POPULATION CENTERS			POWER PLANTS AND TRANSMISSION LINES IN COUNTY	ROADS SERVICING AREA AND DISTANCE FROM SITE	OTHER UTILITIES OR RIGHTS-OF-WAY AND DISTANCE FROM SITE
NAME	DISTANCE FROM RESOURCE	POPULATION			
Bay City (County Seat)	(90 miles) from Matagorda County(21-V)	13,000	There are two 138 kv lines and a 138 kv capacity line operating at 69 kv in the County. All of the lines are owned by Central Power and Light Company (private). (33-III)	State Highways 61, 35 and 71 in the County.(34)	Crude oil and products, and natural gas pipe- lines in the County.(6)
Freeport		12,000			
Houston		1,100,000			

APPENDIX A--REFERENCES

APPENDIX A

REFERENCES

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