National Geothermal Information Resource
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Berkeley, CA 94720 USA
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file

August 1977

GL04185

COMPUTER SEARCHES AVAILABLE FROM THE GRID DATABASE

The National Geothermal Information Resource (GRID) of the Lawrence Berkeley Laboratory is sponsored by the U.S. Energy Research and Development Administration (ERDA) to develop a comprehensive compilation of worldwide literature and data designed to assist in the research and development of geothermal energy for both electrical and non-electrical uses. Included in this compilation is site-dependent and site-independent material related to geothermal exploration, reservoir utilization, physical chemistry, as well as environmental, legal, and economic aspects of geothermal energy. GRID maintains a computerized database which provides the basis for in-depth literature reviews and critical evaluations of the status of data by the technical staff. In addition, computer-produced bibliographies and data tabulations are generated from the databases for distribution at a fixed cost of $19 for ERDA users and $25 for non-ERDA users per search.

Information in the GRID files includes the following:

EXPLORATION considers resource data including geological, geochemical, and geophysical methods, as well as drilling, resource assessment, and land-use factors involved in locating and evaluating high temperature geothermal resources.

ENVIRONMENTAL considers aspects to the air, land, and water environments of geothermal energy utilization: subsidence, hydrogen sulfide.

PHYSICAL CHEMISTRY deals with the basic thermodynamic and transport data at elevated temperatures and pressures of sodium chloride and other salts.

UTILIZATION encompasses the development and production of a geothermal reservoir for both electrical and non-electrical uses: hot water (brine) transport; space, process, and agricultural heating; corrosion, erosion, and scaling.

NUMERICAL DATA contains site-independent and site-dependent tables.

Please specify your literature and data requests in detail to avoid receiving extraneous information. Examples of requests:

1. Please send a listing of geophysical measurements for the Mono-Long Valley area from 1974-1976.
2. We would like a compilation of numerical data on the viscosity of NaCl solutions from 50°C to 150°C.
3. Please send a listing of references studying the toxicological effects of H_2S to vegetation from 1975 to 1977.
4. Which organizations are involved in corrosion and scaling control for geothermal brines?

NATIONAL GEOTHERMAL INFORMATION RESOURCE ORDER FORM

Please send the following:

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Mail to:

National Geothermal Information Resource
LAWRENCE BERKELEY LABORATORY
University of California
Berkeley, California 94720 USA

Lawrence Berkeley Laboratory
University of California
Berkeley, California 94720
Telephone 415/843-2740

January 9, 1979

J. Stringfellow
University of Utah Research Institute
University of Utah
Salt Lake City, UT 84112

Dear Mr. Stringfellow:

The National Geothermal Information Resource (GRID) of the Lawrence Berkeley Laboratory is developing a site-specific computer file on geothermal areas under funding provided by the Department of Energy. An objective of this work is to compile information useful in evaluating the potential of each area for producing electrical power. The current national effort to develop geothermal power production has greatly accentuated the need for reliable site-specific data. New geothermal areas are being evaluated and drilled, new processes and materials are developed for high temperature and highly corrosive environments. These activities all underline the need for more and better data.

Because of your interest in geothermal energy power production, I have sent by separate mail a copy of our computer file on geothermal exploration and evaluation, LBL-3220, Vol. I, containing references to data on geothermal areas. The bibliography is intended to alert users of data to new results of interest to them; results that may not get into the standard tabulations for many years. Additional copies may be obtained at a cost of $40.00 each from: National Geothermal Information Resource, Lawrence Berkeley Laboratory, University of California, Berkeley, California, 94720.

We expect to maintain this database by adding new information from the best available sources. In this connection, we would very much appreciate copies of any reports or publications from your organization dealing with geothermal power production. In particular, could you provide reports on leasing, applications for permits to drill, environmental assessments, reservoir fluid data, cost of electricity and other relevant data. The information will be added to our database and be made generally available.

Thank you for your time, and I look forward to receiving your comments.

Sincerely,

Sidney L. Phillips

Sidney L. Phillips
Principal Investigator
National Geothermal Information Resource

SLP:sp

Lawrence Berkeley Laboratory
University of California
Berkeley, California 94720
Telephone 415/843-2740

November 21, 1978

The National Geothermal Information Resource (GRID) of the Lawrence Berkeley Laboratory is compiling site-specific information which can be used as reference data under funding provided by the Department of Energy. An objective of this file (ENCON) is to collect data useful in evaluating the potential of each geotnermal area to produce electrical power. In scanning the published material, we have collected data which originated from your organization. In this context, I have enclosed copies of our ENCON file for any corrections, additions or deletions in the data attributed to your organization.

We expect to maintain this database by adding new information from the best available sources. Thus, we would very much appreciate copies of any reports or publications from your organization dealing with geothermal power production. This data includes permits, drilling, environmental assessments, reservoir properties, scaling tests, notice of intent, leasing, spent fluid treatment, plant construction and transmission lines. The information will be added to our database and be made generally available.

Could I have your comments in two weeks so that we can meet our publication deadline? Thank you for your time, and I look forward to receiving your comments.

Sincerely,

Sidney L. Phillips

Sidney L. Phillips
Principal Investigator
National Geothermal Information Resource

SLP:sp
Encl.

DATA ELEMENT	DATA ENTRY
General Information	
Record Number-	14
Site Name-	Cove Fort-Sulphurdale
Location-Country-	United States
State-	Utah
County-	Millard & Beaver
Project Life-Years/Output-	1500 MWe/30 years (Trehan 78), 277 MWe/30 years (White 75), 500-1500 MWe/30 years (Williams 78)
Site Developer-Federal-	Department of Energy (Trehan 78)
State-	
Industrial-	Union Oil Co., Phillips Petroleum Co., O'Brien Resources Corp., Chevron Oil Co., W.H. Hunt, Amax Exploration, Gillette, Geothermal Power Co.
Site Description-	
Terrain- (desert to lower Sonoran)	Forest and open woodland with some grazing, in area of low and high mountains, adjacent to National Forest (Williams 78)
Areal Extent-	Total KGRA acres = 24,874 (Trehan 78, Williams 78) Subsurface area = 15 km^2 (White 75)
Nearest Community-	24 km from Manderfield, 40 km from Beaver, 19 km from Kanosh (Williams 78)
Access Roads-	Interstate Routes 70 and 15 at the site, primary railroad within 24 km of site (Williams 78)
Comments-	May be a vapor-dominated geothermal system, or it may be an extension of the Roosevelt Hot Springs system (Williams 78, White 75). Volume of reservoir = 22.5 km^3 best estimate (White 75)
Reservoir Parameters	
Fluid Temperature-	*100-240°C, best estimate = 200°C (Trehan 78, White 75)
Well Cost-	Direct cost of Forminco #1 = $600,000 (Trehan 78). For well depth of 2000m, the default cost per production well = $1,523,129 the default cost per injection well = $1,015,420 (Trehan 78)
Field Flow Rate-	
Well Life-	*10 years (Trehan 78)
Noncondensible Gas Content-	
Steam Quality-	
Wellhead Temperature-	
Fluid Rate-	Default Flow Rate = 264,817 kg/hour/well (Trehan 78)
Enthalpy-	
Operational Parameters /not applicable	
Plant Size-	*50 MWe (Trehan 78)
Plant Cost-	
Power Cost to Load Center-	*42.1 mills/kwh in 1985, *55 mills/kwh in 1977 (Trehan 78)
Power Cycle (Flashed, Binary)-	Binary (Trehan 78)
O & M Cost-	*2.852 mills/year (Trehan 78)
Well Spacing-	
Parasitic Power-	
Well Replacement Rate, Per Year (Infield Drilling)-	
Heat Transfer Coefficient, U Factor-	

DATA ELEMENT	DATA ENTRY
Well Drilling Data-	See Table 1
Well Completion Type (Slotted; Open)-	
Depth to Production-	*1500 m (White 75, Trehan 78)
Wellhead Pressure-	
Materials Used-	
Piping-	
Valves-	
Throttle Plates-	
Pumping Wells, Number-	
Non-Producing Wells, Number-	

Environmental Aspects

Gas Data-	
Sample Date-	
H_2S-	
CO_2-	
Other-	
Fluid Data-	
Sample Data-	
Boron-	
Total Dissolved Solids-	
pH-	
Silica-	
Bicarbonate-	
Carbonate-	
Sulfide-	
Sulfate-	
Waste Water Disposal Method-	
Pre-Disposal Treatment Method-	
Subsidence-	
Environmental Impact Report-	
Environmental Impact Statement-	EAR/EIS completed for Forest Service (Beeland 78)
Comments-	EA #57 completed in Feb. 77 (Geological Survey 77B), EA #94 completed in Oct. 77 (Geological Survey 77C), EA #90 in preparation Oct. 77 (Geological Survey 77C). Environmental Analysis Report completed Jan. 75 (Bureau of Land Management 75). Soil Survey Report prepared for Forest Service by Earth Environmental Consultants, Inc., Albuquerque, New Mexico, April 1978.

Reservoir Engineering

Recharge Source-	
Rock Porosity-	
Reservoir Rocks-	Paleozoic sediments, Tertiary volcanics (Williams 78)
Thermal Conductivity-	
Permeability-	

Land Use Factors

Well Spacing-	
Land Improvements Needed- (Clearing, Grading, Roads, Parking)-	

DATA ELEMENT	DATA ENTRY
State Income Tax-	
Federal Income Tax-	
Bond Interest-	

Injection Well Data

Fluid Flow Rate-
Well Stimulation-
Reinjection Power Required-
Comments-

Note: A preceding * indicates inferred, calculated or planned.

Table 1

Well Drilling Data

Well Name	Company	Depth	Comp. Date
Forminco #1	Union Oil Co.	351 M	9/2/76 (Smith 77B, Witham 76)
S1	Phillips Petroleum Co.		2/28/75 (Witham 76)
Cove Fort-Sulphurdale #42-7	Union Oil Co.	2358 M	(Smith 78C)

Union received a contract from Department of Energy to drill, test and provide data from three 3048 M holes in the Cove Fort-Sulphurdale area. Department of Energy's maximum cost would be $2,559,258 (Hot Line 77H).

By February 1977 Union and Phillips had filed for permits to drill up to 33 deep wells, pending preparation of an environmental assessment by the Forest Service (Williams 78, Trehan 78). Union Oil Co. received permit approval for 23 drill sites (Beeland 78)

DATA ELEMENT	DATA ENTRY
General Information	
Record Number-	12
Site Name-	Roosevelt Hot Springs KGRA
Location-Country-	United States
State-	Utah
County-	Beaver
Project Life-Years/Output-	33 MWe/centuries (White 75); 500-1000 MWe/30 years (Williams 78)
Site Developer-Federal-	Bureau of Land Management, Dept. of Energy
State-	University of Denver (Geyser Oct 77)
Industrial-	Phillips Petroleum, Getty Oil, Union Oil, Thermal Power (Natomas Co.), Rogers International, O'Brien Resources Corp., Chevron Oil Co., Arco, Thermal Exploration Amax Exploration, Inc., Utah Power & Light (Williams 78)
Site Description-	
Terrain-	High desert, bordered by mountains (Williams 78)
Areal Extent-	29,791 acres KGRA
Nearest Community-	Milford, 15 miles south (Smith 77)
Access Roads-	State Highway 257 within view (Williams 78)
Comments-	Reservoir volume, 8 km^3 (White 75)
Reservoir Parameters	
Fluid Temperature-	260°C (Geothermal Energy Magazine 78), 230°C (White 75), 205-260°C (Phillips 76), 222°C (Geyser Jan 77)
Well Cost-	*$1.2 million (Burbank 77)
Field Flow Rate-	*4677.2 klb/hr (Burbank 77)
Well Life-	*20 years (Burbank 77)
Noncondensible Gas Content-	
Steam Quality-	17% (Smith 77)
Wellhead Temperature-	222°C (Smith 77B)
Fluid Rate-	1.5 million lb/hr (Smith 77)
Enthalpy-	
Operational Parameters	
Plant Size-	*750 MWe hybrid (Burbank 77), 52 MWe flash steam (Geothermal Energy Magazine 78)
Plant Cost-	*$367 million (1976 dollars) (Burbank 77), $35 million (Geothermal Energy Magazine 78)
Power Cost to Load Center-	*19.34 mills/kwh (Burbank 77)
Power Cycle (Flashed, Binary)-	*Hybrid, coal-geothermal (Burbank 77), *Double flash steam cycle planned for the 52 MWe plant
O & M Cost-	*$13 million/year (Burbank 77)
Well Spacing-	
Parasitic Power-	
Well Replacement Rate, Per Year (Infield Drilling)-	*0.06697 well/year (Burbank 77)
Heat Transfer Coefficient, U Factor-	*245 BTU/hour/ft^2/°F (Burbank 77)
Heat Rejection (Wet Cooling; Dry Cooling)-	*Wet cooling, no cooling water make-up
Make-up Water Cost-	
Wet Bulb Temperature-	
Hot Water Transmission (Direct Utilization)	
Pipe-	
Pipe Material-	

DATA ELEMENT	DATA ENTRY
Pumping Wells, Number-	9 exploration wells to depths 370-2300 meters (Lenzer 77)
Non-Producing Wells, Number-	Case history of well Utah State 72-16 (Rudisill 78)
Comments-	
Environmental Aspects	
Gas Data-	
Sample Date-	
H_2S-	<1 ppm (Geothermal Energy Magazine 78)
CO_2-	
Other-	
Fluid Data-	
Sample Date-	1975
Boron-	25-29 ppm (Phillips 76)
Total Dissolved Solids-	6500-7100 ppm (Phillips 76)
pH-	6.3-6.5 (Phillips 76)
Silica-	550 ppm (Phillips 76)
Bicarbonate-	180-200 ppm (Phillips 76)
Carbonate-	
Sulfate-	54-59 ppm (Phillips 76)
Waste Water Disposal Method-	
Pre-Disposal Treatment Method-	
Subsidence-	Water table withdrawal caused 183 cm subsidence (Williams 78)
Environmental Impact Report-	
Environmental Impact Statement-	
Comments-	
Reservoir Engineering	
Recharge Source-	Two sources postulated for hot water: 1) deep meteoric ground water heated by high geothermal gradients, 2) water heated by a hot mass such as a cooling still or magma complex occurring at shallow depths and fractured by the faulting that extends to the surface (Meidav 76)
Rock Porosity-	
Reservoir Rocks-	Altered volcanic (Williams 78); granitic and metamorphic rocks (Crosby 77)
Thermal Conductivity-	
Permeability-	
Land Use Factors	
Well Spacing-	
Land Improvement Needed- (Clearing, Grading, Roads, Parking)-	
Existing Land Use-	Mining, Agriculture, Tourism (Williams 78)
Physical Conditions (Climate, Accessibility)-	Average temperature = -3°C to 21°C. Relative humidity: summer 30%, winter 60-70%. Precipitation 29.9cm.
Land-Use Planning-	
Fresh Water Suuply (Fire Protection, Cooling Tower, Drinking)-	Petition state engineer or import water (Roxburgh 77)
Water rights-	State Division of Water Rights (Anderson 72)
Proximity to Markets/Transmission Lines	32 km to existing 138 kv line, line being planned near site (Williams 78)

TABLE 1

WELL DRILLING DATA

WELL NAME	COMPANY	DEPTH	COMP. DATE
U-27386 12-35	PHILLIPS PETROLEUM		10/01/75
U-27386 54-3(P)	PHILLIPS PETROLEUM		08/28/75
U-27386 55-3	PHILLIPS PETROLEUM		05/24/75
U-27386 82-33	PHILLIPS PETROLEUM		12/23/75
U-27398 9-1	PHILLIPS PETROLEUM		04/08/75
U-27389 OB.2	PHILLIPS PETROLEUM		02/15/75
U-27399 13-10	PHILLIPS PETROLEUM		11/04/75
U-27390 OB.1	PHILLIPS PETROLEUM		03/12/75
#42-9(S)	PHILLIPS PETROLEUM	2099 M	1975
#25-15(P)	PHILLIPS PETROLEUM	2290 M	1976
UTAH STATE #14-2(P)	THERMAL POWER	1862 M	1976
UTAH STATE #72-16(P)	THERMAL POWER	382 M	1976
UTAH STATE #24-36(O)	THERMAL POWER	1861 M	1977

(SMITH 76, SMITH 77B, SMITH 73C, WITHAM 76)

REMARKS-
- (P) = PRODUCIBLE
- (S) = SUSPENDED
- (A) = ABANDONED
- (O) = OBSERVATION
- (I) = INJECTION

DATA ELEMENT	DATA ENTRY
General Information	
Record Number-	3
Site Name-	Monroe-Joseph KGRA
Location-Country-	United States
State-	Utah
County-	Sevier
Project Life-Years/Output-	
Site Developer-Federal-	
State-	Utah University (Heylmun 66), State Energy Conservation & Development Council (Snow 78)
Industrial-	Terra Tek Inc. (Snow 78)
Site Description-	
Terrain-	Mountainous (Heylmun 66), located on Sevier fault (White 75)
Areal Extent-	16,364 acres KGRA (Jones 76)
Nearest Community-	Monroe, population 1500 (Snow 78)
Access Roads-	
Comments-	Reservoir volumes are 7.5, 2.25 km^3 (White 75); area contains Monroe Hot Springs and Red Hills Hot Springs (Chapman 78)
Reservoir Parameters	
Fluid Temperature-	120-140°C (White 75), 104-187°C for Na-K-Ca and SiO_2 (Mase 78), 120°C (250°F) (Snow 78)
Well Cost-	$150,000 for one well (Snow 78)
Field Flow Rate-	
Well Life-	
Noncondensible Gas Content-	
Steam Quality-	
Wellhead Temperature-	
Fluid Rate-	
Enthalpy-	
Operational Parameters	
Plant Size-	
Plant Cost-	$1.5 million (Snow 78)
Power Cost to Load Center-	
Power Cycle (Flashed, Binary)-	
O & M Cost-	
Well Spacing-	
Parasitic Power-	
Well Replacement Rate, Per Year (Infield Drilling)-	
Heat Transfer Coefficient, U Factor-	
Heat Rejection (Wet Cooling; Dry Cooling)-	
Make-up Water Cost-	
Wet Bulb Temperature-	
Hot Water Transmission (Direct Utilization)	
Pipe-	
Pipe Material-	
Pipe Fitting Material-	
Welded Pipe Connections-	
Valves-	

DATA ELEMENT	DATA ENTRY
Environmental Aspects	
Gas Data-	
Sample Date-	
H_2S-	
CO_2-	
Other-	
Fluid Data-	
Sample Date-	
Boron-	
Total Dissolved Solids-	
pH-	
Silica-	
Bicarbonate-	
Chloride-	
Sulfate-	
Waste Water Disposal Method-	
Pre-Disposal Treatment Method-	
Subsidence-	
Environmental Impact Report-	
Environmental Impact Statement-	
Comments-	Landslides in area (Parry 76)
Reservoir Engineering	
Recharge Source-	
Rock Porosity-	
Reservoir Rocks-	
Thermal Conductivity-	
Permeability-	
Land Use Factors	
Well Spacing-	
Land Improvements Needed (Clearing, Grading, Roads, Parking)-	
Existing Land Use-	
Physical Conditions (Climate, Accessibility)-	
Land-Use Planning-	Drilling site will occupy 17 acres (Snow 78)
Fresh Water Supply (Fire Protection, Cooling Tower, Drinking)-	Red Hill Spring (Parry 76)
Water Rights-	
Proximity to Markets/ Transmission Lines-	East of Monroe (Parry 76)
Legal Aspects	
Pre-Leasing Procedures-	
Exploration Permits-	
Leasing-	16,364 acres in KGRA (Jones 76)
Lease Holder(s)-	Union Oil: 2400 acres, Aminoil USA: @4067 acres (Geological Survey 77)

DATA ELEMENT	DATA ENTRY
General Information	
Record Number-	19
Site Name-	Thermo KGRA
Location-Country-	United States
State-	Utah
County-	Beaver
Project Life-Years/Output-	Zero-500 MWe/30 years (Williams 78)
Site Developer-Federal-	
State-	
Industrial-	O'Brien Resources Corp. (Williams 78), Republic Geothermal (Smith 78)
Site Description-	
Terrain-	Desert shrubland (Williams 78)
Areal Extent-	26,091 acres KGRA (Jones 76)
Nearest Community-	25 km from Minersville and 50 km from Beaver (Williams 78)
Access Roads-	25 km from State Road 21, railroad tracks at site (Williams 78)
Comments-	May be part of Roosevelt and Cove Fort-Sulphurdale system (Williams 78), 16 hot springs in two groups, travertine deposits, reservoir volume = 2.25 km^3, reservoir surface area = 1.5 km^2 (White 75)
Reservoir Parameters	
Fluid Temperature-	200°C best estimate (White 75), 177-204°C (Smith 78C)
Well Cost-	
Field Flow Rate-	
Well Life-	
Noncondensible Gas Content-	
Steam Quality-	
Wellhead Temperature-	
Fluid Rate-	
Enthalpy-	
Operational Parameters	
Plant Size-	*50 MWe (Trehan 78)
Plant Cost-	*35.4 million (Trehan 78)
Power Cost to Load Center-	*45.9 mills/kwh in 1977, *33.2 mills/kwh in 1988 (Trehan 78)
Power Cycle (Flashed, Binary)-	*Binary (Trehan 78)
O & M Cost-	*2.7 million/year (Trehan 78)
Well Spacing-	
Parasitic Power-	
Well Replacement Rate, Per Year (Infield Drilling)-	
Heat Transfer Coefficient, U Factor-	
Heat Rejection (Wet Cooling; Dry Cooling)-	
Make-up Water Cost-	
Wet Bulb Temperature-	
Hot Water Transmission (Direct Utilization)	
Pipe-	
Pipe Material-	
Pipe Fitting Material-	
Welded Pipe Connections-	
Valves-	

DATA ELEMENT	DATA ENTRY
Insulation-	
Material-	
Installation-	
Thickness-	
Casing-	
Material-	
Installation-	
Site Work-	
Pipe Installation-	
Anchor Pad Material-	
Pipe Support Material-	
Support Installation-	
Site Clearing and Grading-	
Pumps-	
Material-	
Installation-	
Comments-	
Field Baseline Data	
Thermal Water Temperature-	90°C (White 75), minimum temperature = 77°C (Parry 76), maximum temperature = 85°C (Heylmun 66)
Thermal Water Flow Rate-	12.6 L/sec in 1967 (Mundorf 70), 12 L/sec (Swansberg 74)
Inferred Reservoir Temperature-	195-211°C (Swansberg 74)
Electrical Resistivity Low-	
Heat Flow-	
Thermal Gradient-	
Gravity Survey Value-	The regional gravity map shows the following features: 1) a large north-south trend with total relief of 5 mgal extending through the central portion of the study area, 2) an east-west trend with relief of about 7-8 mgal south of the Star Range and Shauntie Hills, 3) a north-south trend with 5 mgal relief east of Blue Mountain, and 4) a broad low of approximately 5 mgal closure southwest of the Shauntie Hills. (Sawyer 77)
Seismic Noise Correlation-	Some low seismic activity in area (Williams 78)
Pumping Power Required-	
Scale Control-	
Fouling Factor-	
Corrosion Control-	
Well Logging Data-	
Well Test Data-	
Drilling Mud Types-	
Acoustic Log-	
Temperature Log-	
Caliper Log-	
Electrical Resistivity Log-	
Dipmeter-	
Log Interpretation-	
Bottom Hole Pressure-	
Well Drilling Data-	"Escalante" #57-29 was drilled to 2221 m in 1977 by Republic Geothermal (Smith 78C)
Well Completion Type (Slotted; Open)-	
Depth to Production-	*1500 m (Williams 78)
Wellhead Pressure-	
Materials Used-	
Piping-	
Valves-	
Throttle Plates-	

DATA ELEMENT	DATA ENTRY
Pumping Wells, Number-	
Non-Producing Wells, Number-	
Environmental Aspects	
Gas Data-	
Sample Date-	
H_2S-	
CO_2-	
Other-	
Fluid Data-	
Sample Date-	
Boron-	
Total Dissolved Solids-	
pH-	
Silica-	
Bicarbonate-	
Carbonate-	
Sulfide-	
Waste Water Disposal Method-	
Pre-Disposal Treatment Method-	
Subsidence-	
Environmental Impact Report-	
Environmental Impact Statement-	
Comments-	Low salinity (Smith 78C)
Reservoir Engineering	
Recharge Source-	
Rock Porosity-	
Reservoir Rocks-	
Thermal Conductivity-	
Permeability-	
Land Use Factors	
Well Spacing-	
Land Improvements Needed- (Clearing, Grading, Roads, Parking)-	
Existing Land Use-	Desert shrubland, grazed (Williams 78)
Physical Conditions (Climate, Accessibility)-	20.3 to 40.6 cm annual precipitation, -6.7 to 26.7°C average temperature, relative humidity: 30-40% summer, 60-70% winter (Williams 78)
Land-Use Planning-	
Fresh Water Supply (Fire Protection, Cooling Tower, Drinking)-	80 km from Sevier River (Williams 78)
Water Rights-	
Proximity to Markets/ Transmission Lines-	Within 64 km of the site there is one 138 kv N-S line owned by the Utah Power and Light Company (Williams 78)
Legal Aspects	
Pre-Leasing Procedures-	
Exploration Permits-	

DATA ELEMENT	DATA ENTRY
Leasing-	
Lease Holder(s)-	See Table 1
Royalty Payment-	
Restrictions-	
Depletion Allowance-	
Government Regulations-	
Loan Guarantee-	
Primary Term Duration-	
Renewal Leasehold Periods-	
Work Requirements-	
Data Monitoring-	
Water Laws-	
Pollution Control-	
Reinjection Control-	
Air Laws-	
Emissions Control-	
State Income Tax-	
Federal Income Tax-	
Bond Interest-	

Injection Well Data

Fluid Flow Rate-
Well Stimulation-
Reinjection Power Required-
Comments-

Note: A preceding * indicates inferred, calculated or planned.

Table 1. KGRA Lease Sales

STATE KGRA	Unit No.	Date of Lease Sale	Acre-age	No. of Bids	Range of Bidding		High Bidder	Lessee
Thermo	1	6-12-75 2-03-76	1,920	0			Reoffered as tract 12	
	2	6-12-75 2-03-76	1,600	0			Reoffered as tract 13	
	3	6-12-75 2-03-76	1,883	0			Reoffered as tract 14	
	4	6-12-75	1,002	2	5,071.09 -	$ 15,165.36	Chevron Oil Company	Western Geothermal
	5	6-12-75 2-03-76	1,201	0			Reoffered as tract 15	
	6	6-12-75 2-03-76	1,679	0			Reoffered as tract 16	
	7	6-12-75 2-03-76	1,925	0			Reoffered as tract 17	
	8	6-12-75 2-03-76	1,920	0			Reoffered as tract 18	
	9	6-12-75	1,920	1		4,051.20	Thermex Company (Intercontinental Energy Corp.)	Thermex Company
	10	6-12-75	1,920	1		4,051.20	Thermex Company	Thermex Company
	12	2-03-76	1,920	0				
	13	2-03-76	1,600	0				
	14	2-03-76	1,883	3	5,406.47 -	6,344.83	So. Union Production Co.	So. Union Prod. Co.
	15	2-03-76	1,201	3	3,085.49 -	6,147.97	Republic Geothermal	Republic Geothermal
	16	2-03-76	1,679	3	5,460.00 -	12,226.54	So. Union Production Co.	So. Union Prod. Co.
	17	2-03-76	1,925	3	4,657.49 -	10,161.78	So. Union Production Co.	So. Union Prod. Co.
	18	2-03-76	1,920	2	4,053.27 -	6,240.00	Geothermal Resources Intl.	Geo. Resources Intl.
Sub-total		6-12-75 2-03-76	16,970 12,127	4 14	Total of Accepted Bids	$ 23,267.76 41,121.12		

(Geothermal Resources Council 76)

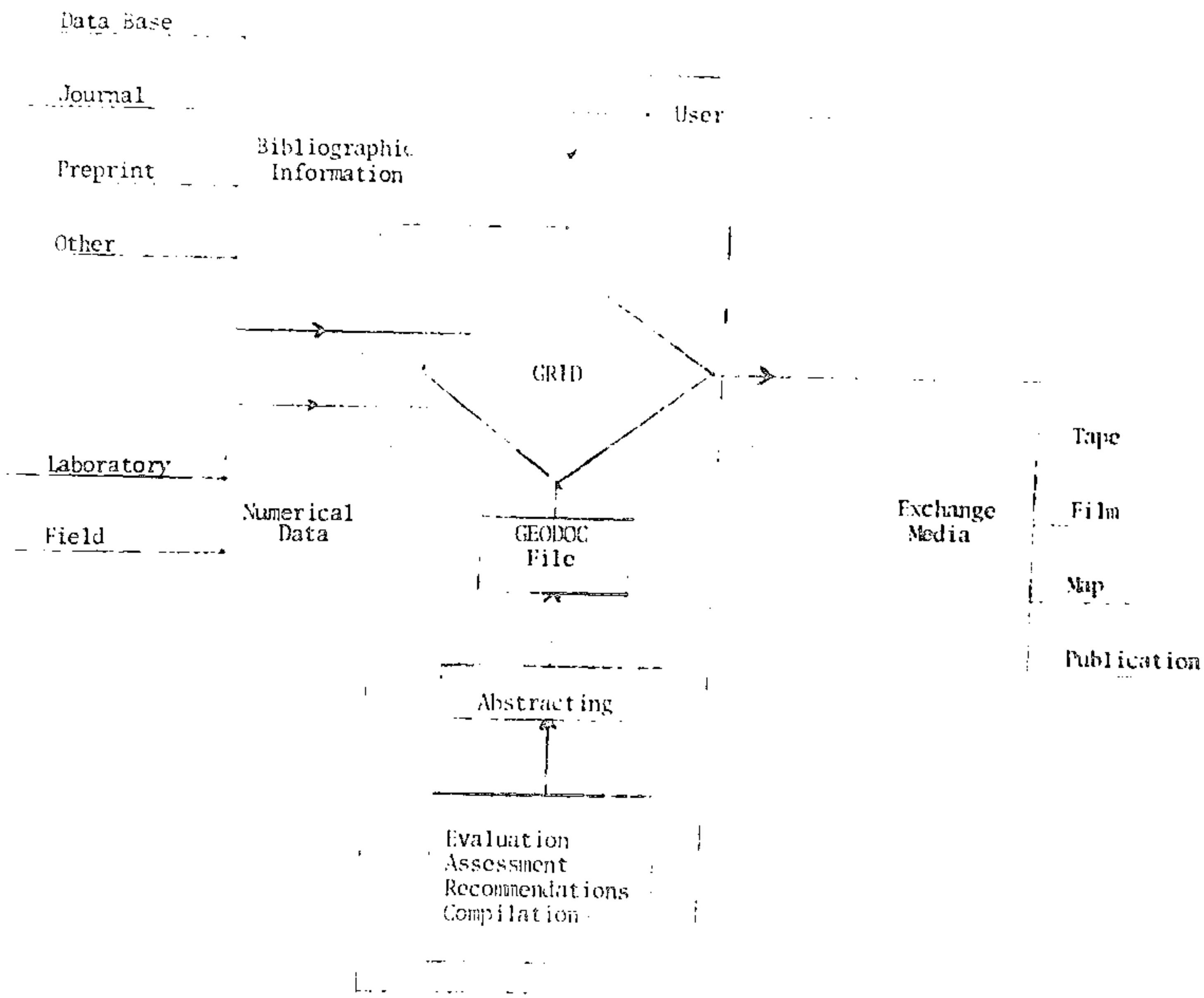

Figure 1. National Geothermal Information Resource (GRID)

necessity for further development work. To fill these information gaps is necessary and urgent; if the gaps are not filled, there is the penalty of unnecessary duplication and expense in research, and the additional expense, not often measurable in monetary terms, that needed energy sources cannot be utilized.

The Lawrence Berkeley Laboratory is sponsored by the Energy Research and Development Administration to establish a National Geothermal Information Resource (GRID). The objective of GRID is mainly to compile and disseminate evaluated data and bibliographic information on the following six major categories of geothermal science and technology: (1) physical chemistry; (2) exploration; (3) utilization; (4) institutional considerations; (5) environmental aspects; and (6) reservoir characteristics. See Figure 1.

GRID is involved in a number of cooperative agreements for the interchange of information and data with other organizations on a worldwide basis; this leads to an active interest in the questions of standards for bibliographic, numerical, and other types of data (e.g., maps). Standards for the interchange of bibliographic data are currently well established, and the utilization of these standards is increasing. GRID's bibliographic file is computer-based and patterned after that of the International Atomic Energy Agency's International Nuclear Information System (INIS). Utilization of the INIS format and file definition ensures that GRID's bibliographic data will be compatible with and usable in other bibliographic systems. Standards for the interchange of data, in general, and bibliographic information, in particular, are discussed below. Appendix II is the GRIDOC Reference Manual, which defines GRID's bibliographic data structure and illustrates this discussion.

Standards for the Interchange of Machine-Readable Data

In the exchange of machine-readable information, there are several levels at which standardization can be discussed. These are: (1) physical characteristics of the medium of exchange (usually, magnetic tape), including size of tape, recording mode, density, block (physical record) structure, interblock gaps, and file marks; (2) overall structure of the file, including character sets and header and trailer labels; (3) format (structure) of individual (logical) records, including the mechanisms(s) for identifiying particular units within each record and specifying their lengths and positions; (4) the types of information to be included with a record (i.e., the data fields or data elements); and (5) the exact definition of the type of information to be included in a data field, its form (or style), and authority files associated with it. Standards for levels 1 and 2 are reasonably well established within the computing community; the following covers levels 3 to 5.

Standards for record formats (or structures) have the advantage of reducing significantly the effort needed to "crack" a new data file and, in addition, can save time and effort when designing a file. Such a standard, established by consensus of suppliers and users of exchanged data, ensures completeness of the information required to decode a tape. The standard structure should permit the recording, without distortion, of all types of data whose inclusion can be anticipated. To the extent possible, such a structure should be hardware and software independent.

Software includes operating systems, and, to an increasing degree, data management systems. Few data management systems are hospitable to all types of data; nearly every one has some restrictions, around which its users must work. Examples of restrictions imposed by data management systems are those on the number of data fields for a record, on the length of data fields, and on the number of occurrences of a particular data field or group of fields. It should be kept in mind that such a structure is for interchange only and says nothing about structures for internal use. The format in use in bibliographic data interchange may be briefly described as one in which a fixed format directory (specifying each type of data present, its length and position within the record) precedes a variable-length area (containing the actual data). Although the use of this structure for hierarchical or otherwise linked information is possible, the usual implementation is linear (i.e., with little or no linking of data elements). The principal barrier to implementing such a standard is the investment in local formats for already established data bases.

Establishing standards for the types of information to be carried in a record is even more difficult. Probably the most difficult aspect is anticipating the degree with which information should be delimited. As an example some bibliographic systems tend to include in one undelimited field all of the journal reference information while in others the journal name, volume, issue, page, and date are in separate fields. The higher the degree of separation of discrete units, the greater the flexibility in manipulation (including format checking) possible. In order to produce data that can be used by other groups, GRID has followed the INIS list of types of data. The two major stumbling blocks to adoption of a standard list of data elements are, again, the investments in existing systems, and the costs of processing a detailed structure, whose value may not be apparent initially.

Finally, perhaps the greatest difficulty lies in standardizing the contents of the data fields. These specify, for instance, the order of authors' names; abbreviations for journal names; forms of institutional names; and codes for recurring information, such as journal CODEN, corporate author identifiers, and country codes, which are a final check on the consistency of the entries. The major advantage of standardization in this area is ease of understanding and searching the data, which should be unambiguous. Probably the most difficult standardization problem in the bibliographic area is that of the means of describing the subjects of a document; this problem includes both the style of the subject description and the particular terms or categories used.

Summary

Standardization of data for interchange means that a product generated for one set of users can be used, without needless effort, by a wider community. Aspects subject to standardization include physical characteristics of the medium of exchange; overall structure of the file; structure of the individual records; types of information to be included within a record; and style of the information and authority files associated with it. Standards for the exchange of bibliographic data are well established and in active use throughout the world. GRID utilizes these