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Reston, VA 22092

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Memorandum Date 6/3/76

To: Branch of Plans and Program Management, Publications Division -

From: Chief, Office of Scientific Publications

Subject: New USGS open-file report

The following report was authorized by W. P. Ketterer for the Director on 5/23/77 for release in the open files:

TITLE: GEOTHERM user guide.

AUTHOR(S): James R. Swanson

CONTENTS: 55 p., ___ pls., 10 figs., ___ tables.

Map scale: ___

Depositories:

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Illustrations

Abstract

GEOTHERM is a computerized geothermal resources file developed by the U.S. Geological Survey. The file contains data on geothermal fields, wells, and chemical analyses from the United States and international sources.

The General Information Processing System (GIPSY) on the IBM 370/155 computer is used to store and retrieve data. The GIPSY retrieval program contains simple commands which can be used to search the file, select a narrowly defined subset, sort the records, and output the data in a variety of forms. Eight commands are listed and explained so that the GEOTHERM file can be accessed directly by geologists. No programming experience is necessary to retrieve data from the file.

Introduction

GEOTHERM is the operational computerized file, created by the U.S. Geological Survey, of national and international geothermal resource information. The data base covers geothermal physical and chemical data and is stored and retrieved by the General Information Processing System (GIPSY).

GEOTHERM contains site-dependent geothermal information The format is divided into three sections which contain information on three subtopics: Geothermal field/area, chemical analyses of geothermal fluids, and geothermal well/drill hole.

Section A: Geothermal field/area - This topic contains data on the locality, developments, subsurface dimensions, geology, heat content, etc. of a geothermal field or area.

Section B: Chemical analysis - This topic includes chemical analysis data of geothermal fluids. Space is provided for three types of analyses--water, condensate, and residual gas. Data items include sampling conditions, solutes, and isotopes.

Section C: Geothermal well/drill hole - This topic contains information on geothermal wells. Data items include locality, temperature, pressure, enthalpy, and well flow.

The GEOTHERM input forms are illustrated in figures 1-3.

The rest of this paper is devoted to the use of the GEOTHERM file. No previous computer knowledge is required and the necessary job control language (JCL) is illustrated. Further details on the GIPSY program can be found in the GIPSY "Users Guide" and "Programmer Guide" (University of Oklahoma, 1975).

Geothermal Resources File (GEOTHERM)
Revision 8 (February 1976)

Section A: Geothermal Field-Area (H1)

Record Identification

Record No.	A10	< _ _ _ _ _ _ _ _ >
Cross Index No.	A20	< _ _ _ _ _ _ _ _ >
Revision	A25	< _ >
Record Type	A30	< A >

Reporter

Name	A50	< ________________ >
Date	A60	< _ _ / _ _ > (Yr. / Mo.)
Organization	A70	< ________________ >

Geographic Locality

Name of Field-Area	B10	< ________________ >
Users of Area	B13	< ________________ >
Waring Figure (USGS)	B14	< _ _ >
Waring Number (USGS)	B15	< __________ >
Country Code (List A)	B40	< _ _ >
Country Name	B50	< __________ >
State/Province	B60	< ________________ >
County	B65	< ________________ >
Latitude	B70	< _ _ - _ _ - _ _ | _ > (D M S N/S)
Longitude	B80	< _ _ _ - _ _ - _ _ | _ > (D M S E/W)
Available Maps of Area	B81	< ________________ >

Page 2 - Section A

Township, Range, Section, 1/4, 1/4

B95 < _ _ _ > (Township) B105 < _ _ _ > (Range) B115 < _ _ _ _ _ _ _ _ _ _ _ | _ _ _ _ | _ _ _ > (Section, 1/4, 1/4)

Base & Meridian	B125	< ________ >
Other Locality Information	B83	< ________ >

General Description

Size of Surface Expression	C10	< _ _ _ _ _ _ _ _ _ _ _ | _ _ _ _ _ _ > units
Elevation	B140	< _ _ _ _ _ _ _ _ _ _ _ | _ _ _ _ _ _ > units
Resource Catagory	C15	< _ >
Development Status	C20	< _ >
Present Use & Developments	C30	< ________ >
Potential Use	C40	< ________ >
Inferred Heat Source	C50	< ________ >
Depths to Production Zones		
Zone 1	C70	< _ _ _ _ _ _ _ _ _ _ _ | _ _ _ _ _ _ _ > units
Zone 2	C80	< _ _ _ _ _ _ _ _ _ _ _ | _ _ _ _ _ _ _ > units
Thickness of Production Zones		
Zone 1	C100	< _ _ _ _ _ _ _ _ _ _ _ | _ _ _ _ _ _ _ > units
Zone 2	C110	< _ _ _ _ _ _ _ _ _ _ _ | _ _ _ _ _ _ _ > units
Average Temperature of Production Zones		
Zone 1	C114	< _ _ _ _ _ _ _ _ _ _ _ | _ _ _ _ _ _ > units
Zone 2	C115	< _ _ _ _ _ _ _ _ _ _ _ | _ _ _ _ _ _ > units
Surface Thermal Activity	C120	< ________ >

Page 3 - Section A

Associated Deposits	C130	< ______________________________ >
No. of Hot Springs	C135	< ______ >
Electric Power Capacity	C140	< _______________ units >
Year Production Began	C150	< ______ >
Number of Wells		
Producing	C170	< ______ >
Injection	C180	< ______ >
Test	C190	< ______ >
Abandoned	C195	< ______ >
Other	C200	< ______ >
Total No. of Wells	C210	< ______ >
Principal Exploration Techniques	C220	< ______________________________ >
Comments (General Description)	C230	< ______________________________ >

<u>Geothermal Characteristics</u>

Main Reservoir Fluid	E10	< ____________________ >
Natural Surface Discharge	E20	< _______________ units >
		E16 Measured E17 Estimated (Circle Label)
Total Calculated Discharge of Deep Water	E15	< _______________ units >
Natural Recharge	E30	< _______________ units >
Injection Recharge	E40	< _______________ units >
Total Natural Heat Flux	E50	< _______________ units >
Total Withdrawal Flux	E60	< _______________ units >
Excess Withdrawal/Natural	E70	< ________ >

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Heat Flow of Surrounding Area	E75	< ____ > units
Range of Spring Temperatures	E76	< ____ > units to E77 < ____ > units
Spring Description (if no temp. measured)	E78	< Boiling Hot Warm > (Circle word)
Well information		
Maximum Well Temperature	E95	< ____ > units
Depth Datum	E96	< ____ > units
Bottom-Hole Temperature	E97	< ____ > units
Depth Datum	E98	< ____ > units
Ave. Thermal Gradient	E80	< ____ > units
Comments	E90	< ____ >

<u>Reservoir Properties</u>

Reservoir Temperatures	R15	< ____ > units
to	R20	< ____ > units
	R30 Assumed	R40 Measured (Circled Label)
Best Estimate	R50	< ____ > units
Based on	R55	< ____ >
Subsurface Area	R60	< ____ > units
to	R70	< ____ > units
Best Estimate	R100	< ____ > units
Based on	R110	< ____ >
Depth to Reservoir Top	R120	< ____ > units
to	R130	< ____ > units
Best Estimate	R140	< ____ > units

Depth to Reservoir Bottom	R145	< ___ units >
to	R146	< ___ units >
Best Estimate	R147	< ___ units >
Reservoir Thickness	R150	< ___ units >
to	R160	< ___ units >
Best Estimate	R170	< ___ units >
Reservoir Volume	R180	< ___ units >
to	R190	< ___ units >
Best Estimate	R200	< ___ units >
Porosity	R210	< ___ > to R220 < ___ >
Best Estimate	R230	< ___ >
Ave. Well Flow (Mass)	R270	< ___ units >
to	R280	< ___ units >
Well Diameter	R290	< ___ units >
Comments	R300	< ___ >

<u>Reserves</u>

Total Stored Heat	F13	< ___ units >
to	F14	< ___ units >
Best Estimate	F10	< ___ units >
Depth Datum	F20	< ___ units >
Temperature Datum	F30	< ___ units >
Recoverable Heat	F40	< ___ units >
Depth Datum	F50	< ___ units >
Temperature Datum	F60	< ___ units >

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Method Used	F70	< ________ >
Recoverable By-Product	F80	< ________ >
Potential By-Product	F90	< ________ >
Comments (Reserves):	F100	< ________ >

<u>Geology</u>

General Rock Types	G10	< ________ >
Cap Rock	G30	< ________ >
Aquifer	G40	< ________ >
Depth	G50	< ________ > units
Thickness	G60	< ________ > units
Cap Rock	G70	< ________ >
Aquifer	G80	< ________ >
Depth	G90	< ________ > units
Thickness	G100	< ________ > units
Other Horizons & Units	G20	< ________ >
Comments (Horizons):	G110	< ________ >
Hydrothermal Index Minerals	G120	< ________ >
Important Control or Locus	G140	< ________ >
Other Structures or Trends	G130	< ________ >
Hydrology	G150	< ________ ________ >
Comments (Geology):	G160	< ________ ________ >

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Geophysics

Gravity Survey Information	J20 < ______________________ >
Magnetic Survey Information	J30 < ______________________ >
Seismic Survey Information	J40 < ______________________ >
Electrical Resistivity	J50 < ______________________ >
Other Geophysical Resistivity	J60 < ______________________ >
Comments (Geophysics):	J70 < ______________________ >
Environmental Factors	H18 < ______________________ >

Primary Reference (Geothermal Field)

Author	K20 < ______________________ >
Date	K30 < __________ >
Title	K40 < ______________________ >
Reference	K50 < ______________________ >

References

1)	K70 < ______________________ >
2)	K80 < ______________________ >
3)	K90 < ______________________ >
4)	K100 < ______________________ >

Geothermal Resources File (GEOTHERM)
Revision 8 (February 1976)

ction B - Chemical Analysis (H2)

cord Identification

Record No. A10 < _ _ _ _ _ _ _ _ >

Cross Index No. A20 < _ _ _ _ _ _ _ _ >

Record Type A30 < B >

Sample Type A34 < WELL SURFACE > (Circle word)

porter

Name A50 < ______________________________ >

Date A60 < _ _ / _ _ >
Yr. Mo.

Organization A70 < ______________________________ >

ographic Locality

Geothermal field B10 < ______________________________ >

Name of Sample Source B20 < ______________________________ >

Country Code B40 < _ _ >

Country Name B50 < ______________________________ >

State/Province B60 < ______________________________ >

County B65 < ______________________________ >

Latitude B70 < _ _ - _ _ . _ _ _ _ >
D M N/S

Longitude B80 < _ _ _ - _ _ . _ _ _ _ >
D M E/W

Township, Range, Section, 1/4, 1/4

B95< _ _ _ > B105< _ _ _ > B115< _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ >
Township Range Section 1/4 1/4

USGS WRD Well-Spring Numbering System

B116 < ____________________ >

Other Grid System

System Used B100 < ______________________________ >

X Coord. B110 < ______________________________ >

Y Coord. B120 < ______________________________ >

UTM Zone No. B130 < ______________________________ >

Map Reference B82 < ______________________________ >

Other Locality Information B83 < ______________________________ >

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Surface Sample Information

Source Type	S10	< ______________________ >
Sample No.	M190	< ______________________ >
Collection Date	M200	< ______________________ >
Collector(s)	S20	< ______________________ >
Point of Collection	N210	< ______________________ >
Volume Flow Rate of Spring	M220	< | | | | | | | | | | | | | | | | | | > units
Temperature	M210	< | | | | | | | | | | | | > units
Qualitative Steam/Water Ratio	S40	< ______________________ >
Deposits or Alteration	S30	< ______________________ ______________________ >
Water Treatment Data	M234	< ______________________ ______________________ >
Other Sample Information	S50	< ______________________ ______________________ >
References	M790	< ______________________ ______________________ >

Well Sample Information

Sample No.	M190	< ______ >
Collection Date	M200	< ______ >
Collector(s)	S20	< ______ >
References	M790	< ______ >
Wellhead Status	N10	< ______ >
Wellhead Pressure	N30	< ______ units A/G >
Water		
Point of Collection	P55	< ______ >
Separation Pressures		
First	P60	< ______ units A/G >
Second	P70	< ______ units A/G >
Third	P80	< ______ units A/G >
Water Sampling Temp.	M210	< ______ units >
Steam		
Point of Collection	P75	< ______ >
Separation pressure	P65	< ______ units A/G >
Steam Sampling Temp.	S60	< ______ units >
Steam Flow Rate (Mass)	N50	< ______ units >
Water Flow Rate (Mass)	M220	< ______ units >
Enthalpy of Total Flow	N60	< ______ units >
Water Treatment Data	M234	< ______ ______ >
Other sample information	S50	< ______ >

Water Analysis	A31	< W >
Analysis Date	M233	< >
Analyst(s)	M236	< >
pH 1)	M20	< > At M20A < Temp. units >
2)	M202	< > At M202A < Temp. units >
Eh	M221	< units >
Temperature	M222	< units >
Specific Gravity	M91	< >
Specific Conductance	M21	< units >
Temperature	M740	< units >
Alkalinity	M22	< units >
Total Dissolved Solids	M23	< units >
Total Suspended Solids	M24	< units >
Isotopic Data		
Del O (18) of Water	Q270	< units >
Del D of Water	Q250	< units >
Del C (13) of Dissolved CO_2	Q150	< units >
Del O (18) of Dissolved SO_4	Q200	< units >
Del S (34) of Dissolved SO_4	Q190	< units >
Del S (34) of Dissolved H_2S	Q185	< units >
Tritium Content of Water	Q186	< units >
C(14) Content of CO_2	Q187	< units >
Other	Q310	< >

Solute Analysis (Water) Units Used M341 <____________>

Li	M30	<______>	Mg	M70	<______>	Cu	M360	<______>	F	M90	<______>
Na	M40	<______>	Ca	M60	<______>	Zn	M390	<______>	Cl	M80	<______>
K	M50	<______>	Sr	M380	<______>	Hg	M440	<______>	Br	M350	<______>
Rb	M480	<______>	Ba	M330	<______>	B	M120	<______>	I	M490	<______>
Cs	M500	<______>	Ca+Mg	M180	<______>	HBO_2	M170	<______>	O_2	M610	<______>
Na+K	M300	<______>	Mn+3	M630	<______>	Al	M310	<______>	N_2	M530	<______>
NH_4	M150	<______>	Mn(TOT)	M520	<______>	Pb	M370	<______>	CO_2	M570	<______>
NO_3	M590	<______>	Fe+3	M620	<______>	As	M320	<______>	SO_2	M540	<______>
PO_4	M600	<______>	Fe(TOT)	M510	<______>	Sb	M470	<______>	H_2S	M160	<______>
SiO_2	M130	<______>				U	M450	<______>	H_2	M550	<______>
SO_4	M110	<______>							CH_4	M560	<______>
CO_3	M580	<______>									
HCO_3	M140	<______>									

Rare Earths Analyzed M750 <____________________>

Actinides Analyzed M760 <____________________>

Rare Gases Analyzed M770 <____________________>

Other Solutes & Gases M780 <____________________________

____________________________>

Comments M800 <____________________________

____________________________>

<u>Condensate Analysis</u>	A32	< C >
Analysis Date	S70	< ______________ >
Analyst(s)	S80	< ______________ >
pH 1)	N191	< ______________ > At N191A < Temp. ___ units >
2)	S100	< ______________ > At S100A < Temp. ___ units >
Eh	S110	< ___ units ___ >
Temperature	S130	< ___ units >
Specific Gravity	S140	< ______________ >
Specific Conductance	S150	< ___ units ___ >
Temperature	S160	< ___ units >
Alkalinity	S170	< ___ units ______________ >
Total Dissolved Solids	S180	< ___ units ___ >
Total Suspended Solids	S190	< ___ units ___ >
<u>Isotopic Data</u>		
Del O (18) of Water	Q260	< ___ units ___ >
Del D of Water	Q240	< ___ units ___ >
Del C (13) of Dissolved CO_2	S220	< ___ units ___ >
Del O (18) of Dissolved SO_4	S230	< ___ units ___ >
Del S (34) of Dissolved SO_4	S240	< ___ units ___ >
Del S (34) of Dissolved H_2S	S250	< ___ units ___ >
Tritium Content of Water	S260	< ___ units ___ >
C(14) Content of CO_2	S270	< ___ units ___ >
Other	S280	< ______________ >

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Solute Analysis (Condensate) — Units Used T500 <________________>

Li	T10	<______>	Mg	T140	<______>	Cu	T230	<______>	F	T330	<______>
Na	T20	<______>	Ca	T150	<______>	Zn	T240	<______>	Cl	T340	<______>
K	T30	<______>	Sr	T160	<______>	Hg	T250	<______>	Br	T350	<______>
Rb	T40	<______>	Ba	T170	<______>	B	T260	<______>	I	T360	<______>
Cs	T50	<______>	Ca+Mg	T180	<______>	HBO_2	T270	<______>	O_2	T370	<______>
Na+K	T60	<______>	Mn+3	T190	<______>	Al	T286	<______>	N_2	T380	<______>
NH_4	T70	<______>	Mn(TOT)	T200	<______>	Pb	T290	<______>	CO_2	T390	<______>
NO_3	T80	<______>	Fe+3	T210	<______>	As	T300	<______>	SO_2	T400	<______>
PO_4	T90	<______>	Fe(TOT)	T220	<______>	Sb	T310	<______>	H_2S	T410	<______>
SiO_2	T100	<______>				U	T320	<______>	H_2	T420	<______>
SO_4	T110	<______>							CH_4	T430	<______>
CO_3	T120	<______>									
HCO_3	T130	<______>									

Rare Earths Analyzed T440 <____________________________>

Actinides Analyzed T450 <____________________________>

Rare Gases Analyzed T460 <____________________________>

Other Solutes & Gases T470 <____________________________

____>

Comments T490 <____________________________

____>

Gas Analysis A33 < G >

Analysis Date U10 <____________________>

Analyst(s) U20 <____________________>

Gas/H_2O Ratio (mol/mol) U30 <____________________>

Units Used N230 <____________________>

CO_2	N80	<______>	H_2	N120	<______>	Ar	N183	<______>
H_2S	N90	<______>	CH_4	N130	<______>	Rn	N110	<______>
N_2	N140	<______>	C_2H_6	N182	<______>	Hg	N160	<______>
O_2	N150	<______>	He	N170	<______>			

Other Hydrocarbons U40 <____________________________>

Other U50 <____________________________>

Isotopic Data

Del C (13) of CO_2 U60 <____________________> units

C(14) Content of CO_2 U70 <____________________> units

Del C (13) of CH_4 Q170 <____________________> units

Del D of CH_4 U90 <____________________> units

Del D of H_2 Q220 <____________________> units

Del S (34) of H_2S U110 <____________________> units

Ratio Ar(40)/Ar(36) Q290 <____________________>

Other U130 <____________________________________>

Comments U140 <____________________________________>

TION C - Geothermal Well/Drill Hole

ord Identification

ecord No. A10 < >

ross Index No. A20 < >

ecord Type A30 < >

orter

ame A50 < >

ate A60 < / > (YR. / MO.)

rganization A70 < >

ation

eothermal Field B10 < >

GRA B11 < >

PI No. B12 < >

ell name B30 < >

ompany B35 < >

ountry Code B40 < >

ountry B50 < >

tate B60 < >

ounty B65 < >

atitude B70 < - > (D - M N/S)

ongitude B80 < - > (D - M E/W)

ownship, Range, Section, ¼, ¼

B95 < > (TOWNSHIP) B105 < > (RANGE) B115 < > (SECTION 1/4 1/4)

se & Meridian B125 < >

M Coordinate System

Northing B120 < >

Easting B110 < >

UTM Zone No. B130 < >

p Reference B82 < >

her Locality Information B83 < >

illing & Casing

Date Started	D11	< ___ / ___ / ___ > (YR. / MO. / DAY)
Date Completed	D12	< ___ / ___ / ___ > (YR. / MO. / DAY)
Date Abandoned	D13	< ___ / ___ / ___ > (YR. / MO. / DAY)
Well Status	D10	< ________ >
Total Depth	D20	< ________ > (UNITS)
Elevation	B150	< ________ > (UNITS)
Casing	D45	< ________ >
Producing Interval	D40	< ________ >
Water Level	D25	< ________ > (UNITS)
Drawdown	D26	< ________ > (UNITS)
Porosity	D27	< ________ >
Permeability	D28	< ________ > (UNITS)
Well Log Information	D29	< ________ >
Comments	C230	< ________ >

ting & Completion Data

Production Type	L61 < DRY STEAM HOT WATER >
Measurements From	L62 < INITIAL TEST SUBSEQUENT TEST >
Date	L63 < ___ / ___ / ___ (YR. / MO. / DAY)
Flow Rate	L64 < ________ UNITS >
Orifice Plate Size	D90 < ________ >
Steam Quality	D190 < ________ >
Wellhead Temperature	L65 < ________ UNITS >
Bottom Hole Temperature	D130 < ________ UNITS >
Wellhead Pressure	L67 < ________ UNITS A/G >
Enthalpy Of Steam	D230 < ________ UNITS >
Enthalpy Of Brine	D240 < ________ UNITS >
Enthalpy Of Total	L66 < ________ UNITS >
Production Rate	D140 < ________ UNITS >
Comments	L68 < ________ >

ll Stem Test

Date	L20 < ___ / ___ / ___ > (YR. / MO. / DAY)
Interval	L25 < ________ >
Flow Rate	L26 < ________ UNITS >
Fluid Recovery	L27 < ________ >
Fluid Temperature	L40 < ________ UNITS >
Final Flow Pressure	L41 < ________ UNITS A/G >
Final Shut-in Pressure	L42 < ________ UNITS A/G >
Final Hydrostatic Press.	L43 < ________ UNITS A/G >
Comments	L44 < ________ >

CTION C - PAGE 4

imary Reference

Author K20 < ______________________________ >

Date K30 < ____________ >

Title K40 < ______________________________ >

Reference K50 < ______________________________

______________________________ >

her References

1) K70 < ______________________________

____

______________________________ >

2) K80 < ______________________________

____

______________________________ >

GIPSY

The General Information Processing System (GIPSY), developed by the University of Oklahoma, is used for the storage and retrieval of GEOTHERM data. The GIPSY program provides for easy access to the file by a set of simple user commands. A retrieval setup consists of job control language (JCL) and GIPSY retrieval cards. The JCL needed to make a retrieval from GEOTHERM is listed in figure 4. The retrieval cards, which follow the JCL cards, contain the user commands and command parameters relating to a specific retrieval.

GIPSY commands are user-oriented so that no prior computer experience is necessary to make a retrieval. With a set of eight commands, the user can select, sort, and output information from the file. A successful retrieval can best be accomplished by using the following questions as a check list.

What kind of data is desired (e.g., geochemical, wells, or fields)?

Should the data be restricted by geographic locality, temperature, chemical constituents, etc.?

Should the data be sorted?

What data items are desired for output (all or a partial list of items)?

How should the output be organized (entire records, tables, lists, etc.)?

```
//    Job Card
//A EXEC QUESTRAN,DNAME=`A93400.AZ231.WG9B200.GEOD`,DVOL=CCD915,
//    DUNIT=3330,RNAME=`RIF.W0020.THERM1`,RVOL=CCD921,
//    UNIT=3330,CLOCK=15,SPACE=800,RGN=110K
//QUESTRAN.SYSRDR DD *
FORM
 GEOTHERM
          - GIPSY retrieval cards -

/*
//
```

Figure 4.--Job control language

The answers to these questions are important in formulating a search strategy and assembling a set of GIPSY retrieval cards.

The retrieval cards are a sequence of GIPSY commands and conditions. A command always begins in the first column of the computer card. Parameter statements that follow each command begin in Column 2. For example, the SELECT command is followed by parameter statements which define and list criteria for selection. The most common commands, and the function they perform, are listed in figure 5.

GIPSY Commands	FUNCTION
SELECT	
ITERATE	Search/Retrieval
BACK	
SORT	Processing
SUM	
PRINT LINESIZE=120	
LIST	Output
COPY	

Figure 5.--GIPSY commands

The designators (A, B) are unique single alphabetic characters used to identify one characteristic in one search. Up to 26 designators can be listed for each use of the SELECT command. Following the designators are the data labels (B40, A30). These unique labels identify the data items of the file (see input forms for subtopics in figures 1-3). "B40" is associated with country code and "A30" is associated with record type. Following the labels are restrictions which the user can impose. The first conditions (<US>) indicates that the country code, "US," is a factor in the search. The brackets (< >) enclose character strings. A list of variable description formats and options are illustrated in figure 6.

<u>Logic Statement</u> - The logic statement is the key to the search procedure. It links the variable descriptions using the boolean operators, "AND," "OR," and "NOT" (the symbols * (AND), + (OR), - (NOT) can be used also). In the example, both characteristics (i.e., geothermal field records from the United States) are required. The logic statement is:

LOGIC A AND B

A. A30

B. A30<b̸Ab̸>

C. A30<A>

D. A30<b̸A>

E. A30<Ab̸>

F. A30<b̸Ab̸> THRU <b̸Cb̸>

G. A30<b̸20b̸>

H. A30 EQ 20

I. A30 GT 20

J. A30 LT 20

K. A30 10 THRU 20

L. A30 EQ A20

M. A30 LT A20

N. A30 GT A20

A. Use only the label by itself when it is desired to select on existence (presence) of a data item. For example, the user may want to select analysis records only if they contain temperature data.

B. This setup means the user wants any data with the word "b̸Ab̸" (a word is defined as a string of one or more characters or numbers bounded by blanks).

C. This setup requires only the existence of the letter "A." All words that contain the letter "A" will be selected.

Figure 6.--Variable description formats and options.

D. Use this setup for the prefix, "bA." Records with "around" or "about" will be selected but not "Canada."

E. Use to find the suffix, "Ab." Records with "Canada" or "Nevada" would be selected but not "average."

F. The user can retrieve on a range of letters. In this example, the words "A," "B," and "C" will be retrieved.

G. In this example, the character value of "20" would be selected. The string, "20.0," would not be selected.

H. The numeric value, 20, would be selected whether it was 20.0, 020, or 20.

I. Records with a numeric value greater than (GT) 20 will be selected.

J. Records with a numeric value less than (LT) 20 will be selected.

K. The user can select a range of numbers. In this case, all records with value of 10 through 20.

L-N. Numbers under two lables can be compared. In these cases, the numeric values in labels A20 and A30 are compared. (EQ = equal, LT = less than, GT = greather than.)

Figure 6.--(cont`d)

Another logic statement could have been used with the same variable descriptions to select a different subset. For example:

LOGIC A AND NOT B

This example would retrieve records from the United States but not if they were geothermal field records. Parentheses may be used as in mathematical equations to eliminate ambiguities.

LOGIC A OR B AND C

LOGIC A OR (B AND C)

<u>ITERATE</u>.--The ITERATE command performs a function similar to the SELECT command. When the SELECT command is invoked the entire file is searched and all previous subsets are deleted. The ITERATE command is used to search a previously selected subset. The SELECT command produces a subset 1. The ITERATE command will often follow the SELECT command and it is used to search subset 1. The resultant subset is subset 2 which in turn can be searched using the ITERATE command a second time. These subsets are deleted when (1) the job is finished (2) the SELECT command is used again (3) the BACK command is used. The ITERATE command is used like the SELECT command and contains the same variable description and logic statements. For use of the ITERATE command see examples 2 and 3.

BACK.--The BACK command is used to return to a previously selected subset. That subset can be either searched with the ITERATE command or it can be sorted, printed, etc.

```
BACK
 2
ITERATE
```

In this example, the user returns to subset 2 and then searches it. Subsets 3 and greater are deleted but subset 1 is still retained. The resultant subset in this case would be a new subset 3. See example 3 for use of the BACK command.

SORT.--The SORT or SORTD (descending sort) command is optional. Records can be sorted by any information item and the sorts can be nested.

```
SORT
 B60  10
 M130  5.2
```

The parameter-statements consist of a list of the sort fields and the number of characters involved in the sort. In the example, B60 and M130 refer to state and silica content respectively. The subset is first sorted on the first ten characters of state. The secondary sort is on silica content and is ordered numerically for five digits with two decimal places. See example 2 for use of the SORT command.

SUM.--The SUM command produces the following information.

1. The number of occurrences of the item in the selected subset
2. The arithmetic mean
3. The algebraic sum
4. Maximum value
5. Minimum value

This operation ignores text. The parameter statements consist of a list of the items to be processed.

```
SUM
 M130
 M40
```

This example would perform the SUM procedure for silica content (M130) and sodium content (M40) for the selected subset. See example 4 for use of the SUM command.

PRINT LINESIZE=120.--The PRINT command instructs the system to print the records from the selected subset. No parameter statements are required. Each record begins at the top of a computer page. The NOPAGE option which prevents beginning a new page for each record can be added.

PRINT LINESIZE=120 NOPAGE

See example 2 for use of the PRINT command.

LIST.--Sometimes the user only wishes to see a few data items. The LIST command is used to print designated portions of the selected records. The items are printed in their entirety and are continued on subsequent lines if there is an overflow. The parameters are a list of the data items to be printed.

```
LIST
 M130
 M40
 M30
```

See example 3 for use of the LIST command.

COPY.--The COPY command is probably the most useful output command. Fixed-length records can be produced from GEOTHERM with this command. The system, therefore, has a report generating capability which can produce tables or formatted records for user-written processing programs. The COPY command is used in example 3.

Copy to Printer - The user may wish to produce tables from a subset of GEOTHERM records. The parameter statements that follow the command consist of a list of data items and character strings to be included in the table. A line is printed for each record of the subset. The parameter statements consist of the following types.

A10 x	In this case the first "x" number of characters from A10 will be printed. Blanks are inserted if there is no data.
A10 x.y	This format causes the first number in A10 to be printed with "x" number of digits and "y" decimal places. The decimal point is assumed.
\`STRING\`	Literal character strings can be inserted by putting the string between single quotes. This character string would be printed for every record. Maximum length is 60 characters.

The first statement after the COPY command is a literal used for carriage control on the printer. The user has three choices of spacing:

` ` a blank provides single spacing

`1` double space

`-` triple space

If one of these three cards is not entered, then the first character of each line will be truncated. If output is going to disk then this card is unnecessary.

Copy for Extended Applications - The COPY command is very useful in producing formatted subfiles for further processing. For example, silica, sodium, potassium, and calcium concentrations from chemical analysis records can be extracted, formatted, and output to cards, tape or disk. Data that is extracted can be formatted to fit the needs of the user program.

Suppose the user had a program designed to process the following data input format.

Column	Field	Data type	Length
1	Geothermal field	Character	15
16	State	Character	15
31	County	Character	15
46	Silica	Decimal	5.2
51	Sodium	Decimal	5.2
56	Potassium	Decimal	5.2
61	Calcium	Decimal	5.2

The COPY output would be the following:

```
COPY
 B10 15
 B60 15
 B65 15
 M130 5.2
 M30  5.2
 M60  5.2
```

With the addition of one job control statement this data could go to cards, tape or temporary disk space. The extra statement would be inserted just before //QUESTRAN.SYSRDR DD*. This extra JCL card for each output is listed below:

Card Output

```
//QUESTRAN.SYSWRKO DD SYSOUT=B,DCB=(RECFM=FA,LRECL=80,BLKSIZE=80)
```

Temporary disk output

```
//QUESTRAN.SYSWRKO DD DSN=&&TEMP,UNIT=SYSDK,DISP=(MOD,PASS),
//     DCB=(RECFM=FB,LRECL=XX,BLKSIZE=XX),
//     SPACE=(CYL,(6,1),RLSE)
```

This example would create a data set (&&TEMP) on a system disk pack. The LRECL (record length) and BLKSIZE (block size) will vary with the total length issued from the COPY command. This GIPSY procedure could be followed by a program written in PL/1, FORTRAN, etc.

Tape Output

```
//QUESTRAN.SYSWRKO DD DSN=myset,UNIT=TAPE9,
//      DISP=(,KEEP),DCB=(RECFM=FB,LRECL=XX,BLKSIZE=XX),
//      LABEL=(1,SL)
```

In this example a data set called "myset" would be created on a standard label 9-tract tape. The LRECL (record length) and BLKSIZE (block size) will vary with the total length issued from the COPY command.

References cited

University of Oklahoma, 1975, General Information Processing System Users Guide, GIPSY documentation series, vol. 2: University of Oklahoma, Office of Information Systems Programs.

University of Oklahoma, 1975, General Information Processing System Programmers Guide, GIPSY documentation series, vol. 3: University of Oklahoma, Office of Information Systems Programs.

Examples

<u>Example 1</u>

Objective - The user wishes to get a count of chemical analysis (Analysis (A30=B) records from the states (B60) of California and Nevada with temperature (M210) greater than 35°C. In this case none of the output options will be selected.

Input setup

```
//      JCL
FORM
 GEOTHERM
SELECT
  A.  A30<B>
  B.  B60<CALIFORNIA>
  C.  B60<NEVADA>
  D.  M210 GT 35
 LOGIC A*(B+C)*D
/*
```

Figure 7.--Example 1

```
SELECT

 A. A30<B>
       RECORD TYPE.....

 B. B60<NEVADA>
       STATE/PROVINCE.........

 C. B60<CALIFORNIA>
       STATE/PROVINCE.........

 D. M210 GT 35
       WATER SAMPLING TEMP....

 LOGIC A*(B+C)*D
    SEARCH
20:23:41.2 SEARCH BEGINNING
20:23:49.7 SEARCH COMPLETED

 SEARCHED     1850

 SELECTED      416      SUBSET    1

 VARIABLES  SATISFIED

     A        1389

     B         386

     C         732

     D         652
```

Example 2

Objective - The user wishes to select all records from the United States and then search that subset for Arizona records. The selected records are to be sorted by county (B65) and geothermal field (B10) and then are to be printed.

Input setup

```
//      JCL
FORM
 GEOTHERM
SELECT
 A.  B40<US>
 LOGIC A
ITERATE
 A. B60<ARIZONA>
 LOGIC A
PRINT LINESIZE=120
/*
```

Note: It would actually be easier in this particular example to ask for the Arizona records directly. However, by selecting the U.S. records, the user has a smaller subset to deal with. Thus, another ITERATE command on the U.S. records could have followed the first. Search time and cost would be lower because the U.S. subset is searched instead of the entire file.

Figure 8.--Example 2

```
SELECT

 A. 840<US>
       COUNTRY CODE...........

 LOGIC A
    SEARCH
20:23:49.8 SEARCH BEGINNING
20:24:06.0 SEARCH COMPLETED

 SEARCHED     1860

 SELECTED     1495       SUBSET     1

 VARIABLES  SATISFIED




    A         1495

ITERATE

 A. 860<ARIZONA>
       STATE/PROVINCE.........

 LOGIC A
    SEARCH
20:24:06.2 SEARCH BEGINNING
20:24:17.1 SEARCH COMPLETED

 SEARCHED     1495

 SELECTED       11       SUBSET     2

 VARIABLES  SATISFIED

    A           11

SORT

 865 15

 810 15
END OF SORT

PRINT LINESIZE=120
```

Figure 8.--Example 2 (cont'd)

RECORD 00001

```
GEOTHERMAL RESOURCES FILE (GEOTHERM) REVISION 8

SECTION A.- GEOTHERMAL FIELD-AREA
 RECORD IDENTIFICATION
   RECORD NO........ 0000256                        NAME........... J. RENNER
   CROSS INDEX NO.. CF C0281                        DATE........... 75/05
   RECORD TYPE..... A                               ORGANIZATION.. U.S.G.S.

 GEOGRAPHIC LOCALITY
   GEOTHERMAL FIELD-AREA..  POWER RANCHES INC. WELLS
   COUNTRY CODE...........  US                      COUNTRY NAME........... UNITED STATES
   STATE/PROVINCE.........  ARIZONA
   LATITUDE...............  33-17-06N               LONGITUDE.............. 111-41-12W

   TOWNSHIP     RANGE    SECTION     1/4  1/4
     02S         06E        1        SW

   BASE & MERIDIAN........  GILA & SALT RIVER
   AVAILABLE MAPS OF AREA:  HIGLEY 1:24,000

 GENERAL DESCRIPTION
   ELEVATION.................... 408.43     M       1340.     FT
   RESOURCE CATEGORY.............B
   PRESENT USE & DEVELOPMENTS:  2 WELLS OF ABOUT 3KM DEPTH
   SURFACE THERMAL ACTIVITY...... FOUND BY DRILLING
   NO. OF HOT SPRINGS............

 GEOTHERMAL CHARACTERISTICS
   NATURAL SURFACE DISCHARGE.......... 316.65     L/S     1.9000E+04 L/MIN     ESTIMATED
   WELL INFORMATION
     MAXIMUM WELL TEMPERATURE........... 184.       C     TO 3200.      M
     BOTTOM-HOLE TEMPERATURE............ 184.0      C     TO 3200.00    M

 RESERVOIR PROPERTIES
   RESERVOIR TEMPERATURES......... 163.       C   TO 184.      C     MEASURED
       BEST ESTIMATE.............. 180.0      C
   SUBSURFACE AREA................ 1.0        KM**2                     TO 5.0        KM**2
       BEST ESTIMATE.............. 2.5        KM**2
       BASED ON:  DRILLING
   DEPTH TO TOP OF RESERVOIR.....
       BEST ESTIMATE.............. 2000.00    M       2.000      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........
       BEST ESTIMATE.............. 1000.00    M       1.000      KM
   VOLUME OF RESERVOIR...........
       BEST ESTIMATE.............. 2.500      KM**3
   COMMENTS:  DEPTH TO BOTTOM OF RESERVOIR IS ASSUMED.

 RESERVES
   TOTAL STORED HEAT..........
       BEST ESTIMATE.......... 8.3716E+17 J      1.9999E+17 CAL     ABOVE  15.        C
```

Figure 8.--Example 2 (cont'd)


```
GEOLOGY
  GENERAL R3CK TYPES:  VOLCANICS (AGE?)

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) PERS. COMM. MR MIKE O DONNELL & MR. WARD AUSTIN OF GEOTHERMAL KINETICS
```

Example 3

Objectives: 1) Select U.S. records.

2) Use the LIST command to print sample source (B20), temperature (M210), sodium (M40), potassium (M50), calcium (M60), and silica (M130).

3) Search the U.S. subset and select chemical analyses records from Nevada.

4) Produce a tabular format of the Nevada records including the same data elements from the LIST command.

In order to illustrate the BACK command in this example, the Nevada records will be selected from the U.S. subset and output in tabular form. The U.S. subset is then called back to be listed.

Input setup

```
//     JCL
FORM
 GEOTHERM
SELECT
 A. B40<US>
 LOGIC A
ITERATE
 A. B60<NEVADA>
 B. A30<B>
 LOGIC A*B
```

```
COPY
 . .
 B20 20
 . .
 M210 14
 M40 7
 . .
 M50 7
 . .
 M60 7
 . .
 M130 7
BACK
 1
LIST
 B20
 M210
 M40
 M50
 M60
 M130
```

Figure 9.--Example 3

```
SELECT

 A. B40<US>
      COUNTRY CODE...........

 LOGIC A
    SEARCH
20:24:51.1 SEARCH BEGINNING
20:24:56.5 SEARCH COMPLETED

 SEARCHED    1860

 SELECTED    1495      SUBSET    1

 VARIABLES  SATISFIED

     A       1495

ITERATE

 A. B60<NEVADA>
      STATE/PROVINCE.........

 B. A30<B>
      RECORD TYPE.....

 LOGIC A*B
    SEARCH
20:24:56.7 SEARCH BEGINNING
20:25:22.9 SEARCH COMPLETED

 SEARCHED    1495

 SELECTED     340      SUBSET    2

 VARIABLES  SATISFIED

     A        386

     B       1203

COPY

 . .

 B20 20

 . .

 M210 14

 M40 7

 . .

 M50 7

 . .
```

Figure 9.--Example 3 (cont'd)

```
M60 7
. .
M130 7
BACK
1
LIST
320
M210
M40
M50
M60
M130
```

Figure 9.--Example 3 (cont'd)

	90.0	C	160.00	16.00	12.00	165.00
	90.0	C	1000.00	48.00	82.00	160.00
	95.0	C	110.00	2.60	1.30	98.00
						242.00
CARSON (SHAW) HOT SP	44.	C	85.9		10.9	44
MAIN GEYSER	BOILING				TRACE	418
SPRING 21-N			744	77	6	343
	95.6	C				
SPRING 8			682	103	6.8	311
			806	77	13	205
	85.	C	866	108	7	325
BOWER'S MANSION, NEV	48.	C	37.8	5.7	6.7	44
SOUTH STEAMBOAT WELL	WARM		66	8.2		
SS-5	52.	C			15	
SS-5	97.	C			5.9	
SPRING 247			753	78	11	335
	97.	C				
UNNAMED HOT SPRING N						
MONTE NEVA						
UNNAMED HOT SPRING (						
BOWER'S HOT SPRING						
UNNAMED HOT SPRING N						
SHALLOW RESEARCH WEL						
UNNAMED HOT SPRING N						
			774.3	66.9	30	278.8
SMALL GEYSER			741	91	6	271
ALKALI SPRINGS	49-60.	C	282		46	42
ALKALI SPRINGS	60.	C	282		46	42
SPRING	77.	C	130.95	53.38	100.3	133.4
SMALL GEYSER	BOILING		239	33	2	449
LAS VEGAS SPRINGS	41.	C			56	13
SODAVILLE WARM SPRIN			295	17	44	43
MELVIN HOT SPRINGS (	79.	C			67	54
WELL NEAR HOT SPRING	98.	C			37	
GEYSER RANCH SPRINGS	18-21.	C			44	11
HIKO SPRING					52	35
PANACA WARM SPRING	29-31.	C			40	46
SHALLOW RESEARCH WEL						
UNNAMED HOT SPRING (	61.	C	300	31	75	105
"STEAM" WELL			250	38	1.3	500
	77.	C	540	80	95	150
	92.	C	160	13	8.8	135
UNNAMED HOT SPRING	29.	C	180	20	36	110
FLOWING WELL IN STIL	72.	C	1480	42	108	170
	97.	C	277	15	38	115
	88.	C	450	26	44	180
UNNAMED HOT SPRING	86.	C	170	8.4	4.8	110
	54.	C	81	1.0	.2	57
FLOWING WELL NEAR GE	80.	C	340	17	31	82
	86.	C	463	9.3	25	85
	56.	C	120	39	60	65
UNNAMED HOT SPRING	79.	C	45	16	60	70
	90.	C	390	41	49	84
	54.	C	230	58	53	67
	72.	C	44	14	56	68
	72.	C	200	36	43	77
	58.	C	288	33	29	80
	49.	C	250	34	45	80
	74.	C	130	22	33	66
	73.	C	165	26	110	65

Figure 10.--Example 4

SELECT

A. B60<NEVADA>
STATE/PROVINCE.........

B. A30<B>
RECORD TYPE.....

LOGIC A*B
SEARCH
20:35:29.9 SEARCH BEGINNING
20:35:41.6 SEARCH COMPLETED

SEARCHED 1860

SELECTED 340 SUBSET 1

VARIABLES	SATISFIED
A	386
B	1399

SUM

LABEL	(N)	SUM	AVE	MAX	MIN
M210	234	15,768.5	67.38675	186	3
M40	290	103,941.72	358.41972	1,510	1.73
M50	275	9,575.67	34.82061	160	0.18
M60	273	10,226.1	37.45824	412	0
M130	260	30,768.65	118.34096	534	4.7

G I P S Y - UNIVERSITY OF OKLAHOMA 8:35 P.M. TUESDAY MARCH 8,1977