GELCOM

A Geothermal Levelized Busbar Cost Model

DESCRIPTION AND USER'S GUIDE

J. N. Gupta

J. G. Leigh

JANUARY 1978

M78-17

METREK Division of The MITRE Corporation
1820 Dolley Madison Blvd. McLean, Virginia 22101

DISCLAIMER

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

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

DISCLAIMER

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

DISCLAIMER

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

Department Approval:

Steven N. Peltier

MITRE Project Approval:

Harpal P. Shilka

TABLE OF CONTENTS

	<u>Page</u>
LIST OF ILLUSTRATIONS	iv
LIST OF TABLES	iv
1.0 INTRODUCTION	1
2.0 ENGINEERING COST AND LEVELIZED BUSBAR COST MODELS	4
2.1 Engineering Cost Estimates	4
2.2 Levelized Busbar Cost Method	7
2.2.1 Input Data	17
2.2.2 Methodology for Calculating Busbar Energy Cost	18
3.0 DESCRIPTION OF THE GELCOM OUTPUT DISPLAY	23
4.0 GELCOM	33
4.1 Data Files Maintained in GELCOM	33
4.1.1 File: RAJ DATA	34
4.1.2 File: FINANCE DATA	34
4.1.3 File: RADFIL DATA	37
4.2 Available Features and Options	39
4.3 Accessing GELCOM	42
4.4 Sample Session at a Terminal With GELCOM	42
APPENDIX A - GELCOM COMPUTER PROGRAM LISTING	83
DISTRIBUTION LIST	127

LIST OF ILLUSTRATIONS

<u>FIGURE NUMBER</u>		<u>Page</u>
2-1	Effects of Inflation on Levelized Costs and Revenue Requirements, Constant Dollars	15
2-2	Effects of Inflation on Levelized Costs and Revenue Requirements, Nominal Dollars	16
3-1	Economic Analysis: Brawley, California	28

LIST OF TABLES

<u>TABLE NUMBER</u>		<u>Page</u>
2-I	System Characteristics, Capital and O&M Costs, and Equipment Lifetimes for Selected Hydrothermal Liquid-Dominated Electrical Generating Systems	6
2-II	Capital Costs for Production and Injection Wells As a Function of Rock Type and Depth	8
2-III	Annual Operating and Maintenance Costs	9
2-IV	Definition of Capital Categories	10
2-V	Capital and O&M Cost Factors for High-Salinity Brines	11
4-I	Geothermal Prospects Included in the Data Base	35
4-II	Data Record Format for File: RAJ DATA	36
4-III	Data Format for File: FINANCE DATA	38
4-IV	Data Record Format for File: RADFIL DATA	40
4-V	Options/Features Utilized to Generate Reports	43

1.0 INTRODUCTION

The model described in this paper is designed to project the costs of electricity generated from liquid-dominated hydrothermal geothermal resources. It is presented in the form of an interactive computer program called GELCOM, written in FORTRAN IV, together with an analytic explanation of the methodology.

This work was performed under contract to the Department of Energy, Division of Geothermal Energy for the purpose of conducting site-specific analysis of the likely economic viability of geothermal energy. These analyses are being published separately.¹ The model has also been used as a reference point in comparing and analyzing other methods of projecting geothermal energy costs.

GELCOM starts from resource characteristics data (such as temperature, salinity, well flow rate, depth, and rock hardness), and estimates the capital and operating costs for the production field and electrical generating plant. These estimates are made by interpolating between, or extrapolating from, twelve generic geothermal plant designs for different resource temperatures, salinities and conversion cycles. Well costs are estimated separately, from resource depth and rock hardness. The interactive nature of the program allows the program generated parameters to be overridden by the user, if desired.

¹"Site-Specific Analysis of Geothermal Development--Scenarios and Requirements", R.K. Trehan, A. Cohen, J.N. Gupta, W.E. Jacobsen, J.G. Leigh, S. True, The MITRE Corporation, METREK Division, MTR-7586, in process.

The capital and operating costs are used as inputs to the part of the program which computes the levelized busbar costs. This part of the program also requires financial data (debt/equity ratio, cost of money, tax rates, etc). The algorithm used is based upon one which is standard in METREK, with certain extensions which have been found necessary to cope with factors specific to geothermal energy (e.g., capital reinvestment in replacement of production wells, injection wells and the production plant).

Inflation and escalation are specifically taken account of in these calculations. The levelized busbar cost is computed as the cost in mills/kWh whose present value over the life of the project exactly equals the present value of all cost streams associated with the project (including return to equity). GELCOM includes the option of expressing the imputed revenue stream obtained from energy production with or without accounting for inflation (see section 2.2).

The program can take into account potential reductions in the capital and O&M costs of components (perhaps achieved through RD&D or through experience), with different reductions being applicable in different years. It can also perform sensitivity analyses for the cost of electricity for varying resource temperatures and varying plant capacity factors and for fiscal incentives. The fiscal incentives used to date in the sensitivity analyses include 3 parameters: investment tax credit rate, depletion allowance rate, and expensing intangible drilling costs. Finally, the program can compute projected

costs for a sequential series of reservoirs, taking into account different cost reductions for different resource types (based on temperature or salinity).

Section 2 presents a description of the methodology implemented in GELCOM to determine the engineering cost, operating parameter estimates, and the levelized busbar cost.

Section 3 explains the output displayed by the GELCOM for one prospect. The input data files maintained in the computer system and the input data card formats are included in section 4. This section also illustrates a sample session with GELCOM and the economic reports which may be generated from the GELCOM. Finally, Appendix A gives a complete listing of the computer programs.

2.0 ENGINEERING COST AND LEVELIZED BUSBAR COST MODELS

This section describes the economic model which has been implemented in GELCOM to generate the prospect specific geothermal economic results presented in this paper. GELCOM is applicable to hydrothermal liquid-dominated geothermal resources above about 150°C. The model is described in two parts:

- (a) engineering cost and operating parameter estimates
- (b) the levelized busbar cost method.

Under (a), the engineering methods which are used to generate prospect-specific estimates of capital costs, operating and maintenance (O&M) costs, equipment lifetimes, etc., are described. This is the input data to the economic model which computes a value for the levelized busbar cost of electricity over the project life which is described in (b). Certain additional financial data are also described in (b).

2.1 Engineering Cost Estimates*

Engineering cost estimates are made by interpolating between six generic plant designs. These comprise flashed-steam systems and binary systems for geothermal fields with reservoir temperatures of 180°C, 230°C and 290°C. The following assumptions are used:

- (1) In every case the reservoir is assumed to place no limitation on the plant's operation. A basic well flow of 296,000 kgm/hr for a 9-5/8 inch casing diameter at a 290°C bottom hole temperature is assumed. The other well flow rates at temperatures 180°C and 230°C are assumed to be 268,000 kgm/hr and 260,000 kgm/hr, respectively. No other specific assumption on formation permeability was made and each disposal well was assumed to have the same well flow limitation.

* Private Communication from J.R. Schilling, May 1976.

- (2) Deep well pumps were considered in three of the six cases imposing a flow limitation of about 273,000 kgm/hr. While this flow may be less than the well would support naturally, use of a deep well pump is advantageous and economic compared to the otherwise required size of the production well field.
- (3) In each case the well distribution was considered in square array. It has been assumed that the field is not restricted along one or two fault traces. Were a field to be restricted, the costs of the gathering and distribution systems would increase.

In all cases engineering judgment has been used to dictate system design to reflect a nearly optimized plant. This judgment necessitates system design changes over the range of bottom hole temperatures considered herein. The two principal system design changes can be highlighted as follows:

- The 230°C flash system has the higher-pressure flash stage at the well head. This means piping both brine and steam separately to the plant for further processing. In the 290°C flash case, however, the length of the horizontal pipe run (less than 800 feet) is short enough and the resultant pressure drop small enough to allow the higher pressure separators to be located in plant. This is reflected as a considerable cost savings.
- The binary system at 290^{°T_{bh}} can utilize naturally produced wells instead of pumped wells. The high temperature precludes the use of deep well pumps, and the well field is sufficiently compact to significantly reduce the Production System total cost.

The capital costs of these systems are shown in Table 2-I, excluding well costs. The table shows the total plant capital costs for all surface equipment (and deep-well pumps, if used) broken down

TABLE 2-I

SYSTEM CHARACTERISTICS, CAPITAL AND O&M COSTS, AND EQUIPMENT LIFETIMES
FOR SELECTED HYDROTHERMAL LIQUID-DOMINATED ELECTRICAL GENERATING SYSTEMS¹

	RESERVOIR TEMPERATURE AND UTILIZATION PLANT TYPE					
	180°C FLASH	230°C FLASH	290°C FLASH	180°C BINARY	230°C BINARY	290°C BINARY
Generator Rating (kw)	58,400	55,000	55,000	67,500	74,400	69,900
Net Plant Output (kw)	44,627	46,449	47,379	48,648	49,777	48,837
Net Plant Efficiency (%)	5.7	10.3	14.4	7.4	11.7	13.3
Plant Capital Cost (\$(1977)/kw)	-----	-----	-----	-----	-----	-----
Breakdown of Capital Cost: (\$(1977)/kw)	-----	-----	-----	-----	-----	-----
1.0 Production	-----	-----	-----	-----	-----	-----
1.1 Production Wells	See Separate Table A-II					
1.2 Gathering System	25.08	13.00	7.12	17.64	6.65	3.20
1.3 Process Mechanical	75.90	22.32	7.32	29.0	19.0	3.20
1.4 Instrumentation and Control	27.60	12.96	6.24	25.20	12.35	5.60
1.5 Spent Brine Treatment	16.56	5.76	3.12	15.20	6.65	4.80
1.6 Distribution System	23.46	5.04	3.12	19.00	10.00	5.50
1.7 Injection Wells	See Separate Table A-II					
1.8 Engineering and Administration	67.62	23.76	10.40	51.66	26.60	12.00
Number of Production Wells	24	12	6	20	8	5
Number of Injection Wells	10	5	3	8	4	4
2.0 Generating Plant	644.42	465.02	403.06	705.66	672.16	655.93
2.1 Turbine Generator	256.68	160.08	127.48	121.60	121.60	121.60
2.2 Process Mechanical	22.08	18.0	17.16	70.56	70.56	70.56
2.3 Piping and Insulation	45.54	36.0	35.36	87.20	87.20	87.20
2.4 Instrumentation and Control	19.25	19.25	19.25	23.20	23.20	23.20
2.5 Electrical	24.93	24.93	24.93	27.20	27.20	27.20
2.6 Civil and Structural	114.54	86.88	72.80	90.40	90.40	90.40
2.7 Condenser and Heat Rejection	93.84	63.36	53.56	210.00	180.00	165.00
2.8 Switchyard	23.40	23.40	23.40	19.00	19.00	19.00
2.9 Engineering and Administration	44.16	33.12	29.12	57.50	54.00	52.77
3.0 Operations and Maintenance	See Table A-III					
4.0 Lifetimes (years)						
4.1 Wells	10	10	10	10	10	10
4.2 Production Plant	20	20	20	20	20	20
4.3 Generating Plant	30	30	30	30	30	30

¹ Low salinity resources only. Excludes well costs.

into several different categories. Well costs are computed on a cost per foot basis, shown in Table 2-II. (Note: exploration costs are not included).

Operating and maintenance costs are computed as annual percentages of capital costs, as shown in Table 2-III.

Table 2-IV shows a more detailed description of the elements included within each category of capital expense.

Some parameters are dependent upon the salinity level of the resource. Table 2-V shows adjustments which must be made for high-salinity brines (>50,000 ppm TDS). This table should be used in conjunction with Tables 2-I, 2-III and 2-V as appropriate.

The computer model used to derive engineering cost estimates interprets hyperbolically between the generic plant designs, using equations of the form:

$$C_t = \frac{A}{(t - t_o)^B} + D$$

where C_t is the capital cost of a given capital category for a plant operating at temperature t , and t_o , A , B , and D are parameters which vary with capital category and plant type. For the purpose of computation, t_o has been assumed to be 100°F.

2.2 Levelized Busbar Cost Method

This section is a detailed exposition of the METREK stepwise procedure for the calculation and application of the minimum revenue requirement approach to computing busbar energy cost for geothermal

TABLE 2-II

CAPITAL COSTS FOR PRODUCTION AND INJECTION WELLS¹
AS A FUNCTION OF ROCK TYPE AND DEPTH²

ROCK TYPE	COSTS (\$ per foot)	
	<u><5000 FEET</u>	<u>>5000 FEET</u>
Soft	80	160
Medium	100	120
Medium-Hard	125	250
Hard	200	400

¹ See Table A-I, 1.1 and 1.7.

² Assumes wells are not pumped and bottom-hole diameter is ~ 10". If wells are pumped, diameter is assumed to be ~ 15" and costs should be multiplied by 1.5.

Source: E. Friedman and A. Elsayy, Prospects for Improvement in Geothermal Well Technology and Their Expected Benefits, MTR-7613, The MITRE Corporation, METREK Division, December 1977.

TABLE 2-III
ANNUAL OPERATING AND MAINTENANCE COSTS (AS PERCENTAGES OF CAPITAL COSTS)

COST CATEGORIES	UTILIZATION PLANT TYPE AND RESERVOIR TEMPERATURE					
	FLASH			BINARY		
	180°C	230°C	290°C	180°C	230°C	290°C
Materials and Supplies	1.0% per year of the total capital costs for the production field (Tables A-I and A-II).					
Production						
Generation	1.0% per year of the total capital costs for the generating plant (Table A-I).					
Manpower	1.0% per year of the total capital costs for the production field (Tables A-I and A-II).					
Production						
Generation	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
(percent of item 2.0)						
Well Maintenance	1.0% per year of the total capital costs of production and injection wells (Table A-II).					
Deep-Well Pump Maintenance	28%	N/A	N/A	60%	50%	N/A
(Percent of item 1.3)						
Generating Plant Mtce.	0.5%	0.5%	0.5%	1.0%	1.0%	1.0%
(Percent of item 2.0)						
Heat Exchanger Mtce.	N/A	N/A	N/A	2.0%	2.0%	2.0%
(Percent of item 2.2)						

TABLE 2-IV
DEFINITION OF CAPITAL CATEGORIES

	CATEGORY	MAJOR EQUIPMENT OR FUNCTION
PRODUCTION	Production Wells	Production wells, collars, corrals
	Gathering System	Piping for steam, brine or both to plant
	Process Mechanical	Deep well pumps, process pumps, valves, separators at well head or in plant
	Instrumentation and Control	Instrumentation, motor controllers valve operators
	Spent Brine Treatment	Clean up of brine for disposal
	Distribution System	Piping for disposal brine from plant to injection wells
	Injection Wells	Wells, collars, corrals
	Engineering and Administration	Support of design and construction
GENERATION	Turbine Generator	Turbine, generator and aux. systems
	Process Mechanical	Heat exchangers, pumps, valves, process support equipment
	Piping and Insulation	In plant process piping and insulation
	Instrumentation and Control	Plant control board, instrumentation, motor controllers, valve operators
	Electrical	In plant electrical requirements
	Civil and Structural	Turbine pedestal, pads, buildings fencing, site roads
	Condenser and Heat Rejection	Condenser, cooling towers, pumps for circulating water system
	Switchyard	Switchyard
	Engineering and Administration	Support of design and construction

TABLE 2-V
CAPITAL AND O&M COST FACTORS FOR HIGH-SALINITY BRINES

EFFECT	APPLICABILITY TO THE CAPITAL CATEGORIES	COST FACTOR		
		FLASH AND BINARY SYSTEMS		
		180°C	230°C	290°C
Scaling ¹	Production: } Gathering System Process Mechanical Instrumentation and Control Spent Brine Treat- ment Generating Plant: Process Mechanical ² }	1.5	1.5	1.5
Corrosion ¹	Same as above except Instrumentation and Control	1.0	1.7	1.7
Spent Brine Treatment O&M Cost	Spent Brine Treatment	50%/yr	75%/yr	100%/yr
Cleaning	Production: } Gathering System Process Mechanical Generating Plant: Process Mechanical }	1.0%/yr	1.5%/yr	2.0%/yr
Well Maintenance	Production Wells } Injection Wells }	2½%/yr	2½%/yr	5%/yr
Equipment	Wells	1.0	.5	.4
Lifetime	Production Plant	1.0	.5	.4
	Generating Plant	1.0	1.0	.67

¹ Multiply capital figures obtained for low-salinity system (Table A-I) by given factors to obtain values for high-salinity systems.

² Binary system only.

power plants. For the case of geothermal power plants the cost basis is computed to include the interest during the construction years and the reinvestment made after the start-up date in replacement wells and producer plant. Also, the geothermal field revenue requirement is used to calculate the fuel cost for the power plant.

It is assumed that the geothermal production field and the electricity generating plant will be owned and operated by two different organizations with differing capital, regulatory and tax structures. These organizations are referred to as the Producer and the Utility, respectively.

The model computes, individually for each plant, the revenues required by the Producer and the Utility to cover all their operating costs and to make a reasonable profit. These revenue requirements are translated into levelized busbar electricity costs. The Producer cost is expressed in mills per kWh (from the generating plant) for convenience. The busbar cost of electricity is the sum of the Producer and Utility costs.

All electricity costs are reported in 1977 dollars, regardless of the plant start-up year.

The computation process is the same for the Producer and the Utility (and also the same for the cost of electricity from competing sources). It equates the present value (in the start-up year) of all

cost streams to the present value of an equivalent level revenue stream. The discount rate used to obtain these present values is the average net after-tax cost of capital to the organization.

The process starts with the computation of charges accruing to capital. These comprise sinking fund payments or equivalent (for capital recovery), interest on debt, profits to equity, property taxes and insurance, and income tax on profits. All these except profit are sheltered from income tax. Interest on debt and property taxes and insurance are tax-deductible, and the sinking fund payments are covered by depreciation allowances. These capital charges are applied to a costbasis consisting of the present value in the start-up year of all investments, allowing for inflation, escalation¹ and the time value of money (cost of capital), and allowing for fiscal adjustments such as reduction of income taxes by accelerated depreciation allowances, investment tax credits and expensing intangible drilling costs.

To the present value of these capital charges are added the present values of the cost streams arising from operating and maintenance charges and fuel (the latter applicable only to competing energy sources), again adjusted for inflation, escalation, and the time value of money.

When adjusted for depletion allowance and royalty payments, if applicable, this figure represents the present value of all costs associated with the plant. This is equated to the present value of

¹ Escalation denotes real cost changes, which are different from general inflation.

the revenue stream in order to determine the levelized busbar cost, in the start-up year.

A crucial factor in determining the levelized busbar cost is the way in which future inflation is handled. Two conventions are in common use, and to clarify the difference between them, it is necessary to distinguish between constant (or real) dollars and nominal (or current) dollars. Constant dollars are the dollars of a particular year (1977 in this report) and have constant purchasing power. Nominal dollars are the dollars of whatever year is under consideration and have differing purchasing powers depending upon inflation.

The two conventions in common use are:

- Convention 1: the levelized revenue requirement is taken to be constant over the life of the plant in constant dollars (and hence increases in nominal dollars with the passage of time due to inflation).
- Convention 2: the levelized revenue requirement is taken to be constant over the life of the plant in nominal dollars (and hence decreases in real value with the passage of time due to inflation).

Figures 2-1 and 2-2 illustrate the differences. Figure 2-1 is plotted in constant dollars and shows the revenue requirements according to convention 2 decreasing in real terms. Figure 2-2 is plotted in nominal dollars and shows the revenue requirements according to Convention 1 apparently increasing (while remaining constant in terms of real value).

The two conventions represent slightly different ways of expressing the levelized value of the same cost stream and are related by an expression which depends only on the inflation rate, discount rate,

FIGURE 2-1
EFFECTS OF INFLATION ON LEVELIZED COSTS AND REVENUE REQUIREMENTS, NOMINAL DOLLARS

FIGURE 2-2
EFFECTS OF INFLATION ON LEVELIZED COSTS AND REVENUE REQUIREMENTS, CONSTANT DOLLARS

and plant life. Under the assumptions made in GELCOM concerning inflation, the value derived under convention 2 is about 41% higher than that derived under convention 1 (used in GELCOM) for the producer for a 30-year project life and about 70% higher for the utility. Care must therefore be taken when comparing cost estimates acquired from different sources, in order to ensure that the costs are presented in equivalent terms.

Electricity-generating costs were roughly constant (or declining in real terms) through the 1950s, but over the last decade they have been rising with the general inflation rate. (It appears that economies of scale associated with larger generating plants are no longer sufficient to offset the effects of increases in capital and fuel costs.) It is for this reason that the constant real cost definition (convention 1) has been adopted in this report.

2.2.1 Input Data

The required input data can be classified as follows:

A. Time Factors:

n = Economic life in years

m = Depreciation life for tax purposes in years

v = Start-up or Vintage year (start up is assumed to occur at the beginning of this year)

s = Start expenditure year

b = Base or Price year

B. Capital Structure and Financing Data:

D_F = Debt Fraction, D_R = Debt Interest Rate (i.e., interest on bonds)

E_F = Equity Fraction, E_R = Rate of Return on Equity

P_F = Preferred Stock Fraction, P_R = Rate of Return on Preferred Stock

C. Tax Rates:

T_{Fd} = Federal Income Tax Rate, T_{st} = State Income Tax Rate

GRTAX = Gross Revenue Tax, ROY = Royalty (as percentage of geothermal field revenue)

ITAXC = Investment Tax Credit, PTAX = Property Tax Rate

D. Inflation and Escalation Factors:

INF = Inflation rate

ESC_F = Escalation¹ rate for fuel cost,

$ESC_{O\&M}$ = Escalation rate for operating and maintenance expenses

ESC_C = Escalation rate for capital cost

ESC_E = Escalation rate for energy revenues

E. Energy Data:

K = Energy output factor in Kwhr = capacity factor x 8760

2.2.2 Methodology for Calculating Busbar Energy Cost

The METREK stepwise procedure for computing the busbar energy cost involves the following steps:

1. Calculate effective tax rate,

$$t = T_{Fd} + T_{st} - T_{Fd} \cdot T_{st} \quad (1)$$

2. Calculate average after tax cost of capital r,

$$r = (1-t) D_F \cdot D_R + E_F \cdot E_R + P_F \cdot P_R \quad (2)$$

¹ Escalation is defined as the real change in cost from year to year, i.e., after removal of the effects of general inflation.

3. Calculate Capital Costbasis

The cost basis is defined as the net present value of all investment brought to the beginning of the start-up year, expressed in b year dollars. Assume that the investment in year j is c_j , expressed in b year dollars. Then the cost basis is:*

$$CB = \sum_{j=s}^{v+n} \frac{c_j (1 + INF + ESC_c)^{j-b} (1 + r)^{v-j}}{(1 + INF)^{v-b}} \quad (3)$$

under the assumption that capital must be available at the beginning of the year in which the investment is to be made.

For certain applications it may happen that some capital items have a life of less than n years; an example in geothermal energy where the well lives may be only 10 years and the project life may be 30 years. In such cases reinvestment is necessary to replace these items. Such reinvestment is treated as part of the capital investment stream (c_j), but a separate cost basis should be calculated for each set of items having the same life. Further, in what follows, separate calculations should be made for each set of items having the same life for: capital recovery factor, income tax factor, tax depreciation and credit allowances, and fixed charge rate, using the parameters applicable to each set as appropriate.

4. Calculate capital recovery factor $CRF_{r,n}$:

$$CRF = \frac{r}{1 - (1 + r)^{-n}} \quad (4)$$

* In the GELCOM print-out, the factors $INF + ESC_*$ are referred to as escalation for brevity.

5. Calculate proportion of cost of capital contributed by equity, PE:

$$PE = (E_F \cdot E_R) / r \quad (5)$$

6. Calculate Income Tax factor, t_{inc} :

$$t_{inc} = \left(\frac{t}{1-t} \right) PE \left(CRF_{r,n} - \frac{1}{n} \right) \quad (6)$$

7. Calculate proportion of capital recaptured through preferential tax treatment (i.e., accelerated depreciation allowance and investment tax credit).

- a. Accelerated Tax Depreciation Allowance, dep_t :

$$dep_t = \left(\frac{t}{1-t} \right) \left[\frac{2(CRF_{r,n}) (m - F_m)}{m(m+1) r} \right] - \frac{1}{n} \quad (7)$$

$$\text{where } F_m = \frac{1}{CRF_{r,m}}$$

assuming sum of years digit depreciation over and above a straight line depreciation

- b. Investment Tax Credit Allowance, ITC:

$$ITC = (CRF_{r,n}) \left(\frac{1}{1-t} \right) \left(\frac{ITAXC}{1+r} \right) \quad (8)$$

8. Calculate Property Tax Factor, t_p :

$$t_p = (PTAX) (F_n) (CRF_{r,n}) \text{ where } F_n = \frac{1}{CRF_{r,n}} \quad (9)$$

9. Calculate Fixed Charge Rate, FCR:

$$FCR = CRF_{r,n} + t_{inc} + t_p - dep_t - ITC \quad (10)$$

10. Calculate Fuel and O&M Escalation Factors:

$$D_{esc, fuel} = \left(\frac{1+INF+ESC_F}{1+INF} \right)^{V-b} \left[\frac{1 - \left(\frac{1+INF+ESC_F}{1+r} \right)^n}{r - INF - ESC_F} \right] \quad (11)$$

$$D_{esc,O\&M} = \left(\frac{1+INF+ESC_{O\&M}}{1 + INF} \right)^{v-b} \left[\frac{1 - \frac{1+INF+ESC_{O\&M}}{1+r}}{r - INF - ESC_{O\&M}} \right] \quad (12)$$

The escalation factors convert the future cost streams to their present values at the beginning of the start-up year v , expressed in b year dollars.

11. Calculate adjustment factors to annualized fuel and O&M costs:

$$AF_{fuel} = D_{esc, fuel} \times CRF_{r,n} \quad (13)$$

$$AF_{O\&M} = D_{esc, O\&M} \times CRF_{r,n} \quad (14)$$

12. Calculate annualized energy factor, AE:

$$AE = (CRF_{r,n}) (K) \left(\frac{1+INF+ESC_E}{1 + INF} \right)^{v-b} \left[\frac{1 - \frac{1+INF+ESC_E}{1+r}}{r - INF - ESC_F} \right] \quad (15)$$

Note that the assumption is made that the revenue stream from energy sales is constant in constant dollars (convention 1). An alternative assumption (convention 2) would be that the stream is constant in current dollars. This would yield an energy price which would be higher in the ratio AE/K .

- B. Calculation of Total Annualized Cost of Energy;

$$ANC = \text{Annualized Capital Cost} = CB \times FCR \quad (16)$$

$$ANF = \text{Annualized Fuel Cost} = \text{Fuel Cost Base}^1 \times AF_{fuel} \quad (17)$$

$$ANOM = \text{Annualized O\&M Cost} = \text{O\&M Cost Base}^1 \times AF_{O\&M} \quad (18)$$

$$TACE = \text{Total Annualized Cost of Energy} = ANC + ANF + ANOM \quad (19)$$

¹Fuel Cost Base = cost of fuel per year expressed in by year dollars, etc.

C. Calculation of Busbar Cost of Energy:

$$\text{BBC} = \text{Busbar Cost} = \frac{\text{TACE} \times 10^3}{\text{AE}} \text{ mills/Kwhr} \quad (20)$$

In the event that a gross revenue tax and royalty apply, the total busbar cost of energy becomes:

$$\text{Busbar Cost} = \frac{\text{BBC}}{(1-\text{GRTAX}-\text{ROY})} \quad (21)$$

In the event that a depletion allowance (DEPL) is allowed as a specified percentage of the gross revenue, equation (21) becomes:

$$\text{Busbar Cost} = \frac{\text{BBC}}{1-\text{GRTAX}-\text{ROY} + \text{DEPL.t}}$$

3.0 DESCRIPTION OF THE GELCOM OUTPUT DISPLAY

Costs of power at the busbar, as estimated by GELCOM are given for each plant assumed for each prospect. The computer print-out first shows the prospect name, conversion cycle designated, and best estimates of resource characteristics. Next, the expected brine flow rate per well and the cost of wells are shown--the internal default algorithms which compute these two factors may be overridden if data are available. The program indicates whether the data were externally specified or internally generated. This section of the print-out showing the economic analysis for the Brawley, California site is reproduced (as a sample) below:

BRAWLEY , CALIFORNIA
BINARY SYSTEM , 50 MW ELECTRIC PLANT
FIRST PLANT ON LINE DATE : 1983

TEMPERATURE IN CENTIGRADE DEGREES (BEST ESTIMATE) : 260
WELL DEPTH IN METERS : 2000
BRINE SALINITY : HIGH
OVERLYING ROCK TYPE : SOFT
THE WELL FLOW RATE IS NOT SPECIFIED : THE DEFAULT FLOW RATE USED (KGM./HR.) = 277856
SPECIFIED COST PER PRODUCTION WELL (\$) : 400000.0
SPECIFIED COST PER INJECTION WELL (\$) : 400000.0

The next section of the print-out details the financial data for the Producer and the Utility. These data include capital structure, tax rates and estimated escalation factors. (Also included are equipment lifetimes and plant capacity factors because these, although technological parameters, are intimately used in calculating unit costs and depreciation). The ultimate capacity factor is the average annual electricity output from the plant as a fraction of plant

capacity once the plant has reached a steady annual output. The start-up cost multiplication factor is the factor by which the cost per kWh must be multiplied to allow for lower output during start-up.¹ The values for the Producer and the Utility are different because of the different discount rates used.

The Producer and Utility cost data for the Brawley site are reproduced below:

PRODUCER FINANCIAL DATA

DEBT FRACTION :	0.30
ANNUAL INTEREST RATE ON DEBT (FRACTION) :	0.08
REQUIRED RATE OF RETURN ON EQUITY (FRACTION) :	0.20
PROPERTY TAX RATE (FRACTION) :	0.01
REVENUE TAX RATE OR ROYALTY (FRACTION) :	0.10
EFFECTIVE TOTAL INCOME TAX RATE (FRACTION) :	0.50
EFFECTIVE INVESTMENT TAX CREDIT (FRACTION) :	0.04
ESCALATION FACTOR FOR O&M COSTS :	0.05
ESCALATION FACTOR FOR ENERGY COSTS :	0.05
ESCALATION FACTOR FOR CAPITAL COSTS :	0.05
LIFE SPAN OF PRODUCTION WELLS (YEARS) :	5.00
LIFE SPAN OF INJECTION WELLS (YEARS) :	5.00
LIFE SPAN OF PRODUCER PLANT (YEARS) :	10.00
START UP COST MULTIPLIER :	1.081

UTILITY FINANCIAL DATA

DEBT FRACTION :	0.50
ANNUAL INTEREST RATE ON DEBT (FRACTION) :	0.08
REQUIRED RATE OF RETURN ON EQUITY (FRACTION) :	0.12
PROPERTY TAX RATE (FRACTION) :	0.01
REVENUE TAX RATE OR ROYALTY (FRACTION) :	0.0
EFFECTIVE TOTAL INCOME TAX RATE (FRACTION) :	0.50
EFFECTIVE INVESTMENT TAX CREDIT (FRACTION) :	0.04
ESCALATION FACTOR FOR O&M COSTS :	0.05
ESCALATION FACTOR FOR ENERGY COSTS :	0.05
ESCALATION FACTOR FOR CAPITAL COSTS :	0.05
LIFE SPAN OF UTILITY PLANT (YEARS) :	20.00
ULTIMATE CAPACITY FACTOR :	0.80
START UP COST MULTIPLIER :	1.038

¹ More precisely, the start-up cost multiplication factor is the inverse ratio of the discounted present values of the revenue streams with and without accounting for lower output during start-up.

The capital and operating and maintenance costs are given next for a 50-MW_e plant using 1977 technology. The Producer capital requirements are broken down into production wells, injection wells, and plant, the latter comprising the system of valves, pipes, pumps, well-head steam separators, etc., necessary to transmit the brine from the wellhead to the conversion plant, and from the conversion plant to the injection wells.

The levelized busbar costs are then computed for this plant, in 1977 dollars. For convenience, the Producer revenue requirements are converted into mills/kWh produced by the generating plant. (Note that the terms busbar cost and revenue requirements are used interchangeably and have the same meaning in this paper.) The cost data for the Brawley site is reproduced below:

* NUMBER OF WELLS , CAPITAL COSTBASIS AND O&M COSTS ,
AND REVENUE REQUIREMENTS WITHOUT ANY R&D IMPACTS *
CAPITAL COSTBASIS (1977 \$M)

6 PRODUCTION WELLS :	2.889	
4 INJECTION WELLS :	1.926	
PRODUCER PLANT EXCLUDING WELLS :	6.428	
REPLACEMENT PRODUCTION WELLS :	4.399	
REPLACEMENT INJECTION WELLS :	2.933	
REPLACEMENT PLANT :	5.116	
TOTAL FOR PRODUCTION FIELD :		23.692
GENERATING PLANT :		39.763
TOTAL :		63.455

O&M COSTS (1977 \$M/YR.)

PRODUCER		
GENERAL :	0.197	
WELL :	0.050	
DEEP WELL PUMP :	1.462	
SPENT BRINE TREATMENT :	0.606	
CHEMICAL & MECHANICAL CLEANING :	0.057	
TOTAL :		2.371
UTILITY		
GENERAL :	1.533	
CHEMICAL & MECHANICAL CLEANING :	3.157	
TOTAL :		1.690

**** REVENUE REQUIREMENTS ****

PRODUCER : 59.667 (\$M/YR.) = 22.261 (MILLS/KWHR)
UTILITY : 73.529 (\$M/YR.) = 15.170 (MILLS/KWHR)
* TOTAL : 37.431 MILLS/KWHR *

The next page of the computer print-out deals with the first commercial-scale development of a 50-MW_e plant at the prospect, as postulated by the development scenario. The impacts of the projected RD&D achievements which are applicable to this plant are shown on an individual basis. The impacts of all these advances are then taken together to give the estimated busbar cost of electricity from this plant.

A sensitivity analysis for the cost of electricity for this first plant is shown next. The following two parameters were varied one at a time (all others were kept constant):

- Resource temperature (where high and low estimates were available)
- Ultimate capacity factor

Additionally, the impact of the following tax measures were investigated:

- Investment tax credit rate (15 percent net)
- Depletion allowance (22 percent of gross revenue)
- Expensing intangible drilling costs

The following sections of the print-out describe the analysis of RD&D impacts for subsequent plant modules of 50 MW_e at their postulated on-line dates. Figure 3-1 reproduces, as an example, this part of the print-out for the Brawley, California site.

BRAWLEY , CALIFORNIA

* R&D IMPACTS FOR PLANT NO. 1 - ON LINE DATE : 1983 *

R&D COMPONENT	ANTICIPATED CHANGE (%)	CHANGE IN REVENUE REQUIREMENTS (MILLS/KWHR)
NUMBER OF PRODUCTION WELLS	-22.00	-0.7690
CAPITAL COST PER PRODUCTION WELL	-5.00	-0.2307
CAPITAL COST PER INJECTION WELL	-5.00	-0.1538
CAPITAL COST OF PROCESS MECHANICAL (UTILITY)	-50.00	-2.1483
CAPITAL COST OF CONDENSER & HEAT REJECTION EQUIPMENT	-20.00	-0.6283
PRODUCER DEEP WELL PUMP O&M COST FACTOR (BINARY SYSTEM , TEMP <260 C)	-33.00	-1.6539

** REVENUE REQUIREMENTS WITH ALL THE R&D IMPACTS INCLUDED. **

PRODUCER : 50.041 (\$M/YR.) = 18.670 (MILLS/KWHR)
 UTILITY : 60.071 (\$M/YR.) = 12.394 (MILLS/KWHR)
 * TOTAL : 31.064 MILLS/KWHR *

* SENSITIVITY OF COST OF ELECTRICITY (FROM PLANT NO. 1 , R&D IMPACTS INCLUDED) *

RESOURCE & OPERATING PARAMETERS	MILLS/KWHR
HIGH RESOURCE TEMPERATURE ESTIMATE (300 DEGREES CENTIGRADE)	22.084
LOW RESOURCE TEMPERATURE ESTIMATE (200 DEGREES CENTIGRADE)	42.304
HIGH CAPACITY FACTOR VALUE : 0.85	29.236
LOW CAPACITY FACTOR VALUE : 0.60	41.418
EXPENSING OF INTANGIBLE DRILLING COSTS (70.0% OF WELL COSTS EXPENSED)	30.190
DEPLETION ALLOWANCE (22.0% OF GROSS INCOME)	27.396
INVESTMENT TAX CREDIT (26.2% GROSS, 15.0% EFFECTIVE)	29.549

FIGURE 3-1

ECONOMIC ANALYSIS: BRAWLEY, CALIFORNIA

* R&D IMPACTS FOR PLANT NO. 2 - ON LINE DATE : 1985 *

R&D COMPONENT	ANTICIPATED CHANGE (%)	CHANGE IN REVENUE REQUIREMENTS (MILLS/KWHR)
NUMBER OF PRODUCTION WELLS	-22.00	-0.7690
CAPITAL COST PER PRODUCTION WELL	-5.00	-0.2307
CAPITAL COST PER INJECTION WELL	-5.00	-0.1538
CAPITAL COST OF PROCESS MECHANICAL (UTILITY)	-50.00	-2.1483
CAPITAL COST OF CONDENSER & HEAT REJECTION EQUIPMENT	-20.00	-0.6283
PRODUCER DEEP WELL PUMP O&M COST FACTOR (BINARY SYSTEM , TEMP <260 C)	-33.00	-1.6539

28

** REVENUE REQUIREMENTS WITH ALL THE R&D IMPACTS INCLUDED. **

PRODUCER : 49.566 (\$/YR.) = 18.493 (MILLS/KWHR)
 UTILITY : 60.071 (\$/YR.) = 12.394 (MILLS/KWHR)
 * TOTAL : 30.886 MILLS/KWHR *

FIGURE 3-1, Continued

ECONOMIC ANALYSIS: BRAWLEY, CALIFORNIA

* R&D IMPACTS FOR PLANT NO. 3 - ON LINE DATE : 1987 *

R&D COMPONENT	ANTICIPATED CHANGE (%)	CHANGE IN REVENUE REQUIREMENTS (MILLS/KWHR)
NUMBER OF PRODUCTION WELLS	-22.00	-0.7690
CAPITAL COST PER PRODUCTION WELL	-12.00	-0.5537
CAPITAL COST PER INJECTION WELL	-12.00	-0.3691
CAPITAL COST OF GATHERING SYSTEM	-10.00	-0.0750
CAPITAL COST OF DISTRIBUTION SYSTEM	-10.00	-0.0462
CAPITAL COST OF PROCESS MECHANICAL (UTILITY)	-50.00	-2.1483
CAPITAL COST OF CONDENSER & HEAT REJECTION EQUIPMENT	-20.00	-0.6283
PRODUCER DEEP WELL PUMP O&M COST FACTOR (BINARY SYSTEM, TEMP <260 C)	-67.00	-3.3578
PRODUCER SPENT BRINE TREATMENT O&M COST FACTOR (HIGH SALINITY)	-10.00	-0.2077
LIFE SPAN OF PRODUCTION WELLS	40.00	-0.7921
LIFE SPAN OF INJECTION WELLS	40.00	-0.5281
LIFE SPAN OF ALL PRODUCER EQUIPMENT EXCLUDING WELLS	20.00	-0.5811
START UP COST MULTIPLIERS	(PRODUCER: -4.16, UTILITY: -2.12)	-1.2482

** REVENUE REQUIREMENTS WITH ALL THE R&D IMPACTS INCLUDED. **

PRODUCER : 41.163 (\$M/YR.) = 14.718 (MILLS/KWHR)
 UTILITY : 60.071 (\$M/YR.) = 12.131 (MILLS/KWHR)
 * TOTAL : 26.849 MILLS/KWHR *

FIGURE 3-1, Concluded

ECONOMIC ANALYSIS: BRAWLEY, CALIFORNIA

* R&D IMPACTS FOR PLANT NO. 4 - ON LINE DATE : 1988 *

R&D COMPONENT	ANTICIPATED CHANGE (%)	CHANGE IN REVENUE REQUIREMENTS (MILLS/KWHR)
NUMBER OF PRODUCTION WELLS	-22.00	-0.7690
CAPITAL COST PER PRODUCTION WELL	-12.00	-0.5537
CAPITAL COST PER INJECTION WELL	-12.00	-0.3691
CAPITAL COST OF GATHERING SYSTEM	-10.00	-0.0750
CAPITAL COST OF DISTRIBUTION SYSTEM	-10.00	-0.0462
CAPITAL COST OF PROCESS MECHANICAL (UTILITY)	-50.00	-2.1483
CAPITAL COST OF CONDENSER & HEAT REJECTION EQUIPMENT	-20.00	-0.6283
PRODUCER DEEP WELL PUMP O&M COST FACTOR (BINARY SYSTEM , TEMP <260 C)	-67.00	-3.3578
PRODUCER SPENT BRINE TREATMENT O&M COST FACTOR (HIGH SALINITY)	-10.00	-0.2077
LIFE SPAN OF PRODUCTION WELLS	40.00	-0.7921
LIFE SPAN OF INJECTION WELLS	40.00	-0.5281
LIFE SPAN OF ALL PRODUCER EQUIPMENT EXCLUDING WELLS	20.00	-0.5811
START UP COST MULTIPLIERS	(PRODUCER: -4.16 , UTILITY: -2.12)	-1.2482

** REVENUE REQUIREMENTS WITH ALL THE R&D IMPACTS INCLUDED. **

PRODUCER : 41.163 (\$M/YR.) = 14.718 (MILLS/KWHR)
 UTILITY : 60.071 (\$M/YR.) = 12.131 (MILLS/KWHR)
 * TOTAL : 26.849 MILLS/KWHR *

FIGURE 3-1, Continued

ECONOMIC ANALYSIS: BRAWLEY, CALIFORNIA

* R&D IMPACTS FOR PLANT NO. 5 - ON LINE DATE : 1989 *

R&D COMPONENT	ANTICIPATED CHANGE (%)	CHANGE IN REVENUE REQUIREMENTS (MILLS/KWHR)
NUMBER OF PRODUCTION WELLS	-22.00	-0.7690
CAPITAL COST PER PRODUCTION WELL	-12.00	-0.5537
CAPITAL COST PER INJECTION WELL	-12.00	-0.3691
CAPITAL COST OF GATHERING SYSTEM	-10.00	-0.0750
CAPITAL COST OF DISTRIBUTION SYSTEM	-10.00	-0.0462
CAPITAL COST OF PROCESS MECHANICAL (UTILITY)	-50.00	-2.1483
CAPITAL COST OF CONDENSER & HEAT REJECTION EQUIPMENT	-20.00	-0.6283
PRODUCER DEEP WELL PUMP O&M COST FACTOR (BINARY SYSTEM , TEMP <260 C)	-67.00	-3.3578
PRODUCER SPENT BRINE TREATMENT O&M COST FACTOR (HIGH SALINITY)	-10.00	-0.2077
LIFE SPAN OF PRODUCTION WELLS	40.00	-0.7921
LIFE SPAN OF INJECTION WELLS	40.00	-0.5281
LIFE SPAN OF ALL PRODUCER EQUIPMENT EXCLUDING WELLS	20.00	-0.5811
START UP COST MULTIPLIERS	(PRODUCER: -4.16 , UTILITY: -2.12)	-1.2482

** REVENUE REQUIREMENTS WITH ALL THE R&D IMPACTS INCLUDED. **

PRODUCER : 41.163 (\$M/YR.) = 14.718 (MILLS/KWHR)
 UTILITY : 60.071 (\$M/YR.) = 12.131 (MILLS/KWHR)
 * TOTAL : 26.849 MILLS/KWHR *

FIGURE 3-1, Continued

ECONOMIC ANALYSIS: BRAWLEY, CALIFORNIA

* R&D IMPACTS FOR PLANT NO. 6 - ON LINE DATE : 1990 *

R&D COMPONENT	ANTICIPATED CHANGE (%)	CHANGE IN REVENUE REQUIREMENTS (MILLS/KWHR)
NUMBER OF PRODUCTION WELLS	-22.00	-0.7690
CAPITAL COST PER PRODUCTION WELL	-20.00	-0.9228
CAPITAL COST PER INJECTION WELL	-20.00	-0.6152
CAPITAL COST OF GATHERING SYSTEM	-10.00	-0.0750
CAPITAL COST OF DISTRIBUTION SYSTEM	-10.00	-0.0462
CAPITAL COST OF PROCESS MECHANICAL (UTILITY)	-50.00	-2.1483
CAPITAL COST OF CONDENSER & HEAT REJECTION EQUIPMENT	-20.00	-0.6283
PRODUCER DEEP WELL PUMP O&M COST FACTOR (BINARY SYSTEM , TEMP <260 C)	-67.00	-3.3578
PRODUCER SPENT BRINE TREATMENT O&M COST FACTOR (HIGH SALINITY)	-10.00	-0.2077
LIFE SPAN OF PRODUCTION WELLS	40.00	-0.7921
LIFE SPAN OF INJECTION WELLS	40.00	-0.5281
LIFE SPAN OF ALL PRODUCER EQUIPMENT EXCLUDING WELLS	20.00	-0.5811
START UP COST MULTIPLIERS	(PRODUCER: -4.16 , UTILITY: -2.12)	-1.2482

** REVENUE REQUIREMENTS WITH ALL THE R&D IMPACTS INCLUDED. **

PRODUCER : 39.934 (\$M/YR.) = 14.279 (MILLS/KWHR)
 UTILITY : 60.071 (\$M/YR.) = 12.131 (MILLS/KWHR)
 * TOTAL : 26.410 MILLS/KWHR *

4.0 GELCOM

The GELCOM is written in FORTRAN IV computer programming language, and is implemented on IBM computer 370/148 at MITRE. It has been made interactive and all of the assumptions about temperature, salinity, geological formation hardness, depth, capital structure, equipment life time, etc. can be changed by the user at a remote terminal. Presently, the GELCOM is resident on a MITRE mini disk which may be accessed by entering the proper user ID and password when logging onto the MITRE computer.

4.1 Data Files Maintained in GELCOM

Eight data files are maintained in the data base. Five of these data files, COMEOFF DATA, WELCOFF DATA, ROCOFF DATA, RRND DATA, and GEOSIT DATA are the integral part of the GELCOM, and should not be altered by the user. The data in the last three files, RAJ DATA, RADFIL DATA, and Finance DATA could be changed by the operator, but a specified format has to be followed. Data formats for these files are defined later in this section.

COMEOFF DATA file contains the coefficients A, B, and D to extrapolate engineering cost estimates (except wells) hyperbolically from the data available for 6 generic plant designs. The coefficients A, B, and D have previously been defined in Section 2.1. WELCOFF DATA file includes similar coefficients to determine the number of production and injection wells. ROCOFF DATA file contains Table 2-II from which the GELCOM computes the capital costs for production and injection wells for a specified geological formation hardness and the depth.

RRND DATA includes a list of all the Research and Development impacts implemented in the GELCOM.

GEOSIT DATA is the main data base maintained in the GELCOM. It contains the assumed parametric information such as operating temperatures, salinity, rock type, depth, power on line years, and equipment lifetime, etc. on 26 geothermal prospects listed in Table 4-I. GEOSIT DATA file is not directly accessed and used in the program, but, the user has to extract the information on a particular prospect of interest from this file. The extracted information is contained in the file called "RAJ DATA," and becomes a direct input to the GELCOM.

The file RAJ DATA is extracted from the file GEOSIT DATA by issuing the following two commands:

1. ERASE RAJ DATA
2. COPY FILE GEOSIT DATA A1 RAJ DATA A1 (FRLABEL XXXXXXXXX FOR 6).

XXXXXXX is a character string defining the name of the Geothermal prospect. Up to 8 non blank characters may be specified.

4.1.1 File: RAJ DATA

There are 6 records of data in the RAJ DATA file. The data elements and their formats are given in Table 4-II.

4.1.2 File: FINANCE DATA

This file includes financial data (debt/equity ratio, cost of money, tax rates, escalation factors, etc.) and the utility plant capacity factor. The GELCOM utilizes this data to compute the

TABLE 4-I

GEOTHERMAL PROSPECTS INCLUDED IN THE DATA BASE

1. Brawley, California	14. Surprise Valley, California
2. Coso, California	15. Alvord, Oregon
3. East Mesa, California	16. Bruneau-Grandview, Idaho
4. Heber, California	17. Raft River, Idaho
5. Mono-Long Valley,
California	18. Vale H.S., Oregon
6. Salton Sea, California	19. Weiser-Crane Creek, Idaho
7. Beowawe, Nevada	20. Chandler, Arizona
8. Brady H.S., Nevada	21. Leach, Nevada
9. Cove Fort-Sulphurdale,
Utah	22. Thermo, Utah
10. Roosevelt H.S., Nevada	23. Safford, Arizona
11. Steamboat Springs,
Nevada	24. Glass Mountain, California
12. Valles Caldera,
New Mexico	25. Puna, Hawaii
13. Lassen, California	26. Baker H.S., Washington

TABLE 4-II
DATA RECORD FORMAT FOR FILE: RAJ DATA

	<u>COLUMN</u>	<u>CONTENTS</u>	<u>FORMAT</u>
RECORD 1:	1-72	SITE--Name of the Geothermal Resource	18A4
RECORD 2:	1-6	NPLANT--No. of Power Plants (Max. 12)	I6
	7-78	Power on Line Years for the NPLANT Power Plants	12I6
RECORD 3:	1-6	ITEMP--Best Resource Temperature Estimate (°C)	I6
	7-12	ITEMPH--High Resource Temperature Estimate (°C)	I6
	13-18	ITEMPL--Low Resource Temperature Estimate (°C)	I6
RECORD 4:	1-6	ISYSTP--Sytem Kind 1 indicates Flash System 0 indicates Binary System	I6
	7-12	IDEPH--Resource Depth (meters)	I6
	13-18	IRKTYP--Geological Formation Hardness 1 designates soft rocks 2 designates medium rocks 3 designates medium-hard rocks 4 designates hard rocks	I6
	19-24	ISAL--Brine Salinity 1 defines High Salinity 2 defines Low Salinity	I6
RECORD 5:	1-10	IFLOW--Well Flow Rate (kgm/hr) 1 will assume Default Conditions	I10
	11-20	IPWCST--Cost per Production Well (\$) 1 will assume Default Conditions	I10
	21-30	IIWCST--Cost per Injection Well (\$) 1 will assume Default Conditions	I10
In all default conditions, GELCOM will compute proper values from internally built logic.			
RECORD 6:	1-6	ALP1--Life Span of a Production Well	F6.2
	7-12	ALP2--Life Span of an Injection Well	F6.2
	13-18	ALP3--Life Span of a Producer Plant	F6.2
	19-24	ALP4--Life Span of a Utility Plant	F6.2

levelized busbar costs. Additionally, some of the data, like, depletion allowance rate, percent intangibles expensed, low and high capacity factors, are used to perform the sensitivity analyses. The data elements and their formats are presented in Table 4-III.

4.1.3 File: RADFIL DATA

The data in the file, RADFIL DATA represents the estimated benefits from the Federal Geothermal RD&D Program on future facility costs and performances. The estimates were derived from the current DGE schedules and anticipated advances from engineering development.¹

It is estimated that the real cost reductions in both the capital and O&M costs because of the engineering R&D program will be first noticed in 1980. The trend toward declining capital and O&M costs has been projected to continue to 1987, in three time frames (1980, 1983, and 1987).

The cost reductions and equipment life expectancy extensions in the individual components of the geothermal plants are identified in the same 3 time frames, 1980, 1983, and 1987, and are included in the RADFIL DATA file. The file is divided in 6 subsections and the subsections are arranged in the following order:

¹R. Trehan, A. Cohen, J. Gupta, W. Jacobsen, J. Leigh, and S. True, "Site-Specific Analysis of Geothermal Development--Scenarios and Requirements", MTR-7586, Volume II, The MITRE Corporation, December 1977.

TABLE 4-III
DATA FORMAT FOR FILE: FINANCE DATA

	<u>COLUMN</u>	<u>CONTENTS</u>	<u>FORMAT</u>
RECORD 1:	1-6	Producer Debt Fraction	F6.2
	7-12	Producer Annual Interest Rate on Debt (fraction)	F6.2
	13-18	Producer Rate of Return on Equity (fraction)	F6.2
	19-24	Effective Income Tax Rate (fraction)	F6.2
	25-30	Producer Property Tax Rate (fraction)	F6.2
	31-36	Producer Revenue Tax Rate (fraction)	F6.2
	37-42	Effective Income Tax Credit Rate (fraction)	F6.2
	43-48	Ultimate Capacity Factor	F6.2
	49-54	Escalation Factor for O&M Costs (Producer)	F6.2
	55-60	Escalation Factor for Energy Costs (Producer)	F6.2
	61-66	Escalation Factor for Capital Costs (Producer)	F6.2
RECORD 2:	1-6	Utility Debt Fraction	F6.2
	7-12	Utility Annual Interest Rate on Debt (fraction)	F6.2
	13-18	Utility Rate of Return on Equity (fraction)	F6.2
	19-24	Utility Property Tax Rate (fraction)	F6.2
	25-30	Utility Revenue Tax Rate (fraction)	F6.2
	31-36	Escalation Factor for O&M Costs (Utility)	F6.2
	37-42	Escalation Factor for Energy Costs (Utility)	F6.2
	43-48	Escalation Factor for Capital Costs (Utility)	F6.2
RECORD 3:	1-7	Depletion Allowance Rate (fraction)	F7.3
	8-14	Expensing Factor of Intangible Drilling Costs	F7.3
	15-21	Start up Cost Multiplier (Producer before 1985)	F7.3
	22-28	Start up Cost Multiplier (Producer after 1985)	F7.3
	29-35	Effective Investment Tax Credit Rate to be used in Sensitivity Analysis (fraction)	F7.3
	36-42	High Capacity Factor	F7.3
	43-49	Low Capacity Factor	F7.3
	50-56	Start up Cost Multiplier (Utility before 1985)	F7.3
	57-63	Start up Cost Multiplier (Utility after 1985)	F7.3

- (1) 1980 - RD&D benefits for Binary Conversion Cycle Plants
- (2) 1983 - RD&D benefits for Binary Conversion Cycle Plants
- (3) 1987 - RD&D benefits for Binary Conversion Cycle Plants
- (4) 1980 - RD&D benefits for Flash Conversion Cycle Plants
- (5) 1983 - RD&D benefits for Flash Conversion Cycle Plants
- (6) 1987 - RD&D benefits for Flash Conversion Cycle Plants

The data formats in all the subsections is identically the same. The data elements and their formats in the first subsection is given in Table 4-IV.

4.2 Available Features and Options

As previously indicated, the GELCOM works in an interactive mode. The user has the option of changing the data in the files, RAJ DATA, and FINANCE DATA either by editing them personally or via a remote terminal in an interactive mode.

The file, RADFIL DATA has not been made interactive, because (1) it contains a large quantity of data and (2) the user has to be fully familiar with the various RD&D impact categories. In case any changes have to be made, the user has to edit this file himself.

The GELCOM has the capability to generate economic analysis reports with and without performing R&D impacts analysis and also with and without any sensitivity analyses done. The user has also the option of projecting the imputed revenue stream obtained from energy production to be expressed as (1) constant in constant dollars, or (2) constant in current dollars.

TABLE 4-IV

DATA RECORD FORMAT FOR FILE: RADFIL DATA

<u>COLUMN</u>	<u>CONTENTS</u>	<u>FORMAT</u>
RECORD 1: 1-72	Identify Conversion Cycle and the RD&D Impact Year	18A6
RECORD 2: 1-7	RDFNPW--% Change in Number of Production Wells	F7.1
8-14	RDRNIW--% Change in Number of Production Wells	F7.1
15-21	RDFCPW--% Change in Cost Per Production Well	F7.1
22-28	RDFCIW--% Change in Cost per Injection Well	F7.1
RECORD 3: 1-7	RDFCC(1)--% Change in Capital Cost of Gathering System	F7.1
8-14	RDFCC(2)--% Change in Capital Cost of Process Mechanical (Producer)	F7.1
15-21	RDFCC(3)--% Change in Capital Cost of Instrumentation and Control (producer)	F7.1
22-28	RDFCC(4)--% Change in Capital Cost of Spent-Brine Treatment (producer)	F7.1
29-35	RDFCC(5)--% Change in Capital Cost of Distribution System	F7.1
36-42	RDFCC(6)--% Change in Capital Cost of Engineering and Administration (producer)	F7.1
RECORD 4: 1-7	RDFCC(7)--% Change in Capital Cost of Turbine Generator	F7.1
8-14	RDFCC(8)--% Change in Capital Cost of Process Mechanical (Utility)	F7.1
15-21	RDFCC(9)--% Change in Capital Cost of Piping and Insulation	F7.1
22-28	RDFCC(10)--% Change in Capital Cost of Instrumentation	F7.1
29-35	RDFCC(11)--% Change in Capital Cost of Electrical Components	F7.1
36-42	RDFCC(12)--% Change in Capital Cost of Civil and Structural	F7.1
43-49	RDFCC(13)--% Change in Capital Cost of Condenser and Heat Rejection Equipment	F7.1
50-56	RDFCC(14)--% Change in Capital Cost of Switchyard	F7.1
57-63	RDFCC(15)--% Change in Capital Cost of Engineering and Administration (Utility)	F7.1

TABLE 4-IV, Concluded

DATA RECORD FORMAT FOR FILE: RADFIL DATA

<u>COLUMN</u>	<u>CONTENTS</u>	<u>FORMAT</u>
RECORD 4: 1-7	ROMF(1)--% Change in Producer General O&M Cost Factor	F7.1
8-14	ROMF(2)--% Change in Producer Well O&M Cost Factor (low salinity)	F7.1
15-21	ROMF(3)--% Change in Producer Well O&M Cost Factor (high salinity, temperature <232°C)	F7.1
22-28	ROMF(4)--% Change in Producer Well O&M Cost Factor (high salinity, temperature >232°C)	F7.1
29-35	ROMF(5)--% Change in Producer Deep Well Pump O&M Cost Factor (flash system), temperature <200°C)	F7.1
36-42	ROMF(6)--% Change in Producer Deep Well Pump O&M Cost Factor (binary system), temperature <260°C)	F7.1
43-49	ROMF(7)--% Change in Producer Spent Brine Treatment O&M Cost Factor	F7.1
50-56	ROMF(8)--% Change in Producer Chemical and Mechanical O&M Cost Factor	F7.1
RECORD 5: 1-7	ROMF(9)--% Change in Utility General O&M Cost Factor (flash system)	F7.1
8-14	ROMF(10)--% Change in Utility General O&M Cost Factor (binary system)	F7.1
15-21	ROMF(11)--% Change in Utility Process Mechanical O&M Cost Factor (binary system)	F7.1
22-28	ROMF(12)--% Change in Utility Chemical and Mechanical O&M Cost Factor	F7.1
RECORD 6: 1-7	% Change in Life Span of Production Wells (low salinity)	F7.1
8-14	% Change in Life Span of Injection Wells (low salinity)	F7.1
15-21	% Change in Life Span of Producer Plant (low salinity)	F7.1
22-28	% Change in Life Span of Utility Plant (low salinity)	F7.1
RECORD 7: 1-7	% Change in Life Span of Production Well (high salinity)	F7.1
8-14	% Change in Life Span of Injection Well (high salinity)	F7.1
15-21	% Change in Life Span of Producer Plant (high salinity)	F7.1
22-28	% Change in Life Span of Utility Plant (high salinity)	F7.1

4.3 Accessing GELCOM

After the user has logged on MITRE computer, he must create RAJ DATA FILE. The file DATA is extracted from the file GEOSIT DATA and the extraction procedure is defined in section 4.1

Once the RAJ DATA FILE is generated, the user is then ready to execute GELCOM program to determine the cost of electricity for the Geothermal prospect. The execution is initiated by issuing the command: GELCOM . GELCOM is an EXEC type element. It contains the CMS control statements.

4.4 Sample Session at a Terminal With GELCOM

A typical terminal session is illustrated on the following pages. The item in lower case letters, is the input to the computer. All the other material is output from the computer. In this session, the user desired the reports with the options listed in Table 4-V.

TABLE 4-V

OPTIONS/FEATURES UTILIZED TO GENERATE REPORTS

REPORT	SITE	R&D IMPACTS ANALYSIS INCLUDED	SENSITIVITY ANALYSIS DONE	CONSTANT/CURRENT DOLLARS	RESOURCE OPERATING PARAMETERS AND FINANCIAL DATA
1	Heber	no	no	constant	none
2	Heber	yes	no	constant	none
3	Heber	no	yes	constant	none
4	Heber	yes	yes	constant	none
5	Heber	yes	yes	current	none
6	Heber	yes	yes	constant	Investment Tax Credit Rate Changed from 4% to 10%

The output of the entire session is given in sample reports 1-6.

A SAMPLE TERMINAL SESSION WITH GELCOM

44
R; T=0.01/0.02 14:58:27
erase raj data
R; T=0.02/0.04 14:58:41
copyfile gecsit data a1 raj data a1 (firlabel heber for 6)
R; T=0.11/0.17 14:59:13
gelcom
GL TXTLIB FORTMOD1
FI 01 DISK COMCOFF DATA A1
FI 02 DISK WELCOFF DATA A1
FI 03 DISK ROCOFF DATA A1
FI 04 DISK RRND DATA A1
FI 07 DISK RAJ DATA A1
FI 08 PRINTER (LRECL 133 BLOCK 133 RECFM FA)
FI 09 DISK RADFIL DATA A1
FI 10 DISK FINANCE DATA A1
LOAD GELCOM
START
DMSLIO740I EXECUTION BEGINS...

NEED TO DETERMINE THE EFFECTS OF R&D IMPACTS ? SAY YES, OR NO.
no

THE PROSPECT IS:
HEBER , CALIFORNIA

NEED SENSITIVITY ANALYSIS ? SAY YES, OR NO.
no

A SAMPLE TERMINAL SESSION WITH GELCOM, Continued

DO YOU WISH THE IMPUTED REVENUE STREAM OBTAINED FROM ENERGY PRODUCTION
TO BE EXPRESSED AS

1. CONSTANT IN CONSTANT DOLLARS
- OR 2. CONSTANT IN CURRENT DOLLARS.

SAY 1 OR 2 IN FORMAT (I1).

1

DO YOU WISH TO EDIT INPUT DATA ? ENTER YES, OR NO.

no

R: T=2.06/2.94 14:59:54

gelcom

GL TXTLIB FORTMOD1

FI 01 DISK COMCOFF DATA A1

FI 02 DISK WELCOFF DATA A1

FI 03 DISK ROCOFF DATA A1

FI 04 DISK RRND DATA A1

FI 07 DISK RAJ DATA A1

FI 08 PRINTER (LRECI 133 BLOCK 133 RECFM FA)

FI 09 DISK RADFIL DATA A1

FI 10 DISK FINANCE DATA A1

LOAD GELCOM

START

DMSLIO740I EXECUTION BEGINS...

NEED TO DETERMINE THE EFFECTS OF R&D IMPACTS ? SAY YES, OR NO.

yes

THE PROSPECT IS:
HEBER , CALIFORNIA

A SAMPLE TERMINAL SESSION WITH GELCOM, Continued

NEED SENSITIVITY ANALYSIS ? SAY YES, OR NO.

no

DO YOU WISH THE IMPUTED REVENUE STREAM OBTAINED FROM ENERGY PRODUCTION
TO BE EXPRESSED AS

1. CONSTANT IN CONSTANT DOLLARS
- OR 2. CONSTANT IN CURRENT DOLLARS.

SAY 1 OR 2 IN FORMAT (I1).

1

DO YOU WISH TO EDIT INPUT DATA ? ENTER YES, OR NO.

no

R; T=4.44/5.55 15:00:57

gelcom

GL TXTLIB FORTMOD1

FI 01 DISK COMCOFF DATA A1

FI 02 DISK WELCOFF DATA A1

FI 03 DISK ROCCOFF DATA A1

FI 04 DISK RRND DATA A1

FI 07 DISK RAJ DATA A1

FI 08 PRINTER (IRECL 133 BLOCK 133 RECFM FA)

FI 09 DISK RADFIL DATA A1

FI 10 DISK FINANCE DATA A1

LOAD GELCOM

START

DMSLIO740I EXECUTION BEGINS...

NEED TO DETERMINE THE EFFECTS OF R&D IMPACTS ? SAY YES, OR NO.

no

THE PROSPECT IS:
HEBER , CALIFORNIA

A SAMPLE TERMINAL SESSION WITH GELCOM, Continued

NEED SENSITIVITY ANALYSIS ? SAY YES, OR NO.

yes

DO YOU WISH THE IMPUTED REVENUE STREAM OBTAINED FROM ENERGY PRODUCTION
TO BE EXPRESSED AS

1. CONSTANT IN CONSTANT DOLLARS
- OR 2. CONSTANT IN CURRENT DOLLARS.

SAY 1 OR 2 IN FORMAT (I1).

1

DO YOU WISH TO EDIT INPUT DATA ? ENTER YES, OR NO.

no

R; T=2.26/3.28 15:01:32

gelcom

GL TXTLIB FCRTMOD1

FI 01 DISK COMCOFF DATA A1

FI 02 DISK WELCOFF DATA A1

FI 03 DISK ROCOFF DATA A1

FI 04 DISK RRND DATA A1

FI 07 DISK RAJ DATA A1

FI 08 PRINTER (LRECL 133 BLOCK 133 RECFM FA)

FI 09 DISK RADFIL DATA A1

FI 10 DISK FINANCE DATA A1

LOAD GELCOM

START

DMSLIO740I EXECUTION BEGINS...

NEED TO DETERMINE THE EFFECTS OF R&D IMPACTS ? SAY YES, OR NO.

yes

THE PROSPECT IS:
HEBER , CALIFORNIA

A SAMPLE TERMINAL SESSION WITH GELCOM, Continued

NEED SENSITIVITY ANALYSIS ? SAY YES, OR NO.

yes

DO YOU WISH THE IMPUTED REVENUE STREAM OBTAINED FROM ENERGY PRODUCTION
TO BE EXPRESSED AS

1. CONSTANT IN CONSTANT DOLLARS
- OR 2. CONSTANT IN CURRENT DOLLARS.

SAY 1 OR 2 IN FORMAT (I1).

1

DO YOU WISH TO EDIT INPUT DATA ? ENTER YES, OR NO.

no

R; T=4.66/5.90 15:02:17

gelcom

GL TXTLIB FCRTMOD1

FI 01 DISK COMCOFF DATA A1

FI 02 DISK WELCOFF DATA A1

FI 03 DISK ROCCOFF DATA A1

FI 04 DISK RRND DATA A1

FI 07 DISK RAJ DATA A1

FI 08 PRINTER (LRECI 133 BLOCK 133 RECFM FA)

FI 09 DISK RADFII DATA A1

FI 10 DISK FINANCE DATA A1

LOAD GELCOM

START

DMSLIO740I EXECUTION BEGINS...

NEED TO DETERMINE THE EFFECTS OF R&D IMPACTS ? SAY YES, OR NO.

yes

THE PROSPECT IS:
HEBER , CALIFORNIA

A SAMPLE TERMINAL SESSION WITH GELCOM, Continued

NEED SENSITIVITY ANALYSIS ? SAY YES, OR NO.

yes

DO YOU WISH THE IMPUTED REVENUE STREAM OBTAINED FROM ENERGY PRODUCTION
TO BE EXPRESSED AS

- 1. CONSTANT IN CONSTANT DOLLARS
- OR 2. CONSTANT IN CURRENT DOLLARS.

SAY 1 OR 2 IN FORMAT (I1).

2

DO YOU WISH TO EDIT INPUT DATA ? ENTER YES, OR NO.

no

R; T=4.69/5.93 15:03:03

gelcom

GL TXTLIB FCRTMOD1

FI 01 DISK COMCOFF DATA A1

FI 02 DISK WELCOFF DATA A1

FI 03 DISK ROCCOFF DATA A1

FI 04 DISK RRND DATA A1

FI 07 DISK RAJ DATA A1

FI 08 PRINTER (LRECL 133 BLOCK 133 RECFM FA)

FI 09 DISK RADFIL DATA A1

FI 10 DISK FINANCE DATA A1

LOAD GELCOM

START

DMSLIO740I EXECUTION BEGINS...

NEED TO DETERMINE THE EFFECTS OF R&D IMPACTS ? SAY YES, OR NO.

yes

THE PROSPECT IS:

HEBER , CALIFORNIA

A SAMPLE TERMINAL SESSION WITH GELCOM, Continued

NEED SENSITIVITY ANALYSIS ? SAY YES, OR NO.

yes

DO YOU WISH THE IMPUTED REVENUE STREAM OBTAINED FROM ENERGY PRODUCTION
TO BE EXPRESSED AS

1. CONSTANT IN CONSTANT DOLLARS
OR 2. CONSTANT IN CURRENT DOLLARS.

SAY 1 OR 2 IN FORMAT (I1).

1

DO YOU WISH TO EDIT INPUT DATA ? ENTER YES, OR NO.

yes

THE CURRENT DATA ARE:

- (1) TEMPERATURE (CENTIGRADE) 190
(2) DEPTH (METERS) 1500
(3) NUMBER OF POWER PLANTS 4

IF THERE ARE NO CHANGES , HIT RETURN.

OTHERWISE, ENTER ITEM NO. AND NEW VALUE IN FORMAT (I1,1X,I6)

NOTE: AFTER LAST ENTRY , HIT RETURN AGAIN.

190 1500 4

THE POWER ON LINE YEARS ARE:

1983 1985 1987 1988

IF THERE ARE NO CHANGES , HIT RETURN.

OTHERWISE ENTER NEW P.O.L. YEARS (NPLANT MAX.) IN FORMAT (12I6)

NOTE: AFTER A FINAL CHANGE , HIT RETURN AGAIN.

A SAMPLE TERMINAL SESSION WITH GELCOM, Continued

THE CURRENT DATA VALUES ARE:

(1) SYSTEM TYPE	BINARY
(2) ROCK TYPE	SOFT
(3) SALINITY	LOW

IF THERE ARE NO CHANGES , HIT RETURN.

OTHERWISE, ENTER ITEM NO. AND NEW VALUE IN FORMAT(I1,1X,2A4)

NOTE: AFTER LAST ENTRY , HIT RETURN AGAIN.

0 1 0

THE CURRENT DATA VALUES ARE :

(1) WELL FLOW RATE	1	(DEFAULT)
(2) COST PER PRODUCTION WELL	600000	
(3) COST PER INJECTION WELL	600000	

IF THERE ARE NO CHANGES , HIT RETURN.

OTHERWISE, ENTER ITEM NO. AND NEW VALUE IN FORMAT (I1,1X,I10)

NOTE (A): FOR DEFAULT VALUES MUST ENTER 1 IN I10 FORMAT.

NOTE (B): AFTER LAST ENTRY , HIT RETURN AGAIN.

1 600000 600000

THE CURRENT DATA VALUES ARE:

(1) LIFE SPAN OF PRODUCTION WELLS (YR.)	10.00
(2) LIFE SPAN OF INJECTION WELLS (YR.)	10.00
(3) LIFE SPAN OF PRODUCER PLANT (YR.)	20.00
(4) LIFE SPAN OF UTILITY PLANT (YR.)	30.00

A SAMPLE TERMINAL SESSION WITH GELCOM, Continued

IF THERE ARE NO CHANGES , HIT RETURN.

OTHERWISE, ENTER ITEM NO. AND NEW VALUE IN FORMAT (I1,1X,F7.2)

NOTE: AFTER LAST ENTRY , HIT RETURN AGAIN.

10.00 10.00 20.00 30.00

THE PRODUCER CURRENT FINANCIAL DATA VALUES ARE:

(1) DEBT FRACTION	0.30
(2) ANNUAL INTEREST RATE ON DEBT	0.08
(3) REQUIRED RATE OF RETURN ON EQUITY (FRACTION)	0.20
(4) TOTAL INCOME TAX RATE (FRACTION)	0.50
(5) PROPERTY TAX RATE (FRACTION)	0.01
(6) REVENUE TAX RATE OR ROYALTY (FRACTION)	0.10
(7) INVESTMENT TAX CREDIT (FRACTION)	0.04
(8) ESCALATION FACTOR FOR O&M COSTS	0.05
(9) ESCALATION FACTOR FOR ENERGY COSTS	0.05
(10) ESCALATION FACTOR FOR CAPITAL COSTS	0.05

IF THERE ARE NO CHANGES , HIT RETURN.

OTHERWISE, ENTER ITEM NO. AND NEW VALUE IN FORMAT (I2,1X,F6.2)

NOTE: AFTER LAST ENTRY , HIT RETURN AGAIN.

7 .10

0.30 0.08 0.20 0.50 0.01 0.10 0.10 0.05 0.05 0.05

THE UTILITY CURRENT FINANCIAL DATA VALUES ARE:

(1) DEBT FRACTION	0.50
(2) ANNUAL INTEREST RATE ON DEBT	0.08
(3) REQUIRED RATE OF RETURN ON EQUITY (FRACTION)	0.12
(4) PROPERTY TAX RATE (FRACTION)	0.01
(5) REVENUE TAX RATE ON ROYALTY (FRACTION)	0.0
(6) ULTIMATE CAPACITY FACTOR	0.80
(7) ESCALATION RATE FOR O&M COSTS (FRACTION)	0.05
(8) ESCALATION RATE FOR ENERGY COSTS (FRACTION)	0.05
(9) ESCALATION RATE FOR CAPITAL COSTS (FRACTION)	0.05

A SAMPLE TERMINAL SESSION WITH GELCOM, Concluded

IF THERE ARE NO CHANGES , HIT RETURN.

OTHERWISE, ENTER ITEM NO. AND NEW VALUE IN FORMAT (I2,1X,F6.2)

NOTE: AFTER LAST ENTRY , HIT RETURN AGAIN.

0.50 0.08 0.12 0.01 0.0 0.80 0.05 0.05 0.05

THE INPUT DATA ON START UP CCST MULTIPLIERS ARE:

- (1) PRODUCER (BEFORE 1985) 1.081
- (2) PRODUCER (AFTER 1985) 1.036
- (3) UTILITY (BEFORE 1985) 1.038
- (4) UTILITY (AFTER 1985) 1.016

IF THERE ARE NO CHANGES , HIT RETURN.

OTHERWISE, ENTER ITEM NO. AND NEW VALUE IN FORMAT (I1,1X,F6.3)

NOTE: AFTER LAST ENTRY , HIT RETURN AGAIN.

1.081 1.036 1.038 1.016

THE INPUT DATA FOR SENSITIVITY ANALYSIS ARE:

- (1) DEPLETION ALLOWANCE RATE (FRACTION) 0.22
- (2) EXPENSING FACTOR OF INTANGIBLE DRILLING COSTS 0.70
- (3) EFFECTIVE INVESTMENT TAX CREDIT (FRACTION) 0.15
- (4) HIGH RESOURCE TEMPERATURE ESTIMATE (CENT.) 225.00
- (5) LOW RESOURCE TEMPERATURE ESTIMATE (CENT.) 150.00
- (6) HIGH CAPACITY FACTOR VALUE 0.85
- (7) LOW CAPACITY FACTOR VALUE 0.60

IF THERE ARE NO CHANGES , HIT RETURN.

OTHERWISE, ENTER ITEM NO. AND NEW VALUE IN FORMAT (I1,1X,F7.2)

NOTE: AFTER LAST ENTRY , HIT RETURN AGAIN.

0.22 0.70 0.15 225 150 0.85 0.60

R; T=5.10/7.01 15:04:39

log

REPORT 1

HEBER , CALIFORNIA
BINARY SYSTEM , 50 MW ELECTRIC PLANT
FIRST PLANT ON LINE DATE : 1983

TEMPERATURE IN CENTIGRADE DEGREES (BEST ESTIMATE) : 190
WELL DEPTH IN METERS : 1500
BRINE SALINITY : LOW
OVERLYING ROCK TYPE : SOFT
THE WELL FLOW RATE IS NOT SPECIFIED : THE DEFAULT FLOW RATE USED (KGM./HR.) = 266270
SPECIFIED COST PER PRODUCTION WELL (\$) : 600000.0
SPECIFIED COST PER INJECTION WELL (\$) : 600000.0

PRODUCER FINANCIAL DATA

DEBT FRACTION : 0.30
ANNUAL INTEREST RATE ON DEBT (FRACTION) : 0.08
REQUIRED RATE OF RETURN ON EQUITY (FRACTION) : 0.20
PROPERTY TAX RATE (FRACTION) : 0.01
REVENUE TAX RATE OR ROYALTY (FRACTION) : 0.10
EFFECTIVE TOTAL INCOME TAX RATE (FRACTION) : 0.50
EFFECTIVE INVESTMENT TAX CREDIT (FRACTION) : 0.04
ESCALATION FACTOR FOR O&M COSTS : 0.05
ESCALATION FACTOR FOR ENERGY COSTS : 0.05
ESCALATION FACTOR FOR CAPITAL COSTS : 0.05
LIFE SPAN OF PRODUCTION WELLS (YEARS) : 10.00
LIFE SPAN OF INJECTION WELLS (YEARS) : 10.00
LIFE SPAN OF PRODUCER PLANT (YEARS) : 20.00
START UP COST MULTIPLIER : 1.081

UTILITY FINANCIAL DATA

DEBT FRACTION : 0.50
ANNUAL INTEREST RATE ON DEBT (FRACTION) : 0.08
REQUIRED RATE OF RETURN ON EQUITY (FRACTION) : 0.12
PROPERTY TAX RATE (FRACTION) : 0.01
REVENUE TAX RATE OR ROYALTY (FRACTION) : 0.0
EFFECTIVE TOTAL INCOME TAX RATE (FRACTION) : 0.50
EFFECTIVE INVESTMENT TAX CREDIT (FRACTION) : 0.04
ESCALATION FACTOR FOR O&M COSTS : 0.05
ESCALATION FACTOR FOR ENERGY COSTS : 0.05
ESCALATION FACTOR FOR CAPITAL COSTS : 0.05
LIFE SPAN OF UTILITY PLANT (YEARS) : 30.00
ULTIMATE CAPACITY FACTOR : 0.80
START UP COST MULTIPLIER : 1.038

* NUMBER OF WELLS , CAPITAL COSTBASIS AND O&M COSTS , AND REVENUE REQUIREMENTS WITHOUT ANY RED IMPACTS *

CAPITAL COSTBASIS (1977 \$M)

16 PRODUCTION WELLS : 11.556
7 INJECTION WELLS : 5.056
PRODUCER PLANT EXCLUDING WELLS : 7.284
REPLACEMENT PRODUCTION WELLS : 9.869
REPLACEMENT INJECTION WELLS : 4.318
REPLACEMENT PLANT : 3.214
TOTAL FOR PRODUCTION FIELD : 41.296
GENERATING PLANT : 35.785
TOTAL : 77.081

O&M COSTS (1977 \$M/YR.)

PRODUCER
GENERAL : 0.409
WELL : 0.138
DEEP WELL PUMP : 0.721
SPENT BRINE TREATMENT : 0.0
CHEMICAL & MECHANICAL CLEANING : 0.0
TOTAL : 1.268
UTILITY
GENERAL : 1.288
CHEMICAL & MECHANICAL CLEANING : 0.0
TOTAL : 1.288

** REVENUE REQUIREMENTS **

PRODUCER : 27.982 MILLS/KWHR
UTILITY : 11.137 MILLS/KWHR
* TOTAL : 39.119 MILLS/KWHR *

REPORT 1, Continued

HEBER , CALIFORNIA
(CONTINUED)

* ON LINE DATE: 1985 *

** REVENUE REQUIREMENTS **

PRODUCER : 27.982 MILLS/KWHR
UTILITY : 11.137 MILLS/KWHR
* TOTAL : 39.119 MILLS/KWHR *

REPORT 1, Continued
HEBER, CALIFORNIA
(CONTINUED)

* ON LINE DATE: 1987 *

** REVENUE REQUIREMENTS **

PRODUCER : 27.982 MILLS/KWHR
UTILITY : 11.137 MILLS/KWHR
* TOTAL : 39.119 MILLS/KWHR *

REPORT 1, Concluded
HEBER, CALIFORNIA
(CONTINUED)

* ON LINE DATE: 1988 *

** REVENUE REQUIREMENTS **

PRODUCER : 27.982 MILLS/KWHR
UTILITY : 11.137 MILLS/KWHR
* TOTAL : 39.119 MILLS/KWHR *

REPORT 2

HEBER, CALIFORNIA
BINARY SYSTEM, 50 MW ELECTRIC PLANT
FIRST PLANT ON LINE DATE : 1983

TEMPERATURE IN CENTIGRADE DEGREES (BEST ESTIMATE) : 190
WELL DEPTH IN METERS : 1500
BRINE SALINITY : LOW
OVERLYING ROCK TYPE : SOFT
THE WELL FLOW RATE IS NOT SPECIFIED : THE DEFAULT FLOW RATE USED (KGM./HR.) = 266270
SPECIFIED COST PER PRODUCTION WELL (\$) : 600000.0
SPECIFIED COST PER INJECTION WELL (\$) : 600000.0

PRODUCER FINANCIAL DATA

DEBT FRACTION : 0.30
ANNUAL INTEREST RATE ON DEBT (FRACTION) : 0.08
REQUIRED RATE OF RETURN ON EQUITY (FRACTION) : 0.20
PROPERTY TAX RATE (FRACTION) : 0.01
REVENUE TAX RATE OR ROYALTY (FRACTION) : 0.10
EFFECTIVE TOTAL INCOME TAX RATE (FRACTION) : 0.50
EFFECTIVE INVESTMENT TAX CREDIT (FRACTION) : 0.04
ESCALATION FACTOR FOR O&M COSTS : 0.05
ESCALATION FACTOR FOR ENERGY COSTS : 0.05
ESCALATION FACTOR FOR CAPITAL COSTS : 0.05
LIFE SPAN OF PRODUCTION WELLS (YEARS) : 10.00
LIFE SPAN OF INJECTION WELLS (YEARS) : 10.00
LIFE SPAN OF PRODUCER PLANT (YEARS) : 20.00
START UP COST MULTIPLIER : 1.081

UTILITY FINANCIAL DATA

DEBT FRACTION : 0.50
ANNUAL INTEREST RATE ON DEBT (FRACTION) : 0.08
REQUIRED RATE OF RETURN ON EQUITY (FRACTION) : 0.12
PROPERTY TAX RATE (FRACTION) : 0.01
REVENUE TAX RATE OR ROYALTY (FRACTION) : 0.0
EFFECTIVE TOTAL INCOME TAX RATE (FRACTION) : 0.50
EFFECTIVE INVESTMENT TAX CREDIT (FRACTION) : 0.04
ESCALATION FACTOR FOR O&M COSTS : 0.05
ESCALATION FACTOR FOR ENERGY COSTS : 0.05
ESCALATION FACTOR FOR CAPITAL COSTS : 0.05
LIFE SPAN OF UTILITY PLANT (YEARS) : 30.00
ULTIMATE CAPACITY FACTOR : 0.80
START UP COST MULTIPLIER : 1.038

* NUMBER OF WELLS, CAPITAL COSTBASIS AND O&M COSTS, AND REVENUE REQUIREMENTS WITHOUT ANY R&D IMPACTS *

CAPITAL COSTBASIS (1977 \$M)

16 PRODUCTION WELLS : 11.556
7 INJECTION WELLS : 5.056
PRODUCER PLANT EXCLUDING WELLS : 7.284
REPLACEMENT PRODUCTION WELLS : 9.869
REPLACEMENT INJECTION WELLS : 4.318
REPLACEMENT PLANT : 3.214
TOTAL FOR PRODUCTION FIELD : 41.296
GENERATING PLANT : 35.785
TOTAL : 77.081

O&M COSTS (1977 \$M/YR.)

PRODUCER
GENERAL : 0.409
WELL : 0.138
DEEP WELL PUMP : 0.721
SPENT BRINE TREATMENT : 0.0
CHEMICAL & MECHANICAL CLEANING : 0.0
TOTAL : 1.268
UTILITY
GENERAL : 1.288
CHEMICAL & MECHANICAL CLEANING : 0.0
TOTAL : 1.288

** REVENUE REQUIREMENTS **

PRODUCER : 27.982 MILLS/KWHR
UTILITY : 11.137 MILLS/KWHR
* TOTAL : 39.119 MILLS/KWHR *

REPORT 2, Continued
 HEBER , CALIFORNIA
 (CONTINUED)

* R&D IMPACTS FOR PLANT NO. 1 - ON LINE DATE : 1983 *

R&D COMPONENT	ANTICIPATED CHANGE (%)	CHANGE IN REVENUE REQUIREMENTS (MILLS/KWHR)
NUMBER OF PRODUCTION WELLS	-22.00	-3.3126
CAPITAL COST PER PRODUCTION WELL	-5.00	-0.6625
CAPITAL COST PER INJECTION WELL	-5.00	-0.2899
CAPITAL COST OF PROCESS MECHANICAL (UTILITY)	-50.00	-0.6586
CAPITAL COST OF CONDENSER & HEAT REJECTION EQUIPMENT	-20.00	-0.6296
PRODUCER DEEP WELL PUMP O&M COST FACTOR (BINARY SYSTEM , TEMP <260 C)	-33.00	-0.8154

** REVENUE REQUIREMENTS WITH ALL THE R&D IMPACTS INCLUDED. **

PRODUCER : 21.586 MILLS/KWHR
 UTILITY : 9.849 MILLS/KWHR
 * TOTAL : 31.435 MILLS/KWHR *

REPORT 2, Continued
 HEBER , CALIFORNIA
 (CONTINUED)

* R&D IMPACTS FOR PLANT NO. 2 - ON LINE DATE : 1985 *

R&D COMPONENT	ANTICIPATED CHANGE (%)	CHANGE IN REVENUE REQUIREMENTS (MILLS/KWHR)
NUMBER OF PRODUCTION WELLS	-22.00	-3.3126
CAPITAL COST PER PRODUCTION WELL	-5.00	-0.6625
CAPITAL COST PER INJECTION WELL	-5.00	-0.2899
CAPITAL COST OF PROCESS MECHANICAL (UTILITY)	-50.00	-0.6586
CAPITAL COST OF CONDENSER & HEAT REJECTION EQUIPMENT	-20.00	-0.6296
PRODUCER DEEP WELL PUMP O&M COST FACTOR (BINARY SYSTEM , TEMP <260 C)	-33.00	-0.8154

** REVENUE REQUIREMENTS WITH ALL THE R&D IMPACTS INCLUDED. **

PRODUCER : 21.318 MILLS/KWHR
 UTILITY : 9.849 MILLS/KWHR
 * TOTAL : 31.167 MILLS/KWHR *

REPORT 2, Continued
 HEBER , CALIFORNIA
 (CONTINUED)

* R&D IMPACTS FOR PLANT NO. 3 - ON LINE DATE : 1987 *

R&D COMPONENT	ANTICIPATED CHANGE (%)	CHANGE IN REVENUE REQUIREMENTS (MILLS/KWHR)
NUMBER OF PRODUCTION WELLS	-22.00	-3.3126
CAPITAL COST PER PRODUCTION WELL	-12.00	-1.5900
CAPITAL COST PER INJECTION WELL	-12.00	-0.6956
CAPITAL COST OF GATHERING SYSTEM	-10.00	-0.0659
CAPITAL COST OF DISTRIBUTION SYSTEM	-10.00	-0.0785
CAPITAL COST OF PROCESS MECHANICAL (UTILITY)	-50.00	-0.6586
CAPITAL COST OF CONDENSER & HEAT REJECTION EQUIPMENT	-20.00	-0.6296
PRODUCER DEEP WELL PUMP O&M COST FACTOR (BINARY SYSTEM , TEMP <260 C)	-67.00	-1.6556
LIFE SPAN OF PRODUCTION WELLS	20.00	-0.9866
LIFE SPAN OF INJECTION WELLS	100.00	-1.3075
START UP COST MULTIPLIERS	(PRODUCER: -4.16 , UTILITY: -2.12)	-1.4009

** REVENUE REQUIREMENTS WITH ALL THE R&D IMPACTS INCLUDED. **

PRODUCER : 18.381 MILLS/KWHR
 UTILITY : 9.640 MILLS/KWHR
 * TOTAL : 28.021 MILLS/KWHR *

REPORT 2, Concluded

HEBER, CALIFORNIA
(CONTINUED)

* R&D IMPACTS FOR PLANT NO. 4 - ON LINE DATE : 1988 *

R&D COMPONENT	ANTICIPATED CHANGE (%)	CHANGE IN REVENUE REQUIREMENTS (MILLS/KWHR)
NUMBER OF PRODUCTION WELLS	-22.00	-3.3126
CAPITAL COST PER PRODUCTION WELL	-12.00	-1.5900
CAPITAL COST PER INJECTION WELL	-12.00	-0.6956
CAPITAL COST OF GATHERING SYSTEM	-10.00	-0.0659
CAPITAL COST OF DISTRIBUTION SYSTEM	-10.00	-0.0785
CAPITAL COST OF PROCESS MECHANICAL (UTILITY)	-50.00	-0.6586
CAPITAL COST OF CONDENSER & HEAT REJECTION EQUIPMENT	-20.00	-0.6296
PRODUCER DEEP WELL PUMP O&M COST FACTOR (BINARY SYSTEM, TEMP <260 C)	-67.00	-1.6556
LIFE SPAN OF PRODUCTION WELLS	20.00	-0.9866
LIFE SPAN OF INJECTION WELLS	100.00	-1.3075
START UP COST MULTIPLIERS	(PRODUCER: -4.16, UTILITY: -2.12)	-1.4009

** REVENUE REQUIREMENTS WITH ALL THE R&D IMPACTS INCLUDED. **

PRODUCER : 18.381 MILLS/KWHR
 UTILITY : 9.640 MILLS/KWHR
 * TOTAL : 28.021 MILLS/KWHR *

REPORT 3

HEBER, CALIFORNIA
BINARY SYSTEM, 50 MW ELECTRIC PLANT
FIRST PLANT ON LINE DATE: 1983

TEMPERATURE IN CENTIGRADE DEGREES (BEST ESTIMATE) : 190
WELL DEPTH IN METERS : 1500
BRINE SALINITY : LOW
OVERLYING ROCK TYPE : SOFT
THE WELL FLOW RATE IS NOT SPECIFIED : THE DEFAULT FLOW RATE USED (KG./HR.) = 266270
SPECIFIED COST PER PRODUCTION WELL (\$) : 600000.0
SPECIFIED COST PER INJECTION WELL (\$) : 600000.0

PRODUCER FINANCIAL DATA

DEBT FRACTION : 0.30
ANNUAL INTEREST RATE ON DEBT (FRACTION) : 0.08
REQUIRED RATE OF RETURN ON EQUITY (FRACTION) : 0.20
PROPERTY TAX RATE (FRACTION) : 0.01
REVENUE TAX RATE OR ROYALTY (FRACTION) : 0.10
EFFECTIVE TOTAL INCOME TAX RATE (FRACTION) : 0.50
EFFECTIVE INVESTMENT TAX CREDIT (FRACTION) : 0.04
ESCALATION FACTOR FOR O&M COSTS : 0.05
ESCALATION FACTOR FOR ENERGY COSTS : 0.05
ESCALATION FACTOR FOR CAPITAL COSTS : 0.05
LIFE SPAN OF PRODUCTION WELLS (YEARS) : 10.00
LIFE SPAN OF INJECTION WELLS (YEARS) : 10.00
LIFE SPAN OF PRODUCER PLANT (YEARS) : 20.00
START UP COST MULTIPLIER : 1.081

UTILITY FINANCIAL DATA

DEBT FRACTION : 0.50
ANNUAL INTEREST RATE ON DEBT (FRACTION) : 0.08
REQUIRED RATE OF RETURN ON EQUITY (FRACTION) : 0.12
PROPERTY TAX RATE (FRACTION) : 0.01
REVENUE TAX RATE OR ROYALTY (FRACTION) : 0.0
EFFECTIVE TOTAL INCOME TAX RATE (FRACTION) : 0.50
EFFECTIVE INVESTMENT TAX CREDIT (FRACTION) : 0.04
ESCALATION FACTOR FOR O&M COSTS : 0.05
ESCALATION FACTOR FOR ENERGY COSTS : 0.05
ESCALATION FACTOR FOR CAPITAL COSTS : 0.05
LIFE SPAN OF UTILITY PLANT (YEARS) : 30.00
ULTIMATE CAPACITY FACTOR : 0.80
START UP COST MULTIPLIER : 1.038

* NUMBER OF WELLS, CAPITAL COSTBASIS AND O&M COSTS, AND REVENUE REQUIREMENTS WITHOUT ANY R&D IMPACTS *

CAPITAL COSTBASIS (1977 \$M)

16 PRODUCTION WELLS : 11.556
7 INJECTION WELLS : 5.056
PRODUCER PLANT EXCLUDING WELLS : 7.284
REPLACEMENT PRODUCTION WELLS : 9.869
REPLACEMENT INJECTION WELLS : 4.318
REPLACEMENT PLANT : 3.214
TOTAL FOR PRODUCTION FIELD : 41.296
GENERATING PLANT : 35.785
TOTAL : 77.081

O&M COSTS (1977 \$M/YR.)

PRODUCER
GENERAL : 0.409
WELL : 0.138
DEEP WELL PUMP : 0.721
SPENT BRINE TREATMENT : 0.0
CHEMICAL & MECHANICAL CLEANING : 0.0
TOTAL : 1.268
UTILITY
GENERAL : 1.288
CHEMICAL & MECHANICAL CLEANING : 0.0
TOTAL : 1.288

** REVENUE REQUIREMENTS **

PRODUCER : 27.982 MILLS/KWHR
UTILITY : 11.137 MILLS/KWHR
* TOTAL : 39.119 MILLS/KWHR *

REPORT 3, Continued
HEBER, CALIFORNIA
(CONTINUED)

* SENSITIVITY OF COST OF ELECTRICITY (FROM PLANT NO. 1) *

RESOURCE & OPERATING PARAMETERS	MILLS/KWHR
HIGH RESOURCE TEMPERATURE ESTIMATE (225 DEGREES CENTIGRADE)	28.940
LOW RESOURCE TEMPERATURE ESTIMATE (150 DEGREES CENTIGRADE)	73.643
HIGH CAPACITY FACTOR VALUE : 0.85	36.818
LOW CAPACITY FACTOR VALUE : 0.60	52.159
EXPENSING OF INTANGIBLE DRILLING COSTS (70.0% OF WELL COSTS EXPENSED)	35.899
DEPLETION ALLOWANCE (22.0% OF GROSS INCOME)	33.623
INVESTMENT TAX CREDIT (26.2% GROSS, 15.0% EFFECTIVE)	37.082

REPORT 3, Continued

HEBER , CALIFORNIA
(CONTINUED)

* ON LINE DATE: 1985 *

** REVENUE REQUIREMENTS **

PRODUCER : 27.982 MILLS/KWHR

UTILITY : 11.137 MILLS/KWHR

* TOTAL : 39.119 MILLS/KWHR *

REPORT 3, Continued

HEBER, CALIFORNIA
(CONTINUED)

* ON LINE DATE: 1987 *

** REVENUE REQUIREMENTS **

PRODUCER : 27.982 MILLS/KWHR
UTILITY : 11.137 MILLS/KWHR
* TOTAL : 39.119 MILLS/KWHR *

REPORT 3, Concluded .

HEBER , CALIFORNIA
(CONTINUED)

* ON LINE DATE: 1988 *

**** REVENUE REQUIREMENTS ****

PRODUCER :	27.982 MILLS/KWHR
UTILITY :	11.137 MILLS/KWHR
* TOTAL :	39.119 MILLS/KWHR *

REPORT 4

HEBER, CALIFORNIA
BINARY SYSTEM, 50 MW ELECTRIC PLANT
FIRST PLANT ON LINE DATE : 1983

TEMPERATURE IN CENTIGRADE DEGREES (BEST ESTIMATE) : 190
WELL DEPTH IN METERS : 1500
BRINE SALINITY : LOW
OVERLYING ROCK TYPE : SOFT
THE WELL FLOW RATE IS NOT SPECIFIED : THE DEFAULT FLOW RATE USED (KGM./HR.) = 266270
SPECIFIED COST PER PRODUCTION WELL (\$) : 600000.0
SPECIFIED COST PER INJECTION WELL (\$) : 600000.0

PRODUCER FINANCIAL DATA

DEBT FRACTION : 0.30
ANNUAL INTEREST RATE ON DEBT (FRACTION) : 0.08
REQUIRED RATE OF RETURN ON EQUITY (FRACTION) : 0.20
PROPERTY TAX RATE (FRACTION) : 0.01
REVENUE TAX RATE OR ROYALTY (FRACTION) : 0.10
EFFECTIVE TOTAL INCOME TAX RATE (FRACTION) : 0.50
EFFECTIVE INVESTMENT TAX CREDIT (FRACTION) : 0.04
ESCALATION FACTOR FOR O&M COSTS : 0.05
ESCALATION FACTOR FOR ENERGY COSTS : 0.05
ESCALATION FACTOR FOR CAPITAL COSTS : 0.05
LIFE SPAN OF PRODUCTION WELLS (YEARS) : 10.00
LIFE SPAN OF INJECTION WELLS (YEARS) : 10.00
LIFE SPAN OF PRODUCER PLANT (YEARS) : 20.00
START UP COST MULTIPLIER : 1.081

UTILITY FINANCIAL DATA

DEBT FRACTION : 0.50
ANNUAL INTEREST RATE ON DEBT (FRACTION) : 0.08
REQUIRED RATE OF RETURN ON EQUITY (FRACTION) : 0.12
PROPERTY TAX RATE (FRACTION) : 0.01
REVENUE TAX RATE OR ROYALTY (FRACTION) : 0.0
EFFECTIVE TOTAL INCOME TAX RATE (FRACTION) : 0.50
EFFECTIVE INVESTMENT TAX CREDIT (FRACTION) : 0.04
ESCALATION FACTOR FOR O&M COSTS : 0.05
ESCALATION FACTOR FOR ENERGY COSTS : 0.05
ESCALATION FACTOR FOR CAPITAL COSTS : 0.05
LIFE SPAN OF UTILITY PLANT (YEARS) : 30.00
ULTIMATE CAPACITY FACTOR : 0.80
START UP COST MULTIPLIER : 1.038

* NUMBER OF WELLS, CAPITAL COSTBASIS AND O&M COSTS, AND REVENUE REQUIREMENTS WITHOUT ANY R&D IMPACTS *

CAPITAL COSTBASIS (1977 \$M)

16 PRODUCTION WELLS : 11.556
7 INJECTION WELLS : 5.056
PRODUCER PLANT EXCLUDING WELLS : 7.284
REPLACEMENT PRODUCTION WELLS : 9.869
REPLACEMENT INJECTION WELLS : 4.318
REPLACEMENT PLANT : 3.214
TOTAL FOR PRODUCTION FIELD : 41.296
GENERATING PLANT : 35.785
TOTAL : 77.081

O&M COSTS (1977 \$M/YR.)

PRODUCER
GENERAL : 0.409
WELL : 0.138
DEEP WELL PUMP : 0.721
SPENT BRINE TREATMENT : 0.0
CHEMICAL & MECHANICAL CLEANING : 0.0
TOTAL : 1.268
UTILITY
GENERAL : 1.288
CHEMICAL & MECHANICAL CLEANING : 0.0
TOTAL : 1.288

** REVENUE REQUIREMENTS **

PRODUCER : 27.982 MILLS/KWHR
UTILITY : 11.137 MILLS/KWHR
* TOTAL : 39.119 MILLS/KWHR *

REPORT 4, Continued
 HEBER , CALIFORNIA
 (CONTINUED)

* R&D IMPACTS FOR PLANT NO. 1 - ON LINE DATE : 1983 *

R&D COMPONENT	ANTICIPATED CHANGE (%)	CHANGE IN REVENUE REQUIREMENTS (MILLS/KWHR)
NUMBER OF PRODUCTION WELLS	-22.00	-3.3126
CAPITAL COST PER PRODUCTION WELL	-5.00	-0.6625
CAPITAL COST PER INJECTION WELL	-5.00	-0.2899
CAPITAL COST OF PROCESS MECHANICAL (UTILITY)	-50.00	-0.6586
CAPITAL COST OF CONDENSER & HEAT REJECTION EQUIPMENT	-20.00	-0.6296
PRODUCER DEEP WELL PUMP O&M COST FACTOR (BINARY SYSTEM , TEMP <260 C)	-33.00	-0.8154

** REVENUE REQUIREMENTS WITH ALL THE R&D IMPACTS INCLUDED. **

PRODUCER : 21.586 MILLS/KWHR
 UTILITY : 9.849 MILLS/KWHR
 * TOTAL : 31.435 MILLS/KWHR *

69

* SENSITIVITY OF COST OF ELECTRICITY (FROM PLANT NO. 1 , R&D IMPACTS INCLUDED) *

RESOURCE & OPERATING PARAMETERS	MILLS/KWHR
HIGH RESOURCE TEMPERATURE ESTIMATE (225 DEGREES CENTIGRADE)	23.868
LOW RESOURCE TEMPERATURE ESTIMATE (150 DEGREES CENTIGRADE)	58.785
HIGH CAPACITY FACTOR VALUE : 0.85	29.586
LOW CAPACITY FACTOR VALUE : 0.60	41.914
EXPENSING OF INTANGIBLE DRILLING COSTS (70.0% OF WELL COSTS EXPENSED)	29.179
DEPLETION ALLOWANCE (22.0% CF GROSS INCOME)	27.195
INVESTMENT TAX CREDIT (26.2% GROSS, 15.0% EFFECTIVE)	29.787

REPORT 4, Continued
 HEBER , CALIFORNIA
 (CONTINUED)

* R&D IMPACTS FOR PLANT NO. 2 - ON LINE DATE : 1985 *

R&D COMPONENT	ANTICIPATED CHANGE (%)	CHANGE IN REVENUE REQUIREMENTS (MILLS/KWHR)
NUMBER OF PRODUCTION WELLS	-22.00	-3.3126
CAPITAL COST PER PRODUCTION WELL	-5.00	-0.6625
CAPITAL COST PER INJECTION WELL	-5.00	-0.2899
CAPITAL COST OF PROCESS MECHANICAL (UTILITY)	-50.00	-0.6586
CAPITAL COST OF CONDENSER & HEAT REJECTION EQUIPMENT	-20.00	-0.6296
PRODUCER DEEP WELL PUMP O&M COST FACTOR (BINARY SYSTEM , TEMP <260 C)	-33.00	-0.8154

** REVENUE REQUIREMENTS WITH ALL THE R&D IMPACTS INCLUDED. **

PRODUCER : 21.318 MILLS/KWHR
 UTILITY : 9.849 MILLS/KWHR
 * TOTAL : 31.167 MILLS/KWHR *

REPORT 4, Continued
 HEBER , CALIFORNIA
 (CONTINUED)

* R&D IMPACTS FOR PLANT NO. 3 - ON LINE DATE : 1987 *

R&D COMPONENT	ANTICIPATED CHANGE (%)	CHANGE IN REVENUE REQUIREMENTS (MILLS/KWHR)
NUMBER OF PRODUCTION WELLS	-22.00	-3.3126
CAPITAL COST PER PRODUCTION WELL	-12.00	-1.5900
CAPITAL COST PER INJECTION WELL	-12.00	-0.6956
CAPITAL COST OF GATHERING SYSTEM	-10.00	-0.0659
CAPITAL COST OF DISTRIBUTION SYSTEM	-10.00	-0.0785
CAPITAL COST OF PROCESS MECHANICAL (UTILITY)	-50.00	-0.6586
CAPITAL COST OF CONDENSER & HEAT REJECTION EQUIPMENT	-20.00	-0.6296
PRODUCER DEEP WELL PUMP O&M COST FACTOR (BINARY SYSTEM , TEMP <260 C)	-67.00	-1.6556
LIFE SPAN OF PRODUCTION WELLS	20.00	-0.9866
LIFE SPAN OF INJECTION WELLS	100.00	-1.3075
START UP COST MULTIPLIERS	(PRODUCER: -4.16 , UTILITY: -2.12)	-1.4009

** REVENUE REQUIREMENTS WITH ALL THE R&D IMPACTS INCLUDED. **

PRODUCER : 18.381 MILLS/KWHR
 UTILITY : 9.640 MILLS/KWHR
 * TOTAL : 28.021 MILLS/KWHR *

REPORT 4, Concluded
 HEBER , CALIFORNIA
 (CONTINUED)

* R&D IMPACTS FOR PLANT NO. 4 - ON LINE DATE : 1988 *

R&D COMPONENT	ANTICIPATED CHANGE (%)	CHANGE IN REVENUE REQUIREMENTS (MILLS/KWHR)
NUMBER OF PRODUCTION WELLS	-22.00	-3.3126
CAPITAL COST PER PRODUCTION WELL	-12.00	-1.5900
CAPITAL COST PER INJECTION WELL	-12.00	-0.6956
CAPITAL COST OF GATHERING SYSTEM	-10.00	-0.0659
CAPITAL COST OF DISTRIBUTION SYSTEM	-10.00	-0.0785
CAPITAL COST OF PROCESS MECHANICAL (UTILITY)	-50.00	-0.6586
CAPITAL COST OF CONDENSER & HEAT REJECTION EQUIPMENT	-20.00	-0.6296
PRODUCER DEEP WELL PUMP O&M CCST FACTOR (BINARY SYSTEM , TEMP <260 C)	-67.00	-1.6556
LIFE SPAN OF PRODUCTION WELLS	20.00	-0.9866
LIFE SPAN OF INJECTION WELLS	100.00	-1.3075
START UP COST MULTIPLIERS	(PRODUCER: -4.16 , UTILITY: -2.12)	-1.4009

** REVENUE REQUIREMENTS WITH ALL THE R&D IMPACTS INCLUDED. **

PRODUCER : 18.381 MILLS/KWHR
 UTILITY : 9.640 MILLS/KWHR
 * TOTAL : 28.021 MILLS/KWHR *

REPORT 5

HEBER , CALIFORNIA
BINARY SYSTEM , 50 MW ELECTRIC PLANT
FIRST PLANT ON LINE DATE : 1983

TEMPERATURE IN CENTIGRADE DEGREES (BEST ESTIMATE) : 190
WELL DEPTH IN METERS : 1500
BRINE SALINITY : LOW
OVERLYING ROCK TYPE : SOFT
THE WELL FLOW RATE IS NOT SPECIFIED : THE DEFAULT FLOW RATE USED (KGM./HR.) = 266270
SPECIFIED COST PER PRODUCTION WELL (\$) : 600000.0
SPECIFIED COST PER INJECTION WELL (\$) : 600000.0

PRODUCER FINANCIAL DATA

DEBT FRACTION : 0.30
ANNUAL INTEREST RATE ON DEBT (FRACTION) : 0.08
REQUIRED RATE OF RETURN ON EQUITY (FRACTION) : 0.20
PROPERTY TAX RATE (FRACTION) : 0.01
REVENUE TAX RATE OR ROYALTY (FRACTION) : 0.10
EFFECTIVE TOTAL INCOME TAX RATE (FRACTION) : 0.50
EFFECTIVE INVESTMENT TAX CREDIT (FRACTION) : 0.04
ESCALATION FACTOR FOR O&M COSTS : 0.05
ESCALATION FACTOR FOR ENERGY COSTS : 0.0
ESCALATION FACTOR FOR CAPITAL COSTS : 0.05
LIFE SPAN OF PRODUCTION WELLS (YEARS) : 10.00
LIFE SPAN OF INJECTION WELLS (YEARS) : 10.00
LIFE SPAN OF PRODUCER PLANT (YEARS) : 20.00
START UP COST MULTIPLIER : 1.081

UTILITY FINANCIAL DATA

DEBT FRACTION : 0.50
ANNUAL INTEREST RATE ON DEBT (FRACTION) : 0.08
REQUIRED RATE OF RETURN ON EQUITY (FRACTION) : 0.12
PROPERTY TAX RATE (FRACTION) : 0.01
REVENUE TAX RATE OR ROYALTY (FRACTION) : 0.0
EFFECTIVE TOTAL INCOME TAX RATE (FRACTION) : 0.50
EFFECTIVE INVESTMENT TAX CREDIT (FRACTION) : 0.04
ESCALATION FACTOR FOR O&M COSTS : 0.05
ESCALATION FACTOR FOR ENERGY COSTS : 0.0
ESCALATION FACTOR FOR CAPITAL COSTS : 0.05
LIFE SPAN OF UTILITY PLANT (YEARS) : 30.00
ULTIMATE CAPACITY FACTOR : 0.80
START UP COST MULTIPLIER : 1.038

* NUMBER OF WELLS , CAPITAL COSTBASIS AND O&M COSTS , AND REVENUE REQUIREMENTS WITHOUT ANY R&D IMPACTS *

CAPITAL COSTBASIS (1977 \$M)

16 PRODUCTION WELLS : 11.556
7 INJECTION WELLS : 5.056
PRODUCER PLANT EXCLUDING WELLS : 7.284
REPLACEMENT PRODUCTION WELLS : 9.869
REPLACEMENT INJECTION WELLS : 4.318
REPLACEMENT PLANT : 3.214
TOTAL FOR PRODUCTION FIELD : 41.296
GENERATING PLANT : 35.785
TOTAL : 77.081

O&M COSTS (1977 \$M/YR.)

PRODUCER
GENERAL : 0.409
WELL : 0.138
DEEP WELL PUMP : 0.721
SPENT BRINE TREATMENT : 0.0
CHEMICAL & MECHANICAL CLEANING : 0.0
TOTAL : 1.268
UTILITY
GENERAL : 1.288
CHEMICAL & MECHANICAL CLEANING : 0.0
TOTAL : 1.288

** REVENUE REQUIREMENTS **

PRODUCER : 39.684 MILLS/KWHR
UTILITY : 18.813 MILLS/KWHR
* TOTAL : 58.497 MILLS/KWHR *

REPORT 5, Continued
 HEBER , CALIFORNIA
 (CONTINUED)

* R&D IMPACTS FOR PLANT NO. 1 - ON LINE DATE : 1983 *

R&D COMPONENT	ANTICIPATED CHANGE (%)	CHANGE IN REVENUE REQUIREMENTS (MILLS/KWHR)
NUMBER OF PRODUCTION WELLS	-22.00	-4.6978
CAPITAL COST PER PRODUCTION WELL	-5.00	-0.9395
CAPITAL COST PER INJECTION WELL	-5.00	-0.4110
CAPITAL COST OF PROCESS MECHANICAL (UTILITY)	-50.00	-1.1125
CAPITAL COST OF CONDENSER & HEAT REJECTION EQUIPMENT	-20.00	-1.0635
PRODUCER DEEP WELL PUMP OEM COST FACTOR (BINARY SYSTEM , TEMP <260 C)	-33.00	-1.1564

** REVENUE REQUIREMENTS WITH ALL THE R&D IMPACTS INCLUDED. **

PRODUCER : 30.614 MILLS/KWHR
 UTILITY : 16.637 MILLS/KWHR
 * TOTAL : 47.251 MILLS/KWHR *

* SENSITIVITY OF COST OF ELECTRICITY (FROM PLANT NO. 1 , R&D IMPACTS INCLUDED) *

RESOURCE & OPERATING PARAMETERS	MILLS/KWHR
HIGH RESOURCE TEMPERATURE ESTIMATE (225 DEGREES CENTIGRADE)	36.450
LOW RESOURCE TEMPERATURE ESTIMATE (150 DEGREES CENTIGRADE)	86.188
HIGH CAPACITY FACTOR VALUE : 0.85	44.471
LOW CAPACITY FACTOR VALUE : 0.60	63.001
EXPENSING OF INTANGIBLE DRILLING COSTS (70.0% OF WELL COSTS EXPENSED)	44.051
DEPLETION ALLOWANCE (22.0% OF GROSS INCOME)	41.237
INVESTMENT TAX CREDIT (26.2% GROSS, 15.0% EFFECTIVE)	44.776

REPORT 5, Continued
 HEBER , CALIFORNIA
 (CONTINUED)

* R&D IMPACTS FOR PLANT NO. 2 - ON LINE DATE : 1985 *

R&D COMPONENT	ANTICIPATED CHANGE (%)	CHANGE IN REVENUE REQUIREMENTS (MILLS/KWHR)
NUMBER OF PRODUCTION WELLS	-22.00	-4.6978
CAPITAL COST PER PRODUCTION WELL	-5.00	-0.9395
CAPITAL COST PER INJECTION WELL	-5.00	-0.4110
CAPITAL COST OF PROCESS MECHANICAL (UTILITY)	-50.00	-1.1125
CAPITAL COST OF CONDENSER & HEAT REJECTION EQUIPMENT	-20.00	-1.0635
PRODUCER DEEP WELL PUMP OEM COST FACTOR (BINARY SYSTEM , TEMP <260 C)	-33.00	-1.1564

** REVENUE REQUIREMENTS WITH ALL THE R&D IMPACTS INCLUDED. **

PRODUCER : 30.233 MILLS/KWHR
 UTILITY : 16.637 MILLS/KWHR
 * TOTAL : 46.870 MILLS/KWHR *

REPORT 5, Continued
 HEBER , CALIFORNIA
 (CONTINUED)

* R&D IMPACTS FOR PLANT NO. 3 - ON LINE DATE : 1987 *

R&D COMPONENT	ANTICIPATED CHANGE (%)	CHANGE IN REVENUE REQUIREMENTS (MILLS/KWHR)
NUMBER OF PRODUCTION WELLS	-22.00	-4.6978
CAPITAL COST PER PRODUCTION WELL	-12.00	-2.2550
CAPITAL COST PER INJECTION WELL	-12.00	-0.9865
CAPITAL COST OF GATHERING SYSTEM	-10.00	-0.0934
CAPITAL COST OF DISTRIBUTION SYSTEM	-10.00	-0.1114
CAPITAL COST OF PROCESS MECHANICAL (UTILITY)	-50.00	-1.1125
CAPITAL COST OF CONDENSER & HEAT REJECTION EQUIPMENT	-20.00	-1.0635
PRODUCER DEEP WELL PUMP O&M COST FACTOR (BINARY SYSTEM , TEMP <260 C)	-67.00	-2.3479
LIFE SPAN OF PRODUCTION WELLS	20.00	-1.3991
LIFE SPAN OF INJECTION WELLS	100.00	-1.8543
START UP COST MULTIPLIERS	(PRODUCER: -4.16 , UTILITY: -2.12)	-2.0507

** REVENUE REQUIREMENTS WITH ALL THE R&D IMPACTS INCLUDED. **

PRODUCER : 26.068 MILLS/KWHR
 UTILITY : 16.284 MILLS/KWHR
 * TOTAL : 42.353 MILLS/KWHR *

REPORT 5, Concluded
 HEBER , CALIFORNIA
 (CONTINUED)

* R&D IMPACTS FOR PLANT NO. 4 - ON LINE DATE : 1988 *

R&D COMPONENT	ANTICIPATED CHANGE (%)	CHANGE IN REVENUE REQUIREMENTS (MILLS/KWHR)
NUMBER OF PRODUCTION WELLS	-22.00	-4.6978
CAPITAL COST PER PRODUCTION WELL	-12.00	-2.2550
CAPITAL COST PER INJECTION WELL	-12.00	-0.9865
CAPITAL COST OF GATHERING SYSTEM	-10.00	-0.0934
CAPITAL COST OF DISTRIBUTION SYSTEM	-10.00	-0.1114
CAPITAL COST OF PROCESS MECHANICAL (UTILITY)	-50.00	-1.1125
CAPITAL COST OF CONDENSER & HEAT REJECTION EQUIPMENT	-20.00	-1.0635
PRODUCER DEEP WELL PUMP O&M COST FACTOR (BINARY SYSTEM , TEMP <260 C)	-67.00	-2.3479
LIFE SPAN OF PRODUCTION WELLS	20.00	-1.3991
LIFE SPAN OF INJECTION WELLS	100.00	-1.8543
START UP COST MULTIPLIERS	(PRODUCER: -4.16 , UTILITY: -2.12)	-2.0507

** REVENUE REQUIREMENTS WITH ALL THE R&D IMPACTS INCLUDED. **

PRODUCER : 26.068 MILLS/KWHR
 UTILITY : 16.284 MILLS/KWHR
 * TOTAL : 42.353 MILLS/KWHR *

REPORT 6

HEBER , CALIFORNIA
BINARY SYSTEM , 50 MW ELECTRIC PLANT
FIRST PLANT ON LINE DATE : 1983

TEMPERATURE IN CENTIGRADE DEGREES (BEST ESTIMATE) : 190
WELL DEPTH IN METERS : 1500
BRINE SALINITY : LOW
OVERLYING ROCK TYPE : SOFT
THE WELL FLOW RATE IS NOT SPECIFIED : THE DEFAULT FLOW RATE USED (KGH./HR.) = 266270
SPECIFIED COST PER PRODUCTION WELL (\$) : 600000.0
SPECIFIED COST PER INJECTION WELL (\$) : 600000.0

PRODUCER FINANCIAL DATA

DEBT FRACTION : 0.30
ANNUAL INTEREST RATE ON DEBT (FRACTION) : 0.08
REQUIRED RATE OF RETURN ON EQUITY (FRACTION) : 0.20
PROPERTY TAX RATE (FRACTION) : 0.01
REVENUE TAX RATE OR ROYALTY (FRACTION) : 0.10
EFFECTIVE TOTAL INCOME TAX RATE (FRACTION) : 0.50
EFFECTIVE INVESTMENT TAX CREDIT (FRACTION) : 0.10
ESCALATION FACTOR FOR O&M COSTS : 0.05
ESCALATION FACTOR FOR ENERGY COSTS : 0.05
ESCALATION FACTOR FOR CAPITAL COSTS : 0.05
LIFE SPAN OF PRODUCTION WELLS (YEARS) : 10.00
LIFE SPAN OF INJECTION WELLS (YEARS) : 10.00
LIFE SPAN OF PRODUCER PLANT (YEARS) : 20.00
START UP COST MULTIPLIER : 1.081

UTILITY FINANCIAL DATA

DEBT FRACTION : 0.50
ANNUAL INTEREST RATE ON DEBT (FRACTION) : 0.08
REQUIRED RATE OF RETURN ON EQUITY (FRACTION) : 0.12
PROPERTY TAX RATE (FRACTION) : 0.01
REVENUE TAX RATE OR ROYALTY (FRACTION) : 0.0
EFFECTIVE TOTAL INCOME TAX RATE (FRACTION) : 0.50
EFFECTIVE INVESTMENT TAX CREDIT (FRACTION) : 0.10
ESCALATION FACTOR FOR O&M COSTS : 0.05
ESCALATION FACTOR FOR ENERGY COSTS : 0.05
ESCALATION FACTOR FOR CAPITAL COSTS : 0.05
LIFE SPAN OF UTILITY PLANT (YEARS) : 30.00
ULTIMATE CAPACITY FACTOR : 0.80
START UP COST MULTIPLIER : 1.038

* NUMBER OF WELLS , CAPITAL COSTBASIS AND O&M COSTS , AND REVENUE REQUIREMENTS WITHOUT ANY R&D IMPACTS *

CAPITAL COSTBASIS (1977 \$M)

16 PRODUCTION WELLS : 11.556
7 INJECTION WELLS : 5.056
PRODUCER PLANT EXCLUDING WELLS : 7.284
REPLACEMENT PRODUCTION WELLS : 9.869
REPLACEMENT INJECTION WELLS : 4.318
REPLACEMENT PLANT : 3.214
TOTAL FOR PRODUCTION FIELD : 41.296
GENERATING PLANT : 35.785
TOTAL : 77.081

O&M COSTS (1977 \$M/YR.)

PRODUCER
GENERAL : 0.409
WELL : 0.138
DEEP WELL PUMP : 0.721
SPENT BRINE TREATMENT : 0.0
CHEMICAL & MECHANICAL CLEANING : 0.0
TOTAL : 1.268
UTILITY
GENERAL : 1.288
CHEMICAL & MECHANICAL CLEANING : 0.0
TOTAL : 1.288

** REVENUE REQUIREMENTS **

PRODUCER : 27.180 MILLS/KWHR
UTILITY : 10.827 MILLS/KWHR
* TOTAL : 38.008 MILLS/KWHR *

REPORT 6, Continued
 HEBER, CALIFORNIA
 (CONTINUED)

* R&D IMPACTS FOR PLANT NO. 1 - ON LINE DATE : 1983 *

R&D COMPONENT	ANTICIPATED CHANGE (%)	CHANGE IN REVENUE REQUIREMENTS (MILLS/KWHR)
NUMBER OF PRODUCTION WELLS	-22.00	-3.2085
CAPITAL COST PER PRODUCTION WELL	-5.00	-0.6417
CAPITAL COST PER INJECTION WELL	-5.00	-0.2807
CAPITAL COST OF PROCESS MECHANICAL (UTILITY)	-50.00	-0.6429
CAPITAL COST OF CONDENSER & HEAT REJECTION EQUIPMENT	-20.00	-0.6117
PRODUCER DEEP WELL PUMP O&M COST FACTOR (BINARY SYSTEM, TEMP <260 C)	-33.00	-0.8154

** REVENUE REQUIREMENTS WITH ALL THE R&D IMPACTS INCLUDED. **

PRODUCER : 20.964 MILLS/KWHR
 UTILITY : 9.573 MILLS/KWHR
 * TOTAL : 30.536 MILLS/KWHR *

* SENSITIVITY OF COST OF ELECTRICITY (FROM PLANT NO. 1, R&D IMPACTS INCLUDED) *

RESOURCE & OPERATING PARAMETERS	MILLS/KWHR
HIGH RESOURCE TEMPERATURE ESTIMATE (225 DEGREES CENTIGRADE)	23.197
LOW RESOURCE TEMPERATURE ESTIMATE (150 DEGREES CENTIGRADE)	57.062
HIGH CAPACITY FACTOR VALUE : 0.85	28.740
LOW CAPACITY FACTOR VALUE : 0.60	40.715
EXPENSING OF INTANGIBLE DRILLING COSTS (70.0% OF WELL COSTS EXPENSED)	28.573
DEPLETION ALLOWANCE (22.0% OF GROSS INCOME)	26.419
INVESTMENT TAX CREDIT (26.2% GROSS, 15.0% EFFECTIVE)	29.787

REPORT 6, Continued
 HEBER , CALIFORNIA
 (CONTINUED)

* R&D IMPACTS FOR PLANT NO. 2 - ON LINE DATE : 1985 *

R&D COMPONENT	ANTICIPATED CHANGE (%)	CHANGE IN REVENUE REQUIREMENTS (MILLS/KWHR)
NUMBER OF PRODUCTION WELLS	-22.00	-3.2085
CAPITAL COST PER PRODUCTION WELL	-5.00	-0.6417
CAPITAL COST PER INJECTION WELL	-5.00	-0.2807
CAPITAL COST OF PROCESS MECHANICAL (UTILITY)	-50.00	-0.6429
CAPITAL COST OF CONDENSER & HEAT REJECTION EQUIPMENT	-20.00	-0.6117
PRODUCER DEEP WELL PUMP O&M COST FACTOR (BINARY SYSTEM , TEMP <260 C)	-33.00	-0.8154

** REVENUE REQUIREMENTS WITH ALL THE R&D IMPACTS INCLUDED. **

PRODUCER : 20.704 MILLS/KWHR
 UTILITY : 9.573 MILLS/KWHR
 * TOTAL : 30.277 MILLS/KWHR *

REPORT 6, Continued
 HEBER, CALIFORNIA
 (CONTINUED)

* R&D IMPACTS FOR PLANT NO. 3 - ON LINE DATE : 1987 *

R&D COMPONENT	ANTICIPATED CHANGE (%)	CHANGE IN REVENUE REQUIREMENTS (MILLS/KWHR)
NUMBER OF PRODUCTION WELLS	-22.00	-3.2085
CAPITAL COST PER PRODUCTION WELL	-12.00	-1.5401
CAPITAL COST PER INJECTION WELL	-12.00	-0.6738
CAPITAL COST OF GATHERING SYSTEM	-10.00	-0.0638
CAPITAL COST OF DISTRIBUTION SYSTEM	-10.00	-0.0760
CAPITAL COST OF PROCESS MECHANICAL (UTILITY)	-50.00	-0.6429
CAPITAL COST OF CONDENSER & HEAT REJECTION EQUIPMENT	-20.00	-0.6117
PRODUCER DEEP WELL PUMP O&M COST FACTOR (BINARY SYSTEM, TEMP <260 C)	-67.00	-1.6555
LIFE SPAN OF PRODUCTION WELLS	20.00	-0.9531
LIFE SPAN OF INJECTION WELLS	100.00	-1.2632
START UP COST MULTIPLIERS	(PRODUCER: -4.16, UTILITY: -2.12)	-1.3609

** REVENUE REQUIREMENTS WITH ALL THE R&D IMPACTS INCLUDED. **

PRODUCER : 17.832 MILLS/KWHR
 UTILITY : 9.370 MILLS/KWHR
 * TOTAL : 27.202 MILLS/KWHR *

REPORT 6, Concluded

HEBER, CALIFORNIA
(CONTINUED)

* R&D IMPACTS FOR PLANT NO. 4 - ON LINE DATE : 1988 *

R&D COMPONENT	ANTICIPATED CHANGE (%)	CHANGE IN REVENUE REQUIREMENTS (MILLS/KWHR)
NUMBER OF PRODUCTION WELLS	-22.00	-3.2085
CAPITAL COST PER PRODUCTION WELL	-12.00	-1.5401
CAPITAL COST PER INJECTION WELL	-12.00	-0.6738
CAPITAL COST OF GATHERING SYSTEM	-10.00	-0.0638
CAPITAL COST OF DISTRIBUTION SYSTEM	-10.00	-0.0760
CAPITAL COST OF PROCESS MECHANICAL (UTILITY)	-50.00	-0.6429
CAPITAL COST OF CONDENSER & HEAT REJECTION EQUIPMENT	-20.00	-0.6117
PRODUCER DEEP WELL PUMP OEM COST FACTOR (BINARY SYSTEM, TEMP <260 C)	-67.00	-1.6555
LIFE SPAN OF PRODUCTION WELLS	20.00	-0.9531
LIFE SPAN OF INJECTION WELLS	100.00	-1.2632
START UP COST MULTIPLIERS	(PRODUCER: -4.16, UTILITY: -2.12)	-1.3609

** REVENUE REQUIREMENTS WITH ALL THE R&D IMPACTS INCLUDED. **

PRODUCER : 17.832 MILLS/KWHR
UTILITY : 9.370 MILLS/KWHR
* TOTAL : 27.202 MILLS/KWHR *

APPENDIX A

GELCOM COMPUTER PROGRAM LISTING

FILE: GELCOM EXEC A

GL TXTLIB FORTMOD1
FI 01 DISK COMCOFF DATA A1
FI 02 DISK WELCOFF DATA A1
FI 03 DISK ROCCOFF DATA A1
FI 04 DISK RRND DATA A1
FI 07 DISK RAJ DATA A1
FI 08 PRINTER (LRECL 133 BLOCK 133 RECFM FA)
FI 09 DISK RADFIL DATA A1
FI 10 DISK FINANCE DATA A1
LOAD GELCOM
START

MAIN PROGRAM (GELCOM)

THIS PROGRAM READS THE DATA FROM FILES 1,2,3,4,7, AND 1).
INTERACTS WITH THE USER AND EDITS ALL THE DATA PROPERLY.

```
COMMON/PAR1/SITE(18),ITEMP,IPOLYR,ITEMPH,ITEMPL,NPLANT,IPYRS(12)
COMMON/PAR/TEMP,ISYSTP,IDEPTH,IRKTP,ISAL,IFLOW,IPWCST,IWCST,TT
COMMON/WWW/A2(4),P2(4),C2(4),A3(4),P3(4)
COMMON/CAP/A1(30),P1(30),C1(30),DCOMP(15)
COMMON/FF1/XP,AP,BP,TR,PTAXP,GRTAXP,AITR,CAPFAC,ESCOMP,ESCEP,ESCCP
COMMON/FF2/XU,AU,BU,PTAXU,GRTAXU,ESCOMU,ESCEU,ESCCU
COMMON/FF3/ALP1,ALP2,ALP3,ALU1
COMMON/FF4/DAR,FWCE,SUCMP1,SUCMP2,AITR1,CAPHI,CAPLO,SUCMU1,SUCMU2
COMMON/RRR/RDFNPW,RDFNIW,RDFCPW,RDFCIW,RDFCC(15),ROMF(12),RLIFS(4)
COMMON/RITE/WRT(35,18)
COMMON/SHSH1/RRWLIF(3,2),RRPWCS(3),RRIWCS(3)
```

```
INTEGER LOGIC(2)
INTEGER BIN(2),FLA(2),SYSTP(2),RKTP(2),SAL,HIGH,SOFT(2)
INTEGER MED(2),MEDHRD(2),HARD(2),CHAR(2)
INTEGER BLANK(3),DEF(3),OPT1(3),OPT2(3),OPT3(3)
DATA LOGIC(1)/'YES '/,LOGIC(2)/'NO '/
DATA BIN/'BINA','RY '/,FLA/'FLAS','H '/
DATA LOW/'LOW '/,HIGH/'HIGH'/
DATA SOFT/'SOFT',' '/,MED/'MED ',' '/,MEDHRD/'MED ','HARD'/
DATA HARD/'HARD',' '/
DATA BLANK/' ',' ',' '/,DEF/'(DEF','AULT',')' '/
```

```
DO 11 I=1,30
11 READ(1,10)A1(I),P1(I),C1(I)
10 FORMAT(5X,E12.6,5X,2F10.4)
DO 12 I=1,4
12 READ(2,10)A2(I),P2(I),C2(I)
DO 13 I=1,4
13 READ(3,17)A3(I),P3(I)
17 FORMAT(2F9.1)
DO 65 I=1,35
65 READ(4,66)(WRT(I,J),J=1,18)
66 FORMAT(18A4)
READ(1,27)XP,AP,BP,TR,PTAXP,GRTAXP,AITR,CAPFAC,ESCOMP,ESCEP,ESCCP
27 FORMAT(11F6.2)
READ(10,28)XU,AU,BU,PTAXU,GRTAXU,ESCOMU,ESCEU,ESCCU
28 FORMAT(8F6.2)
READ(10,31)DAR,FWCE,SUCMP1,SUCMP2,AITR1,CAPHI,CAPLO,SUCMU1,SUCMU2
31 FORMAT(9F7.3)
```

```

      IIRRDD=0
      WRITE(6,887)
887  FORMAT(/,' NEED TO DETERMINE THE EFFECTS OF R&D IMPACTS ? SAY YES,
      1 OR NO.')
```

C

```

      READ(5,51)ITNO
      51  FORMAT(A4)
      IF(ITNO .EQ. LOGIC(2))IIRRDD=1
```

C

```

      CALL RDRAD(IIRRDD)
```

C

```

      IGO=0
      2000 READ(7,66,END=5000)(SITE(I),I=1,18)
      READ(7,24)NPLANT,(IPYRS(I),I=1,NPLANT)
      24  FORMAT(13I6)
      READ(7,32)ITEMP,ITEMPH,ITEMPL
      32  FORMAT(3I6)
      READ(7,15)ISYSTP,IDEPTH,IRKTYP,ISAL
      15  FORMAT(4I6)
      READ(7,21)IFLOW,IPWCST,IIWCST
      21  FORMAT(3I10)
      READ(7,29)ALP1,ALP2,ALP3,ALU1
      29  FORMAT(4F6.2)
```

C

C

```

      WRITE(6,851)(SITE(I),I=1,18)
851  FORMAT(/,10X,'THE PROSPECT IS:',/,5X,18A4,/)
      IISS=0
      WRITE(6,888)
888  FORMAT(/,' NEED SENSITIVITY ANALYSIS ? SAY YES, OR NO.')
```

C

```

      READ(5,51)ITNO
      IF(ITNO .EQ. LOGIC(2))IISS=1
      ICCD=0
      WRITE(6,891)
891  FORMAT(/,' DO YOU WISH THE IMPUTED REVENUE STREAM OBTAINED FROM EN
      ERGY PRODUCTION',/, ' TO BE EXPRESSED AS',
      1/, '      1. CONSTANT IN CONSTANT DOLLARS',
      1/, ' OR      2. CONSTANT IN CURRENT DOLLARS.',
      1/, '      SAY 1 OR 2 IN FORMAT (I1).')
```

C

```

      READ(5,892) ITNO
892  FORMAT(I1)
      IF(ITNO .EQ. 2)ICCD=1
      WRITE(6,50)
      50  FORMAT(/,' DO YOU WISH TO EDIT INPUT DATA ? ENTER YES, OR NO.')
```

C

```

      READ(5,51)ITNO
      IF (ITNO .EQ. LOGIC(2))GO TO 3000
```

C

```

      WRITE(6,100)ITEMP,IDEPTH,NPLANT
      100 FORMAT(10X,' THE CURRENT DATA ARE:',
```

```

1/, ' (1) TEMPERATURE (CENTIGRADE)', T30, I6,
1/, ' (2) DEPTH (METERS) ', T30, I6,
1/, ' (3) NUMBER OF POWER PLANTS ', T30, I6,
1//, ' IF THERE ARE NO CHANGES , HIT RETURN.',
1/, ' OTHERWISE, ENTER ITEM NO. AND NEW VALUE IN FORMAT (I1, I1X, I6)',
1/, ' NOTE: AFTER LAST ENTRY , HIT RETURN AGAIN.')
700 READ(5, 101, END=199) ITNO, IVAL
101 FORMAT(I1, I1X, I6)
   GO TO(701, 702, 703), ITNO
   WRITE(6, 102)
102 FORMAT(' ITEM NO. IS INVALID. MUST BE 1, 2, OR 3. TRY AGAIN.')
   GO TO 700
701 ITEMP=IVAL
   GO TO 700
702 IDEPTH=IVAL
   GO TO 700
703 NPLANT=IVAL
   GO TO 700
199 WRITE(6, 130) ITEMP, IDEPTH, NPLANT
130 FORMAT(3(I6, I1X))
   REWIND 5
   WRITE(6, 852) (IPYRS(I), I=1, NPLANT)
852 FORMAT(/, ' THE POWER ON LINE YEARS ARE:', /, 12I6)
   WRITE(6, 855)
855 FORMAT(' IF THERE ARE NO CHANGES , HIT RETURN.',
1/, ' OTHERWISE ENTER NEW P.O.L. YEARS (NPLANT MAX.) IN FORMAT (12I6
1)', /, ' NOTE: AFTER A FINAL CHANGE , HIT RETURN AGAIN.')
853 READ(5, 24, END=854) (IPYRS(I), I=1, NPLANT)
   GO TO 853
854 REWIND 5
C
   GO TO(801, 802, 803, 804), IRKTYP
801 DO 811 I=1, 2
811 RKTYPI=SOFT(I)
   GO TO 96
802 DO 812 I=1, 2
812 RKTYPI=MED(I)
   GO TO 96
803 DO 813 I=1, 2
813 RKTYPI=MEDHRD(I)
   GO TO 96
804 DO 814 I=1, 2
814 RKTYPI=HARD(I)
96 IF(ISAL .EQ. 1) GO TO 108
   SAL=LOW
   GO TO 97
108 SAL=HIGH
97 IF(ISYSTP .EQ. 1) GO TO 98

```

```

DO 900 I=1,2
900 SYSTP(I)=BIN(I)
GO TO 99
98 DO 901 I=1,2
901 SYSTP(I)=FLA(I)
99 WRITE(6,131)SYSTP,RKTYP,SAL
131 FORMAT(/,10X,'THE CURRENT DATA VALUES ARE: ',
1/, ' (1) SYSTEM TYPE',T30,2A4,
1/, ' (2) RCCK TYPE ',T30,2A4,
1/, ' (3) SALINITY',T30,A4,
1//, ' IF THERE ARE NO CHANGES , HIT RETURN.',
1/, ' OTHERWISE, ENTER ITEM NO. AND NEW VALUE IN FORMAT(I1,1X,2A4)',
1/, ' NOTE: AFTER LAST ENTRY , HIT RETURN AGAIN.')
```

```

132 READ(5,133,END=299)ITNO,CHAR
133 FORMAT(I1,1X,2A4)
GO TO(134,135,136),ITNO
WRITE(6,137)
137 FORMAT(' ITEM NO. IS INVALID. MUST BE 1,2, OR 3. TRY AGAIN.')
```

```

GO TO 132
134 IF (CHAR(1).EQ.BIN(1)) ISYSTP = 0
IF (CHAR(1).EQ.FLA(1)) ISYSTP = 1
GO TO 132
135 IF(CHAR(1) .EQ. SOFT(1))IRKTYP=1
IF(CHAR(1) .EQ. MED(1))IRKTYP=2
IF(CHAR(1) .EQ. MEDHRD(1))IRKTYP=3
IF(CHAR(1) .EQ. HARD(1))IRKTYP=4
GO TO 132
136 IF(CHAR(1) .EQ. LOW)ISAL=0
IF(CHAR(1) .EQ. HIGH)ISAL=1
GO TO 132
299 WRITE(6,140)ISYSTP,IRKTYP,ISAL
140 FORMAT(3I4)
REWIND 5
```

C

```

GO TO (201),IFLOW
DO 202 I=1,3
202 OPT1(I)=BLANK(I)
GO TO 203
201 DO 204 I=1,3
204 OPT1(I)=DEF(I)
203 GO TO (205),IPWCST
DO 206 I=1,3
206 OPT2(I)=BLANK(I)
GO TO 207
205 DO 208 I=1,3
208 OPT2(I)=DEF(I)
207 GO TO (209),IIWCST
DO 210 I=1,3
```

```

210 OPT3(I)=BLANK(I)
    GO TO 211
209 DO 212 I=1,3
212 OPT3(I)=DEF(I)
211 WRITE(6,213)IFLOW,OPT1,IPWCST,OPT2,IIWCST,OPT3
213 FORMAT(/,10X,' THE CURRENT DATA VALUES ARE :',
1/, ' (1) WELL FLOW RATE ',T30,I10,2X,3A4,
1/, ' (2) COST PER PRODUCTION WELL ',T30,I10,2X,3A4,
1/, ' (3) COST PER INJECTION WELL ',T30,I10,2X,3A4,
1//, ' IF THERE ARE NO CHANGES , HIT RETURN.',
1/, ' OTHERWISE, ENTER ITEM NO. AND NEW VALUE IN FORMAT (I1,1X,I10)'
1/, ' NOTE (A): FOR DEFAULT VALUES MUST ENTER 1 IN I10 FORMAT.',
1/, ' NOTE (B): AFTER LAST ENTRY , HIT RETURN AGAIN.')
```

```

215 READ(5,216,END=399)ITNO,IVAL
216 FORMAT(I1,1X,I10)
    GO TO (217,218,219), ITNO
    WRITE(6,220)
220 FORMAT(' ITEM NO. IS INVALID. MUST BE 1,2, OR 3. TRY AGAIN.')
```

```

    GO TO 215
217 IFLOW=IVAL
    GO TO 215
218 IPWCST=IVAL
    GO TO 215
219 IIWCST=IVAL
    GO TO 215
399 WRITE(6,221)IFLOW,IPWCST,IIWCST
221 FORMAT(3(1X,I10))
    REWIND 5
```

C

```

    WRITE(6,225)ALP1,ALP2,ALP3,ALU1
225 FORMAT(/,10X,'THE CURRENT DATA VALUES ARE:',
1/, ' (1) LIFE SPAN OF PRODUCTION WELLS (YR.) ',T45,F7.2,
1/, ' (2) LIFE SPAN OF INJECTION WELLS (YR.) ',T45,F7.2,
1/, ' (3) LIFE SPAN OF PRODUCER PLANT (YR.) ',T45,F7.2,
1/, ' (4) LIFE SPAN OF UTILITY PLANT (YR.) ',T45,F7.2,
1//, ' IF THERE ARE NO CHANGES , HIT RETURN.',
1/, ' OTHERWISE, ENTER ITEM NO. AND NEW VALUE IN FORMAT (I1,1X,F7.2)
1/, ' NOTE: AFTER LAST ENTRY , HIT RETURN AGAIN.')
```

```

226 READ(5,227,END=228)ITNO,FVAL
227 FORMAT(I1,1X,F7.2)
    GO TO (229,230,231,232),ITNO
    WRITE(6,234)
234 FORMAT(' ITEM NO. IS INVALID. MUST BE 1,2,3, OR 4. TRY AGAIN.')
```

```

    GO TO 226
229 ALP1=FVAL
    GO TO 226
230 ALP2=FVAL
    GO TO 226
```

```

231 ALP3=FVAL
    GO TO 226
232 ALU1=FVAL
    GO TO 226
228 WRITE(6,233)ALP1,ALP2,ALP3,ALU1
233 FORMAT(4(1X,F7.2))
    REWIND 5

```

C

```

    WRITE(6,235)XP,AP,BP,TR,PTAXP,GRTAXP,AITR,ESCOMP,ESCEP,ESCCP
235  FORMAT(/,5X,'THE PRODUCER CURRENT FINANCIAL DATA VALUES ARE:',
1/, ' (1) DEBT FRACTION',T55,F6.2,
1/, ' (2) ANNUAL INTEREST RATE ON DEBT',T55,F6.2,
1/, ' (3) REQUIRED RATE OF RETURN ON EQUITY (FRACTION)',T55,F6.2,
1/, ' (4) TOTAL INCOME TAX RATE (FRACTION)',T55,F6.2,
1/, ' (5) PROPERTY TAX RATE (FRACTION)',T55,F6.2,
1/, ' (6) REVENUE TAX RATE OR ROYALTY (FRACTION)',T55,F6.2,
1/, ' (7) INVESTMENT TAX CREDIT (FRACTION)',T55,F6.2,
1/, ' (8) ESCALATION FACTOR FOR O&M COSTS',T55,F6.2,
1/, ' (9) ESCALATION FACTOR FOR ENERGY COSTS',T55,F6.2,
1/, ' (10) ESCALATION FACTOR FOR CAPITAL COSTS',T55,F6.2,
1//, ' IF THERE ARE NO CHANGES , HIT RETURN.',
1/, ' OTHERWISE, ENTER ITEM NO. AND NEW VALUE IN FORMAT (I2,1X,F6.2)
1/,/, ' NOTE: AFTER LAST ENTRY , HIT RETURN AGAIN.')
236 READ(5,856,END=237)ITNO,FVAL
856  FORMAT(I2,1X,F6.2)
    GO TO (238,239,240,241,242,243,244,245,246,857),ITNO
    WRITE(6,247)
247  FORMAT(' ITEM NO. IS INVALID. MUST BE 1,2,3,4,5,6,7,8,9 OR 10. TRY
1 AGAIN.')
    GO TO 236
238  XP=FVAL
    GO TO 236
239  AP=FVAL
    GO TO 236
240  BP=FVAL
    GO TO 236
241  TR=FVAL
    GO TO 236
242  PTAXP=FVAL
    GO TO 236
243  GRTAXP=FVAL
    GO TO 236
244  AITR=FVAL
    GO TO 236
245  ESCOMP=FVAL
    GO TO 236
246  ESCEP=FVAL
    GO TO 236

```



```

857  ESCCP=FVAL
      GO TO 236
237  WRITE(6,248)XP,AP,BP,TR,PTAXP,GRTAXP,AITR,ESCOMP,ESCEP,ESCCP
248  FORMAT(2X,10F6.2)
      REWIND 5

```

C

```

      WRITE(6,249)XU,AU,BU,PTAXU,GRTAXU,CAPFAC,ESCOMU,ESCEU,ESCCU
249  FORMAT(/,5X,'THE UTILITY CURRENT FINANCIAL DATA VALUES ARE:',
1/, ' (1) DEBT FRACTION',T55,F6.2,
1/, ' (2) ANNUAL INTEREST RATE ON DEBT',T55,F6.2,
1/, ' (3) REQUIRED RATE OF RETURN ON EQUITY (FRACTION)',T55,F6.2,
1/, ' (4) PROPERTY TAX RATE (FRACTION)',T55,F6.2,
1/, ' (5) REVENUE TAX RATE ON ROYALTY (FRACTION)',T55,F6.2,
1/, ' (6) ULTIMATE CAPACITY FACTOR',T55,F6.2,
1/, ' (7) ESCALATION RATE FOR O&M COSTS (FRACTION)',T55,F6.2,
1/, ' (8) ESCALATION RATE FOR ENERGY COSTS (FRACTION)',T55,F6.2,
1/, ' (9) ESCALATION RATE FOR CAPITAL COSTS (FRACTION)',T55,F6.2,
1//, ' IF THERE ARE NO CHANGES , HIT RETURN.',
1/, ' OTHERWISE, ENTER ITEM NO. AND NEW VALUE IN FORMAT (I2,1X,F6.2)
1',/, ' NOTE: AFTER LAST ENTRY , HIT RETURN AGAIN.')
251  READ(5,856,END=252)ITNO,FVAL
      GO TO (253,254,255,256,257,858,859,860,861),ITNO
      WRITE(6,258)
258  FORMAT(' ITEM NO. IS INVALID. MUST BE 1,2,3,4,5,6,7,8, OR 9. TRY A
1GAIN.')
      GO TO 251
253  XU=FVAL
      GO TO 251
254  AU=FVAL
      GO TO 251
255  BU=FVAL
      GO TO 251
256  PTAXU=FVAL
      GO TO 251
257  GRTAXU=FVAL
      GO TO 251
858  CAPFAC=FVAL
      GO TO 251
859  ESCOMU=FVAL
      GO TO 251
860  ESCEU=FVAL
      GO TO 251
861  ESCCU=FVAL
      GO TO 251
252  WRITE(6,259)XU,AU,BU,PTAXU,GRTAXU,CAPFAC,ESCOMU,ESCEU,ESCCU
259  FORMAT(2X,9F6.2)
      REWIND 5

```

C

```

WRITE(6,261)SUCMP1,SUCMP2,SUCMU1,SUCMU2
261 FORMAT(/,5X,' THE INPUT DATA ON START UP COST MULTIPLIERS ARE:',
1/,' (1) PRODUCER (BEFORE 1985)',T30,F6.3,
1/,' (2) PRODUCER (AFTER 1985)',T30,F6.3,
1/,' (3) UTILITY (BEFORE 1985)',T30,F6.3,
1/,' (4) UTILITY (AFTER 1985)',T30,F6.3,
1//,' IF THERE ARE NO CHANGES , HIT RETURN.',
1/,' OTHERWISE, ENTER ITEM NO. AND NEW VALUE IN FORMAT (I1,1X,F6.3)
1',/,,' NOTE: AFTER LAST ENTRY , HIT RETURN AGAIN.')
```

```

262 READ(5,877,END=264)ITNO,FVAL
877 FORMAT(I1,1X,F6.3)
GO TO (265,266,267,268),ITNO
WRITE(6,273)
273 FORMAT(' ITEM NO. IS INVALID. MUST BE 1,2,3, OR 4. TRY AGAIN.')
```

```

GO TO 262
265 SUCMP1=FVAL
GO TO 262
266 SUCMP2=FVAL
GO TO 262
267 SUCMU1=FVAL
GO TO 262
268 SUCMU2=FVAL
GO TO 262
264 WRITE(6,274)SUCMP1,SUCMP2,SUCMU1,SUCMU2
274 FORMAT(2X,4F7.3)
REWIND 5
```

C

```

IF(IISS .EQ. 1)GO TO 3000
TEMPH1=ITEMPH
TEMPH2=ITEMPL
WRITE(6,291)DAR,FWCE,AITR1,TEMPH1,TEMPH2,CAPHI,CAPLO
291 FORMAT(/,5X,' THE INPUT DATA FOR SENSITIVITY ANALYSIS ARE:',
1/,' (1) DEPLETION ALLOWANCE RATE (FRACTION)',T64,F7.2,
1/,' (2) EXPENSING FACTOR OF INTANGIBLE DRILLING COSTS',T64,F7.2,
1/,' (3) EFFECTIVE INVESTMENT TAX CREDIT (FRACTION)',T64,F7.2,
1/,' (4) HIGH RESOURCE TEMPERATURE ESTIMATE (CENT.)',T64,F7.2,
1/,' (5) LOW RESOURCE TEMPERATURE ESTIMATE (CENT.)',T64,F7.2,
1/,' (6) HIGH CAPACITY FACTOR VALUE',T64,F7.2,
1/,' (7) LOW CAPACITY FACTOR VALUE',T64,F7.2,
1//,' IF THERE ARE NO CHANGES , HIT RETURN.',
1/,' OTHERWISE, ENTER ITEM NO. AND NEW VALUE IN FORMAT (I1,1X,F7.2)
1',/,,' NOTE: AFTER LAST ENTRY , HIT RETURN AGAIN.')
```

```

292 READ(5,227,END=294)ITNO,FVAL
GO TO (295,296,297,298,300,301,302),ITNO
WRITE(6,293)
293 FORMAT(' ITEM NO. IS INVALID. MUST BE 1,2,3,4,5,6, OR 7. TRY AGAIN
1.')
```

```

GO TO 292
```

```

295  DAR=FVAL
      GO TO 292
296  FWCE=FVAL
      GO TO 292
297  AITR1=FVAL
      GO TO 292
298  TEMPH1=FVAL
      GO TO 292
300  TEMPH2=FVAL
      GO TO 292
301  CAPHI=FVAL
      GO TO 292
302  CAPLO=FVAL
      GO TO 292
294  ITEMPH=TEMPH1
      ITEMPL=TEMPH2
      WRITE(6,305)DAR,FWCE,AITR1,ITEMPH,ITEMPL,CAPHI,CAPLO
305  FORMAT(2X,3F7.2,2I6,2F7.2)
      REWIND 5
C
C
3000 IF(ICCD .EQ. 0)GO TO 3001
      ESCEP=0.
      ESCEU=0.
3001 CALL STEXEC(IIRRDD,IISS)
      GO TO 2000
5000 STOP
      END

```

```

SUBROUTINE RDRAD(IIRRDD)
C
C   THIS SUBROUTINE READS THE R&D IMPACTS FROM FILE 9.
C
  DIMENSION DMHEAD(18)
  DIMENSION RDNPW(6),RDNIW(6),RDFFF(6,15),ROMFF(6,12),RLIFE(6,8),
1 RDCPW(6),RDCIW(6)
  COMMON/RRR/RDFNPW,RDFNIW,RDFCPW,RDFCIW,RDFCC(15),ROMF(12),RLIFS(4)
  COMMON/SHSH1/RRWLIF(3,2),RRPWCS(3),RRIWCS(3)
C
  DO 102 J=1,6
    RDNPW(J)=C
    RDNIW(J)=0
    RDCPW(J)=0
    RDCIW(J)=0
  103 DO 103 I=1,15
    RDFFF(J,I)=0
  104 DO 104 I=1,12
    ROMFF(J,I)=0
  105 DO 105 I=1,8
    RLIFE(J,I)=0
  102 CONTINUE
    IF(IIRRDD .EQ. 1)GO TO 101
    DO 100 J=1,6
      READ(9,35)(DMHEAD(I),I=1,18)
  35  FORMAT(18A4)
      READ(9,25)RDNPW(J),RDNIW(J),RDCPW(J),RDCIW(J)
  25  FORMAT(4F7.1)
      READ(9,26)(RDFFF(J,I),I=1,15)
  26  FORMAT(6F7.1,/,9F7.1)
      READ(9,29)(ROMFF(J,I),I=1,12)
  29  FORMAT(8F7.1,/,4F7.1)
      READ(9,33)(RLIFE(J,I),I=1,8)
  33  FORMAT(4F7.1,/,4F7.1)
  100 CONTINUE
  101 RETURN
C
C   ENTRY FRAD(IPOLYR,ISYSTP,ISAL)
C
  KKK=2
  IF(IPOLYR .LE. 1985)KKK=1
  IF(IPOLYR .GE. 1990)KKK=3
  N=J
  IF(ISYSTP .EQ. 1)N=3
  RDFNPW=RDNPW(KKK+N)
  RDFNIW=RDNIW(KKK+N)
  RDFCPW=RDCPW(KKK+N)
  RDFCIW=RDCIW(KKK+N)

```

```

DO 55 I=1,15
55 RDFCC(I)=RDFFF(N+KKK,I)
DO 36 I=1,12
36 ROMF(I)=ROMFF(N+KKK,I)
M=0
IF(1SAL .EQ. 1)M=4
DO 37 I=1,4
37 RLIFS(I)=RLIFE(N+KKK,M+I)
DO 39 I=1,3
DO 39 J=1,2
39 RRWLIF(I,J)=0.
DO 38 I=1,3
DO 38 J=1,2
38 RRWLIF(I,J)=RLIFE(N+I,M+J)
DO 40 I=1,3
RRPWCS(I)=RDCPW(N+I)
40 RRIWCS(I)=RDCIW(N+I)
RETURN
END

```

SUBROUTINE STEXEC(IIRDD,IISS)

C
C
C

THIS SUBROUTINE STARTS EXECUTION OF THE PROGRAM.

COMMON/PAR1/SITE(18),ITEMP,IPOLYR,ITEMPH,ITEMPL,NPLANT,IPYRS(12)
COMMON/PAR/TEMP,ISYSTP,IDEPTH,IRKTP,ISAL,IFLOW,IPWCST,IIWCST,TT
COMMON/WWW/A2(4),P2(4),C2(4),A3(4),P3(4)
COMMON/CAP/A1(30),P1(30),C1(30),DCOMP(15)
COMMON/CAP1/IDUM,AWELP,AWELI,CPWP,CPIWI,JFLOW
COMMON/RDM/CPWP,CPIW,APWEL,AIWEL,NPWEL,NIWEL
COMMON/ANALCP/COSTPW,COSTIW,COSTPP,COSTGP,PCOST1,PCOST2,CSTRPW,
1CSTRIW,CSTRPP
COMMON/ANALOM/TPOMC,TUOMC
COMMON/FF1/XP,AP,BP,TR,PTAXP,GRTAXP,AITR,CAPFAC,ESCOMP,ESCEP,ESCCP
COMMON/FF2/XU,AU,BU,PTAXU,GRTAXU,ESCOMU,ESCEU,ESCCU
COMMON/FF3/ALP1,ALP2,ALP3,ALU1
COMMON/FF4/DAR,FWCE,SUCMP1,SUCMP2,AITR1,CAPHI,CAPLO,SUCMU1,SUCMU2
COMMON/RRR/RDFNPW,RDFNIW,RDFCPW,RDFCIW,RDFCC(15),ROMF(12),RLIFS(4)
COMMON/DMCM/COMP(15)
COMMON/XXX/RDEVF(35),RDEVFT(35)
COMMON/DDD/PRC(16)
COMMON/FIN1/GP,PRICEP,GU,PRICEU,TOTALC
COMMON/RITE/WRT(35,18)
COMMON/SHSH1/RRWLIF(3,2),RRPWCS(3),RRIWCS(3)
DIMENSION HLCOST(2)

C

TT=(100.-32.)/1.8
IPOLYR=IPYRS(1)
CALL PRNT
CALL FRAD(IPOLYR,ISYSTP,ISAL)
TEMP=FLOAT(ITEMP)
IF(ISYSTP.EQ.1)GO TO 500
IDUM=3
CALL WELNUM(268208,260136,295578)
IDUM=15
GO TO 1000
500 IDUM=1
CALL WELNUM(267528,175800,307936)
IDUM=0
1000 CALL PRINT8
CALL PRINT7
CALL LPCOST
CALL RPLACE
DUM5=SUCMP2
IF(IPOLYR.LE.1985)DUM5=SUCMP1
DUM6=SUCMU2
IF(IPOLYR.LE.1985)DUM6=SUCMU1
AAA=DUM5

BBB=DUM6
DUM1=CAPFAC
DUM2=AITR
DUM3=0.
DUM4=0.

WRITE(8,75)

75 FORMAT(//,13X,'* NUMBER OF WELLS , CAPITAL COSTBASIS AND O&M COSTS
1 , AND REVENUE REQUIREMENTS WITHOUT ANY R&D IMPACTS *')

DO 15 I=1,35

15 RDEVFT(I)=0

CALL RDMPT

CALL CPCST1

CALL OMCOST

IND1=0

IND2=0

CALL RPWEL1(IND1,IND2)

CALL CPCST2

CALL PRINT1

CALL FINA(DUM1,DUM2,DUM3,DUM4,DUM5,DUM6)

WRITE(8,95)

95 FORMAT(//,44X,'** REVENUE REQUIREMENTS **',/)

CALL PRINT3(DUMCOS)

WRDCOS=DUMCOS

IF(IIRRDD .EQ. 1 .AND. IISS.EQ. 1)GO TO 2501

WRITE(8,283)(SITE(J),J=1,18)

283 FORMAT('1',///,45X,18A4,/,50X,'(CONTINUED)')

IF(IIRRDD .EQ. 1)GO TO 2502

WRITE(8,83)IPOLYR

83 FORMAT(///,30X,'* R&D IMPACTS FOR PLANT NO. 1 - ON LINE DATE :',
1I5,' *')

WRITE(8,84)

84 FORMAT(/,15X,'R&D COMPONENT',T74,'ANTICIPATED CHANGE',T97,'CHANGE
1 IN REVENUE',/,T82,'(%)',T96,'REQUIREMENTS (MILLS/KWHR)')

DO 85 II=1,35

IF(RDEVFT(II) .EQ. 0.)GO TO 85

DO 86 J=1,35

86 RDEVFT(J)=0.

RDEVFT(II)=RDEVFT(II)

CALL RDMPT

CALL CPCST1

CALL OMCOST

```

      IND1=J
      IND2=II
      CALL RPWEL1(IND1,IND2)
      CALL CPCST2
      CALL FINA(DUM1,DUM2,DUM3,DUM4,DUM5,DUM6)
      CALL PRINT4(II,WRDCOS)
85  CONTINUE
C
      DO 91 I=1,35
91  RDEVFT(I)=RDEVF(I)
      CALL RDMPCCT
      CALL CPCST1
      CALL QMCOST
      IND1=4
      IND2=4
      CALL RPWEL1(IND1,IND2)
      CALL CPCST2
      CALL FINA(DUM1,DUM2,DUM3,DUM4,DUM5,DUM6)
      WRITE(8,96)
96  FORMAT(///,27X,'** REVENUE REQUIREMENTS WITH ALL THE R&D IMPACTS I
      INCLUDED. **',/)
      CALL PRINT3(DUMCOS)
C
2502 CONTINUE
C
      IF(IISS .EQ. 1)GO TO 2501
C
      START SENSITIVITY ANALYSIS.
C
      CALL FINA(CAPHI,DUM2,DUM3,DUM4,DUM5,DUM6)
      AMIL1=TOTALC
      CALL FINA(CAPLO,DUM2,DUM3,DUM4,DUM5,DUM6)
      AMIL2=TOTALC
      CALL FINA(DUM1,DUM2,FWCE,DUM4,DUM5,DUM6)
      AMIL3=TOTALC
      CALL FINA(DUM1,DUM2,DUM3,DAR,DUM5,DUM6)
      AMIL4=TOTALC
      CALL FINA(DUM1,AITR1,DUM3,DUM4,DUM5,DUM6)
      AMIL5=TOTALC
      JJ=0
      TEMP=FLOAT(ITEMPH)
800  JJ=JJ+1
      IF(JJ .GT. 2)GO TO 900
      IF(ISYSTP .EQ. 1)GO TO 600
      IDUM=3
      CALL WELNUM(268208,260136,295578)
      IDUM=15
      GO TO 1100

```



```

600  IDUM=1
      CALL WELNUM(267528,175800,307936)
      IDUM=0
1100  CALL CPCOST
      CALL RPLACE
      DO 99 I=1,35
99    RDEVFT(I)=RDEVF(I)
      CALL RDMPCST
      CALL CPCST1
      CALL OMCOST
      IND1=4
      IND2=4
      CALL RPWEL1(IND1,IND2)
      CALL CPCST2
      CALL FINA(DUM1,DUM2,DUM3,DUM4,DUM5,DUM6)
      HLCOST(JJ)=TOTALC
      TEMP=FLOAT(ITEMPL)
      GO TO 800
900  IF(IIRRDD .NE. 1)GO TO 2521
      WRITE(8,2522)
2522  FORMAT(//////,22X,'* SENSITIVITY OF COST OF ELECTRICITY (FROM PLANT
1 NO. 1) *',
1////,11X,'RESOURCE & OPERATING PARAMETERS',T87,'MILLS/KWHR',/)
      GO TO 2523
2521  WRITE(8,105)
105  FORMAT(//////,14X,'* SENSITIVITY OF COST OF ELECTRICITY (FROM PLANT
1 NO. 1 , R&D IMPACTS INCLUDED) *',
1////,11X,'RESOURCE & OPERATING PARAMETERS',T87,'MILLS/KWHR',/)
2523  GG1=100.*FWCE
      GG2=100.*DAR
      GG3=100.*AITR1
      GROSS=GG3*7./4.
      WRITE(8,106)ITEMPH,HLCOST(1),ITEMPL,HLCOST(2),CAPHI,AMIL1,CAPLO,
1AMIL2,GG1,AMIL3,GG2,AMIL4,GROSS,GG3,AMIL5
106  FORMAT(5X,'HIGH RESOURCE TEMPERATURE ESTIMATE (' ,I3,' DEGREES CENT
1IGRADE)',T87,F8.3,
1/,5X,'LOW RESOURCE TEMPERATURE ESTIMATE (' ,I3,' DEGREES CENTIGRADE
1)',T87,F8.3,
1/,5X,'HIGH CAPACITY FACTOR VALUE :',F6.2,T87,F8.3,
1/,5X,'LOW CAPACITY FACTOR VALUE :',F6.2,T87,F8.3,
1/,5X,'EXPENSING OF INTANGIBLE DRILLING COSTS (' ,F5.1,'% OF WELL CO
1STS EXPENSED)',T87,F8.3,
1/,5X,'DEPLETION ALLOWANCE (' ,F5.1,'% OF GROSS INCOME)',T87,F8.3,
1/,5X,'INVESTMENT TAX CREDIT (' ,F5.1,'% GROSS',' ,F5.1,'% EFFECTIVE)'
1,T87,F8.3)

```

```

C
2501 CONTINUE
C

```

```

C      DETERMINE ELECTRIC COSTS FOR THE SUBSEQUENT PLANTS.
C
      IF(NPLANT .EQ. 1)GO TO 2500
      DO 1400 KP=2,NPLANT
      IPOLYR=IPYRS(KP)
      CALL FRAD(IPOLYR,ISYSTP,ISAL)
      TEMP=FLOAT(ITEMP)
      IF(ISYSTP .EQ. 1)GO TO 1200
      IDUM=3
      CALL WELNUM(268208,260136,295578)
      IDUM=15
      GO TO 1500
1200   IDUM=1
      CALL WELNUM(267528,175800,307936)
      IDUM=0
1500   CALL CPCOST
      CALL RPLACE
      DUM5=SUCMP2
      IF(IPOLYR .LE. 1985)DUM5=SUCMP1
      DUM6=SUCMU2
      IF(IPOLYR .LE. 1985)DUM6=SUCMU1
      DUM1=CAPFAC
      DUM2=AITR
      DUM3=0.
      DUM4=0.

C
      WRITE(8,283)(SITE(J),J=1,18)
      IF(IIRRDD .NE. 1)GO TO 2513
      WRITE(8,2514)IPOLYR
2514   FORMAT(/,45X,'* ON LINE DATE:',I5,' *')
      GO TO 2515

C
2513   WRITE(8,183)KP,IPOLYR
183    FORMAT(///,30X,'* R&D IMPACTS FOR PLANT NO. ',I2,' - ON LINE DATE
1: ',I5,' *')
      WRITE(8,184)
184    FORMAT(/,15X,'R&D COMPONENT',T74,'ANTICIPATED CHANGE',T97,'CHANGE
1 IN REVENUE',/,T82,'(%)',T96,'REQUIREMENTS (MILLS/KWHR)')

C
      DO 185 II=1,35
      IF(RDEVF(II) .EQ. 0.)GO TO 185
      DO 186 J=1,35
186    RDEVFT(J)=0.
      RDEVFT(II)=RDEVF(II)
      CALL RMPCT
      CALL CPCST1
      CALL QMCOST
      IND1=0

```

```

IND2=II
CALL RPWEL1(IND1,IND2)
CALL CPCST2
CALL FINA(DUM1,DUM2,DUM3,DUM4,AAA,BBB)
CALL PRINT4(II,WRDCOS)
185  CONTINUE
    IF(DUM5 .EQ. AAA)GO TO 291
    DO 286 J=1,35
286  RDEVFT(J)=0.
    CALL RDMPCST
    CALL CPCST1
    CALL OMPCOST
    IND1=J
    IND2=0
    CALL RPWEL1(IND1,IND2)
    CALL CPCST2
    CALL FINA(DUM1,DUM2,DUM3,DUM4,DUM5,DUM6)
    CALL PRINT6(WRDCOS)
C
2515 CONTINUE
C
291  DO 191 I=1,35
191  RDEVFT(I)=RDEVFT(I)
    CALL RDMPCST
    CALL CPCST1
    CALL OMPCOST
    IND1=4
    IND2=4
    CALL RPWEL1(IND1,IND2)
    CALL CPCST2
    IF(IIIRDD .EQ. 1)GO TO 2516
    CALL FINA(DUM1,DUM2,DUM3,DUM4,DUM5,DUM6)
    WRITE(8,196)
196  FORMAT(///,27X,'** REVENUE REQUIREMENTS WITH ALL THE R&D IMPACTS I
    INCLUDED. **',/)
    CALL PRINT3(DUMCOS)
    GO TO 1400
2516 CALL FINA(DUM1,DUM2,DUM3,DUM4,AAA,BBB)
    WRITE(8,2517)
2517 FORMAT(///,44X,'** REVENUE REQUIREMENTS **',/)
    CALL PRINT3(DUMCOS)
1400 CONTINUE
2500 RETURN
END

```

```

SUBROUTINE WELNUM(IF1,IF2,IF3)
C
C THIS SUBROUTINE DETERMINES THE NO. OF PRODUCTION WELLS, INJECTION
C WELLS , AND PER WELL CCSTS.
C
COMMON/ PAR/TEMP, ISYSTP, IDEPTH, IRKTYP, ISAL, IFLOW, IPWCST, IIWCST, TT
COMMON/ WWH/ A2(4), P2(4), C2(4), A3(4), P3(4)
COMMON/ CAP1/ IDUM, AWELP, AWELI, CPPWP, CPIWI, JFLOW
C
JJ=IDUM
C
C DETERMINE WELL FLOW RATE AND NO. OF PRODUCTION & INJECTION WELLS.
C
AWELI=C2(JJ+1)+A2(JJ+1)/(TEMP-TT)**P2(JJ+1)
AWELP=C2(JJ)+A2(JJ)/(TEMP-TT)**P2(JJ)
B1=((IF2-IF1)/(232.222-176.667))*(TEMP-176.667)
B2=((IF3-IF2)/(287.778-232.222))*(TEMP-232.222)
IF(TEMP .LE. 176.667) JFLOW=FLOAT(IF1)
IF(TEMP .GT. 176.667 .AND. TEMP .LE. 232.222) JFLOW=FLOAT(IF1)+B1
IF(TEMP .GT. 232.222 .AND. TEMP .LE. 287.778) JFLOW=FLOAT(IF2)+B2
IF(TEMP .GT. 287.778) JFLOW=FLOAT(IF3)
IF(IFLOW .EQ. 1) GC TC 46
AWELP=AWELP*FLOAT(JFLOW)/FLOAT(IFLOW)
46 CONTINUE
C
C DETERMINE PER WELL CCSTS.
C
DEP=FLOAT(IDEPTH)*100./(2.54*12.)
IF(DEP .LE. 5000.) GO TO 40
CPW=5000.*A3(IRKTYP)+(DEP-5000.)*P3(IRKTYP)
GC TC 42
40 CPW=DEP*A3(IRKTYP)
42 CPPWP=CPW
CPIWI=CPW
IF(ISYSTP .NE. 1 .AND. TEMP .LE. 260.) CPPWP=1.5*CPPWP
IF(ISYSTP .EQ. 1 .AND. TEMP .LE. 200.) CPPWP=1.5*CPPWP
IF(IPWCST .NE. 1) CPPWP=IPWCST
IF(IIWCST .NE. 1) CPIWI=IIWCST
RETURN
END

```

SUBROUTINE RPLACE

THIS SUBROUTINE DETERMINES THE NUMBER OF REPLACEMENT WELLS , AND
CALCULATES COSTBASIS OF REPLACING WELLS & PRODUCER PLANT.

COMMON/PAR1/SITE(18),ITEMP,IPOLYR,ITEMPH,ITEMPL,NPLANT,IPYRS(12)
COMMON/CAP1/IDUM,AWELP,AWELI,CPPWP,CPIWI,JFLOW
COMMON/ANALCP/COSTPW,COSTIW,COSTPP,COSTGP,PCOST1,PCOST2,CSTRPW,
1CSTRIW,CSTRPP
COMMON/RDM/CPWP,CPIW,APWEL,AIWEL,NPWEL,NIWEL
COMMON/FF1/XP,AP,BP,TR,PTAXP,GRTAXP,AITR,CAPFAC,ESCOMP,ESCEP,ESCCP
COMMON/FF2/XU,AU,BU,PTAXU,GRTAXU,ESCOMU,ESCEU,ESCCU
COMMON/FF3/ALP1,ALP2,ALP3,ALU1
COMMON/SHSH1/RRWLIF(3,2),RRPWCS(3),RRIWCS(3)
COMMON/DDD/PRC(16)
DIMENSION RPWN(50),RIWN(50),COSRPW(50),COSRIW(50),ALIFP(50),
1ALIFI(50),ACSP(50),ACSI(50),ABLP(3),ABLI(3),ABCP(3),ABCI(3),
1AVLP(50),AVLI(50),AVCP(50),AVCI(50)

IJK=2
IF(IPOLYR .LE. 1985) IJK=1
IF(IPOLYR .GE. 1990) IJK=3

DO 50 I=1,3
ABLP(I)=ALP1*(100.+RRWLIF(I,1))/100.
ABLI(I)=ALP2*(100.+RRWLIF(I,2))/100.
ABCP(I)=CPPWP*(100.+RRPWCS(IJK))/100.
50 ABCI(I)=CPIWI*(100.+RRIWCS(IJK))/100.
L=0
DO 51 I=1,4
L=L+1
AVLP(L)=ALP1
AVLI(L)=ALP2
AVCP(L)=CPPWP
51 AVCI(I)=CPIWI
AVCP(4)=ABCP(1)
AVCI(4)=ABCI(1)
DO 52 I=1,3
L=L+1
AVLP(L)=((ABLP(1)-ALP1)/3.)*I+ALP1
AVLI(L)=((ABLI(1)-ALP2)/3.)*I+ALP2
AVCP(L)=ABCP(1)
52 AVCI(L)=ABCI(1)
AVCP(7)=ABCP(2)
AVCI(7)=ABCP(2)
DO 49 I=1,4
L=L+1
AVLP(L)=((ABLP(2)-ABLP(1))/4.)*I+ABLP(1)

```

      AVLI(L)=((ABLI(2)-ABLI(1))/4.)*I+ABLI(1)
      AVCP(L)=ABCP(2)
49    AVCI(L)=ABCI(2)
      AVCP(11)=ABCP(3)
      AVCI(11)=ABCI(3)
      DO 53 I=1,3
      L=L+1
      AVLPL(L)=((ABLP(3)-ABLP(2))/3.)*I+ABLP(2)
      AVLI(L)=((ABLI(3)-ABLI(2))/3.)*I+ABLI(2)
      AVCP(L)=ABCP(3)
53    AVCI(L)=ABCI(3)
      DO 54 L=15,50
      AVLPL(L)=ABLP(3)
      AVLI(L)=ABLI(3)
      AVCP(L)=ABCP(3)
54    AVCI(L)=ABCI(3)
      RETURN
C
      ENTRY RPWEL1(IND1,IND2)
C
      DO 15 I=1,50
      RPWN(I)=0.
      RIWN(I)=0.
      COSRPW(I)=0.
15    COSRIW(I)=0.
      IS=IPOLYR-1976
      MP=IS+PRC(16)-0.5*PRC(13)
      MI=IS+PRC(16)-0.5*PRC(14)
      MPP=IS+PRC(16)-0.5*PRC(15)
      IB=IS-2
      IF(IND1 .EQ. 4 .AND. IND2 .EQ. 4)GO TO 60
      IF(IND1 .EQ. 0 .AND. IND2 .EQ. 32)GO TO 61
      IF(IND1 .EQ. 0 .AND. IND2 .EQ. 33)GO TO 63
      IF(IND1 .EQ. 0 .AND. IND2 .EQ. 3)GO TO 65
      IF(IND1 .EQ. 0 .AND. IND2 .EQ. 4)GO TO 67
      DO 31 I=1,50
      ALIFP(I)=ALP1
      ALIFI(I)=ALP2
      ACSP(I)=CPPWP
31    ACSI(I)=CPIWI
      GO TO 45
61    DO 62 I=1,50
      ALIFP(I)=AVLP(I)
      ALIFI(I)=ALP2
      ACSP(I)=CPPWP
62    ACSI(I)=CPIWI
      GO TO 45
63    DO 64 I=1,50

```

```

ALIFP(I)=ALP1
ALIFI(I)=AVLI(I)
ACSP(I)=CPPWP
64 ACSI(I)=CPIWI
GO TO 45
65 DO 66 I=1,50
ALIFP(I)=ALP1
ALIFI(I)=ALP2
ACSP(I)=AVCP(I)
66 ACSI(I)=CPIWI
GO TO 45
67 DO 68 I=1,50
ALIFP(I)=ALP1
ALIFI(I)=ALP2
ACSP(I)=CPPWP
68 ACSI(I)=AVCI(I)
GO TO 45
60 DO 69 I=1,50
ALIFP(I)=AVLP(I)
ALIFI(I)=AVLI(I)
ACSP(I)=AVCP(I)
69 ACSI(I)=AVCI(I)
45 DO 20 I=IS,MP
20 RPWN(I)=NPWEL/ALIFP(I)
DO 21 I=IS,MI
21 RIWN(I)=NIWEL/ALIFI(I)
DO 22 I=1,50
COSRPW(I)=RPWN(I)*ACSP(I)/1000000.
22 COSRIW(I)=RIWN(I)*ACSI(I)/1000000.
A1=(1.-TR)*XP*AP+(1.-XP)*BP
CSTRPW=0.
DO 23 J=IB,MP
23 CSTRPW=CSTRPW+COSRPW(J)*((1.+ESCCP)**(J-IS))*((1.+A1)**(IS-J))
CSTRIW=0.
DO 24 J=IB,MI
24 CSTRIW=CSTRIW+COSRIW(J)*((1.+ESCCP)**(J-IS))*((1.+A1)**(IS-J))
COSRPP=COSTPP/PRC(15)
CSTRPP=0.
DO 25 J=IS,MPP
25 CSTRPP=CSTRPP+COSRPP*((1.+ESCCP)**(J-IS))*((1.+A1)**(IS-J))
RETURN
END

```

SUBROUTINE CPCOST

THIS SUBROUTINE DETERMINES CAPITAL COSTS.

```
COMMON/PAR/TEMP,ISYSTP,IDEPTH,IRKTP,ISAL,IFLOW,IPWCST,IIWCST,TT
COMMON/CAP/A1(30),P1(30),C1(30),DCOMP(15)
COMMON/CAP1/IDUM,AWELP,AWELI,CPWP,CPIWI,JFLOW
COMMON/RDM/CPWP,CPIW,APWEL,AIWEL,NPWEL,NIWEL
COMMON/ANALCP/COSTPW,COSTIW,COSTPP,COSTGP,PCOST1,PCOST2,CSTRPW,
1CSTRIW,CSTRPP
COMMON/FF1/XP,AP,BP,TR,PTAXP,GRTAXP,AITR,CAPFAC,ESCOMP,ESCEP,ESCCP
COMMON/FF2/XU,AU,BU,PTAXU,GRTAXU,ESCOMU,ESCEU,ESCCU
COMMON/RRR/RDFNPW,RDFNIW,RDFCPW,RDFCIW,RDFCC(15),ROMF(12),RLIFS(4)
COMMON/DMCM/COMP(15)
COMMON/XXX/RDEVF(35),RDEVFT(35)
```

```

RDEVF(1)=RDFNPW
RDEVF(2)=RDFNIW
RDEVF(3)=RDFCPW
RDEVF(4)=RDFCIW
L=4
DO 12 I=1,15
  L=L+1
12 RDEVF(L)=RDFCC(I)
  DO 13 I=1,12
    L=L+1
13 RDEVF(L)=ROMF(I)
    DO 14 I=1,4
      L=L+1
14 RDEVF(L)=RLIFS(I)
    DO 16 J=1,15
16 DCOMP(J)=C1(IDUM+J)+A1(IDUM+J)/(TEMP-TT)**P1(IDUM+J)
    IF(ISYSTP.NE.1.AND. TEMP.LE.260.)DCOMP(2)=DCOMP(2)+17.0
    DO 34 I=1,15
34 DCOMP(I)=DCOMP(I)*50000.
    IF(ISAL.EQ.1)GO TO 35
    GO TO 36
35 DCOMP(1)=DCOMP(1)*2.55
    DCOMP(2)=DCOMP(2)*2.55
    DCOMP(3)=DCOMP(3)*1.50
    DCOMP(4)=DCOMP(4)*2.55
    IF(ISYSTP.NE.1)DCOMP(8)=DCOMP(8)*2.55
36 CONTINUE
    IF(ISAL.NE.1)RDEVF(22)=0.
    IF(ISAL.NE.1)RDEVF(23)=0.
    IF(ISAL.EQ.1)RDEVF(21)=0.
    IF(ISAL.EQ.1.AND. TEMP.LE.232.222)RDEVF(23)=0.
    IF(ISAL.EQ.1.AND. TEMP.GT.232.222)RDEVF(22)=0.
```



```

IF(ISAL .NE. 1)RDEVF(26)=0.
IF(ISYSTP .EQ. 1)RDEVF(25)=0.
IF(ISYSTP .EQ. 1)RDEVF(29)=0.
IF(ISYSTP .EQ. 1)RDEVF(30)=0.
IF(ISYSTP .NE. 1)RDEVF(24)=0.
IF(ISYSTP .NE. 1)RDEVF(28)=0.
IF(ISYSTP .NE. 1 .AND. TEMP .GT. 260.)RDEVF(25)=0.
IF(ISYSTP .EQ. 1 .AND. TEMP .GT. 200.)RDEVF(24)=0.
RETURN

```

C

ENTRY CPCST1

C

```

NPWEL=0.9+APWEL
NIWEL=0.9+AIWEL
COSTPW=CPPW*NPWEL/1000000.
COSTIW=CPIW*NIWEL/1000000.
COSTPP=0.
DO 37 I=1,6
COMP(I)=COMP(I)/1000000.
37 COSTPP=COSTPP+COMP(I)
COSTGP=0.
DO 38 I=7,15
COMP(I)=COMP(I)/1000000.
38 COSTGP=COSTGP+COMP(I)
RETURN

```

C

ENTRY CPCST2

C

```

Z1=(1.-TR)*XP*AP+(1.-XP)*BP
Z2=(1.-TR)*XU*AU+(1.-XU)*BU
ZZ1=(1.+Z1)/(1.+ESCCP)
ZZ2=(1.+Z2)/(1.+ESCCU)
COSTPW=COSTPW*ZZ1*ZZ1
COSTIW=COSTIW*ZZ1*ZZ1
COSTPP=COSTPP*ZZ1
COSTGP=COSTGP*ZZ2
PCOST1=COSTPW+COSTIW+COSTPP+CSTRPW+CSTRIW+CSTRPP
PCOST2=PCOST1+COSTGP
RETURN
END

```

SUBROUTINE OMCOST

THIS SUBROUTINE DETERMINES THE O&M COSTS.

COMMON/PAR/TEMP,ISYSTP,IDEPTH,IRKTYP,ISAL,IFLOW,IPWCST,IIWCST,TT
COMMON/ANALCP/COSTPW,COSTIW,COSTPP,COSTGP,PCOST1,PCOST2,CSTRPW,
ICSTRIW,CSTRPP

COMMON/ANALOM/TPOMC,TUOMC

COMMON/DMCM/COMP(15)

COMMON/DDD/PRC(16)

COMMON/OMC1/GOMPC,WOMPC,WPOMPC,PUOMPC,CLOMPC

COMMON/GMC2/GOMUC,CLOMUC

DETERMINE PRODUCER'S O&M COSTS.

GOMPC=PRC(1)*(COSTPW+COSTIW+COSTPP)

FAC1=(TEMP-232.22)/56.

FAC2=COSTPW+COSTIW

IF(ISAL .NE. 1)WOMPC=PRC(2)*FAC2

IF(ISAL .EQ. 1 .AND. TEMP .LE. 232.22)WOMPC=PRC(3)*FAC2

IF(ISAL .EQ. 1 .AND. TEMP .GT. 232.22)WOMPC=PRC(4)*FAC1*FAC2

WPOMPC=0.

IF(TEMP .LE. 200. .AND. ISYSTP .EQ. 1)WPOMPC=PRC(5)*COMP(2)

IF(TEMP .LE. 260. .AND. ISYSTP .NE. 1)WPOMPC=PRC(6)*COMP(2)

PUOMPC=0.

CLOMPC=0.

IF(ISAL .EQ. 1)PUOMPC=PRC(7)*(.75+.25*FAC1)*COMP(4)

IF(ISAL .EQ. 1)CLOMPC=PRC(8)*(.015+.005*FAC1)*(COMP(1)+COMP(2))

TPOMC=GOMPC+WOMPC+WPOMPC+PUOMPC+CLOMPC

DETERMINE UTILITY O&M COSTS.

IF(ISYSTP .EQ. 1)GOMUC=PRC(9)*COSTGP

IF(ISYSTP .NE. 1)GOMUC=PRC(10)*COSTGP+PRC(11)*COMP(8)

CLOMUC=0.

IF(ISAL .EQ. 1)CLOMUC=PRC(12)*(.015+.005*FAC1)*COMP(8)

TUOMC=GOMUC+CLOMUC

RETURN

END

SUBRCUTINE RDMPC

THIS SUBROUTINE INTRODUCES THE FUTURE R&D IMPACTS IN THE ANALYSIS.

```
COMMON/CAP/A1(30),P1(30),C1(30),DCOMP(15)
COMMON/CAP1/IDUM,AWELP,AWELI,CPPWP,CPIWI,JFLOW
COMMON/RDM/CPWP,CPIW,APWEL,AIWEL,NPWEL,NIWEL
COMMON/ANALCP/COSTPW,COSTIW,COSTPP,COSTGP,PCOST1,PCOST2,CSTRPW,
1CSTRIW,CSTRPP
COMMON/ANALOM/TPOMC,TUOMC
COMMON/FF3/ALP1,ALP2,ALP3,ALU1
COMMON/RRR/RDFNPW,RDFNIW,RDFCPW,RDFCIW,RDFCC(15),ROMF(12),RLIFS(4)
COMMON/DMCM/COMP(15)
COMMON/XXX/RDEVF(35),RDEVFT(35)
COMMON/DDD/PRC(16)
```

```
APWEL=AWELP*(100.+RDEVFT(1))/100.
AIWEL=AWELI*(100.+RDEVFT(2))/100.
CPPW=CPPWP*(100.+RDEVFT(3))/100.
CPIW=CPIWI*(100.+RDEVFT(4))/100.
DO 18 I=1,15
18 COMP(I)=DCOMP(I)*(100.+RDEVFT(4+I))/100.
PRC(1)=0.02*(100.+RDEVFT(20))/100.
PRC(2)=0.01*(100.+RDEVFT(21))/100.
PRC(3)=0.025*(100.+RDEVFT(22))/100.
PRC(4)=0.025*(100.+RDEVFT(23))/100.
PRC(5)=0.28*(100.+RDEVFT(24))/100.
PRC(6)=0.55*(100.+RDEVFT(25))/100.
PRC(7)=1.00*(100.+RDEVFT(26))/100.
PRC(8)=1.00*(100.+RDEVFT(27))/100.
PRC(9)=0.03*(100.+RDEVFT(28))/100.
PRC(10)=0.035*(100.+RDEVFT(29))/100.
PRC(11)=0.02*(100.+RDEVFT(30))/100.
PRC(12)=1.00*(100.+RDEVFT(31))/100.
PRC(13)=ALP1*(100.+RDEVFT(32))/100.
PRC(14)=ALP2*(100.+RDEVFT(33))/100.
PRC(15)=ALP3*(100.+RDEVFT(34))/100.
PRC(16)=ALU1*(100.+RDEVFT(35))/100.
RETURN
END
```

```

C      SUBROUTINE FINA(DUM1,DUM2,DUM3,DUM4,DUM5,DUM6)
C
C      THIS SUBROUTINE DETERMINES GEOTHERMAL ENERGY PRICES BASED ON
C      THE 10 EASY STEPS TO BUSBAR COSTS.
C
C      COMMON/ANALCP/COSTPW,COSTIW,COSTPP,COSTGP,PCOST1,PCOST2,CSTRPW,
1CSTRIW,CSTRPP
C      COMMON/ANALQM/TPQMC,TUQMC
C      COMMON/FF1/XP,AP,BP,TR,PTAXP,GRTAXP,AITR,CAPFAC,ESCOMP,ESCEP,ESCCP
C      COMMON/FF2/XU,AU,BU,PTAXU,GRTAXU,ESCOMU,ESCEU,ESCCU
C      COMMON/FF3/ALP1,ALP2,ALP3,ALU1
C      COMMON/DDC/PRC(16)
C      COMMON/FIN1/GP,PRICEP,GU,PRICEU,TOTALC
C
C      FRAC=COSTPW+CSTRPW+COSTIW+CSTRIW
C      FRAC=FRAC/(FRAC+COSTPP+CSTRPP)
C
C      CALCULATE COST OF CAPITAL RATES.
C
C      A1=(1.-TR)*XP*AP+(1.-XP)*BP
C      A2=(1.-TR)*XU*AU+(1.-XU)*BU
C      PE1=(1.-XF)*BP/A1
C      PE2=(1.-XU)*BU/A2
C
C      CALCULATE PRESENT VALUE OF THE ANNUITY FACTORS.
C
C      B1=1./((1.+A1)**PRC(16))
C      B2=1./((1.+A2)**PRC(16))
C      FN1=(1./A1)*(1.-B1)
C      FN2=(1./A2)*(1.-B2)
C      AM1=PRC(16)*2./3.
C      AM2=PRC(16)*2./3.
C      B1=1./((1.+A1)**AM1)
C      B2=1./((1.+A2)**AM2)
C      FM1=(1./A1)*(1.-B1)
C      FM2=(1./A2)*(1.-B2)
C
C      CALCULATE PRESENT VALUES OF THE TAX DEPRECIATION USING SUM OF THE
C      DIGIT VALUES.
C
C      DEPT1P=2.*(AM1-FM1)/(AM1*(1.+AM1)*A1)
C      DEPT2=2.*(AM2-FM2)/(AM2*(1.+AM2)*A2)
C      DEPT1=(1.-DUM3*FRAC)*DEPT1P+DUM3*FRAC/(1.+A1)
C
C      CALCULATE PRESENT VALUES OF THE INVESTMENT TAX CREDITS.
C
C      AITC1=DUM2*(1.-DUM3*FRAC)/(1.+A1)
C      AITC2=DUM2/(1.+A2)

```

C
C
C
CALCULATE PRESENT VALUES OF THE STATE & FEDERAL INCOME TAX RATES.

TINC1=TR*(PE1+((1.-PE1)/PRC(16))*FN1-DEPT1-AITC1)/(1.-TR)
TINC2=TR*(PE2+((1.-PE2)/PRC(16))*FN2-DEPT2-AITC2)/(1.-TR)

C
C
C
CALCULATE PROPERTY TAX FACTORS.

TP1=PTAXP*FN1
TP2=PTAXU*FN2

C
C
C
CALCULATE CAPITAL AMORTIZATIONS.

AMOR1=1.+TINC1+TP1
AMOR2=1.+TINC2+TP2

C
C
C
CALCULATE O&M COST FACTORS.

DOM1=(1.-((1.+ESCOMP)/(1+A1))**PRC(16))/(A1-ESCOMP)
DOM2=(1.-((1.+ESCOMU)/(1+A2))**PRC(16))/(A2-ESCOMU)

C
DE1=(1.-((1.+ESCEP)/(1+A1))**PRC(16))/(A1-ESCEP)
DE2=(1.-((1.+ESCEU)/(1+A2))**PRC(16))/(A2-ESCEU)

C
C
C
CALCULATE O&M COSTS.

OAMP=TPOMC*DOM1
OAMU=TUOMC*DOM2

C
C
C
CALCULATE REVENUE REQUIREMENTS.

GP=(COSTPW+CSTRPW+COSTIW+CSTRIW+COSTPP+CSTRPP)*AMOR1+OAMP
GP=GP/(1.-GRTAXP+DUM4)
GU=(COSTGP*AMOR2+OAMU)/(1.-GRTAXU)
PRICEP=GP*1000.*1000000./(DE1*8760.*50000.*DUM1)
PRICEU=GU*1000.*1000000./(DE2*8760.*50000.*DUM1)
PRICEP=PRICEP*DUM5
PRICEU=PRICEU*DUM6
TOTALC=PRICEP+PRICEU
RETURN
END

SUBROUTINE PRNT

THIS SUBROUTINE PRINTS THE DESIRED OUTPUT.

```
COMMON/PAR1/SITE(18),ITEMP,IPOLYR,ITEMPH,ITEMPL,NPLANT,IPYRS(12)
COMMON/PAR/TEMP,ISYSTP,IDEPTH,IRKTYP,ISAL,IFLOW,IPWCST,IIWCST,TT
COMMON/ANALCP/COSTPW,COSTIW,COSTPP,COSTGP,PCOST1,PCOST2,CSTRPW,
1CSTRIW,CSTRPP
COMMON/CAP1/IDUM,AWELP,AWELI,CPPWP,CPIWI,JFLOW
COMMON/RDP/CPPW,CPIW,APWEL,AIWEL,NPWEL,NIWEL
COMMON/ANALOM/TPOMC,TUOMC
COMMON/FF1/XP,AP,BP,TR,PTAXP,GRTAXP,AITR,CAPFAC,ESCOMP,ESCEP,ESCCP
COMMON/FF2/XU,AU,BU,PTAXU,GRTAXU,ESCOMU,ESCEU,ESCCU
COMMON/FF3/ALP1,ALP2,ALP3,ALU1
COMMON/FF4/DAR,FWCE,SUCMP1,SUCMP2,AITR1,CAPHI,CAPLO,SUCMU1,SUCMU2
COMMON/RRR/RDFNPW,RDFNIW,RDFCPW,RDFCIW,RDFCC(15),ROMF(12),RLIFS(4)
COMMON/OMC1/GOMPC,WOMPC,WPOMPC,PUOMPC,CLOMPC
COMMON/OMC2/GOMUC,CLOMUC
COMMON/FIN1/GP,PRICEP,GU,PRICEU,TOTALC
COMMON/XXX/RDEVF(35),RDEVFT(35)
COMMON/RITE/WRT(35,18)
```

```
WRITE(8,23)(SITE(I),I=1,18)
23 FORMAT('1',///,40X,18A4)
IF(ISYSTP .EQ. 1)WRITE(8,24)
24 FORMAT(40X,'FLASH SYSTEM , 50 MW ELECTRIC PLANT')
IF(ISYSTP .NE. 1)WRITE(8,125)
125 FORMAT(40X,'BINARY SYSTEM , 50 MW ELECTRIC PLANT')
WRITE(8,126)IPOLYR
126 FORMAT(40X,'FIRST PLANT ON LINE DATE : ',I4)
WRITE(8,14)ITEMP,IDEPTH
14 FORMAT(//,5X,'TEMPERATURE IN CENTIGRADE DEGREES (BEST ESTIMATE) : '
1,T57,I4,/,5X,'WELL DEPTH IN METERS : ',T55,I6)
IF(ISAL .NE. 1)WRITE(8,19)
IF(ISAL .EQ. 1)WRITE(8,18)
19 FORMAT(5X,'BRINE SALINITY : LOW')
18 FORMAT(5X,'BRINE SALINITY : HIGH')
IF(IRKTYP .EQ. 1)WRITE(8,52)
IF(IRKTYP .EQ. 2)WRITE(8,53)
IF(IRKTYP .EQ. 3)WRITE(8,54)
IF(IRKTYP .EQ. 4)WRITE(8,55)
52 FORMAT(5X,'OVERLYING ROCK TYPE : SOFT')
53 FORMAT(5X,'OVERLYING ROCK TYPE : MEDIUM')
54 FORMAT(5X,'OVERLYING ROCK TYPE : MEDIUM HARD')
55 FORMAT(5X,'OVERLYING ROCK TYPE : HARD')
RETURN
```

ENTRY PRINT8

```

C
  IF(IFLOW .EQ. 1)WRITE(8,148)JFLOW
148  FORMAT(5X,'THE WELL FLOW RATE IS NOT SPECIFIED :',
1' THE DEFAULT FLOW RATE USED (KGM./HR.) =' ,I8)
  IF(IFLOW .NE.1)WRITE(8,149)IFLOW
149  FORMAT(5X,'SPECIFIED WELL FLOW RATE (KGM./HR.) :',T50,I8)
  IF(IPWCST .EQ. 1)WRITE(8,150)CPPWP
150  FORMAT(5X,'THE COST PER PRODUCTION WELL IS NOT SPECIFIED :',
1' THE DEFAULT COST PER PRODUCTION WELL ($) =' ,F9.1)
  IF(IPWCST .NE. 1)WRITE(8,151)CPPWP
151  FORMAT(5X,'SPECIFIED COST PER PRODUCTION WELL ($) :',T48,F9.1)
  IF(IIWCST .EQ. 1)WRITE(8,152)CPIWI
152  FORMAT(5X,'THE COST PER INJECTION WELL IS NOT SPECIFIED :',
1' THE DEFAULT COST PER INJECTION WELL ($) =' ,F9.1)
  IF(IIWCST .NE. 1)WRITE(8,153)CPIWI
153  FORMAT(5X,'SPECIFIED COST PER INJECTION WELL ($) :',T48,F9.1)
  RETURN

C
  ENTRY PRINT7

C
  WRITE(8,12)
12  FORMAT(/,15X,'PRODUCER FINANCIAL DATA',
1T65,15X,'UTILITY FINANCIAL DATA',/)
  WRITE(8,13)XP,XU,AP,AU,BP,BU,PTAXP,PTAXU,GRTAXP,GRTAXU,TR,TR,
1AITR,AITR
13  FORMAT(5X,'DEBT FRACTION :',T52,F6.2,
2T70,'DEBT FRACTION :',T117,F6.2,
1/,5X,'ANNUAL INTEREST RATE ON DEBT (FRACTION) :',T52,F6.2,
2T70,'ANNUAL INTEREST RATE ON DEBT (FRACTION) :',T117,F6.2,
1/,5X,'REQUIRED RATE OF RETURN ON EQUITY (FRACTION) :',T52,F6.2,
2T70,'REQUIRED RATE OF RETURN ON EQUITY (FRACTION) :',T117,F6.2,
1/,5X,'PROPERTY TAX RATE (FRACTION) :',T52,F6.2,
2T70,'PROPERTY TAX RATE (FRACTION) :',T117,F6.2,
1/,5X,'REVENUE TAX RATE OR ROYALTY (FRACTION) :',T52,F6.2,
2T70,'REVENUE TAX RATE OR ROYALTY (FRACTION) :',T117,F6.2,
1/,5X,'EFFECTIVE TOTAL INCOME TAX RATE (FRACTION) :',T52,F6.2,
2T70,'EFFECTIVE TOTAL INCOME TAX RATE (FRACTION) :',T117,F6.2,
1/,5X,'EFFECTIVE INVESTMENT TAX CREDIT (FRACTION) :',T52,F6.2,
2T70,'EFFECTIVE INVESTMENT TAX CREDIT (FRACTION) :',T117,F6.2)
  AA3=SUCMP2
  IF(IPOLYR .LE. 1985)AA3=SUCMP1
  AA4=SUCMU2
  IF(IPOLYR .LE. 1985)AA4=SUCMU1
  WRITE(8,200)ESCOMP,ESCOMU,ESCEP,ESCEU,ESCCP,ESCCU,ALP1,ALU1,ALP2,
1CAPFAC,ALP3,AA4,AA3
200  FORMAT(5X,'ESCALATION FACTOR FOR O&M COSTS :',T52,F6.2,
2T70,'ESCALATION FACTOR FOR O&M COSTS :',T117,F6.2,
1/,5X,'ESCALATION FACTOR FOR ENERGY COSTS :',T52,F6.2,

```

```

2T70,'ESCALATION FACTOR FOR ENERGY COSTS :',T117,F6.2,
1/,5X,'ESCALATION FACTOR FOR CAPITAL COSTS :',T52,F6.2,
2T70,'ESCALATION FACTOR FOR CAPITAL COSTS :',T117,F6.2,
1/,5X,'LIFE SPAN OF PRODUCTION WELLS (YEARS) :',T52,F6.2,
2T70,'LIFE SPAN OF UTILITY PLANT (YEARS) :',T117,F6.2,
1/,5X,'LIFE SPAN OF INJECTION WELLS (YEARS) :',T52,F6.2,
2T70,'ULTIMATE CAPACITY FACTOR :',T117,F6.2,
1/,5X,'LIFE SPAN OF PRODUCER PLANT (YEARS) :',T52,F6.2,
2T70,'START UP COST MULTIPLIER :',T117,F7.3,
1/,5X,'START UP COST MULTIPLIER :',T52,F7.3,/)
RETURN

```

C

ENTRY PRINT1

C

```

WRITE(8,25)
25 FORMAT(/,15X,'CAPITAL COSTBASIS (1977 $M)',
1T65,15X,'G&M COSTS (1977 $M/YR.)',/)
WRITE(8,26)NPWEL,COSTPW,NIWEL,COSTIW,GOMPC,COSTPP,WOMPC,CSTRPW,
1WPOMPC,CSTRIW,PUOMPC,CSTRPP,CLOMPC,PCOST1,TPOMC
26 FORMAT(5X,I3,1X,'PRODUCTION WELLS :',T39,F8.3,T68,'PRODUCER',
1/,5X,I3,1X,'INJECTION WELLS :',T39,F8.3,T75,'GENERAL :',T108,F8.3,
1/,5X,'PRODUCER PLANT EXCLUDING WELLS :',T39,F8.3,
2T75,'WELL :',T108,F8.3,
1/,5X,'REPLACEMENT PRODUCTION WELLS :',T39,F8.3,
2T75,'DEEP WELL PUMP :',T108,F8.3,
1/,5X,'REPLACEMENT INJECTION WELLS :',T39,F8.3,
2T75,'SPENT BRINE TREATMENT :',T108,F8.3,
1/,5X,'REPLACEMENT PLANT :',T39,F8.3,
2T75,'CHEMICAL & MECHANICAL CLEANING :',T108,F8.3,
1/,5X,'TOTAL FOR PRODUCTION FIELD :',T47,F8.3,T75,'TOTAL :',T116,
1F8.3)
WRITE(8,70)COSTGP,PCOST2,GOMUC,CLOMUC,TUOMC
70 FORMAT(5X,'GENERATING PLANT :',T47,F8.3,T68,'UTILITY',
1/,5X,'TOTAL :',T47,F8.3,T75,'GENERAL :',T108,F8.3,
2/,T75,'CHEMICAL & MECHANICAL CLEANING :',T108,F8.3,
2/,T75,'TOTAL :',T116,F8.3,/)
RETURN

```

C

ENTRY PRINT3(DUMCOS)

C

```

WRITE(8,92)PRICEP,PRICEU,TOTALC
92 FORMAT(42X,'PRODUCER :',F8.3,' MILLS/KWHR ',
1/,43X,'UTILITY :',F8.3,' MILLS/KWHR ',
1/,41X,'* TOTAL :',F8.3,' MILLS/KWHR *')
DUMCOS=TOTALC
RETURN

```

C

ENTRY PRINT4(II,WRDCOS)


```

C      DIFCOS=TOTALC-WRDCOS
      WRITE(8,95)(WRT(II,J),J=1,18),RDEVF(II),DIFCOS
95     FORMAT(5X,18A4,F8.2,T102,F8.4)
      RETURN

C      ENTRY PRINT6(WRDCOS)

C      DIFCOS=TOTALC-WRDCOS
      AA1=100.*(SUCMP2-SUCMP1)/SUCMP1
      AA2=100.*(SUCMU2-SUCMU1)/SUCMU1
      WRITE(8,195)AA1,AA2,DIFCOS
195    FORMAT(5X,'START UP COST MULTIPLIERS',T65,'(PRODUCER:',F6.2,' , UT
1     ILITY:',F6.2,')',T102,F8.4)
      RETURN
      END

```

FILE: COMCOFF DATA

A

0.388055E+05	1.4430	-6.3269
0.795978E+09	3.2650	-4.4710
0.111728E+06	1.6380	-6.9520
0.132214E+10	3.7060	1.4048
0.121628E+16	6.4250	2.6438
0.176328E+09	2.9900	-1.5226
0.794951E+08	2.6540	93.1103
0.719037E+10	4.2600	16.7221
0.538791E+18	7.8030	35.2553
0.00	0.00	19.25
0.00	0.00	24.93
0.462193E+05	1.2930	36.1327
0.530463E+08	2.8130	44.0281
0.00	0.0	23.40
0.305047E+07	2.4210	24.3461
0.276496E+08	2.8910	-0.0301
0.388624E+09	3.5410	1.9457
0.136942E+05	1.1880	-13.7986
0.696341E+10	4.1000	3.7742
0.195045E+05	1.3530	-5.6097
0.644491E+04	0.8410	-50.0196
0.0	0.0	121.60
0.0	0.0	70.56
0.0	0.0	87.20
0.0	0.0	23.20
0.0	0.0	27.20
0.0	0.0	90.40
0.650151E+05	1.3530	127.9675
0.0	0.0	19.00
0.154334E+07	2.5210	51.3793

FILE: WELCOFF DATA A

0.215836E+05	1.3110	-9.5033
0.303276E+06	2.0940	0.1123
0.103515E+10	3.6330	2.9903
0.177546E+10	3.9740	2.5756

FILE: ROCOFF DATA A

80.0	160.0
100.0	200.0
125.0	250.0
200.0	400.0

FILE: RRND DATA A

NUMBER OF PRODUCTION WELLS
NUMBER OF INJECTION WELLS
CAPITAL COST PER PRODUCTION WELL
CAPITAL COST PER INJECTION WELL
CAPITAL COST OF GATHERING SYSTEM
CAPITAL COST OF PROCESS MECHANICAL (PRODUCER)
CAPITAL COST OF INSTRUMENTATION & CONTROL (PRODUCER)
CAPITAL COST OF SPENT BRINE TREATMENT
CAPITAL COST OF DISTRIBUTION SYSTEM
CAPITAL COST OF ENGINEERING & ADMINISTRATION (PRODUCER)
CAPITAL COST OF TURBINE GENERATOR
CAPITAL COST OF PROCESS MECHANICAL (UTILITY)
CAPITAL COST OF PIPING AND INSULATION
CAPITAL COST OF INSTRUMENTATION & CONTROL (UTILITY)
CAPITAL COST OF ELECTRICAL
CAPITAL COST OF CIVIL & STRUCTURAL
CAPITAL COST OF CONDENSER & HEAT REJECTION EQUIPMENT
CAPITAL COST OF SWITCHYARD
CAPITAL COST OF ENGINEERING & ADMINISTRATION (UTILITY)
PRODUCER GENERAL O&M COST FACTOR
PRODUCER WELL O&M COST FACTOR (LOW SALINITY)
PRODUCER WELL O&M COST FACTOR (HIGH SALINITY , TEMP <232 C)
PRODUCER WELL O&M COST FACTOR (HIGH SALINITY , TEMP >232 C)
PRODUCER DEEP WELL PUMP O&M COST FACTOR (FLASH SYSTEM , TEMP <200 C)
PRODUCER DEEP WELL PUMP O&M COST FACTOR (BINARY SYSTEM , TEMP <260 C)
PRODUCER SPENT BRINE TREATMENT O&M COST FACTOR (HIGH SALINITY)
PRODUCER CHEMICAL & MECHANICAL CLEANING O&M COST FACTOR
UTILITY GENERAL O&M COST FACTOR (FLASH SYSTEM)
UTILITY GENERAL O&M COST FACTOR (BINARY SYSTEM)
UTILITY PROCESS MECHANICAL O&M COST FACTOR (BINARY SYSTEM)
UTILITY CHEMICAL & MECHANICAL CLEANING O&M COST FACTOR
LIFE SPAN OF PRODUCTION WELLS
LIFE SPAN OF INJECTION WELLS
LIFE SPAN OF ALL PRODUCER EQUIPMENT EXCLUDING WELLS
LIFE SPAN OF UTILITY PLANT

FILE: RADFIL DATA A

BINARY(1980)

-22.0	0.0	-5.0	-5.0						
0.0	0.0	0.0	0.0	0.0	0.0				
0.0	-50.0	0.0	0.0	0.0	0.0	-20.0	0.0	0.0	
0.0	0.0	0.0	0.0	-33.0	-33.0	0.0	0.0		
0.0	0.0	0.0	0.0						
0.0	0.0	0.0	0.0						
0.0	0.0	0.0	0.0						

BINARY(1983)

-22.0	0.0	-12.0	-12.0						
-10.0	0.0	0.0	0.0	-10.0	0.0				
0.0	-50.0	0.0	0.0	0.0	0.0	-20.0	0.0	0.0	
0.0	0.0	0.0	0.0	-67.0	-67.0	-10.0	0.0		
0.0	0.0	0.0	0.0						
20.0	100.0	0.0	0.0						
40.0	40.0	20.0	0.0						

BINARY(1987)

-22.0	0.0	-20.0	-20.0						
-10.0	0.0	0.0	0.0	-10.0	0.0				
0.0	-50.0	0.0	0.0	0.0	0.0	-20.0	0.0	0.0	
0.0	0.0	0.0	0.0	-67.0	-67.0	-10.0	0.0		
0.0	0.0	0.0	0.0						
20.0	100.0	0.0	0.0						
40.0	40.0	20.0	0.0						

FLASH(1980)

0.0	0.0	-5.0	-5.0						
0.0	0.0	0.0	0.0	0.0	0.0				
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0.0	0.0	0.0	0.0	-33.0	-33.0	0.0	0.0		
0.0	0.0	0.0	0.0						
0.0	0.0	0.0	0.0						
0.0	0.0	0.0	0.0						

FLASH(1983)

-3.0	0.0	-12.0	-12.0						
-10.0	0.0	0.0	0.0	-10.0	0.0				
-3.0	-10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0.0	0.0	0.0	0.0	-67.0	-67.0	-10.0	0.0		
0.0	0.0	-17.0	0.0						
20.0	100.0	0.0	0.0						
40.0	40.0	20.0	0.0						

FLASH(1987)

-3.0	0.0	-20.0	-20.0						
-10.0	0.0	0.0	0.0	-10.0	0.0				
-3.0	-10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0.0	0.0	0.0	0.0	-67.0	-67.0	-10.0	0.0		
0.0	0.0	0.0	0.0						
20.0	100.0	0.0	0.0						
40.0	40.0	20.0	0.0						

FILE: FINANCE DATA A

0.30	0.08	0.20	0.50	0.01	0.10	0.04	0.80	0.05	0.05	0.05
0.50	0.08	0.12	0.01	0.00	0.05	0.05	0.05			
0.220	0.700	1.081	1.036	0.150	0.850	0.600	1.038	1.016		

FILE: GEOSIT DATA A

BRAWLEY , CALIFORNIA

	1983	1985	1987	1988	1989	1990
6	1983	1985	1987	1988	1989	1990
260	300	200				
0	2000	1	1			
	1	400000	400000			
5.00	5.00	10.00	20.00			

COSO , CALIFORNIA

	1985	1986	1987	1988	1989	1990
6	1985	1986	1987	1988	1989	1990
220	240	150				
1	1500	3	0			
	1	1	1			
10.00	10.00	20.00	30.00			

EAST MESA , CALIFORNIA

	1985	1988				
2	1985	1988				
180	225	150				
0	1500	1	0			
	1	600000	600000			
10.00	10.00	20.00	30.00			

HEBER , CALIFORNIA

	1983	1985	1987	1988		
4	1983	1985	1987	1988		
190	225	150				
0	1500	1	0			
	1	600000	600000			
10.00	10.00	20.00	30.00			

MONO-LONG VALLEY , CALIFORNIA

	1985	1987	1990			
3	1985	1987	1990			
220	250	200				
1	1500	3	0			
	1	1	1			
10.00	10.00	20.00	30.00			

SALTON SEA , CALIFORNIA

	1983	1985	1986	1987	1988	1989	1990
7	1983	1985	1986	1987	1988	1989	1990
340	360	300					
0	1500	1	1				
	1	400000	400000				
5.00	5.00	10.00	20.00				

BEOWAWE , NEVADA

	1983	1986	1988	1990		
4	1983	1986	1988	1990		
240	280	165				
1	1500	4	0			
	1	1	1	1		
10.00	10.00	20.00	30.00			

BRADY H.S. , NEVADA

	4	1983	1986	1988	1990
214	230	200			
1	1000	4	0		
	1		1		1

10.00 10.00 20.00 30.00

COVE FORT-SULPHURDALE , UTAH

	4	1985	1987	1989	1990
200	240	100			
0	2000	3	0		
	1		1		1

10.00 10.00 20.00 30.00

ROOSEVELT H.S. , NEVADA

	4	1983	1986	1988	1990
230	260	200			
1	1300	3	0		
363000			1		1

10.00 10.00 20.00 30.00

STEAMBOAT SPRINGS , NEVADA

	3	1985	1988	1990
210	250	180		
1	800	3	0	
	1		1	1

10.00 10.00 20.00 30.00

VALLES CALDERA , NEW MEXICO

	4	1983	1986	1988	1990
240	300	100			
1	1500	4	0		
	1		1		1

10.00 10.00 20.00 30.00

LASSEN , CALIFORNIA

	2	1987	1990
240	300	180	
1	1500	3	0
	1		1

10.00 10.00 20.00 30.00

SURPRISE VALLEY , CALIFORNIA

	4	1986	1988	1989	1990
175	225	110			
0	1500	3	0		
	1		1		1

10.00 10.00 20.00 30.00

ALVORD , OREGON

	2	1987	1990
200	240	150	
0	2000	4	0
	1		1

10.00 10.00 20.00 30.00

BRUNEAU-GRANDVIEW , IDAHO
 2 1987 1990
 210 250 160
 0 2500 3 0
 1 1 1
 10.00 10.00 20.00 30.00
 RAFT RIVER , IDAHO
 2 1988 1990
 140 170 130
 0 2000 1 0
 1 607000 607000
 10.00 10.00 20.00 30.00
 VALE H.S. , OREGON
 2 1988 1990
 160 180 145
 0 1500 1 0
 1 1 1
 10.00 10.00 20.00 30.00
 WEISER-CRANE CREEK , IDAHO
 2 1988 1990
 160 250 130
 0 1500 3 0
 1 1 1
 10.00 10.00 20.00 30.00
 CHANDLER , ARIZONA
 2 1986 1990
 178 200 150
 0 2500 2 0
 1 1 1
 10.00 10.00 20.00 30.00
 LEACH , NEVADA
 2 1987 1990
 170 200 140
 0 2500 3 0
 1 1 1
 10.00 10.00 20.00 30.00
 THERMO , UTAH
 1 1988
 200 225 140
 0 2000 2 0
 1 1 1
 10.00 10.00 20.00 30.00
 SAFFORD , ARIZONA
 1 1987
 210 250 160
 0 2500 3 0
 1 1 1
 10.00 10.00 20.00 30.00

GLASS MOUNTAIN , CALIFORNIA

1	1990			
210	250	160		
1	2500	3	0	
	1		1	1
10.00	10.00	20.00	30.00	

PUNA , HAWAII

1	1990			
356	390	320		
1	2500	4	0	
	1		1	1
10.00	10.00	20.00	30.00	

BAKER H.S. , WASHINGTON

1	1990			
165	190	145		
0	2500	3	0	
	1		1	1
10.00	10.00	20.00	30.00

DISTRIBUTION LIST

D-10

S. Blum
W. Gouse
C. Zraket

D-12

H. Bennington
C. Grandy
A. Tachmindji

W-50

J. Golden
R. Greeley
R. Ouellette
R. Pikul

W-51

L. Gsellman
E. Sharp

W-52

H. Abelson
G. Bennington
D. Blake
P. Curto
H. Dhillon (10)
A. El-Sawy
D. Entingh
N. Gadsby
S. Goldstein (50)
W. Jacobsen
J. Leigh (5)
V. Nguyen
R. Pfundstein
K. Rebibo
M. Scholl
R. Trehan
F. Williams

W-53

J. Gupta (5)
E. Ward
T. Wright

W-54

E. Krajewski

W-55

A. Challis*
N. Coates
J. Stone

W-56

G. Erskine
S. Lubore
L. Thomas

W-57

S. Lewis

W-50 Library (5)

MITRE/METREK Library

Technical Center (2)

Sponsor (DOE/DGE) (30)

*Send to Jean Reynolds (W-300). She will mail to Mr. Challis.