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ECONOMIC STUDIES

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SPERRY LOW TEMPERATURE GEOTHERMAL
CONVERSION SYSTEM - PHASE I
Contract No. DE-AC03-78ET27125
(Formerly ET-78-C-02-4633)
and PHASE II
Contract No. DE-AC03-79-ET27131

FINAL REPORT - VOLUME VI
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FOREWORD

This final report covers the work performed under the "Sperry Low Temperature Geothermal Conversion System" project, both Phase I under Contract No. DE-AC03-78-ET27125 (formerly ET-78-C-02-4633) and Phase II under Contract No. DE-AC03-79-ET27131.

Vols. I and II, submitted in 1982 covered a portion of the work accomplished under Phase I. Vols. III, IV, V, and VI submitted at this time cover the balance of work performed under Phase I and work performed under Phase II.

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6.0 INTRODUCTION

At the time that the analyses contained in this volume were performed, the avoided energy costs of California's regulated electric utilities were at historic highs and were projected to continue to increase at double-digit annual rates. Since that time, oil prices have slipped, the general rate of inflation has abated, domestic electric power consumption has fallen short of expectations, and a host of other economic elements have shifted in directions which have resulted in substantial reductions in current California avoided energy costs. The question of whether these changes are merely short-term aberrations or represent a fundamental shift in the long-term energy supply and demand balance is beyond the scope of this report.

Although the present depressed avoided electric energy prices are not consistent with the projections on which this report's analyses are based, a fact which results in significant discrepancies between the absolute financial returns predicted and those achievable under current circumstances, the comparative results of the study remain valid. The basic thrust of the studies represented in this report was to compare the overall economics of the Gravity Head system with that of optimized conventional binary generating plants.

The study is site-specific to the East Mesa geothermal reservoir. It begins with an analysis of optimum individual well production based on the known characteristics of the reservoir. The limiting factors at East Mesa are reservoir drawdown and maximum practical brine pump impeller setting depth. The individual-well production limit is achieved when brine pressure at the pump inlet is reduced to the point at which CO_2 starts to come out of solution, and fouling and impeller cavitation become imminent. The optimum pumping rate was found to be 1300 gpm (at 360°F density) and required that the Gravity Head pump impeller be set 2,033 feet below grade. The required conventional plant pump setting was 1,887 feet below grade,

a depth which is probably at the practical limit for shaft-driven conventional pumps.

Using the 1300 gpm, 360° F resource as a starting point, detailed cost estimates and performance calculations were made for the Gravity Head and various conventional alternative well-head systems. The most cost effective of the conventional alternatives was found to be a 700 psi cycle using R114 as the working fluid (actually optimized at 682 psi). That system produced 3,805 kW busbar net vs. 4,995 kW busbar net for the Gravity Head unit. Since both the Gravity Head and conventional binary plant cost estimates for commercially mature units came out roughly equal, it was obvious that the Gravity Head system would produce more attractive financial returns - it became a question of degree.

The study is in two parts. In Part I, emphasis is placed on the economic sensitivities of the compared systems to variations in capital cost, O&M cost, avoided energy inflation rates, and brine cost. In Part II, a somewhat more rigorous attempt is made to derive the actual economic performance of the systems under more realistic circumstances with contingencies, cost penalties, and multiple-unit developments added.

The results of the Part I study are given in Section 6.1. The results of the Part II study are given in Section 6.2. Detailed cash flow analysis charts for both studies are presented in Appendix A.

6.1 ECONOMIC STUDY OF GRAVITY HEAD VS. CONVENTIONAL BINARY PLANTS - PART I

6.1.1 Scope, Methodology and Bases

6.1.1.1 Plants Compared

- Gravity Head well-head plant using R114.
- Conventional binary well-head plant using R114 at 700 psi.
- Conventional binary well-head plant using R114 at 900 psi.
- Conventional binary well-head plant using isobutane at 900 psi.

6.1.1.2 Methodology

A detailed cost estimate was prepared for each of the above plants. An analysis was made of each plant cycle in order to calculate the net plant output. The most economically attractive of the conventional binary plants was selected, and a ten-year cash flow analysis was prepared. An identical analysis was also prepared for the Gravity Head plant. Return on investment sensitivity studies were "what effect does a \$500,000 variation in plant construction cost have on the ten-year R.O.I.?"

6.1.1.3 Basis for Fabrication and Construction Cost-Estimates

- Each plant was assumed to be a standardized (tenth generation) production model representing very little engineering and design cost.
- Conventional plant costs include everything required except the production well, reinjection well, downhole brine pump, brine piping to and from the wells, and electrical transmission lines.
- Gravity Head plant costs include everything required except the production well, reinjection well, spent brine piping to the injection well, and electrical transmission lines. Downhole pump cost is included.
- Costs include no mark-up profit for any of the contractors.

6.1.1.4 Brine Cost Basis

- It is assumed that the resource holder drills and completes the production and injection wells in all cases.
- The resource holder provides the downhole pump for the conventional system.
- The plant owner provides the downhole pump for the Gravity Head system (included in plant cost).

6.1.1.5 Electrical Sale Price Basis

- Assume price per kilowatt-hour equal to 90% of San Diego Gas and Electric Company's 1981 non-time-of-day average avoided cost escalated at the annual rate reflected in S.D.G. & E's five-year projections as published by the California P.U.C. in March 1981.
- Assume capacity price offers in effect for S.D.G. & E as published in the March, 1981 P.U.C. publication. Capacity price payments to begin after plant shakedown.
- Plant shakedown lasts three months.
- Plant availability is 50% during shakedown and 80% thereafter.

6.1.1.6 Basis for Operating and Maintenance (O&M) Costs

- Eight men x \$30/man-hr. x 2,080 hrs./year = \$500K (Jan. 1981 dollars).
- Materials, crafts, and services = \$500K (Jan. 1981 dollars).

(The O&M costs as a function of capital costs are excessive in this case; in actuality they would be lowered on a per plant basis by spreading them over a multi-unit complex of five units or more to be run by the same eight operators).

6.1.1.7 Basis for Cash Flow Analysis

- Financial structure is a limited partnership.
- The partners are assumed to have sufficient outside income to be able to utilize tax credits and write-offs as they occur (50% tax bracket assumed).

- A 10% investment tax credit plus 15% alternate energy and geothermal tax credits are taken as funds are expended.
- Plant is depreciated on a five-year schedule (15-year life assumed) beginning at plant start-up per the following schedule:

<u>Plant Start-up Date</u>	<u>1st Year</u>	<u>2nd Year</u>	<u>3rd Year</u>	<u>4th Year</u>	<u>5th Year</u>
1982,83,84	15%	22%	21%	21%	21%
1985	18	33	25	16	8
after 1985	20	32	24	16	8

- Annual rate of inflation is assumed to be 10% calculated at $(1.1)^N$.
- The construction period is six months (production model plants being produced in volume). Construction start date is January 1, 1982.
- Return on investment is calculated using the Discounted Cash Flow method:

$$\sum_{\text{year}=1}^{\text{year}=10} \frac{\text{Net cash flow for year}}{(1+i)^{\text{year}}} = 0.$$

For computer use, the zero condition was assumed to be satisfied when $\sum \leq 10$.

- S.D.G. & E avoided cost and capacity payment projections were approximated as follows:

$$A \times (1+i)^N$$

where

A = S.D.G. & E 1981 non-TOD average cost

i = average annual increase shown on S.D.G. & E.'s five-year projections for the P.U.C.

N = year minus 1981

- Operating and capital costs were escalated at the assumed general rate of inflation using a January 1981 dollar basis.
- Brine costs were escalated at a rate of 65% of the assumed general rate of inflation.

6.1.2 Results of Sensitivity Study

A baseline cash flow analysis was made for both a 3,800 kW net, 700 psi, R114 conventional binary system and a 5,000 kW net Gravity Head system. The baseline parameters were:

- capital cost - \$5 million
- brine cost - 30.2873¢/1000 lb.
- O&M cost = \$1 million/year
- general inflation rate - 10%/year
- utility elec. rate inflation - 11%/year.

Subsequently, cash flow analyses were made while holding four of the above five parameters constant and varying the fifth with the following results.

<u>Capital Cost</u>	<u>Binary R.O.I.</u>	<u>G.H. R.O.I.</u>
\$4.0M	17.2%	43.1%
baseline- \$5.0M	13.6%	36.0%
\$6.0M	11.0%	31.0%
\$7.0M	8.9%	27.1%
<u>O&M Cost</u>	<u>Binary R.O.I.</u>	<u>G.H. R.O.I.</u>
\$500K/yr	29.0%	49%
\$750K/yr	21.8%	42.4%
baseline- \$1,000K/yr	13.6%	36.0%
\$1,250K/yr	4.0%	29.5%

	<u>Elec. Rate Inflation</u>	<u>Binary R.O.I.</u>	<u>G.H. R.O.I.</u>
	10%	8.4%	32.1%
baseline-	11%	13.6%	36.0%
	12%	18.1%	39.7%
	13%	22.2%	43.4%

	<u>Brine Cost/1000 lb.</u>	<u>Binary R.O.I.</u>	<u>G.H. R.O.I.</u>
	21.6338¢	23%	44.0%
baseline-	30.2873¢	13.6%	36.0%
	34.6141¢	8.4%	32.0%
	38.9408¢	2.3%	28.0%

These results are plotted in Figures 1-4.

6.2 ECONOMIC STUDY OF GRAVITY HEAD VS. CONVENTIONAL BINARY PLANTS - PART II

6.2.1 Scope, Methodology and Bases

6.2.1.1 Plants Compared

- Gravity Head well-head plant using R114.
- Conventional binary well-head plant using R114 at 700 psi (the most economically attractive of the conventional alternatives studied).

6.2.1.2 Methodology

- A 10% contingency is added to the estimated capital cost of the plants. Cash flow analyses are made for single-unit Gravity Head and conventional binary plants, both with and without wells included at various assumed brine charges. Also, five-unit cluster plants of both the Gravity Head and conventional binary type are analyzed.

6.2.1.3 Basis for Fabrication and Construction Cost Estimates

- Each plant is assumed to be a standardized (tenth generation) production model representing very little engineering and design cost.
- Conventional plant costs "without wells" include everything except the production well, reinjection well, downhole brine pump, brine piping to and from the wells, and transmission lines.
- Conventional and Gravity Head plant costs "including wells" include everything except transmission lines.
- Gravity Head plant costs "without wells" include everything required except the production well, reinjection well, spent brine piping, and electrical transmission lines. Downhole pump cost is included. A \$352,000 penalty is added to the capital cost in this case to compensate the resource holder for the additional well investment required to accommodate the Gravity Head unit (a large-bore production well vs. a conventional well plus brine pump).

- A 10% contingency is added to all estimated costs.
- Costs include no mark-up or profit for any of the contractors.

6.2.1.4 Brine Cost Basis

- For plants "without wells" it is assumed that the resource holder drills and completes the production and injection wells, in which event:
 - The resource holder provides the downhole brine pump for the conventional system.
 - The plant owner provides the downhole brine pump for the Gravity Head system and pays the resource holder a one-time charge of \$352,000 to compensate him for the increased well cost. This amount is included in the Gravity Head capital cost.
- For plants with "wells included" the brine is purchased "in situ" and all well costs are borne by the plant owner.

6.2.1.5 Electrical Sale Price Basis

- Same as PART I plus the following:
- Each well-head unit shakedown lasts three months.
- Unit availability is 50% during shakedown and 80% thereafter.
- Multi-unit complexes are constructed on a staggered unit schedule.

6.2.1.6 Basis for Operating and Maintenance Costs

- Single unit O&M = \$1,000K/year (Jan. 1981 dollars).
- For each unit added to the first to make up a multi-unit complex, add \$366K (Jan. 1981 dollars).

6.2.1.7 Basis for Cash Flow Analysis

- Same as PART I.

6.2.2 Results of PART II Study

	<u>Brine Cost</u> <u>¢/1000 lb.</u>	<u>10 Year</u> <u>R.O.I.</u>
Five-Unit Gravity Head	8.6535	43.23%
Five-Unit Binary	8.6535	31.34%
Five-Unit Gravity Head	17.247	38.95%
Five-Unit Binary	17.247	26.65%

	<u>Brine Cost</u> <u>¢/1000 lb.</u>	<u>10 Year</u> <u>R.O.I.</u>
Single-Unit Gravity Head	21.6338	36.4%
Single-Unit Binary	21.6338	18.3%
Single-Unit Gravity Head	30.2873	30.0%
Single-Unit Binary	30.2873	10.2%
Single-Unit Gravity Head	38.9408	23.15%
Single-Unit Binary	38.9408	0.20%

These results are plotted in Figures 5 and 6.

6.3 PLANT PERFORMANCE CALCULATIONS

6.3.1 Assumptions and Conditions

6.3.1.1 Condensing Conditions

- All plants that have a 90°F rated condensing temperature have a 5°F subcooling condition or a liquid temperature out of the condenser of 85°F. Both temperature conditions are at a pressure of 39.0 PSIA.
- There is a 3 psi loss between turbine outlet and condenser outlet. This results in a 42.0 PSIA turbine outlet.
- In the gravity-head system, the condenser outlet conditions of a subcooled 85°F and 39.0 PSIA are increased in the ERU to a saturated 94°F and 41.75 PSIA. Although this does result in approximately 9°F less cooling of the brine, it does not appreciably increase the output of the system. It does, however, reduce the amount of heat exchanger and condenser surface required.

The ERU also serves the need for an R114 storage vessel during plant standby, a distribution manifold for turbine exhaust, and a vapor desuperheater. In the case of a stand-alone turbine pump system, the restoration of temperature and pressure by the ERU does significantly decrease the pump parasitic load since less temperature is removed from the brine for the pumping function.

- One Baltimore Air Coil unit is rated at a heat rejection capacity of 6×10^6 Btu/hr in operating between a wet bulb temperature of 60°F and a condensing temperature of 90°F. The parasitic load for one unit is 21 hp composed of two 3 hp pumps and two 7.5 hp fans. For consistency, the calculations treat

the condenser load as a continuous function rather than incrementally.

6.3.1.2 Fluid Properties

- Brine thermodynamic properties from Keenan and Keys.
- Brine transport properties are from ASHRAE.
- R114 thermodynamic properties are from Hules (Vol. 1, this Final Report).
- R114 transport properties above the dome are from the several Russian sources as presented in the Sperry report SRC-CR-81-74. Subcritical properties are from ASHRAE.
- Isobutane thermodynamic properties are from the Starling PH diagram of 1973.

6.3.2 Conventional Binary Plants Using R114

6.3.2.1 R114 Parameters

- Peak R114 temperature = 340°F:

$$\begin{aligned} & \dot{w}_0 \quad (\dot{w}_B) \quad (R) \\ \dot{w}_0(666) &= 160.5 \times 2.6118 = 419.2 \text{ lb sec} \\ \dot{w}_0(682) &= 160.5 \times 2.7658 = 443.9 \text{ lb sec} \\ \dot{w}_0(700) &= 160.5 \times 2.91623 = 468.1 \text{ lb sec} \end{aligned}$$

- Isentropic drop to 42 PSI:

$$\begin{aligned} H'(666) &= \frac{105.84 \text{ Btu} - 90.2 \text{ Btu}}{\text{lb}} = 15.57 \text{ Btu/lb} \\ H'(682) &= \frac{104.6 \text{ Btu} - 89.28 \text{ Btu}}{\text{lb}} = 15.32 \text{ Btu/lb} \\ H(700) &= \frac{103.2 \text{ Btu} - 88.2 \text{ Btu}}{\text{lb}} = 15.00 \text{ Btu/lb} \end{aligned}$$

6.3.2.2 Generator Output

$$\text{Power}(666) = \frac{15.57 \text{ Btu/lb} \times 419.2 \text{ lbs/sec} \times .85 \text{ Eff. Turb.} \times .96 \text{ Eff. Gen.}}{.9482 \text{ Btu/kW-sec}}$$

$$= 5617 \text{ kW.}$$

$$\text{Power}(682) = \frac{15.32 \text{ Btu/lb} \times 443.9 \text{ lb/sec.} \times .85 \text{ Eff. Turb.} \times .96 \text{ Eff. Gen.}}{.9482 \text{ Btu/kW-sec}}$$

$$= 5852 \text{ kW.}$$

$$\text{Power}(700) = \frac{15.00 \text{ Btu/lb} \times 468.1 \text{ lb/sec} \times .83 \text{ Eff. Turb.} \times .96 \text{ Eff. Gen.}}{.9482 \text{ Btu/kW-sec}}$$

$$= 5901 \text{ kW.}$$

6.3.2.3 Feed Pump

- Organic volume flow at an average density of 86.88:

$$Q(666) = \frac{419.2 \text{ lb/sec} \times 60 \text{ sec/min} \times 7.48 \text{ gal/ft}^3}{86.88 \text{ lb/ft}^3} = 2165 \text{ gpm.}$$

$$Q(682) = \frac{443.9 \text{ lb/sec} \times 60 \text{ sec/min} \times 7.48 \text{ gal ft}^3}{86.88 \text{ lb/ft}^3} = 2222 \text{ gpm.}$$

$$Q(700) = \frac{468.1 \text{ lb/sec} \times 60 \text{ sec/min} \times 7.48 \text{ gal/ft}^3}{86.88 \text{ lb/ft}^3} = 2328 \text{ gpm.}$$

- Electric power into feed pump:

$$\text{Power}(666) = \frac{2165 \text{ gpm} \times (686 - 39) \text{ psi} \times 1.01 \text{ (Compressibility)}}{2298 \text{ gpm} \times \text{psi/kW} \times .77 \text{ (Eff. Turb.)} \times .93 \text{ (Eff. Motor)}}$$
$$= 870 \text{ kW.}$$

$$\text{Power}(682) = \frac{2222 \text{ gpm} \times (702 - 39) \text{ psi} \times 1.01 \text{ (Compressibility)}}{2298 \text{ gpm} \times \text{psi/kW} \times .77 \text{ (Eff. Turb.)} \times .93 \text{ (Eff. Motor)}}$$
$$= 904 \text{ kW.}$$

$$\text{Power}(700) = \frac{2342 \text{ gpm} \times (720 - 39) \text{ psi} \times 1.01 \text{ (Compressibility)}}{2298 \text{ gpm} \times \text{psi/kW} \times .77 \text{ (Eff. Turb.)} \times .93 \text{ (Eff. Motor)}}$$
$$= 979 \text{ kW.}$$

NOTE: Compressibility is approximately 2% by diagram. Half of this should be charged to pumping energy.

6.3.2.4 Brine Pump Power

$$\text{Power(BP)} = \frac{755 \text{ psi} \times 1300 \text{ gpm}}{2298 \text{ gpm} \times \text{psi/kW} \times .51 \text{ (Eff. Pump)}} = 837 \text{ kW.}$$

6.3.2.5 Condenser Load

- Turbine exhaust enthalpy:

$$H(666) = \frac{90.27 \text{ Btu} + (15.57 \text{ Btu} \times .15 \text{ Eff. Loss})}{\text{lb}} = 92.61 \text{ Btu/lb}$$

$$H(682) = \frac{89.28 \text{ BTU} + (15.32 \text{ Btu} \times .15 \text{ Eff. Loss})}{\text{lb}} = 91.58 \text{ Btu/lb}$$

$$H(700) = \frac{88.20 \text{ Btu} + (15.00 \text{ Btu} \times .15 \text{ Eff. Loss})}{\text{lb}} = 90.48 \text{ Btu/lb.}$$

- Heat load in Btu/hr:

$$\begin{aligned} H(666) &= (92.61 - 29.3) \text{ Btu/lb} (419.2 \text{ lb/sec} \times 3600 \text{ sec/hr}) \\ &= 95.5 \times 10^6 \text{ Btu/hr} \end{aligned}$$

$$\begin{aligned} H(682) &= (91.58 - 29.3) \text{ Btu/lb} (443.9 \text{ lb/sec} \times 3600 \text{ sec/hr}) \\ &= 99.5 \times 10^6 \text{ Btu/hr} \end{aligned}$$

$$\begin{aligned} H(700) &= (90.48 - 29.3) \text{ Btu/lb} (465.2 \text{ lb/sec} \times 3600 \text{ sec/hr}) \\ &= 103.1 \times 10^6 \text{ Btu/hr} \end{aligned}$$

- Condenser load:

$$\text{Power}(666) = \frac{95.5 \text{ Btu/hr} \times 10^6 \times 21.0 \text{ hp} \times .746 \text{ kW/hp}}{6 \times 10^6 \text{ Btu/hr} \times .85 \text{ Eff. Motor}} = 293 \text{ kW}$$

$$\text{Power}(682) = \frac{99.5 \text{ Btu/hr} \times 10^6 \times 21.0 \text{ hp} \times .746 \text{ kW/hp}}{6 \times 10^6 \text{ Btu/hr} \times .85 \text{ Eff. Motor}} = 306 \text{ kW}$$

$$\text{Power}(700) = \frac{103.1 \text{ Btu/hr} \times 10^6 \times 21.0 \text{ hp} \times .746 \text{ kW/hp}}{6 \times 10^6 \text{ Btu/hr} \times .85 \text{ Eff. Motor}} = 318 \text{ kW}$$

6.3.2.6 Busbar Output

$$\text{Power}(666) = 5617 \text{ kW} - 870 \text{ kW} - 837 \text{ kW} - 293 \text{ kW} = 3617 \text{ kW.}$$

$$\text{Power}(682) = 5852 \text{ kW} - 904 \text{ kW} - 837 \text{ kW} - 306 \text{ kW} = 3805 \text{ kW.}$$

$$\text{Power}(700) = 5901 \text{ kW} - 979 \text{ kW} - 837 \text{ kW} - 318 \text{ kW} = 3767 \text{ kW.}$$

6.3.2.7 Temperature Rise Due to Feed Pumping (682 psi)

- Reversible increase:

$$\Delta T = 3.5^{\circ}\text{F} \text{ (from diagram)}$$

- Temperature increase due to impeller loss:

$$\Delta H = 979 \text{ kW} \times .93 \text{ (Eff.)} \times .2 \text{ (Eff. Loss)} = 182 \text{ kW.}$$

$$\Delta H_{\text{lb}} = \frac{182 \text{ kW} \times .9482 \text{ Btu sec/kW}}{443.9 \text{ lb/sec}} = .39 \text{ Btu/lb.}$$

$$\Delta T = .39 \text{ Btu/lb} / .22 \text{ (Cp)} = 1.77^{\circ}\text{F.}$$

$$\text{Total temperature increase} = 3.5^{\circ}\text{F} + 1.77^{\circ}\text{F} = 5.27^{\circ}\text{F.}$$

- Temperature into heat exchanger:

$$T = 85^{\circ}\text{F} + 5^{\circ}\text{F} = 90^{\circ}\text{F.}$$

6.3.3 Gravity Head Plant

6.3.3.1 R114 Conditions

- Flow $w_0 = 160.5 (w_B) \times 3.99015 (R) = 640.4 \text{ lb/sec}$
- Conditions out of heat exchanger:
 $H = 97.48 \text{ Btu/lb}$ $T = 340.0^\circ\text{F}$ $P = 900 \text{ psi}$
- Isentropic drop to 42 psi
- $\Delta H' = 97.48 \text{ Btu/lb} - 83.43 \text{ Btu/lb} - 14.05 \text{ Btu/lb}$
(for reference only)

6.3.3.2 Downhole Brine Pump

- Pressure added = 767 psi
- Power into impeller
$$\frac{1300 \text{ gpm} \times 767 \text{ psi}}{2298 \text{ gpm} \times \text{psi/kW} \times .75 (\text{Eff. Imp.})} = 578.5 \text{ kW}$$
- Energy rate into impeller
$$578.5 \text{ kW} / .9482 (\text{kW-sec}) / \text{Btu} = 548.4 \text{ Btu/sec}$$
- Energy/lb of R114
$$548.4 \text{ Btu/sec} / 640.4 \text{ lb/sec} = .8563 \text{ Btu/lb}$$
- Isentropic energy drop across turbine
$$\frac{548.4 \text{ Btu/sec}}{.75 (\text{Eff. Turb.})} = 731.2 \text{ Btu/sec}$$
- Energy/lb of R114 across turbine:
$$\Delta H' = 731.2 \text{ Btu/sec} / 640.4 \text{ lb/sec} = 1.142 \text{ Btu/lb}$$

- Irreversibility

$$1.145 \text{ Btu} - .8563 \text{ Btu} = .2854 \text{ Btu}$$

- Diagram 1.142 Btu/lb as isentropic drop from 97.48 Btu:

$$H = 97.48 \text{ Btu/lb} - 1.142 \text{ Btu/lb} = 96.34 \text{ Btu/lb}$$

$$P = 583 \text{ psi by diagram}$$

- Diagram irreversibility at constant pressure:

$$H = 96.34 \text{ Btu/lb} + .2854 \text{ Btu/lb} = 96.63 \text{ Btu/lb}$$

$$P = 584 \text{ psi as before}$$

6.3.3.3 Lift Work From 2,280 Feet

- $\Delta H = 2280 \text{ ft} / 778.3 \text{ Btu/ft-lb} = 2.93 \text{ Btu lb}$
- Compute friction loss as in incompressible fluid and convert to heat energy:

$$\Delta H = \frac{40 \text{ psi} \times 144 \text{ in}^2/\text{ft}^2}{778.3 \text{ Btu/ft}^2\text{-lb} \times 26.1 (P_{AV})} = .284 \text{ Btu/lb}$$

- Required isentropic drop for ideal lift work plus friction loss:

$$\Delta H = 2.93 \text{ Btu/lb} + .284 \text{ Btu/lb} = 3.21 \text{ Btu/lb}$$

- Diagram above:

$$H = 96.63 \text{ Btu/lb} - 3.21 \text{ Btu/lb} = 93.42 \text{ Btu/lb}$$

$$P = 256 \text{ (by diagram)}$$

- Diagram irreversibility:

$$H = 93.42 \text{ Btu/lb} + .284 \text{ Btu/lb} = 93.70 \text{ Btu lb}$$

$$P = 256 \text{ psi as before}$$

- Remaining $\Delta H'$ expanding from 256 to 42 psi:

$$\Delta H'_{\text{TURB}} = 93.70 \text{ Btu/lb} - 83.83 \text{ Btu/lb} = 9.87 \text{ Btu/lb}$$

6.3.3.4 Ideal Energy Split Between Pelton Wheel and Main Turbine

- Combined energy from two-phase flow :

$$\Delta H' = 9.87 \text{ Btu/lb}$$

$$E = 9.87 \text{ Btu/lb} \times 640.4 \text{ lb/sec} = 6321 \text{ Btu/sec}$$

- Liquid flow:

$$\text{Flow ratio from diagram} = .1719/1$$

$$\dot{w} \text{ (LIQ)} = 640.4 \text{ lb/sec} \times .1719 \text{ lb/sec} = 110.1 \text{ lb/sec}$$

$$\Delta H' \text{ (from diagram)} = 65.19 \text{ Btu/lb} - 61.02 \text{ Btu/lb} = 4.17 \text{ Btu/lb}$$

- Ideal Pelton wheel energy rate

$$E = 110.1 \text{ lb/sec} \times 4.17 \text{ Btu/lb} = 459 \text{ Btu/sec}$$

- Ideal main turbine energy

$$E = 6321 \text{ Btu/sec} - 459 \text{ Btu/sec} = 5862 \text{ Btu/sec}$$

6.3.3.5 Generator Output

- Pelton wheel

$$\frac{459 \text{ Btu/sec} \times .7 \text{ (Eff. Wheel)} \times .96 \text{ (Eff. Gen.)}}{.9482 \text{ kW sec/Btu}} = 325.3 \text{ kW}$$

- Main turbine

$$\frac{5862 \text{ Btu/sec} \times .85 \text{ (Turb. Eff.)} \times .96 \text{ (Gen. Eff.)}}{.9482 \text{ Btu/kW sec}} = 5045 \text{ kW}$$

- Total generator output

$$5045 \text{ kW} + 325 \text{ kW} = 5370 \text{ kW}$$

6.3.3.6 Condenser Parasitic Load

- Turbine exit enthalpy:

$$H = 83.84 \text{ Btu/lb} + 9.94 \text{ Btu/lb} \times .15 \text{ (Eff. Loss)} = 85.33 \text{ Btu/lb}$$

- Heat Load

$$(85.33 - 31.3) \text{ Btu/lb} \times 640.4 \text{ lb/sec} \times 3600 \text{ sec/hr} \\ = 122.2 \times 10^6 \text{ Btu/hr}$$

- Condenser electric load

$$\frac{122.2 \times 10^6 \text{ Btu/hr} \times .746 \text{ kW/hp} \times 21 \text{ hp}}{6 \times 10^6 \text{ Btu/hr} \times .85 \text{ (Motor Eff.)}} = 375 \text{ kW}$$

6.3.3.7 Busbar Power

$$\text{Power (busbar)} = 5370 \text{ kW} - 375 \text{ kW} = 4995 \text{ kW}$$

6.3.4 Conventional Binary Plant Using Isobutane (900 psi)

6.3.4.1 Organic Parameters

- Flow: $\dot{w}_0 = 160.5 \text{ (}\dot{w}_B\text{)} \times 1.0961 \text{ (R)} = 175.9 \text{ lb/sec}$

- Peak conditions: $H_0 = 594.8 \text{ Btu/lb}$

- $P_0 = 900 \text{ psi}, T_0 = 340.0^\circ\text{F}$

- Isentropic drop

$$\Delta H' = 594.8 \text{ Btu/lb} + 635.7 \text{ Btu/lb} = 40.9 \text{ Btu/lb}$$

6.3.4.2 Generator Output

- Generator output

$$\frac{40.9 \text{ Btu/lb} \times 175.9 \text{ lb/sec} \times .85 \text{ (Eff. Turb.)} \times .96 \text{ Eff. Gen.}}{.9482 \text{ Btu/kW} \cdot \text{sec}}$$

$$= 6191 \text{ kW}$$

6.3.4.3 Feed Pump Work

- Organic volume flow:

$$Q = \frac{175.9 \text{ lb/sec} \times 60 \text{ sec/min} \times 7.48 \text{ gal/ft}^3}{34.49 \text{ lb/ft}^3} = 2289 \text{ gpm}$$

- Electrical power into feed pump:

$$\frac{2289 \text{ gpm} \times (920 - 60) \text{ psi} \times 1.015 \text{ (Compressibility)}}{2298 \text{ gpm} \times \text{psi/kW} \times .77 \text{ (Eff. Turb.)} \times .93 \text{ (Eff. Motor)}} = 1214 \text{ kW}$$

NOTE: Compressibility is approximately = 3.0%. Half of this should be charged to pumping energy.

6.3.4.4 Brine Pump Power

$$\frac{1300 \text{ gpm} \times 755 \text{ psi}}{2298 \text{ gpm} \cdot \text{psi/kW} \times 0.51 \text{ (Pump Eff.)}} = 837 \text{ kW}$$

6.3.4.5 Condenser Parasitic Load

- $H_{\text{TURB}} = 635.7 \text{ Btu} - (40.9 \text{ Btu} \times .15 \text{ Eff. Loss}) = 629.6 \text{ Btu}$
- $\Delta H = 794 \text{ Btu/lb} - 629.6 \text{ Btu/lb} = 164 \text{ Btu/lb}$
- Heat load = $164 \text{ Btu/lb} \times 175.9 \text{ lb/sec} \times 3600 \text{ sec/hr} = 99.4 \times 10^6 \text{ Btu/hr}$
- Condenser load = $\frac{99.4 \times 10^6 \text{ Btu/hr} \times 21 \text{ hp} \times .746 \text{ kW/hp}}{6 \times 10^6 \text{ Btu/hr} \times .85 \text{ Eff.}} = 319 \text{ kW}$

6.3.4.6 Busbar Output

$$6191 \text{ kW} - 1214 \text{ kW} - 837 \text{ kW} - 319 \text{ kW} = 3821 \text{ kW}$$

6.3.4.7 Temperature Rise Due to Feed Pumping

- Reversible increase in temperature:

$$\Delta T = 5^{\circ}\text{F} \text{ (from diagram)}$$

- Temperature increase due to impeller loss:

$$\text{PWR} = 1214 \text{ kW} \times .93 \text{ Eff.} \times .23 \text{ Eff. Loss} = 260 \text{ kW}$$

$$\Delta H_{\text{lb}} = \frac{260 \text{ kW} \times .9482 \text{ Btu/sec/kw}}{175.9 \text{ lb/sec}} = 1.4 \text{ Btu/lb}$$

$$\Delta T = 1.4 \text{ Btu/lb} \times .58 \text{ (Cp)} = 2.42^{\circ}\text{F}$$

- Total temperature increase = $5^{\circ}\text{F} + 2.42^{\circ}\text{F} = 7.42^{\circ}\text{F}$

- Heat exchanger inlet temperature:

$$T = 85^{\circ}\text{F} + 7^{\circ}\text{F} = 92^{\circ}\text{F}$$

6.3.5 Conventional Binary Plant Using R114 (900 psi)

6.3.5.1 R114 Parameters

$$(\dot{w}_B) \quad (R)$$

- Flow: $160.5 \times 3.54868 = 569.6 \text{ lb/sec.}$

- Peak conditions:

$$H = 97.48 \text{ Btu} \quad P_0 = 900 \text{ psi} \quad T_0 = 340.0^{\circ}\text{F}$$

- Isentropic drop to 42.0 PSIA

$$\Delta H' = 97.48 \text{ Btu/lb} - 83.43 \text{ Btu/lb} = 14.05 \text{ Btu/lb}$$

6.3.5.2 Generator Output

- Turbine efficiency considering the 9% average wetness = .774

- Generator power:

$$\frac{14.05 \text{ Btu/lb} \times 569.6 \text{ lb/sec} \times .774 \text{ Eff. Turb.} \times .96 \text{ Eff. Gen.}}{.9482 \text{ Btu/kW sec}}$$

$$= 6271 \text{ kW}$$

6.3.5.3 Feed Pump Work

- Organic volume flow at an average density of 89.7 lb/ft³

$$Q = \frac{569.6 \text{ lb/sec} \times 60 \text{ sec/min} \times 7.48 \text{ gal/ft}^3}{89.68 \text{ lb/ft}^3} = 2851 \text{ gpm}$$

- Electric power into feed pump:

$$\frac{2851 \text{ gpm} \times (920 - 39) \text{ psi} \times 1.012 \text{ (Compressibility)}}{2298 \text{ gpm} \cdot \text{psi/kW} \times .77 \text{ (Eff. Turb.)} \times .93 \text{ (Eff. Motor)}} = 1544 \text{ kW}$$

NOTE: Compressibility is approximately 2.5% by diagram.
Half of this should be charged to pumping energy.

6.3.5.4 Brine Pump Power

$$\frac{1300 \text{ gpm} \times 755 \text{ PSIA}}{2298 \text{ gpm} \times \text{PSIA/kW} \times .51 \text{ Eff. Pump}} = 837 \text{ kW}$$

6.3.5.5 Condenser Load

- R114 enthalpy at turbine exhaust

$$H = 83.43 \text{ Btu} + (14.05 \text{ Btu} \times .15 \text{ (Eff. Loss)}) = 85.54 \text{ Btu}$$

- Heat Load = $\frac{(85.54 \text{ Btu} - 29.3 \text{ Btu}) (569.4 \text{ lb/sec} \times 3600 \text{ sec/hr})}{\text{lb}}$

$$= 115.3 \times 10^6 \text{ Btu/hr}$$

- Condenser load = $\frac{115.3 \text{ Btu/hr} \times 10^6 \times .746 \text{ kW/hp} \times 21 \text{ hp}}{6 \times 10^6 \text{ Btu/hr} \times .85 \text{ (Eff. Motor)}} = 354 \text{ kW}$

6.3.5.6 Busbar Output

$$6271 \text{ kW} - 1544 \text{ kW} - 837 \text{ kW} - 354 \text{ kW} = 3536 \text{ kW}$$

6.3.5.7 Temperature Rise Due to Feed Pumping

- Reversible increase in temperature

$$\Delta T = 5^{\circ}\text{F} \text{ (from diagram)}$$

- Temperature increase to impeller loss:

$$\text{PWR} = 1474 \text{ kW} \times .93 \text{ Eff. Motor} \times .23 \text{ Eff. Loss} = 315 \text{ kW}$$

$$\Delta H_{\text{lb}} = \frac{274 \text{ kW} \times .9482 \text{ Btu/kW sec}}{569.6 \text{ lb/sec}} = .52 \text{ Btu/lb}$$

$$\Delta T = .46 \text{ Btu/lb} / .22 \text{ (Cp)} = 2.36^{\circ}\text{F}$$

- Total temperature increase = $5^{\circ}\text{F} + 2^{\circ}\text{F} = 7^{\circ}\text{F}$

- Temperature into heat exchanger:

$$T = 85^{\circ}\text{F} + 7^{\circ}\text{F} = 92^{\circ}\text{F}$$

6.3.6 Brine Pumping Requirements

6.3.6.1 Assumptions and Conditions

- Ignore 2.000 PPM solids; consider brine to be pure water.
- Temperature at pump setting = 360°F .
- No loss of heat to formation.
- Pumped flow = 1,300 gpm at density of 55.2 lb/ft^3 .
- Depth to top of PERFS in production - 5,000 ft.
- Hot column shut-in pressure in production well - 153 PSIA.
- Pump efficiencies:
 - RC shaft = $.70 \text{ (impeller)} \times .92 \text{ (electrical)} \times .79 \text{ (mechanical)} = .51$
 - GH turbine pump = .56 (lab tests show .60).

- Required pressure at well head:

$$P(RC) = 153 (P_{SAT}) + 70 (CO_2) = 223 \text{ PSIA}$$

$$P(GH) = 1.0 (P_{SAT}) + \approx 5 (CO_2) = 6 \text{ PSIA}$$

- Production index - 2.4 gpm/psi
- Reinjection index - 5.0 gpm/psi
- Depth to top of PERFS in reinjection well - 5,000 ft.
- Formation temperature top of PERFS = 250°F
- Static cold column pressure at top of PERFS in reinjection well

$$P = 5,000 \text{ ft} \times \frac{60.89 (P_{AV})}{144} = 2114 \text{ psi}$$

(P at average temperature - 165°F)

6.3.6.2 Conventional Binary Plant Requirements

- Flow losses

Production Well	44 psi	Calculated
Heat Exchanger	20 psi	Estimated
Reinjection Line	30 psi	Estimated
Reinjection Well	40 psi	Calculated

- Volumetric flow in reinjection well

$$Q = \frac{160.5 (\dot{w}) \times 7.48 (\text{gal/ft}^3) \times 60 (\text{sec/min})}{60.99 (P \text{ at } 160^\circ\text{F})} = 1181 \text{ gpm}$$

- Column head during reinjection

$$P = \frac{5000 \text{ ft} \times 60.99 (P)}{144} = 2118 \text{ psi}$$

- Pump pressure addition required

$$\begin{aligned}\Delta P &= \frac{1300 \text{ gpm}}{2.4 \text{ (P.I.)}} - 153 \text{ (well head pressure)} \\ &+ 44 \text{ (well loss)} + 20 \text{ (H}_x \text{ loss)} + 2114 \text{ (static column)} \\ &- 2118 \text{ (reinjection column)} + 30 \text{ (line)} + 40 \text{ (well loss)} \\ &+ \frac{1181 \text{ gpm}}{5.0 \text{ (P.I.)}} \\ &= 755 \text{ psi}\end{aligned}$$

- Check production well head margin

$$P \text{ (well head)} = 153 \text{ (static hot column)} + 755 \text{ (pump } \Delta P)$$

$$\begin{aligned}&- \frac{1300 \text{ gpm}}{2.4 \text{ (P.I.)}} - 44 \text{ (well loss)} \\ &= 322 \text{ psi}\end{aligned}$$

$$\text{Margin} = 322 - 223 \text{ (required)} = 99 \text{ psi}$$

6.3.6.3 Gravity Head Plant

- Flow and head losses

Production Well (5,000 to 2,300)	24 psi
Heat Exchanger	50 psi
Head Loss in H _x (due to cooling of brine)	37 psi
Reinjection Line	30 psi
Reinjection Well	40 psi

- Volumetric flow in reinjection well

$$Q = \frac{160.5 \text{ (w)} \times 7.48 \text{ (gal/ft}^2) \times 60 \text{ (sec/min)}}{61.83 \text{ (P - 112°F)}} = 1165 \text{ gpm}$$

- Column head during reinjection

$$P = \frac{5000 \text{ (ft)} \times 61.83 \text{ (P)}}{144} = 2147 \text{ psi}$$

- Pump pressure addition required

$$\Delta P = \frac{1300 \text{ gpm}}{2.4 \text{ (P.I.)}} - 153 \text{ (well head)} + 24 \text{ (well loss)}$$

$$+ 50 \text{ (H}_x \text{ loss)} + 37 \text{ (head loss)} + 30 \text{ (line)}$$

$$- 2147 \text{ (reinjection column)} + 2114 \text{ (static column)}$$

$$+ 39 \text{ (well loss)} + \frac{1165 \text{ gpm}}{5.0 \text{ (P.I.)}}$$

$$= 767 \text{ psi}$$

- Check margin

$$P \text{ (well head)} = 153 \text{ (static column)} + 767 \text{ (Pump)} - \frac{1300 \text{ gpm}}{2.4 \text{ (P.I.)}}$$

$$- 24 \text{ (well)} - 50 \text{ (H}_x \text{)} - 37 \text{ (head)}$$

$$= 114 \text{ psi} - \text{required } 6.0 \text{ psi}$$

6.3.6.4 Necessary pump setting depths

- Flow loss from 5,000 ft to 2,280 ft = 28 psi

- Required inlet pressure above saturation to provide for suction specific speed of 4,500

$$\text{R.C.} = 15 \text{ psi}$$

$$\text{G.H.} = 140 \text{ psi}$$

- Inlet pressures

$$P(\text{RC}) = 223 + 15 = 238 \text{ psi}$$

$$P(\text{GH}) = 223 + 140 = 363 \text{ psi}$$

- RC depth required

$$\begin{aligned}
 2 \text{ (RC)} &= [283 \text{ (inlet)} + 27 \text{ (well P to 1900 ft)}] + \frac{1300 \text{ gpm}}{2.4 \text{ (P.I.)}} \\
 &- 153 \text{ (well head)} \left(\frac{144}{55.22 \text{ (P)}} \right) \\
 &= 1704
 \end{aligned}$$

- GH depth required

$$\begin{aligned}
 2 \text{ (GH)} &+ (363 + 28 + \frac{1300}{2.4} - 153) \left(\frac{144}{55.22 \text{ (P)}} \right) \\
 &= 2033
 \end{aligned}$$

- RC setting depth

Add 70 psi margin to provide for observed variability in CO₂ content

$$Z = (1740 + 70) \times \frac{144}{55.22} = 1887 \text{ ft}$$

GH pressure margin

$$\Delta P = (2280 - 2033) \times \frac{55.22}{144} = 95 \text{ psi}$$

6.4 CONCLUSIONS

The Gravity Head System of well-head generating units shows clearly superior rates of return on investment over conventional binary systems. The economic advantages of the Gravity Head System stem from two major characteristics: 1) lower cost per installed kW of net generating capacity, and 2) higher net kW output per pound of geothermal brine utilized. It can be argued that if the brine charges were based solely on Btus extracted rather than on pounds of brine utilized, a part of the Gravity Head system economic advantage would disappear. However, it does not seem reasonable that for a pressure-dominated reservoir such as East Mesa, where the useful life of the resource is limited by the volume of brine (rather than head) extracted, the brine charge for a given temperature resource should be based on anything other than volume utilized.

In any event, for reservoirs which are temperature dominated and a brine charge based on Btus rather than volume extracted is justified, or where there are minimum reinjection temperature constraints, a less efficient and less expensive version of the Gravity Head System would be indicated. In such a case, the loss in economic advantage for superior volumetric efficiency would be at least partially recaptured by lowered capital cost.

Finally, it must be recognized that the economic advantages indicated in this report can be realized only if the downhole equipment is made to operate reliably. For this reason, a great deal of research into bearings, seals, lubricants, etc. has been undertaken under this contract in order to achieve a composite mean-time-between-failure in excess of twelve months. This research, combined with the field experience acquired in inserting and withdrawing dummy heat exchanges from well 87-6, plus the successful operation of the automated welding and automated arc-air weld removal systems which were developed under this contract, supports the conclusion that reliable operation and efficient installation and removal of the downhole equipment are imminently achievable.

Fig. 1

83-626

83-627

Fig. 2

Fig. 3

83-628

Fig. 4

83-715

Fig. 5

Fig. 6

APPENDIX A

CASH FLOW ANALYSIS

CHARTS

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,313	3,555	3,911	4,302	4,732	5,205	5,726	6,298	6,928	7,621
CAPACITY PAYMENTS	67	267	267	267	267	267	267	267	267	267
BRINE COSTS	(531)	(1,391)	(1,481)	(1,578)	(1,680)	(1,789)	(1,906)	(2,030)	(2,162)	(2,302)
O & M COSTS	(550)	(1,291)	(1,331)	(1,464)	(1,611)	(1,772)	(1,949)	(2,144)	(2,358)	(2,594)
DEPRECIATION	(825)	(1,210)	(1,155)	(1,155)	(1,155)	0	0	0	0	0
BOOK	(526)	12	211	372	554	1,912	2,139	2,392	2,676	2,992
TAXABLE	(526)	12	211	372	554	1,912	2,139	2,392	2,676	2,992
TAX (-PAY, + CREDIT)	263	(6)	(105)	(186)	(277)	(956)	(1,069)	(1,196)	(1,338)	(1,496)
BOOK	(526)	12	211	372	554	1,912	2,139	2,392	2,676	2,992
TAX										
DEPRECIATION	825	1,210	1,155	1,155	1,155	0	0	0	0	0
INVESTMENT	(5,500)	0	0	0	0	0	0	0	0	0
TAX CREDIT (ITC, ETC)	1,357	0	0	0	0	0	0	0	0	0
CASH FLOW	(3,563)	1,216	1,260	1,341	1,432	956	1,069	1,196	1,338	1,496
R.O.I (D.C.F) =	32.1%									

PART I STUDY --10% elec. escalator--Gravity Head

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,361	3,753	4,203	4,707	5,272	5,905	6,614	7,407	8,296	9,292
CAPACITY PAYMENTS	67	267	267	267	267	267	267	267	267	267
BRINE COSTS	(531)	(1,391)	(1,481)	(1,578)	(1,680)	(1,789)	(1,906)	(2,030)	(2,162)	(2,302)
O & M COSTS	(550)	(1,210)	(1,331)	(1,464)	(1,611)	(1,772)	(1,949)	(2,144)	(2,358)	(2,594)
DEPRECIATION	(825)	(1,210)	(1,155)	(1,155)	(1,155)	0	0	0	0	0
BOOK	(478)	209	503	778	1,094	2,611	3,026	3,501	4,044	4,663
TAXABLE	(478)	209	503	778	1,094	2,611	3,026	3,501	4,044	4,663
TAX (-PAY, + CREDIT)	239	(105)	(251)	(389)	(547)	(1,306)	(1,513)	(1,751)	(2,022)	(2,332)
BOOK	(478)	209	503	778	1,094	2,611	3,026	3,501	4,044	4,663
TAX										
DEPRECIATION	825	1,210	1,155	1,155	1,155	0	0	0	0	0
INVESTMENT	(5,500)	0	0	0	0	0	0	0	0	0
TAX CREDIT (ITC,ETC)	1,375	0	0	0	0	0	0	0	0	0
CASH FLOW	(3,539)	1,315	1,406	1,544	1,702	1,306	1,513	1,751	2,022	2,332
R.O.I (D.C.F) =	39.7%									

PART I STUDY --12% elec. escalator --Gravity Head

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,386	3,854	4,355	4,921	5,561	6,284	7,101	8,024	9,067	10,246
CAPACITY PAYMENTS	67	267	267	267	267	267	267	267	267	267
BRINE COSTS	(531)	(1,391)	(1,481)	(1,578)	(1,680)	(1,789)	(1,906)	(2,030)	(2,162)	(2,302)
O & M COSTS	(550)	(1,210)	(1,331)	(1,464)	(1,611)	(1,772)	(1,949)	(2,144)	(2,358)	(2,594)
DEPRECIATION	(825)	(1,210)	(1,155)	(1,155)	(1,155)	0	0	0	0	0
BOOK	(453)	310	655	992	1,383	2,990	3,514	4,118	4,815	5,617
TAXABLE	(453)	310	655	992	1,383	2,990	3,514	4,118	4,815	5,617
TAX (-PAY, + CREDIT)	227	(155)	(328)	(496)	(691)	(1,495)	(1,757)	(2,059)	(2,408)	(2,809)
BOOK	(453)	310	655	992	1,383	2,990	3,514	4,118	4,815	5,617
TAX										
DEPRECIATION	825	1,210	1,155	1,155	1,155	0	0	0	0	0
INVESTMENT	(5,500)	0	0	0	0	0	0	0	0	0
TAX CREDIT (ITC, ETC)	1,375	0	0	0	0	0	0	0	0	0
CASH FLOW	(3,527)	1,365	1,483	1,651	1,846	1,495	1,757	2,059	2,408	2,809
R.O.I (D.C.F) =	43.4%									

PART I STUDY -- 13% elec. escalator-Gravity Head

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	998	2,702	2,972	3,269	3,596	3,956	4,352	4,787	5,265	5,792
CAPACITY PAYMENTS	51	203	203	203	203	203	203	203	203	203
BRINE COSTS	(531)	(1,391)	(1,482)	(1,578)	(1,681)	(1,790)	(1,906)	(2,030)	(2,162)	(2,302)
O & M COSTS	(550)	(1,210)	(1,331)	(1,464)	(1,611)	(1,772)	(1,949)	(2,144)	(2,358)	(2,594)
DEPRECIATION	(825)	(1,210)	(1,155)	(1,155)	(1,155)	0	0	0	0	0
BOOK	(857)	(906)	(792)	(724)	(647)	598	700	816	949	1,099
TAXABLE	(857)	(906)	(792)	(724)	(647)	598	700	816	949	1,099
TAX (-PAY, + CREDIT)	429	453	396	362	323	(299)	(350)	(408)	(474)	(549)
BOOK	(857)	(906)	(792)	(724)	(647)	598	700	816	949	1,099
TAX										
DEPRECIATION	825	1,210	1,155	1,155	1,155	0	0	0	0	0
INVESTMENT	(5,500)	0	0	0	0	0	0	0	0	0
TAX CREDIT (ITC, ETC)	1,375	0	0	0	0	0	0	0	0	0
CASH FLOW	(3,729)	757	759	793	832	299	350	408	474	549
R.O.I (D.C.F) =	8.4%									

PART I STUDY - 10% ELEC. ESCALATOR - BINARY

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,035	2,852	3,194	3,578	4,007	4,488	5,026	5,629	6,305	7,062
CAPACITY PAYMENTS	51	203	203	203	203	203	203	203	203	203
BRINE COSTS	(531)	(1,391)	(1,482)	(1,578)	(1,681)	(1,790)	(1,906)	(2,030)	(2,162)	(2,302)
O & M COSTS	(550)	(1,210)	(1,331)	(1,464)	(1,611)	(1,772)	(1,949)	(2,144)	(2,358)	(2,594)
DEPRECIATION	(825)	(1,210)	(1,155)	(1,155)	(1,155)	0	0	0	0	0
BOOK	(820)	(756)	(570)	(416)	(236)	1,130	1,375	1,659	1,988	2,369
TAXABLE	(820)	(756)	(570)	(416)	(236)	1,130	1,375	1,659	1,988	2,369
TAX (-PAY, + CREDIT)	410	378	285	208	118	(565)	(687)	(830)	(994)	(1,184)
BOOK	(820)	(756)	(570)	(416)	(236)	1,130	1,375	1,659	1,988	2,369
TAX										
DEPRECIATION	825	1,210	1,155	1,155	1,155	0	0	0	0	0
INVESTMENT	(5,500)	0	0	0	0	0	0	0	0	0
TAX CREDIT (ITC,ETC)	1,375	0	0	0	0	0	0	0	0	0
CASH FLOW	(3,710)	832	870	947	1,037	565	687	830	994	1,184
R.O.I (D.C.F) =	18.1%									

PART I STUDY - 12% ELEC. ESCALATOR - BINARY

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,053	2,929	3,310	3,740	4,226	4,776	5,397	6,098	6,891	7,787
CAPACITY PAYMENTS	51	203	203	203	203	203	203	203	203	203
BRINE COSTS	(531)	(1,391)	(1,482)	(1,578)	(1,681)	(1,790)	(1,906)	(2,030)	(2,162)	(2,302)
O & M COSTS	(550)	(1,210)	(1,331)	(1,464)	(1,611)	(1,772)	(1,949)	(2,144)	(2,358)	(2,594)
DEPRECIATION	(825)	(1,210)	(1,155)	(1,155)	(1,155)	0	0	0	0	0
BOOK	(802)	(679)	(455)	(254)	(16)	1,418	1,745	2,128	2,574	3,094
TAXABLE	(802)	(679)	(455)	(254)	(16)	1,418	1,745	2,128	2,574	3,094
TAX (-PAY, + CREDIT)	401	339	227	127	8	(709)	(873)	(1,064)	(1,287)	(1,547)
BOOK	(802)	(679)	(445)	(254)	(16)	1,418	1,745	2,128	2,574	3,094
TAX										
DEPRECIATION	825	1,210	1,155	1,155	1,155	0	0	0	0	0
INVESTMENT	(5,500)	0	0	0	0	0	0	0	0	0
TAX CREDIT (ITC,ETC)	1,375	0	0	0	0	0	0	0	0	0
CASH FLOW	(3,701)	871	928	1,028	1,147	709	873	1,064	1,287	1,547
R.O.I (D.C.F) =	22.2%									

PART I STUDY - 13% ELEC. ESCALATOR - BINARY

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,337	3,653	4,055	4,501	4,996	5,546	6,156	6,833	7,584	8,419
CAPACITY PAYMENTS	67	267	267	267	267	267	267	267	267	267
BRINE COSTS	(531)	(1,391)	(1,481)	(1,578)	(1,680)	(1,789)	(1,906)	(2,030)	(2,162)	(2,302)
O & M COSTS	(550)	(1,210)	(1,331)	(1,464)	(1,611)	(1,772)	(1,949)	(2,144)	(2,358)	(2,594)
DEPRECIATION	(660)	(968)	(924)	(924)	(924)	0	0	0	0	0
BOOK	(337)	351	586	803	1,049	2,252	2,569	2,927	3,332	3,790
TAXABLE	(337)	351	586	803	1,049	2,252	2,569	2,927	3,332	3,790
TAX (-PAY, + CREDIT)	168	(176)	(293)	(401)	(524)	(1,126)	(1,284)	(1,463)	(1,666)	(1,895)
BOOK	(337)	351	586	803	1,049	2,252	2,569	2,927	3,332	3,790
TAX										
DEPRECIATION	660	968	924	924	924	0	0	0	0	0
INVESTMENT	(4,400)	0	0	0	0	0	0	0	0	0
TAX CREDIT (ITC,ETC)	1,100	0	0	0	0	0	0	0	0	0
CASH FLOW	(2,808)	1,144	1,217	1,324	1,448	1,126	1,284	1,463	1,666	1,895
R.O.I (D.C.F) =	43.1%									

PART I STUDY - \$4,000K CAPITAL COST - GRAVITY HEAD

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,337	3,653	4,055	4,501	4,996	5,546	6,156	6,833	7,584	8,419
CAPACITY PAYMENTS	67	267	267	267	267	267	267	267	267	267
BRINE COSTS	(131)	(1,391)	(1,481)	(1,578)	(1,680)	(1,789)	(1,906)	(2,030)	(2,162)	(2,302)
O & M COSTS	(550)	(1,210)	(1,331)	(1,464)	(1,611)	(1,772)	(1,949)	(2,144)	(2,358)	(2,594)
DEPRECIATION	(825)	(1,210)	(1,155)	(1,155)	(1,155)	0	0	0	0	0
BOOK	(502)	109	355	572	818	2,252	2,569	2,927	3,332	3,790
TAXABLE	(502)	109	355	572	818	2,252	2,569	2,927	3,332	3,790
TAX (-PAY, + CREDIT)	251	(55)	(177)	(286)	(409)	(1,126)	(1,284)	(1,463)	(1,666)	(1,895)
BOOK	(502)	109	355	572	818	2,252	2,569	2,927	3,332	3,790
TAX										
DEPRECIATION	825	1,210	1,155	1,155	1,155	0	0	0	0	0
INVESTMENT	(5,500)	0	0	0	0	0	0	0	0	0
TAX CREDIT (ITC,ETC)	1,375	0	0	0	0	0	0	0	0	0
CASH FLOW	(3,551)	1,265	1,332	1,441	1,564	1,126	1,284	1,463	1,666	1,895
R.O.I (D.C.F) =	36.0%									

PART I STUDY - \$5,000k CAPITAL COST GRAVITY
BASE LINE CASE

HEAD

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,337	3,653	4,055	4,501	4,996	5,546	6,156	6,833	7,584	8,419
CAPACITY PAYMENTS	67	267	267	267	267	267	267	267	267	267
BRINE COSTS	(531)	(1,391)	(1,481)	(1,578)	(1,680)	(1,789)	(1,906)	(2,030)	(2,162)	(2,302)
O & M COSTS	(550)	(1,210)	(1,331)	(1,464)	(1,611)	(1,772)	(1,946)	(2,144)	(2,358)	(2,594)
DEPRECIATION	(990)	(1,452)	(1,386)	(1,386)	(1,386)	0	0	0	0	0
BOOK	(667)	(133)	124	341	587	2,252	2,569	2,927	3,332	3,790
TAXABLE	(667)	(133)	124	341	587	2,252	2,569	2,927	3,332	3,790
TAX (-PAY, + CREDIT)	333	66	(62)	(170)	(293)	(1,126)	(1,284)	(1,463)	(1,666)	(1,895)
BOOK	(667)	(133)	124	341	587	2,252	2,569	2,927	3,332	3,790
TAX										
DEPRECIATION	990	1,452	1,386	1,386	1,386	0	0	0	0	0
INVESTMENT	(6,600)	0	0	0	0	0	0	0	0	0
TAX CREDIT (ITC, ETC)	1,650	0	0	0	0	0	0	0	0	0
CASH FLOW	(4,293)	1,386	1,448	1,556	1,679	1,126	1,284	1,463	1,666	1,895
R.O.I (D.C.F) =	31.0%									

PART I STUDY - \$6,000 CAPITAL COST GRAVITY HEAD

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,337	3,653	4,055	4,501	4,996	5,546	6,156	6,833	7,584	8,419
CAPACITY PAYMENTS	67	267	267	267	267	267	267	267	267	267
BRINE COSTS	(531)	(1,391)	(1,481)	(1,578)	(1,680)	(1,789)	(1,906)	(2,030)	(2,162)	(2,302)
O & M COSTS	(550)	(1,210)	(1,331)	(1,464)	(1,611)	(1,772)	(1,949)	(2,144)	(2,358)	(2,594)
DEPRECIATION	(1,155)	(1,694)	(1,617)	(1,617)	(1,617)	0	0	0	0	0
BOOK	(832)	(375)	(107)	110	356	2,252	2,569	2,927	3,332	3,790
TAXABLE	(832)	(375)	(107)	110	356	2,252	2,569	2,927	3,332	3,790
TAX (-PAY, + CREDIT)	416	187	54	(55)	(178)	(1,126)	(1,284)	(1,463)	(1,666)	(1,895)
BOOK	(832)	(375)	(107)	110	356	2,252	2,569	2,927	3,332	3,790
TAX										
DEPRECIATION	1,155	1,694	1,617	1,617	1,617	0	0	0	0	0
INVESTMENT	(7,700)	0	0	0	0	0	0	0	0	0
TAX CREDIT (ITC, ETC)	1,925	0	0	0	0	0	0	0	0	0
CASH FLOW	(5,036)	1,507	1,563	1,672	1,795	1,126	1,284	1,463	1,666	1,895
R.O.I (D.C.F) =	27.1%									

PART I STUDY - \$7,000K CAPITAL COST - GRAVITY HEAD

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,016	2,776	3,082	3,421	3,797	4,215	4,678	5,193	5,764	6,398
CAPACITY PAYMENTS	51	203	203	203	203	203	203	203	203	203
BRINE COSTS	(531)	(1,391)	(1,482)	(1,578)	(1,681)	(1,790)	(1,906)	(2,030)	(2,162)	(2,302)
O & M COSTS	(550)	(1,210)	(1,331)	(1,464)	(1,611)	(1,772)	(1,949)	(2,144)	(2,358)	(2,594)
DEPRECIATION	(660)	(968)	(924)	(924)	(924)	0	0	0	0	0
BOOK	(674)	(590)	(452)	(342)	(215)	857	1,027	1,223	1,447	1,705
TAXABLE	(674)	(590)	(452)	(342)	(215)	857	1,027	1,223	1,447	1,705
TAX (-PAY, + CREDIT)	337	295	226	171	107	(428)	(513)	(611)	(724)	(853)
BOOK	(674)	(590)	(452)	(342)	(215)	857	1,027	1,223	1,447	1,705
TAX										
DEPRECIATION	660	968	924	924	924	0	0	0	0	0
INVESTMENT	(4,400)	0	0	0	0	0	0	0	0	0
TAX CREDIT (ITC,ETC)	1,100	0	0	0	0	0	0	0	0	0
CASH FLOW	(2,977)	673	698	753	817	428	513	611	724	853
R.O.I (D.C.F) =	17.2%									

PART I STUDY - \$4,000 K CAPITAL COST - BINARY

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,016	2,776	3,081	3,420	3,797	4,214	4,678	5,192	5,764	6,398
CAPACITY PAYMENTS	50	203	203	203	203	203	203	203	203	203
BRINE COSTS	(530)	(1,391)	(1,481)	(1,577)	(1,680)	(1,789)	(1,906)	(2,030)	(2,161)	(2,302)
O & M COSTS	(550)	(1,210)	(1,331)	(1,464)	(1,610)	(1,771)	(1,948)	(2,143)	(2,357)	(2,593)
DEPRECIATION	(825)	(1,210)	(1,155)	(1,155)	(1,155)	0	0	0	0	0
BOOK	(838)	(831)	(682)	(573)	(445)	856	1,026	1,222	1,447	1,705
TAXABLE	(838)	(831)	(682)	(573)	(445)	856	1,026	1,222	1,447	1,705
TAX (-PAY, + CREDIT)	419	415	341	286	222	(428)	(513)	(611)	(723)	(852)
BOOK	(838)	(831)	(682)	(573)	(445)	856	1,026	1,222	1,447	1,705
TAX										
DEPRECIATION	825	1,210	1,155	1,155	1,155	0	0	0	0	0
INVESTMENT	(5,500)	0	0	0	0	0	0	0	0	0
TAX CREDIT (ITC,ETC)	1,375	0	0	0	0	0	0	0	0	0
CASH FLOW	(3,719)	794	813	868	932	428	513	611	723	852
R.O.I (D.C.F) =	13.6%									

PART I STUDY - \$5,000K CAPITAL COST -
BASE LINE CASE

BINARY

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,016	2,776	3,082	3,421	3,797	4,215	4,678	5,193	5,764	6,398
CAPACITY PAYMENTS	51	203	203	203	203	203	203	203	203	203
BRINE COSTS	(531)	(1,391)	(1,482)	(1,578)	(1,681)	(1,790)	(1,906)	(2,030)	(2,162)	(2,302)
O & M COSTS	(550)	(1,210)	(1,331)	(1,464)	(1,611)	(1,772)	(1,949)	(2,144)	(2,358)	(2,594)
DEPRECIATION	(990)	(1,452)	(1,386)	(1,386)	(1,386)	0	0	0	0	0
BOOK	(1,004)	(1,074)	(914)	(804)	(677)	857	1,027	1,223	1,447	1,705
TAXABLE	(1,004)	(1,074)	(914)	(804)	(677)	857	1,027	1,223	1,447	1,705
TAX (-PAY, + CREDIT)	502	537	457	402	388	(428)	(513)	(611)	(724)	(853)
BOOK	(1,004)	(1,074)	(914)	(804)	(677)	857	1,027	1,223	1,447	1,705
TAX										
DEPRECIATION	990	1,452	1,386	1,386	1,386	0	0	0	0	0
INVESTMENT	(6,600)	0	0	0	0	0	0	0	0	0
TAX CREDIT (ITC,ETC)	1,650	0	0	0	0	0	0	0	0	0
CASH FLOW	(4,462)	915	929	984	1,048	428	513	611	724	853
R.O.I (D.C.F) =	11.0%									

PART I STUDY - \$6,000K CAPITAL COST - BINARY

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,016	2,776	3,082	3,421	3,797	4,215	4,678	5,193	5,764	6,398
CAPACITY PAYMENTS	51	203	203	203	203	203	203	203	203	203
BRINE COSTS	(531)	(1,391)	(1,482)	(1,578)	(1,681)	(1,790)	(1,906)	(2,030)	(2,162)	(2,302)
O & M COSTS	(550)	(1,210)	(1,331)	(1,464)	(1,611)	(1,772)	(1,949)	(2,144)	(2,358)	(2,594)
DEPRECIATION	(1,155)	(1,694)	(1,617)	(1,617)	(1,617)	0	0	0	0	0
BOOK	(1,169)	(1,316)	(1,145)	(1,035)	(908)	857	1,027	1,223	1,447	1,705
TAXABLE	(1,169)	(1,316)	(1,145)	(1,035)	(908)	857	1,027	1,223	1,447	1,705
TAX (-PAY, + CREDIT)	584	658	572	518	454	(428)	(513)	(611)	(724)	(853)
BOOK	(1,169)	(1,316)	(1,145)	(1,035)	(908)	857	1,027	1,223	1,447	1,705
TAX										
DEPRECIATION	1,155	1,694	1,617	1,617	1,617	0	0	0	0	0
INVESTMENT	(7,700)	0	0	0	0	0	0	0	0	0
TAX CREDIT (ITC,ETC)	1,925	0	0	0	0	0	0	0	0	0
CASH FLOW	(5,204)	1,036	1,045	1,099	1,163	428	513	611	724	853
R.O.I (D.C.F) =	8.9%									

PART I STUDY - \$7,000K CAPITAL COST - BINARY

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,337	3,653	4,055	4,501	4,996	5,546	6,156	6,833	7,584	8,419
CAPACITY PAYMENTS	67	267	267	267	267	267	267	267	267	267
BRINE COSTS	(531)	(1,391)	(1,481)	(1,578)	(1,680)	(1,789)	(1,906)	(2,030)	(2,162)	(2,302)
O & M COSTS	(275)	(605)	(666)	(732)	(805)	(886)	(974)	(1,072)	(1,179)	(1,297)
DEPRECIATION	(825)	(1,210)	(1,155)	(1,155)	(1,155)	0	0	0	0	0
BOOK	(227)	714	1,020	1,304	1,623	3,138	3,543	3,999	4,511	5,087
TAXABLE	(227)	714	1,020	1,304	1,623	3,138	3,543	3,999	4,511	5,087
TAX (-PAY, + CREDIT)	113	(357)	(510)	(652)	(811)	(1,569)	(1,771)	(1,999)	(2,256)	(2,544)
BOOK	(227)	714	1,020	1,304	1,623	3,138	3,543	3,999	4,511	5,087
TAX										
DEPRECIATION	825	1,210	1,155	1,155	1,155	0	0	0	0	0
INVESTMENT	(5,500)	0	0	0	0	0	0	0	0	0
TAX CREDIT (ITC, ETC)	1,374	0	0	0	0	0	0	0	0	0
CASH FLOW	(3,413)	1,567	1,665	1,807	1,966	1,569	1,771	1,999	2,256	2,544
R.O.I (D.C.F) =	49.0%									

PART I STUDY - \$500K O & M - Gravity Head

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,337	3,653	4,055	4,501	4,996	5,546	6,156	6,833	7,584	8,419
CAPACITY PAYMENTS	67	267	267	267	267	267	267	267	267	267
BRINE COSTS	(531)	(1,391)	(1,481)	(1,578)	(1,680)	(1,789)	(1,906)	(2,030)	(2,162)	(2,302)
O & M COSTS	(413)	(908)	(998)	(1,098)	(1,208)	(1,329)	(1,462)	(1,608)	(1,768)	(1,945)
DEPRECIATION	(825)	(1,210)	(1,155)	(1,155)	(1,155)	0	0	0	0	0
BOOK	(364)	412	688	938	1,220	2,695	3,056	3,463	3,922	4,439
TAXABLE	(364)	412	688	938	1,220	2,695	3,056	3,463	3,922	4,439
TAX (-PAY, + CREDIT)	182	(206)	(344)	(469)	(610)	(1,347)	(1,528)	(1,731)	(1,961)	(2,219)
BOOK	(364)	412	688	938	1,220	2,695	3,056	3,463	3,922	4,439
TAX										
DEPRECIATION	825	1,210	1,155	1,155	1,155	0	0	0	0	0
INVESTMENT	(5,500)	0	0	0	0	0	0	0	0	0
TAX CREDIT (ITC,ETC)	1,375	0	0	0	0	0	0	0	0	0
CASH FLOW	3,482	1,416	1,499	1,624	1,765	1,347	1,528	1,731	1,961	2,219
R.O.I (D.C.F) =	42.4%									

PART I STUDY --\$750K O & M-- Gravity Head

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,337	3,653	4,055	4,501	4,996	5,546	6,156	6,833	7,584	8,419
CAPACITY PAYMENTS	67	267	267	267	267	267	267	267	267	267
BRINE COSTS	(531)	(1,391)	(1,481)	(1,578)	(1,680)	(1,789)	(1,906)	(2,030)	(2,162)	(2,302)
O & M COSTS	(688)	(1,513)	(1,664)	(1,830)	(2,013)	(2,214)	(2,436)	(2,679)	(2,947)	(3,242)
DEPRECIATION	(825)	(1,210)	(1,155)	(1,155)	(1,155)	0	0	0	0	0
BOOK	(639)	(193)	22	205	415	1,809	2,081	2,391	2,743	3,142
TAXABLE	(639)	(193)	22	205	415	1,809	2,081	2,391	2,743	3,142
TAX (-PAY, + CREDIT)	320	97	(11)	(103)	(208)	(905)	(1,041)	(1,195)	(1,371)	(1,571)
BOOK	(639)	(193)	22	205	415	1,809	2,081	2,391	2,743	3,142
TAX										
DEPRECIATION	825	1,210	1,155	1,155	1,155	0	0	0	0	0
INVESTMENT	(5,500)	0	0	0	0	0	0	0	0	0
TAX CREDIT (ITC, ETC)	1,375	0	0	0	0	0	0	0	0	0
CASH FLOW	(3,620)	1,113	1,166	1,258	1,363	905	1,041	1,195	1,371	1,571
R.O.I (D.C.F) =	29.5%									

PART I STUDY -- \$1,250K O & M-- Gravity Head

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,016	2,776	3,082	3,421	3,797	4,215	4,678	5,193	5,764	6,398
CAPACITY PAYMENTS	51	203	203	203	203	203	203	203	203	203
BRINE COSTS	(531)	(1,391)	(1,482)	(1,578)	(1,681)	(1,790)	(1,906)	(2,030)	(2,162)	(2,302)
O & M COSTS	(275)	(605)	(666)	(732)	(805)	(886)	(974)	(1,072)	(1,179)	(1,297)
DEPRECIATION	(825)	(1,210)	(1,155)	(1,155)	(1,155)	0	0	0	0	0
BOOK	(564)	(227)	(17)	159	359	1,742	2,001	2,294	2,626	3,002
TAXABLE	(564)	(227)	(17)	159	359	1,742	2,001	2,294	2,626	3,002
TAX (-PAY, + CREDIT)	282	113	9	(79)	(180)	(871)	(1,001)	(1,147)	(1,313)	(1,501)
BOOK	(564)	(227)	(17)	159	359	1,742	2,001	2,294	2,626	3,002
TAX										
DEPRECIATION	825	1,210	1,155	1,155	1,155	0	0	0	0	0
INVESTMENT	(5,500)	0	0	0	0	0	0	0	0	0
TAX CREDIT (ITC, ETC)	1,375	0	0	0	0	0	0	0	0	0
CASH FLOW	(3,582)	1,097	1,146	1,234	1,335	871	1,001	1,147	1,313	1,501
R.O.I (D.C.F) =	29.0%									

PART I STUDY - \$500 K O&M - BINARY

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,016	2,776	3,082	3,421	3,797	4,215	4,678	5,193	5,764	6,398
CAPACITY PAYMENTS	51	203	203	203	203	203	203	203	203	203
BRINE COSTS	(531)	(1,391)	(1,482)	(1,578)	(1,681)	(1,790)	(1,906)	(2,030)	(2,162)	(2,302)
O & M COSTS	(413)	(908)	(998)	(1,098)	(1,208)	(1,329)	(1,462)	(1,608)	(1,768)	(1,945)
DEPRECIATION	(825)	(1,210)	(1,155)	(1,155)	(1,155)	0	0	0	0	0
BOOK	(701)	(529)	(350)	(207)	(43)	1,299	1,514	1,758	2,037	2,354
TAXABLE	(701)	(529)	(350)	(207)	(43)	1,299	1,514	1,758	2,037	2,354
TAX (-PAY, + CREDIT)	(351)	265	175	104	22	(650)	(757)	(879)	(1,018)	(1,177)
BOOK	(701)	(529)	(350)	(207)	(43)	1,299	1,514	1,758	2,037	2,354
TAX										
DEPRECIATION	825	1,210	1,155	1,155	1,155	0	0	0	0	0
INVESTMENT	(5,500)	0	0	0	0	0	0	0	0	0
TAX CREDIT (ITC,ETC)	1,375	0	0	0	0	0	0	0	0	0
CASH FLOW	(3,651)	945	980	1,051	1,133	650	757	879	1,018	1,177
R.O.I (D.C.F) =	21.8%									

PART I STUDY - \$750K O&M - BINARY

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,016	2,776	3,082	3,421	3,797	4,215	4,678	5,193	5,764	6,398
CAPACITY PAYMENTS	51	203	203	203	203	203	203	203	203	203
BRINE COSTS	(531)	(1,391)	(1,482)	(1,578)	(1,681)	(1,790)	(1,906)	(2,030)	(2,162)	(2,302)
O & M COSTS	(688)	(1,513)	(1,664)	(1,830)	(2,013)	(2,214)	(2,436)	(2,679)	(2,947)	(3,242)
DEPRECIATION	(825)	(1,210)	(1,155)	(1,155)	(1,155)	0	0	0	0	0
BOOK	(976)	(1,134)	(1,015)	(939)	(848)	414	539	687	858	1,057
TAXABLE	(976)	(1,134)	(1,015)	(939)	(848)	414	539	687	858	1,057
TAX (-PAY, + CREDIT)	488	567	508	470	424	(207)	(270)	(343)	(429)	(528)
BOOK	(976)	(1,134)	(1,015)	(939)	(848)	414	539	683	858	1,057
TAX										
DEPRECIATION	825	1,210	1,155	1,155	1,155	0	0	0	0	0
INVESTMENT	(5,500)	0	0	0	0	0	0	0	0	0
TAX CREDIT (ITC,ETC)	1,375	0	0	0	0	0	0	0	0	0
CASH FLOW	(3,788)	643	647	685	731	207	270	343	429	528
R.O.I (D.C.F) =	4.0%									

PART I STUDY - \$1,250K O&M - BINARY

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,337	3,653	4,055	4,501	4,996	5,546	6,156	6,833	7,584	8,419
CAPACITY PAYMENTS	67	267	267	267	267	267	267	267	267	267
BRINE COSTS	(379)	(994)	(1,058)	(1,127)	(1,200)	(1,278)	(1,361)	(1,450)	(1,544)	(1,644)
O & M COSTS	(550)	(1,210)	(1,331)	(1,464)	(1,611)	(1,772)	(1,949)	(2,144)	(2,358)	(2,594)
DEPRECIATION	(825)	(1,210)	(1,155)	(1,155)	(1,155)	0	0)	0	0	0
BOOK	(350)	507	778	1,022	1,298	2,763	3,113	3,507	3,950	4,448
TAXABLE	(350)	507	778	1,022	1,298	2,763	3,113	3,507	3,950	4,448
TAX (-PAY, + CREDIT)	175	(253)	(389)	(511)	(649)	(1,382)	(1,557)	(1,753)	(1,975)	(2,224)
BOOK	(350)	507	778	1,022	1,298	2,763	3,113	3,507	3,950	4,448
TAX										
DEPRECIATION	825	1,210	1,155	1,155	1,155	0	0	0	0	0
INVESTMENT	(5,500)	0	0	0	0	0	0	0	0	0
TAX CREDIT (ITC,ETC)	1,375	0	0	0	0	0	0	0	0	0
CASH FLOW	(3,475)	1,463	1,544	1,666	1,804	1,382	1,557	1,753	1,975	2,224
R.O.I (D.C.F) =	44.0%									

PART I STUDY - 21.6338c/1000 lb. BRINE - GRAVITY HEAD

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,337	3,653	4,055	4,501	4,996	5,546	6,156	6,833	7,584	8,419
CAPACITY PAYMENTS	67	267	267	267	267	267	267	267	267	267
BRINE COSTS	(606)	(1,590)	(1,693)	(1,803)	(1,920)	(2,045)	(2,178)	(2,320)	(2,470)	(2,631)
O & M COSTS	(550)	(1,210)	(1,331)	(1,464)	(1,611)	(1,772)	(1,949)	(2,144)	(2,358)	(2,594)
DEPRECIATION	(825)	(1,210)	(1,155)	(1,155)	(1,155)	0	0	0	0	0
BOOK	(578)	(89)	143	346	578	1,996	2,296	2,637	3,023	3,461
TAXABLE	(578)	(89)	143	346	578	1,996	2,296	2,637	3,023	3,461
TAX (-PAY, + CREDIT)	289	45	(72)	(173)	(289)	(998)	(1,148)	(1,318)	(1,512)	(1,731)
BOOK	(578)	(89)	143	346	578	1,996	2,296	2,637	3,023	3,461
TAX										
DEPRECIATION	825	1,210	1,155	1,155	(1,155)	0	0	0	0	0
INVESTMENT	(5,500)	0	0	0	0	0	0	0	0	0
TAX CREDIT (ITC,ETC)	1,375	0	0	0	0	0	0	0	0	0
CASH FLOW	(3,589)	1,165	1,227	1,328	1,444	998	1,148	1,318	1,512	1,731
R.O.I (D.C.F) =	32.0%									

PART I STUDY - 34.6141c/1000 lb. - brine - Gravity Head

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,337	3,653	4,055	4,501	4,996	5,546	6,156	6,833	7,584	8,419
CAPACITY PAYMENTS	67	267	267	267	267	267	267	267	267	267
BRINE COSTS	(682)	(1,788)	(1,905)	(2,029)	(2,160)	(2,301)	(2,450)	(2,610)	(2,779)	(2,960)
O & M COSTS	(550)	(1,210)	(1,331)	(1,464)	(1,611)	(1,772)	(1,949)	(2,144)	(2,358)	(2,594)
DEPRECIATION	(825)	(1,210)	(1,155)	(1,155)	(1,155)	0	0	0	0	0
BOOK	(653)	(288)	(68)	121	338	1,741	2,024	2,347	2,715	3,132
TAXABLE	(653)	(288)	(68)	121	338	1,741	2,024	2,347	2,715	3,132
TAX (-PAY, + CREDIT)	327	144	34	(60)	(169)	(870)	(1,012)	(1,173)	(1,357)	(1,566)
BOOK	(653)	(288)	(68)	121	338	1,741	2,024	2,347	2,715	3,132
TAX										
DEPRECIATION	825	1,210	0	1,155	1,155	0	0	0	0	0
INVESTMENT	(5,500)	0	0	0	0	0	0	0	0	0
TAX CREDIT (ITC,ETC)	1,375	0	0	0	0	0	0	0	0	0
CASH FLOW	(3,627)	1,066	1,121	1,215	1,324	870	1,012	1,173	1,357	1,566
R.O.I (D.C.F) =	28.0%									

PART I STUDY - 38.9408c/1000 lb. brine - Gravity Head

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,016	2,776	3,082	3,421	3,797	4,215	4,678	5,193	5,764	6,398
CAPACITY PAYMENTS	51	203	203	203	203	203	203	203	203	203
BRINE COSTS	(379)	(994)	(1,058)	(1,127)	(1,200)	(1,278)	(1,362)	(1,450)	(1,544)	(1,645)
O & M COSTS	(550)	(1,210)	(1,331)	(1,464)	(1,611)	(1,772)	(1,949)	(2,144)	(2,358)	(2,594)
DEPRECIATION	(825)	(1,210)	(1,155)	(1,155)	(1,155)	0	0	0	0	0
BOOK	(687)	(434)	(259)	(122)	34	1,368	1,571	1,803	2,065	2,363
TAXABLE	(687)	(434)	130	(122)	34	1,368	1,571	1,803	2,065	2,363
TAX (-PAY, + CREDIT)	344	217	130	61	(17)	(684)	(786)	901	(1,033)	(1,182)
BOOK	(687)	(434)	(259)	(122)	34	1,368	1,571	1,806	2,065	2,363
TAX										
DEPRECIATION	825	1,210	1,155	1,155	1,155	0	0	0	0	0
INVESTMENT	(5,500)	0	0	0	0	0	0	0	0	0
TAX CREDIT (ITC,ETC)	1,375	0	0	0	0	0	0	0	0	0
CASH FLOW	(3,644)	993		1,094	1,172	684	786	901	1,033	1,182
R.O.I (D.C.F) =	23%									

PART I STUDY - 21.6338c/1000 lb. BRINE - BINARY

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,016	2,776	3,082	3,421	3,797	4,215	4,678	5,193	5,764	5,698
CAPACITY PAYMENTS	51	203	203	203	203	203	203	203	203	203
BRINE COSTS	(607)	(1,590)	(1,693)	(1,803)	(1,921)	(2,045)	(2,178)	(2,320)	(2,471)	(2,631)
O & M COSTS	(550)	(1,210)	(1,331)	(1,464)	(1,611)	(1,772)	(1,949)	(2,144)	(2,358)	(2,594)
DEPRECIATION	(825)	(1,210)	(1,155)	(1,155)	(1,155)	0	0	0	0	0
BOOK	(915)	(1,030)	(894)	(799)	(686)	601	754	933	1,139	1,376
TAXABLE	(915)	(1,030)	(894)	(799)	(686)	601	754	933	1,139	1,376
TAX (-PAY, + CREDIT)	457	515	447	399	343	(300)	(377)	(466)	(569)	(688)
BOOK	(915)	(1,030)	(894)	(799)	(686)	601	754	933	1,139	1,376
TAX										
DEPRECIATION	825	1,210	1,155	1,155	1,155	0	0	0	0	0
INVESTMENT	(5,500)	0	0	0	0	0	0	0	0	0
TAX CREDIT (ITC,ETC)	1,375	0	0	0	0	0	0	0	0	0
CASH FLOW	3,757	695	708	756	812	300	377	466	569	688
R.O.I (D.C.F) =	8.4%									

PART I STUDY - 34.6141c/1000 lb. BRINE - BINARY

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,016	2,776	3,082	3,421	3,797	4,215	4,678	5,193	5,764	6,398
CAPACITY PAYMENTS	51	203	203	203	203	203	203	203	203	203
BRINE COSTS	(682)	(1,789)	(1,905)	(2,029)	(2,161)	(2,301)	(2,451)	(2,610)	(2,780)	(2,960)
O & M COSTS	(550)	(1,210)	(1,331)	(1,464)	(1,611)	(1,772)	(1,949)	(2,144)	(2,358)	(2,594)
DEPRECIATION	(825)	(1,210)	(1,155)	(1,155)	(1,155)	0	0	0	0	0
BOOK	(990)	(1,229)	(1,106)	(1,024)	(926)	345	482	643	830	1,047
TAXABLE	(990)	(1,229)	(1,106)	(1,024)	(926)	345	482	643	830	1,047
TAX (-PAY, + CREDIT)	495	615	553	512	463	(173)	(241)	(321)	(415)	(524)
BOOK	(990)	(1,229)	(1,106)	(1,025)	(926)	345	482	643	830	1,047
TAX										
DEPRECIATION	825	1,210	1,155	1,155	1,155	0	0	0	0	0
INVESTMENT	(5,500)	0	0	0	0	0	0	0	0	0
TAX CREDIT (ITC,ETC)	1,375	0	0	0	0	0	0	0	0	0
CASH FLOW	(3,795)	595	602	643	692	173	241	321	415	524
R.O.I (D.C.F) =	2.3%									

PART I STUDY - 38.9408c/1000 lb BRINE - BINARY

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,851	14,498	20,275	22,505	24,980	27,728	30,778	34,164	37,922	42,093
CAPACITY PAYMENTS	67	1,100	1,599	1,599	1,599	1,599	1,599	1,599	1,599	1,599
BRINE COSTS	(210)	(1,577)	(2,116)	(2,254)	(2,400)	(2,556)	(2,723)	(2,900)	(3,088)	(3,289)
O & M COSTS	(619)	(2,193)	(2,662)	(2,928)	(3,221)	(3,543)	(3,897)	(4,287)	(4,716)	(5,187)
DEPRECIATION	(4,049)	(8,841)	(9,925)	(9,731)	(9,731)	(4,063)	0	0	0	0
BOOK	(2,960)	2,987	7,170	9,190	11,226	19,165	25,757	28,576	31,717	35,216
TAXABLE	(2,960)	2,987	7,170	9,190	11,226	19,165	25,757	28,576	31,717	35,216
TAX (-PAY, + CREDIT)	1,480	(1,493)	(3,585)	(4,595)	(5,613)	(9,582)	(12,879)	(14,288)	(15,858)	(17,608)
BOOK	(2,960)	2,987	7,170	9,190	11,226	19,165	25,757	28,576	31,717	35,216
TAX										
DEPRECIATION	4,049	8,841	9,925	9,731	9,731	4,063	0	0	0	0
INVESTMENT	(31,493)	(14,847)	0	0	0	0	0	0	0	0
TAX CREDIT (ITC, ETC)	7,873	3,712	0	0	0	0	0	0	0	0
CASH FLOW	(21,050)	(801)	13,510	14,326	15,345	13,645	12,879	14,288	15,858	17,608
R.O.I (D.C.F) =	43.23%									

PART II STUDY - FIVE-UNIT GRAVITY HEAD WITH 8.6535c/1000 lb. BRINE COST - WELL COST INCLUDED

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,851	14,498	20,275	22,505	24,980	27,728	30,778	34,164	37,922	42,093
CAPACITY PAYMENTS	67	1,100	1,599	1,599	1,599	1,599	1,599	1,599	1,599	1,599
BRINE COSTS	(420)	(3,155)	(4,233)	(4,508)	(4,801)	(5,113)	(5,445)	(5,799)	(6,176)	(6,577)
O & M COSTS	(619)	(2,193)	(2,662)	(2,928)	(3,221)	(3,543)	(3,897)	(4,287)	(4,716)	(5,187)
DEPRECIATION	(4,049)	(8,841)	(9,925)	(9,731)	(9,731)	(4,063)	0	0	0	0
BOOK	(3,170)	1,409	5,054	6,936	8,826	16,609	23,035	25,676	28,629	31,927
TAXABLE	(3,170)	1,409	5,054	6,936	8,826	16,609	23,035	25,676	28,629	31,927
TAX (-PAY, + CREDIT)	1,585	(705)	(2,527)	(3,468)	(4,413)	(8,304)	(11,517)	(12,838)	(14,314)	(15,964)
BOOK	(3,170)	1,409	5,054	6,936	8,826	16,609	23,035	25,676	28,629	31,927
TAX										
DEPRECIATION	4,049	8,841	9,925	9,731	9,731	4,063	0	0	0	0
INVESTMENT	(31,493)	(14,847)	0	0	0	0	0	0	0	0
TAX CREDIT (ITC,ETC)	7,873	3,712	0	0	0	0	0	0	0	0
CASH FLOW	(21,115)	(1,590)	12,452	13,200	14,144	12,367	11,517	12,838	14,314	15,964
R.O.I (D.C.F) =	38.95%									

PART II STUDY - FIVE-UNIT GRAVITY HEAD WITH 17.247c/1000 lb BRINE COST - WELL COST INCLUDED

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,407	11,019	15,409	17,104	18,985	21,073	23,391	25,965	28,821	31,991
CAPACITY PAYMENTS	51	836	1,215	1,215	1,215	1,215	1,215	1,215	1,215	1,215
BRINE COSTS	(210)	(1,578)	(2,117)	(2,254)	(2,401)	(2,557)	(2,723)	(2,900)	(3,089)	(3,289)
O & M COSTS	(619)	(2,193)	(2,662)	(2,928)	(3,221)	(3,543)	(3,897)	(4,287)	(4,716)	(5,187)
DEPRECIATION	(4,107)	(8,966)	(10,066)	(9,869)	(9,869)	(4,120)	0	0	0	0
BOOK	(3,477)	(882)	1,780	3,267	4,709	12,068	17,986	19,993	22,231	24,729
TAXABLE	(3,477)	(882)	1,780	3,267	4,709	12,068	17,986	19,993	22,231	24,729
TAX (-PAY, + CREDIT)	1,736	441	(890)	(1,634)	(3,255)	(6,034)	(8,993)	(9,996)	(11,116)	(12,365)
BOOK	(3,477)	(882)	1,780	3,267	4,709	12,068	17,986	19,993	22,231	24,729
TAX										
DEPRECIATION	4,107	8,966	10,066	9,869	9,869	4,120	0	0	0	0
INVESTMENT	(31,940)	(15,057)	0	0	0	0	0	0	0	0
TAX CREDIT (ITC,ETC)	7,985	3,764	0	0	0	0	0	0	0	0
CASH FLOW	(21,587)	(2,768)	10,955	11,503	12,224	10,154	8,993	9,996	11,116	12,365
R.O.I (D.C.F) =	31.34%									

PART II STUDY - FIVE-UNIT BINARY WITH 8.6535c/1000 lb BRINE COST - WELL COST INCLUDED.

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,407	11,019	15,409	17,104	18,985	21,073	23,391	25,965	28,821	31,991
CAPACITY PAYMENTS	51	836	1,215	1,215	1,215	1,215	1,215	1,215	1,215	1,215
BRINE COSTS	(420)	(3,155)	(4,233)	(4,508)	(4,802)	(5,114)	(5,446)	(5,800)	(6,177)	(6,579)
O & COSTS	(619)	(2,193)	(2,662)	(2,928)	(3,221)	(3,543)	(3,897)	(4,287)	(4,716)	(5,187)
DEPRECIATION	(4,107)	(8,966)	(10,066)	(9,869)	(9,869)	(4,120)	0	0	0	0
BOOK	(3,687)	(2,460)	(337)	1,013	2,308	9,512	15,263	17,093	19,143	21,440
TAXABLE	(3,687)	(2,460)	(337)	1,013	2,308	9,512	15,263	17,093	19,143	21,440
TAX (-PAY, + CREDIT)	1,844	1,230	169	(506)	(1,154)	(4,756)	(7,632)	(8,546)	(9,571)	(10,720)
BOOK	(3,687)	(2,460)	(337)	1,013	2,308	9,512	15,263	17,093	19,143	21,440
TAX										
DEPRECIATION	4,107	8,966	10,066	9,869	9,869	4,120	0	0	0	0
INVESTMENT	(31,940)	(15,057)	0	0	0	0	0	0	0	0
TAX CREDIT (ITC,ETC)	7,985	3,764	0	0	0	0	0	0	0	0
CASH FLOW	(21,692)	(3,557)	9,897	10,376	11,023	8,876	7,632	8,546	9,571	10,720
R.O.I (D.C.F) =	26.65%									

PART II STUDY - FIVE-UNIT BINARY WITH 17.247c/1000 lb BRINE COST - WELL COST INCLUDED

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,337	3,653	4,055	4,501	4,996	5,546	6,156	6,833	7,584	8,419
CAPACITY PAYMENTS	67	267	267	267	267	267	267	267	267	267
BRINE COSTS	(531)	(1,391)	(1,481)	(1,578)	(1,680)	(1,789)	(1,906)	(2,030)	(2,162)	(2,302)
O & M COSTS	(550)	(1,210)	(1,331)	(1,464)	(1,611)	(1,772)	(1,949)	(2,144)	(2,358)	(2,594)
DEPRECIATION	(1,030)	(1,511)	(1,442)	(1,442)	(1,442)	0	0	0	0	0
BOOK	(707)	(191)	68	285	531	2,252	2,569	2,927	3,332	3,790
TAXABLE	(707)	(191)	68	285	531	2,252	2,569	2,927	3,332	3,790
TAX (-PAY, + CREDIT)	353	96	(34)	(142)	(265)	(1,126)	(1,284)	(1,463)	(1,666)	(1,895)
BOOK	(707)	(191)	68	285	531	2,252	2,569	2,927	3,332	3,790
TAX										
DEPRECIATION	1,030	1,511	1,442	1,442	1,442	0	0	0	0	0
INVESTMENT	(6,866)	0	0	0	0	0	0	0	0	0
TAX CREDIT (ITC,ETC)	1,717	0	0	0	0	0	0	0	0	0
CASH FLOW	(4,473)	1,415	1,476	1,584	1,707	1,126	1,284	1,463	1,666	1,895
R.O.I (D.C.F) =	30.0%									

PART II STUDY - SINGLE-UNIT GRAVITY HEAD WITH 30.2873c/1000 lb BRINE COST - WELL COST EXCLUDED

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,337	3,653	4,055	4,501	4,996	5,546	6,156	6,833	7,584	8,419
CAPACITY PAYMENTS	67	267	267	267	267	267	267	267	267	267
BRINE COSTS	(682)	(1,788)	(1,905)	(2,029)	(2,160)	(2,301)	(2,450)	(2,610)	(2,779)	(2,960)
O & M COSTS	(550)	(1,210)	(1,331)	(1,464)	(1,611)	(1,772)	(1,949)	(2,144)	(2,358)	(2,594)
DEPRECIATION	(1,030)	(1,511)	(1,442)	(1,442)	(1,442)	0	0	0	0	0
BOOK	(858)	(589)	(355)	(166)	51	1,741	2,024	2,347	2,715	3,132
TAXABLE	(858)	(589)	(355)	(166)	51	1,741	2,024	2,347	2,715	3,132
TAX (-PAY, + CREDIT)	429	294	178	83	(25)	(870)	(1,012)	(1,173)	(1,357)	(1,566)
BOOK	(858)	(589)	(355)	(166)	51	1,741	2,024	2,347	2,715	3,132
TAX										
DEPRECIATION	1,030	1,511	1,442	1,442	1,442	0	0	0	0	0
INVESTMENT	(6,866)	0	0	0	0	0	0	0	0	0
TAX CREDIT (ITC,ETC)	1,717	0	0	0	0	0	0	0	0	0
CASH FLOW	(4,549)	1,216	1,264	1,359	1,467	870	1,012	1,173	1,357	1,566
R.O.I (D.C.F) =	23.15%									

PART II STUDY - SINGLE UNIT GRAVITY HEAD WITH 38.9408c/1000 lb BRINE COST - WELL COST EXCLUDED

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,016	2,776	3,082	3,421	3,797	4,215	4,678	5,193	5,764	6,398
CAPACITY PAYMENTS	51	203	203	203	203	203	203	203	203	203
BRINE COSTS	(531)	(1,391)	(1,482)	(1,578)	(1,681)	(1,790)	(1,906)	(2,030)	(2,162)	(2,302)
O & M COSTS	(550)	(1,210)	(1,331)	(1,464)	(1,611)	(1,772)	(1,949)	(2,144)	(2,358)	(2,594)
DEPRECIATION	(1,047)	(1,536)	(1,466)	(1,466)	(1,466)	0	0	0	0	0
BOOK	(1,061)	(1,158)	(994)	(885)	(757)	857	1,027	1,223	1,447	1,705
TAXABLE	(1,061)	(1,158)	(994)	(885)	(757)	857	1,027	1,223	1,447	1,705
TAX (-PAY, + CREDIT)	531	579	497	442	379	(428)	(513)	(611)	(724)	(853)
BOOK	(1,061)	(1,158)	(994)	(885)	(757)	857	1,027	1,223	1,447	1,705
TAX										
DEPRECIATION	1,047	1,536	1,466	1,466	1,466	0	0	0	0	0
INVESTMENT	(6,983)	0	0	0	0	0	0	0	0	0
TAX CREDIT (ITC, ETC)	1,746	0	0	0	0	0	0	0	0	0
CASH FLOW	(4,720)	957	969	1,024	1,088	428	513	611	724	853
R.O.I (D.C.F) =	10.2%									

PART II STUDY - SINGLE UNIT BINARY WITH 30.2873c/1000 lb. BRINE COST-WELL COST EXCLUDED.

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,016	2,776	3,082	3,421	3,797	4,215	4,678	5,193	5,764	6,398
CAPACITY PAYMENTS	51	203	203	203	203	203	203	203	203	203
BRINE COSTS	(682)	(1,789)	(1,905)	(2,029)	(2,161)	(2,301)	(2,451)	(2,610)	(2,780)	(2,960)
O & M COSTS	(550)	(1,210)	(1,331)	(1,464)	(1,611)	(1,772)	(1,949)	(2,144)	(2,358)	(2,594)
DEPRECIATION	(1,047)	(1,536)	(1,466)	(1,466)	(1,466)	0	0	0	0	0
BOOK	(1,213)	(1,555)	(1,417)	(1,335)	(1,237)	345	482	643	830	1,047
TAXABLE	(1,213)	(1,555)	(1,417)	(1,355)	(1,237)	345	482	643	830	1,047
TAX (-PAY, + CREDIT)	606	778	709	668	619	(173)	(241)	(321)	(415)	(524)
BOOK	(1,213)	(1,555)	(1,417)	(1,335)	(1,237)	345	482	643	830	1,047
TAX										
DEPRECIATION	1,047	1,536	1,466	1,466	1,466	0	0	0	0	0
INVESTMENT	(6,983)	0	0	0	0	0	0	0	0	0
TAX CREDIT (ITC,ETC)	1,746	0	0	0	0	0	0	0	0	0
CASH FLOW	(4,796)	759	758	799	848	173	241	321	415	524
R.O.I (D.C.F) =	0.2%									

PART II STUDY - SINGLE UNIT BINARY WITH 38.9408c/1000 lb BRINE COST - WELLS EXCLUDED

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,337	3,653	4,055	4,501	4,996	5,546	6,156	6,833	7,584	8,419
CAPACITY PAYMENTS	67	267	267	267	267	267	267	267	267	267
BRINE COSTS	(152)	(397)	(423)	(451)	(480)	(511)	(545)	(580)	(618)	(658)
O & M COSTS	(550)	(1,210)	(1,331)	(1,464)	(1,611)	(1,772)	(1,949)	(2,144)	(2,358)	(2,594)
DEPRECIATION	(1,350)	(1,980)	(1,890)	(1,890)	(1,890)	0	0	0	0	0
BOOK	(647)	333	678	964	1,283	3,530	3,930	4,377	4,876	5,435
TAXABLE	(647)	333	678	964	1,283	3,530	3,930	4,377	4,876	5,435
TAX (-PAY, + CREDIT)	324	(167)	(339)	(482)	(642)	(1,765)	(1,965)	(2,188)	(2,438)	(2,717)
BOOK	(647)	333	678	964	1,283	3,530	3,930	4,377	4,876	5,435
TAX										
DEPRECIATION	1,350	1,986	1,890	1,890	1,890	0	0	0	0	0
INVESTMENT	(8,998)	0	0	0	0	0	0	0	0	0
TAX CREDIT (ITC,ETC)	2,250	0	0	0	0	0	0	0	0	0
CASH FLOW	(5,723)	2,146	2,229	2,372	2,531	1,765	1,965	2,188	2,438	2,717
R.O.I (D.C.F) =	36.4%									

PART II STUDY - SINGLE UNIT GRAVITY HEAD WITH 8.6535c/1000 lb BRINE COST - WELL COST INCLUDED

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,337	3,653	4,055	4,501	4,996	5,546	6,156	6,833	7,584	8,419
CAPACITY PAYMENTS	67	267	267	267	267	267	267	267	267	267
BRINE COSTS	(379)	(994)	(1,058)	(1,127)	(1,200)	(1,278)	(1,361)	(1,450)	(1,544)	(1,644)
O & M COSTS	(550)	(1,210)	(1,331)	(1,464)	(1,611)	(1,772)	(1,848)	(2,144)	(2,358)	(2,594)
DEPRECIATION	(1,030)	(1,511)	(1,442)	(1,442)	(1,442)	0	0	0	0	
BOOK	(555)	206	491	735	1,011	2,763	3,113	3,507	3,950	4,448
TAXABLE	(555)	206	491	735	1,011	2,763	3,113	3,507	3,950	4,448
TAX (-PAY, + CREDIT)	278	(103)	(246)	(368)	(505)	(1,382)	(1,557)	(1,753)	(1,975)	(2,224)
BOOK	(555)	206	491	735	1,011	2,763	3,113	3,507	3,950	4,448
TAX										
DEPRECIATION	1,030	1,511	1,442	1,442	1,442	0	0	0	0	0
INVESTMENT	(6,866)	0	0	0	0	0	0	0	0	0
TAX CREDIT (ITC,ETC)	1,717	0	0	0	0	0	0	0	0	0
CASH FLOW	(4,397)	1,614	1,688	1,810	1,957	1,382	1,557	1,753	1,975	2,224
R.O.I (D.C.F) %	36.4%									

PART II STUDY - SINGLE-UNIT GRAVITY HEAD WITH 21.6338c/1000 lb BRINE COST - WELL COST INCLUDED

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,016	2,776	3,082	3,421	3,797	4,215	4,678	5,193	5,764	6,398
CAPACITY PAYMENTS	51	203	203	203	203	203	203	203	203	203
BRINE COSTS	(152)	(397)	(423)	(451)	(480)	(511)	(545)	(580)	(618)	(658)
O & M COSTS	(550)	(1,210)	(1,331)	(1,464)	(1,611)	(1,772)	(1,949)	(2,144)	(2,358)	(2,594)
DEPRECIATION	(1,369)	(2,008)	(1,916)	(1,916)	(1,916)	0	0	0	0	0
BOOK	(1,004)	(636)	(386)	(207)	(7)	2,135	2,388	2,673	2,992	3,350
TAXABLE	(1,004)	(636)	(386)	(207)	(7)	2,135	2,388	2,673	2,992	3,350
TAX (-PAY, + CREDIT)	502	318	193	104	3	(1,067)	(1,194)	(1,336)	(1,496)	(1,675)
BOOK	(1,004)	(636)	(386)	(207)	(7)	2,135	2,388	2,673	2,992	3,550
TAX										
DEPRECIATION	1,369	2,008	1,916	1,916	1,916	0	0	0	0	0
INVESTMENT	(9,126)	0	0	0	0	0	0	0	0	0
TAX CREDIT (ITC,ETC)	2,281	0	0	0	0	0	0	0	0	0
CASH FLOW	(5,977)	1,690	1,723	1,813	1,913	1,067	1,194	1,336	1,496	1,675
R.O.I (D.C.F) =	22.6%									

PART II STUDY - SINGLE UNIT BINARY WITH 8.6535c/1000 lb - BRINE COST - WELL COST INCLUDED

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	1,016	2,776	3,082	3,421	3,797	4,215	4,678	5,193	5,764	6,938
CAPACITY PAYMENTS	51	203	203	203	203	203	203	203	203	203
BRINE COSTS	(379)	(994)	(1,058)	(1,127)	(1,200)	(1,278)	(1,362)	(1,450)	(1,544)	(1,645)
O & M COSTS	(550)	(1,210)	(1,331)	(1,464)	(1,611)	(1,772)	(1,949)	(2,144)	(2,358)	(2,594)
DEPRECIATION	(1,047)	(1,536)	(1,466)	(1,466)	(1,466)	0	0	0	0	0
BOOK	(910)	(760)	(571)	(434)	(277)	1,368	1,571	1,803	2,065	2,363
TAXABLE	(910)	(760)	(571)	(434)	(277)	1,368	1,571	1,803	2,065	2,363
TAX (-PAY, + CREDIT)	455	380	285	217	139	(684)	(786)	(901)	(1,033)	(1,182)
BOOK	(910)	(760)	(571)	(434)	(277)	1,368	1,571	1,803	2,065	2,363
TAX										
DEPRECIATION	1,047	1,536	1,466	1,466	1,466	0	0	0	0	0
INVESTMENT	(6,938)	0	0	0	0	0	0	0	0	0
TAX CREDIT (ITC, ETC)	1,746	0	0	0	0	0	0	0	0	0
CASH FLOW	(4,644)	1,156	1,181	1,250	1,328	684	786	901	1,033	1,182
R.O.I (D.C.F) =	18.3%									

PART II STUDY - SINGLE-UNIT BINARY WITH 21.6338c/1000 lb BRINE COST - WELL COST INCLUDED

YEAR	1	2	3	4	5	6	7	8	9	10
POWER SALE	0	5,639	15,409	17,104	18,985	21,073	23,391	25,965	28,821	31,991
CAPACITY PAYMENTS	0	316	1,265	1,265	1,265	1,265	1,265	1,265	1,265	1,265
BRINE COSTS	0	(1,615)	(4,233)	(4,508)	(4,802)	(5,114)	(5,446)	(5,800)	(6,177)	(6,579)
O & M COSTS	0	(1,210)	(2,662)	(2,928)	(3,221)	(3,543)	(3,897)	(4,287)	(4,716)	(5,187)
DEPRECIATION	(964)	(7,517)	(10,301)	(9,894)	(9,894)	(8,544)	0	0	0	0
BOOK	(964)	(4,386)	(522)	1,038	2,334	5,138	15,313	17,142	19,193	21,490
TAXABLE	(964)	(4,386)	(522)	1,038	2,334	5,138	15,313	17,142	19,193	21,490
TAX (-PAY, + CREDIT)	482	2,193	261	(519)	(1,167)	(2,569)	(7,656)	(8,571)	(9,596)	(10,745)
BOOK	(964)	(4,386)	(522)	1,038	2,334	5,138	15,313	17,142	19,193	21,490
TAX										
DEPRECIATION	964	7,517	10,301	9,894	9,894	8,544	0	0	0	0
INVESTMENT	(30,776)	(16,337)	0	0	0	0	0	0	0	0
TAX CREDIT (ITC,ETC)	7,694	4,084	0	0	0	0	0	0	0	0
CASH FLOW	(22,600)	(6,929)	10,039	10,413	11,061	11,113	7,656	8,571	9,596	10,745
R.O.I (D.C.F) =	23.52%									

PART II STUDY - 19 mw BINARY GATHERING PLANT WITH 17.247c/1000 lb BRINE COST - WELLS INCLUDED