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QUARTERLY REPORT #1

December 1980 - February 1981

In Support Of

Heber Ethanol Fuel Facility

Imperial Valley, California

Submitted to:

DEPARTMENT OF ENERGY

in accordance with

~~PRDA #DE-RA03-80RA50121~~

FG03-80SF11429

Submitted by:

VTN Corporation

April 1981

DISCLAIMER

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INTRODUCTION

This Quarterly Report describes the activities for the first three months (December 1980 through February 1981) of the VTN Corporation commercial scale ethanol project in the Imperial Valley, California. The report describes the activities undertaken by VTN in fulfillment of the requirements of PRDA #DE-RA03-80RA50121. These activities are described by tasks outlined in the proposal of June 5, 1980 and shown on the project schedule. As the project progresses, various additional tasks will be begun, in accordance with the GNATT and Milestone Chart presented in the proposal.

The tasks and issues addressed in this report are:

- Task 1--Geothermal Resource Evaluation
- Task 2--Process Engineering
  - Definition of preliminary process parameters
  - Preliminary process design
  - Preliminary site design
- Task 4--Marketing
  - Preliminary market description
- Task 6--Environmental
- Task 7--Permit Processing and Legal Issues
  - Preliminary identification of permits

TASK 1.0--RESOURCE EVALUATION

The Resource Evaluation task is being conducted by Chevron Resources, San Francisco. Chevron has not completed this task, so the data are not yet available. Chevron is currently conducting an analysis of the reservoir and is scheduled for completion on or about May 1, 1981. Until such time as specific data are available, preliminary estimates and related information are being utilized as a basis for preliminary design considerations.

1.1 Resource Delivery System

The geothermal fluid for the project will be flowed from a shallow zone of the reservoir, at slightly less than one million pounds per hour and a temperature of about 330°F. The chemical composition of the fluid to be utilized for the ethanol plant is not yet available. However, data are available from a higher temperature, deeper zone of the same reservoir. These are presented in Table 1. It should be noted that the silica content of the fluid from the shallow zone to be utilized for the proposed project would be about 250 ppm, about 50 ppm less than indicated on the table. The table indicates substantial calcium and bicarbonate concentrations which, if similar to the shallower resource, would create deposition of calcium carbonate on flashing of the geothermal fluid. Information is not yet available on the vapor-to-liquid ratio of the geothermal fluid at production flow rates.

The various options for utilizing a geothermal fluid as a heat source are:

1) Maintaining pressure on the fluid and transferring the heat in a liquid heat exchanger;

2) Dropping the pressure to produce flash steam and transferring the heat by condensing the steam, or

3) A combination of 1 and 2.

TABLE 1

ESTIMATED COMPOSITION OF GEOTHERMAL FLUID[a]

Component	Concentration (mg/l)
Sodium	4,312
Potassium	228
Lithium	4
Calcium	844
Iron	68[b]
Manganese	3.1
Lead	0.6
Magnesium	5.9
Strontium	38
Aluminum	1.0[b]
Chloride	7,363
Boron	4.0
Sulfate	80
Silica	294
Total Solids	14,195
pH	6.45
Bicarbonate	64
Noncondensibles:	48.37
CO_2 60.4 mole %	
N_2 29.0 mole %	
CH_4 8.4 mole %	
Other 2.2 mole %	

a) Data from 1974
b) Questionable data

Source: Chevron 1977.

Flashing the geothermal fluid is thermodynamically inefficient. Greater thermodynamic efficiency is obtained by minimizing temperature differences during heat transfer. Such minimum temperature differential is achieved with the use of countercurrent heat exchangers.

Furthermore, flashing releases CO_2 from solution, causing deposition of calcium carbonate. Such deposition is prevented if pressure is maintained and the CO_2 remains in solution. Also, the solubility of calcium carbonate increases as temperature decreases, so extraction of the heat from the geothermal fluid would reduce the opportunity for calcium carbonate deposition.

Consequently, the preferred method for utilizing the resource is as a pressurized geothermal fluid.

1.1.1 Process Heat Requirements

The design and optimization studies assumed a 20 million gallon/year alcohol plant utilizing a corn feedstock, operating at a rate of 8,000 hours/year, and producing 16,475 pounds/hour of ethanol. The significant thermal energy requirements are presented in Table 2. It is assumed that heat for the mash and beer and other thermal needs will be provided by recovered heat, so these secondary requirements are not listed.

1.2 Design and Cost of Delivery System

Information not yet available.

TABLE 2

MAJOR THERMAL ENERGY REQUIREMENTS

Operation	Million Btu/Hr
Cooking	5
Distillation	45
Dehydration	35
Multiple Effect Evaporators (3 effects)	55
Rotary Dryers	30
Total	170

1.3 Economic Value of the Geothermal Resource

1.3.1 Electric Power Equivalent

A geothermal resource of 330°F, such as will be utilized for the proposed project, could be used for a variety of purposes, including direct heating, producing steam to generate electricity, and providing heat for making alcohol. The value of the geothermal resource is being utilized in the ethanol process, the 330°F geothermal fluid will be returned for reinjection at a temperature of 161°F; the process will have consumed 45,618 thermal kw-hr. Based on a value of $151.34 for the 921,000 lb/hr geothermal fluid, the value of the thermal energy would be 3.3 mils/thermal kw-hr.

The 20 million gallon per year alcohol plant produces 16, 476 lbs/hr of alcohol and uses 921,000 lbs/hr of geothermal fluid. The 330°F geothermal fluid provides 129 million BTU of low temperature heat to produce this alcohol.

1.3.2 Economic Value of Fluid

The proposed 20 million gallon per year ethanol plant will require 921,000 pounds per hour of 330°F geothermal fluid. This same fluid could product 3.22 mw-hr of electricity. Assuming that electricity is valued at $47/mw-hr, the 3.22 mw-hr would be valued at $151.34. After being utilized in the ethanol process, the 330°F geothermal fluid will be returned for reinjection at a temperature of 161°F; the process will have consumed 456,618 thermal kw-hr. Based on a value of $151.34 for the 921,000 lb/hr geothermal fluid, the value of the thermal energy would be 3.3 mils/thermal kw-hr.

TASK 2.0--PROCESS ENGINEERING

Geothermal Heat Supply

Five different schemes were selected for comparison in routing the geothermal fluid through the ethanol process. These are shown on Figures 1, 2 and 3. For each of these schemes, the geothermal fluid rate was calculated relative to various first-stage temperatures of the multiple effect evaporator in order to determine optimum evaporator temperature. This calculation was a function of resource temperature. The resulting fluid rate for the optimum evaporator temperature as a function of resource temperature for each of the five processes is plotted in Appendix A. This was also done for temperature differences of 5°F and 10°F, and for differences between effects of 30°F, 35°F and 40°F (see Appendix B). In all cases, the best results were obtained from the Type 1 process. The next best, Type 4, requires 40% more geothermal fluid than does Type 1.

Also, decreasing geothermal fluid temperatures does not create a rapid deterioration of Type 1 performance until the fluid temperature drops below 300°F. This is shown in Appendices A and B.

The above calculations were repeated to determine the geothermal fluid rate for optimized plants in which up to 30% of the thin stillage is produced in liquid form to be used, for example, as a liquid feed supplement. In all cases, the Type-1 system retained the same advantages (see Appendices A, B, and C). Consequently, the Type-1 system was selected. A preliminary process schematic for this system is shown in Figure 1.

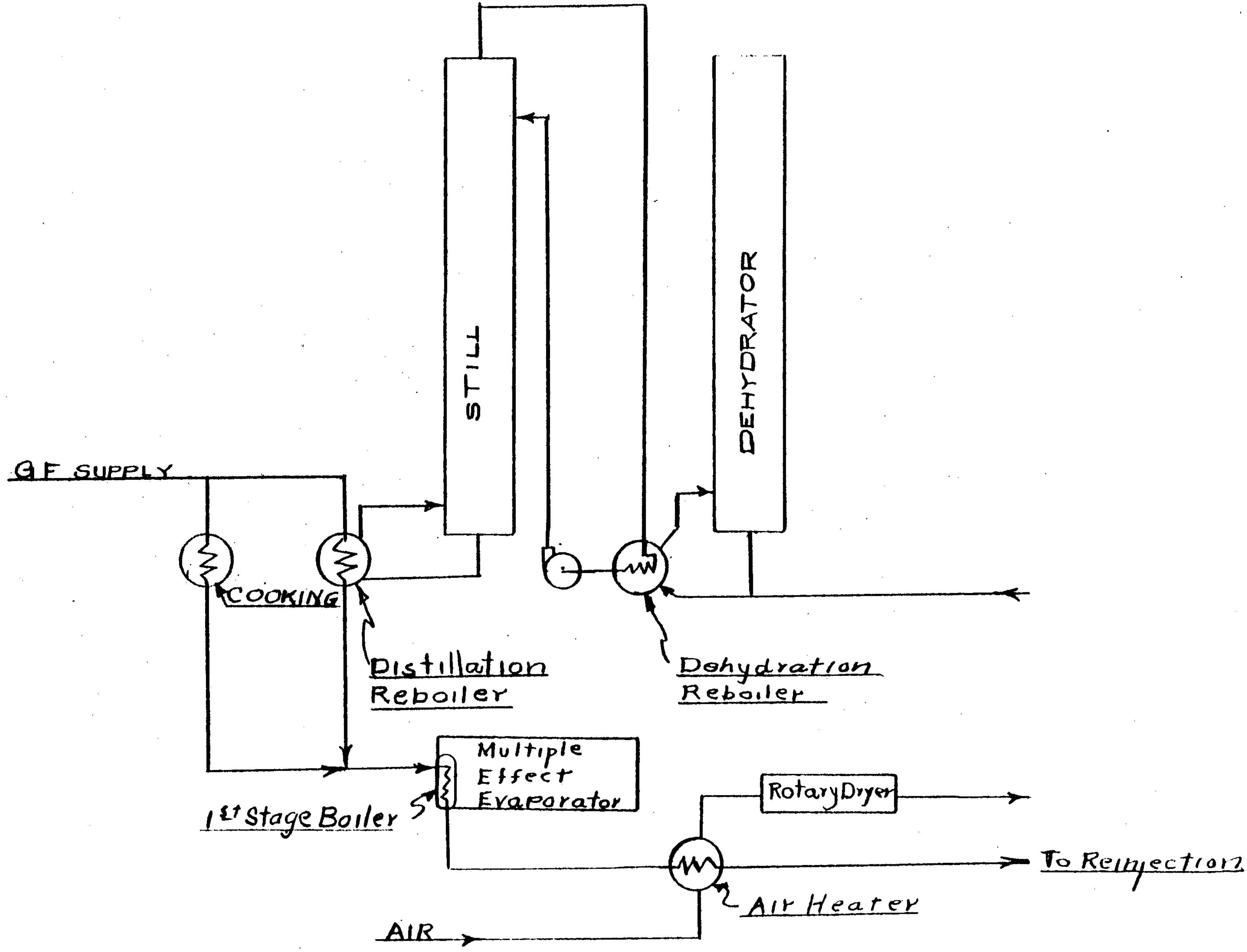

FIGURE 1 Geothermal Fluid Routing For Type 1, 2, and 3 System

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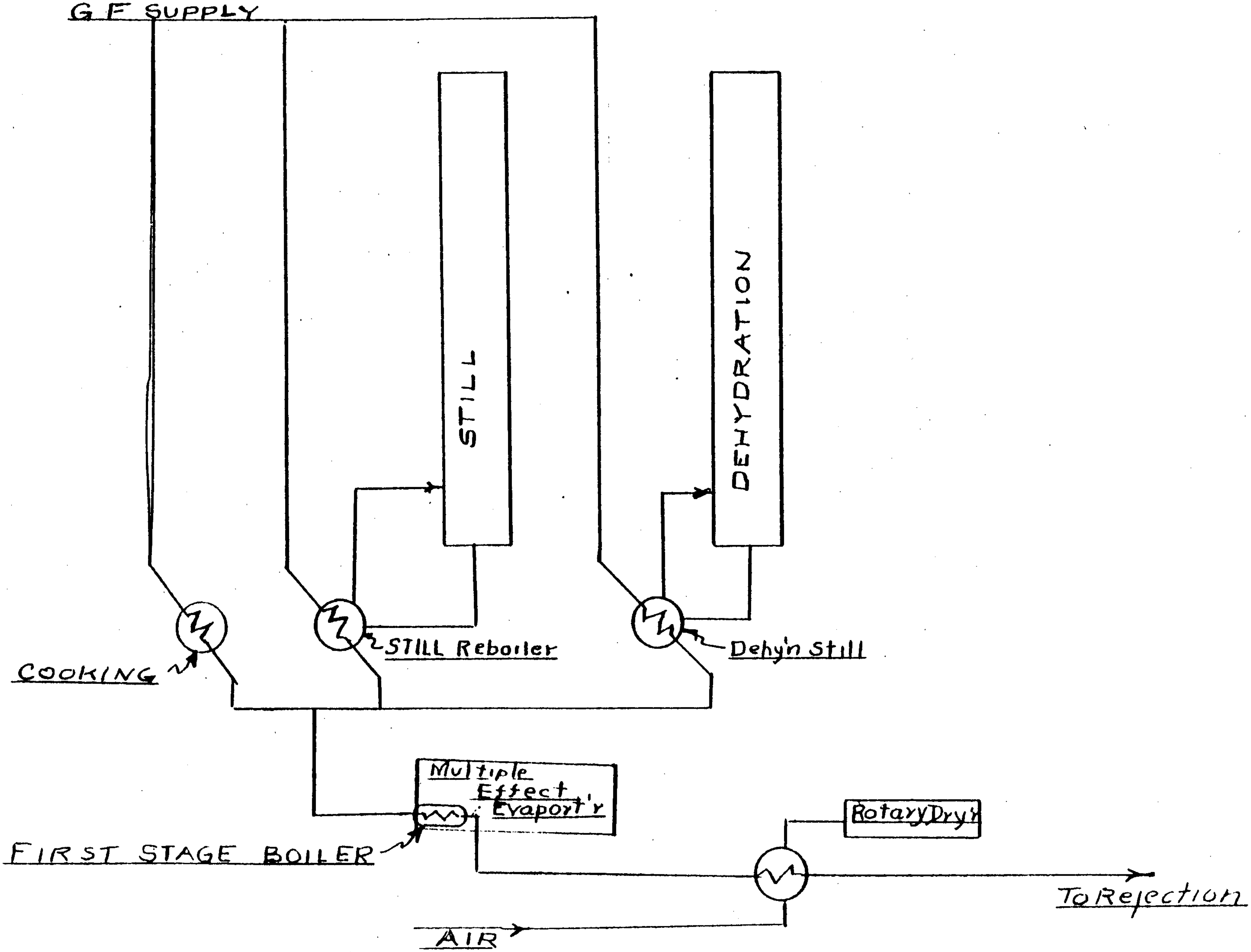

FIGURE 2 GEOTHERMAL FLUID ROUTING FOR TYPE 4 SYSTEM, ATMOSPHERIC STILL & DEHYDRATOR

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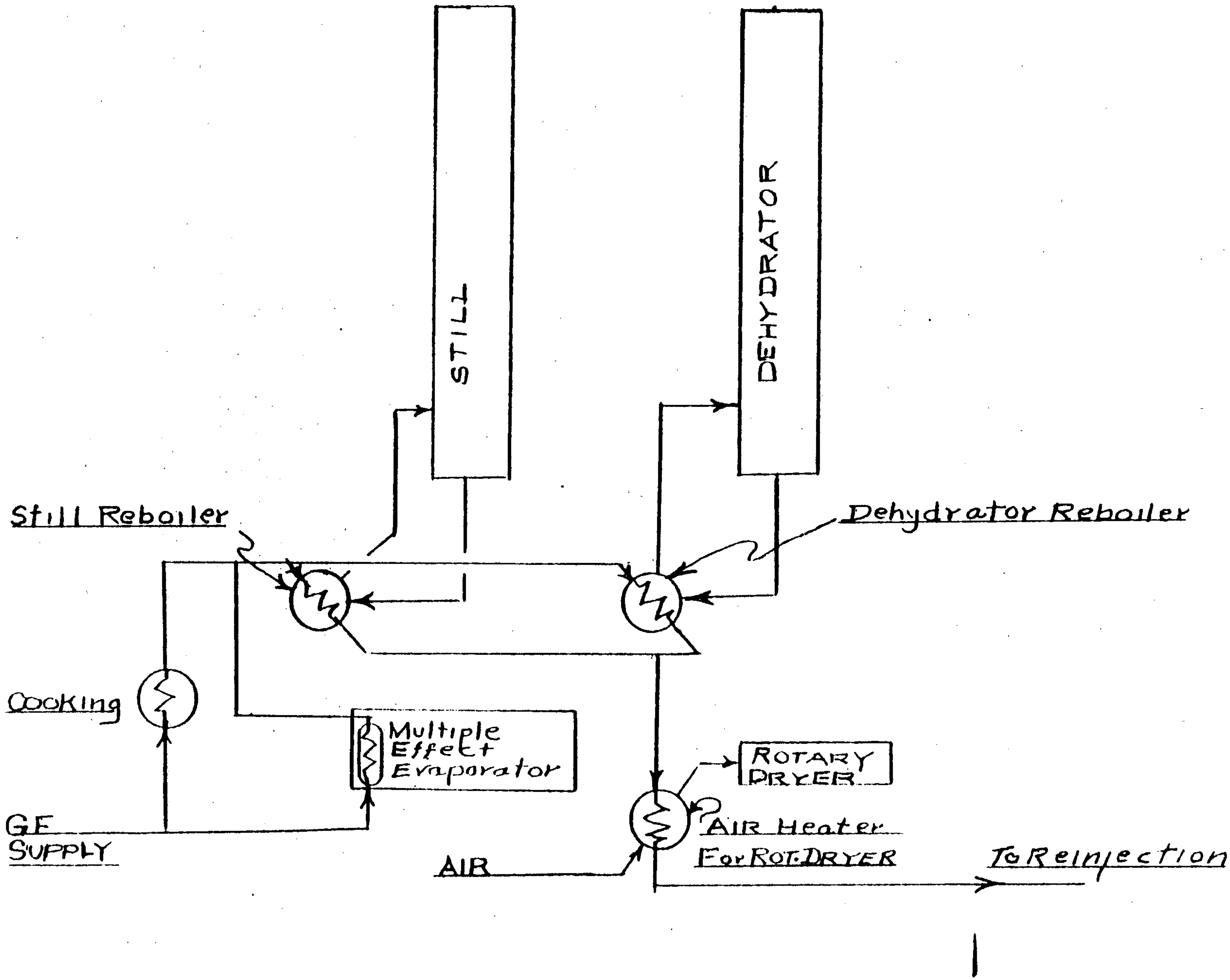

FIGURE 3 GEOTHERMAL FLUID ROUTING FOR TYPE 5 SYSTEM, ATMOSPHERIC STILL AND DEHYDRATOR

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TASK 4.0--MARKETING

The objective of the marketing program is to establish both long- and short-term marketing and sales programs for the ethanol project. Five subtasks will be addressed later, as the feasibility study progresses: 1) feedstock evaluation; 2) ethanol sales; 3) by-product sales; 4) transportation, and 5) the marketing plan.

Also, international, domestic and local problems and issues will eventually be addressed in the marketing task. However, for this initial phase of the study, a situational analysis was conducted to establish a basis for marketing strategy and for the assumptions to be used later in the preparation of the subtasks.

4.1 The U.S. Ethanol Market

The economic viability of the proposed project depends heavily on the price of crude oil (and gasoline) and the cost of feedstock. Therefore, the situational analysis focuses on crude oil pricing and feedstock cost and availability, but also considers competition, demand projections, and institutional factors. The following discussion is concerned primarily with domestic issues, and although situational analysis is recognized as a dynamic process, the following is a summary of current conditions:

1. From 1970 to 1977, U.S. crude oil imports increased from 1 to 8.7 million barrels per day. In 1980, the U.S. imported $100 billion of oil.

2. The increase in crude oil prices (over 1200% between 1973 and 1979), has been a major contributor of cost-push inflation in the United States.

3. The price of gasoline has increased substantially since 1973 and will probably continue to rise in the future. The timing and extent of such increases are not known.

4. An economic analysis of possible increases in the cost of gasoline at the pump has been prepared for the National Alcohol Fuels Commission by Wharton Econometric Forecasting Associates, Inc. (WEFA).

The Wharton study assumed that the real price of crude oil would increase from a minimum rate of 2.5% per year to a maximum of 7% per year over the next ten years. At an average annual rate of 2.5% per year, the real cost of crude oil would be $68/barrel by 1990, and the real cost of gasoline would be about $3.12 per gallon at the pump. If the price of crude oil increased at an average annual rate of 7%, then the price of crude oil would be $114/barrel, and the price of gasoline at the pump about $4.24 per gallon.

Demand, however, will vary with price. WEFA estimated that if the price of crude oil escalated at a 2.5% rate, then the demand for imported oil would increase from 5.8 million barrels per day in 1980 to 8 million barrels per day in 1990. However, if the annual rate were 7%, the demand for imported crude would be less, about 3.4 million barrels per day in 1990.

As the price of gasoline increases, the potential demand for ethanol should also increase, assuming that the real cost of ethanol increases more slowly than the real cost of gasoline. In the near-term, the use of ethanol in gasohol represents the major potential demand for the alcohol. However, the pharmaceutical and chemical industries are also users of ethanol.

Currently, the U.S. alcohol industry consists of four major producers:

1) Archer-Daniels-Midland
2) Midwest Solvents
3) Georgia Pacific
4) Milbrew

Archer-Daniel-Midland produced at least one-half of the 105 million gallons of ethanol produced in the U.S. in 1980. All of this, plus over 100 billion gallons of gasoline, was used to fuel motor vehicles. An additional 22 million gallons of ethanol were used by the pharmaceutical and chemical industries. This ethanol was produced from ethylene, a petroleum based product.

Research by the National Alcohol Commission indicates that 850 million gallons of ethanol could be available by 1983 and 1.4 to 2.1 billion gallons by 1985. While the necessary technology is currently available, the growth rate of domestic production capacity depends largely upon government and other institutional factors. Not only must the design, construction, and labor capabilities be available, but financing must also be in place. Barriers to entry into the alcohol industry will have to be lowered if actual production is to approach existing production capacity.

From a national perspective, it appears that a viable alcohol industry exists, but is only in the introductory phase. Currently, we know of no producing commercial-scale ethanol facility in the state of California. However, the California Energy Commission (CEC) is variously supporting several proposed plants. The production rates and start-up dates of these plants are as follows:

Company	Annual Capacity (10^6 gal)	Projected Start Date	Location
Raven	10	7/81	Selma, CA
Still Gas, Inc.	4.5	4/82	Holt, CA
Golden Products	2	4/82	Turlock, CA
City of Tulare	0.5	1/82	Tulare, CA
Tulare Ethanol Products	1.5	1/82	Visalia, CA
Adams Alcohol	10	?	Woodland, CA

TASK 6.0--ENVIRONMENTAL

6.1 Environmental Concerns

Work completed relative to this task has consisted primarily of becoming familiar with project processes and requirements in preparation for conducting the requisite environmental analyses. This has involved gathering data to compile the project description to be used later in determining and evaluating impacts of the proposed project on the existing environment. Most data have been obtained from process engineering and are subject to further refinement as the project progresses. They include:

- geothermal, process, and culinary water requirements
- effluents and emissions
- feedstock type, quantity, and method of delivery
- preliminary site layout
- quantity of ethanol produced
- type and quantity of by-products produced
- preliminary facility dimensions

It is known that the 50-100 acres for the facility will be located within the Heber KGRA. Specific siting, however, will depend on various engineering, legal, and environmental considerations. The environmental considerations include distance from roads, railroad, geothermal fluid supply, process water, transmission lines, and sensitive receptors. The potential for noise will be a consideration, emanating from plant operations as well as rail and vehicular transport of plant supplies and products. This would include rail delivery of the feedstock, truck delivery of other necessary supplies, plus off-site delivery of both the produced ethanol, distillers' dried grain, and waste material.

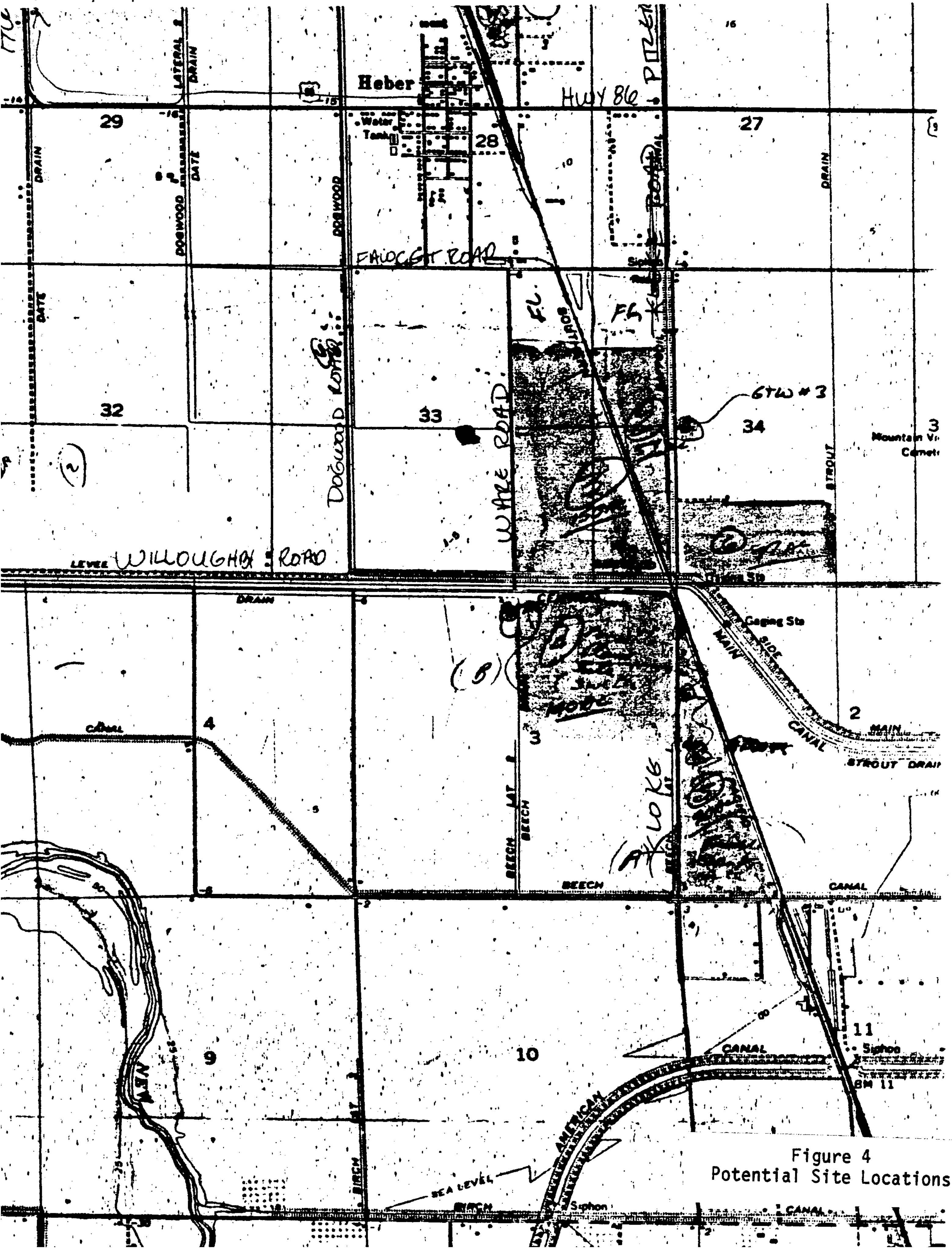

Figure 4
Potential Site Locations

Initial evaluations identified six potential sites which may be available and are in proximity to both geothermal and process water supplies and transportation routes. An approximate indication of these areas is shown on Figure 4. Four of the six potential sites are southeast of Heber, within the KGRA, and are contiguous to one another. Also, each site is adjacent to the Southern Pacific Railroad track, Pitzer Road, the Daffodil Canal, the Central Main Canal, and/or the Beech Canal.

TASK 7.0--PERMIT PROCESSING AND LEGAL ISSUES

7.1 Identify Permits

A preliminary identification of permits has been made. A complete list and schedule can be compiled once the project description is completed. Certain of the permits will be obtained by VTN relative to the ethanol plant and manufacturing process, while others will be obtained by Chevron relative to well drilling and the production, transport and injection of the geothermal fluid. VTN will obtain a Conditional Use Permit from the County of Imperial for the ethanol facility. In conjunction with this, certain County environmental procedures will be followed, relative to preparation of an Environmental Impact Report in compliance with requirements of the California Environmental Quality Act. A brief discussion of these procedures follows.

Other permits to be obtained by VTN include:

1. Authorization to Construct
   from Imperial County Air Pollution Control District

2. Permit to Operate
   from Imperial County Air Pollution Control District

3. Zone Change to M-2, Heavy Industry
   from Imperial County Board of Supervisors

4. Discharge Permit
   from Imperial County Health Department

5. Building Permit
   from Imperial County Building Department

6. NPDES Permit
   from the Regional Water Quality Control Board

In addition to the above, certain permits will be obtained by Chevron Resources. These include:

1. Notice Of Intention to Drill a Geothermal Well (for each well)
   from California Division of Oil and Gas (DOG)
2. "P" Permit (for each well)
   from California Division of Oil and Gas
3. Injection Permit
   from California Division of Oil and Gas
4. Exploration Permit
   from County of Imperial
5. Testing Permit
   from County of Imperial
6. Production Permit
   from County of Imperial

It should be noted that Imperial County is unique to California, as it is the only county in the state which has a Geothermal Element to its General Plan and can therefore be its own lead agency to implement the California Environmental Quality Act (CEQA) for exploration as well as development projects. The role of DOG is that of a responsible agency.

A brief description of the steps required to comply with Imperial County's environmental procedures, as applicable to the proposed project, follows. A more detailed discussion is contained in the County of Imperial's Rules and Regulations to Implement CEQA, California Assembly Bill 884: Streamlining the Permit Process.

1. Appropriate VTN staff meet with the Imperial County Planning Director to discuss the various aspects of the proposed project and the information which VTN will need to furnish to the County.

2. VTN completes and submits Form #201, the Application Environmental Information Form.

3. The County has 30 days to determine whether the Application is complete. If incomplete, an additional 30 days is allotted each time VTN submits additional information.

4. VTN is notified by mail of the completed application.

5. The County conducts an Initial Study, during which responsible state and local agencies are contacted to determine their concerns, to be addressed in the Initial Study.

6. The Initial Study is reviewed by the County Environmental Evaluation Committee (EEC). If it is determined that an EIR must be prepared, the County will issue a Notice of Preparation. These two tasks are completed within 45 days of the date the Application was determined to be complete.

7. The County receives Comments on the Notice for a 45-day period.

8. If required, a Draft EIR (DEIR) is prepared over a period of about six months.

9. The DEIR is circulated through the California State Clearinghouse for a 30- to 45-day period.

10. The Final EIR is then prepared and printed - 30 days.

11. The Final EIR is adopted and Imperial County approves or disapproves the project - 30 days.
    a. Public notice - 14 days
    b. Public hearing - 14 days
    c. County files Notice of Determination

12. Board of Supervisors meets on VTN's application for M-2 Zone change - 14 days.

13. Planning Commission renders decision on VTN/Chevron Conditional Use Permits - 14 days.

CONCLUSION

This report has summarized the activities and findings of the first calendar quarter of work on the VTN/O'Brien ethanol feasibility study. Activities to be conducted during the second three months of the project will result in the completion of certain additional tasks. It is anticipated that the following items will be included in the Second Quarterly Report:

1. Project description
2. Reservoir analysis data
3. Detailed process schematic diagrams
4. Capital and operating costs
5. Complete list of permits
6. Permitting schedule

APPENDIX A

(b)

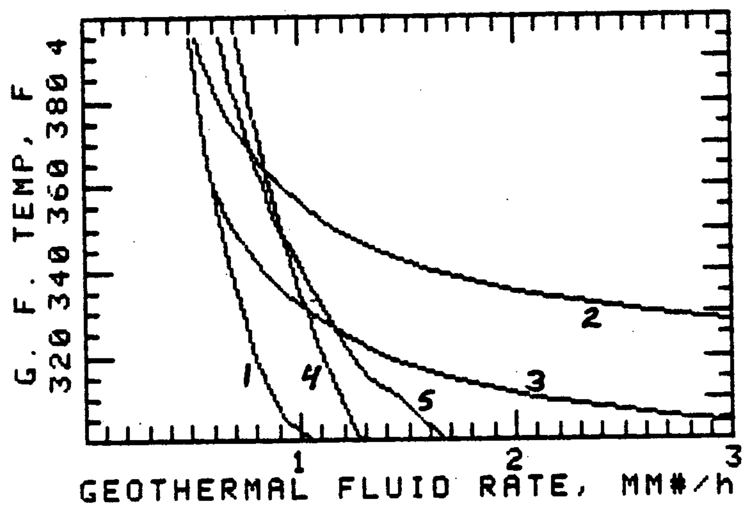

Figure 4. Geothermal fluid rate versus geothermal resource temperature (assumed all liquid) for various distillation-dehydration schemes. 1. medium-pressure still and countercurrent heat exchange; 2. high-pressure still; 3. medium-pressure still; 4. and 5. low pressure still; 1, 2, and 3 are cascaded heat flows from distillation to dehydration; 4. G.F. heats still first; 5. G.F. heats M.E. evap. first. The heat exchanger minimum ΔT is 10°F and the ΔT between effects is 30°F.

APPENDIX B

(a)

(b)

(c)

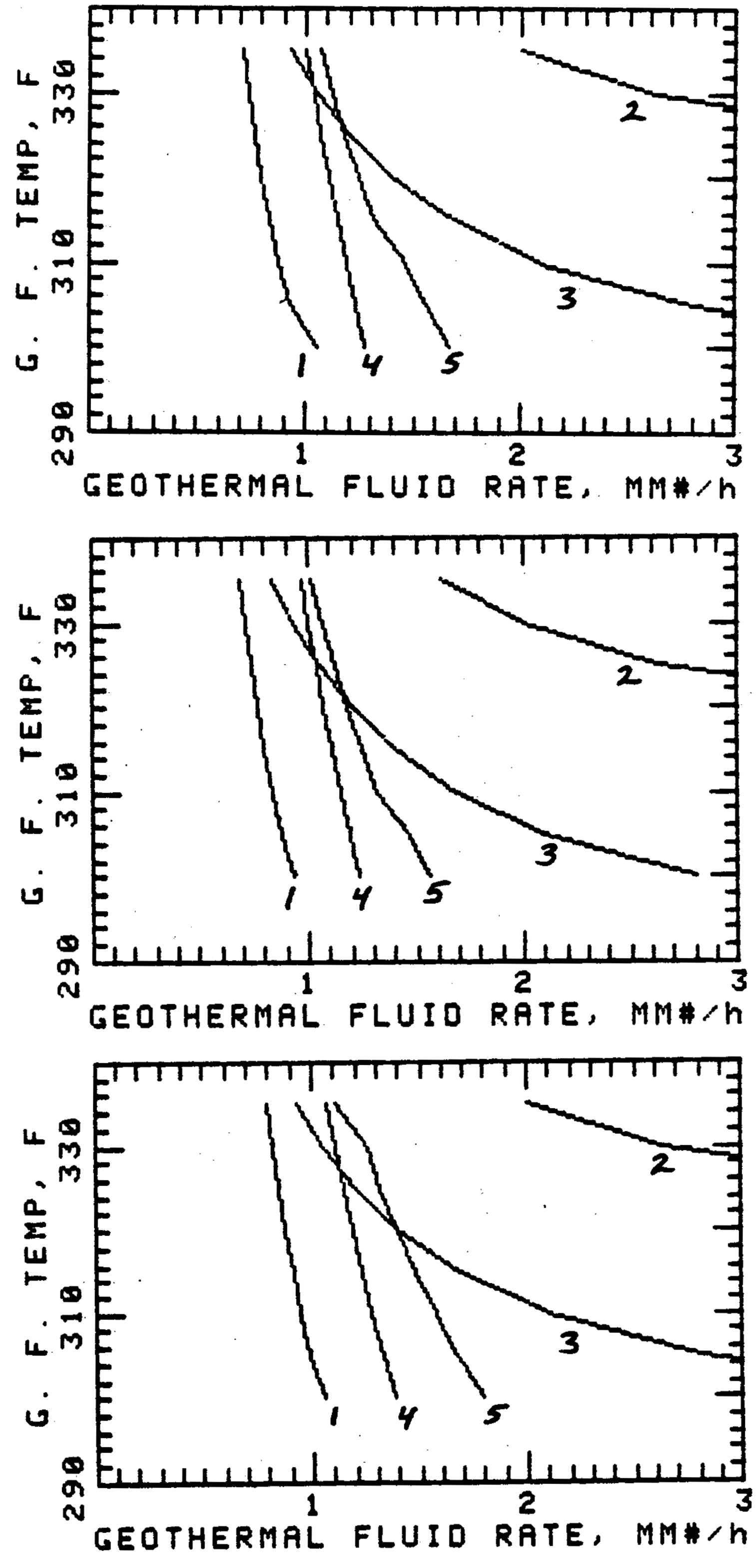

Figure 5. Effect of heat exchanger $\Delta\bar{t}$ and Δt between effects on the temperature (assumed all liquid) for various distillation-dehydration schemes. 1. medium-pressure still and counter-current heat exchange flows; 2. high-pressure still; 3. medium-pressure still; 4. and 5. low-pressure still; 1, 2, and 3 are cascaded heat supplies; 4. G.F. heats still first; 5. G.F. heats M.E. evap. first.

	a	b	c
Heat exchanger minimum ΔT	10	5	10
ΔT between effects	30	30	40

APPENDIX C

(a)

(b)

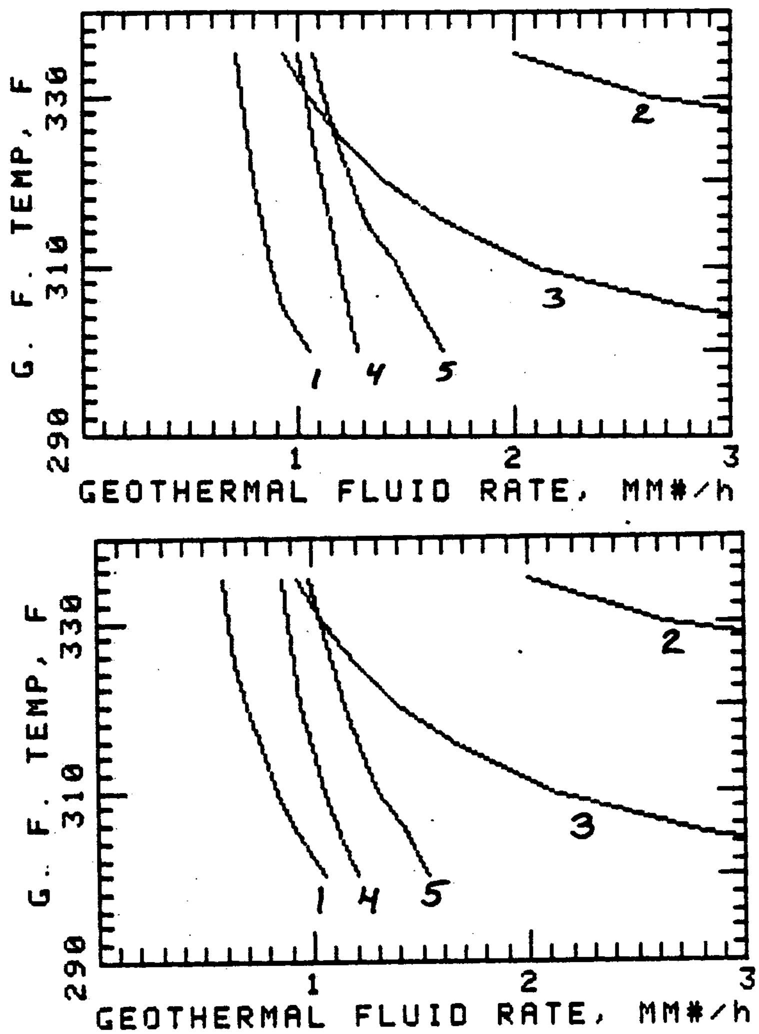

Figure 6. Effect of shipping through stillage in liquid form on geothermal fluid rate versus geothermal resource temperature (assumed all liquid) for various distillation-dehydration schemes. 1. Medium-pressure still and countercurrent heat exchange flows; 2. high-pressure still; 4. and 5. low-pressure still; 1, 2, and 3 are cascaded heat supplies; 4. G.F. heats still first; 5. G.F. heats M.E. evap. first. The heat exchanger minimum ΔT is 10°F and the ΔT between effects is 30°F. The fraction of R of thin stillage directly to product is for a:R=0; for b:R=0.3.