San Diego Gas & Electric Company

MECHANICAL ENGINEERING

MASTER

DOE/ET/28443--T15

**DESIGN
GUIDE
FOR**

**GEOHERMAL
TEST
FACILITY**

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AUG. 20TH 1974**

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CONTENTS

I. INTRODUCTION	1
II. PROJECT SCOPE	4
III. OVERALL DESIGN.....	7
IV. PROCESS DESIGN.....	18
V. COMPONENT DESIGN.....	28
VI. PROJECT CONTROL.....	35

APPENDICES

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I. Introduction

The intent of this design guide is to provide the engineer with the necessary information available to produce, to the San Diego Gas & Electric Company's satisfaction, a design for a workable installation. To this end, this document contains a project scope, specific design information and project control procedures.

At the present time, SDG&E possesses a process design and equipment for a Geothermal Test Facility (GTF). The existing GTF concept was designed to extract the heat energy from geothermal brine and steam using a binary fluid process. The working fluid is industrially pure isobutane. Construction engineering was performed and detailed working drawings are available. The existing engineering and hardware pertain only to the extraction of geothermal heat energy and the circulation of the binary fluid portions.

Construction of the existing GTF was postponed pending small scale field tests duplicating the brine and steam heat transfer process. These tests indicated that brine heat exchangers experienced rapid decay of heat transfer performance due to scale deposition on tube surfaces exposed to the brine. Furthermore, significant information was yielded concerning scale deposition with regard to the process piping.

A GTF design based on flashed geothermal brine to steam appeared feasible and in March, 1974, field tests were begun to prove this concept. These tests indicated that scale deposition on heat exchanges tubes exposed to steam was minimized. Heat transfer rates could be maintained above the design fouled condition for at least one year extended operation.

San Diego Gas & Electric intends to proceed with the installation of a GTF, however, this existing design and equipment must be modified based on the information from both the 1973 and 1974 tests. The desired process now is to flash the geothermal brine to steam in three or four stages and transfer the steam heat energy to the working fluid circulating in closed loop.

The goals are to demonstrate with the GTF installation, (1) the workability and practicability of the geothermal fluid handling equipment; (2) determine the geothermal reservoir characteristics needed for deciding on future, expanded development; and (3) the economics of extracting heat energy from the geothermal resource for electric power generation.

If the demonstration plant is successful and the reservoir information favorable, SDG&E intends to proceed

with a major power generating complex in the Niland area of the Imperial Valley. A decision to proceed with a large geothermal power complex by 1977 requires the start-up of the GTF by mid-1975. Therefore, time is of the essence in completing the design modification of the GTF by the end of November, 1974.

II. Project Scope

In general, this project entails the necessary engineering to modify the existing demonstration GTF using, to the maximum economic extent possible, available engineering and equipment. A complete set of drawings, specifications, soils investigation report and the engineering data books including manufacturers data will be provided to the engineer by SDG&E prior to the start of the redesign work. Assistance for equipment procurement, follow-on engineering during construction and preparing as-built drawings will be the other services requested of the engineer.

This project will be developed in two phases. Phase I will consist of the complete engineering and construction of the GTF excluding only the power generation equipment. With this installation, valuable information on the extent of the geothermal reservoir and equipment performance can be obtained prior to committing for full development of the project.

After obtaining satisfactory and encouraging information from Phase I, Phase II will consist of the detailed design, procurement and installation of the equipment required for the generation of electric power.

Some Phase II engineering will be performed under Phase I design work. Phase II engineering shall be such that the installation of generation equipment shall not perturb the Phase I operation of the GTF until the final tie-ins have to be made to make Phase II operational.

The services requested of the engineer under Phase 1 of the project are as follows:

- a) Prepare a definitive design, equipment specifications, estimate of installed cost and schedule. Refer to Table 1 of Appendix A.
- b) Provide detailed engineering and prepare final construction drawings including bills of material. Refer to Table 2 of Appendix A. At this time the engineer is to provide a re-estimate of construction and follow-on costs to revise the initial installed cost projection.
- c) Prepare bid analyses and submit purchase requisitions to assist with the procurement of new equipment prior to and during construction of the facility.
- d) Provide follow-on engineering during construction for necessary design modifications. Included with this task is the preparation of as-built drawings.

Arrangements for construction of the GTF will be established by SDG&E at the completion of the design package.

III. Overall Design Considerations

A. Location:

A map of the Imperial Valley showing the lease area now held by SDG&E is shown in Figure 1 of Appendix

B. The location of the test facility process, supply wells and injection wells are shown in Figure 2.

No change in the plant location relative to Magmamax #1 and Woolsey #1 should be contemplated by the engineer.

Geothermal fluid shall be supplied to the process from Magmamax #1 and Woolsey #1 wells. All spent geothermal fluids shall be returned to Magmamax #2 and #3 wells.

B. Geothermal Development Guidelines:

A copy of the terms, conditions, standards and application features for initial geothermal development in the Imperial County as published by the Imperial County Department of Public Works is given in Appendix

B. The engineer shall follow these guidelines, but if conformance to these guidelines will cause major project cost or delays, then the engineer shall inform SDG&E.

A copy of SDG&E's conditional use permit is given in Appendix B. The conditions set forth in this permit shall be met and are provided to the engineer to prevent design modification(s) which could result in a violation. SDG&E's present conditional use permit expires June 30, 1975.

C. Schedule:

All designs, purchasing, construction and start-up schedules shall be based upon completion of construction date of June 1, 1975. The engineer shall develop a project schedule to meet this date. It is of major importance that all long lead items and/or material be itemized early in the design stage and purchased at the proper time to meet the June 1, 1975 target date.

D. Imperial Irrigation District:

During Phase I, operation of the Test Facility electric power must be supplied by the Imperial Irrigation District. In addition, cooling water will also be provided under the jurisdiction of the IID. Therefore, the engineer shall consult with them in

preparing any modifications to these portions of the design to ensure compatibility with the operations of the Imperial Irrigation District.

The engineer shall ensure that the generation of electric power during Phase II is compatible with the IID system. It is desired to transmit electric power generated at the facility with the same lines that supply power to the facility. When inserting electric power into IID's system the unit will be block loaded.

E. Process Interface:

The engineer shall be responsible, in the design, for receiving the geothermal fluids at the source well(s) head, on the downstream side of the valve and delivering the spent fluid to the injection well(s) head, up to the upstream face of the valve.

The partnership of NARCO, an SDG&E wholly owned subsidiary, and Magma Power, Inc., has jurisdiction over, and shall be responsible for, the wells and well head valves.

F. Well Head Conditions:

The one-week flow test of the producing well, Magmamax #1, yielded the following information downstream of the separator:

Total Average Flow	400,000 lb/hr
Average Temperature.	370°F
Average Pressure	150 psig

With the type of stream separator used during the test, the total average flow was divided as follows:

<u>STEAM FLOW</u>	<u>BRINE FLOW</u>	<u>NON-CONDENSIBLE GAS</u>
60,000 lb/hr	340,000 lb/hr	12,000 lb/hr

Unfortunately, it is not known what the ultimate drawdown pressure and temperature of the well will be since the flow tests were of a short duration. However, since existing equipment is designed for the preceding temperature and pressure, the engineer shall use these values for the design of additional equipment.

A table of the one-week flow test results and a flow diagram of the equipment is provided in Appendix B.

G. Available Equipment:

SDG&E has, in storage, the equipment purchased for the present GTF process design, but only that to initiate well flow and the heat exchange processes. Included are separators heat exchangers, pumps, control valves, instruments and electric distribution equipment.

These may be inspected at any time by the engineer so long as notification is given to SDG&E within a reasonable time of the visit.

It is of the utmost importance to SDG&E that as much of the equipment be used in the proposed GTF.

H. Plant Start-Up:

The engineer shall be responsible for the information and data books on the plant equipment and operation. Training operating personnel will be provided by SDG&E.

I. Cost Evaluation Factors:

Economic factors such as lifetime, capital cost, etc., for the design of the facility and purchasing equipment are listed in Appendix B.

J. Plant Operating Philosophy

This facility shall be designed for frequent start-up and shut-down for the purpose of obtaining test information on the process, equipment and wells as well as operating experience. Since this plant is a demonstration facility, as such it will be manned during operation, however, the control and start-up features should be designed as simple and practicable as possible. It should be automated to the extent that continuous control monitoring and manipulation by an operator is not required. Transient and steady data conditions will be studied during operation.

Tese and evaluation will focus on the following areas during GTF operation. In this manner sufficient technical information will be gained to permit a realistic appraisal of the potential of geothermal development in the Niland area.

The engineer shall recommend a test program to SDG&E that will provide the required data:

1. Reservoir Analysis (Consultant)
 - a. Communication
 - b. Pressure change with time
 - c. Temperature change with time
 - d. Withdrawal and injection rates
 - e. Electric resistance logging
 - f. Subsidence and seismic
 - g. Develop reservoir model
2. Production Well
 - a. Optimum production rate vs. pressure and temperature
 - b. Production characteristics vs. time
 - c. Well scaling and erosion
3. Injection of Spent Fluid
 - a. Flow rate
 - b. Required injection pressure
 - c. Temperature
 - d. Plugging of well casing
 - e. Down hole inspection

4. Separator Design

- a. Separator feed characteristics
- b. Steam characteristics
- c. Brine characteristics
- d. Corrosion, scaling & erosion
- e. Configuration
- f. Operating parameters
- g. Efficiency (thermal & physical)

5. Heat Exchangers

- a. Efficiency
- b. Heat transfer coefficient
- c. Scaling rate
- d. Configuration
- e. Operating parameters
- f. Cleaning

6. Isobutane Loop

- a. Thermal efficiency
- b. Heat transfer coefficient
- c. Fluid stability
- d. Fluid composition
- e. Knock out drum efficiency
- f. System leakage
- g. Corrosion

7. Geothermal Fluid Process Controls

- a. Reliability
- b. Accuracy
- c. Reproducibility
- d. Scaling
- e. Erosion
- f. Maintenance log
- g. Anti-acaling methods

8. Process Piping

- a. Scaling
- b. Corrosion
- c. Erosion
- d. Materials
- e. Cleaning

9. Brine Disposal System

- a. Design
- b. Size
- c. Deposition rate
- d. Cleaning
- e. Leakage
- f. Drift

10. Pumps

- a. Type
- b. Seals

- c. Size
- d. Corrosion and erosion
- e. Temperature limits
- f. Reliability
- h. Maintenance required

11. Cleaning

- a. Methods
- b. Effectiveness
- c. Frequency
- d. Cost
- e. Damage due to cleaning
- f. Equipment needed for cleaning

12. Other Areas to be Investigated

- a. Down hole heat exchanger
- b. Direct contact exchanger
- c. Multiple flash
- d. Elliptical expander
- e. Impulse turbine
- f. Down hole pump

K. Maintenance and Support Facilities:

Suitable maintenance and office facilities were planned for in the existing GTF design. An on-site chemical analysis laboratory is also desired.

The engineer shall provide space for a 20 x 50 foot trailer near the office trailer to house laboratory equipment. The laboratory shall be provided with the essential facilities, excluding chemicals, glassware, and special electronic analytical tools.

All of the specified laboratory support facilities, maintenance and office facilities shall conform to OSHA standards.

No changes in the orientation of the existing maintenance building and office trailer relative to the process area should be contemplated by the engineer during the redesign work.

IV. Process Design

This section of the design guide treats those areas of the GTF where desired changes are to be made by the engineer. Caution: the engineer is advised to review those areas not specifically covered here but which could be affected by the desired modifications.

Those areas where no changes or minor changes will occur and previous engineering can be used are:

1. Electrical
2. Structural
3. Cooling Water Spray Pond
4. Brind Pond
5. Off-Site Areas
6. Switch Yard
7. Office, Maintenance & Parking Areas

Revisions to the existing piping design are major and will be required for the steam separators, scrubbers and heat exchangers for the new process.

A. Design Conditions:

Table I of Appendix C lists the design flows, temperatures and pressures for the multi-flash binary cycle.

B. Heat Extraction:

A flow diagram of the desired mode of utilizing the geothermal fluid heat energy is shown in Figure 1 of Appendix C.

Shown here are three stages of steam separation and clean-up for illustrative purposes only. SDG&E anticipates there will be four stages. The actual number of stages will be determined by the engineer within the constraints imposed by utilizing two production wells, six available heat exchangers, an isobutane flow of 1,000,000 lbs/hr, an isobutane sink temperature that is 120°F, and the economics of steam cleaning equipment.

It should be emphasized here, that SDG&E considers maintaining 1,000,000 lbs/hr isobutane flow of prime importance.

C. Geothermal Fluid Disposition:

The present design utilizes a brine holding pond as shown in Figure 2 of Appendix C. This open basin is to be retained for emergency blowdown operations. During normal operations of the facility the unflashed

brine shall be pumped directly from the last stage flash vessel to the injection well. The brine fluid temperature at the pump suction should be 140°F.

Pumping brine in this manner should eliminate oxygen entrainment in the brine and preclude corrosion of the injection line.

If the brine temperature is 140°F or less the net positive suction head will prevent cavitation in the injection pump. Figure 3 shows the desired configuration and critical dimensions.

D. Steam Condensate Disposition:

All of the steam flowing through the heat exchanger should be condensed during the heat transfer process to heat the working fluid.

A portion of the condensate will be used for cooling water make-up for the spray pond.

During start up operations it is desirable to use pure condensate as wash water in the steam scrubbers. Storage capacity would provide this capability. After

steady state operations are reached, the source of wash water would be condensed steam leaving the scrubber. The storage tank would be recharged with steam condensate after the plant is on steam. Figure 4 of Appendix C is a flow diagram of this sub-system.

At this time the balance of the unused condensate will be injected together with the unflashed brine.

The steam condensate should be fed to the suction of the injection pump.

E. Noncondensable Gas:

A mixture of noncondensable gas dissolved in the geothermal fluid is liberated at the first stage of steam separation and is mixed with the steam. The various gasses that have been detected and their percentages are listed in Table 2 of Appendix C.

The gas mixture may be discharged to the atmosphere, however, 1000 ppm to 1200 ppm hydrogen sulfide (H_2S) were detected during recent field tests. Hydrogen sulfide in this quantity indicates the gas mixture will require pre-treatment to remove it before discharging the mixture to atmosphere.

An H₂S detection and alarm system is desired for reasons of safety and environmental factors. The engineer is referred to Condition #14 of the conditional use permit in Appendix B.

F. Instrumentation:

Adequate test points and instrumentation shall be incorporated in the process cycle and equipment to permit the collection of information to evaluate a full-size plant. These will include temperatures, pressures, flows, fluid samples and corrosion coupons.

Other provisions the designer shall incorporate in the instrumentation systems are set forth below.

1. Standard orifice plates may be used for steam and isobutane vapor flows as the primary metering elements. A small hole shall be provided in the orifice plates near the bottom (in the direction of gravity) for draining condensation which would otherwise collect behind the orifice.
2. Same as (1) above for steam and isobutane condensate flow measurement. The drainage hole is not required in this case.
3. Brine flow metering shall use the Annubar device as the primary metering element.

4. Separator pots shall be used between the primary element and the meter for flow measurement. These pots shall have a diaphragm to separate the fluid to be metered and the clean fluid, i.e. distilled water or glycol, to the meter. These shall be used for the steam flow, isobutane and condensate flow. Refer to Figure 5 shows the arrangement.
5. Pressure indications shall use standard glycol pots between the fluid and the pressure measuring instrument. Bourdon tube type of gage may be used for pressure indication.
6. Each temperature measurement point shall be provided with a thermowell. Should a thermometer require replacement, this may be performed without a shutdown.
7. Pressure tap points will be of the maximum practical diameter to prevent plugging.
8. Valves used in the instrumentation system that are exposed to brine and steam shall have hard seats.
9. Both the production and injection wells shall be instrumented to record temperature and pressure. Sample taps are to be provided to allow fluid sampling during operation.
10. Means of installing corrosion coupons are to provided to evaluate the effects on material

specimens. Process piping for brine between flash stages, steam and condensate are to be fitted with no less than two coupon insertion points. The production well lines are to have two material coupon test points every 200 feet, the first being at the well head. The injection line is to be fitted with a means of inserting two coupons every 500 feet, beginning at the injection pump discharge.

11. A flow measurement shall be installed in the brine injection line to provide the Division of Oil and Gas with data on the total quantity of fluid injected. SDG&E will use the data for reservoir analysis. Any other fluid, i.e. irrigation water blowdown, isobutane, chemicals, condensate; that is disposed of by injection shall be metered and recorded to make this information accurate.
12. Steam sample probes shall be designed and installed per the ASME standards.

G. Controls:

Process controls are critical elements to the success of the operation and performance of the GTF. Of utmost importance are the reliability and function of the controls.

The control system designer is to consider that electric power generation is planned to be added to the energy transfer process at a later date. Therefore, the response of the heat energy transfer process will ultimately respond to changes in electric load on the generator. Load changes will be limited to the turbine/generator start up and shut down as well as those for test purposes. During steady state operations the generator will be blocked and will not respond to IID system changes.

1. The designer is to provide protection against corrosion, sand and dust for all controls exposed to the atmospheric environment in the Niland area of the Imperial Valley. High velocity winds cause dust infiltration from adjacent agriculture fields which is especially critical to maintenance and continuous operating reliability.

Enclosed controls can be purged with an air system pressurized above atmospheric to prevent dust infiltration. The engineer is to evaluate this type of system to be incorporated with the process controls.

2. Ultrasonic control of liquid level is recommended for brine level control in the steam separators.

This type of control mode shall also be considered for the wash water liquid level in the bottom of the steam scrubbers.

This system should be designed such that the ultrasonic level sensors may be removed without requiring a shutdown. Refer to Figure 6 which shows the recommended installation.

3. Pneumatically operated valves shall fail to the CLOSE position on the inlet side of the separators and to the OPEN position on the downstream side of the scrubbers and heat exchangers.
4. Rupture discs are required on the separators, scrubbers and heat exchangers. Design pressure shall be 400 psig. Shut-off pressure for the supply wells is 330 psia. The temperature at shut-off condition before well is killed is 460°F.
5. All separators and scrubbers shall have HI-LO level alarms and annunciators. The separator high level alarm set point is 2 feet, the low level alarm is one-half feet.

The high level alarm for the scrubbers is one-half foot below the steam inlet line. A low level alarm should annunciate at one-half feet.

6. Steam flow control or demand is set by isobutane flow through the heat exchanger system. This mode

of control is similar to feedwater heater control for a fossil fuel steam unit.

7. No flow control of the producing wells shall be performed so as to minimize thermal cycles on the well casing.

V. Component Design

This section deals with specific design features that are necessary for satisfactory performance, operating reliability and long term operation of the various process hardware.

A. Separator Design

SDG&E purchased two steam separators for the GTF. The vessels are not identical in configuration. Small scale tests in the field indicated that neither vessel would efficiently separate steam from brine at the design production flow from two wells.

1. The engineer shall utilize the values shown in Table 1 of Appendix D for designing an addition separator unit(s) required for the multi-stage flash process. These values were used as criteria to specify the modifications required to obtain desired dynamic performance for solids carry-over in the range of 100 to 300 ppm.
2. Figures 1 and 2 of Appendix D show required flow design modifications required for the

existing two separators. These vessels may be utilized with modifications specified, in two areas of the steam separation train:

1. Both used in parallel as the first stage of separation.
2. Each used in series as individual stages of separation.

The engineer has the option to recommend their use for either position in the separator train based on a thorough evaluation of economics and impact on the overall process design. These recommendations shall be made to SDG&E for a final decision.

3. Additional features that the engineer shall incorporate in the mechanical design of new separators are:

- a. Add a boot at the brine outlet of the separator and internal to the vessel to prevent scale chips, from being carried to a succeeding stage. The boot design is shown in Figure 1 of Appendix D.
- b. Vortex arrestors are required for each separator at the brine outlet. The

vortex arrestor shall be designed so that its performance is not affected by scale deposition.

B. Scrubber Design:

The Ben Holt Company holds the patent rights for the steam scrubber design and as such is proprietary hardware. The multi-flash GTF process will require one steam scrubber for each stage of steam flash and separation. The design tested with steam from Niland brines is shown in Figure 3 of Appendix D.

1. The full-scale scrubber design shall have five trays conforming to the design shown in Figure 4. The average efficiency for the five trays is 98%.
2. Overall dimensions of a full-size scrubber that shall be maintained are shown in Figure 5 of Appendix D.
3. Dynamic design factors which are to be used by the engineer are given in Table 2 of Appendix D. These are based on field tests with the unit.

4. Other design features that the engineer shall include with the scrubber design are as follows:

- a. A manhole for access to clean the vessel.
- b. Individual wash water drains lines for each scrubber. A manifold type of drain system presents operating problems with wash water level control due to pressure differences between stages.
- c. High-low control and alarm for each scrubber in addition to visual indication.
- d. Pressure and temperature points above and below each tray. Sample taps for chemical analyzing wash water for dissolved solids content.
- e. Provisions to supply wash water from condensate storage during a start-up or upset operation. Wash water, under normal operation, is provided by refluxing steam from the scrubber steam outlet that has been condensed. The steam condensers use condensate as the cooling medium. Refer to Figure 6 of Appendix D which shows the flow diagram for the wash water system.

C. Heat Exchangers:

The only additional provision for the existing heat exchangers is for chemically cleaning tubes. Placement of the connections on the heat exchangers depends on whether steam is to be used inside or on the outside surfaces of the tubes.

A determination of which heat exchangers shall use steam tube-side and those utilizing steam shell-side will be made by the engineer during the design preparation. When this point is reached SDG&E will provide the design information required for the chemical cleaning system.

It has been SDG&E's experience that scale deposit removal is simplified with steam flowing tube-side through the heat exchangers. It would also require a smaller volume of chemicals, therefore, the designer is to attempt to use all of the heat exchangers with steam flow through the tubes if it is feasible to do so.

D. Re-injection Pump:

A high pressure source of seal water shall be provided to the mechanical seals of the re-injection pump

to extend pump life. The sealing water shall be of condensate quality and under pressure greater than the pump's shut-off pressure.

This seal water system must have a maximum reliability and shall be instrumented to detect a failure, should any occur. In this manner the injection pump, which is critical to GTF operation, will be protected.

E. Valves:

1. Flow Control:

Butterfly valves shall be used for all steam and brine flow control.

Valve trim shall be:

- a. Teflon seat liner
- b. Inconel 625 shaft
- c. Ceramic coated steel disc

2. Positive Shut-Off:

Gate valves are to be used where the need exists for a tight, positive shut-off for shut-down and/or maintenance purposes.

Valves in geothermal steam and brine service shall be of steel with steel trim.

F. Brine Injection Pipe:

The initial design specification for this pipe called for 1/4" thick chlorobutyl rubber lining inside of 10 inch diameter schedule 40 pipe. This lining is to be deleted from the specification.

New specifications for the reinjection line are 10 inch diameter, 0.500 inch wall, seamless, carbon steel, ASTM A53 Grade B.

Procurement of approximately 7000 feet of this pipe will be a long-lead item. As such the engineer should review the re-injection system, at the earliest, in the redesign effort. SDG&E may then proceed to place the order for the material so that manufacturer delivery will not delay construction of the GTF.

VI. Project Control

A. Reports:

The engineer shall provide SDG&E with a monthly project status report by the first of each month, and these reports shall include as a minimum:

1. a narrative description of status of the project.
2. an up-date of the project major milestone schedule.
3. status of purchasing.
4. curves showing actual expenditures versus estimated expenditures.
5. current and potential problems that could result in over expenditure or project delay.

B. Drawings:

All drawings and specifications shall be submitted to SDG&E for review by the project engineer. As built drawings and microfilm of plant and equipment shall be provided.

C. Scope and Estimate:

The engineer is requested to prepare a project scope and cost estimate covering complete design, construction,

installation, start-up and testing of this demonstration plant breaking this down into Phase 1 and Phase 2.

D. Correspondence:

All correspondence and drawings shall be sent in accordance with the communication procedures contained in Appendix E.

TABLE 1

1. PROCESS DESIGN
2. PROCESS FLOW DIAGRAM
3. PIPING AND INSTRUMENT FLOW DIAGRAM
4. PRELIMINARY PLOT PLAN
5. EQUIPMENT SPECIFICATIONS FOR MAJOR ITEMS
 - PRESSURE VESSELS
 - HEAT EXCHANGERS AND CONDENSERS
 - PUMPS
 - EXPANDER-GENERATOR SET
 - INSTRUMENTS AND CONTROLS
6. UTILITIES FLOW DIAGRAMS
7. ELECTRICAL SINGLE LINE
8. DEFINITION OF OFFSITE FACILITIES REQUIRED, INCLUDING
 - ROADS
 - BUILDING AND OFFICE
 - FENCE
9. COST ESTIMATE
10. OPERATING REQUIREMENTS
11. GENERAL ENGINEERING AND CONSTRUCTION SPECIFICATIONS
12. PROJECT SCHEDULE

TABLE 2

1. GRADING PLAN
2. FINAL PLOT PLAN
3. PIPING DRAWINGS

Plans, Sections, Details & Isometrics and Bills of Material

4. FOUNDATION DRAWINGS AND BILLS OF MATERIAL
5. STRUCTURAL DRAWINGS AND BILLS OF MATERIAL
6. ELECTRICAL DRAWINGS AND BILLS OF MATERIAL
7. ARCHITECTURAL DRAWINGS AND BILLS OF MATERIAL

FIGURE 1b

SALTON SEA

SALTON SEA NATIONAL WILDLIFE REFUGE

OBSIDIAN BUTTE

SEC. 5

MAGMAX NO. 2

BOYLE RD.

MAGMAX NO. 4

MAGMAX NO. 3

SEC. 4

VAIL LATERAL 4-A

MAGMAX NO. 1

MCKENDRY RD.

GEOTHERMAL TEST FACILITY

WOOLSEY NO. 1

GENTRY RD.

SHUCLAIR RD.

SEC. 3

1" = 1000'

May, 1971

TERMS, CONDITIONS, STANDARDS, AND APPLICATION PROCEDURES
FOR
INITIAL GEOTHERMAL DEVELOPMENT
IMPERIAL COUNTY

PREPARED BY
IMPERIAL COUNTY
DEPARTMENT OF PUBLIC WORKS

TERMS AND CONDITIONS
FOR
INITIAL GEOTHERMAL DEVELOPMENT
IMPERIAL COUNTY

I. PREAMBLE

The Board of Supervisors and the Planning Commission of the County of Imperial have adopted a Resolution stating General Public Policy surrounding the initiation of Geothermal Development within this County. This policy is interim in nature in that it calls for the development of a General Plan for the total development of the Geothermal Resource within the County. In addition, this Policy provides for the initiation of Geothermal Development by allowing various agencies, both public and private, to commence their own initial development projects.

It is the intent of this policy to encourage exploration and development projects and to increase the store of knowledge surrounding this resource. It is also the intent of this policy that there be coordination of existing and anticipated data so that the end result may be General Planning that will provide for the optimum development of the available resource.

In many areas of the State, the Geothermal Resources are under study and in one area is already producing electrical energy. Current explorations in most areas are pointed chiefly at the energy field and property so as there is much need for a clean source of energy for the development of electrical power. However, it must not be overlooked that there is a possibility for a new source of potable water and mineral recovery. Additional research is needed in all fields if this Geothermal Resource is to be developed to its ultimate.

The early studies show that much of the Geothermal Resource in this area lies below the floor of the Imperial Valley. This Valley is a major Agricultural area and its preservation is necessary for the continued economy of the County and to provide food and fibre for the populace.

The University of California and other State Agencies; several Federal Agencies, most prominently the Department of the Interior; and Industry are all involved in research and study programs surrounding the development of this Geothermal Resource. Many industries have stated their desire to continue to explore and begin production of the resource.

It is recognized that a General Plan providing for total development of the resource is needed but that it cannot be a Comprehensive General Plan without the input of additional research and data.

It is therefore the intent of this policy to allow for the complete development of a series of initial projects in addition to exploratory well drilling and testing. To accomplish this, following in Paragraph III are a series of terms and conditions designed; (1) to allow these initial developments; (2) to provide for the optimum use of the land; (3) to protect the environment; and (4) to provide for cooperation in the development of a Comprehensive General Plan for Geothermal Development.

II. POLICY

BE IT RESOLVED, that a general plan shall be prepared to designate where, and under what conditions, geothermal production wells, power plants, and attendant uses may be located in Imperial County;

BE IT FURTHER RESOLVED, that pending preparation of the general plan, the County shall:

(1) Authorize the establishment of geothermal production projects in designated locations and under prescribed terms and conditions;

(2) Authorize the drilling of exploratory geothermal wells and the use of resources produced therefrom for testing purposes, in various land use zones;

(3) Advocate the adoption of legislation designed to insure the orderly development of geothermal resources and to protect the public interest.

III. TERMS AND CONDITIONS

A. DEFINITIONS

1. "Operator" means any person, firm, or corporation; drilling maintaining, operating, pumping, or in control of any well or related facilities for power generation, mineral extraction, desalination or any other use of geothermal resources.
2. "Geothermal Production Project" includes the right to explore for, test, produce, process, transport and sell geothermal resources and by-products such as electrical power, desalinated water, minerals and heat from within the "G" Zone area designated by the Planning Commission.
3. "Exploratory Geothermal Well" includes the right to explore for the test geothermal resources within an area designated by the Planning Commission.
4. "Test" means to produce geothermal fluids and/or steam for a length of time, at a volume and rate accepted by the County and Regional Water Quality Control Board.
5. "Test Facilities" means lines, pumps, separators, metering facilities, ponds and sumps used during the testing of a geothermal well or injection well.
6. "Permit for Geothermal Exploratory Well", is a Conditional Use Permit allowable in various zones within the County.

7. "Permit for Geothermal Development Project", is a Conditional Use Permit to produce Geothermal Well or Wells in a "G-Zoned Area".

8. "G-Zone", Geothermal Development Zone in a land classification zone overlay permitting additional uses within other zones including Geothermal Well operation (after obtaining a Conditional Use Permit).

B. GENERAL CONDITIONS

1. Proposal - A definite detailed proposal for a Geothermal Development Project shall be submitted in accordance with the procedures and standards. This proposal shall include geologic and engineering evidence that gives reasonable assurance of success.

2. Application Reservation - The Planning Commission reserves the right to deny an application if it will not be compatible with the area or that, in its findings, that some of the terms and conditions are not met satisfactorily.

3. Procedures and Standards - All applicants will be required to comply with Governmental procedures and standards applicable to the particular phase of work.

4. Compliance with the Law - The operator engaged in the drilling, production maintenance and abandonment of Geothermal Wells and related facilities including the disposal of waste products shall comply with all applicable local, State, and Federal laws and ordinances in effect or subsequently duly enacted.

5. Commencement of Work - Prior to commencing any operation all Governmental conditions and standards applicable to the particular phase of work contemplated shall be complied with.

6. General Compliance - All well drilling, plant construction, testing and operations shall be conducted so as to be in harmony with the area and do not conflict with the public health, safety, comfort, convenience and general welfare.

7. General Plan Development - The operator shall cooperate with the County or the County's agent in the development of the County's Geothermal Element for the General Plan. The operator will be expected to provide data and knowledge up to, but not including "proprietary information".

8. Permit Expiration - All permits (for exploratory wells and for development projects) shall contain terms and conditions. Abandonment of a project for six (6) months shall cause the permit then in effect to expire and to become null and void.

9. Timetable - A reasonable timetable for project development will be made a condition of any permits granted.

10. Bonds - Each operator of a "Geothermal Production Project" and/or "Exploratory Geothermal Well" shall file and furnish with County an indemnity bond in the sum of \$50,000.00 for each well drilled or abandoned well re-entered or a blanket bond in the sum of \$150,000.00

for any number of wells drilled or re-entered. The Bond will indemnify the County for any costs incurred by the County in repairing any drill, test, or production facility site, to as near as possible to its original state and in abating any public nuisance caused by the principal's exploratory, testing, or producing operations.

11. Insurance - Before commencing or continuing any Geothermal operations, the owner or operator shall show continuing evidence of insurance against liability in tort in a minimum amount of \$1,000,000.00 arising from the production activities or operations incidental thereto conducted or carried on under, or by virtue of any law or ordinance. Such insurance shall be kept in full force and effect during the period of such operations.

12. Subsidence - Any operator of a Geothermal Production Project shall participate in a Geothermal subsidence prevention and detection program developed by the County, State, and Federal Government.

13. Cleanup - Upon completion of any phase of the project, the site shall be cleaned up in accordance with the Standards, and insofar as practical, the land returned to its original condition.

14. Waste Disposal - All waste, whether liquid or solid, must be disposed of in compliance with the existing County, State, and Federal rules and regulations.

15. Noise and Vibration Supression - The operation of temporary or permanent equipment and all other operation performed on the premises

shall be done in a manner so as to suppress all noise and vibration to an acceptable level.

16. Electronic Interference - No operator shall operate electrical equipment or transmission facilities that will have a detrimental effect on the transmission of radio or television signals.

17. Air Pollution - All operations shall be conducted in compliance with the requirements of the Imperial County Air Pollution Control Officer.

18. Aesthetic Requirements - All permanent installation and premises including power, steam and/or fluid transmission lines, shall be harmonious in appearance with the area and not of obnoxious, undesirable or unsightly appearance.

19. Land Use - Site development plan and land use shall provide for maximum surface land usage including preservation of productive farm land and shall be in accordance with the Standards.

20. Odor and Gas Control - All operators shall take steps to insure that no harmful or obnoxious gases be released as a result of their operations.

21. Right of Entry - The County reserves the right to enter the premises under the control of the operator of any Geothermal operation to make appropriate inspections to determine if the conditions of this policy are being fulfilled.

22. Public Facilities - If location or site of the proposed project is such as to require additional public access facilities, the operator shall be required to provide where necessary, rights of way on property he controls and to provide the necessary road work.

23. Operation Personnel - All development operations shall be conducted under the direction of a responsible engineer or agent. The operator shall insure that a maintenance crew is immediately available to insure compliance with the conditions and standards required.

24. Scope of Terms and Conditions - The terms and conditions prescribed shall be for a particular project and will pertain to that project only. Future projects may receive additional and/or different terms and conditions.

APPLICATION PROCEDURES

I. PROCEDURES

A. Exploratory Geothermal Well. To obtain an "Exploratory Geothermal Well" permit, an operator must submit a conditional use permit application for a geothermal exploratory well. In addition, the operator must submit to the Planning Commission for their approval, a definite proposal for the work to be done, including, but not limited to:

1. Name, location, and elevation of the well to be drilled;
2. Name, address, and telephone number of operator's designated agent;
3. A surface plat of the property to be explored including:
 - a. surface location sites of the proposed well, including the size and shape of location and access roads;
 - b. north arrow, scale, date, and contours of land where the grade exceeds two percent;
 - c. the boundary of the parcel to be explored;
 - d. the locations of existing roads, water ways, and cultural features including the present use of the property to be developed, and use of the surrounding property;
 - e. the location of test facilities including complete engineering data concerning any holding pond or reservoir proposed in conjunction with testing and waste discharge requirements.
 - f. the location of existing roads, water ways and cultural features.
4. Proof that the well program has been approved by the State Division of Oil and Gas, and that all test and waste discharge operations have been filed with the State's Regional Water Quality Control Board.

B. Geothermal Production Project. To obtain a "Geothermal Production Project" permit, an operator must submit:

1. a rezoning application for the "G" Zone if necessary;
2. a conditional use permit application for a geothermal exploratory well or copy of existing permit;
3. a conditional use permit application for a geothermal production project.

As a part of the application the operator must submit to the Planning Commission for their approval, a definite proposal for total development which includes the following data but is not limited to:

1. Name, location, elevation of well or wells to be drilled;
2. Name, address, and telephone number of the operator's designated agent;
3. A surface plat of the property to be developed including:
 - a. surface location sites of proposed wells, including size and shape of drilling locations and access roads;
 - b. north arrow, scale, date and contours of land where the grade exceed two percent;
 - c. the locations of existing roads, water ways, and cultural features, including the present use of the property to be developed, and the use of surrounding property;
 - d. the boundary of the parcel to be developed;
 - e. the location of test facilities including complete engineering data concerning any holding pond or

reservoir proposed in connection with testing and waste discharge requirements;

f. a tentative plan showing the size and location of power generation, mineral extraction, desalination and other surface facilities including their relationship to known active faults.

4. A general geologic and engineering presentation showing enough data to demonstrate that the area contains geothermal resources.

5. A timetable showing a schedule of projected development.

6. Proof that the program for well or wells, has been approved by the State Division of Oil and Gas and that all test and waste discharge operations have been filed with the State's Regional Water Quality Control Board.

7. Submit for approval any additional anticipated land use needs such as extra facilities and proposed sites for new industry.

C. General Procedures

1. Upon receipt of applications and the required information, the Department of Public Works will set a Public Hearing for the Planning Commission, notify appropriate property owners, agencies and individuals of said Hearing. Planning Commission will consider testimony of all interested parties and then take appropriate action on the various applications.

2. The Planning Commission has a scheduled meeting for the 2nd Tuesday of each month. In order for an application to be heard it, along with all zoning information, must be filed at least two weeks prior to the meeting.

II. STANDARDS

A. Classification of Standards

1. Class I Standards:

- a. Class I Standards shall apply to any exploratory Geothermal Well, or Geothermal Production Site in Imperial County.

2. Class II Standards:

- a. Class II Standards shall apply in addition to the Class I Standards, to any Exploratory Geothermal Well or Geothermal Production Site adjacent or near existing development as determined by the Planning Commission.

B. Planning Standards

1. Class I Planning Standards:

- a. All Geothermal Drilling sites including test facilities and ponds shall be as small as possible and in no case larger than five acres on arable land. Exceptions will be allowed if two or more wells are drilled from the same site.
- b. Every site shall be designed to retain the maximum amount of usable agricultural land and the site shall not interfere with the irrigation and drainage pattern. Drill sites shall be constructed adjacent to existing roads insofar as possible. Well density shall be justified and in accordance with good Reservoir Engineering Practices.
- c. Unless specifically waived by the Planning Commission where legally permissible, the following minimum distances shall

be observed in sitting a well:

Outer Boundary of Parcel	100'
Permanent Public Waterway	50'
Public Roads	100'
Residence	300'
School	1320'
Hospital	5280'
Any other development	500'

- d. Production Facilities shall where possible, be located in centralized areas to serve the maximum number of wells. These shall include but are not limited to power plants, extraction plants, and separators.
- e. All electrical transmission lines shall be constructed on existing right of way wherever possible.
- f. The plans for all permanent sumps, brine ponds, waste holding ponds, and any other ponds, shall include a soils investigation and shall be designed and constructed under the supervision of a registered Civil Engineer. The following are considered minimum criteria:
 - (1) Pond bottoms and dykes shall be either impervious or shall be lined to prevent seepage;
 - (2) Earthen dykes shall have 3:1 slopes;
 - (3) Dykes shall be designed to provide three feet free board when at design capacity;
 - (4) Plan should minimize wave and wind erosion;

- (5) Protect from any flood hazard.

The Plans shall be submitted to the County for approval.

- g. A reproducible copy of the plot plan shall be submitted on suitable material. It shall be 18" x 26" with an appropriate scale and shall be prepared in accordance with good engineering and drafting techniques. It shall show all existing topography and facilities and shall clearly show proposed development.

C. Drilling Standards

1. Class I Drilling Standards:

- a. All Geothermal Well sites shall have a sign having a surface of not less than two square feet and not more than six square feet bearing the current name and number of the well; emergency telephone number of agent; name and/or insignia of the operator and the owner and this sign shall be displayed at all times from the commencement of drilling operations until the well has been abandoned.
- b. Each operator shall limit the continuous generation of wide band noise to that shown on the chart. The level shown may be exceeded by ten percent (10%) if the noise is intermittent and during daylight hours. The noise levels shall be measured at the parcel boundary.
- c. Sound pressure levels shall be measured at the points specified and shall be measured with a sound level meter and associated octave band analyzer conforming to standards prescribed by the United States of America Standards Institute.

Frequency Band CPS

- d. The foregoing graph shall conform to standard units of measurement in accordance with United States of America Standards Institute Code, S-1.11-1966, Appendix: A.
- e. Within sixty (60) days after the completion of the drilling of a well, all drilling wastes must be removed from the drilling site and disposed of, in accordance with County and State regulations.
- f. Suitable and adequate sanitary facilities as approved by the Imperial County Health Department shall be installed and maintained in a clean and sanitary condition at all times.
- g. Drilling operations shall be diligently pursued until

each well is completed or abandoned. All drilling equipment including derrick shall be removed from the premises within sixty (60) days after completion of any well.

- h. Prior to abandonment it shall be the responsibility of the operator to comply with all regulations of the Geothermal Resources Law of the State of California in regards to subsurface actions. In addition, the following surface requirements are imposed. These surface requirements shall also apply when the well or wells goes on production and auxiliary facilities are no longer necessary.

- (1) The derrick and all appurtenant equipment thereto shall be removed;
- (2) All tank, towers, other surface installations shall be removed;
- (3) All concrete, pipe, wood, or other foreign materials shall be removed from the drill site to a depth of six feet below grade;
- (4) All holes and depressions shall be filled and packed with native earth. All waste material shall be removed from the drill site;
- (5) In agricultural or potential agricultural areas any brine holding ponds shall be purged of brine, the salts shall be removed from the dykes and bottom and the berms leveled to the satisfaction of the County.

2. Class II Drilling Standards:

- a. All work in preparation of the site for drilling shall be done between the hours of 7 a.m. and 7 p.m.
- b. All unattended well sites shall be enclosed by a steel chain link type fence, six (6) feet high. There shall be no opening below such fence greater than four (4) inches. The gate shall be placed at a non-hazardous location and shall be locked at all times.
- c. The Planning Commission shall direct which Noise Level curve as shown on the chart shall apply. Each operator shall limit the continuous generation of wide band noise to that required. The level may be exceeded by ten percent (10%) for any one occurrence if the noise is intermittent and during daylight hours.
- d. Sound pressure levels shall be measured at the points specified and shall be measured with a sound level meter and associated octave band analyzer conforming to standards prescribed by the United States of America Standards Institute.
- e. The following graph shall conform to standard units of measurement in accordance with United States of America Standards Institute Code, S-1.11-1966, Appendix A.

- f. Off street parking shall be provided with not less than five spaces for each well site.
- g. All lights shall be directed or shielded so as to confine all direct rays to the site.
- h. The delivery or removal of equipment or material shall be limited to the hours from 7 a.m. to 7 p.m., except in the case of emergency.
- i. No drill pipe shall be racked or made up except between the hours of 7 a.m. to 7 p.m. Exception to this is allowed where sound proofing is provided or in case of emergency.
- j. The drilling site shall be treated to eliminate dust and mud.

k. Drilling may be on a 24 hour basis providing above is met.

D. Production Standards

1. Class I Production Standards:

- a. All requirements imposed by the Class I drilling standards shall remain in effect.
- b. All construction work will require a building permit. The fees and procedures will be based on the current Building Code adopted by the Board of Supervisors of Imperial County.
- c. All construction plans shall be prepared in accordance with the Architectural Design Zone.
- d. Continuous and intermittent sound shall be controlled to the levels listed under C 1 (c) (Drilling Noise Standards for Class I).
- e. The operator shall install a minimum of one permanent benchmark per well as directed by the County Surveyor in order to participate in the Subsidence Detection Program. The benchmark shall be constructed of concrete and firmly set. A brass cap as furnished by the County Surveyor shall be placed in the monument. The operator shall tie this benchmark into the nearest point of the U.S.G.S. level net by First Order Leveling techniques.
- f. Power lines shall be constructed on existing power right of ways where possible. Efforts shall be made to share existing facilities. Any new power line installations shall conform with County optimum land use and aesthetic requirements.

- g. All on site roads and parking areas shall be paved. On site parking shall be provided for all employees, customers, or clients.
- h. Shrubs, trees, and ground cover shall be planted and maintained to compliment the appearance of the project where soil conditions permit.

2. Class II Production Standards

- a. All applicable requirements imposed by the Class II Drilling Standards shall remain in effect.
- b. Continuous and intermittent sound shall be controlled in accordance with paragraph C 2 (c) (Drilling Standards Class II).
- c. All off site collection pipe lines shall be buried and shall utilize and share existing dedicated right of ways. On site collection pipe lines shall be painted and/or landscaped to blend with the environment.

COPY

COPY

GEOTHERMAL PRODUCTION PERMIT
AS PROVIDED BY SECTION 83226a
OF CODIFIED ORDINANCES
OF THE COUNTY OF IMPERIAL

Permit No. 1-73

Date: January 19, 1973

ISSUED TO:

San Diego Gas & Electric Company
P. O. Box 1831
San Diego, California 92112

having duly applied for a Geothermal Production Permit as per Section 83226a of the Codified Ordinances of the County of Imperial, and the Planning Commission having duly considered said application as per Section 83226a of Codified Ordinances of the County of Imperial, permission is hereby granted to:

install a Geothermal Production Project that will provide information on the extent and type of geothermal resources available in this area and the feasibility of extracting the heat energy from these geothermal fluids for the production of electrical energy, at the following described location: The South 600.00 feet of the East half of the Southeast Quarter of Section 33, T. 11 S., R. 13 E., S.B.B. & M., West side of Gentry Road, south of McKendry Road, in the Niland area, subject to the conditions listed on the attached resolution.

NOTE: This permit shall expire by limitation and become null and void if the building or work authorized herein is not commenced within six (6) months from the date issued and pursued diligently until completion of work.

COUNTY OF IMPERIAL

By:

RICHARD D. MITCHELL, Secretary
Imperial County Planning Commission

cd

RECEIVED
San Diego Gas & Electric Company

JAN 22 1973

GOV'T R/W. SEC.

1 RESOLUTION GRANTING GEOTHERMAL
2 PRODUCTION PERMIT TO SAN DIEGO
3 GAS AND ELECTRIC COMPANY.

4 WHEREAS, there was submitted to the Imperial County Planning
5 Commission a request for a Geothermal Production Permit by San Diego
6 Gas & Electric Company to install a Geothermal Production Project at
7 the following described location: The South 600.00 feet of the East
8 half of the Southeast quarter of Section 33, T. 11 S., R. 13 E.,
9 S.B.B. & M., west side of Gentry Road, South of McKendry Road, in the
10 Niland area, and

11 WHEREAS, there was a public hearing scheduled pursuant to the
12 Imperial County Codified Ordinances, Section 83226, in the Board of
13 Supervisors Chambers, Courthouse, El Centro, California at 10:30 a.m.,
14 January 9, 1973, and

15 WHEREAS, a number of representatives of San Diego Gas & Electric
16 Company were present to give pertinent information concerning the
17 application,

18 NOW THEREFORE BE IT RESOLVED, that it was the Commission's findings
19 that the above described Geothermal Production Permit be granted subject
20 to the following described conditions:

- 21 1. Procedures and Standards - All applicants will be required to
22 comply with Governmental procedures and standards applicable
23 to the particular phase of work.
- 24 2. Compliance with the Law - The operator engaged in the drilling,
25 production maintenance and abandonment of Geothermal Wells
26 and related facilities including the disposal of waste products
27 shall comply with all applicable local, State, and Federal laws
28 and ordinances in effect or subsequently duly enacted.
- 29 3. Commencement of Work - Prior to commencing any operation all
30 Governmental conditions and standards applicable to the parti-
31 cular phase of work contemplated shall be complied with.
- 32 4. General Compliance - All well drilling, plant construction,

1 testing and operations shall be conducted so as to be in
2 harmony with the area and do not conflict with the public
3 health, safety, comfort, convenience, and general welfare.

4 5. General Plan Development - The operator shall cooperate with
5 the County or the County's agent in the development of the
6 County's Geothermal Element for the General Plan. The operator
7 will be expected to provide data and knowledge up to, but not
8 including "proprietary information".

9 6. Permit Expiration - The permit shall be for a period of two
10 and one-half (2 1/2) years. Abandonment of a project for
11 six months shall cause permit to expire and become null and
12 void.

13 7. Timetable - The timetable for development as contained in the
14 application is hereby made a portion of the conditions. Failure
15 to complete the project in accordance with the timetable could
16 cause the permit to become null and void.

17 8. Bonds - Each operator of a "Geothermal Production Project"
18 and/or "Exploratory Geothermal Well" shall file and furnish with
19 County an indemnity bond in the sum of \$50,000.00 for each well
20 drilled or abandoned well re-entered or a blanket bond in the
21 sum of \$150,000.00 for any number of wells drilled or re-entered.
22 The Bond will indemnify the County for any costs incurred by the
23 County in repairing any drill, test, or production facility site,
24 to as near as possible to its original state and in abating any
25 public nuisance caused by the principal's exploratory, testing,
26 of producing operations.

27 9. Insurance - Before commencing or continuing any Geothermal
28 operations, the owner or operator shall show continuing
29 evidence of insurance against liability in tort in a minimum
30 amount of \$1,000,000.00 arising from the production activi-
31 ties or operations incidental thereto conducted or carried
32 on under, or by virtue of any law or ordinance. Such insur-

1 ance shall be kept in full force and effect during the period
2 of operations.

3 10. Subsidence - The operator shall participate in geothermal
4 subsidence prevention and detection program. The monuments
5 previously set shall be rerun and tied into the Imperial County
6 level net during each year the well is flowed. The surveys
7 will be conducted by a registered engineer or a licensed land
8 surveyor and the detailed information and the results of
9 these surveys shall be certified and shall be submitted to
10 the Department of Public Works within 30 days after completing
11 the field work.

12 11. Cleanup - Upon completion of any phase of the project, the
13 site shall be cleaned up in accordance with the Standards,
14 and insofar as practical, the land returned to its original
15 condition.

16 12. Waste Disposal - All waste, whether liquid or solid, must be
17 disposed of in compliance with the existing County, State, and
18 Federal rules and regulations.

19 13. Noise and Vibration Suppression - The operation of temporary
20 or permanent equipment and all other operation performed on
21 the premises shall be done in a manner so as to suppress all
22 noise and vibration to an acceptable level.

23 14. Odor and Gas Control - All operators shall take steps to insure
24 that no harmful or obnoxious gases be released as a result of
25 their operations.

26 15. Right of Entry - The County reserves the right to enter the
27 premises under the control of the operator of any Geothermal
28 operation to make appropriate inspections to determine if the
29 conditions of this policy are being fulfilled.

30 16. Operation Personnel - All development operations shall be
31 conducted under the direction of a responsible engineer or
32 agent. The operator shall insure that a maintenance crew

1 is immediately available to insure compliance with the con-
2 ditions and standards required.

3 17. The applicant shall comply with the Class I Standards for
4 Geothermal Development as adopted by the County with the
5 exception of paragraph II D 1. h..

6 18. The granting of this permit to conduct a geothermal test
7 program shall not be construed to commit the Planning Commission
8 or the Board of Supervisors to future Geothermal Projects.

9 Motion made by Commissioner Jensen, seconded by Commissioner Bell,
10 and carried on the affirmative roll call vote of Commissioners Anderholt,
11 Bell, Bornt, Haskell, Jensen, and Rutherford with Commissioner Villalobos
12 not voting by reason of his absence.

13 This is to certify that the foregoing is a true and correct copy
14 of a resolution passed by the Imperial County Planning Commission in a
15 meeting held in the Board of Supervisors Chambers, Courthouse,
16 January 9, 1973.

17 LESTER A. BORNT, Chairman

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20 RICHARD D. MITCHELL, Secretary
21 Imperial County Planning Commission

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Geothermal
TEST EQUIPMENT ARRANGEMENT
FOR FLOW TESTING OF
MAGMAX #1 FROM
4-28-72 TO 5-4-72

1

MAGMAMAX #1 FLOW TEST

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
TIME	WELL HEAD PRESS	WELL HEAD TEMP	SEPARATOR INLET PRESS.	SEP. INLET VALVE POSITION	LIQUID LEVEL IN SEP.	STEAM TEMP	STEAM PRESS.	STEAM FLOW LB/HR	% STEAM FLOW	BRINE TEMP	BRINE PRESS.	BRINE FLOW LB/HR	VALVE POSITION DOWNSTREAM	VALVE POSITION DOWNSTREAM	WATER COIL TEMP	PUMP DISCHARGE PRESS.	INJECTION WELL PRESS.	TOTAL FLOW GPM	TOTAL FLOW GPM
FRIDAY APR. 28TH																			
1:00 PM	200 PSI	398°F	150 PSI	60%	?	358°F	130 PSI	84,000	15.1	362°F	140 PSI	470,000					300 PSI	554,000	1120
1:25 PM	190	392°F	182	100%	50%	374°F	162	63,000	11.3	377	168	495,000					320 PSI	558,000	1120
1:45 PM	190	390°F	178	100%	40%	372°F	160	72,000	13.3	377	168	473,000					320 PSI	542,000	1080
SATURDAY APR. 29TH																			
1:00 PM	240	410	152	80%	0	354	123	80,000	—	358	130	—	50%	50%				574,000	1156
1:35 PM	165	382	152	100%	60%	357	130	74,000	12.9	362	137	500,000						466,000	975
2:00 PM	165	382	152	100%	60%	356	120	71,000	14.6	362	136	415,000	50%	25%		750	320	541,000	1080
2:50 PM	165	380	150	100%	60%	355	127	71,000	13.1	362	135	470,000	50%	25%				530,500	1060
3:15 PM	170	380	148	100%	60%	354	127	70,560	13.7	362	134	460,000	50%	25%		750	320	540,560	1090
4:10 PM	170	380	150	100%	60%	355	128	70,560	13.1	361	134	470,000	50%	25%				530,560	1060
5:00 PM	170	379	148	100%	65%	355	125	70,560	13.3	362	134	460,000	50%	25%		750	320	510,400	1020
6:00 PM	170	378	146	100%	60%	350	124	70,600	13.8	360	132	440,000	50%	25%					
6:30 PM	THROTTLED BACK ON SEPARATOR INLET VALVE, WAIT ON ADDITIONAL PUMP TRUCK																		
7:00 PM	300	424	111	35%	50%	326	96	53,000	13.2	342	100	350,000	50%	25%				403,000	806
8:00 PM	300	424	112	35%	50%	336	91	54,000	13.4	342	101	350,000	50%	25%				404,000	806
9:10 PM	300	428	115	35%	50%	332	95	55,000	13.6	342	105	350,000	50%	25%				405,000	810
10:05 PM	300	428	114	35%	55%	332	95	55,000	13.6	342	102	350,000	50%	25%				405,000	810
11:00 PM	300	428	115	35%	55%	332	95	55,000	13.6	344	104	350,000	50%	25%				405,000	810
12:00 MIDNIGHT	300	427	116	35%	55%	334	96	55,000	13.6	342	105	350,000	50%	25%				405,000	810
SUNDAY APR. 30TH																			
2:00 AM	300	428	115	35%	55%	336	96	55,000	13.6	342	105	350,000	50%	25%				405,000	810
3:00 AM	300	428	115	35%	55%	335	97	55,000	13.5	344	105	300,000	50%	25%				355,000	711
4:00 AM	300	428	115	35%	55%	336	97	56,000	13.5	344	105	300,000	50%	25%				356,000	711
5:00 AM	300	428	115	35%	55%	336	97	55,000	14.1	344	105	336,000	50%	25%				391,000	782
6:00 AM	300	428	115	35%	55%	336	97	55,000	13.6	344	105	336,000	50%	25%				405,000	810
7:00 AM	300	428	115	35%	55%	335	96	54,000	13.6	345	105	350,000	50%	25%				404,000	807
8:00 AM	300	429	117	35%	55%	338	99	56,000	13.6	345	105	350,000	50%	25%				406,000	812
9:00 AM	300	429	117	35%	55%	340	100	55,000	13.6	345	105	350,000	50%	25%				405,000	810
10:00 AM	300	428	117	35%	55%	338	100	56,000	13.8	344	106	350,000	50%	25%				406,000	812
11:00 AM	300	429	118	35%	55%	338	100	56,000	13.8	345	106	350,000	50%	25%				406,000	812
12:00 NOON	305	429	118	35%	55%	338	100	56,000	14.3	345	106	336,000	—	—				392,000	782
12:50 PM	OPENED SEPARATOR INLET VALVE 100%																		
1:15 PM	175	365	160	100%	60%	358	137	71,000	13.5	343	143	456,000	40%	25%				527,000	1050
2:00 PM	175	364	155	100%	60%	358	135	71,000	13.5	344	138	456,000	✓	✓				527,000	1050
3:00 PM	175	382	152	100%	50%	355	130	69,000	13.9	364	137	426,000	40%	25%	258	500	340	495,000	990
4:00 PM	175	378	150	100%	50%	340	129	68,000	14.4	363	135	404,000	40%	25%	182	500	340	472,000	995
5:00 PM	140	363	123	100%	50%	338	105	58,500	14.6	344	110	336,000	40%	25%	159	500	340	394,500	786
6:00 PM	140	364	128	100%	55%	342	110	54,000	13.3	349	117	350,000	30%	25%	256	500	340	405,000	810
7:00 PM	140	364	126	100%	55%	342	108	52,000	12.9	348	115	350,000	30%	25%	258	500	350	402,000	804
8:00 PM	140	364	125	100%	55%	342	107	50,800	13.3	348	115	320,000	30%	25%	260	✓	✓	360,800	760

CHANGE TO DAYLIGHT SAVING TIME

NOT IN OPERATION

ADJUSTED FLOW

2

MAGMAMAX #1 FLOW TEST

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
TIME	WELL HEAD PRESS	WELL HEAD TEMP	SEP. INLET PRESS.	SEP. VALVE POSITION	SEP. LIQUID LEVEL	STEAM TEMP.	STEAM PRESS	STEAM FLOW LB/HR	% STEAM FLOW	BRINE TEMP	BRINE PRESS.	BRINE FLOW LB/HR	VALVE STEAM	POSITION TBRINE	WATER COIL TEMP.	INJECTION PUMP PRESS	INJECTION WELL PRESS.	TOTAL FLOW	TOTAL FLOW GPM
<u>SUNDAY APR. 30TH</u>																			
9:00 PM	135	362	121	100%	50	338	108	50,000	12.6	346	110	347,000	30%	40%	269	500	350	347,000	790
10:00 PM	125	362	121	100%	50	338	107	50,000	12.6	348	109	347,000	30%	40%	259	500	350	347,000	790
11:00 PM	125	362	120	100%	55	336	106	50,000	14.3	346	110	300,000	✓	✓	260	500	360	350,000	700
12:00 MIDNIGHT	120	360	119	100%	55	336	103	49,000	14.0	344	108	300,000	✓	✓	266	500	375	349,000	698
<u>MONDAY MAY 1ST</u>																			
1:00 AM	120	359	118	100%	55%	336	102	49,000	14.0	342	107	300,000	✓	✓	266	500	375	349,000	698
2:00 AM	120	359	118	100%	55%	336	102	49,000	14.0	342	105	300,000	✓	✓	270	500	380	349,000	698
3:00 AM	120	358	120	100%	55%	336	101	49,500	14.0	342	106	300,000	✓	✓	269	500	380	349,000	698
4:00 AM	120	357	120	100%	55%	336	98	48,000	14.0	342	104	300,000	✓	✓	269	500	375	348,000	696
5:00 AM	120	358	113	100%	55%	336	97	47,500	15.2	342	103	266,000	✓	✓	272	500	380	313,500	626
6:00 AM	110	357	113	100%	55%	333	96	47,000	16.0	340	100	246,000	✓	✓	272	500	375	293,000	556
7:00 AM	110	355	116	100%	55%	333	96	47,000	16.0	339	100	246,000	✓	✓	270	500	375	293,000	586
8:00 AM	105	358	118	100%	60%	332	98	47,500	16.0	340	100	246,000	✓	✓	272	500	380	293,000	586
9:15 AM	105	354	112	100%	60%	332	98	48,000	16.3	339	100	246,000	✓	✓	268	500	385	294,000	590
10:00 AM	105	354	112	100%	60%	334	96	47,000	15.0	340	100	266,000	✓	✓	272	500	380	313,000	625
11:00 AM	105	354	110	100%	65%	334	94	48,000	15.3	338	100	266,000	✓	✓	274	500	390	314,000	625
12:00 NOON	105	354	110	100%	65%	333	95	47,000	15.0	338	100	266,000	✓	✓	275	500	390	313,000	625
1:00 PM	105	352	107	100%	65%	332	93	46,000	16.3	338	100	246,000	✓	✓	274	500	390	294,000	590
2:00 PM	105	354	110	100%	65%	332	93	48,000	16.3	338	98	246,000	✓	✓	274	500	390	294,000	590
3:00 PM	105	353	110	100%	65%	331	85	48,000	15.3	338	100	246,000	✓	✓	274	500	320	314,000	625
4:00 PM	110	353	110	100%	55%	332	94	48,000	15.3	338	98	266,000	✓	✓	274	500		314,000	625
5:00 PM	110	353	110	100%	50%	332	94	47,500	16.2	339	98	246,000	30%	20%	274			314,000	590
6:00 PM	112	352	107	100%	45%	332	97	46,500	17.1	340	97	225,000	30%	20%	274			299,000	545
7:00 PM	112	352	107	100%	45%	332	97	44,500	16.5	338	95	225,000	30%	20%	275			271,500	540
8:00 PM	110	346	100	100%	40%	324	82	42,000	14.6	332	95	246,000	30%	20%	275	500	400	269,500	575
9:00 PM	105	342	93	100%	70%	320	75	41,000	17	328	80	225,000	50%	25%				288,000	545
10:00 PM	100	344	92	100%	45%	317	75	42,000	15.7	326	76	225,000	50%	25%				272,000	535
11:00 PM	100	344	90	100%	55%	315	75	49,000	15.7	326	76	266,000	50%	25%	252		360	267,000	625
12:00 MIDNIGHT	130	363	130	100%	55%	344	122	38,000	11.6	352	146	290,000	50%	20%	252		320	315,500	655
<u>TUESDAY MAY 2ND</u>																			
1:00 AM	148	370	146	100%	50%	352	135			360	140				292			328,000	
2:00 AM	130	363	126	100%	50%	344	117			352	122				284				
3:00 AM	130	363	130	100%	50%	344	117			352	122				284				
4:00 AM	130	363	130	100%	50%	344	117			352	122				284				
5:00 AM	130	363	130	100%	52%	344	118			352	124				285				
6:00 AM	130	364	130	100%	50%	344	118			352	124				287				
	SHUT	DOWN	TO	OVERFLOW	OF FLASH	TANK													
11:00 AM	285	421	115	?	57%	336	105			344	107		25%	25%	286				
12:00 NOON	290	422	115	?	52%	336	105			344	109		25%	25%	286				
1:00 PM	290	422	116	?	54%	336	105			344	109		25%	25%	286	500			
2:00 PM	290	422	117	30%	60%	337	107			344	109		25%	25%	286	500			
3:00 PM	295	422	118	30%	58%	337	107			345	110		25%	25%	286	500			
4:00 PM	295	423	119	30%	54%	337	107			346	110		25%	25%	278	500			

TOO LOW TO MEASURE

TOO LOW TO MEASURE

3

MAGMAMAX #1 FLOW TEST

TIME	(1) WELL HEAD PRESS	(2) WELL HEAD TEMP	(3) SEP INLET PRESS	(4) SEP VALVE POSITION	(5) SEP LIQUID LEVEL	(6) STEAM TEMP	(7) STEAM PRESS	(8) STEAM FLOW LB/HR.	(9) % STEAM	(10) BRINE TEMP	(11) BRINE PRESS.	(12) FLOW LB/HR.	(13) VALVE STEAM	(14) POSITION BRINE	(15) WATER COIL TEMP	(16) INJECTION PUMP PRESS	(17) INJECTION WELL PRESS	(18) TOTAL FLOW LB/HR.	(19) TOTAL FLOW GPM
<u>TUESDAY MAY 2ND</u>																			
5:00 PM	300	424	120	30%	61%	338	107	15,600	(	346	111		25%	25%	276	500		TOO LOW	
6:00 PM	300	424	120	30%	66%	338	107	16,500	TOO	346	111		25%	25%	278	500			
7:00 PM	300	424	119	30%	39%	338	107	15,200	LOW	346	110		25%	30%	278	500	320		
8:00 PM	300	424	119	30%	49%	337	106	15,900	(	346	110								
9:00 PM		INCREASING	RATE	OPENING	INLET	VALVE													
10:00 PM	160	381	138	75%	55%	349	120	49,500	14.4	354	127	294,000	30%	30%				343,500	690
11:00 PM	140	370	135	100%	50%	348	117	49,500	12.9	355	125	333,000	✓	✓				382,500	766
12:00 MIDNIGHT	180	368	180	100%	45%	370	171	36,000	10.1	379	176	320,000	25%	✓	298			356,000	710
<u>WEDNESDAY MAY 3RD</u>																			
1:00 AM	180	386	180	100%	50%	367	172	36,000	9.8	376	175	353,000	✓	✓				369,000	740
2:00 AM	180	386	180	100%	50%	367	172	38,000	10.6	376	175	320,000						358,000	715
3:00 AM	140	386	180	100%	50%	368	172	36,000	10.4	376	175	310,000			298			347,000	695
4:00 AM	SHUT DOWN, HOLDING TANK OVERFLOWED																		
5:00 AM																			
6:00 AM																			
2:00 PM	160	376	152	100%	60%	354	133	49,700	13.0	306	138	333,000	25%	30%	162			382,700	765
3:00 PM	155	375	150	100%	55%	356	135	49,400	12.9	308	135	333,000	25%	30%	158			382,400	762
4:00 PM	150	372	145	100%	47%	352	127	48,000	11.1	362	132	362,000	25%	30%	159			407,000	815
5:00 PM	110	352	98	100%	50%	319	70	58,600	15.5	274	77	320,000	50%	27%	140			378,300	755
6:00 PM	168	382	168	100%	46%	364	150	43,500	12.0	312	157	320,000	20%	27%	158			363,500	725
7:00 PM	165	380	162	100%	55%	362	150	34,000	9.6	312	157	320,000	✓	✓	✓			354,000	710
8:00 PM	165	380	162	100%	55%	359	147	33,000	11.0		155	266,000						299,000	600
9:00 PM	140	364	125	100%	60%	338	105	52,500	13.6		111	333,000						385,500	772
10:00 PM	140	362	123	100%	60%	336	105	52,500	13.6		111	333,000						385,500	772
11:00 PM	140	362	123	100%	55%	336	103	51,500	12.9		110	348,000						349,500	749
12:00 MIDNIGHT	125	360	120	100%	52%	334	101	46,900	12.8		108	320,000			288			366,900	734
<u>THURSDAY MAY 4</u>																			
1:00 AM	145	370	142	100%	50%	349	127	41,000	12.6		135	284,000	20%		301			325,000	650
2:00 AM	145	370	142	100%	50%	349	127	41,000	12.6		135	284,000	✓		300			325,000	650
3:00 AM	145	370	142	100%	50%	350	127	41,000	11.0		132	333,000	✓		303			374,000	746
4:00 AM	145	369	142	100%	50%	350	134	32,300	9.6		144	320,000	✓		307			335,000	670
5:00 AM	150	378	147	100%	50%	359	145	28,600	9.1		150	284,000	✓		308			313,000	625
6:00 AM	240	407	131	30%	55%	349	135	30,800	10.6		140	266,000	✓		302			291,000	582
7:00 AM	290	421	130	30%	50%	343	125				126	201,000	10%		300				
8:00 AM	290	422	138	30%	56%	344	125				132	224,000	✓		292				
9:00 AM	295	422	138	30%	56%	348	127				131	224,000	10%	20%	300				
10:00 AM	290	422	138	30%	58%	348	127				132	224,000	10%	24%					
11:30 AM	110	344	90	100%	41%	316	65	67,000	16.8		75	333,000	60%	27%				400,000	800

CAPITAL COST FACTORS

Book Life (yrs)	5
Income Tax Life (yrs)	28
Capital Recovery (percent/year)	26.65
Income Tax (percent/year)	12.46
Property Tax (percent/year)	2.52
Salvage Effect (percent/year)	0.0
TOTAL (percent/year)	41.63
Debt Ratio (percent)	49.20
Debt Interest (percent)	9.00
Federal Tax Rate (percent)	48.00
State Tax Rate (percent)	9.00
Federal Surtax (percent)	0.0

Rule 113 - Opacity of Emissions.

A. No person shall release or discharge into the atmosphere from any existing single source of emission whatsoever, any air contaminant for a period or periods aggregating more than three (3) minutes in any hour which is:

1. As dark or darker in shades as that designated as No. 2 Ringlemann Chart as published by the United States Bureau of Mines or,
2. Of such opacity as to obscure an observer's view to a degree equal to or greater than does smoke described in subsection 1 above.

B. No person shall release or discharge into the atmosphere from any single source of emission whatsoever constructed after July 1, 1972, any air contaminant for a period or periods aggregating more than three (3) minutes in any one hour which is;

1. As dark or darker in shade than No. 1 on the Ringlemann Chart as published by the United States Bureau of Mines, or
2. Of such opacity as to obscure an observer's view to a degree equal to or greater than does smoke described in subsection 1 above.

Rule 114 - Quantity of Emissions

A. No person shall release or discharge into the atmosphere from any existing single processing unit source consisting of any article, machine, equipment, or other contrivance which emits dust, fumes, or particulate matter in excess of 0.3 grains per cubic foot of gas, or equivalent metric measurement, at standard conditions.

B. No person, after July 1, 1972, shall build, erect, install, or expand a single processing unit source consisting of any article, machine, equipment or other contrivance which emits dust, fumes, or particulate matter in excess of 0.2 grains per cubic foot of gas, or equivalent metric measurement, at standard conditions.

Rule 116 - Specific Contaminants

A. No person shall discharge into the atmosphere from any single source of emission, sulfur compounds, calculated as sulphur dioxide (SO_2) in excess of 0.2 percent by volume, measured at point of discharge.

B. No person shall discharge into the atmosphere from any existing single source of emission, exceeding in concentration at the point of discharge, combustion contaminants consisting of 0.3 grains per cubic foot of gas calculated to 12 percent of carbon dioxide (CO_2) at standard conditions, except during the start of an operation, or change in energy source, during the time necessary to bring the combustion process up to operating level. In measuring the combustion contaminants from incinerators used to dispose of combustible refuse, by burning, the carbon

TABLE 1
DESIGN FLOW CONDITIONS
MULTI-STAGE FLASH

GEO THERMAL FLUID:

Production Well Flow - 2 wells	(lbs/hr)	800,000
Water	(lbs/hr)	544,000
Solids	(lbs/hr)	136,000
Non-Condensable gas	(lbs/hr)	24,000
Steam	(lbs/hr)	96,000
First Stage Temp - inlet	(°F)	370
First Stage Press - inlet	(psig)	150
Last Stage Temp - inlet	(°F)	140

ISOBUTANE:

Flow	(lbs/hr)	1,000,000
Temperature - turbine inlet	(°F)	325
Pressure - turbine inlet	(psig)	485
Temperature - condenser outlet	(°F)	120
Pressure - condenser outlet	(psig)	80

COOLING WATER:

Temperature - inlet	(°F)	90
---------------------	------	----

FIG. 1
APPENDIX C

FIG. 3
APPENDIX C

FIG. 4
APPENDIX C

TABLE 2
NON-CONDENSIBLE GAS ANALYSES

First Stage Steam Sample: May 10, 1974

CO ₂	96.04%
CH ₄	1.55%
N ₂	1.12%
O ₂	1.29%
H ₂	Trace
H ₂ S	1000-1200 ppm

First Stage Temp: 375°F

First Stage Press: 150 psig

Non-condensable gas flow 3% (by weight)

Total flow (two wells)

SEPARATOR
POTS

FIG. 5
APPENDIX C

FIG. 6
APPENDIX C

TABLE 1
SEPARATOR DESIGN PARAMETERS

Maximum Vapor Velocity (ft/sec) Through Vessel Space	3.0
Mixed Phase Velocity (ft/sec) Through Inlet	60.0
Maximum Liquid Level (inch)	18.0
Number of Inlets	1
Length to Diameter Ratio	3.0
(*)Maximum Dissolved Solids (TDS) in Steam Leaving Separator	300

(*)Normal operation. See steam sample analysis in
Appendix D.

FIG. 3
APPENDIX D

ELEVATION

NOTE

TRAYS TO BE ONE PIECE
LIQUID TIGHT

THE BEN HOLT CO.			
VERTICAL STEAM WASHER TOWER			
SURFACES			
DESIGNED BY	DATE	7887-B-2800	1

FIG. 5
APPENDIX D

TABLE 2

SCRUBBER DESIGN PARAMETERS

Maximum Pressure Loss (psi) Across Five Trays	1.0
Maximum Pressure Loss (psi) Across Scrubber	1.25
Maximum Wash Water Flow (GPM) Per 5000 lbs/hr Steam Flow	0.2
Number of Trays	5.0
Tray Spacing (inches)	24.0
Maximum Tower Height (feet) Not Including Top Cap	24.0
(*)Maximum Dissolved Solids (TDS) in Steam Leaving Scrubber	30

(*)See steam sample analysis in Appendix D.

FIG. 6
APPENDIX D

GHT LABORATORIES OF IMPERIAL VALLEY, INC.
106 SOUTH 8th STREET • BRAWLEY, CALIFORNIA
344-2532

LABORATORY NO.	D 108k	REPORTED	3-15-74
FOR	SAN DIEGO GAS & ELECTRIC	SAMPLED	
SAMPLE	LIQUID (4)	RECEIVED	3-13-74
IDENTIFICATION	1. 3/7/74 1st EFFECT STM. 4:00 PM 6" LEVEL		
	2. 3/7/74 2nd EFFECT STM. 5:00 PM 6" LEVEL		
	3. 3/7/74 2nd EFFECT STM. 4:00 PM 6" LEVEL		
	4. 3/7/74 1st EFFECT STM. 5:00 PM 6" LEVEL		

Based on sample --- drawn by this laboratory ☐

delivered to us - . - X

RESULTS OF ANALYSIS

SEE ATTACHED SHEET

GHT LABORATORIES OF IMPERIAL VALLEY

ROBERT A. REYNOLDS

As a mutual protection to clients, the public and ourselves, all reports are submitted as the confidential property of clients, and authorization for publication of statements, conclusions or extracts from or regarding our reports is reserved, pending our written approval.

G H T LABORATORIES

D 1081

SAN DIEGO GAS & ELECTRIC

of Imperial Valley

LIQUID (4)

ANALYTICAL & CONSULTING CHEMISTS
PESTICIDE RESIDUE & FEED ANALYSIS106 South 8th Street
Brawley, California 4

	1	2	106 South 8th Street Brawley, California 4	
SODIUM (Na)	45 mg/l	40 mg/l	55 mg/l 344-2532	15 mg/l
POTASSIUM (K)	5 mg/l	5 mg/l	5 mg/l	3 mg/l
MAGNESIUM (Mg)	0.5 mg/l	1 mg/l	0.5 mg/l	ND
MANGANESE (Mn)	0.5 mg/l	0.4 mg/l	0.2 mg/l	0.3 mg/l
IRON (Fe)	1 mg/l	N.D.	4 mg/l	2 mg/l
COPPER (Cu)	0.6 mg/l	0.2 mg/l	0.2 mg/l	0.4 mg/l
ZINC (Zn)	0.3 mg/l	N.D.	0.1 mg/l	0.1 mg/l
LEAD (Pb)	3 mg/l	N.D.	N.D.	N.D.
CALCIUM (Ca)	8 mg/l	TRACE	10 mg/l	3 mg/l
LITHIUM (Li)	N.D.	N.D.	N.D.	N.D.
ALUMINUM (Al)	20 mg/l	15 mg/l	20 mg/l	10 mg/l
BARIUM (Ba)	N.D.	N.D.	N.D.	N.D.
STRONTIUM (Sr)	0.4 mg/l	0.3 mg/l	0.4 mg/l	0.4 mg/l
SILICA(SiO ₂)	15 mg/l	25 mg/l	42 mg/l	10 mg/l
CHLORIDE (Cl)	99 mg/l	88 mg/l	120 mg/l	50 mg/l
FLUORIDE(F)	1 mg/l	9 mg/l	5 mg/l	TRACE
BORON (B)	6 mg/l	4 mg/l	4 mg/l	6 mg/l
SULFATE (SO ₄)	10 mg/l	7 mg/l	4 mg/l	4 mg/l
SULFIDE (S)	2.1 mg/l	N.D.	N.D.	N.D.
TOTAL SOLIDS	180 mg/l	122 mg/l	262 mg/l	103 mg/l

NOTE: N.D. ON Mg = less than 0.5 mg/l
 N.D. ON Fe = less than 1 mg/l
 N.D. ON Zn = less than 0.1 mg/l
 N.D. ON Pb = less than 0.5 mg/l
 N.D. ON Li = Less than 0.5 mg/l
 N.D. ON Ba = less than 2 mg/l
 N.D. ON S = NONE DETECTED
 TRACE ON CALCIUM = less than 3 mg/l
 TRACE ON FLUORIDE = less than 1 mg/l

 ROBERT A. REYNOLDS

STEAM CHEMICAL ANALYSIS
SMALL-SCALE C. F. BRAUN SEPARATOR
BEN HOLT CO. STEAM SCRUBBER

PERFORMED BY: SDG&E MATERIALS
TEST LABORATORY

IDENTIFICATION: #1 - First Stage Separator Outlet
#2 - First Stage Scrubber Outlet
#3 - Second Stage Separator Outlet
#4 - Second Stage Scrubber Outlet

GEOTHERMAL TESTS

	SAMPLE NO. SAMPLE DATE	SAMPLE NO. SAMPLE DATE	SAMPLE NO. SAMPLE DATE	SAMPLE NO. SAMPLE DATE
	600 5/11/74 #1	600 5/11/74 #2	600 5/11/74 #3	600 5/11/74 #4
ALUMINUM	<1	<1	<1	<1
AMMONIA	-	-	-	-
BARIUM	<0.5	<0.5	<0.5	<0.5
BORON	<20	<20	<20	<20
CALCIUM	24	1.1	3.7	1.0
CHLORIDE	60	<2	420	9
COPPER	0.5	<0.1	1.4	<0.1
FLUORIDE	-	-	-	-
IRON	0.1	<0.1	<0.1	<0.1
LEAD	<0.5	<0.5	<0.5	<0.5
LITHIUM	-	-	-	-
MAGNESIUM	0.06	0.05	0.28	0.09
MANGANESE	0.7	<0.1	<0.1	<0.1
POTASSIUM	0.5	0.2	25	0.1
SILICON	2	2	2	2
SILVER	0.1	0.1	0.1	0.1
SODIUM	3	1.4	141	1.4
STRONTIUM	-	-	-	-
SULFATE	-	-	-	-
SULFIDE	-	-	-	-
ZINC	0.28	<0.02	<0.02	<0.02
T.D.S.	103	10	667	20
PH	8.4	8.6	9.1	9.4
OTHER	1150	1100	1120	740

GEOHERMAL TESTS

	SAMPLE NO. SAMPLE DATE	SAMPLE NO. SAMPLE DATE	SAMPLE NO. SAMPLE DATE	SAMPLE NO. SAMPLE DATE
	2200 5/15/74 #1	2200 5/15/74 #2	2200 5/15/74 #3	2200 5/15/74 #4
ALUMINUM	<1	<1	<1	<1
AMMONIA	-	-	-	-
BARIUM	<0.5	<0.5	<0.5	1.5
BORON	<20	<20	<20	<20
CALCIUM	30	0.8	20	0.5
CHLORIDE	160	3	168	<2
COPPER	<0.1	<0.1	<0.1	<0.1
FLUORIDE	-	-	-	-
IRON	<0.1	0.1	0.4	<0.1
LEAD	<0.5	<0.5	<0.5	<0.5
LITHIUM	-	-	-	-
MAGNESIUM	0.19	<0.01	0.30	0.05
MANGANESE	0.1	<0.1	1.2	<0.1
POTASSIUM	10	0.3	9	0.1
SILICON	<2	<2	17	<2
SILVER	<0.1	<0.1	<0.1	<0.1
SODIUM	58	1.1	54	0.3
STRONTIUM	-	-	-	-
SULFATE	-	-	-	-
SULFIDE	-	-	-	-
ZINC	0.03	<0.01	1	<0.01
T.D.S.	285	8	280	5
pH	8.3	8.5	8.4	8.6
OTHER <small>nalcometer</small>	300	1100	1050	930

GEOTHERMAL TESTS

	SAMPLE NO. SAMPLE DATE	SAMPLE NO. SAMPLE DATE	SAMPLE NO. SAMPLE DATE	SAMPLE NO. SAMPLE DATE
	200 5/16/74 #1	200 5/16/74 #2	200 5/16/74 #3	200 5/16/74 #4
ALUMINUM	<1	<1	<1	<1
AMMONIA	-	-	-	-
BARIUM	0.9	<0.5	13	<0.5
BORON	<20	<20	86	<20
CALCIUM	66	0.6	1635	10
CHLORIDE	950	4	9600	24
COPPER	0.3	<0.1	<0.1	<0.1
FLUORIDE	-	-	-	-
IRON	0.1	0.1	4	0.1
LEAD	<0.5	<0.5	4	<0.5
LITHIUM	-	-	-	-
MAGNESIUM	0.38	<0.01	4.3	0.01
MANGANESE	0.2	<0.1	42	0.5
POTASSIUM	64	0.3	676	0.3
SILICON	3	<2	63	<2
SILVER	<0.1	<0.1	<0.1	<0.1
SODIUM	400	1.2	3220	1.2
STRONTIUM	-	-	-	-
SULFATE	-	-	-	-
SULFIDE	-	-	-	-
ZINC	0.03	0.02	18	0.36
T.D.S.	1482	8	16430	48
pH	8.1	7.3	7.3	8.0
OTHER <small>nalcometer</small>	2650	1300	16,800	1000

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PURCHASING FLOWCHART - BEN HOLT + SDG&E

FIGURE 1

NOTE

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