

GLOIBAO

I N D E X

- A. Plan of Operations - (Section 270.34, Rules and Regulations, Geothermal Steam Act 1970)
- B. Geothermal Resources Operational Orders
  - (GRO Order 1 - Exploratory Operations)
  - (GRO Order 2 - Drilling Completion and Spacing of Geothermal Wells)
  - (GRO Order 3 - Plugging and Abandonment of Wells)
  - (GRO Order 4 - General Environmental Protection Requirements)
- C. Plan of Operation (Getty Oil Company)
- D. Plan of Operation (Republic Geothermal, Inc.)

## RULES AND REGULATIONS

(b) The lessee shall take all reasonable precautions to prevent: (1) Waste; (2) damage to any natural resource including trees and other vegetation, fish and wildlife and their habitat; (3) injury or damage to persons, real or personal property; and (4) any environmental pollution or damage.

(c) Any significant effect on the environment created by the lessee's operations or failure to comply with environmental standards shall be reported to the Supervisor within 24 hours and confirmed in writing within 30 days.

### § 270.31 Designation of operator or agent.

In all cases where operations are not conducted by the lessee but are to be conducted under authority of an unapproved operating agreement, assignment or other arrangement, a "designation of operator" shall be submitted to the Supervisor, in a manner and form approved by him, prior to commencement of operations. Such a designation will be accepted as authority of the operator or his local representative to act for the lessee and to sign any papers or reports required under the regulations in this part. All changes of address and any termination of the authority of the operator shall be immediately reported, in writing, to the Supervisor.

### § 270.32 Local agent.

When required by the Supervisor, the lessee shall designate a local representative empowered to receive notices and comply with orders of the Supervisor issued pursuant to the regulations in this part.

### § 270.33 Drilling and producing obligations.

(a) The lessee shall diligently drill and produce such wells as are necessary to protect the lessor from loss by reason of production on other properties, or in lieu thereof, with the consent of the Supervisor, shall pay a sum determined by the Supervisor as adequate to compensate the lessor for failure to drill and produce any such well.

(b) The lessee shall promptly drill and produce such other wells as the Supervisor may require in order that the lease be developed and produced in accordance with good operating practices. (See 43 CFR 3204.5.)

### § 270.34 Plan of operation.

Prior to commencing any operations on the leased lands or on any lands covered by a unit or cooperative agreement, the lessee shall submit in triplicate and obtain the approval of the Supervisor and the appropriate land management agency of a plan of operation for the area. Such plan shall include:

(a) The proposed location of each well including a layout showing the position of the mud tanks, reserve pits, cooling towers, pipe racks, etc.;

(b) Existing and planned access and lateral roads;

(c) Location and source of water supply and road building material;

(d) Location of camp sites, air-strips, and other supporting facilities;

(e) Other areas of potential surface disturbance;

(f) The topographic features of the land and the drainage patterns;

(g) Methods for disposing of waste material;

(h) A narrative statement describing the proposed measures to be taken for protection of the environment, including, but not limited to, the prevention or control of (1) fires, (2) soil erosion, (3) pollution of the surface and ground water, (4) damage to fish and wildlife or other natural resources, (5) air and noise pollution, and (6) hazards to public health and safety during lease activities;

(i) All pertinent information or data which the Supervisor may require to support the plan of operations for the utilization of geothermal resources and the protection of the environment;

(j) Provisions for monitoring deemed necessary by the Supervisor to ensure compliance with these regulations for the operations under the plan; and

(k) A requirement for the collection of data concerning the existing air and water quality, noise, seismic and land subsidence activities, and ecological system of the leased lands covering a period of at least one year prior to the submission of a plan for production. The information required for paragraphs (a) through (f) of this section may be shown on a map or maps available from State or Federal sources.

### § 270.35 Subsequent well operations.

After completion of all operations authorized under any previously approved notice or plan, the lessee shall not begin to redrill, repair, deepen, plug back, shoot, or plug and abandon any well, make casing tests, alter the casing or liner, stimulate production, change the method of recovering production, or use any formation or well for brine or fluid injection until he has submitted to the Supervisor in writing a new plan of operations and has received written approval from him. However, in an emergency a lessee may take action to prevent damage without receiving prior approval from the Supervisor, but in such cases the lessee shall report his action to the Supervisor as soon as possible.

### § 270.36 Well designations.

The lessee shall mark each derrick upon commencement of drilling operations and each producing or suspended well in a conspicuous place with his name or the name of the operator, the serial number of the lease, the number and location of the well. Whenever possible, the well location shall be described by section or tract, township, range, and by quarter-quarter section or lot. The lessee shall take all necessary means and precautions to preserve these markings.

### § 270.37 Well records.

(a) The lessee shall keep for each well at his field headquarters or at other locations conveniently available to the Supervisor, accurate and complete rec-

ords of all well operations including production, drilling, logging, directional well surveys, casing, perforation, safety devices, redrilling, deepening, repairing, cementing, alterations to casing, plugging, and abandoning. The records shall contain a description of any unusual malfunction, condition or problem; all the formations penetrated; the content and character of mineral deposits and water in each formation; thermal gradients, temperatures, pressures, analyses of geothermal waters, the kind, weight, size, grade, and setting depth of casing and any other pertinent information.

(b) The lessee shall, within 30 days after completion of any well, transmit to the Supervisor copies of the records of all operations in a form prescribed by the Supervisor.

(c) Upon request of the Supervisor, the lessee will furnish (1) legible, exact copies of service company reports on cementing, perforating, acidizing, analyses of cores, electrical, and temperature logs, chemical analyses of steam and waters, or other similar services; (2) other reports and records of operations in the manner and form prescribed by the Supervisor.

### § 270.38 Samples, tests, and surveys.

(a) The lessee, when required by the Supervisor, will make adequate sampling, tests and/or surveys using acceptable techniques, to determine the presence, quantity, quality, and potential of geothermal resources, mineral deposits, or water; the amount and direction of deviation of any well from the vertical; and/or formation temperatures and pressures, casing, tubing, or other pressures and such other facts as the Supervisor may require. Such tests or surveys shall be made without cost to the lessee.

(b) The lessee shall, without cost to the lessor, take such formation samples or cores to determine the identity and character of any formation as are required and prescribed by the Supervisor.

### § 270.39 Directional survey.

The Supervisor may require an angular deviation and directional survey to be made of the finished hole of each directionally drilled well. The survey shall be made at the risk and expense of the lessee unless requested by an offset lessee, and then, at the risk and expense of the offset lessee. A copy of the survey shall be furnished the Supervisor.

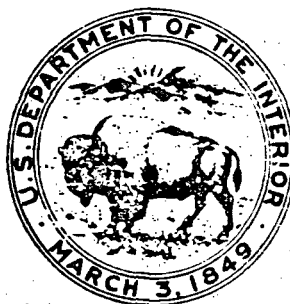
### § 270.40 Well control.

The lessee or operator shall: (a) Take all necessary precautions to keep all wells under control at all times; (b) utilize trained and competent personnel; (c) utilize properly maintained equipment and materials; and (d) use operating practices which insure the safety of life and property. The selection of the types and weights of drilling fluids and provisions for controlling fluid temperatures, blowout preventers, and other surface control equipment and materials, casing and cementing programs, etc., to be used shall be based on sound engineering principles and shall take into account apparent geothermal gradients, depths and

# **GEOHERMAL RESOURCES OPERATIONAL ORDERS**

**Issued under the Geothermal Steam Act of 1970**

- GRO Order 1. Exploratory Operations**
- GRO Order 2. Drilling, Completion and Spacing of Geothermal Wells**
- GRO Order 3. Plugging and Abandonment of Wells**
- GRO Order 4. General Environmental Protection Requirements**



**United States Department of Interior  
Geological Survey  
Conservation Division  
Office of the Area Geothermal Supervisor**

*January 1976*

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**GRO Order No. 1: Exploratory Operations**

UNITED STATES  
DEPARTMENT OF THE INTERIOR  
GEOLOGICAL SURVEY  
CONSERVATION DIVISION

GEOHERMAL RESOURCES OPERATIONAL ORDER NO. 1

Effective February 1, 1975

EXPLORATORY OPERATIONS

This Order is established pursuant to the authority prescribed in 30 CFR 270.11 and in accordance with 30 CFR 270.78. All exploratory operations other than drilling of exploratory and development wells will be conducted in accordance with the provisions of this Order. All plans for exploratory operations to be conducted shall include provisions for appropriate environmental protection and reclamation of disturbed lands. A cultural resources investigation approved by the Area Geothermal Supervisor (Supervisor) shall be performed prior to any surface disturbance other than Casual Use.

All variances from the requirements specified in this Order shall be subject to approval pursuant to 30 CFR 270.48. Each Notice of Intent to Conduct Geothermal Resources Exploration Operations shall include a notation of any proposed variances from the requirements of this Order. References in this Order to approvals, determinations, or requirements are to those given or made by the Supervisor or his delegated representative.

The following exploratory operations and reasonable expenditures therefor will qualify as diligent exploration if approved by the Supervisor prior to the initiation of such operations.

1. Casual Use. Casual Use shall include any entrance on the leased lands for geological reconnaissance or surveying purposes. Sampling of springs and water wells on the lease for geochemical analysis shall be construed as casual use. Such non-disturbing surveys and reconnaissance operations will not require a Notice of Intent to Conduct Geothermal Resources Exploration Operations. The lessee shall notify the Supervisor prior to commencing such casual use operations. Casual Use operations proposed or completed shall be included in any subsequent Plan of Operations.

2. Geophysical Exploration. Geophysical exploration shall include, but is not limited to, surface electrical resistivity surveys, seismic ground noise surveys, passive micro-earthquake monitoring surveys, magneto-telluric surveys and all other geophysical surveys, including airborne techniques.

Geophysical surveys other than airborne techniques will require a Notice of Intent to Conduct Geothermal Resources Exploration Operations, (Form 3200-9). All such anticipated surveys should be included in the Plan of Operations and must be approved by the Supervisor before the work is begun.

The lessee shall furnish the Supervisor two copies of the records of such surveys within 30 days after the completion of such operations.

3. Drilling of Shallow Holes. Drilling of shallow holes for the measurement of temperature gradients or heat flow will be considered as an exploration operation and will require approval of a Notice of Intent to Conduct Geothermal Resources Exploration Operations (Form 3200-9) by the Supervisor. The following stipulations shall apply to the drilling of such shallow holes:

A. Holes for measuring temperature gradients shall be limited to a depth of 152 metres (500 feet), unless otherwise authorized by the Supervisor.

B. Return-line temperatures shall be taken at no less than 9-metre (30 foot) intervals during drilling operations on shallow holes drilled with mud. If return-line mud temperature should reach 52°C. (125°F.), drilling ahead shall cease immediately and the hole will be either

(1) Completed as an observation hole by running steel tubing as deep as possible, filling the annulus with drilling mud from total depth to 3 metres (10 feet) below the surface and with cement from 3 metres (10 feet) to the surface;

(2) Abandoned by filling the hole with drilling mud from total depth to 3 metres (10 feet) below the surface and cement to the surface thereafter, or

(3) Equipped with mud cooling and wellhead control devices to maintain well control and mud returns temperature at or below 52°C. (125°F.).

C. If flowing steam or hot water at 65°C (150°F.) or greater is encountered, further drilling shall stop immediately and the hole will be either

(1) Completed as an observation hole using steel tubing cemented from total depth to surface; or

(2) Abandoned by plugging with cement from total depth to surface.

D. If cold flowing artesian water is encountered, the hole will be completed as in (C) hereinabove, except that plastic tubing may be used.

If the conditions outlined in (B), (C) or (D) are encountered, the Supervisor shall be notified immediately.

No exceptions to the stipulations of (B), (C) or (D) will be allowed without specific prior permission of the Supervisor.

E. The lessee shall submit the following information with the Notice of Intent to Conduct Geothermal Resources Exploration Operations (Form 3200-9):

(1) The approximate location (to the nearest 30 metres (100 feet) from some identifiable marker or object within the smallest legal subdivision) and hole number or designation of each proposed hole and probable order of drilling;

(2) The type and size of drilling rig;

(3) The proposed drilling program including the drilling system (type of bit and circulating medium), approximate depths and casing (conductor) program for each such hole;

(4) The type of drilling sump and proposed method of sump abandonment at each location;

(5) The approximate time that each hole will be used for observation; and

(6) The proposed method of abandonment for each hole. Additionally, the lessee shall notify and receive the approval of the Supervisor prior to any change in the location of an approved hole or for any additional holes which the lessee desires to drill.

F. Locations proposed in natural thermal areas within a 300-metre (1,000-foot) radius of hot springs, fumaroles, or other surface geothermal indicia, or in areas of known artesian water flow, will require a detailed drilling program for each hole, approved by the Supervisor. The Supervisor may require special drilling and completion techniques for such holes (such as cemented surface casing and simple expansion-type blowout preventers) to safely control formations containing geothermal or other resources which may be penetrated.

G. A supply of mud and lost circulation material shall be kept on hand while drilling to control abnormal pressure if rotary equipment is used.



H. Holes shall be completed for observation purposes in a manner which will allow satisfactory subsequent abandonment. As a minimum, the annular space shall be filled with mud (cuttings and dirt if drilled with air or auger) to 3 metres (10 feet) below the surface and with cement from 3 metres (10 feet) to the surface, and the tubing shall be capped when not in use.

I. Holes shall be abandoned in a manner that will prevent subsurface interzonal migration of fluids and surface leakage. As a minimum, the top 3 metres (10 feet) of tubing below the surface shall be filled with cement. Tubing shall be cut off at ground level or as directed by the Supervisor.

4. Reporting Completion of Exploration Operations. The Notice of Completion of Geothermal Resources Exploration Operations (Form 3200-10) shall be submitted in triplicate, and shall include the following information for each hole drilled:

- A. Final hole designation and location;
- B. A driller's log noting water table and water aquifers encountered (if determined), and salt, coal beds or other mineral deposits, if present;
- C. Method of completion, cementing, and casing and/or tubing used;
- D. Complete details of the abandonment procedures;
- E. Any information on drilling difficulties or unusual circumstances encountered which would be helpful in assuring future safety of operations or protection of the environment in the area concerned; and
- F. Temperature data and logs for each hole surveyed.

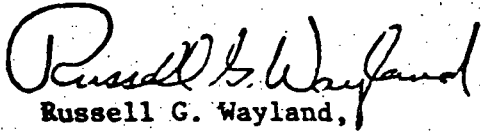
5. General. Drilling fluids or cuttings shall not be discharged onto the surface where such discharge might contaminate lakes and perennial or intermittent streams. Excavated pits or sumps used in drilling shall be backfilled as soon as drilling is completed and restored to conform with the original topography. Unattended sumps shall be completely fenced for the protection of the public, domestic animals and wildlife.

6. Notice of Entry. Applicant shall contact the appropriate U. S. Geological Survey Geothermal District Office prior to entry on the land to conduct exploration operations.



Reid T. Stone  
Area Geothermal Supervisor

Approved:



Russell G. Wayland,  
Chief, Conservation Division

**GRO Order No. 2: Drilling, Completion and Spacing  
of Geothermal Wells**

UNITED STATES  
DEPARTMENT OF THE INTERIOR  
GEOLOGICAL SURVEY  
CONSERVATION DIVISION

GEOHERMAL RESOURCES OPERATIONAL ORDER NO. 2

Effective February 1, 1975

DRILLING, COMPLETION AND SPACING OF GEOTHERMAL WELLS

This Order is established pursuant to the authority prescribed in 30 CFR 270.11 and in accordance with 30 CFR 270.14, 270.15, and 270.40. All wells shall be drilled in such a manner as to minimize damage to the environment and to protect life, health, property, usable ground waters and geothermal resources.

All exploratory wells drilled for geothermal resources shall be drilled in accordance with the provisions of this Order. Initial development wells drilled for geothermal resources shall be drilled in accordance with the provisions of this Order, and these provisions shall continue in effect until field rules are issued. After field rules have been established by the Area Geothermal Supervisor (Supervisor), development wells in the individual fields shall be drilled in accordance with such rules.

Where sufficient geologic and engineering information is obtained through exploratory drilling, lessees may make application or the Supervisor may request the lessee to submit an application for the establishment of field rules. The Supervisor may issue field rules at any time he deems appropriate upon failure of the lessee to timely file for such field rules.

All wells drilled under the provisions of this Order shall have been included in an exploratory or development Plan of Operations as required under 30 CFR 270.34. Each Application for Permit to Drill (Form 9-331C) shall include all information required under 30 CFR 270.71, and shall include a notation of any proposed variances from the requirements of this Order. All variances from the requirements specified in this Order shall be subject to approval pursuant to 30 CFR 270.48. References in this Order to approvals, determinations, and requirements for submitting of information or applications for approval are to those granted, made or required by the Supervisor or his delegated representative. The lessee shall comply with the following requirements:

1. Well Casing. All wells shall be cased and cemented in accordance with the requirements of 30 CFR 270.15, and the application for permit to drill shall include the casing design safety factors for collapse, tension and burst. The permanent wellhead completion equipment shall be attached to the production casing or to the intermediate casing if the production casing does not reach to the surface except as otherwise authorized by the Supervisor to meet special well conditions. All casing strings reaching the surface shall be cemented at a sufficient

depth to provide adequate anchorage and support for the casing and any blowout prevention equipment required thereon. For the purpose of this Order, the several casing strings in order of normal installation are (1) conductor, (2) surface, (3) intermediate and (4) production strings. The following casing setting depth requirements are general in nature and subject to variations to permit the casing to be set and cemented in a competent formation. The Supervisor's determination of adequate casing setting depths shall be based upon all geologic and engineering factors including apparent geothermal gradients, depths and pressures of the various formations to be penetrated and all other pertinent information about the area. All depths in this Order refer to true vertical depth (TVD) below ground level, unless otherwise specified.

A. Conductor Casing. This casing shall be set at a minimum depth of 15 metres (50 feet) and a maximum depth of 60 metres (200 feet) before drilling into shallow formations suspected or known to contain geothermal resources, non-condensable gases, or other mineral resources or upon encountering such formations.

B. Surface Casing. This casing shall be set at a depth equivalent to or in excess of ten percent of the proposed total depth of the well provided, however, that such setting depth shall be not less than 60 metres (200 feet) nor more than 400 metres (1,300 feet).

C. Intermediate Casing. This casing shall be set at any time when required by well conditions encountered in drilling below the surface casing such as anomalous pressure zones, uncased fresh water aquifers, cave-ins, washouts, lost circulation zones, rapidly increasing thermal gradients or other drilling hazards. If a liner is used as an intermediate string, the lap shall be tested by a fluid entry or pressure test to determine whether a seal between the liner top and the next larger casing string has been achieved. The liner overlap shall be a minimum of 30 metres (100 feet). The test shall be recorded on the driller's log and may be witnessed by the Supervisor. In the event of lap or casing failure during the test, the lap or casing must be repaired or recemented and successfully retested as required by the Supervisor.

D. Production Casing. This casing may be set at the top of or through the potential producing zone and shall be set before completing the well for production. Production casing shall be run to the surface or lapped into the next larger casing string. The liner overlap, if utilized, shall be at least 30 metres (100 feet) and shall be tested, witnessed and recorded as in the case of intermediate casing hereinabove. In the event of lap or casing failure during the test, the lap or casing must be repaired or recemented and successfully retested as required

by the Supervisor. Production casing shall normally be of consistent nominal outside diameter from the surface or from the top of the lap to the casing shoe. The surface casing shall not be used as production casing, unless otherwise authorized by the Supervisor to meet special well conditions.

**E. Cementing of Casing.** The conductor and surface casing strings shall be cemented with a quantity of cement sufficient to fill the annular space back to the surface. The intermediate casing string shall likewise be cemented back to the surface or to the top of the lap if a liner is used as an intermediate string. Production casing shall be cemented with a high temperature resistant admix, unless waived by the Supervisor and shall be cemented in a manner necessary to exclude, isolate or segregate overlying formation fluids from the geothermal resources zone and to prevent the movement of fluids into possible fresh water zones. Production casing shall be cemented back to the surface or, if lapped, to the top of the lap. A temperature or cement bond log may be required by the Supervisor after setting and cementing the production casing and after all primary cementing operations if an unsatisfactory cementing job is indicated. Proposed well cementing techniques differing from the requirements of this paragraph will be considered by the Supervisor on an individual well basis.

**F. Pressure Testing.** Prior to drilling out the casing shoe after cementing, all casing strings set to a depth of 152 metres (500 feet) or greater, except for conductor casing, shall be pressure tested to a minimum pressure of 69 bars (1,000 psi) or 0.045 bars/metre (0.2 psi/ft) whichever is greater. All casing strings set at a depth less than 152 metres (500 feet), except for conductor casing, shall be pressure tested to a minimum pressure of 35 bars (500 psi). Such test shall not exceed the rated working pressure of the casing or the blow-out preventer stack assembly, whichever is lesser.

In the event of casing failure during the test, the casing must be repaired or recemented until a satisfactory test is obtained. A pressure decline of 10 percent or less in 30 minutes shall be considered satisfactory.

Casing test results shall be recorded on the driller's log and reported to the Supervisor within 30 days after the completion of such test. Advance notice of all casing and lap tests shall be given in sufficient time to enable the Supervisor to be present to witness such tests. The casing and lap test reports shall give a detailed description of the test, including mud and cement volumes, lapse of time between running and cementing casing and testing, method of testing and test results.

## G. Directional Surveys.

(1) General. Deviation surveys (inclination from vertical or single shot) shall be taken on all wells during the normal course of drilling at intervals not to exceed 152 metres (500 feet). The Supervisor may require a directional survey giving both inclination and azimuth or a dipmeter to be obtained on all wells. In calculating all surveys, a correction from true north to Lambert-Grid north shall be made after making the magnetic to true north correction. All surveys shall be filed with the Supervisor. Where directional surveys are required, composite surveys shall be filed with the Supervisor showing the interval from the bottom of the conductor casing to total depth.

(2) Vertical Wells. Wells are considered vertical if inclination does not exceed an average of five degrees from the vertical. The Supervisor may require a directional survey giving both inclination and azimuth at intervals not exceeding 30 metres (100 feet) between stations prior to, or upon, setting any casing string or liner (except conductor casing) and at total depth on any vertical well drilled in close proximity to lease boundaries or areas with an unstable land surface, highly faulted or steeply dipping beds, or in areas of suspected abnormal formation pressures.

(3) Directional Wells. Wells are considered directional if inclination exceeds an average of five degrees from the vertical. Directional surveys giving both inclination and azimuth shall be obtained at intervals not to exceed 30 metres (100 feet) between stations prior to, or upon, setting any casing string or liner (except conductor casing) and at total depth.

2. Blowout Prevention Equipment and Procedures. All necessary precautions shall be taken to keep all wells under control at all times, utilize trained and competent personnel, and utilize properly maintained equipment and materials. Blowout preventers and related well control equipment shall be installed, tested immediately thereafter and maintained ready for use until drilling operations are completed. Certain components, such as packing elements and ram rubbers, shall be of high temperature resistant material as necessary. All kill lines, blowdown lines, manifolds and fittings shall be steel and shall have a temperature derated minimum working pressure rating equivalent to the maximum anticipated wellhead surface pressure. Subject to subparagraphs (A) and (B) hereinbelow blowout prevention equipment shall have manually operated gates and hydraulic actuating systems and accumulators of sufficient capacity to close all of the hydraulically-operated equipment and have a minimum pressure of 69 bars (1,000 psi) remaining on the accumulator. Dual control stations shall be installed with a high

pressure backup system. One control panel shall be located at the driller's station and one control panel shall be located on the ground at least 15 metres (50 feet) away from the wellhead or rotary table. Air or other gaseous fluid drilling systems shall have blowout prevention assemblies. Such assemblies may include, but are not limited to, a rotating head, a double ram blowout preventer or equivalent, a banjo-box or an approved substitute therefor and a blind ram blowout preventer or gate valve, respectively. Exceptions to the requirements of this paragraph will be considered by the Supervisor only for certain geologic and well conditions such as stable surface areas with known low subsurface formation pressures and temperatures.

A proposed blowout prevention program and a blowout contingency plan including proposed containment, public health and safety and clean-up measures shall be submitted with the Application for Permit to Drill (Form 9-331C).

A. Conductor Casing. Before drilling below this string, at least one remotely controlled hydraulically-operated expansion type preventer or an acceptable alternative, approved by the Supervisor, including a drilling spool with side outlets or equivalent, shall be installed. A kill line and blowdown line with appropriate fittings shall be connected to the drilling spool.

B. Surface, Intermediate and Production Casing. Before drilling below any of these strings, the blowout prevention equipment shall include a minimum of:

- (1) One expansion-type preventer and accumulator or a rotating head;
- (2) A manual and remotely controlled hydraulically-operated double ram blowout preventer or equivalent having a temperature derated minimum working pressure rating which exceeds the maximum anticipated surface pressure at the anticipated reservoir fluid temperature;
- (3) A drilling spool with side outlets or equivalent;
- (4) A fillup line;
- (5) A kill line equipped with at least one valve; and
- (6) A blowdown line equipped with at least two valves and securely anchored at all bends and at the end.

C. Testing and Maintenance. Ram-type blowout preventers and auxiliary equipment shall be tested to a minimum of 69 bars (1,000 psi) or to the working pressure of the casing or assembly, whichever is the lesser. Expansion-type blowout preventers shall be tested to 70



percent of the above pressure testing requirements.

The blowout prevention equipment shall be pressure tested:

- (1) When installed;
- (2) Prior to drilling out plugs and/or casing shoes;
- (3) Not less than once each week, alternating the control stations; and
- (4) Following repairs that require disconnecting a pressure seal in the assembly.

During drilling operations blowout prevention equipment shall be actuated to test proper functioning as follows:

- (1) Once each trip for blind and pipe rams but not less than once each day for pipe rams; and
- (2) At least once each week on the drill pipe for expansion-type preventers.

All flange bolts shall be inspected at least weekly and re-tightened as necessary during drilling operations. The auxiliary control systems shall be inspected daily to check the mechanical condition and effectiveness and to ensure personnel acquaintance with the method of operation. Blowout prevention and auxiliary control equipment shall be cleaned, inspected and repaired, if necessary, prior to installation to assure proper functioning. Blowout prevention controls shall be plainly labeled, and all crew members shall be instructed on the function and operation of such equipment. A blowout prevention drill shall be conducted weekly for each drilling crew. All blowout prevention tests and crew drills shall be recorded on the driller's log.

D. Related Well Control Equipment. A full opening drill string safety valve in the open position shall be maintained on the rig floor at all times while drilling operations are being conducted. A kelly cock shall be installed between the kelly and the swivel.

3. Drilling Fluid. The properties, use and testing of drilling fluids and the conduct of related drilling procedures shall be such as are necessary to prevent the blowout of any well. Sufficient drilling fluid materials to ensure well control shall be maintained in the field area readily accessible for use at all times.

**A. Drilling Fluid Control.** Before pulling drill pipe, the drilling fluid shall be properly conditioned or displaced. The hole shall be kept reasonably full at all times, however, in no event shall the annular mud level be deeper than 30 metres (100 feet) from the rotary table when coming out of the hole with drill pipe. Mud cooling techniques shall be utilized when necessary to maintain mud characteristics for proper well control and hole conditioning.

**B. Drilling Fluid Testing.** Mud testing and treatment consistent with good operating practice shall be performed daily or more frequently as conditions warrant. Mud testing equipment shall be maintained on the drilling rig at all times.

The following drilling fluid system monitoring or recording devices shall be installed and operated continuously during drilling operations, with mud, occurring below the shoe of the conductor casing. No exceptions to these requirements will be allowed without the specific prior permission of the Supervisor:

(1) High-low level mud pit indicator including a visual and audio-warning device;

(2) Degassers, desilters and desanders;

(3) A mechanical, electrical or manual surface drilling fluid temperature monitoring device. The temperature of the drilling fluid going into and coming out of the hole shall be monitored, read and recorded on the driller's or mud log for a minimum of every 9 metres (30 feet) of hole drilled below the conductor casing; and

(4) A hydrogen sulfide indicator and alarm shall be installed in areas suspected or known to contain hydrogen sulfide gas which may reach levels considered to be dangerous to the health and safety of personnel in the area.

**C. Monitoring.** From the time drilling operations are initiated and until the well is completed or abandoned, a member of the drilling crew or the toolpusher shall monitor the rig floor at all times for surveillance purposes, unless the well is secured with blowout preventers or cement plugs.

**4. Well Logging.** All wells shall be logged with an induction electric log or equivalent from total depth to the shoe of the conductor casing. The Supervisor may grant an exception to this requirement when well conditions make it impractical or impossible to meet the above requirements.

**A. Electric Logs.** The lessee shall furnish to the Supervisor two legible exact copies of all logs run, within 30 days after completion of drilling operations on each well. Two copies of field prints of such logs shall be made immediately available to the Supervisor upon his request. Two copies of chemical analyses of geothermal fluids or other similar services performed shall be submitted to the Supervisor within 30 days after such services are completed.

**B. Lithologic Logs.** Two legible exact copies of core analysis reports and lithologic (mud) logs shall be submitted to the Supervisor within 30 days after the completion of such reports or logs, when such services are used. However, daily logs shall be made available to the Supervisor immediately upon the completion of such daily logs upon his request.

**5. Wellhead Equipment and Testing.**

**A. Completions.** All wellhead connections shall be fluid pressure tested to the API or ASA working pressure rating. Cold water is recommended as the testing fluid. Welding of wellhead connections shall be performed by a certified welder using materials in conformance with ASTM specifications.

**B. Wellhead Equipment.** All completed wells shall be equipped with a minimum of one casinghead with side outlets, one master valve and one production valve, unless otherwise authorized by the Supervisor. All casingheads, Christmas trees, fittings and connections shall have a temperature derated working pressure equal to or greater than the surface shut-in pressure of the well at reservoir temperature. Packing, sealing mediums and lubricants shall consist of materials or substances that function effectively at, and are resistant to, high temperatures. Wellhead equipment, valves, flanges and fittings shall meet minimum ASA standards or minimum API Standard 6A specifications. Casinghead connections shall be made such that fluid can be pumped between casing strings.

**C. Testing.** Any well showing sustained casinghead pressure or leaking of geothermal fluids between casing strings shall be tested to determine the origin of the failure, when such failure point is not otherwise determinable, and corrective measures shall be taken.

**6. Well Spacing.** No producing interval of any well shall be located within 30 metres (100 feet) of the outer boundaries of the leased lands, except where approved by the Supervisor. No surface location of a well shall be located within 15 metres (50 feet) of the boundary of any legal subdivision unless otherwise authorized by the Supervisor. The Supervisor may approve or prescribe such well

spacing as he determines to be necessary for the proper development of the geothermal resources in accordance with the provisions of 30 CFR 270.15.

*Reid T. Stone*

Reid T. Stone

Area Geothermal Supervisor

Approved:

*Russell G. Wayland*

Russell G. Wayland

Chief, Conservation Division

**GRO Order No. 3: Plugging and Abandonment of Wells**

UNITED STATES  
DEPARTMENT OF THE INTERIOR  
GEOLOGICAL SURVEY  
CONSERVATION DIVISION

GEOHERMAL RESOURCES OPERATIONAL ORDER NO. 3

Effective February 1, 1975

PLUGGING AND ABANDONMENT OF WELLS

This Order is established pursuant to the authority prescribed in 30 CFR 270.11 and in accordance with 30 CFR 270.14 and 270.45. The lessee shall comply with the following minimum plugging and abandonment procedures for all geothermal resources wells. Oral approvals shall be in accordance with 30 CFR 270.11. All variances from the requirements specified in this Order shall be subject to approval pursuant to 30 CFR 270.48. Each Sundry Notice (Form 9-331) shall include a notation of any proposed variances from the requirements of this Order. References in this Order to approvals, determinations or requirements are to those given or made by the Area Geothermal Supervisor (Supervisor) or his delegated representative.

The lessee shall promptly plug and abandon any well on the leased land that is not in use or demonstrated to be potentially useful. No well shall be abandoned until its lack of capacity for further profitable production of geothermal resources has been demonstrated to the satisfaction of the Supervisor. No well shall be plugged and abandoned until the manner and method of plugging have been approved or prescribed by the Supervisor.

Cement used to plug any geothermal resources well, except that cement or concrete used for surface plugging, shall be placed in the hole by pumping through drill pipe or tubing. Such cement shall consist of a high temperature resistant admix, unless this requirement is waived by the Supervisor in accordance with the particular circumstances existing in that well or area.

Prior to commencing abandonment operations, the Supervisor shall be notified of all such proposed operations.

Each Sundry Notice (Form 9-331) shall include all information required under 30 CFR 270.45 and 270.72. Any bond or rider thereto covering a lease or an individual well thereon, shall remain in full force and effect until the lease or individual well is properly abandoned and the surface properly restored. Written approval of the abandonment must be obtained from the Supervisor before release of any bonds will be recommended.

1. Permanent Abandonment.

A. Uncased Hole. In uncased portions of wells, cement plugs shall be placed to protect all subsurface mineral resources including fresh water aquifers. Such plugs shall extend a minimum of 30 metres

(100 feet) below, if possible, and 30 metres (100 feet) above such aforementioned zones. Cement plugs shall be placed in a manner necessary to isolate formations and to protect the fluids in such formations from interzonal migration or contamination.

**B. Open Hole.** Where there is open hole (uncased and open into the casing string above), a cement plug shall be placed in the deepest casing string by either (1) or (2) below. In the event lost circulation conditions exist or are anticipated, or if the well has been drilled with air or other gaseous substance, the plug shall be placed in accordance with (3) below.

(1) A cement plug shall be placed across the shoe extending a minimum of 30 metres (100 feet) above and 30 metres (100 feet) below; or

(2) A cement retainer with effective back pressure control set approximately 30 metres (100 feet) above the casing shoe with at least 61 metres (200 feet) of cement below the retainer and 30 metres (100 feet) of cement above.

(3) A permanent bridge plug set at the casing shoe and capped with a minimum of 61 metres (200 feet) of cement.

**C. Perforations, Junk, Fish and Collapsed Pipe.** A cement plug shall be placed across production perforations, extending 30 metres (100 feet) below (where possible) and 30 metres (100 feet) above the perforated interval. When a cement retainer is used to squeeze cement the perforated interval, the retainer shall be set a minimum of 30 metres (100 feet) above the perforations. Where the casing contains perforations at or below fish, junk or collapsed casing, thereby preventing cleanout operations, a cement retainer shall be set at least 30 metres (100 feet) above such point, and the interval below the retainer shall be squeeze cemented.

**D. Casing Shoes, Stubs, Laps, and Liners.** No casing shall be cut and recovered without first obtaining the written approval of the Supervisor. A cement plug shall be placed across all casing stubs, laps, liner tops and all casing shoes not protected by an inner casing string. Such plug shall extend a minimum of 15 metres (50 feet) below and 15 metres (50 feet) above any such shoe, stub, lap or liner top.

**E. Plugging of Annular Space.** All open annuli extending to the surface shall be plugged with cement.

**F. Surface Plug.** The innermost casing string which reaches ground level shall be cemented or concreted to a minimum depth of 15 metres (50 feet) measured from 2 metres (6 feet) below ground level.

**G. Testing of Plugs.** The hardness and location of cement plugs placed across perforated intervals and at the top of uncased or open hole shall be verified by setting down with tubing or drill pipe a minimum of 6,803 kilograms (15,000 pounds) weight on the plug or the maximum weight of the available tubing or drill pipe string, if less than 6,803 kilograms (15,000 pounds).

**H. Mud.** The intervals of the hole not filled with cement shall be filled with good quality heavy mud.

**2. Surface Restoration.** All casing strings shall be cut off at least 2 metres (6 feet) below ground level and capped by welding a steel plate on the casing stub. Cellars, pads, structures and other facilities shall be removed. The surface area shall be restored as specified by the Supervisor in consultation with the appropriate surface management agency.

**3. Temporary Abandonment.** An uncompleted drilling well that is to be temporarily abandoned shall be mudded and cemented as required hereinabove for permanent abandonment except for the provisions of subparagraphs E, F, and I.

**4. Suspended Wells.** The drilling equipment shall not be removed on any geothermal resources well where drilling operations have been suspended, either temporarily or indefinitely, without prior approval of the Supervisor and after approved measures have been taken to close the well and to protect all subsurface resources, including fresh water aquifers.

*Reid T. Stone*

Reid T. Stone  
Area Geothermal Supervisor

Approved:

*Russell G. Wayland*

Russell G. Wayland,  
Chief, Conservation Division



**GRO Order No. 4: General Environmental Protection  
Requirements**

UNITED STATES  
DEPARTMENT OF THE INTERIOR  
GEOLOGICAL SURVEY  
CONSERVATION DIVISION

GEOHERMAL RESOURCES OPERATIONAL ORDER NO. 4

Effective August 1, 1975

GENERAL ENVIRONMENTAL PROTECTION REQUIREMENTS

This Order is established pursuant to the authority prescribed in 30 CFR 270.11 and in accordance with 30 CFR 270.2, 270.34(k), 270.37, 270.41, 270.42, 270.43, 270.44, and 270.76. Lessees shall comply with the provisions of this Order. All variances from the requirements specified in this Order shall be subject to approval pursuant to 30 CFR 270.48. References in this Order to approvals, determinations, or requirements are to those given or made by the Area Geothermal Supervisor (Supervisor) or his delegated representative.

All data submitted under this Order shall be available for inspection in accordance with the Freedom of Information Act of 1966 (P.L. 89-487), as amended in 1974 (P.L. 93-502), except information such as geological, geophysical, reservoir, trade secrets, and financial data and interpretations of such data, maps, and related files for which a lessee requests proprietary status; provided that such status is determined by the Supervisor to be warranted and is approved by appropriate officials of the Department of the Interior.

Protection of the environment includes the lessee's responsibility to: conduct exploration and development operations in a manner that provides maximum protection of the environment; rehabilitate disturbed lands; take all necessary precautions to protect the public health and safety; and conduct operations in accordance with the spirit and objectives of all applicable Federal environmental legislation and supporting executive orders.

Adverse environmental impacts from geothermal-related activity shall be prevented or mitigated through enforcement of applicable Federal, State, and local standards, and the application of existing technology. Inability to meet these environmental standards or continued violation of environmental standards due to operations of the lessee, after notification, may be construed as grounds for the Supervisor to order a suspension of operations.

The lessee shall be responsible for the monitoring of readily identifiable localized environmental impacts associated with specific activities that are under the control of the lessee. Monitoring of environmental impacts may be conducted by the use of aerial surveys, inspections, periodic samplings, continuous recordings, or by such other means or methods as required by the Supervisor. Due to the differing natural environmental conditions among geothermal areas, the extent and frequency of such monitoring activities will be determined by the Supervisor on an individual basis. In the event the Supervisor determines that the degree and adequacy of existing environmental protection regulations in certain areas are insufficient, the Supervisor may establish additional and more stringent requirements by the issuance of field orders or by modifying existing orders.

Lessees shall provide for acquisition of environmental baseline data as required in accordance with 30 CFR 270.34(k) for a period of one year prior to submission of a plan for production. Techniques and standards to be used by the lessee for meeting these requirements shall receive prior approval by the Supervisor.

1. Aesthetics. The lessee shall reduce visual impact, where feasible, by the careful selection of sites for operations and facilities on leased lands. The design and construction of facilities shall be conducted in a manner such that the facilities will blend into the natural environmental setting of the area by the appropriate use of landscaping, vegetation, compatible color schemes, and minimum profiles. Native plants or other compatible vegetation shall be used, where possible, for landscaping and revegetation.

2. Land Use and Reclamation. Operating plans shall be designed so that operations will result in the least disturbance of land, water, and vegetation. Existing roads shall be used where suitable. Entry upon certain environmentally fragile land areas, as designated by the surface management agency, may be either seasonally restricted or restricted to special vehicles or transportation methods which will minimize disturbance to the surface or other resources as specified by the Supervisor and surface management agency.

Operating plans shall provide for the reclamation and revegetation of all disturbed lands in a manner approved by the Supervisor and the appropriate surface management agency. Land

reclamation may include preparation and seeding with prescribed wildlife food and plant cover or improved and acceptable substitutes thereof which will equal or enhance the food values for indigenous wildlife species and domesticated animals. Temporary fencing for such reclaimed areas may be required to facilitate restoration thereof.

The lessee shall at all times maintain the leased lands in a safe and orderly condition and shall perform the operations in a workmanlike manner. The lessee shall remove or store all supplies, equipment, and scrap in a timely and orderly fashion.

Operations under a geothermal lease shall not unreasonably interfere with or endanger operations under any other lease, license, claim, permit, or other authorized use on the same lands.

3. Public Access. The public shall have free and unrestricted access to geothermal leased lands, excepting however, where restrictions are necessary to protect public health and safety or where such public access would unduly interfere with the lessee's operations or the security thereof. The lessee shall provide warning signs, fencing, flagmen, barricades, or other safety measures deemed necessary by the Supervisor to protect the public, wildlife, and livestock from hazardous geothermal or related activities.

4. Recreation. Recreational values shall be adequately protected through planning and designing of site development to minimize the aesthetic degradation of the particular recreation area. The lessee shall generally be restricted from surface locations for drilling and other lease operations within 61 metres (200 feet) of established recreation sites and access routes thereto. However, the lessee may relocate a recreational site and/or access routes thereto when approved by the Supervisor with the concurrence of the land management agency.

5. Slope Stability and Erosion Control. Operations shall be conducted in such a manner so as to minimize erosion and disturbance to natural drainage. The lessee shall provide adequate erosion and drainage control to prevent sediments from disturbed sites from entering water courses for soil and natural resource conservation protection.

Mitigating measures to lessen environmental damage may include reseeded of disturbed soils, chemical stabilization, and dust and erosion control on well sites, roads, and construction areas.

All operating plans shall give proper consideration to the potential hazards of slope instability. Where potentially unstable ground conditions exist, design of proposed roads, drill sites, and surface facilities shall be approved by and constructed under the supervision of a qualified engineer or engineering geologist satisfactory to the Supervisor.

6. Biota. The lessee shall conduct all operations in such a manner as to afford reasonable protection of fish, wildlife, and natural habitat. The lessee shall take such measures as are necessary for the conservation of endangered and threatened species of flora and fauna as set forth in applicable executive orders, regulations, and State or Federal legislation such as the Endangered Species Act of 1973 and the Fish and Wildlife Coordination Act. When such species would be adversely affected by the lessee's operations on the leased lands, the lessee shall implement those measures necessary to minimize or eliminate such adverse effects and to protect the flora and fauna as specified by the Supervisor in accordance with recommendations by appropriate Federal and State agencies. Such measures may be in addition to provisions set forth in the lease or accompanying stipulations.

The Supervisor may receive information from recognized experts that a delicate balance of flora and/or fauna exists in the area of operations or proposed operations. Upon receiving such notice, the Supervisor will request timely advice and assistance from appropriate Federal and State agencies regarding: (1) an assessment of the status of flora and fauna in the area which may be adversely affected by operations, and (2) advice as to reasonable mitigating measures appropriate to minimizing or preventing adverse trends in populations, growth, vegetative recovery, or repopulations in potentially affected flora and/or fauna. Based on timely receipt of advice from appropriate agencies, the Supervisor will direct the lessee to take appropriate measures to minimize significant adverse trends in flora and fauna. Such measures may include, but not be limited to, revegetation with grasses, shrubs, or other vegetation of high forage values desirable for habitat, replacement of fauna where lost, replacement of water supply, or sources where destroyed.

Where the lessee's operations have destroyed significant flora and/or fauna or their natural habitat and replacement by natural processes will not take place in a normal growth cycle, the lessee shall take reasonable measures to replace those species or their habitat with the same or other acceptable species or habitat as directed by the Supervisor. The Supervisor's requirements shall be based on recommendations and advice received from appropriate Federal and State agencies.

7. Cultural Resources Preservation. The lessee shall exercise due diligence in the conduct of his operations to protect and preserve significant archaeological, historical, cultural, paleontological, and unique geologic sites. The lessee shall not disturb any known cemetery or burial ground of any group or culture.

Previously unknown sites uncovered by the lessee shall be immediately reported to the Supervisor, and operations on the particular site shall cease until said site can be assessed for its archaeological value and preservation. Necessary controls and remedial actions for the protection and preservation of cultural resources shall be issued on an individual site basis by the Supervisor as warranted.

The preservation, restoration, maintenance, and nomination of all resources for purposes of the National Register of Historic Places shall be in accordance with the provisions of Executive Order 11593 (36 FR 8921) entitled, "Protection and Enhancement of the Cultural Environment," or any amendments thereto.

8. Subsidence and Seismicity. Surveying of the land surface prior to and during geothermal resources production will be required for determining any changes in elevation of the leased lands. Lessees shall make such resurveys as required by the Supervisor to ascertain if subsidence is occurring. Production data, pressures, reinjection rates, and volumes shall be accurately recorded and filed monthly with the Supervisor as provided in 30 CFR 270.37. In the event subsidence activity results from the production of geothermal resources, as determined by surveys by the lessee or a governmental body, the lessee shall take such mitigating actions as are required by the lease terms and by the Supervisor.

If subsidence is determined by the Supervisor to present a significant hazard to operations or adjoining land use, then the Supervisor may require remedial action including, but not limited to, reduced production rates, increased injection of waste or other fluids, or a suspension of production.

A. Surveys. All required surveys shall be second order or better and shall be conducted under the direct supervision of a registered civil engineer or licensed land surveyor using equipment acceptable by the National Ocean Survey for second order surveys. All such work shall be coordinated with the county surveyor of the county in which the surveys and bench marks are to be established. Level lines and networks shall be tied to available regional networks.

Adjusted survey data shall be filed with the Supervisor within 60 days after leveling is completed. Any

lessee having a commercially productive geothermal well or wells shall participate in cooperative County/State subsidence detection programs. All survey data filed with the Supervisor shall be available to the public.

B. Bench Marks. One or more wellsite bench marks shall be required at each completed well prior to prolonged production and said bench marks shall be located in a manner such that there is a minimal probability of destruction or damage to said bench marks. Wellsite bench marks shall be tied to existing regional networks. Additional bench marks between the wellsites and the regional network shall be at 0.8-km (one-half mile) intervals or as otherwise specified by the Supervisor. These bench marks shall be resurveyed during well production operations on a periodic basis as determined by the Supervisor.

Acceptable bench marks include, but are not limited to, a brass rod driven to refusal or 9 metres (about 30 feet) and fitted with an acceptable brass plate or a permanent structure with an installed acceptable brass plate.

C. Reservoir Data. Initial reservoir pressure and temperature shall be reported to the Supervisor in duplicate on Well Completion or Recompletion Report (Form 9-330C) for all completed wells within 30 days after the completion of measurements or tests conducted for the purpose of obtaining such data. Initial production test data including steamwater ratio, surface pressure and temperature, quality, and quantity of well effluent shall also be filed with the Supervisor on Form 9-330C within 30 days after a well is completed.

D. Seismicity. The installation of seismographs or other like instruments in producing geothermal areas for the purpose of detecting potential seismic activity may be initiated from time to time by appropriate public agencies. Lessees shall cooperate with the appropriate public agencies in this regard. The lessee and the appropriate public agency should take care not to unreasonably interfere with or endanger each other's respective operations. The Supervisor shall coordinate such detection programs between the appropriate public agency conducting the program and the lessee.

Where induced seismicity caused by the production of geothermal fluids is determined to exist by the Supervisor, then the Supervisor may require the lessee to install such monitoring devices as necessary to adequately quantify the effects thereof. If induced seismicity is determined to represent a significant hazard, the Supervisor may require remedial

actions including, but not limited to, reduced production rates, increased injection of waste or other fluids, or suspension of production.

9. Pollution, Waste Disposal, and Fire Prevention. The lessee shall comply with all applicable Federal and State standards with respect to the control of all forms of air, land, water, and noise pollution, including the control of erosion and the disposal of liquid, solid, and gaseous wastes. The Supervisor may, at his discretion, establish additional and more stringent standards. Plans for disposal of well effluents must be approved by the Supervisor before any implementation action is undertaken. Immediate corrective action shall be taken in all cases where pollution has occurred.

The lessee shall timely remove or dispose of all waste including human waste, trash, refuse, and extraction and processing waste generated in connection with the lessee's operations in a manner acceptable to the Supervisor.

The lessee shall provide safeguards to minimize potential accidental fires and shall instruct field personnel in fire-prevention methods. The lessee shall maintain fire-fighting equipment in working order at strategic locations on the leased lands.

A. Pollution Prevention. In the conduct of all geothermal operations, the lessee shall not contaminate any natural waters and shall minimize adverse effects on the environment.

(1) Liquid Disposal. Liquid well effluent or the liquid residue thereof containing substances, including heat, which may be harmful or injurious and cannot otherwise be disposed of in conformance with Federal, State, and regional standards, shall be injected into the geothermal resources zone or such other formation as is approved by the Supervisor.

Toxic drilling fluids shall be disposed of in a manner approved by the Supervisor and in conformance with applicable Federal, State, and regional standards.

(2) Solid Waste Disposal. Drill cuttings, sand, precipitates, and other solids shall be disposed of as directed by the Supervisor either on location or at other approved disposal sites. Containers for mud additives for chemicals and other solid waste materials shall be disposed of in a manner and place approved by the Supervisor.



(3) Air Quality. Noncondensable gases such as carbon dioxide, ammonia, and hydrogen sulfide may be vented or ejected into the atmosphere, provided, however, that the volume and the measured concentration of such vented gas or gases shall not exceed applicable Federal, State, or regional air pollution standards. Copies of each permit issued by the appropriate air pollution control agency and the reports required thereunder shall be submitted to the Supervisor.

(4) Pits and Sumps. Pits and sumps shall be lined with impervious material and purged of environmentally harmful chemicals and precipitates before backfilling. In no event shall the contents of a pit or sump be allowed to contaminate streams, lakes, and ground waters. Pits and sumps shall be constructed in a manner and in such locations so as to minimize damage to the natural environment and aesthetic values of the lease or adjacent property. When no longer used or useful, pits and sumps shall be backfilled and the premises restored to as near a natural state as reasonably possible. Temporary fencing of unattended pits and sumps to protect wildlife, livestock, and the public may be required by the Supervisor and the surface management agency.

(5) Production Facilities Maintenance. Production facilities shall be operated and maintained at all times in a manner necessary to prevent pollution. The lessee's field personnel shall be instructed in the proper maintenance and operations of production facilities for the prevention of pollution.

B. Inspection and Reports. Lessees shall comply with the following pollution inspection and reporting requirements.

(1) Pollution Inspections. Drilling and production facilities shall be inspected daily by the lessee. Appropriate preventative maintenance shall be performed as necessary to prevent failures and malfunctions which could lead to pollution. Wells and areas not under production shall be inspected by the lessee at intervals prescribed by the Supervisor. Necessary repairs or maintenance shall be made as required.

(2) Pollution Reports. All pollution incidents shall be reported orally within 18 hours to the appropriate Geothermal District Supervisor and shall be followed within 30 days thereof by a written report stating the cause and corrective action taken.

C. Injection. The use of any subsurface formation, including the geothermal resources zone for the disposal of well effluent, the residue thereof, or the injection of fluids

for other purposes such as subsidence prevention shall not be permitted until the lessee has submitted a plan of injection covering the proposed injection project and has subsequently received the Supervisor's written approval thereof.

(1) Plan of Injection. The plan of injection shall include the quantity, quality, and source of the proposed injection fluid; the means and method by which the fluid is to be injected; a structure map contoured on the intended injection zone; and cross-sections showing producing well locations and the proposed injection well location(s).

(2) Injection Report. The lessee shall file in duplicate with the Supervisor a Monthly Water Injection Report in a form approved by the Supervisor. The subject report shall be filed on or before the last day of the month following the month in which the injection took place.

(3) Inspection. Injection wells and facilities shall be inspected by the lessee at intervals as prescribed by the Supervisor to ascertain that all injected fluids are confined to the approved injection zone. A spinner survey, a radioactive tracer survey, and a cement bond log may be required on each injection well within 30 days after injection begins. The lessee shall furnish to the Supervisor two legible exact copies of any and all such surveys and logs. In the event of a casing failure, inadequate annular cement, or other mechanical failure, the lessee shall without unreasonable delay repair, suspend, or abandon the well. Where failure occurs in a zone which may damage surface or fresh water aquifers, injection shall immediately cease.

(4) New Wells. The drilling of new injection wells in accordance with an approved plan of injection shall be in conformance with the provisions of GRO Order No. 2. An Application for Permit to Drill, Form 9-331C, shall be filed in triplicate and approved for each injection well.

(5) Conversions. The conversion of an existing well to an injection well in accordance with or modification of an approved plan of injection shall be in conformance with the requirements of GRO Order No. 2. The lessee shall demonstrate to the satisfaction of the Supervisor by appropriate testing and logging that the well is mechanically sound and suitable for injection purposes. A Sundry Notice, Form 9-331, shall be filed in triplicate and approved for each conversion.

10. Water Quality. The primary responsibility for water quality and pollution control has been delegated to the States where such States have standards approved by the Environmental

Protection Agency. Such State standards must meet basic Federal requirements prohibiting the deterioration of waters whose existing quality is higher than established water quality standards. The lessee shall comply with the State water quality control organization's standards in such States as have federally-approved standards. The Supervisor, at his discretion, may establish additional and more stringent standards.

The lessee shall file, in duplicate, a detailed water analysis report for all completed geothermal wells within 30 days after completion and annually thereafter or as otherwise specified by the Supervisor. Unless otherwise prescribed by the Supervisor, such analyses shall include a determination of arsenic, boron, radioactive content, and radioactivity of the produced fluids. In the event that a health hazard exists, the Supervisor shall require appropriate health and safety precautions, periodic monitoring, or the suspension of production.

11. Noise Abatement. The lessee shall minimize noise during exploration, development, and production activities. The method and degree of noise abatement shall be as approved by the Supervisor.

The lessee shall conduct noise level measurements during exploration, development, and production operations to determine the potential objectionability to nearby residents as well as the potential health and safety danger due to noise emissions.

Noise level measurements and accompanying data shall be filed with the Supervisor. Such data shall provide the basis for operational and noise control decisions by the Supervisor and shall be based on an assessment of the noise relative to Federal or State criteria including adjustments for the area involved, meteorological conditions, and the time of day of the noise occurrence.

The lessee shall comply with Federal occupational noise exposure levels applicable to geothermal activity under the Occupational Safety and Health Act of 1970 as set forth in 29 CFR 1910.95, which are incorporated herein by reference, or with State standards for protection of personnel where such State standards are more restrictive than Federal standards.

A. Measurement Condition. Outdoor noise measurements shall be made at least 3 metres (10 feet) from structures, facilities, or other sound reflecting sources and approximately 1 metre (3 feet) above ground level. Extreme weather conditions, electrical interference, and unusual background noise levels shall be avoided or given due consideration when measuring sound levels.

B. Measurements. The lessee shall monitor and measure noise levels using an octave band noise analyzer with an A-weighted frequency response or a standard sound level meter that conforms to the requirements set forth in USA Standard Specifications for General Purpose Sound Level Meters USASI S1.4-1961 or the latest approved revision thereof. Bandpass filters shall conform to the requirements of USASI S1.11-1966. The lessee shall measure noise level frequency distribution as required by the Supervisor. Sound levels shall be measured in conformance with the USA Standard-Method for the Physical Measurement of Sound USASI S1.2-1962.

C. Criteria. In the absence of more restrictive criteria as may be established in this paragraph, the lessee shall not exceed a noise level of 65 dB(A) for all geothermal-related activity including but not limited to, exploration, development, or production operations as measured at the lease boundary line or 0.8 km (one-half mile) from the source, whichever is greater, using the A-weighted network of a standard Sound Level Meter. However, the permissible noise level of 65 dB(A) may be exceeded under emergency conditions or with the Supervisor's approval if written permission is first obtained by the lessee from all residents within 0.8 km (one-half mile).

D. Assessment. The lessee shall be responsible for taking such noise level measurements as are deemed necessary by the Supervisor. The background noise level shall serve as the criterion for the rating and assessment, by the Supervisor, of the objectionableness of noise emission from a particular source. The background or ambient noise is defined hereby as the minimum sound level at the relevant place and time in the absence of the source noise and shall include consideration for the type of land use, the season, atmospheric conditions, and the time of day.

E. Attenuation. To attenuate objectionable noise, the lessee shall utilize properly designed muffling devices as required by the Supervisor.

F. Relationships. Reference levels and relationships for noise measurements shall be as follows:

(1) Reference sound pressure for airborne sounds shall be 20 MN/m (20 micronewtons per square metre).

(2) Reference power shall be 10-12 watts.

(3) Sound levels shall be measured using a standard Sound Level Meter with an "A" frequency response characteristic (weighting network).

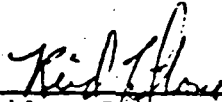
(4) Sound level meter controls shall be set for as uniform a frequency response as possible when measuring sound pressure levels.

(5) Octave band noise levels shall be reported in equivalent A-weighted levels.

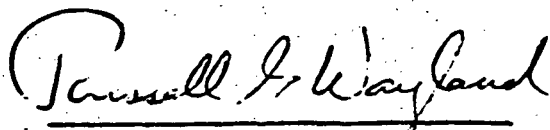
G. Record of Sound Measurements. The Supervisor may require sound level measurements during drilling, testing, and producing operations. Such measurements shall be filed in duplicate with the Supervisor and shall include the following data:

- (1) Date, time, and location.
- (2) Name of observer.
- (3) Description of primary noise source emitter under test.
- (4) Kind of operation and operating conditions.
- (5) Description of secondary noise sources including location, type, and kind of operation.
- (6) Type and serial numbers on all microphones, sound level meters, and octave band analyzers used. Length and type of microphone cables.
- (7) Position of observer.
- (8) Direction of arrival of sound with respect to microphone orientation.
- (9) Approximate temperature of microphone.
- (10) Results of maintenance and calibration tests.
- (11) Weighting network and meter speed used.
- (12) Measured overall response and band levels at each microphone position and extent of meter fluctuation.
- (13) Background overall response and band levels at each microphone position with primary noise source not operating.
- (14) Cable and microphone corrections.
- (15) Any other pertinent data such as personnel.

exposed directly and indirectly, time pattern of the exposure, atmospheric conditions, attempts at noise control, and personnel protection.

  
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Reid T. Stone  
Area Geothermal Supervisor

APPROVED:

  
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Russell G. Wayland  
Chief, Conservation Division

GEOHERMAL RESOURCES  
OPERATIONAL ORDERS

Issued under the Geothermal Steam Act of 1970

- GRO Order 6. Pipelines and Surface Production Facilities  
GRO Order 7. Production and Royalty Measurement, Equipment, and  
Testing Procedures

United States Department of Interior  
Geological Survey  
Conservation Division  
Office of the Area Geothermal Supervisor

January 1977

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UNITED STATES  
DEPARTMENT OF THE INTERIOR  
GEOLOGICAL SURVEY  
CONSERVATION DIVISION

GEOHERMAL RESOURCES OPERATIONAL ORDER NO. 6

Effective January 1, 1977

PIPELINES AND SURFACE PRODUCTION FACILITIES

This Order is established pursuant to the authority prescribed in 30 CFR 270.11. The design, operation, and testing of all pipelines and surface facilities will be conducted in accordance with the provisions of this Order. All variances from the requirements specified in this Order shall be subject to approval pursuant to 30 CFR 270.48. References in this Order to approvals, determinations, or requirements are to those given or made by the Area Geothermal Supervisor (Supervisor) or his delegated representative.

The design of all pipelines and surface facilities, including but not limited to, production, injection, and waste water disposal systems, shall be submitted with the Application for Permit to Drill or on a Sundry Notice to the Supervisor for approval prior to construction. In addition, a Plan of Operation with contents and approval according to 30 CFR 270.34, shall be required when surface or environmental disturbances are anticipated beyond those covered by a previously approved Plan of Operation.

1. Design and Construction Requirements. All geothermal pipelines and surface facilities shall be designed and constructed in accordance with the following:

A. General Design

(1) Thermal Expansion. All pipelines and production facilities shall be designed to prevent failure in tension or compression due to thermal stresses based on limitations specified in applicable piping codes. Pipelines shall be anchored to isolate or transfer stress to the ground or solid structure, and to prevent unsafe movement in case of line failure. Main anchor locations are to be predicated on the surface configuration of the area, and may be required at pipe ends, at changes in direction, at shut-off valves, at manifolds where lines are interconnected, or at other points as dictated by the expansion design adopted. Intermediate anchors may be required to divide the pipeline into separate expanding sections and to bear any unbalanced

thrust. Intermediate supports between anchors should allow free lateral and longitudinal movement. Vibration, expansion direction and magnitude, and internal turbulence as well as effects of mineral scaling should be considered before including slip joints or expansion bellows in the design.

(2) Two-Phase Flow. Submission of complete design criteria and calculations may be required for planned two-phase production pipelines and surface facilities to demonstrate that the design of such facilities has given consideration to the water hammer stresses that may be caused by two-phase flow. Example stress calculations for the pipeline shall be submitted.

(3) Environmental Considerations. All pipelines and surface facilities shall be designed and constructed in accordance with the environmental protection requirements of GRO Order No. 4 and other applicable laws and regulations.

#### B. Safety Control Devices

(1) Production Pipelines and Related Facilities. All steam and hot water production pipelines and related surface facilities shall be equipped with the following devices except as noted in 1.B.(1)(d) below:

(a) Each producing well shall be equipped with a low pressure sensing device to actuate a valve to shut in production to minimize safety or pollution hazards caused by pipeline or facility failure.

(b) Pipelines and related surface facilities shall be protected against pressure buildup in excess of the system's design limit by high pressure sensors which will actuate either (1) well shut-in valves, or (2) system or well pressure relief valves and/or rupture discs. If only pressure relief valves and/or rupture discs are installed, it must be demonstrated that such venting in an emergency will not result in exceeding applicable pollution standards; otherwise shut-in valves shall be installed. Vented production must be properly muffled so as to comply with provisions of GRO Order No. 4. A remote controlled shut-in or venting system may be required, in addition to pressure sensors.

(c) Check valves or other approved devices shall be required in the system to prevent uncontrolled crossflow from other parts of the system in case of a line or facility failure, or where a line failure may result in pollution due to line drainage.

(d) Exceptions to requirements 1.B.(1)(a) through (c) above may be made for systems or parts of systems where the lessee can demonstrate to the satisfaction of the Supervisor that lack of such controls will not result in danger of pollution or to public health

and safety. Information to be considered in an evaluation of a requested exception should include, but is not limited to, chemical analysis of the produced fluids, steam and gases; the rate, temperature and pressure of production; environmental conditions in the area; type of geothermal reservoir system; type of resource utilization; the number, hourly coverage, and supervision of personnel operating the facilities; and the type of manually operated controls installed.

(2) Injection Facilities. All injection pipelines and related surface facilities must be designed to safely accommodate maximum expected surface injection pressures and shall be equipped with the following devices, except as noted in 1.B.(1)(d) above.

(a) Each injection well shall be equipped with a pressure sensing or other approved device to actuate a valve to shut in injection to minimize safety or pollution hazards caused by injection pipeline or facility failure.

(b) Injection pipelines and related surface injection facilities shall be protected against pressure buildup in excess of the system's design limit by pressure sensors which will actuate either (1) well shut-in valves, or wellhead or injection pipeline shut-in valves, or (2) a system of well pressure relief valves and/or rupture discs. If only pressure relief valves and/or rupture discs are installed, it must be demonstrated that such venting in an emergency will not result in exceeding applicable pollution standards; otherwise, shut-in valves shall be installed. A remote-controlled shut-in or venting system may be required, in addition to pressure sensors.

(c) Check valves or other approved devices shall be required to prevent uncontrolled backflow from injection wells in the system in case of a line or facility failure, or where a line failure may result in pollution due to line drainage.

### C. Testing and Operation

#### (1) Pipeline Integrity Tests.

(a) Pipeline - steam. The pipes shall be joined and joints tested in accordance with appropriate piping codes for steam distribution systems. The pipeline shall be operationally tested in service with steam during the initial clean-out by pressure testing to the maximum anticipated working pressure for one hour. The Supervisor shall be notified at least 48 hours in advance of the estimated date and time of each test so that the test may be witnessed.

(b) Pipeline - water. The pipeline shall be hydrostatically tested to 1.25 times the design working pressure for a minimum of 2 hours prior to placing the line in service. Certain low pressure lines such as waste disposal drains and all piping designed for internal pressures

at or below 5 psig. regardless of temperature, may be exempted from this requirement; if authorized by the Supervisor. The Supervisor shall be notified at least 48 hours in advance of the estimated date and time of each test so that the test may be witnessed.

(2) Safety Device Tests. The automatic and remote control devices installed in accordance with 1.B.(1) and (2) above shall be tested semiannually or at more frequent intervals as required by the Supervisor. Advance notification of at least 48 hours shall be given so that the Supervisor may witness the test. The lessee shall maintain records on each device showing present status and past history, including dates and details of inspection, testing, repairing, adjustment, reinstallation or replacement, and will forward copies of these records to the Supervisor semiannually.

(3) Operator Monitoring. Production, injection, and other waste disposal systems which are not completely equipped with shut-in or relief devices, shall require 24-hour on-site monitoring by operator personnel unless it can be demonstrated to the satisfaction of the Supervisor that less frequent monitoring will not increase the danger of pollution or to human life and health. Supervisory control system monitoring by power plant or steam supply operators of steam turbine header pressure, water disposal liquid level and injection line pressure can be substituted for the above monitoring provision, if approved by the Supervisor.

2. Application for Construction of Pipeline and Related Surface Facilities. The operator shall submit the items listed below with the Application for Permit to Drill or on a Sundry Notice, in triplicate, to the Supervisor for approval. In addition, as appropriate, a Plan of Operation according to 30 CFR 270.34 items (a) through (i) may be required for submittal for joint approval by the Supervisor and the appropriate land management agency. Production and injection pipelines for wells may be included as a part of the Application for Permit to Drill and Plan of Operation required for drilling the well.

A. Maps. A plat(s) showing the major topographic features and other pertinent data including the proposed route, length, size, and location of the line(s), and any connecting facilities.

B. Equipment Plans. A schematic drawing showing the location of the following pipeline and facilities safety equipment and the manner in which the equipment functions:

- (1) high-low pressure sensor(s)
- (2) automatic shut-in valve(s)
- (3) check valve(s)
- (4) metering system(s)
- (5) pressure relief valve(s)
- (6) other manual or automatic valve(s) or equipment

C. Design Information. General information concerning the pipeline and facilities including the following:

- (1) Product(s) to be transported by the pipeline
- (2) Size, weight, and grade of the pipeline
- (3) Length of line(s)
- (4) Type(s) of corrosion protection
- (5) Description of protective coatings
- (6) Description of pipe insulation and the application of exterior color camouflage
- (7) Anticipated gravity or density of the product(s) and a chemical analysis
- (8) Design working pressure and capacity
- (9) Maximum working pressure and capacity
- (10) Pipeline integrity tests  
Steam Pipeline - testing pressure and hold time to which the pipeline will be tested after installation.  
  
Water Pipeline - hydrostatic pressure and hold time to which the pipeline will be tested after installation.
- (11) Other related information as required by the Supervisor

3. Completion Report. The operator shall submit a report to the Supervisor when installation of the pipeline is completed, accompanied by all hydrostatic test data, including procedure, test pressure, hold time, and results.

*Reid T. Stone*

Reid T. Stone  
Area Geothermal Supervisor

APPROVED:

*Eddie R. Wyatt*

Russell G. Wayland  
Acting Chief, Conservation Division

UNITED STATES  
DEPARTMENT OF THE INTERIOR  
GEOLOGICAL SURVEY  
CONSERVATION DIVISION

GEOHERMAL RESOURCES OPERATIONAL ORDER NO. 7

Effective January 1, 1977

PRODUCTION AND ROYALTY MEASUREMENT, EQUIPMENT, AND TESTING PROCEDURES

This Order is established pursuant to the authority prescribed in 30 CFR 270.11 and 270.12 and in accordance with 30 CFR 270.60, 270.64, 270.74, and 270.75. All geothermal production and the resulting produced energy (electricity) or byproducts, and leasehold operational utilization thereof, shall be measured and monitored in accordance with the provisions of this Order.

All variances from the requirements specified in this Order shall be subject to approval pursuant to 30 CFR 270.48. References in this Order to approvals, determinations, or requirements are to those given or made by the Area Geothermal Supervisor (Supervisor) or his delegated representatives.

All metering systems shall be approved by the Supervisor prior to installation. Field production metering shall be accomplished with sufficient accuracy to assure that royalty calculations using such measurement data will result in fair market value to the Government, and to enable evaluation of well and reservoir production performance and trends. Where royalty is due on other than a well production basis, i.e., plant output in kilowatt hours or production of byproducts, metering systems used in that regard shall also be approved by the Supervisor.

1. Metering. The general requirements and accuracy for measuring production and utilized energy or byproducts of geothermal resources are outlined below:

A. Measurement of Production. Surface facilities and measuring devices shall be installed so that the production mass flow rate (or volume, when appropriate) of water and/or steam and the pressure and temperature of the produced fluids from each well are accurately determined. If metering is not to be accomplished on a continuous basis, each well shall be gauged periodically at the frequency prescribed by the Supervisor.

The operator shall maintain detailed records available for inspection by the Supervisor concerning the performance measurements relative to each well. The record shall show average flow rates, temperature, pressure, and any other pertinent data gathered. Except for drilling and well workover operations, and low rate venting of new geothermal wells to prevent well bore damage prior to facility hook up, vented production shall also be measured and reported.

Each well shall be equipped to permit fluid sampling for determining the enthalpy and chemical content of produced geothermal fluids. Enthalpy and chemical analysis for each well shall be provided the Supervisor yearly or more frequently if required by the Supervisor.

B. Royalty Metering. Metering systems involved in the calculation of royalty values due shall be designed, installed, operated, and maintained to attain the accuracy herein specified. However, the Supervisor may require greater accuracy where conditions dictate that necessity and the technology exists, or may permit a lesser degree of accuracy when physical problems, such as severe corrosion or scaling, preclude attainment of the desired standards.

(1) Steam. Dry steam metering systems and the mass flow calculations derived therefrom shall be designed and maintained to achieve an accuracy of +4.0% of the measured flow.

(2) Hot Water. Hot water metering systems and the mass flow or volumetric calculations derived therefrom shall be designed and maintained to achieve an accuracy of +2.0% of the measured flow.

(3) Steam and Water (two-phase flow). Metering of two-phase flow shall be designed and maintained to achieve the maximum reasonable attainable accuracy consistent with the nature of the production to be measured. Due to the complexity and difficulties involved in this type of metering, the Supervisor shall establish the initial accuracy limits for each specific installation based on the nature of existing flow conditions and commensurate with the then existing state-of-the-art. The operator shall, upon request, demonstrate to the satisfaction of the Supervisor that the approved metering system(s) being employed is operating within the prescribed range of accuracy. The Supervisor is authorized, when warranted, to require modifications in the system consistent with new technology to improve the accuracy of measurement or, when required accuracy is not attainable, to direct that the two-phase fluid flow be separated and the steam and water metered individually.

(4) Heat Content. Where the heat content of produced water or steam is the primary use, including but not limited to heating a greenhouse complex, space heating, and plant processing, metering systems shall be designed and maintained to achieve an accuracy of +2.0% for both the input and discharge flows.

(5) Electrical Power Output or Consumption. Where the resource sales payment is equated to kilowatts of electric power output or geothermal-produced electricity is consumed in geothermal operations, the metering systems shall be designed and maintained to achieve an accuracy of +0.5%.

(6) By-Products. When the by-product is in liquid form, metering accuracies shall be maintained within +1.0%. When the by-product is a solid, measurement thereof shall be either by volume or weight and shall be accurate to +1.0%.

(7) Waste Heat. Waste heat shall be metered in accordance with the standards set forth in 1.B.(4) when such measurements are involved in royalty calculations.

C. Non-Royalty Metering. Measurement of produced or injected fluids that are not involved directly in royalty calculations, such as waste waters or injected waters shall be metered with accuracies sufficient to evaluate well, reservoir, and project performance. Such metering systems shall be designed and maintained to achieve an accuracy of +5.0%, unless otherwise specified by the Supervisor.

2. Commingling Production. In accordance with 30 CFR 270.64, the Supervisor may authorize a lessee to commingle production from wells on a lease with production from other leases held by the lessee or by other lessees subject to such conditions as the Supervisor may prescribe. Where utilization of the geothermal resource for energy and/or by-products involves commingling production from two or more leases, the following conditions and requirements shall be met:

A. The surface facilities, metering, and fluid sampling systems employed shall be approved by the Supervisor.

B. The commercially utilized production leaving each lease shall be measured in accordance with the standards set forth in Section 1 hereof, either on or off the leasehold, in a manner that will allow accurate allocation and royalty calculation for that lease.

3. Common Storage. Where commercial utilization involves common storage from two or more leases, e.g., a common brine evaporation pool for production of chemical by-products, the contributions of each lease to that facility shall be measured in accordance with the standards set forth in Section 1 hereof, either on or off the leasehold, in a manner that will allow accurate allocation and royalty calculation for that lease. The surface facilities, metering, and fluid sampling systems employed shall be approved by the Supervisor.

4. Meter Testing and Maintenance. All meters and metering systems shall be maintained in acceptable working condition and shall be inspected, tested, and adjusted to meet appropriate design standards.



The frequency and stringency of tests shall be prescribed by the Supervisor. The Supervisor may witness any periodic metering system test or inspection, and the operator shall schedule an acceptable time and date for such tests when requested by the Supervisor.

A. Royalty Meter Tests and Inspections. The following tests and inspections shall be performed on all meters involved in royalty calculations. Depending on inspection results, the Supervisor may alter the inspection frequencies herein specified.

(1) Orifice Meter Tests and Inspections.

(a) Visual functional inspection shall be performed as part of the daily well check. Recorders shall be inspected for malfunctions at that time and repaired if necessary.

(b) Recorders shall be inspected and the calibration checked with master test gauges at least once per month. The equipment used for the calibration check shall verify the differential and static pressure ranges. Field error of a meter exceeding  $\pm 1.0\%$  of the meter's differential and static pressure ranges shall require removal of that instrument and installation of a recalibrated instrument.

(c) Orifice plates and meter tube runs shall be inspected by the operator for wear and recalipered to the nearest thousandth of an inch. Worn plates or runs shall be remachined or replaced. The inspection period shall depend on well performance and on the production demand, but meter runs and accessory equipment shall be inspected at intervals not exceeding one year.

(2) Turbine Meter Tests and Inspections.

(a) Daily readout checks shall be made to verify functional operation.

(b) At least once every six months, the turbine meter shall be checked for accuracy with a prover. If a discrepancy in excess of  $\pm 0.5\%$  over limited range or  $\pm 1.0\%$  over stated range is noted, the meter shall be inspected for bearing wear, turbine damage, or corrosion and repaired or replaced as necessary.

(3) Electrical Meters (Power Meters).

(a) Inspect daily for function.

(b) A detailed check and inspection shall be accomplished at least once each month.

(c) At least every six months, the meter shall be calibrated with a master meter. The meter shall be repaired or replaced if a discrepancy greater than  $\pm 0.5\%$  is found.

(4) Other Types of Meters.

(a) Where metering systems depend on static and differential pressure measurements, e.g., venturi or nozzles, testing shall be as outlined above for orifice meters in 4.A.(1).

(b) Testing procedures and frequencies for all other metering systems shall be as approved by the Supervisor.

B. Non-Royalty Meter Tests and Inspections. Metering systems measuring produced or injected fluids which are not involved in royalty calculation shall normally be checked at least weekly for functional operation, and be inspected, calibrated, and/or proven at yearly intervals to demonstrate an overall accuracy of +5.0%, unless otherwise specified by the Supervisor.

5. Application for Meter Installation. All metering systems shall be approved by the Supervisor prior to installation. Approval may be obtained by inclusion of the required details in a Plan of Exploration, Development, or Production, or where appropriate, separately by submission of a Sundry Notice, in triplicate, to the Supervisor.

Applications shall include the following information:

A. Purpose of the meter and whether it will be involved in royalty calculations.

B. Location; e.g., Well No. 53-6, SE $\frac{1}{4}$ SE $\frac{1}{4}$ , Section 6, T. 3 S., R. 10E., M.D.M.

C. What is to be metered, such as steam, water, or combination thereof, and appropriate physical characteristics, such as the temperature, pressure, density, corrosive or scaling tendencies, and a chemical analysis.

D. Anticipated average and range of daily rates to be metered.

E. If the meter is involved in royalty calculations, the estimated monthly gross dollar value that will be measured by the meter and how the measurement will be used in royalty calculations.

F. Drawing of the installation showing piping, locations of equipment, and valves.

G. If not shown in a drawing, indicate (a) type of meter, manufacturer, model number, and range of coverage; (b) pressure ratings of piping, valves, and other equipment; and, (c) design code or standards used for installation design.

H. Anticipated accuracy.

I. Proposed inspection, testing or calibration procedures and the testing schedule.

*Reid T. Stone*

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Reid T. Stone  
Area Geothermal Supervisor

APPROVED:

*Russell G. Wayland*

*R* Russell G. Wayland  
Acting Chief, Conservation Division





UNITED STATES  
DEPARTMENT OF THE INTERIOR

RECEIVED

GEOLOGICAL SURVEY  
Area Geothermal Supervisor's Office  
Conservation Division, MS 92  
345 Middlefield Road  
Menlo Park, CA 94025

JUN 3 1977

CITY OF BOULDER  
LIGHT & POWER

JUN - 2 1977

Memorandum

To: INTERESTED PARTIES

From: <sup>Acting</sup> Area Geothermal Supervisor

Subject: Plan of Operation, Getty Oil Company, Federal Lease U-27391,  
Roosevelt Hot Springs KGRA, Beaver County, Utah.

Getty Oil Company has submitted a Plan of Operation pursuant to 30 CFR 270.34, to drill eight 7500'+ geothermal resources exploratory wells on Federal Lease U-27391, within the Roosevelt Hot Springs KGRA, Beaver County, Utah.

A copy of the Plan of Operation is enclosed for your information, review, and files.

Interested parties are invited hereby, to participate in an on-site field inspection of the proposed access roads and well locations scheduled for June 22, 1977. The inspection party will depart from the Hong Kong Cafe, Milford, Utah at 8:30 a.m. Mr. Ken Bull, District Geothermal Supervisor, Salt Lake City, Utah (tel: (801) 524-5245, FTS: 588-5245) will be the field inspection coordinator. Any questions interested parties may have in regard to this inspection and proposed action should be addressed to Mr. Bull.

An Environmental Analysis (EA#82) will be prepared by the Office of the Area Geothermal Supervisor for the proposed action. All comments concerning this Plan of Operation, in order to be considered, must be received no later than July 8, 1977, by:

Area Geothermal Supervisor  
USGS, Conservation Division  
345 Middlefield Road MS 92  
Menlo Park, California 94025  
Tel: 415-323-8111, Ext. 2848 (FTS: 467-2841)

We urge you to send written commentary and will appreciate hearing from you even if you are of the opinion that the existing regulations,

lease terms, and operational orders provide adequate environmental protection. Further, we solicit your comments and suggestions on the proposed action even though you may not be able to participate in the field inspection. All comments will be given serious consideration in the preparation of the Environmental Analysis and any subsequent conditions of approval.

The Area Geothermal Supervisor's Office will not send a draft Environmental Analysis (EA #82) to interested parties for review for the proposed action. Certain parties however, such as the surface managing agency, the lessee, GEAP, and USFWS will receive a copy of the completed EA #82. Other interested parties will not receive a copy of the final EA unless such parties comment on the proposed action in writing or request a copy of the particular EA pursuant to the Freedom of Information Act. Copies of Environmental Analyses are available for inspection during normal business hours at the Area Geothermal Supervisor's Office, the appropriate District Geothermal Supervisor's Office, and the appropriate BLM District Manager's Office.

*Barry A. Boudreau*

INTERESTED PARTIES  
GETTY OIL COMPANY  
Environmental Analysis #82  
Plan of Operation: 8-7500' + wells  
Federal Lease U-27391  
Roosevelt Hot Springs KGRA  
Beaver County, Utah

District Geothermal Supervisor  
USGS-Conservation Division  
Post Office Bldg., Rm. 443  
350 S. Main Street  
Salt Lake City, Utah 84101  
FTS: 588-5245 (801-524-5245)

Conservation Manager, Central Region  
USGS-Conservation Division MS 609  
Environmental Staff (Don Libbey)  
Box 25046  
Denver Federal Center  
Denver, Colorado 80225  
FTS: 234-2855 (303-234-2855)

Office of the Area Geologist  
USGS-Conservation Division  
Attn: Dan Jobin  
Bldg. 25, Rm. 1322  
Denver Federal Center  
Denver, Colorado 80225  
FTS: 234-4435 (303-234-4435)

Donald Alvord, District Geologist  
USGS-Conservation Division  
Federal Bldg., Rm. 8422  
125 S. State Street  
Salt Lake City, Utah 84138  
FTS: 588-5643 (801-524-5643)

District Manager  
Cedar City District Office  
Bureau of Land Management  
P. O. Box 729  
Cedar City, Utah 84720  
(801-586-2401)

Bureau of Land Management  
Beaver River Resource Area Office  
Attn: Lanny Ream  
P. O. Box 729  
Cedar City, Utah 84720  
(801-586-2458)

State Director  
Bureau of Land Management  
University Club Building  
136 E. South Temple  
P. O. Box 11505  
Salt Lake City, Utah 84111  
FTS: 588-5311 (801-524-5311)

Mr. Max Crittenden, Chairman  
Geothermal Environmental Advisory Panel  
U. S. Geological Survey  
345 Middlefield Rd., MS 75  
Menlo Park, California 94025  
FTS 467-2317 (415-323-8111, Ext. 2317)

U. S. Fish & Wildlife Service  
Regional Director, Region 6  
Attn: Hal Boeker  
Denver Federal Center  
P. O. Box 25486  
Denver, Colorado 80225  
FTS: 234-2209 (303-234-2209)

U. S. Fish & Wildlife Service  
Area Office  
Attn: Lewis Richardson  
Federal Building  
125 S. State Street  
Salt Lake City, Utah 84138  
FTS: 588-5637 (801-524-5637)

U. S. Fish & Wildlife Service  
Division of Ecological Services  
Attn: Felix Smith  
2800 Cottage Way, Room E-2720  
Sacramento, California 95825  
FTS; 468-4657 (916-484-4657)

U. S. ERDA, Nevada Operations Office  
Attn: John O. Cummings/James B. Cotter  
P. O. Box 14100  
Las Vegas, Nevada 89114  
FTS: 598-3591 (702-734-3591)

INTERESTED PARTIES - EA#82

U. S. ERDA

Division of Geothermal Energy, 3rd Floor  
Attn: Bert Barnes/Ron Loose  
Mission Team Leader, Southwest  
20 Massachusetts Avenue NW  
Washington, D.C. 20545  
FTS: 376-4902 (202-376-4902)

U. S. Forest Service

Attn: Ralph S. Rawlinson  
500 S. Main Street  
Cedar City, Utah 84720  
(801-586-2461)

U. S. Forest Service

Forest Ranger  
Attn: Floyd Bartlett  
Beaver, Utah 84713  
(801-438-2372)

Federal Energy Administration

Attn: Charles E. Denton  
Post Office Bldg., Rm. 464  
350 S. Main Street  
Salt Lake City, Utah 84101  
FTS: 588-4108 (801-524-4108)

Environmental Protection Agency

Regional Office, Region 8  
Attn: Jon Herrmann  
1860 Lincoln Street  
Denver, Colorado 80203  
FTS: 327-5914 (303-327-5914)

Environmental Protection Agency

Las Vegas Office  
Attn: Don Gillmore  
P. O. Box 15027  
Las Vegas, Nevada 89114  
FTS: 595-2969, Ext. 241 (702-736-2969)

Senator Jake Garn

Federal Building, Rm. 4227  
125 S. State Street  
Salt Lake City, Utah 84138  
FTS: 588-5933 (801-524-5933)

Senator Orrin Hatch

Federal Building, Rm. 5430  
125 S. State Street  
Salt Lake City, Utah 84138  
FTS: 588-4380 (801-524-4380)

Representative Dan Marriott

Federal Building, Room 2311  
125 South State Street  
Salt Lake City, Utah 84138  
FTS: 588-4394 (801-524-4394)

Representative Dan Marriott

& Jula Rose DeMille  
P. O. Box 667  
Cedar City, Utah 84720  
(801-586-2451)

Utah State Planning Commission

Attn: Dave Conine  
Room 118 State Capitol Bldg.  
Salt Lake City, Utah 84114  
(801-533-6491)

Utah Water Resources Division

Attn: Brice Montgomery, Geologist  
Room 435 State Capitol Bldg.  
Salt Lake City, Utah 84114  
(801-533-5401)

Utah Natural Resources Department

Attn: Clifford Colling  
Room 438 State Capitol Bldg.  
Salt Lake City, Utah 84114  
(801-533-5356)

Utah Water Rights Division

Attn: Dee Hansen, State Engineer  
Room 442 State Capitol Bldg.  
Salt Lake City, Utah 84114  
(801-533-6071)

Mr. Cleon B. Feight

State of Utah  
Industrial Commission  
350 East Fifth South  
Salt Lake City, Utah 84111  
(801-533-6411)



INTERESTED PARTIES - EA#82

Utah Division of Health  
Environmental Health Service Branch  
Attn: Lynn Thatcher, Director  
44 Medical Drive  
Salt Lake City, Utah 84113  
(801-533-6121)

Utah Oil, Gas & Mining Division  
Attn: Patrick Driscoll  
Chief, Petroleum Engineer  
1588 West North Temple  
Salt Lake City, Utah 84116  
(801-533-5771)

Utah Wildlife Resources Division  
Attn: Earl Sparks  
1596 West North Temple  
Salt Lake City, Utah 84116  
(801-533-9333)

Utah Geological and Mineral Survey  
Attn: Dan Mc Millan  
USGS Building, University of Utah  
Salt Lake City, Utah 84112  
(801-581-6831)

Dr. Richard E. Turley  
State Science Advisor  
3008 MEB  
University of Utah  
Salt Lake City, Utah 84112  
(801-581-6479)

University of Utah  
Bureau of Economic & Business Research  
Mrs. Ronda W. Brinkerhoff, Research Analy.  
Room 401  
Salt Lake City, Utah 84112

Beaver County Planning Council  
Attn: Russell Mayer, Chairman  
P. O. Box 811  
Milford, Utah 84751  
(801-387-2636)

Beaver County News  
Attn: N. E. "Red" Wilson  
P. O. Box 368  
Milford, Utah 84751  
(801-387-2881)

Val Finlayson  
Director of Research  
Utah Power & Light Co.  
1407 West North Temple  
Salt Lake City, Utah 84110  
(801-350-3722)

City of Bountiful Light & Power  
Attn: W. Berry Hutchings  
198 South 200 West  
Bountiful, Utah 84010  
(801-295-9496)

Getty Oil Company  
Attn: Wayne Shaw  
P. O. Box 5237  
Bakersfield, California 93308  
(805-399-2961)

California Energy Company, Inc.  
Attn: Mr. Paul Storm  
Wells Fargo Bldg., Suite 300  
200 B Street  
Santa Rosa, California 95401  
(707-526-1000)

Chevron USA, Inc.  
Attn: Mr. J. G. Turner  
P. O. Box 3722  
San Francisco, California 94119  
(415-894-2726)

Exxon Company  
Attn: James H. Hafenbrack  
P. O. Box 120  
Denver, Colorado 80201

Geothermal Power Corporation  
Attn: Frank G. Metcalfe  
1127 Grant Avenue, Suite 6  
P. O. Box 1186  
Novato, California 94947  
(415-897-7833)

GeothermEx  
Attn: Mr. James B. Koenig  
901 Mendocino Avenue  
Berkeley, California 94707  
(415-524-9242)

INTERESTED PARTIES - EA#82

Gulf Mineral Resources Co.  
Attn: Mr. E. W. Westrick  
Exploration Department  
1720 South Bellaire Street  
Denver, Colorado 80222  
(303-758-1700)

Hydro-Search, Inc.  
Attn: Mario L. Davis  
333 Flint Street  
Reno, Nevada 89501  
(702-322-4172)

Phillips Petroleum Company  
Attn: R. L. Wright  
P. O. Box 752  
Del Mar, California 92014  
(714-755-0131)

Republic Geothermal, Inc.  
Attn: Dwight Carey  
P. O. Box 3388  
Santa Fe Springs, California 90670  
(213-945-3661)

Sunoco Energy Development Co.  
Attn: E. R. Sausser  
12700 Park Central Pl., Suite 1500  
Dallas, Texas 75251  
(214-744-4300)

Union Oil Company  
Attn: Don Ash  
1250 Coddington Center  
P. O. Box 6854  
Santa Rosa, California 95406  
(707-542-9543)

Samuel M. Eisenstat  
Eisenstat & Gottesman, P.C.  
400 Park Avenue  
New York, N.Y. 10022

Mr. Clyde E. Kuhn  
2207 Carroll Street, Apt. 3  
Oakland, California 94606  
(415-451-3714)

bcc: Chron  
Subject: 1760 U-27391 (POO  
Folder EA#82) w/a  
ENG w/a  
EVA w/a  
ENV EA#82 w/a  
BAB (2) wo/a

BABoudreau/ew/5/31/77



Getty Oil Company | P.O. Box 5237, Bakersfield, California 93308 • Telephone: (805) 399-2961

California Exploration and Production Division

May 25, 1977

Area Geothermal Supervisor's Office  
Conservation Division, MS 92  
345 Middlefield Road  
Menlo Park, California 94025

Attention: Mr. Barry A. Boudreau

Re: Proposed Plan of Operations  
Roosevelt Hot Springs KGRA  
Beaver County, Utah

Gentlemen:

Please find enclosed our Proposed Plan of Operations to drill up to eight wells at the Roosevelt Hot Springs KGRA in Beaver County, Utah. The proposed locations, access roads to be constructed, present roads and drainage are shown on the enclosed Exhibit "A". The individual site plans and the cultural resource inventory will be sent under separate cover as soon as we are in receipt of the finished reports.

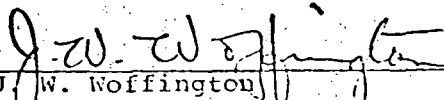
Included in the Proposed Plan of Operations are Attachments covering Blowout Prevention Equipment and a plan for the proposed drilling and testing activities.

If additional information is desired to complete this application, please let us know.

ERDA  
Nevada Operations Office  
James B. Collier  
Las Vegas, NV

Very truly yours,

GETTY OIL COMPANY

  
J. W. Woffington  
Division Exploration Manager

RECEIVED

MAY 26 1977

AREA GEOTHERMAL SUPERVISOR'S OFFICE  
CONSERVATION DIVISION  
U.S. GEOLOGICAL SURVEY  
MENLO PARK, CALIFORNIA

JWW:br  
Encls.

**RECEIVED**  
 Form 9-311 C  
 (May 1963)  
**MAY 26 1977**

**SUBMIT IN TRIPLICATE\***  
 (Other instructions on reverse side)

Form approved.  
 Budget Bureau No. 42-R1425.

AREA GEOTHERMAL SUPERVISOR'S OFFICE  
 CONSERVATION DIVISION  
 U.S. GEOLOGICAL SURVEY

**UNITED STATES DEPARTMENT OF THE INTERIOR  
 GEOLOGICAL SURVEY**

**APPLICATION FOR PERMIT TO DRILL, DEEPEN, OR PLUG BACK**

**1a. TYPE OF WORK**  
 DRILL       DEEPEN       PLUG BACK

**b. TYPE OF WELL**  
 OIL WELL       GAS WELL       OTHER Geothermal      SINGLE ZONE       MULTIPLE ZONE

**2. NAME OF OPERATOR**  
Getty Oil Company

**3. ADDRESS OF OPERATOR**  
P. O. Box 5237, Bakersfield, California 93308

**4. LOCATION OF WELL (Report location clearly and in accordance with any State requirements.)\***  
 At surface 990' South along section line and 2310' Westerly at right angles to said line from the NE corner of Sec. 21,  
 At proposed prod. zone T.27S/R.9W., Salt Lake B&M. Straight hole from surface location above.

**14. DISTANCE IN MILES AND DIRECTION FROM NEAREST TOWN OR POST OFFICE\***  
12 miles northeast of Milford, Utah

**15. DISTANCE FROM PROPOSED\* LOCATION TO NEAREST PROPERTY OR LEASE LINE, FT. (Also to nearest drlg. unit line, if any)**  
990'

**18. DISTANCE FROM PROPOSED LOCATION\* TO NEAREST WELL, DRILLING, COMPLETED, OR APPLIED FOR, ON THIS LEASE, FT.**  
None

**16. NO. OF ACRES IN LEASE**  
1,920

**17. NO. OF ACRES ASSIGNED TO THIS WELL**  
40

**19. PROPOSED DEPTH**  
7500'+

**20. ROTARY OR CABLE TOOLS**  
Rotary

**21. ELEVATIONS (Show whether DF, RT, GR, etc.)**  
Ground (Est.) 5890' above sea level from Adamsville Quadrangle.

**22. APPROX. DATE WORK WILL START\***  
October 1977

**5. LEASE DESIGNATION AND SERIAL NO.**  
U-27391

**6. IF INDIAN, ALLOTTEE OR TRIBE NAME**

**7. UNIT AGREEMENT NAME**

**8. FARM OR LEASE NAME**

**9. WELL NO.**  
USL #52-21

**10. FIELD AND POOL, OR WILDCAT.**  
Roosevelt Hot Springs  
 KGRA Wildcat

**11. SEC., T., R., S., OR BLK. AND SURVEY OR AREA**  
Sec. 21 - T.27S/R.9W

**12. COUNTY OR PARISH**      **13. STATE**  
Beaver      Utah

**PROPOSED CASING AND CEMENTING PROGRAM**

SIZE OF HOLE	SIZE OF CASING	WEIGHT PER FOOT	SETTING DEPTH	QUANTITY OF CEMENT

(\* See attached plan for drilling, casing and cementing operations.)

IN ABOVE SPACE DESCRIBE PROPOSED PROGRAM: If proposal is to deepen or plug back, give data on present productive zone and proposed new productive zone. If proposal is to drill or deepen directionally, give pertinent data on subsurface locations and measured and true vertical depths. Give blowout preventer program, if any.

**24. GETTY OIL COMPANY**  
 SIGNED J. W. Hollington      TITLE Div. Exploration Manager      DATE May 25, 1977  
 (This space for Federal or State office use)

PERMIT NO. \_\_\_\_\_ APPROVAL DATE \_\_\_\_\_

APPROVED BY \_\_\_\_\_ TITLE \_\_\_\_\_

CONDITIONS OF APPROVAL, IF ANY:

RECEIVED  
 MAY 26 1977  
 U.S. GEOLOGICAL SURVEY  
 CONSERVATION DIVISION  
 AREA GEOTHERMAL SUPERVISOR'S OFFICE

\*See Instructions On Reverse Side

400  
MAY 26 1977  
AREA GEOTHERMAL SUPERVISOR  
CONSERVATION DIVISION  
U.S. GEOLOGICAL SURVEY  
MENLO PARK, CALIFORNIA

UNITED STATES  
DEPARTMENT OF THE INTERIOR  
GEOLOGICAL SURVEY

SUNDRY NOTICES AND REPORTS ON WELLS

(Do not use this form for proposals to drill or to deepen or plug back to a different reservoir. Use Form 9-331-C for such proposals.)

1. oil well  gas well  other Geothermal

2. NAME OF OPERATOR  
Getty Oil Company

3. ADDRESS OF OPERATOR  
P. O. Box 5237, Bakersfield, Ca. 93308

4. LOCATION OF WELL (REPORT LOCATION CLEARLY. See space 17 below.) 990'S & 2310'W from NE corner  
AT SURFACE: Sec. 21 - T.27S/R.9W  
AT TOP PROD. INTERVAL: Straight hole (as above)  
AT TOTAL DEPTH: Straight hole (as above)

16. CHECK APPROPRIATE BOX TO INDICATE NATURE OF NOTICE, REPORT, OR OTHER DATA

REQUEST FOR APPROVAL TO:		SUBSEQUENT REPORT OF:	
TEST WATER SHUT-OFF	<input type="checkbox"/>		<input type="checkbox"/>
FRACTURE TREAT	<input type="checkbox"/>		<input type="checkbox"/>
SHOOT OR ACIDIZE	<input type="checkbox"/>		<input type="checkbox"/>
REPAIR WELL	<input type="checkbox"/>		<input type="checkbox"/>
PULL OR ALTER CASING	<input type="checkbox"/>		<input type="checkbox"/>
MULTIPLE COMPLETE	<input type="checkbox"/>		<input type="checkbox"/>
CHANGE ZONES	<input type="checkbox"/>		<input type="checkbox"/>
ABANDON*	<input type="checkbox"/>		<input type="checkbox"/>
(other) <u>Drill Geothermal Wildcat Well</u>			

5. LEASE  
U-27391

6. IF INDIAN, ALLOTTEE OR TRIBE NAME

7. UNIT AGREEMENT NAME

8. FARM OR LEASE NAME

9. WELL NO.  
USL #52-21

10. FIELD OR WILDCAT NAME  
KGRA Wildcat, Roosevelt Hot Springs

11. SEC., T., R., M., OR BLK. AND SURVEY OR AREA  
Section 21 - T.27S/R.9W

12. COUNTY OR PARISH  
Beaver

13. STATE  
Utah

14. API NO.

15. ELEVATIONS (SHOW DF, KDB, AND WD)  
Ground 5890'+ above sea level

(NOTE: Report results of multiple completion or zone change on Form 9-330.)

17. DESCRIBE PROPOSED OR COMPLETED OPERATIONS (Clearly state all pertinent details, and give pertinent dates, including estimated date of starting any proposed work. If well is directionally drilled, give subsurface locations and measured and true vertical depths for all markers and zones pertinent to this work.)\*

The Getty Oil-Western Division Operations with headquarters in Bakersfield, California, is proposing to drill and test a geothermal wildcat well in the Roosevelt Hot Springs Area of Beaver County, Utah. A depth of +7500' is anticipated with the borehole essentially vertical from the surface location to total depth with a maximum deviation of 10°. The fracture system which produces sufficient heat and pressure to provide a geothermal reservoir should be encountered from 1800' - 2000' in the subsurface. From this point on, the completion depth will be dictated by reservoir parameters and hole conditions. A starting date is tentatively set for October 15, 1977.

Subsurface Safety Valve: Manu. and Type \_\_\_\_\_ Set @ \_\_\_\_\_ Ft.

18. I hereby certify that the foregoing is true and correct  
GETTY OIL COMPANY  
SIGNED J. W. Woffington TITLE Div. Exploration Manager DATE May 25, 1977  
(This space for Federal or State office use)

APPROVED BY \_\_\_\_\_ TITLE \_\_\_\_\_ DATE \_\_\_\_\_  
CONDITIONS OF APPROVAL, IF ANY:

\*See Instructions on Reverse Side

PROPOSED PLAN OF OPERATION  
TO DRILL GEOTHERMAL TEST WELLS  
ON UNITED STATES GEOTHERMAL RESOURCES LEASE

U-27391

BEAVER COUNTY, UTAH

Getty Oil Company  
Geothermal Operations

Bakersfield, California  
May 20, 1977

RECEIVED

MAY 26 1977

AREA GEOTHERMAL SUPERVISOR'S OFFICE  
CONSERVATION DIVISION  
U.S. GEOLOGICAL SURVEY  
MENLO PARK, CALIFORNIA

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XIII. ABANDONMENT PLAN



### ATTACHMENTS

- Exhibit "A" - Topographic Map (Adamsville Quad Expanded)  
Scale 1" = 2,000' with proposed well sites,  
existing roads, proposed access roads and  
drainage.
- Exhibit "B" - Typical well site layout with rig and  
equipment.
- Exhibit "C" - Loffland Bros. Rig #5 with all necessary  
equipment to drill in the Roosevelt Hot  
Springs Area. This rig has been used  
successfully by Phillips Petroleum and  
Thermal Power Company.
- Exhibit "D" - Typical Choke Manifold Plan for Geothermal  
Drilling.
- Exhibit "E" - B.O.P.E. Stack for drilling first phase  
of hole from +100 feet to +800 feet  
through 20" casing.
- Exhibit "F" - B.O.P.E. Stack for drilling second phase  
of hole from +800 feet to +2000 feet  
through 13-3/8" casing.
- Exhibit "G" - B.O.P.E. Stack for drilling third phase  
of hole from +2,000 feet to TD (+7500').

## I. INTRODUCTION

Getty Oil Company proposes to drill up to eight (+7500') geothermal test wells on Federal Geothermal Resources Lease U-27391 in the Roosevelt Hot Springs KGRA, Beaver County, Utah. In accordance with 30 CFR 270.71, 270.34 and GRO 2, 3 and 4, this Application, Plan of Operation and attached Exhibits are submitted for consideration and approval for the proposed work schedule. The pertinent data is shown on the attachment listed as Exhibit "A".

Exhibit "A" is a USGS Adamsville quadrangle map expanded to a scale of 1" = 2,000', and shows proposed well locations, drainage, existing and proposed roads.

The wells are to be drilled as straight (vertical) holes with only minor deviations to projected depths of +7500'. The approximate well locations in feet and directions from the nearest known and established section corner marker are given below. General access to the drill sites will be from Milford, Utah, south along State Highway 257, then via the Pass Road and Lower Ranch Canyon Road, an improved dirt surface road.

Lease U-27391

1. Well Location USL #52-21 - Exhibit "A"  
T. 27 S., R. 9 W., Section 21. From the northeast corner approximately 990 feet south along the east line and 2310 feet westerly at right angles to said line.
  
2. Well Location USL #72-21 - Exhibit "A"  
T. 27 S., R. 9 W., Section 21. From the northeast corner approximately 990 feet south along the east line and 990 feet westerly at right angles to said line.
  
3. Well Location USL #34-21 - Exhibit "A"  
T. 27 S., R. 9 W., Section 21. From the northwest corner approximately 2310 feet south along the west line and 1650 feet easterly at right angles to said line.
  
4. Well Location USL #38-21 - Exhibit "A"  
T. 27 S., R. 9 W., Section 21. From the southwest corner 330 feet approximately northerly along the west line and 1650 feet easterly at right angles to said line.

5. Well Location USL #76-21 - Exhibit "A"

T. 27 S., R. 9 W., Section 21. From the southeast corner 1650 feet north approximately along the east line and 990 feet westerly at right angles to said line.

6. Well Location USL #62-29 - Exhibit "A"

T. 27 S., R. 9 W., Section 29. From the northeast corner approximately 990 feet southerly along the east line and 1650 feet westerly at right angles to said line.

7. Well Location USL #12-28 - Exhibit "A"

T. 27 S., R. 9 W., Section 28. From the northwest corner approximately 990 feet southerly along the west line and 330 feet easterly at right angles to said line.

8. Well Location USL #34-28 - Exhibit "A"

T. 27 S., R. 9 W., Section 28. From the northwest corner approximately 2310 feet southerly along the west line and 1650 feet easterly at right angles to said line.

## II. DETAILS OF WORK

As of the date of this application, a rig with the following specifications has not been secured, but negotiations are currently under way to contract for equipment sufficient to meet all requirements for drilling, testing and completion of a test well with complete safety for personnel and equipment. An addendum will be sent to the USGS as soon as possible.

### a. General Rig Specifications

The following equipment will be used to drill and complete a +7500-foot test well:

1. A rotary-type rig with capability of drilling 7500-8000' with 4½" D.P.
2. Two draw-works engines - 400 HP or equivalent.
3. Two pumps - EMSCO D-500 type.
4. Mast - 112-126' portable type 500,000# capacity.
5. Substructure - Normally required to handle a full BOP stack commonly used in Roosevelt Area.
6. 7500' minimum 4½" drill pipe.
7. Two 500 bbl. steel water storage tanks.
8. One 100 bbl. vacuum water truck.
9. Mud logging unit from conductor pipe to T.D.
10. Mud D-sander and D-silter.

e. Surveys and Bench Marks

The area in this proposal Plan of Operation is one in which the section corners have been established, but section-line roads and quarter-corner markers are practically non-existent. The section corners that have been emplaced will be the initial points from which the surveyed well-site coordinates will be measured. Base map and grid control will be from the USGS Adamsville quadrangle expanded to a scale of 1" = 2,000 feet.

In order to insure accuracy as closely as possible, Getty Oil Company has contracted for Bullock Bros. Engineering Company of Cedar City, Utah, to handle the basic engineering work involving well location, location corners for the rig site, staking the access roads and furnishing a rig layout with sumps and reserve pit areas layed out on the site location. The Bullock Bros.' firm will place the required cement bench marker away from the center of the location, as regulations require. In addition, they will emplace a cement pad for subsidence and seismicity control.

At such time as their work is completed, a scaled plat showing the pertinent details for each location will be drafted. A copy of this work will then be sent to the regulatory bodies, as an addendum to complete the Plan of

Operations. Any additional bench marks or surveys recommended by the Geothermal Supervisor will be established in accordance with his recommendations.

f. Proposed Drilling and Casing Detail Program

1. Drill 26" hole to 100'. Run and set 20" OD, buttress thread K-55 casing (interval yield 3060 psi and collapse 1600 psi). Equip casing with bow-type centralizers. Cement to surface. Allow for 50% excess and treat with 2% CaCl<sub>2</sub>. Install 20" casing head and 20", 2000 psi blowout prevention equipment. Install mud loggers before drilling out.

2. Drill 17½" hole to +800'. (Penetrate hard rock, if possible). Keep hole within 3° vertical. Check hole with surveys at 100' intervals. Run and cement to surface 13-3/8", 54.5#, K-55 buttress thread, range III casing (interval yield 2730 psi, collapse resistance 1140 psi). Use 1:1 perlite, 80% silica flour, 2% gel, 1/2% CFR-2 (ratios may vary as dictated by hole conditions), with sufficient excess to bring slurry to surface. Cut off casing, weld on 12", 3000 psi head with two - 2" outlets and equip well with 12" series 900 blowout preventor, consisting of 3000 psi working pressure double ram and hydril. Test BOPE before drilling out shoe.

3. Drill 12½" hole with a botton-hole locked assembly to +2000'. Run drift surveys on dull bits. Keep hole deviation to minimum with no greater maximum than 10° at casing point. Maintain continuous surveillane of mud temperatures on 20' intervals and continuously log gas shows.

4. Run and cement 9-5/8", 40#, K-55 buttress thread range III casing (interval yield 3950 psi and collapse 2760 psi) with sufficient excess to bring cement to surface. Cement to be 1:1 perlite, 80% silica flour, 2% gel, 1/2% CFR-2 (ratio of ingredients may vary as dictated by hole conditions). Equip bottom joint with a guide shoe and float collar at top. Tack weld bottom two joints. Install latch-on type centralizers, one near guide shoe and float, and on collar every other joint to surface.

5. Remove BOPE. Install 12", 2000 psi x 10", 2000 psi expansion spool, 10" master valve, and BOPE stack as shown in attachment. Test all BOPE equipment and casing to 1000 psi for 15 minutes. Note results on tour sheet and driller initial. Notify USGS if they wish to witness test.

6. Drill out float collar, cement, guide shoe and drill ahead in 8½" hole. Maintain constant temperature check until hole reaches total depth.



7. Run logs before running casing strings.

Additional logs, cores or formation tests will be scheduled as needed.

Drilling Fluids

<u>Interval</u>	<u>Type</u>	<u>Weight</u>	<u>Viscosity</u>	<u>Water Loss</u>
0" - 100'	Gel Water	Minimum	55-65	No Control
100' - 800'	Diammonium Phosphate	"	45-55	" "
800' - 2000'	" "	"	40-50	" "
2000 - +6000'	" "	"	36-40	" "

Use Desander and Desilter to keep weight down.

g. Logging and Testing Program

A mud-logging unit will be installed before drilling out conductor casing, and will log and monitor hole to T.D. +7500'. Other logs to be run selectively at casing depths (800', 2000', 6000'), include:

Dual Induction - Laterlog  
Formation Density Compensated Log  
Compensated Neutron Porosity Log  
Borehole Compensated Sonic Log  
Gamma Ray - Caliper Log  
Temperature Log - Selected Intervals

Flow tests: One day utilizing a range of orifices.

Fluid chemistry: Standard industrial water analysis of produced fluids, sampled at intervals during flow tests.

Well Bore Treatment: None contemplated.

h. Optional Procedures for Drilling and Testing Activities

During drilling operations, hole conditions may be altered or changed, which would require alternate procedures to further gain an insight to the reservoir conditions or fracturing, temperatures, influx of formation fluids, pressures from formation gases. All of these conditions may indicate the feasibility of one or more of the following activities to further evaluation of the geothermal resource.

Activities deemed normal for drilling operations include:

1. Taking cores with diamond heads.
2. Plugging back.
3. Redrilling.
4. Perforating.
5. Running liners to seal off conate waters.
6. Side tracking.
7. Setting packers.
8. Conducting flow tests of short duration through manifold and blooie line to determine flow characteristics.

9. Running a series of wireline electrical and temperature surveys for evaluation purposes.
10. Setting cement plugs.
11. Plugging and abandonment.

i. Topographic Features and Drainage Patterns

The immediate area of this proposed Plan of Operation lies on the westward slope of a typical basin and range province in southwestern Utah. A gently sloping alluvial fan dips westward into the Escalante Valley away from the Mineral Mt. Pluton. The surface is cut by small intermediate streams and shallow washes which contain water only in heavy snowfall years. Rare cobbles and small boulders of metamorphic, volcanic and pegmatitic origin are found on the fan, along with pediment-type gravels, silts and clays. Bedrock is not exposed in this part of the alluvial fan. An east-west fault is exposed in Section 22 (Peterson, 1974), which may or may not project through part of the proposed area of work. A more prominent feature, the Dome Fault, which runs northerly, is apparently terminated near the north line of Section 21. A southerly extension of this fault, if present, is buried underneath the alluvium. The semi-arid condition of the area is not conducive to abundant plant growth. Most common type of plants are small juniper trees and sagebrush, interspersed with an occasional bitterbush. A brief physiographical well-site discussion follows, with reference to the location map, Exhibit "A".

SITE #72-21: This well site is located on the north-east flank of a fairly wide shallow wash, which trends north-westerly toward the Escalante Valley. This drainage bed cuts across the southern end of the Dome Fault and may represent a cross fault, which terminates the extension of the Dome Fault structure into Section 21. The stream bed is approximately two feet in depth below the terrace where the location would be built. An existing road will be utilized and the access road will require only a minimum of grading. The ground elevation is +5900' above sea level. Approximately 500' of new road will be necessary for access.

SITE #52-21: This location is proposed as the initial drill site, and lies on the opposite side of the shallow wash from the #72-21 location. This location is on a gently dipping slope which lies between two intermittent stream drainages. The ground elevation is approximately +5845' above sea level. A similar-type lithologic section, which would compare to the Phillips #25-15 well in Section 15, should be present in this well. The two wells would be or should be fairly near on strike with each other. Approximately +1800' of new access road will be constructed.

SITE #34-21: The 5840' contour line passes through the surface or ground elevation at this location. This well location is generally on strike with the #52-21 site, and falls very near a projection of the Dome Fault. If the fault is not terminated in Section 21, the plane should pass near or through this location. This well is on the same type alluvial fan deposit as are the other proposed locations, and will present no problem in drill pad or road construction. New access will require +800' of road to be constructed.

SITE #76-21: This well-site location is the nearest site to the mineral mountain complex. Pre-Cambrian metamorphics outcrop approximately +1000' to the east. This location will also be the furthest away from the Dome Fault trend and should encounter a very shallow section of alluvium before entering weathered basement. A possibility exists that cross faulting may be encountered in this well section. A tentative ground elevation is +5985' above sea level. Drainage is northwestward and only +50' of new road will be necessary for location entry.

SITE #38-21: This well location is closely on strike with the #52-21 well, and is super-imposed on the alluvium fan cut by dendritic drainage to the northeast. The gulleys or washes are very shallow, intermittent type, which flow for short periods in times of excessive snowmelt or rainfall. As much as 700-800+' of alluvium may be encountered at this well site. The ground elevation lies at +5860'. This sites drains westward and will require the most new construction for access. A total of about 1600' will be necessary, but fortunately, will be on or near the elevation all the way from Site #34-21.

SITE #12-28: This site is updip from the confluence of several stream drainages which form a dendritic pattern to the west. The top of these small terraces or benches are generally very shallow dipping and are very easily made to conform to drill-pad sites, with a minimum of surface disturbance. Approximately +1800' of new access road will be necessary. The ground elevation above sea level is approximately +5800'.

SITE #34-28: The drill site is on a wide-flat bench between very shallow drainage areas of intermittent stream beds. This site will be on typical alluvium clay and gravels. The elevation above sea level is +5860' at ground. Approximately 600' of new access road will be necessary to utilize this drill site.

SITE #62-29: This well site is on the apex of a gently dipping terrace, which terminates into a wash formed by the merging of two intermittent stream beds. The area is fairly flat on top of the bench and will conform to drill-site construction with only a minimum of surface disturbance. This location is the furthest down-dip site away from the mineral mountains and lies at a ground elevation of +5740'. A maximum of 50' of new access road will be necessary. A good existing road runs northerly from the Ranch Canyon Road, and will give the easiest access of any of the proposed locations.

### III. EXISTING AND PLANNED ACCESS AND LATERAL ROADS

A plan of the proposed well locations is shown on Exhibit "A". Existing roads and trails will be used for the most part for access to well location sites. Some new construction will be necessary to complete access from nearest roadway, but will be minimized to avoid any unnecessary surface disturbance. Construction will be limited to the initial well location (#52-21) access road, and any additional work required for the other proposed locations will be delayed until individually required. Local operators and equipment will be engaged to do this work.

Two types of roads are shown in color on Exhibit "A":

- a. Existing roads or trails are in brown and may require some degree of improvement.
- b. New access roads. These roads will require some construction to provide access into rig locations, and are shown in green color. Each new road is labeled with an alphabet letter, beginning with A, B, C, etc. - Some of the roads will require combination of two letters to achieve the desired total access road to a particular location. (Example: Well #52-21 would require A & B or possibly C & D from nearest established road or trail.
- c. All necessary construction and road improvements will comply with the BLM and USGS specifications.

#### IV. CULTURAL RESOURCES PRESERVATION

As required under GRO-4, to protect and preserve the cultural and archaeological inventory in the areas to be disturbed for roads and drill sites, an approved competent archaeologist, Dr. R. A. Thompson, of the Southern Utah State College in Cedar City, has been engaged to examine the lands involved in this Plan of Operations. His report and exhibits, if any, including an access road survey, will be an addendum to be attached to this proposal when the study is finished. Any area which might prove to be a part of the cultural inventory will be mitigated by adjusting the access road or drill site to less sensitive coordinates.



All water to be used at the rig site during construction of the access roads, drilling pad, and in the drilling operations for various usage will be purchased from the City of Milford, Utah. Any additional supplies, such as road building materials, will also be purchased from local contractors, using approved sources of supply.

V. LOCATION OF CAMPSITES, AIRSTRIPS AND  
OTHER SUPPORTING FACILITIES

There is no need for any of these facilities to be constructed in the current Plan of Operations, and none are being contemplated. Drilling supplies, pipe and equipment will be stored in Milford, Utah.

VI. LAND USE AND RESTORATION

a. Additional Areas of Surface Disturbance

In addition to access roads and drill pads, there are other areas which may have potential surface disturbance. These are down-dip drainages from the rig site, which could receive overflows of fluids from liquid dominant reservoirs in the event of an uncontrolled blowout. These areas would require dikes of earthen fill temporarily, and in this unforeseen event, additional berms would be constructed to contain superfluous fluids.

At the conclusion of any site usage, a restoration program, including obliterating and revegetating access roads, drill pads and other disturbed areas will be done in conjunction with the Utah State Division of Wildlife Resources.

b. Pollution of Surface and Groundwaters

All fluids utilized or produced at the rig site will be controlled and stored in gel-lined pits to avoid any contamination. After settling of any solids, the fluids will be drained off and used to keep down dust on the roads and rig site with permission from the Beaver County road officials. Casing strings are designed to avoid any near surface or sub-surface contamination. Reserve pits will be lined with gel to prevent percolation of fluids into ground waters. Any produced fluids will not be allowed to enter natural drainages without express permission from the regulatory agencies.

c. Damage to Fish and Wildlife

All surface disturbance will be kept to a minimum to limit destruction of wildlife habitat. There are no streams or lakes nearby which would suffer contamination and no fish which might be endangered as a result. Well discharge lines will be directed away from nearby vegetation to prevent injury or contamination.

d. Noise and Air Pollution

Getty Oil Company will control noise levels and air emissions from operations in accordance with Federal and State Quality Standards, and any local imposed standards. The area is uninhabited, and noise would not be a nuisance factor except to occasional visitors.

Mufflers will be used on rig engines and compressors as standard equipment. Any testing of steam or effluents from the well will be under muffling devices designed by the best technology available.

e. Hazards to Public Health and Safety

1. Access to and around the drilling rig and assessorry equipment will be strictly regulated to unauthorized personnel by Getty Oil Company.
2. A normal compliment of safety and accident prevention equipment will be available at all times.
3. All rig personnel will be familiarized with geothermal operations and associated hazards.
4. Any usage or occurrence of toxic substances will be noted and immediate response for safety of personnel will be taken.

VII. SOIL EROSION AND SUBSIDENCE

Any new roadway, grading, leveling or pad construction

will be designed to prevent erosion or degradation of the surface. Care will be taken to avoid scarring or removal of excessive ground cover. Vehicular travel by rig personnel, company operatives and other authorized persons will be confined to existing roads and trails. Any upgrading of roads shall be done in accordance with local and county road standards, which might include the installation of culverts, construction of drainage ditches and gravelling or capping the road bed. Any soil disturbance will be returned as near to original state as closely as possible. Reserve pits will be allowed to settle out before the final backfill. After a well has sustained production for a given period of time, a careful monitoring at the surface will be a part of the on-going program to produce steam from this area.

#### VIII. SUMPS AND PITS

All materials excavated from the sump, reserve pits and rig-site leveling, will be utilized in the construction of the berms around these features to contain any geothermal fluids which may be a part of the testing procedure. These berms will be tamped to conform with good engineering practices, and leveled across the top to blend in with the surroundings as near as possible. Any material left over from construction of the berms or pad leveling will be stockpiled in an area adjacent to the

drill pad and within the confines of the well-site boundaries. This material will be used later on to backfill or restore to original the grades of excavations as needed. Contamination of the ground water resources will be avoided by lining the sump and pits with one-quarter pound of bentonitic gel per foot of surface. This forms an impervious layer of clay which will allow only a minimum of seepage of produced fluids from the well along with any drilling fluid which might be objectional. Any unused or vacant pits will be fenced to protect wildlife or livestock. A program of backfilling and restoration will ultimately be proposed after a reasonable evaluation period.

IX. WASTE DISPOSAL INCLUDING LIQUIDS,  
SOLIDS, TRASH AND HUMAN WASTE

A reserve pit will be located adjacent to the drilling pad and all fluids will be contained in this pit. The pit will be lined with an impervious gel to seal off any percolation of fluids. The solids will be allowed to settle out and along with other debris, such as drill cuttings, will be buried after the pit dries and is reclaimed. Garbage and other foreign materials will be deposited at an authorized dump. Excess uncontaminated fluids will be used as dust inhibitors on the roads.

During testing operations, any effluents produced as liquids during flow tests to determine reservoir capacity will be confined to the reserve pit. After drying, any residue will be buried before reclaiming the pit. Any steam which is flashed during testing (Est. 15-20%), will be vented to the atmosphere. It is expected that only flow tests of short duration will be carried out since Getty Oil Company would have no injection facilities at this time. Any long-term testing would require an injection program. The duration of testing will be limited to the capacity of the sump and reserve pit.

#### X. PROTECTION OF THE ENVIRONMENT

##### a. Fire Prevention

All brush and vegetation will be disposed of in a manner compatible with the Bureau of Land Management and U.S. Geological Survey regulations. Every reasonable effort will be made to avoid spillage of inflammable materials. Fire-fighting equipment will be located at the proposed well sites - exhaust stacks from all engines will be equipped with spark arrestors or built-in water cooled exhaust systems for spark control. All precautions will be taken to control and suppress any fires started in or near Getty Oil Company leases. The authorized officer shall be informed as soon as possible of all fires in the rig area.

b. Hydrogen Sulfide Contingency Plan

Introduction

Getty Oil Company recognizes that hydrogen sulfide gas (sour gas) could be encountered during the drilling of this project. Although dangerous amounts of this toxic gas have not been associated with other wells drilled in this area, Getty Oil Company will be prepared to protect all personnel in the event dangerous amounts of hydrogen sulfide are discharged into the atmosphere. The wells will be drilled using accepted drilling practices, including keeping an overbalance of hydrostatic pressure upon any zones that might contribute gas. Hydrogen sulfide gas could reach the surface in the event of lost circulation.

Our plan will provide safety programs for personnel, safety equipment, safety drills, and up-to-date instructions on rescue techniques. The overall plan will be directed by consultants who have specialized in these emergency procedures. Each person participating in the drilling of the wells will know the location of all safety equipment and will be responsible for its maintenance.

General Information

All personnel involved with the mechanics of

drilling, evaluating and testing the wells will be thoroughly trained in the recognition of warning signals, the operation of breathing equipment and their responsibilities in case of emergency rescue techniques and first aid.

Devices for the detection and measurement of hydrogen sulfide concentration and visual and audio alarms will be provided. Each drillsite shall have two briefing areas so situated that one would be upwind from the well at any given time. Two bore pits will be provided, enabling gas to be stacked <sup>down</sup> upwind from the well.

Should hazardous amounts of H<sub>2</sub>S be encountered, all personnel, when arriving on the drillsite, should contact the Getty Oil Company Supervisor or the Drilling Contractor's Supervisor for assignment of breathing apparatus and instruction and orientation briefing. Each person must verify that he has read and understands the "H<sub>2</sub>S Contingency Plan".

Lists of phone numbers of agencies and personnel to be contacted in case of an emergency will be posted in the Getty Oil Supervisor's trailer, the Drilling Contractor Supervisor's trailer, the drilling crew's dog house and the briefing area.

Before drilling has begun, all personnel will be advised of an escape route other than the main access road, and will be instructed as to evacuation procedures. If danger to



life becomes extreme, all non-essential personnel will be evacuated.

TOXIC EFFECTS OF HYDROGEN SULFIDE

Table "A"

<u>%</u>	<u>0 to 2 minutes</u>	<u>15 to 30 minutes</u>	<u>30 minutes to 1 hour</u>
0.001	Detectable by "rotton-egg" smell.	Detectable.	Detectable. Maximum allowable concentration for 8-hour exposure without protective mask.
0.01	Coughing. slight irritation of eyes. Loss of sense of smell.	Disturbed respiration. Pain in eyes. Sleepiness.	Throat and eye irritation.
0.025	Loss of sense of smell.	Throat and eye irritation.	Throat and eye irritation.
0.035	Irritation of eyes. Loss of sense of smell.	Irritation of eyes and respiratory tract.	Painful secretion of tears, weariness; may cause death in longer exposure.
0.045	Irritation of eyes. Loss of sense of smell.	Difficult respiration. Irritation of eyes.	Increased irritation of eyes and nasal tract. Dull headache. Serious respiratory disturbances.
0.09	Coughing, unconsciousness. Serious respiratory disturbances.	Respiratory disturbances. Eye irritation. Unconsciousness.	Serious eye irritation. Slow pulse, rapid shallow breathing. Respiratory paralysis, convulsions, asphyxis and death.
0.01	Unconsciousness.	Death.	Death.

TOXIC OF VARIOUS GASES

Table "B"

<u>Common Name</u>	<u>Chemical Formula</u>	<u>Specific Gravity (SG) SG Air = 1</u>	<u>Threshold<sup>1</sup> Limit</u>	<u>Hazardous<sup>2</sup> Limit</u>	<u>Lethal<sup>3</sup> Concentration</u>
Hydrogen Cyaide	HCN	0.94	10 ppm	150 ppm/hr	300 ppm
Hydrogen Sulfide	H <sub>2</sub> S	1.18	10 ppm <sup>4</sup> 20 ppm <sup>5</sup>	250 ppm/hr	600 ppm
Sulfur Dioxide	SO <sub>2</sub>	2.21	5 ppm	-	1,000 ppm
Chlorine	Cl <sub>2</sub>	2.45	1 ppm	4 ppm/hr	1,000 ppm
Carbon Monoxide	CO	0.97	50 ppm	400 ppm/hr	1,000 ppm
Carbon Dioxide	CO <sub>2</sub>	1.52	5,000 ppm	5%	10%
Methane	CH <sub>4</sub>	0.55	90,000 ppm (9%)	Combustible - above 5% in Air	

<sup>1</sup>Threshold Limit - concentration at which it is believed that all workers may be repeatedly exposed day after day without adverse effects.

<sup>2</sup>Hazardous Limit - concentration that may cause death.

<sup>3</sup>Lethal Concentration - concentration that will cause death with short-term exposure.

<sup>4</sup>Threshold Limit = 10 ppm - 1972 ACGIH (American Conference of Governmental Industrial Hygienists).

<sup>5</sup>Threshold Limit = 20 ppm - 1966 ANSI acceptable ceiling concentration for eight-hour exposure (based on 40-hour week) is 20 ppm. OSHA Rules and Regulations (Federal Register, Volume 37, No. 202, Part II, dated October 18, 1972).

Drills with breathing equipment will be conducted for each crew and for each person associated with the operation at the drillsite. These persons include, but are not limited to:

1. Rig Crew.
2. Drilling Contractor's Supervisor.
3. Mud Logger.
4. Mud Engineer.
5. Getty Oil Company Drilling Supervisor.
6. Getty Oil Company Geothermal Project Geologist.
7. Service Company Personnel.

Drill Procedure:

1. The Mud Logger will activate an alarm or simulate a potentially dangerous show of H<sub>2</sub>S gas.
2. The Rig Crew, Mud Logger, Drilling Supervisors and Mud Engineer will put on breathing equipment. Other personnel will report to the proper briefing station.
3. The Driller will pull off bottom, shut down mud pumps and check for flow from the well.
4. The Driller will proceed as if the well were flowing and simulate proper well shut-in and well killing procedures.
5. Mud Logger will continue to monitor his equipment.
6. Mud Engineer will check mud for weight, viscosity and run test to determine the sulfide concentration.

7. Drilling Supervisors will observe the performance of all personnel involved in the drill for evaluation or any corrections.

#### Safety Equipment

The presence of hydrogen sulfide gas will be detected by monitoring devices with audio and visual alarms. These monitors will be placed at the shale shakers and on the rig floor. Mud circulated out of the hole will be continuously monitored by the Mud Loggers. Approved hand-held hydrogen sulfide detectors will be available for spot checking.

Approved self-contained breathing apparatus and oxygen resuscitators will be readily available for emergency use.

Blowout-prevention equipment designed to shut-in the well in any emergency will be installed, maintained and regularly tested.

A de-gasser will be provided. The gas discharged from this apparatus will be vented to one of the two burning pits.

Adequate air circulation in critical areas will be provided through the use of large electric fans. Wind socks

or streamers will be positioned so as to be readily visible from the rig floor, day or night. Visual and audio alarms for the detection of H<sub>2</sub>S will be signals that cannot be confused with the monitoring alerts of any other drilling operation.

Warning signs will be available for posting on the access road to the location.

#### PROCEDURE OF OPERATIONS AFTER H<sub>2</sub>S DETECTION

##### Condition I = Potential Danger

Alarm in Mud Logger's trailer would indicate less than 10 ppm H<sub>2</sub>S concentration. Though this alert is in effect, there is no danger to personnel as long as concentration remains below 10 ppm.

##### General Action:

1. Be alert for any increase in H<sub>2</sub>S concentration.
2. Check all safety equipment, monitors and alarms for proper functioning.
3. Conduct drills and familiarization programs.

##### Condition II = Moderate Danger

Horn or siren is activated at 10 ppm.

##### General Action:

1. The following personnel will immediately put on their breathing equipment:

- a. All personnel on rig floor.
- b. All personnel in area of mud pits.
2. Notify Drilling Supervisors.
3. Follow instructions of Drilling Supervisors.
4. Immediately begin to ascertain the source of the H<sub>2</sub>S and take the required steps to suppress the H<sub>2</sub>S. Drilling will not proceed until the source is determined, the well is circulated and the gas is controlled.
5. The Supervisors will make sure all non-essential personnel are out of the potential danger area.
6. Check all gas monitoring devices and increase gas monitoring activities with the portable hand-operated H<sub>2</sub>S detector units.
7. The Getty Oil Drilling Supervisor will assess the situation, outline a control program and assign duties to each person or group as required to bring the situation under control.
8. Signs to be posted on access road to location indicating:  
"DANGER - POISONOUS GAS - H<sub>2</sub>S"
9. Access to drill site to be limited to authorized personnel only.
10. Notify District Drilling Superintendent:  
Jack B. Rogers - Bus. (805) 399-2961  
Res. (805) 832-6878

Condition III = Extreme Danger to Life

Alarm - Horn or Siren  
Blinking Lights

Characterized by:

Critical well operations, well-control problems, poisonous gas above threshold levels (as defined under Toxicity of Various Gases); and in the extreme, loss of well control.

General Action:

1. All personnel will put on their protective breathing equipment.
2. All personnel not required for well control, proceed to upwind briefing area for evacuation instructions.
3. Follow instructions of Drilling Supervisors.
4. The Getty Oil Company Supervisor will assess the situation, outline a control program and assign duties to each person or group as required to bring the situation under control.
5. Notify District Drilling Superintendent:

Jack B. Rogers - Bus. (805) 399-2961  
Res. (805) 832-6878

District Drilling Superintendent will:

- a. Brief his immediate Supervisor of the situation:  
M. L. Smith - District Superintendent  
Bus. - (805) 399-2961  
Res. - (805) 871-6975

- b. Notify United States Geological Survey

District Geothermal Supervisor  
Salt Lake City, Utah  
Bus. - (801) 524-5245  
Res. - (801) 532-2642

c. Notify Bureau of Land Management

District Manager  
Department of the Interior  
1579 No. Main Street  
Cedar City, Utah

Bus. - (801) 586-2401

Area Office - (801) 586-2458

6. Extreme Emergency:

- a. If there is no hope of containing well under prevailing conditions, and there is a definite threat to human life and property:

1. Initiate Emergency Evacuation Plan (See Page     ).
2. Refer to Contingency Plan for Uncontrolled Blowout.
3. Time and circumstances permitting, the District Office should be notified of the situation.
4. As a last resort, the well is to be ignited (Poison Gas).

b. Instructions for Igniting the Well

1. Two people are required for the actual igniting operation. Both men will wear self-contained breathing units and will have 200-foot retrieval ropes tied around their waists. One man is responsible for checking the atmosphere for explosive gases with Explosimeter. The other is responsible for lighting the well. Keep personnel not assigned special duties within the "Safe Briefing Area". Those in the "Safe Briefing Area" will be alert to the needs of the two men assigned to ignite the well. Should either of these men be overcome by fumes, they will immediately pull him to safety by the retrieval ropes.



2. The primary method for igniting the well is a 25mm meteor-type flare gun. It has a range of approximately 500 feet. If this method fails or well conditions are such that a safer or better method is apparent, then the alternate should be used.
  3. If the well is ignited, the burning hydrogen sulfide will be converted to sulfur dioxide, which is also poisonous; therefore, DO NOT ASSUME THAT THE AREA IS SAFE AFTER THE GAS IS IGNITED. CONTINUE TO OBSERVE EMERGENCY PROCEDURES AND FOLLOW THE INSTRUCTIONS OF SUPERVISORS.
7. Initiate program to kill, plug and abandon well.

#### Rescue

While drilling operations have made extensive preparations for personnel safety, all personnel should be aware of First-Aid procedures in the event someone becomes careless.

First Aid for H<sub>2</sub>S victims is based primarily on:

1. Move the victim to fresh air immediately.
  - a. WARNING - DO NOT jeopardize your own safety. Always wear a self-contained breathing apparatus while attempting rescue.
  - b. If victim is unconscious and not breathing, move the victim at once to the safe-breathing area and apply mouth-to-mouth artificial respiration until a resuscitator is available. Use the resuscitator until normal breathing is restored. Symptoms may pass rapidly; however, keep the victim warm and take him to a hospital and place under the care of a physician.

OPERATIONS PERSONNEL

GETTY OIL COMPANY

<u>Title</u>	<u>Name</u>	<u>Location</u>	<u>Telephone</u>
*DISTRICT OPERATIONS MANAGER		Bakersfield California	(805) 399-2961
EAST AREA SUPERINTENDENT	M. L. Smith	Bakersfield California	(805) 399-2961 (805) 871-6975 Res.
DISTRICT DRILLING SUPERINTENDENT	Jack B. Rogers	Bakersfield California	(805) 399-2961 (805) 832-6878 Res.
DIVISION EXPLORATION PROJECT GEOLOGIST	Wayne A. Shaw	Bakersfield California	(805) 399-2961 (805) 871-4820 Res.
*DRILLING ENGINEER			

DRILLING CONTRACTOR

<u>Title</u>	<u>Name</u>	<u>Location</u>	<u>Telephone</u>
*DIVISION MANAGER			
*DRILLING SUPERINTENDENT			
*DRILLING SUPERVISOR			

\*These names will be supplied prior to commencing operations.

EMERGENCY EVACUATION PLANS

1. Personnel will assemble at the most upwind briefing area for instruction.
2. Notify the following:

Sheriff - Beaver County

Telephone Number (801) 438-2862  
(801) 387-2750

Ambulance and Hospitals

Ambulance Service

Milford, Utah (801) 387-2854  
Beaver, Utah (801) 438-2651

Hospital

Beaver Valley Hospital  
Beaver, Utah (801) 438-2416

Milford Valley Memorial  
Milford, Utah (801) 387-2411

Valley View Medical Center  
Cedar City, Utah (801) 586-6587

Doctors

Dr. Henrie E. Terry  
Beaver, Utah (801) 438-2844

Dr. P. A. Symond  
Milford, Utah (801) 387-2471  
(801) 387-2411

Dr. David W. Brown  
Cedar City, Utah (801) 586-4456

Residences within three-mile radius keyed to location map

None

c. List of Medical Doctors and Hospitals

Doctors

Dr. D. A. Symond	Milford	(801) 387-2471
Dr. Henrie E. Terry	Beaver	(801) 438-2844 (801) 438-2416
Dr. David W. Brown	Cedar City	(801) 586-4456

Hospitals

Beaver Valley	Beaver	(801) 438-2416
Milford Valley Memorial	Milford	(801) 387-2411
Valley View Medical Center	Cedar City	(801) 586-6587

Ambulances

Ground	Milford	(801) 387-2854
Ground	Beaver	(801) 438-2651
Air	Richfield	(801) 896-5484
Air	Cedar City	(801) 373-1508
Air	Cedar City	(801) 586-3881

d. Uncontrolled Blowout and Contingency Plan

Uncontrolled blowout can occur as a result of the loss of control or means to shut-in a well if a substantial flow of steam or fluid is encountered in the bore hole with sufficient pressure to temporarily render the blowout equipment ineffective or inoperative. When this occurs, the person in charge of the drilling operations will immediately notify the Getty Oil Company Drilling Supervisor. If the flow cannot be contained, the Supervisor will take the following action:

1. Arrange for any injured persons to be dispatched to the nearest medical facility:

Ambulance Service

Ground - Milford, Utah	(801) 387-2854
Beaver, Utah	(801) 438-2651
Air - Richfield, Utah	(801) 896-8074

Hospital

Milford Valley Memorial Milford, Utah	(801) 387-2411
Beaver Valley Beaver, Utah	(801) 438-2416

Doctors

Dr. D. A. Symond Milford, Utah	(801) 387-2471 (801) 387-2411
Dr. Henrie E. Terry Beaver, Utah	(801) 438-2844 (801) 438-2416

If there is a threat to any local residents, the Sheriff should be notified as soon as possible:

Beaver County Sheriff's Department  
Beaver, Utah

Office: (801) 438-2862

Home: (801) 387-2750

2. Put into motion plans for containment or confinement of the flow.

3. See that all access roads are secured to prevent entry to the drillsite of unauthorized persons.

4. Report the situation to the District Drilling Superintendent, who will follow the same procedure as outlined in the Major Spill Contingency Plan.

5. Notify "Wild Well Control" specialists and apprise them of the problem:

Red Adair Company, Inc.  
Houston, Texas

(713) 526-4717

(713) 562-1602

6. Construct sumps or dikes to contain fluid flow if necessary.

7. Attempt to control well with rig personnel.

8. Attempt to remove any damaged wellhead facility or blowout prevention equipment and install operable equipment.

9. If contractor's personnel is unable to contain flow, notify "Wild Well Control" specialists.

10. Maintain an inspection of the drillsite for any erosion that could undermine the rig structure.

11. After the flow has been contained, prepare to return the area as nearly as possible to its original contour, and reseed with approved vegetation.

#### Injuries

In the event of injuries that may occur, connected with this operation, Getty Oil procedures will be followed, with specific and immediate attention given to proper air and/or <sup>ground</sup> transportation to a medical facility as required.

Refer to Emergency Phone Numbers, Emergency Personnel and Services.

Copies of accident reports from Getty Oil Company and/or the contractor employing the injured individual will be submitted to the Utah State Health Department and other organizations, as required.

e. Spill Program and Contingency Plans

Introduction

Roosevelt Hot Springs Prospect is located approximately 12 miles northeast of Milford, Utah, in a sparsely populated, gently sloping area. The country side is used for cattle grazing, watershed and for hunting.

Types of Potential Spills in Geothermal Drilling and Producing Operations

Drilling Fluids (Mud):

These are a mixture of water, chemicals, and solid particles used in drilling operations. Mud is pumped down the drill pipe, through the bit and carries drilled cuttings to the surface. The cuttings are screened out and the mud recirculated. A small amount of mud is spilled into the sump, along with water used to wash down the rig floor, etc. The sump is designed to be large enough to contain all cuttings, mud and water that will accumulate during the drilling of the well. The sump is an earthen pit whose bottom is lined with Bentonite to prevent any percolation. The sump is positioned in such a manner as to prevent flooding from runoff water from a heavy rainstorm.

Although the danger is slight, a spill could occur by the sump overflowing, the wall breaking or through fluid seepage. Some mud is spilled onto the area immediately round the well



bore during normal drilling operations, but these volumes are small. A spill could occur if circulation were lost at a very shallow depth and mud channeled back to the surface.

Fuel Oil:

Any spillage from fuel oil delivery trucks, fuel oil storage tanks or fuel lines would be extremely small.

Lubricating Oils and Other Petroleum Products:

There is often some accumulation of lubricating oil associated with stationary engines and machinery at the drillsite. There may be some leakage from earth-moving equipment used to build the drillsites and access roads.

Possible Water Quality Affects

Condensate or Drilling Muds

1. Contaminate water possibly making it unsuitable for human or wildlife consumption.
2. Possible detrimental affect to flora of area.
3. Increase turbidity of water by particulates in fluid or by soil erosion.

Petroleum Products

1. Contaminate water.
2. Cover wildlife and plant life.

Plan for Clean-up and Abatement

In the event of discharges of condensate, drilling muds, petroleum products or construction debris, the overall contingency plan for the Roosevelt Hot Springs Area, Beaver, Utah, is as follows:

1. The person responsible for the operation will make an immediate investigation, then call the Getty Oil Drilling Supervisor and advise him of spill. The Getty Oil Drilling Supervisor will, in turn, call out heavy equipment, regulate field operations, or do other work as applicable for control and clean-up of spill. If spill is small (i.e., less than 250 gallons) and easily containable without endangering watershed, Getty Oil Drilling Supervisor will direct and supervise complete clean-up and return to normal operations.

2. If spill is larger than 250 gallons, or is not easily contained, or endangers or has entered watershed, Getty Oil Drilling Supervisor will proceed to take necessary action to curtail, contain and clean-up spill, and notify personnel as follows:

- a. Call out heavy equipment, regulate field production, etc.
- b. Call for contract vacuum trucks or water pump trucks.
- c. Call Drilling Superintendent and advise of spill.

Jack B. Rogers    Office: (805) 399-2961  
Home:            (805) 832-6878

- d. Local residence phone number will be furnished after field operations begin.

The Drilling Superintendent Will:

1. Brief his immediate supervisor on the situation and course of action under way.

M. Lloyd Smith      Office: (805) 399-2961  
                                 Home:      (805) 871-6975

2. Notify the following agencies or regulatory bodies as soon as practical, and work closely with them in all phases of operations:

United States Geological Survey  
District Geothermal Supervisor  
Room 442, Post Office Bldg.  
Salt Lake City, Utah

Office: (801) 524-5245  
Res.:    (801) 532-2642

Bureau of Land Management  
District Manager  
Department of the Interior  
1579 No. Main  
Cedar City, Utah

(801) 586-2401

Department of Natural Resources  
Division of Water Rights  
State Engineer  
442 State Capital  
Salt Lake City, Utah

(801) 328-6071

United States Geological Survey  
Conservation Division - Western Region Area  
Geothermal Supervisor  
2465 East Bayshore  
Suite 400 - Second Floor  
Palo Alto, California 94303

(415) 323-8111 x 2845

Utah State Fish and Game Department  
Regional Office  
622 North Main  
Cedar City, Utah

(801) 586-6803

Any livestock owners or landowners, if  
spill affects stock or property.

Specific Procedures (if spill is larger than 250 gallons)

For Drilling Mud:

- a. Repair sump or contain with dikes.
- b. Haul pumpable liquid to another sump or to an approved disposal site and bury.

For Petroleum Products:

- a. Contain spill with available manpower.
- b. Use absorbents and dispose of same in county-approved area.

Have source of spill repaired at earliest practical time. Continue working crews, equipment and vacuum trucks on clean-up until all concerned agencies are satisfied.

Plan for Clean-up and Abatement (continued)

3. Field Personnel Responsible for carrying out

Overall Contingency Plan:

- a. Drilling Contractor Tool Pusher
- b. Getty Oil Company Drilling Supervisor
- c. Getty Oil Company Exploration Field Supervisor
- d. Getty Oil Company Drilling Superintendent
- e. Outside contractors for crews and equipment:
  - AAA Welding, Inc. (801) 387-2442
  - Del Mar Construction Co. (801) 387-2202
  - Howard Construction Co. (801) 676-2312
- f. Other available trucking and construction firms in the area, as required:

Confirmation of Telephone  
Notification to Agencies  
and Regulatory Bodies

Telephone notification shall be confirmed by the Drilling Superintendent in writing within two (2) weeks of telephone notification, containing:

- a. Reason for discharge or spillage
- b. Duration and volume of discharge
- c. Steps taken to correct problem
- d. Steps taken to prevent re-occurrence of problem

XI. RESERVOIR DATA, PRESSURE AND TEMPERATURE REPORTS.

A record of the formations encountered, the thickness, lithologic characteristics and recorded temperatures, will be a part of the data-gathering process along with the initial results of testing. All pressure data will be recorded, including the steamwater ratio, surface pressures and temperatures. This data, along with the quantity and quality of the steam and effluent from the well bore, will be reported immediately to the Supervisor within thirty (30) days after a well is completed. The Area Geothermal Supervisor will be notified of any cementing or testing operations in ample time to witness proposed operations, if he so desires.

## XII. DATA GATHERING PROGRAM

A program of data gathering will begin with the approval of the Plan of Operations to sample air, soil, wind velocities, directions, water qualities, known temperature gradient well data, and noise levels. Sound levels will not exceed the required 65 db<sup>(A)</sup> limits, except in case of an emergency or with the express permission from the Geothermal Supervisor. Getty Oil Company personnel will contact environmental governmental agencies and the Supervisor for assistance in implementing a program which will be designed to comply with regulations and to carry out an on-going, data-gathering process acceptable to all parties.

## XIII. ABANDONMENT PROGRAM

After drilling and testing operations are concluded at the Getty Oil Company's "USL" #52-21, and the well should prove uneconomically feasible to complete, a detailed Abandonment Program, in accordance with CFR #270.45, will be initiated. Any plan or program of abandonment will have demonstrated to the satisfaction of the Geothermal Area Supervisor that the well lacks productive capacity, and should be abandoned. Only then, with written consent from the Supervisor, will the Abandonment Program be completed.

ATTACHMENTS

Getty Oil Company  
Geothermal Operations

Bakersfield, California  
May 20, 1977



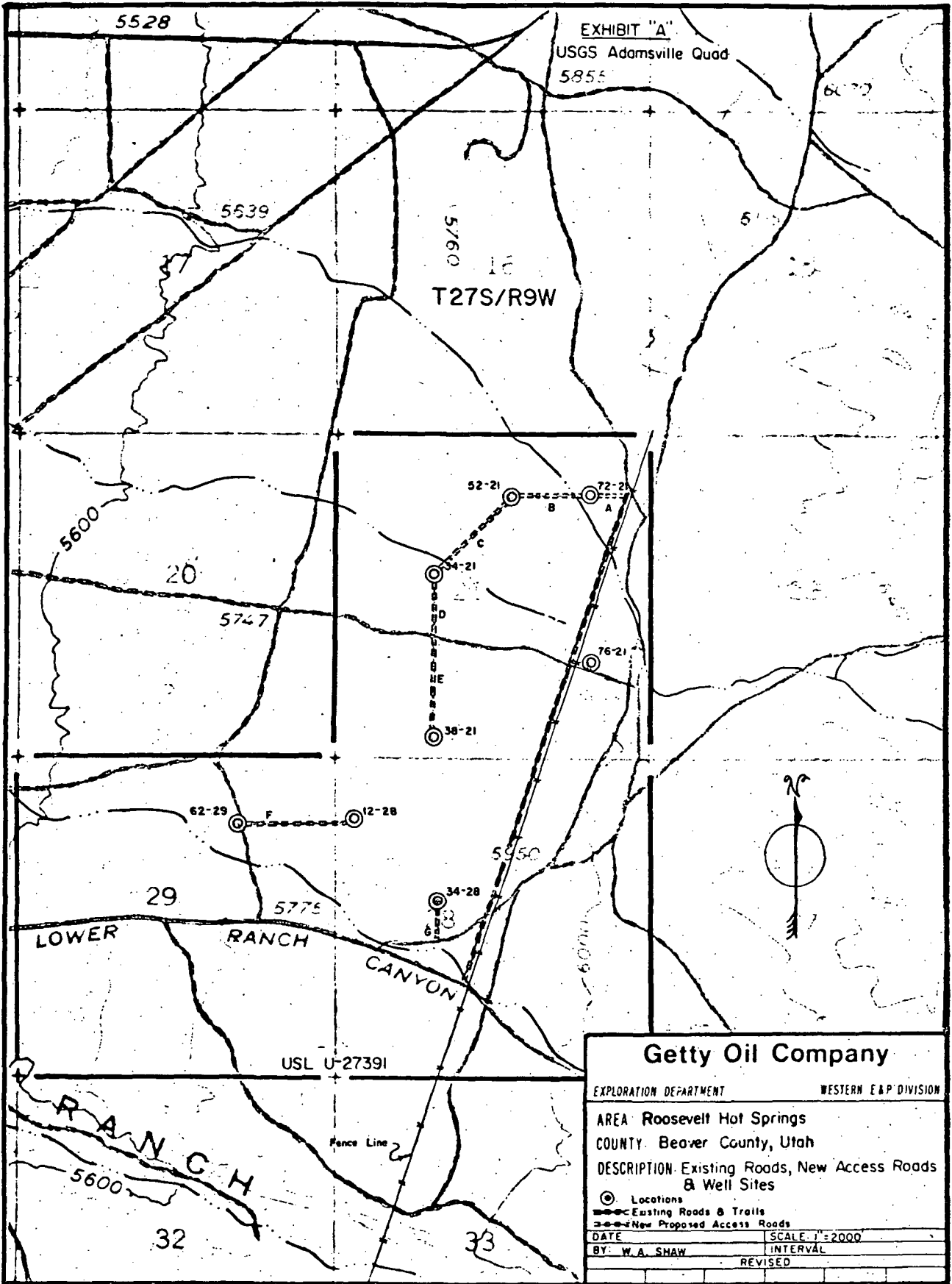


EXHIBIT "A"  
USGS Adamsville Quad  
5855

T27S/R9W

LOWER RANCH CANYON

USL U-27391

Fence Line

**Getty Oil Company**

EXPLORATION DEPARTMENT WESTERN E&P DIVISION

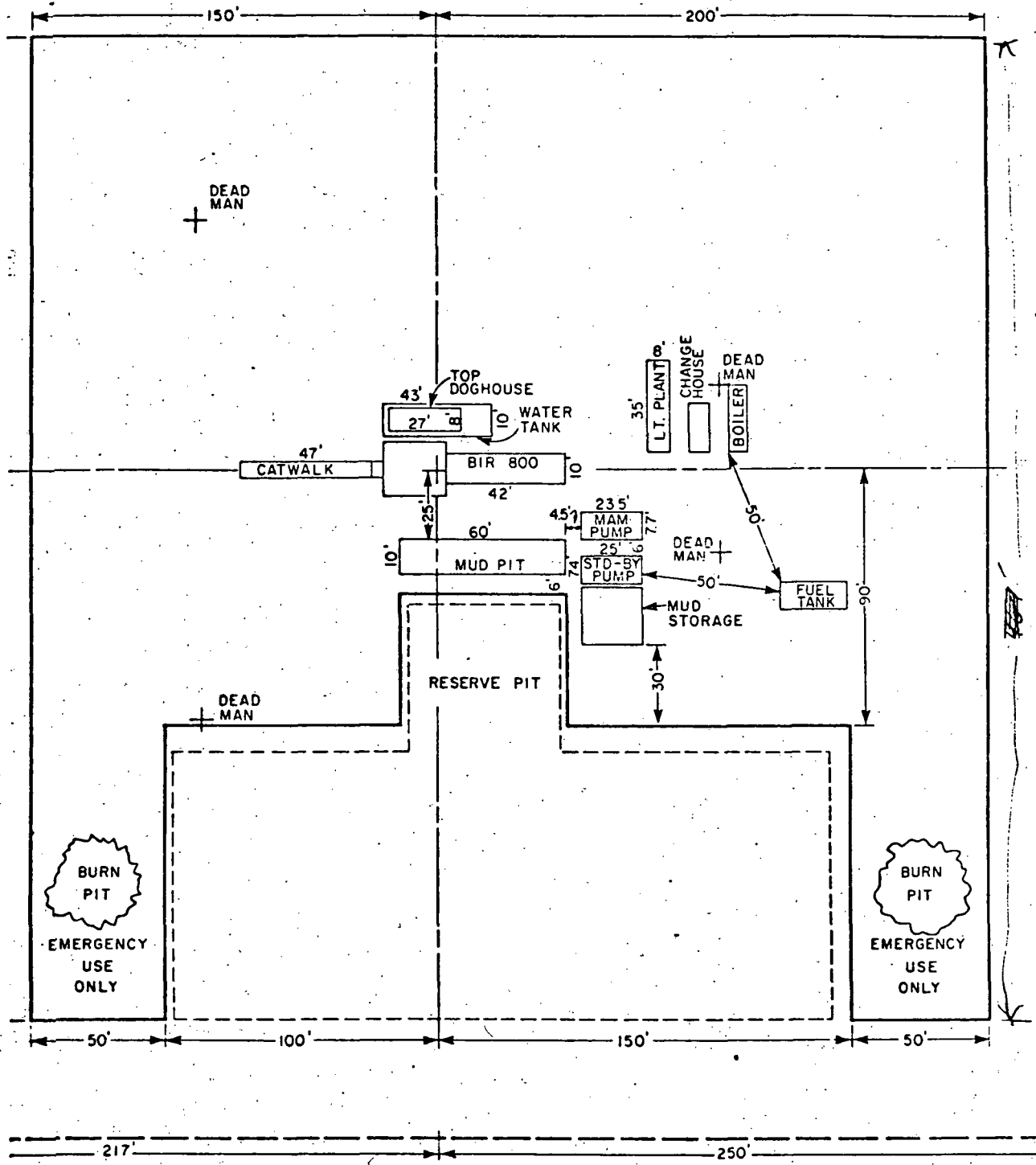
AREA Roosevelt Hot Springs

COUNTY Beaver County, Utah

DESCRIPTION Existing Roads, New Access Roads & Well Sites

- ⊙ Locations
- Existing Roads & Trails
- - - New Proposed Access Roads

DATE	SCALE: 1"=2000'
BY: W.A. SNAW	INTERVAL
	REVISED



476

## LOFFLAND BROTHERS COMPANY

EXHIBIT "C"

## FOUR CORNERS DIVISION

## RIG #5

RATED DEPTH CAPACITY 12,000 FEET

**MAST:** Ideco - 112' - 482,000# Gross Nominal Capacity  
358,000# Hook Load w/ 10 Lines

**SUBSTRUCTURE:** Ideco 275T - 350,000# Casing Capacity  
300,000# Set Back Capacity

**SUBSTRUCTURE HEIGHT:** 20'

**GROUND TO ROTARY BEAM:** 17' 1"

**DRAWWORKS:** Ideco Hydrair H-1000, Single Drum

**AUXILIARY BRAKE:** Parkersburg 22" Hydramatic

**POWER DRIVE:** 2 - Allison TC-955 Torque Converters  
2 - Allison TG-602 Torquematic Transmissions  
3 speeds forward, 1 reverse

**ENGINES:** 2 - General Motors 12V-71N - 434 Int. HP @ 1800 RPM

**MUD PUMPS:** Emsco D-500 Driven by Caterpillar 379 TA  
Emsco D-500 Driven by Caterpillar 397 TA

**DESANDER:** San Angelo - 3 Cone

**MUD TANK:** 1 - 500 Barrel Capacity

**WATER STORAGE:** 1 - 500 Barrel Capacity

**GENERATORS:** 2 - 150 KW AC

**ROTARY TABLE:** Ideco 23"

**TRAVELING BLOCK:** Unit Rig 438A - 200 Ton

**CROWN BLOCK:** Ideco - 1 1/8" - 6 Sheave - Crossover Type

**HOOK:** Neb Wilson

**SWIVEL:** Gray Model B-44

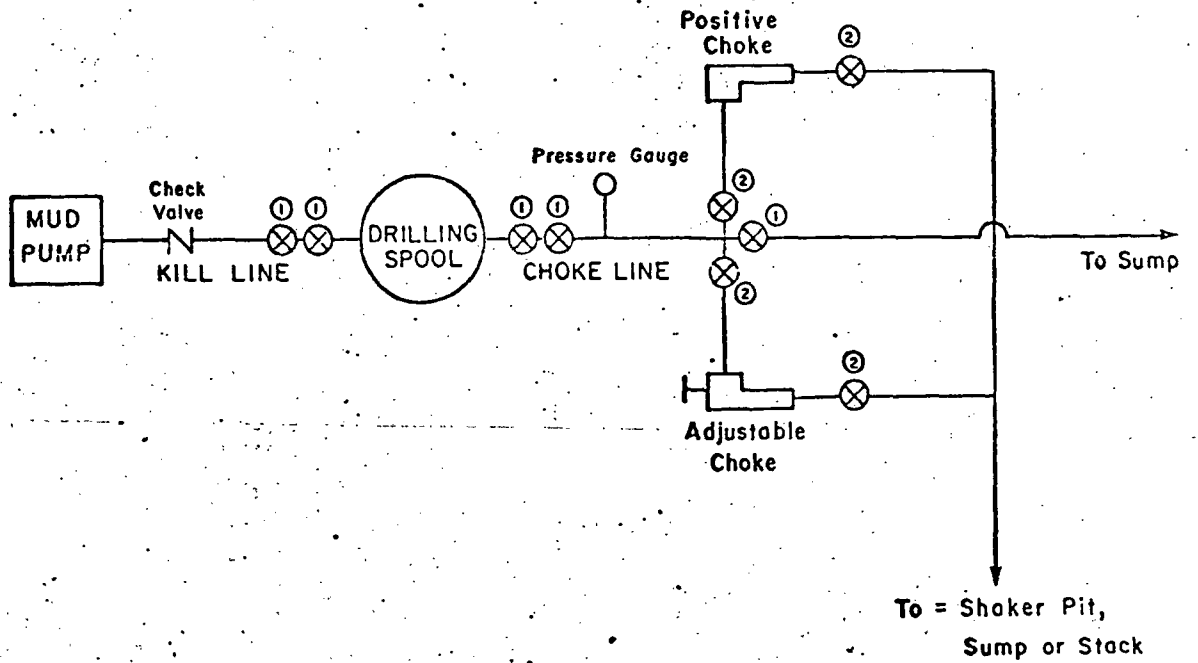
**BLOWOUT PREVENTERS:** Shown on Attached Drawing

**SPECIAL TOOLS:** Tong Torque Gauge Automatic Driller  
Crown-o-Matic Rate of Penetration Recorder  
Two way Radio

June, 1975

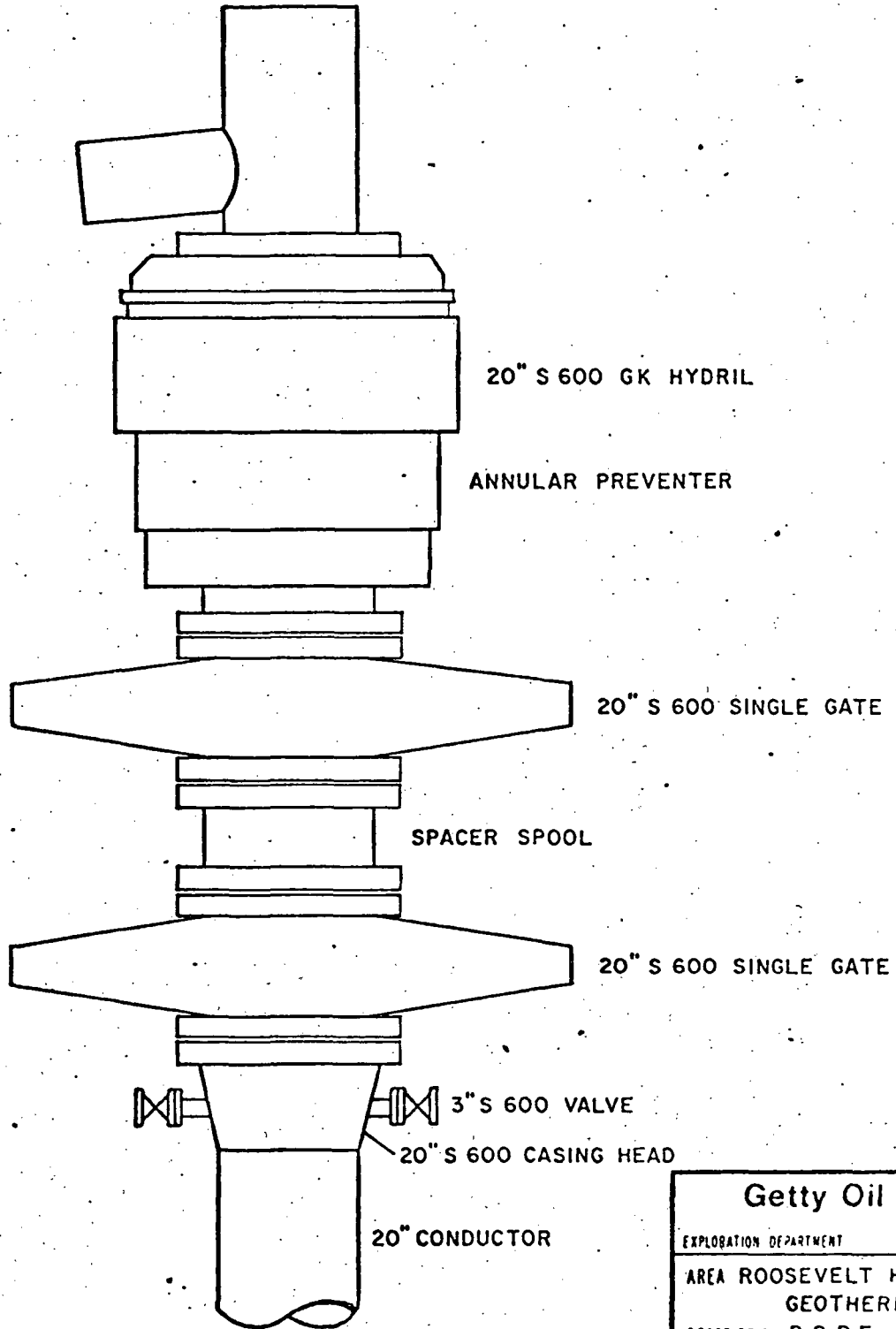
EXHIBIT "D"

- ① = 3" S 900 VALVE
- ② = 2" " " "



<b>Getty Oil Company</b>	
EXPLORATION DEPARTMENT	WESTERN E&P DIVISION
AREA: ROOSEVELT HOT SPRINGS	
COUNTY: BEAVER, UTAH	
DESCRIPTION: CHOKE MANIFOLD FOR GEOHERMAL DRILLING	
DATE: 5-13-77	SCALE: NONE
BY: J. B. R.	INTERNAL
	REVISED

EXHIBIT "E"



20" S 600 GK HYDRIL

ANNULAR PREVENTER

20" S 600 SINGLE GATE

SPACER SPOOL

20" S 600 SINGLE GATE

3" S 600 VALVE

20" S 600 CASING HEAD

20" CONDUCTOR

B.O.P.E.

Getty Oil Company

EXPLORATION DEPARTMENT

WESTERN E&P DIVISION

AREA ROOSEVELT HOT SPRINGS  
 GEOTHERMAL WELL  
 DESCRIPTION B.O.P.E. STACK FOR  
 DRILLING ±100 - ±800  
 THRU 20" CASING

DATE 9-13-77

SCALE NONE

BY

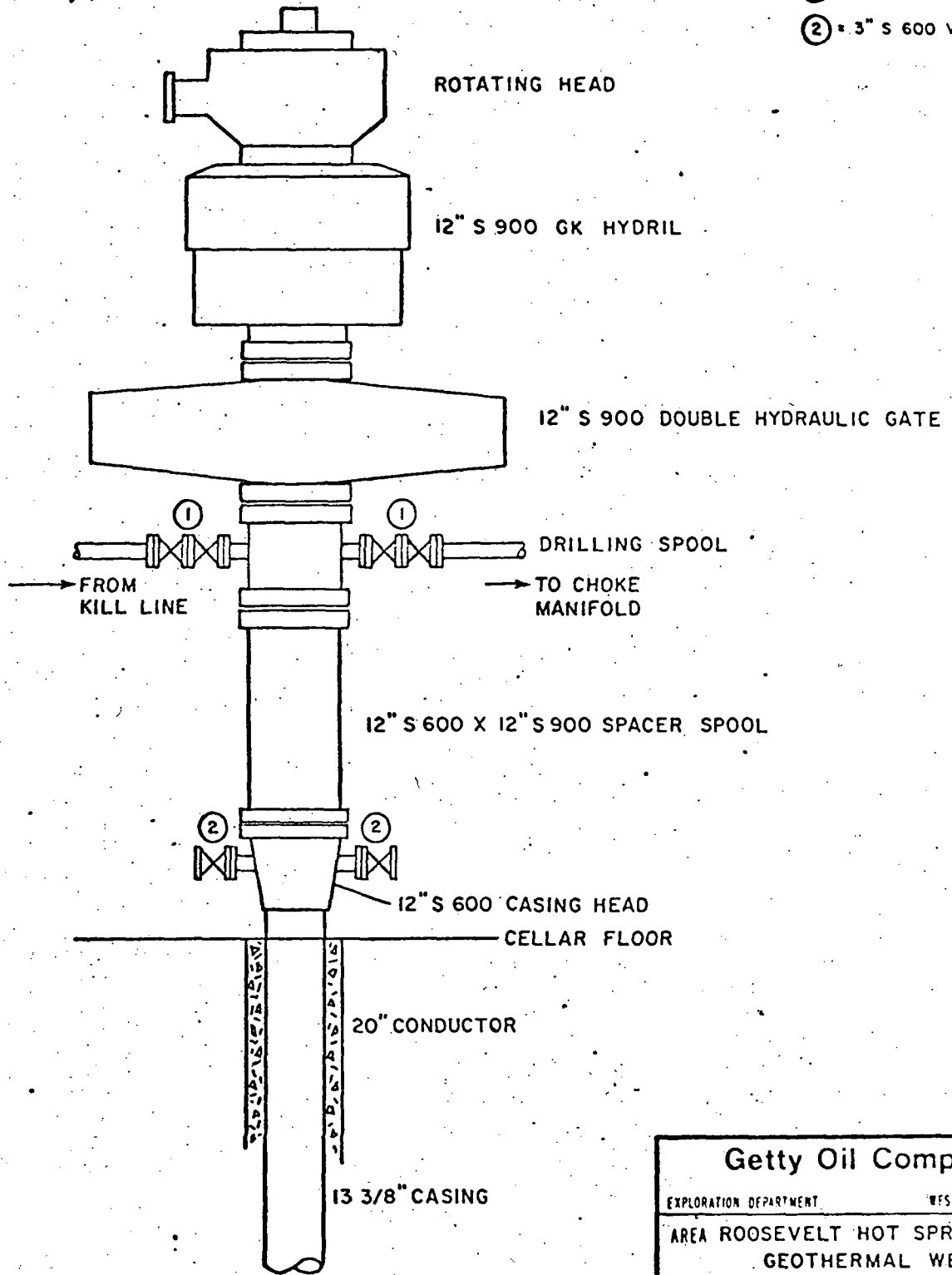
WILLIAMS

REVISED

EXHIBIT "F"

① = 3" S 900 VALVES

② = 3" S 600 VALVES



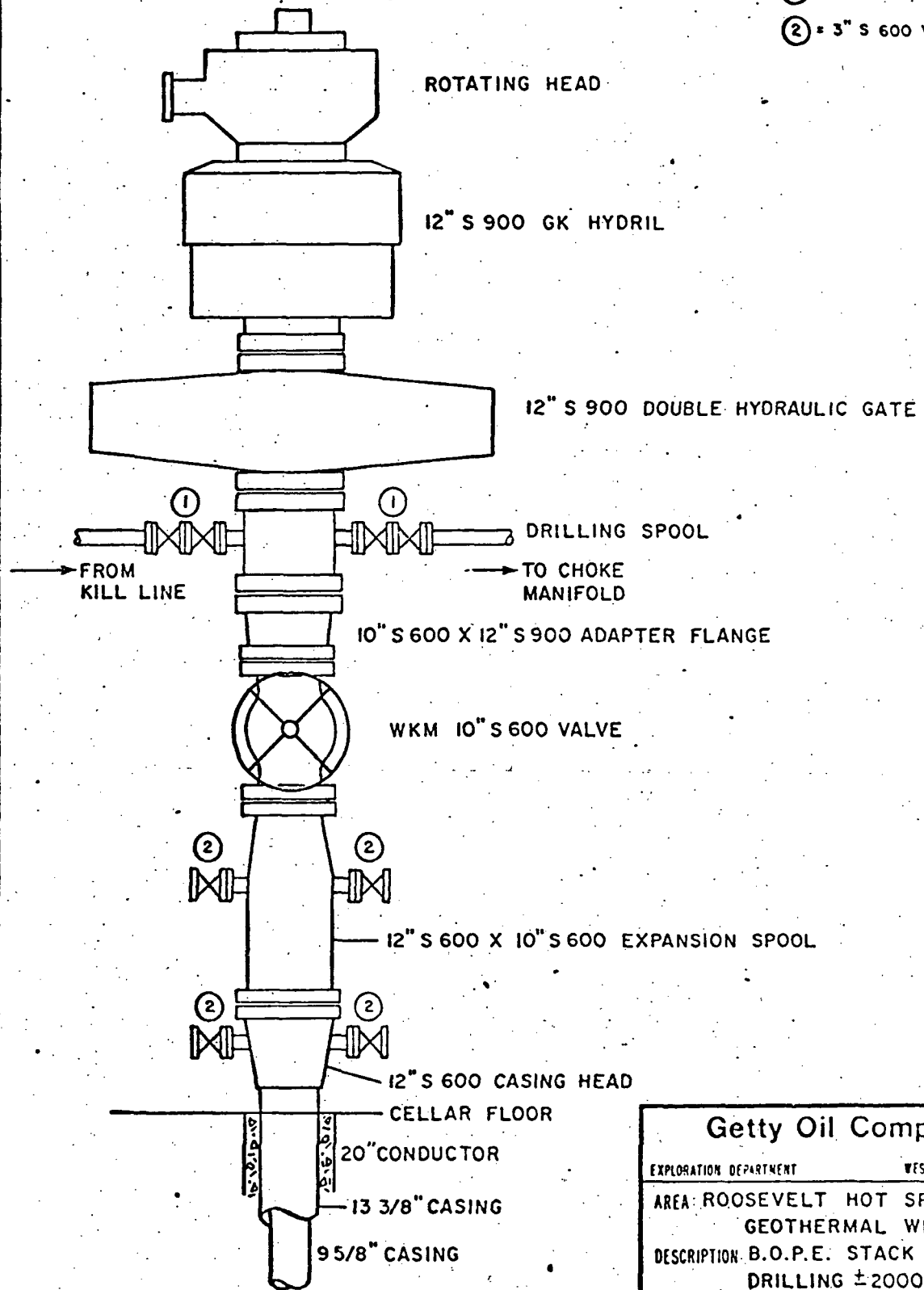
B.O.P.E.

<b>Getty Oil Company</b>	
EXPLORATION DEPARTMENT	WESTERN E&P DIVISION
AREA ROOSEVELT HOT SPRINGS GEOTHERMAL WELL	
DESCRIPTION B.O.P.E. STACK FOR DRILLING ± 800' - ± 2000' THRU 13 3/8" CASING	
DATE 5-13-77	SCALE NONE
BY J.B.R.	APPROVAL
	REVISED

EXHIBIT "G"

① = 3" S 900 VALVES

② = 3" S 600 VALVES



B.O.P.E.

<b>Getty Oil Company</b>	
EXPLORATION DEPARTMENT	WESTERN E&P DIVISION
AREA: ROOSEVELT HOT SPRINGS	
GEOHERMAL WELL	
DESCRIPTION: B.O.P.E. STACK FOR	
DRILLING ±2000' - ±6000'	
THRU 9 5/8" CASING	
DATE: 5-15-77	SCALE: NONE
BY: J. O. R.	INITIALS
	REVISED



UNITED STATES  
DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Area Geothermal Supervisor's Office  
Conservation Division, MS 92  
345 Middlefield Road  
Menlo Park, CA 94025

JUN - 2 1977

RECEIVED

BY \_\_\_\_\_

JUN 3 1977

CITY OF BOULDER  
LICHT & CLERK

Memorandum

To: INTERESTED PARTIES  
From: <sup>Acting</sup> Area Geothermal Supervisor

Subject: Plan of Operation, Republic Geothermal, Inc., Federal Lease U-32256, Thermo Hot Springs KGRA, Beaver County, Utah

Republic Geothermal, Inc. has submitted a Plan of Operation (copy attached) pursuant to 30 CFR 270.34, to drill three 10,000'+ geothermal resources exploratory wells and three fluid disposal wells on Federal Lease U-27391, within the Thermo Hot Springs KGRA, Beaver County, Utah.

Coincidentally Getty Oil Company has submitted a Plan of Operation to drill eight 7500'+ geothermal exploratory wells on Federal Lease U-27391 within the Roosevelt Hot Springs KGRA, Beaver County, Utah. A copy of Getty's plan was sent to interested parties under separate cover.

Interested parties are invited hereby, to participate in an on-site field inspection of the proposed access roads and well locations under the Getty Oil Company Plan of Operation scheduled for June 22, 1977. The inspection party will depart from the Hong Kong Cafe, Milford, Utah, at 8:30 a.m. for Roosevelt Hot Springs KGRA. Mr. Ken Bull, District Geothermal Supervisor, Salt Lake City, Utah (tel: (801) 524-5245, FTS: 588-5245) will be the field inspection coordinator.

The inspection party will return to Milford, Utah, for lunch and depart immediately thereafter to inspect the proposed access roads and well locations pursuant to Republic Geothermal Inc.'s Plan of Operation, Federal Lease U-32256, located in the Thermo area, Escalante Desert, approximately 20 miles southwest of Milford, Utah. Any questions interested parties may have in regard to these inspections and proposed actions should be addressed to Mr. Bull.

An Environmental Analysis (EA#83) will be prepared by the Office of the Area Geothermal Supervisor for the Republic Geothermal, Inc. Plan of Operation, and also (EA#82) for the Getty Oil Company Plan of Operation. All comments concerning these Plans of Operation, in order to be considered, must be received no later than July 8, 1977, by:



Area Geothermal Supervisor  
USGS, Conservation Division  
345 Middlefield Road MS 92  
Menlo Park, California 94025  
Tel: 415-323-8111, Ext. 2848 (FTS: 467-2848)

We urge you to send written commentary and will appreciate hearing from you even if you are of the opinion that the existing regulations, lease terms, and operational orders provide adequate environmental protection. Further, we solicit your comments and suggestions on the proposed actions even though you may not be able to participate in the field inspections. All comments will be given serious consideration in the preparation of the environmental analyses and any subsequent conditions of approval thereafter.

The Area Geothermal Supervisor's Office will not send draft Environmental Analyses (EA#82, EA#83) to interested parties for review for the proposed actions. Certain parties however, such as the surface managing agency, the lessee, GEAP, and USFWS will receive a copy of the completed EA#82 and EA#83. Other interested parties will not receive a copy of the final EA's unless such parties comment on the proposed actions in writing or request a copy of the particular EA pursuant to the Freedom of Information Act. Copies of Environmental Analyses are available for inspection during normal business hours at the Area Geothermal Supervisor's Office, the appropriate District Geothermal Supervisor's Office, and the appropriate BLM, District Manager's Office.

*Barry A Boudreau*

INTERESTED PARTIES

Republic Geothermal, Inc.

Environmental Analysis #83

Plan of Operation: 6-10,000' wells (3 prod., 3 inj.)

Federal Lease U-32256

Thermo Hot Springs KGRA, Escalante Desert

Beaver County, Utah

District Geothermal Supervisor  
USGS-Conservation Division  
Post Office Bldg., Rm. 443  
350 S. Main Street  
Salt Lake City, Utah 84101  
FTS: 588-5245 (801-524-5245)

Conservation Manager, Central Region  
USGS-Conservation Division MS 609  
Environmental Staff (Don Libbey)  
Box 25046  
Denver Federal Center  
Denver, Colorado 80225  
FTS: 234-2855 (303-234-2855)

Office of the Area Geologist  
USGS-Conservation Division  
Attn: Dan Jobin  
Bldg. 25, Rm. 1322  
Denver Federal Center  
Denver, Colorado 80225  
FTS: 234-4435 (303-234-4435)

Donald Alvord, District Geologist  
USGS-Conservation Division  
Federal Bldg., Rm. 8422  
125 S. State Street  
Salt Lake City, Utah 84138  
FTS: 588-5643 (801-524-5643)

District Manager  
Cedar City District Office  
Bureau of Land Management  
P. O. Box 729  
Cedar City, Utah 84720  
(801-586-2401)

Bureau of Land Management  
Beaver River Resource Area Office  
Attn: Lanny Ream  
P. O. Box 729  
Cedar City, Utah 84720  
(801-586-2458)

State Director  
Bureau of Land Management  
University Club Building  
136 E. South Temple  
P. O. Box 11505  
Salt Lake City, Utah 84111  
FTS: 588-5311 (801-524-5311)

Mr. Max Crittenden, Chairman  
Geothermal Environmental Advisory Panel  
U. S. Geological Survey  
345 Middlefield Rd., MS 75  
Menlo Park, California 94025  
FTS 467-2317 (415-323-8111, Ext. 2317)

U. S. Fish & Wildlife Service  
Regional Director, Region 6  
Attn: Hal Boeker  
Denver Federal Center  
P. O. Box 25486  
Denver, Colorado 80225  
FTS: 234-2209 (303-234-2209)

U. S. Fish & Wildlife Service  
Area Office  
Attn: Lewis Richardson  
Federal Building  
125 S. State Street  
Salt Lake City, Utah 84138  
FTS: 588-5637 (801-524-5637)

U. S. Fish & Wildlife Service  
Division of Ecological Services  
Attn: Felix Smith  
2800 Cottage Way, Room E-2720  
Sacramento, California 95825  
FTS: 468-4657 (916-484-4657)

U. S. ERDA, Nevada Operations Office  
Attn: John O. Cummings  
P. O. Box 14100  
Las Vegas, Nevada 89114  
FTS: 598-3591 (702-734-3591)

INTERESTED PARTIES - EA#03

U. S. ERDA

Division of Geothermal Energy, 3rd Floor  
Attn: Bert Barnes/Ron Loose  
Mission Team Leader, Southwest  
20 Massachusetts Avenue NW  
Washington, D.C. 20545  
FTS: 376-4902 (202-376-4902)

U. S. Forest Service

Attn: Ralph S. Rawlinson  
500 S. Main Street  
Cedar City, Utah 84720  
(801-586-2461)

U. S. Forest Service

Forest Ranger  
Attn: Floyd Bartlett  
Beaver, Utah 84713  
(801-438-2372)

Federal Energy Administration

Attn: Charles E. Denton  
Post Office Bldg., Rm. 464  
350 S. Main Street  
Salt Lake City, Utah 84101  
FTS: 588-4108 (801-524-4108)

Environmental Protection Agency

Regional Office, Region 8  
Attn: Jon Herrmann  
1860 Lincoln Street  
Denver, Colorado 80203  
FTS: 327-5914 (303-327-5914)

Environmental Protection Agency

Las Vegas Office  
Attn: Don Gillmore  
P. O. Box 15027  
Las Vegas, Nevada 89114  
FTS: 595-2969, Ext. 241 (702-736-2969)

Senator Jake Garn

Federal Building, Rm. 4227  
125 S. State Street  
Salt Lake City, Utah 84138  
FTS: 588-5933 (801-524-5933)

Senator Orrin Hatch

Federal Building, Rm. 5430  
125 S. State Street  
Salt Lake City, Utah 84138  
FTS: 588-4380 (801-524-4380)

Representative Dan Marriott

Federal Building, Room 2311  
125 South State Street  
Salt Lake City, Utah 84138  
FTS: 588-4394 (801-524-4394)

Representative Dan Marriott

\* Jula Rose DeMille  
P. O. Box 667  
Cedar City, Utah 84720  
(801-586-2451)

Utah State Planning Commission

Attn: Dave Conine  
Room 118 State Capitol Bldg.  
Salt Lake City, Utah 84114  
(801-533-6491)

Utah Water Resources Division

Attn: Brice Montgomery, Geologist  
Room 435 State Capitol Bldg.  
Salt Lake City, Utah 84114  
(801-533-5401)

Utah Natural Resources Department

Attn: Clifford Colling  
Room 438 State Capitol Bldg.  
Salt Lake City, Utah 84114  
(801-533-5356)

Utah Water Rights Division

Attn: Dee Hansen, State Engineer  
Room 442 State Capitol Bldg.  
Salt Lake City, Utah 84114  
(801-533-6071)

Mr. Cleon B. Feight

State of Utah  
Industrial Commission  
350 East Fifth South  
Salt Lake City, Utah 84111  
(801-533-6411)

INTERESTED PARTIES - EA#83

Utah Division of Health  
Environmental Health Service Branch  
Attn: Lynn Thatcher, Director  
44 Medical Drive  
Salt Lake City, Utah 84113  
(801-533-6121)

Utah Oil, Gas & Mining Division  
Attn: Patrick Driscoll  
Chief, Petroleum Engineer  
1588 West North Temple  
Salt Lake City, Utah 84116  
(801-533-5771)

Utah Wildlife Resources Division  
Attn: Earl Sparks  
1596 West North Temple  
Salt Lake City, Utah 84116  
(801-533-9333)

Utah Geological and Mineral Survey  
Attn: Dan Mc Millan  
USGS Building, University of Utah  
Salt Lake City, Utah 84112  
(801-581-6831)

Dr. Richard E. Turley  
State Science Advisor  
3008 MEB  
University of Utah  
Salt Lake City, Utah 84112  
(801-581-6479)

University of Utah  
Bureau of Economic & Business Research  
Mrs. Ronda W. Brinkerhoff, Research Analy.  
Room 401  
Salt Lake City, Utah 84112

Beaver County Planning Council  
Attn: Russell Mayer, Chairman  
P. O. Box 811  
Milford, Utah 84751  
(801-387-2636)

Beaver County News  
Attn: N. E. "Red" Wilson  
P. O. Box 368  
Milford, Utah 84751  
(801-387-2881)

Val Finlayson  
Director of Research  
Utah Power & Light Co.  
1407 West North Temple  
Salt Lake City, Utah 84110  
(801-350-3722)

City of Bountiful Light & Power  
Attn: W. Berry Hutchings  
198 South 200 West  
Bountiful, Utah 84010  
(801-295-9496)

Getty Oil Company  
Attn: Wayne Shaw  
P. O. Box 5237  
Bakersfield, California 93308  
(805-399-2961)

California Energy Company, Inc.  
Attn: Mr. Paul Storm  
Wells Fargo Bldg., Suite 300  
200 B Street  
Santa Rosa, California 95401  
(707-526-1000)

Chevron USA, Inc.  
Attn: Mr. J. G. Turner  
P. O. Box 3722  
San Francisco, California 94119  
(415-894-2726)

Exxon Company  
Attn: James H. Hafenbrack  
P. O. Box 120  
Denver, Colorado 80201

Geothermal Power Corporation  
Attn: Frank G. Metcalfe  
1127 Grant Avenue, Suite 6  
P. O. Box 1186  
Novato, California 94947  
(415-897-7833)

GeothermEx  
Attn: Mr. James B. Koenig  
901 Mendocino Avenue  
Berkeley, California 94707  
(415-524-9242)

INTERESTED PARTIES - EA#83

Gulf Mineral Resources Co.  
Attn: Mr. E. W. Westrick  
Exploration Department  
1720 South Bellaire Street  
Denver, Colorado 80222  
(303-758-1700)

Hydro-Search, Inc.  
Attn: Mario L. Davis  
333 Flint Street  
Reno, Nevada 89501  
(702-322-4172)

Phillips Petroleum Company  
Attn: R. L. Wright  
P. O. Box 752  
Del Mar, California 92014  
(714-755-0131)

Republic Geothermal, Inc.  
Attn: Dwight Carey  
P. O. Box 3388  
Santa Fe Springs, California 90670  
(213-945-3661)

Sunoco Energy Development Co.  
Attn: E. R. Sausser  
12700 Park Central Pl., Suite 1500  
Dallas, Texas 75251  
(214-744-4300)

Union Oil Company  
Attn: Don Ash  
1250 Coddington Center  
P. O. Box 6854  
Santa Rosa, California 95406  
(707-542-9543)

Samuel M. Eisenstat  
Eisenstat & Gottesman, P.C.  
400 Park Avenue  
New York, N.Y. 10022

Mr. Clyde E. Kuhn  
2207 Carroll Street, Apt. 3  
Oakland, California 94606  
(415-451-3714)

bcc: Chron  
Subject: 1760 U-32256 (POO  
Folder EA#83 w/a

ENG, w/a  
ENV EA#83 w/a  
BAB (2) wo/a

BABoudreau/ew/6/1/77  
JD/aen/6/2/77

REPUBLIC GEOTHERMAL, INC.

11823 EAST BLAUSON AVENUE, SUITE ONE  
SANTA FE SPRINGS, CALIFORNIA 90670

TIMOTHY M. EVANS  
VICE PRESIDENT - LAND

(215) 630-9230

May 27, 1977

Area Geothermal Supervisor  
United States Geological Survey  
345 Middlefield Road  
Menlo Park, California 94205

Attention: Mr. Barry Boudreau

Re: Lease No. U-32256

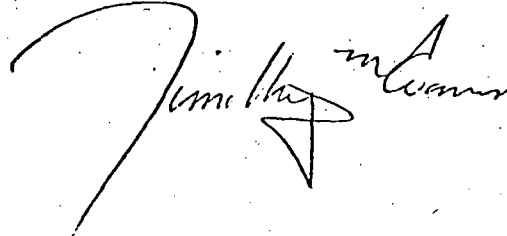
Dear Mr. Boudreau:

Enclosed please find our Plan of Operation (Plan of Exploration-Drilling), in triplicate, for the above-referenced lease, pursuant to 30 CFR 270.34 of the Rules and Regulations for geothermal resource operations.

In the interest of expediency, we are submitting this information to you at this time to hasten the initiation of the environmental review process. In the near future we will submit Form 9-331C and supplemental information for each of the proposed wells; with this Plan of Operation we have enclosed the procedure for a typical well drilling operation at Escalante Valley.

Please contact me if you have any questions or if our office can be of any assistance.

Respectfully,



TME:TJN:dej  
Enclosures, Exhibit B  
Exhibit A, map, under  
separate cover

RECEIVED

MAY 31 1977

AREA GEOTHERMAL SUPERVISOR'S OFFICE  
CONSERVATION DIVISION  
U.S. GEOLOGICAL SURVEY  
MENLO PARK, CALIFORNIA

R 13 W

R 12 W

R 11 W

R 10 W

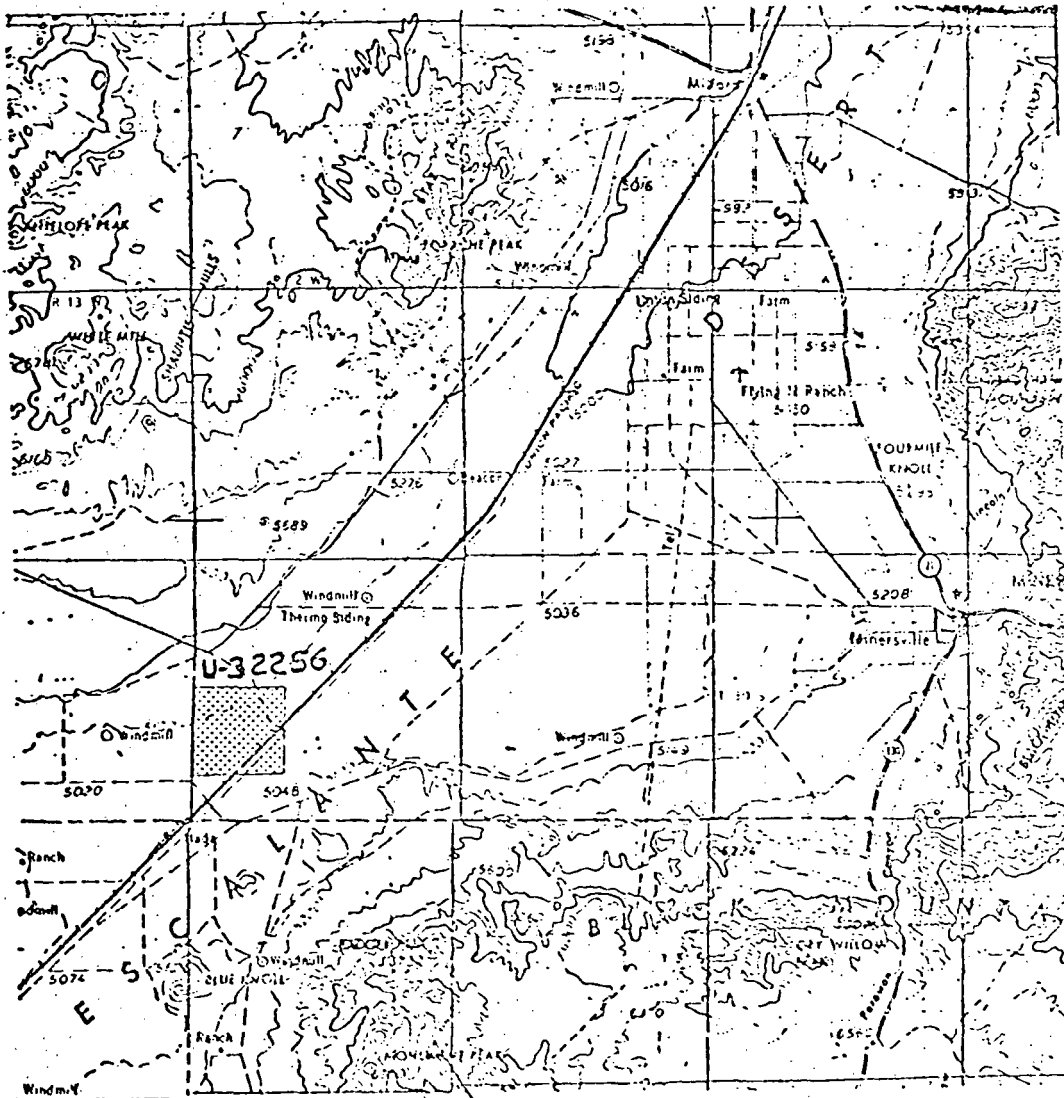
R 9 W

T 28 S

T 29 S

T 30 S

T 31 S



AREA TOPOGRAPHY &  
SECTION TO SHOW DRAINAGE

SCALE 1:250,000

PROPOSED PLAN OF OPERATION  
PLAN OF EXPLORATION-DRILLING

Lease No. U-32<sup>2</sup>56  
Secs. 29 and 30, T30S, R12W, S.L.B.&M.

Republic Geothermal, Inc.  
11823 East Slauson Avenue, Suite One  
Santa Fe Springs, California 90670  
(213) 945-3661

Proposed drilling of three exploratory resource wells and  
up to three injection wells.

Estimated Starting Date: October 1, 1977

Estimated Completion Date: December 31, 1978

RECEIVED

MAY 31 1977  
AREA GEOTHERMAL SUPERVISOR'S OFFICE  
CONSERVATION DIVISION  
U.S. GEOLOGICAL SURVEY



PROPOSED PLAN OF OPERATION  
UNITED STATES GEOTHERMAL LEASE

Serial Number U32256

Pursuant to Title 30, Chapter II, Section 270.34 of the Rules and Regulations for Geothermal Resources Operations, Republic Geothermal, Inc. submits the following plan of operation:

Republic Geothermal, Inc. proposes to drill three deep exploratory resource wells and up to three potential temporary injection wells. One exploratory well and one injection well will be located at each site. One or both of the wells at each pad will be directionally drilled.

Republic plans to first drill the exploratory well. If there is an indication of success, initial testing will be flowed into the storage basin up to capacity. If success is further indicated, Republic intends to drill an offset well for temporary injection purposes on the same pad as each exploratory well.

It is not anticipated that Republic will drill all three potential injection wells. Republic is requesting approval of the three locations to allow flexibility of siting. Republic may only drill one temporary injection well and connect other wells to the injection well via pipelines. In the latter event, a Supplemental Plan of Operation will be filed.

The locations of the three deep exploratory resource wells are as follows:

- |       |   |
|-------|---|
| 57-29 | 3280' E, 4030' S from NW corner, Section 29, T30S, R12W, Salt Lake B&M. |
| 71-29 | 4450' W, 150' S from NW corner, Section 29, T30S, R12W, Salt Lake B&M.  |
| 88-30 | 500' W, 4780' S from NW corner, Section 29, T30S, R12W, Salt Lake B&M.  |

Any potential injection well will be located 50' from the corresponding exploratory well.

1. Exhibits:

a. Exhibit A

Attached hereto please find our Dwg. No. 289-14, which is a map showing the following:

- (1) The proposed location of each well, including a layout showing the position of the mud tanks, reserve pits, pipe, racks, etc.;
- (2) Existing access and lateral roads;
- (3) Topographic features of the land and the drainage patterns.

Exhibit A was compiled from a 7.5 minute series USGS quadrangle map, (Lund 4 NW).

b. Exhibit B

Attached hereto please find Exhibit B, Procedure to Drill Typical Escalante Valley Well.

2. Source of Water:

In accordance with Section 270.34(c), please be advised that it is our intent to obtain water for operations from outside sources. Water will be trucked to the drilling site.

3. Road Building Material:

No road building material will be obtained from federal lands. If road building material such as gravel is needed, it will be trucked from outside commercial sources.

4. Fluid Discharge:

The geothermal fluid discharge from the first well testing will be stored in a steel tank or in a storage basin lined with a mix of compacted native soil and bentonite.

As previously discussed, if success is indicated from initial well tests, a potential temporary injection well will be drilled.

The well(s) would be used for further temporary waste disposal until such time when and if full field development commences.

Any reinjection will take place at a depth sufficient to prevent contact of the effluent with the fresh water aquifer.

5. Drilling Muds:

No toxic drilling mud components will be used. Drilling muds will be stored in a lined storage basin and later either neutralized and spread on the surface of existing roads or trucked out of the area to a Class-1 dump. Republic favors the former method of disposal.

6. Solid Waste:

The area will be kept clean, and all human wastes stored in temporary facilities. All solid waste will be removed and transported to a proper dump.

7. Environmental Protection:

The following measures will be taken for protection of the environment:

a. Fire

- (1) All local, state and federal fire protection standards applicable to Republic's activities will be observed.
- (2) Vegetation on the drill sites is sparse and will be cleared to the extent needed for proper operation. Smoking will be allowed only in designated areas.
- (3) Exhaust stacks from all engines in service will be equipped with flame arresters or a built-in water cooled exhaust.
- (4) Water and fire extinguishers will be available at each site in the unlikely event that a fire should occur.

b. Soil Erosion

Best efforts will be made to minimize the environmental impact of pad construction and road improvement upon the area. To the extent possible only existing roads and trails will be used. Because the topography is essentially level and rainfall is very sparse, soil erosion is expected

to be minimal. Best efforts will be made to minimize disturbance of perennial woody vegetation, and when vegetation is removed from the area, best efforts will be used to return the site promptly to its natural condition upon completion of the operation.

c. Pollution of the Surface and Groundwater

There is no surface water in the area, and all requirements of the United States Geological Survey and the Utah Department of Public Health will be followed to insure that groundwaters are not contaminated.

d. Fish and Wildlife

There are no fish in the area. There will be some unavoidable dislocation of wildlife in the area due to loss of habitat. Since the sites will be restored to their normal condition upon completion of the operations, however, loss of habitat will most likely be short-term only. Furthermore, disturbance of natural soil and vegetation will be kept to a minimum. Unattended storage basins will be fenced with three-strand wire to keep out wildlife and livestock. Noise will be controlled as discussed below.

e. Noise and Air Quality

Noise levels will be maintained within guidelines specified by Federal Occupational Safety and Health Act Standards, and requirements of the United States Geological Survey. Rig engines and compressors will be equipped with muffling devices. Air quality will comply with local air pollution control standards.

f. Hazards to Public Health and Safety

All equipment will be secured within a chain link fence or stored on non-federal lands when not in use. Supervisory personnel will be on the site at all times during the course of operations. All state and federal requirements for casing and blowout prevention will be followed.

g. Section 270.34(i), (j) and (k)

Republic is prepared to submit, upon notification to do so, any further information not included herein which the Supervisor may require. Republic is also

prepared to carry out provisions for monitoring deemed necessary by the Supervisor to insure compliance with the regulations and to participate in the collection of data concerning the existing air and water quality, noise, seismic and land subsidence activities, and ecological systems of the subject lands for a period of one year prior to submission of a plan for production.

#### Emergency Contingency Plan

If a well control problem (in this case, the well blowing steam, hot water, or other well effluent with loss of means to shut in or divert the flow), or any other emergency develops or is determined to be impending, appropriate control procedures will be initiated. The specific procedures will vary greatly depending on the nature of the problem. The following measures will be taken:

1. If any injuries have occurred, arrangements will be made to care for the injured party(ies).

Milford Valley Memorial Hospital  
451 North Main  
Milford, Utah 84751

First aid supplies will be available at the site.

2. If there is a threat to local residents, the Sheriff and/or Police Department will be notified as soon as possible.

Beaver County Sheriff's Department  
40 S. 100 E.  
Beaver, Utah 94713  
(801) 438-2862

Milford Police Department  
(801) 387-2251

3. The Vice President, Production, will be advised and consulted as soon as practicable.

James Barkman  
Vice President, Production  
11823 E. Slauson, Suite One  
Santa Fe Springs, California 90670  
(213) 945-3661

4. Field supervisory personnel will contact the Senior Drilling Engineer and consult with him as to any further or supplemental steps which may be necessary or advisable.

Thomas A. Turner  
Sr. Drilling Engineer  
11823 E. Slauson, Suite One  
Santa Fe Springs, California 90670  
(213) 945-3661

5. All prescribed safety practices and procedures will be followed. All members of the drilling crew will perform duties assigned for the specific purpose, following specified safety practices.
6. Any spills that may have occurred will be contained.
7. A pump truck will be in the vicinity, and earth moving equipment may be obtained from local contractors, if necessary.

Del Mar Construction Co.  
Milford, Utah 84715  
(801) 387-2202

Howard Construction Co.  
55 W. 200 N.  
Panguitch, Utah 84759  
(801) 676-2312

The Senior Drilling Engineer will:

1. Brief his immediate supervisor (Vice President, Production) on the situation and course of action underway.

James Barkman  
Vice President, Production  
11823 East Slauson Avenue, Suite One  
Santa Fe Springs, California 90670  
(213) 945-3661

2. Contact the following agencies or regulatory bodies as soon as practicable and in the following order:

United States Geological Survey  
Conservation Division-Western Region  
345 Middlefield Road  
Menlo Park, California 94025  
(415) 323-8711

Bureau of Land Management  
1579 North Main  
Cedar City, Utah 84720  
(801) 586-2401

Department of Natural Resources  
State of Utah  
Division of Water Rights  
442 State Capitol  
Salt Lake City, Utah 84114  
(801) 533-6071

He will also notify as soon as possible the following additional state and local agencies:

Social Services Department - State of Utah - Health Division

Air Pollution  
72 E. 400 S.  
Salt Lake City, Utah  
(801) 533-6108

Water Supply & Water Pollution  
72 E. 400 S.  
Salt Lake City, Utah  
(801) 533-6146

Beaver County Clerk  
105 E. Center  
Beaver, Utah  
(801) 438-2352

United States Fish and Wildlife  
Service  
125 South State  
Salt Lake City, Utah  
(801) 524-5637

Natural Resources Department  
State of Utah  
Wildlife Resources Division  
1596 West North Temple  
Salt Lake City, Utah  
(801) 533-9333

EXHIBIT B

REPUBLIC GEOTHERMAL, INC.  
Santa Fe Springs, California

Generalized Procedure to Drill Typical Escalante Valley Well

Sec. 29, T.30S., R.12W., S.L.B. & M.  
Escalante Valley, Utah

A production well scheduled to drill to + 10,000'

(All measurements refer to K.B., approximately 13.5 feet above ground level and are true vertical depths).

Total Depth

+ 10,000'

Tubular Goods Required:

+ 90' of 20" conductor pipe  
+ 1500' of 13-3/8" O.D., 54.5#/ft. K-55, buttress casing  
+ 4700' of 8-5/8" O.D., 32#/ft. K-55, buttress  
+ 4200' of 6-5/8" O.D., 27.65#/ft. K-55. Liner to consist  
of 200' of blank pipe and 2200' slotted.

Wellhead:

13-3/8" S.O.W. x 12", 400# RTJ flange with two 2" flanged side outlets and 400#, 12" master valve and fittings per attached drawing. Side outlets to be equipped with 2-2", 600# RF flanged Hancock Gate valves each.

Mud Program:

From surface to T.D. use lightweight, low solids fresh water clay base mud treated with lignite for temperature stability, bicarbonate of soda for cement contamination, and bit lube as required. Desanders and desilters to be run in order to keep sand below 1% and drilled solids as low as practical. A cooling tower will be installed in the mud system and the mud will be pumped through this cooling tower when the mud return temperature exceeds 160°F (71.1°C).



Procedure to Drill Typical Escalante Valley Well  
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<u>Depth</u>	<u>Weight (lb/gal.)</u>	<u>Viscosity (Sec.)</u>	<u>Fluid Loss (cc/30 min)</u>
0-1500'	8.65-8.9	50 - 60	No control
1500'-6000'	8.7-9.0	55 - 60	10-15cc (1500'/3500') 10 or less (3500'/6000')
6000'-10,000'	8.8-9.2	60 - 70	10 or less

BOPE Requirements:

1500'/10,000'-Install API class 3M (min) double hydraulic pipe and blind ram blow-out preventers on 13-3/8" casing and 12" gate valve with 400# RTJ flanges on well-head per Fig. 2. Kelly cock, stand pipe valve, and drill pipe float will be maintained on floor.

A fill-up line will be installed above BOPE with a kill line below the BOPE fitted with a direct line to the mud pumps and valve suitable for cementing.

Hydraulic BOPE control stations to be equipped with dual controls, one at the rig floor and one at least 50' from the wellhead. Accumulator capacity to be at least 80 gallons.

A blow-down line will be installed below the BOPE with two valves with one at the wellhead.

Mud flow line temperature and pit level will be monitored continuously. A pit level warning device will be installed.

Directional Program:

Drift will be allowed with combined angle or directional changes of no greater than 5°/100'.

<u>Interval</u>	<u>Maximum Deviation From Vertical</u>	<u>Maximum Closure Distance</u>
0' - 1500'	4°	75'
1500' -10,000'	5°	200'

Procedure:

1. Move in and rig up over 20" conductor set at 90 ft.
2. Pick up Kelly and drill rat hole and mouse hole.

## Procedure to Drill Typical Escalante Well

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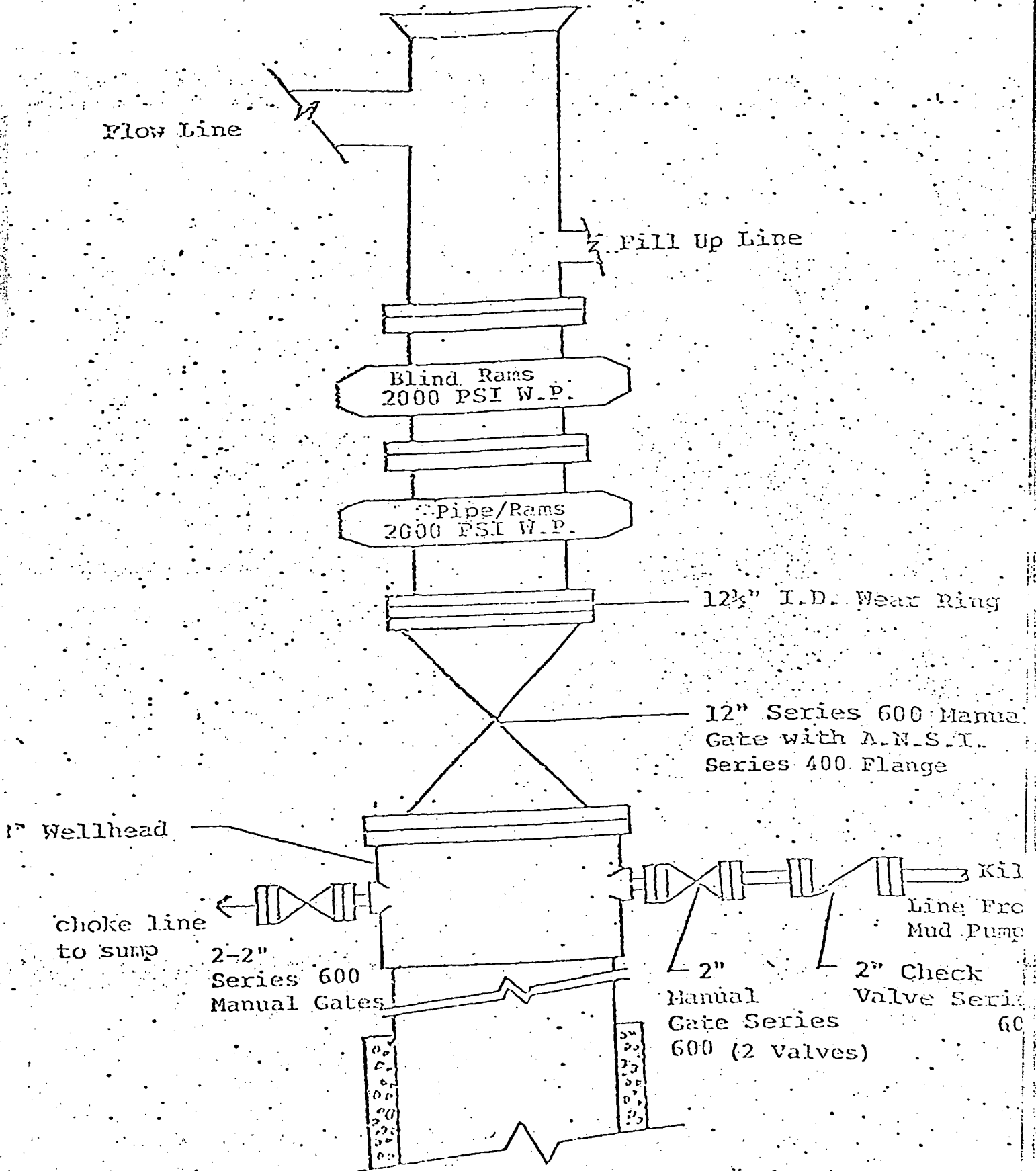
3. Make up 17-1/2" bit and drill collars. Drill to 1500' using a fresh water and gel mud system as outlined in Mud Program.
4. Pull out and run dual induction log from 90' to 1500'. Go back in hole and condition for running casing.
5. Run 13-3/8" surface casing to 1500'.
6. Center casing in rotary. Make up cementing assembly and establish circulation. Cement casing.
7. Wait on cement, cut off 13-3/8" casing and weld on a 13-3/8" slip-on wellhead with a 12" series 400 flange. Install 12" gate valve and blowout prevention equipment in accordance with Figure 2.
8. Test blowout preventors and casing to 1000 psi, hold for 30 min. Report any bleed-off rate to USGS (should be notified in time to witness and approve tests).
9. Drill to 6000' & circulate & condition mud for logs.
10. P.O.H. and run Coriband log series.
11. R.I.H., condition hole for casing and run 8-5/8" casing to +6000'.
12. Once casing is in position, pick up weight, set hanger, establish circulation and cement casing.
13. Clean out to lap & pressure test to 1000 psi surface pressure. Hold for 30 minutes. If test holds, clean out to shoe and pressure test casing to 1000 psi. NOTE: USGS to be notified in time to witness and approve pressure test. Report any bleed off rate to USGS.
14. Drill to 10,000' depending on DST results. Use a fresh water and gel mud system as outlined in Mud Program.
15. Pull out of hole and run Schlumberger Coriband log series.
16. Run in hole and condition for running 6-5/8" slotter liner.
17. Run 6-5/8" slotted liner and hang @ + 5800' with tail to + 10,000'.
18. Pull out of hole and install wellhead equipment in accordance with Figure 3.
19. If well does not flow naturally, install rotating head above wellhead tee and go in hole to + 1200' with drill pipe or Nowsco tubing and stimulate with air or nitrogen.

Procedure to Drill Typical Escalante Well  
Page 4

20. In order to clean up well and gather preliminary flow data, flow well to empty sump or steel Baker tanks gauging flow rate with sump or tank level measurements every 15 minutes until sump or tanks are full. If preliminary data indicate commercial potential, check for fill with wire line and move out drilling rig if no fill is present. If fill was present, reverse out fill and move out rig. Should flow be less than commercial, proceed to step 21.
21. Allow well temperature to stabilize and run temp. traverses at 12 hrs., 24 hrs., 48 hrs., and one week. During this time analyze logs for possible behind pipe commercial sands and upon verbally notifying USGS proceed to jet perforate additional intervals as required. Re test well to sump repeating steps 20 and 21 until commercial production is established.
22. Upon completion of preliminary testing, transmit history and results of testing go USGS and rig up for production test per production department specifications.

ATTACHMENT 1 TO EXHIBIT B

12" WELLHEAD AND B.O.P.E.



# WELLHEAD EQUIPMENT

