FC
USGS
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Son. Co.
8/1/78

PLANS OF OPERATION,

DEVELOPMENT AND PRODUCTION

Lease No. CA-1863

Sections 18 and 19, T11N, R8W, M.D.B.&M.

Big Geysers, Sonoma County, California

UNION OIL COMPANY

Geothermal Division

2099 Range Avenue

Santa Rosa, California 95406

(707) 542-9543

Proposal to commence operations for initial development and production of the geothermal resource on Lease No. CA-1863 Starting with two production wells, related pipelines, testing, surface facilities necessary to supply steam for the production of electricity.

Estimated Starting Date: August 1, 1978

Estimated Completion Date: Life of project expect to be in excess of thirty years.

UNION OIL COMPANY

PLANS OF OPERATION, DEVELOPMENT & PRODUCTION

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UNION OIL COMPANY

PLANS OF OPERATION, DEVELOPMENT & PRODUCTION

UNITED STATES GEOTHERMAL LEASE NO. CA-1863

BIG GEYSERS, SONOMA COUNTY, CALIFORNIA

A. PROPOSED PLANS OF OPERATION

Union Oil Company proposes herein to commence production operations on Occidental Federal Wells No. 1 and 2 (96-18, 96-A18). The Plans of Operation, Development and Production are submitted in accordance with 30 CFR270.34 and draft GRO No. 5.

Occidental Federal Wells No. 1 and 2 will be directionally drilled from Cobb Mountain Hunting Club, CMHC 12-32.4, drill site into United States Lease CA-1863. Union Oil Company plans to use these wells along with several other wells to provide steam to PG&E's geothermal power plant Unit 12.

Union has previously submitted a Plan of Operation Exploration for these wells which included the proposed well locations, access roads and drilling programs. The U.S.G.S. has reviewed this data, Environmental Analysis #56, and has issued a drilling permit for Occidental Federal Well No. 1 (961-8). The permit for Occidental Federal Well No. 2 (96-A18) is pending the outcome of the first well.

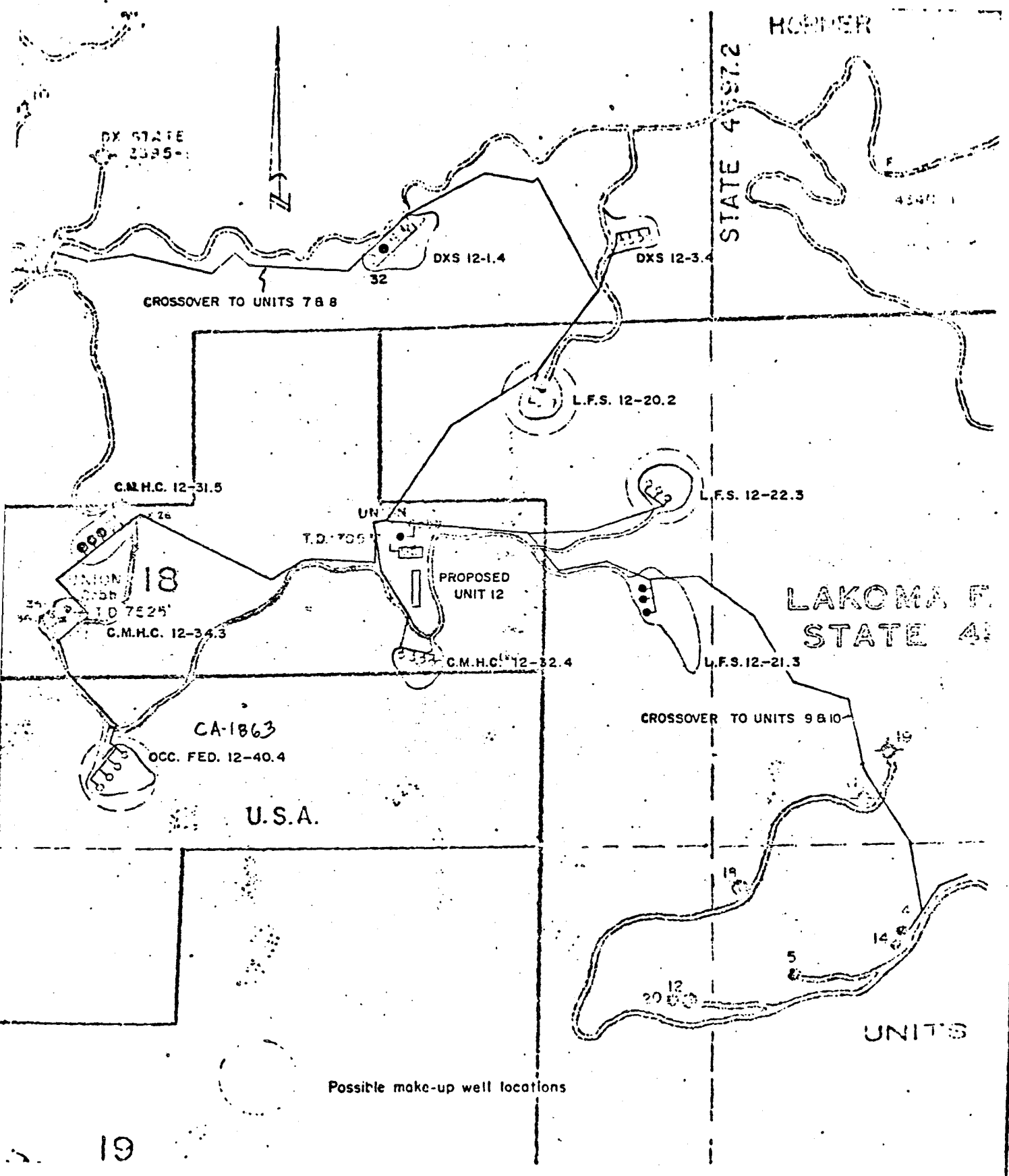
1. Maps

Attached hereto and made a part hereof as Exhibit A is our Drawing No. 1018-Rev., Unit 12 Development Area, which shows the topography, drainage patterns, wells location, existing access roads and power plant site. Pipelines will transport steam from well sites to the power plant

B. PLAN OF DEVELOPMENT

1. Location and Placement of Proposed Operation

Per listed criterias in draft GRO No. 5 1.E.(1)(a)-(g), wells are spaced such that optimum production can be obtained with a minimum number of wells and disturbance to the surface. For detail, please refer to Union's



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UNION OIL COMPANY OF CALIFORNIA - GEOTHERMAL DIVISION

UNIT 12 WELL SITES AND ROADS

SONOMA CO. CALIF.

DRAWN
FOR: O. & M.
BY: L. C.
DATE: 2-10-71
SCALE: 1" = 100'
DRAWING NUMBER
1018 Rev

approved Plan of Operation, Exploration (U.S.G.S.-Environmental Analysis #56).

2. Geological and Geophysical Descriptive Information

Wells drilled on leases adjacent to CA-1863 have penetrated reservoir rock, but it is believed that none have been drilled completely through the reservoir. The entire area of Lease CA-1863 is considered productive, however, reservoir thickness is not known.

Occidental Federal Wells #1 and #2 are expected to encounter the following lithology when drilled:

surface to 200'	weathered greenstone and some graywacke
200' to 1000'±	greenstone Fq
1000' to 3000'±	serpentine MUM
3000' to T.D.	graywacke Fs2

For detail discussion of lithology please refer to U.S.G.S. Open File Report #78-389 by R. J. McLaughlin.

The reservoir rock is a fractured graywacke (Fs2) type distributed over the developed portion of The Geysers field. Effective porosity is unknown. Anticipated static pressure is 450 psig at the well head. Anticipated reservoir fluid is steam at or near saturation conditions with no free water.

Flow rates of from 30,000 lb/hr to as high as 300,000 lb/hr are possible. Production rates of other wells have demonstrated decline with time.

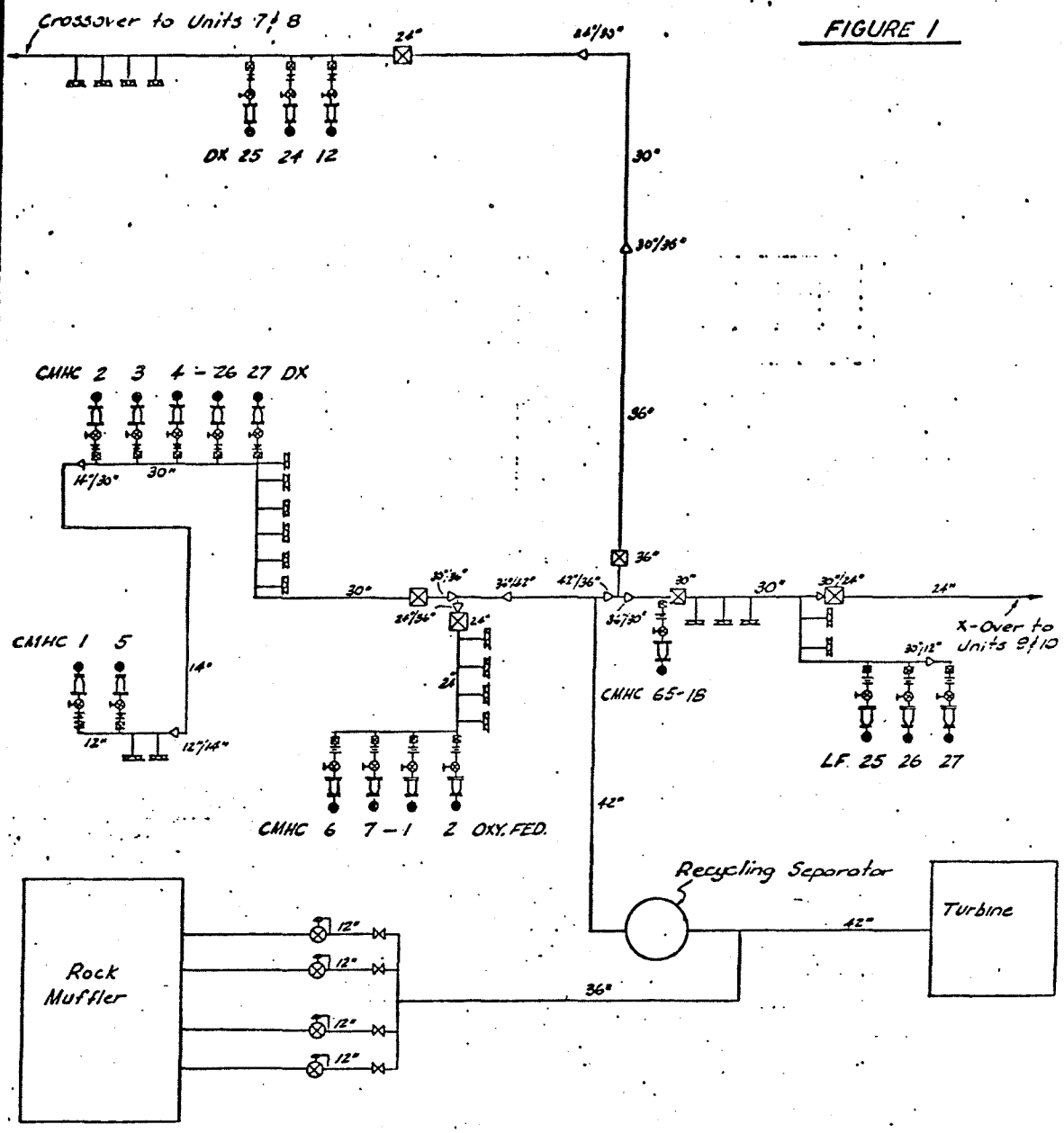
3. Representative drilling program

Drilling Programs have been submitted previously with Union's Plan of Operation on January 17, 1977.

4. Proposed Manner of Commercial Utilization Including By-Products

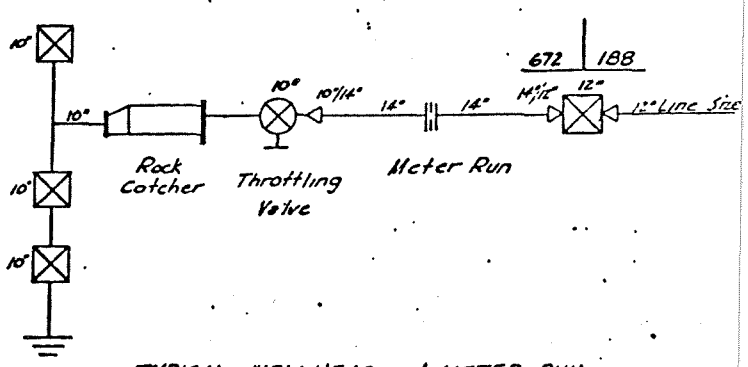
Steam produced from the geothermal resource will be utilized to drive a steam turbine generator having a nominal capacity of 110 MW. There are no usable by-products.

FIGURE 1



LEGEND

- Well
- Rupture Disc Assembly
- Gate Valve
- Vee-Ball Valve
- Reducer



TYPICAL WELLHEAD and METER RUN

REVISED	DATE
6/21/78	M.L.B.

UNION 76

UNION OIL COMPANY OF CALIFORNIA - GEOTHERMAL DIVISION

UNIT 12 PIPELINE SCHEMATIC

SONOMA COUNTY, CALIF.

DRAWN	
FOR:	T.K.
BY:	L.D.C.
DATE:	2-10-77
SCALE:	NONE
DRAWING NUMBER	2239

5. Surface Equipment Installation

No surface equipment will be installed on United States land because Occidental Federal wells No. 1 and 2 will be drilled directionally from Cobb Mountain Hunting Club, CMHC 12-32.4 drill site.

Included is a detailed description of the surface facilities required to handle the steam production from these wells. Figure I is a system schmatic showing the production facilities from the well head to the power plant. Figure II shows a typical well head tie-in assembly.

a. Well Head Assembly

The well head consists of a 10-3/4" casing head flange, three 10" ASA 300# WKM through conduit gate valves and one 10" flow tee. The steam flows from the well head flow tee through a rock catcher designed to protect the pipeline and turbine from rock particulates which may be produced with the steam. The rock fragments will be purged from the rock catcher by periodically blowing them out through a 3" vent valve or by manual cleanout.

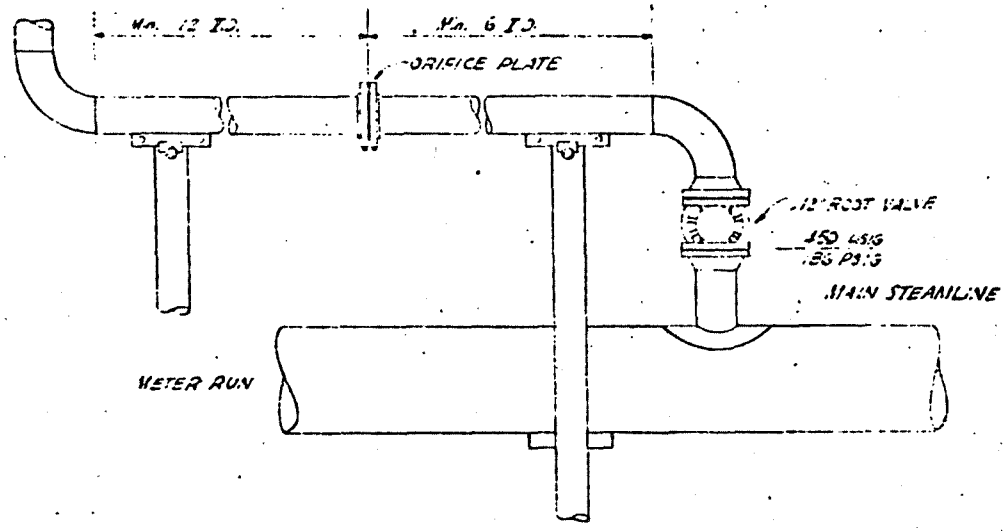
Down stream of the rock catcher is a throttling valve used to reduce steam flow from the well whenever the plant goes down or to balance steam supply to the plant vs. plant demand.

Orifice flanges are included in the piping down stream of the throttling valve so that the production from the well can be metered and accounted for. A root valve is provided just before the main steam transmission line so that the well head piping assembly can be isolated from the rest of the steam gathering system for required maintenance. The designed working pressure of the well head piping assembly is sufficient to contain the shut-in pressure of the well.

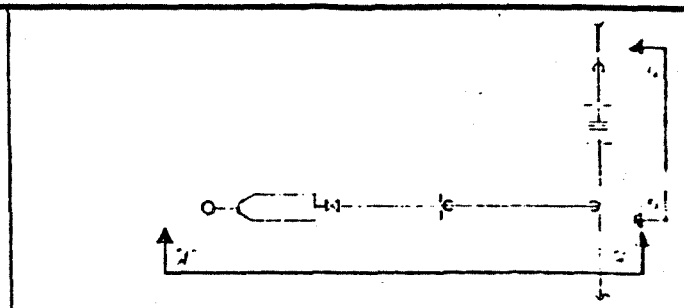
b. Pipeline

The steam flows from the well head assemblage into the steam transmission pipeline which transports the steam to the power plant.

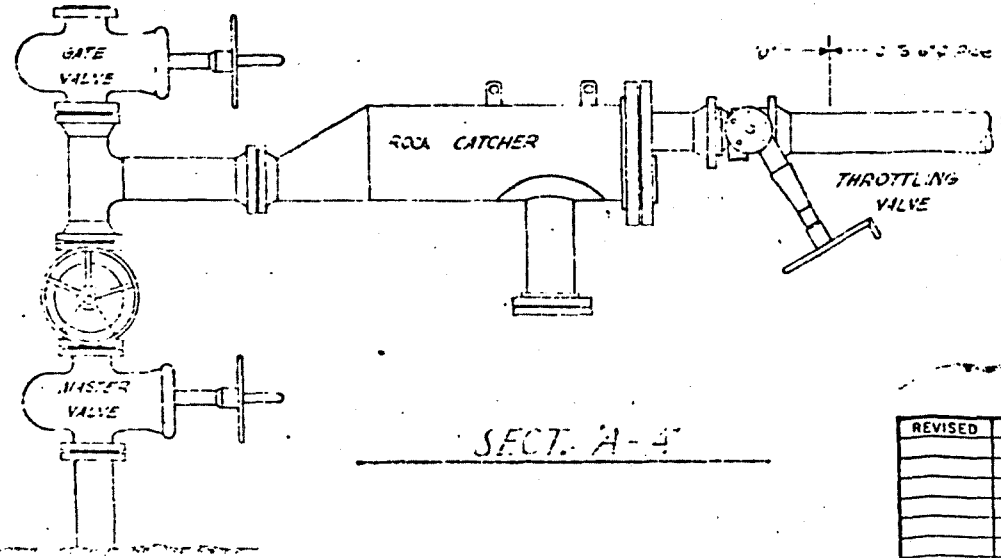
The pipeline is an insulated steel line designed



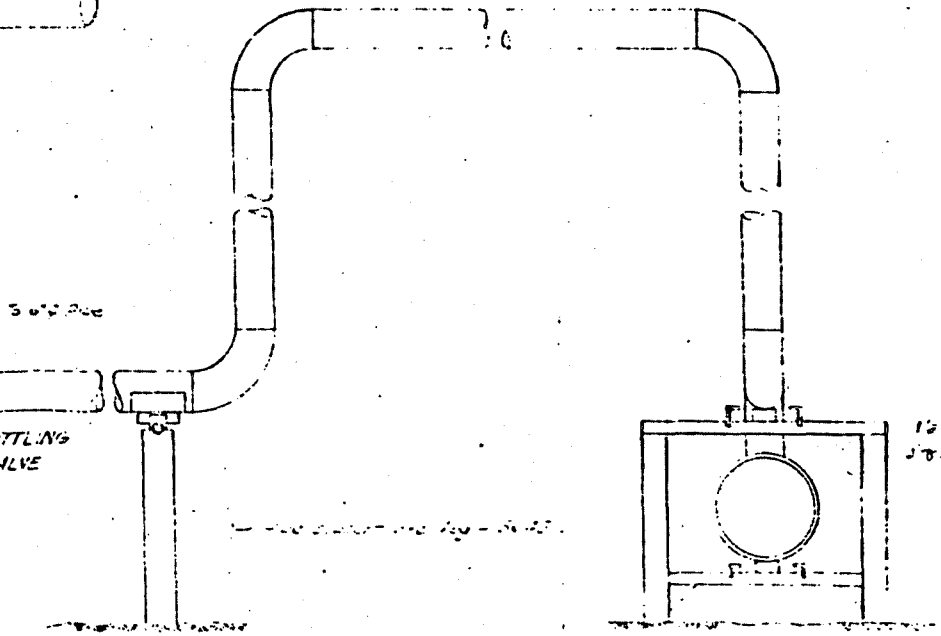
SECT. B-B'



PLAN VIEW



SECT. A-A'



REVISED	DATE

UNION OIL COMPANY OF CALIFORNIA - GEOTHERMAL DIVISION

TYPICAL WELL TIE-IN PIPING

THE GEYSERS SONOMA CO. CAL.

DRAWN	
FOR:	
BY:	
DATE:	
SCALE:	
DRAWING NUMBER	

to optimize pressure drop and heat loss. The pipeline will be installed above ground level and routed along existing roads or specially prepared rights of way. Expansion loops, anchors, and supports are installed as required to maintain temperature related stresses at acceptable levels.

The design working pressure of the pipeline is ASA 150# (188 psi at operating temperature). The pipeline is designed and installed in accordance with normally accepted codes. Auxiliary equipment associated with the pipeline are burst heads for emergency pressure relief, isolation valves, and condensate removal valves and facilities.

c. Plant Yard Facilities

Plant yard facilities consist of a steam water separator to remove condensate and particulate from the steam prior to delivery to the turbine. Relief valves and mufflers are also included to automatically vent the steam in the event of turbine outage. Yard facilities are designed to adequately handle the 2,000,000 lbs/hr of steam required to operate the turbine at full capacity.

d. Safety Provisions

Normally acceptable codes and regulations will be utilized during construction and operation. All facilities will have protective over pressure systems designed to prevent damage to equipment or personal as result of equipment malfunction.

6. Proposed Liquid Disposal Program

The energy conversion cycle utilized by PG&E results in 80% of the steam supplied to the turbine being vaporized and exhausted to the atmosphere as steam vapor. Approximately 20% of the steam is condensed and returned to Union Oil. This excess water over flows through a weir in the cooling tower basin, and is disposed of by reinjection into the steam reservoir under a different lease.

C. PLAN OF PRODUCTION OPERATION

1. Environmental Data

In compliance with 30 CFR 270.34 (k) Union has completed

a minimum of one year of required environmental baseline monitoring. Descriptions of the studies performed are presented in Appendix A.

2. Production

Union plans to finish surface equipment installation, and be able to turn on line Occidental Federal wells #1 and #2 in October, 1978, which is when Unit 12 is planned to be in commercial operation.

a. Use for the Geothermal Resource Production

Geothermal Federal Lease CA-1863 is located in Unit 12 generating area, hence, most of the steam produced will be used by Unit 12 to produce electricity. At times, steam may be transported through cross-over piping to be used to supply steam to other units within The Geysers project.

b. Proposed Manner and Rates of Production, Commingling

Steam from Occidental Federal wells #1 and #2 will be produced and metered through the well head assemblage described previously. The metering specifications and methods of accountability are described in the Appendix B. Steam produced from these wells will be commingled with steam from other leases when it enters the main steam transmission line.

Essentially, the wells will be produced at rates, along with other unit supply wells, sufficient to operate Unit 12 at full capacity. Normal well head flowing pressure is 125 to 150 psig. Approximately 2,000,000 pounds of steam per hour at 100 psig and 355°F (179°C) are required for turbine operation.

In the event of unit outage, flow to the turbine is automatically shut-off by means of flow control valves. This causes the steam transmission line pressure to increase to a predetermined level at which time automatic relief valves open and the steam is vented through mufflers designed to attenuate noise to reasonable levels. Production from the supply wells is curtailed in accordance with the expected duration of the outage and with predetermined guidelines as described in the appendix.

Outages of long duration require that the wells be completely shut-in, with the exception of a small vent to keep the well bores hot, and the pipeline is allowed to cool. Prior to resuming steam delivery to the turbine the wells must be vented to purge the well bore of rock, and then steam must be passed through the pipeline and vented at the muffler to bring the line up to operating temperature, and purge the line of any condensate which might have collected during the shut-in or warm-up operation. Condensate purge valves are located at strategic locations along the pipeline for this purpose.

Steam is sometimes transferred from one unit area to other unit areas to make up steam deficiencies or reduce atmospheric emissions. Steam transferred from one unit area to another area shares in the revenue produced by that unit area in proportion to the quantity of steam transferred to the whole.

Revenue for steam produced is determined by the quantity and value of power produced. The wells serving any unit share in the revenue produced by that unit proportionally to the quantity of steam produced by that well to the whole. No revenue is paid for vented steam.

c. Proposed Method for Determination of and Evaluation Reservoirs

Reservoir performance parameters will be evaluated using those methods commonly applied by the petroleum engineering profession in evaluating natural gas and saturated steam reservoirs.

d. Proposed Method of Processing and Disposing of Waste Products

The significant waste product is the condensate that remains after the energy is extracted from the steam. The condensate from Unit 12 cooling tower basin will be returned to Union and received in a concrete pond. From here the condensate is disposed by reinjection into existing deep wells according to the North Coast Regional Water Quality Control Board requirements. Condensate reinjection wells are approved and permitted by the State's Division of Oil and Gas.

e. Environmental Monitoring Programs

- Air Quality/Meteorology

The Stanford Research Institute study begun in 1976, sponsored by Union Oil Company, PG&E, Aminoil USA and Thermogenics will continue monitoring at the present eight stations.

- Water Quality

The long term monthly monitoring study described in references 1 and 2 in Appendix A "Water Quality" will continue.

- Noise, Seismic Activity and Land Subsidence Activity

Periodic specific studies will be conducted in the area.

- Ecological Systems

An evaluation of the effects of development has been conducted (see Appendix A). Periodic monitoring of indicator species or parameters may be conducted.

D. ENVIRONMENTAL PROTECTION

1. Fire Prevention Measures

Construction and drilling equipment are equipped with exhaust spark arresters. Smoking will be allowed in designated areas only. Fire extinguisher stations will be established at strategic locations around the drilling rig. Water trucks and sprayers are available to respond to any emergency. Drilling water stored on the drill site (approximately 7000 barrels) is available for fire fighting. PG&E maintains a fire hazard warning sign near the project entrance to remind employees daily of the level of fire hazard.

2. Soil Erosion

Please see Appendix "A", previously approved Union's Plan of Operation, Exploration.

3. Pollution of Surface and Ground Waters

According to the U. S. Geological Survey, the area is underlain by essentially non-water bearing rocks of the franciscan assemblage. Further, this site is located on a ridge crest where no surface waters occur.

To assure that pollutants do not escape the drill site, drilling wastes, machine drippings, and rain on and around the equipment will be directed into the mud sump as described in the "Exploration Plan for Union Geothermal's Drill Site CMHC 12-32.4."

4. Protection of Fish and Wildlife

Habitat disturbance will be confined to the described construction area. Re-establishment of habitat and prevention of stream siltation by erosion control is described in Appendix "A" of the "Exploration Plan for Union Geothermal's Drill Site CMHC 12-32.4."

5. Protection From Air and Noise Pollution

While drilling with air, dust and noise will be reduced to a minimum by use of the blooie line and separator/muffler. Noise levels will not exceed an equivalent sound level (Leq) of 65 db(A) at a distance of one-half mile. The nearest Geysers Project property line is approximately one mile away and the nearest residence is approximately one and one-half miles away from the drill site.

6. Protection of Public Health and Safety

Hard hats will be worn by personnel during construction and drilling.

Personnel will not be allowed in trenches five feet or more in depth.

OSHA regulations will be followed.

Drinking water and sanitary facilities will be provided.

7. Section 270.34, (i) and (j)

a. Method for Disposal of Waste Material

Portable chemical sanitary facilities will be used by personnel on the drilling or construction sites. These will be maintained and wastes disposed of by a local contractor. Permanent sanitary facilities will be located at Union's field office.

b. Delineation of Potential Environmental Impacts

Union anticipates that there should be only negligible environmental impacts from these proposed operations over and above those from existing approved operations.

c. Environmental Monitoring and Any Additional Information

Noncondensable gases will be monitored in accordance with the requirements of the Sonoma County Air Pollution Control District.

Geothermal fluids will be monitored and disposed of in accordance with the requirements of the California Regional Water Quality Control Board, North Coastal Region.

d. Approximate Crew Size, Probable Type and Location of Housing and Support Facilities

Approximately twelve to fifteen people may be working on the location at any one time during drilling and/or production testing operations. No housing or special support facilities will be required on-site during these operations due to proximity of existing facilities.

E. EMERGENCY CONTINGENCY PLANS

If any 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. During the years of operation Union has developed the following Contingency Plans for the Big Geysers Project.

- Fire Prevention and Control Plan
- Emergency Medical Response and Transport Plan
- Spill Prevention Control and Countermeasure Plan
- Contingency Plan for Uncontrolled Blow-out
- Geothermal (Water) Fluid Spill Control Plan

A copy of each Contingency Plans is available to each employee who operates in field and copies are sent to respective local, state and federal agencies. These Plans are updated periodically and training sessions are held to acquaint the operation personnel with recent developments and improved operation procedures.

If you wish to have a copy of each plan, we will be happy to forward them upon request.

APPENDICES

1. Appendix A - Environmental Monitoring Programs

The Geysers geothermal field has been the object of numerous extensive environmental studies and monitoring programs. Thus, the effects of geothermal development in The Geysers are well defined and well documented. Of the many potential environmental hazards, some have been proven insignificant and some have been mitigated by improved technology and/or improved operating practices. The odor of hydrogen sulfide receives the most attention and is the most significant impact on the local environment.

A general evaluation of the baseline environmental conditions can be reviewed in the Environmental Impact Report, "The Geothermal Leasehold of Union Oil Company at The Geysers, Sonoma County, California," February 1975, and the Environmental Assessment for CA-1863. The following are studies and monitoring programs conducted to evaluate the areal air quality, water quality, noise, seismic activity, subsidence activity and ecological systems:

a. Air Quality

The air quality in The Geysers area has always been influenced by geothermal emissions. Before the advent of geothermal resource development, fumeroles and hot springs were reported to emit loud noises, billowing tall plumes and the putrid odor of rotten eggs. Development has increased the emissions and several studies have been conducted to ascertain the compositions and quantities of emissions, the meteorology of The Geysers area and the ambient air quality. The subject lease is a part of the area studied

--Meteorology and Hydrogen Sulfide

(1) S. L. Altshuker, "Ambient Air Quality at and in the Vicinity of The Geysers, 1970-75," PG&E, April 1976.

(2) R. E. Ruff and L. A. Cavanagh, "1976 Executive Summary Specialized Monitoring Services," Stanford Research Institute, April 1977.

(3) R. E. Ruff and L. A. Cavanagh, "Combined Quarterly Reports Covering the Period

1 January through 30 June 1977, Specialized Monitoring Services," Stanford Research Institute

These studies and many other studies have been assimilated and evaluated by Environmental Research and Technology, Inc., under contract to the Geysers Geothermal Environmental Committee. The data tapes and report are in preparation.

--Suspended Particulate Matter

(1) "High Volume Air Sampler Data, Feb. 6, 1977 - Aug. 17, 1977," Environmental Systems and Service.

In addition, a similar study was conducted by the Northern Sonoma County Air Pollution Control District in December, 1976 and January, 1977 (the data is attached to the above study). All values were lower than the state standard.

(2) O. D. Whitescarver, "Mufflers to Abate Noise and Particulate Emissions from Geothermal Development Operations," presented at 3rd Annual Geothermal Environmental Conference, May 10, 1978.

Also, a long-term total suspended particulate matter monitoring program has been conducted near Unit 3 and 4 at the Union Oil maintenance shop. Records from April, 1975, to June, 1976, show that the stated 24-hour ambient air quality standard of 100 mg/m^3 was exceeded on 6 days. The geometric mean for the period April, 1975, to March, 1976, was 43 mg/m^3. The annual geometric mean standard for suspended particulate set by the State of California is $60/m^3$. The high values correlated to unusual local activity such as sweeping the parking lot.

--Other pollutants

(1) ERT report (to be published)

(2) L. R. Anspaugh, "Final Report on the Investigation of the Impact of the Release of ^{222}Rn, Its Daughters and Precursors at The Geysers Geothermal Field and Surrounding Area," Lawrence Livermore Laboratories, March 20, 1978

(3) D. P. Serpa, "Summary Report of The Geysers Radiological Measurement Program," PG&E, May 3, 1978.

(4) D. E. Robertson et al, "Mercury Emissions from Geothermal Power Plants," Science, volume 196, pp. 1094-7, June 3, 1977.

b. Water Quality

The subject lease U. S. Geothermal Lease CA-1863 is in the Russian River watershed. An ephemeral stream cuts southward through the lease into Cobb Creek which flows across the southeast corner of the lease into Big Sulphur Creek. Big Sulphur Creek and its tributaries drain a watershed of about 82 square miles before joining the Russian River. Several studies have been completed on the Big Sulphur Creek system and a long-term monitoring program continues.

(1) D. G. Price and D. P. Griffin, "An evaluation of Stream Water Quality Monitoring Data Collected from May, 1968, through May, 1975, at The Geysers and its Implications to the Biological, Chemical and Physical Environment," PG&E, Nov. 14, 1975.

This report includes data collected at the confluence of Cobb Creek and Big Sulphur Creek.

The parameters measured on a monthly basis were: pH, amonia, dissolved oxygen, color, turbidity, settleable solids, temperature, dissolved solids, boron, nitrates and nitrites. A determination of possible trends with time, significant correlations among the parameters collected, and relationships of the 13 variables to flow were made.

(2) D. G. Price, "An Investigation of Unique Water Quality Conditions in the Big Sulphur Creek Watershed Related to Natural Geothermal Activity, Streamflow and Geothermal Development," PG&E, Aug. 26, 1977 [a continuation of (1)].

(3) R. S. LeGore, "The Effects of Geothermal Energy Utilization on Stream Biota and Water Quality at The Geysers, California," Parametrix, 1975.

c. Noise

Ambient noise conditions in the area of the subject lease are highly variable depending on weather conditions, season and activity in adjacent developed areas. The report by Whitescarver (reference #2 under "Suspended Particulate Matter") describes a long-term monitoring program to the west of CA-1863.

d. Seismic and Land Subsidence Activities

--Seismicity

No active faults are recognized or suspected in the lease area. The nearest known active fault in the region is the Healdsburg fault, which trends northwest through the Healdsburg area. The October 1, 1969 earthquake at Santa Rosa appears to have had its epicenter along the fault. Although that earthquake was felt at The Geysers, there were no damages caused by it. A number of studies have been done concerning the seismology of The Geysers field including:

R. M. Hamilton, L. J. P. Muffler 1972, "Micro-earthquakes at The Geysers Geothermal Area, California," J. of Geophys. Research 4-77, pp. 2081-2086.

E. Majer, T. V. McEuilly, "Seismological Investigations at The Geysers Geothermal Field," Lawrence Berkeley Laboratory, University of California, Berkeley, California, Dec. 1977.

C. G. Bufe et al, "U.S.G.S. Open File Report 76-802," map showing preliminary hypocenters of earthquakes in the Healdsburg Quad., Lake Berryessa to Clear Lake, California, Jan. 1969 to June 1976.

S. M. Marks and C. G. Bufe, "U.S.G.S. Open File Report 78-126," map preliminary hypocenters of earthquakes in the Ukiah and Santa Rosa 1° by 2° quad., Jan. 1968-77.

--Land Subsidence

Mr. Ben E. Lofgren of the U.S.G.S. office in Sacramento, California has been conducting vertical and horizontal first order surveys over the Clear Lake - Geysers

KGRA since 1973.

The following publications are listed below which deal with the known information about subsidence related to the Occidental Federal Lease:

Ben E. Lofgren, "Monitoring Ground Movement in Geothermal areas. Hydraulic Engineering and the Environment." Proceedings of the Hydraulic Division Specialty Conference Bozeman, Montana, Aug. 15-17, 1973.

Ben E. Lofgren, "Open File Report," (in press June 1978).

The report will be an updated report of subsidence work conducted in The Geysers - Clear Lake KGRA since 1973 to the present. Until this report is open filed in the next few weeks, details on the findings are not available.

e. Ecological System

Monitoring programs to estimate shifts in status or condition of biological elements in the KGRA in which lease CA-1863 is located, have been the concern of the developers, the public and the government.

(1) *PG&E et al, "The Distribution and Abundance of Wildlife Populations in Relation to Geothermal Development: Interim Report - The Geysers KGRA Wildlife Study," October 1977

* PG&E, Union Oil Co., USFWS, CDFG, St. Mary's College, Western Ecological Services Co., University of California Berkeley.

(2) See reference #3 under "Water Quality."

(3) R. S. LeGore et al, "Substrate and Sediment Studies in the Big Sulphur Creek Drainage, California," Parametrix, 1976.

(4) P. F. Kubicek and D. G. Price, "An Evaluation of Water Temperature and Its Effect on Juvenile Steelhead Trout in Geothermally Active Areas of Big Sulphur Creek, Final Report," PG&E, Jan. 16, 1976.

2. Appendix B - Manner of Steam Production

a. Steam Accountability

The basis for steam accountability is generating unit areas. Wells assigned to unit areas will share in the revenue from their respective generating units proportionally to flow rates. Individual well flow rates are monitored continuously and accumulated each 24-hour day. This accumulated figure is then divided by the total accumulated flow rate for all wells within the unit area to determine the well's proportion of the unit output for that 24-hour period. Our Drawing No. 5048 shows the steam measurement schematic at The Geysers Geothermal Project.

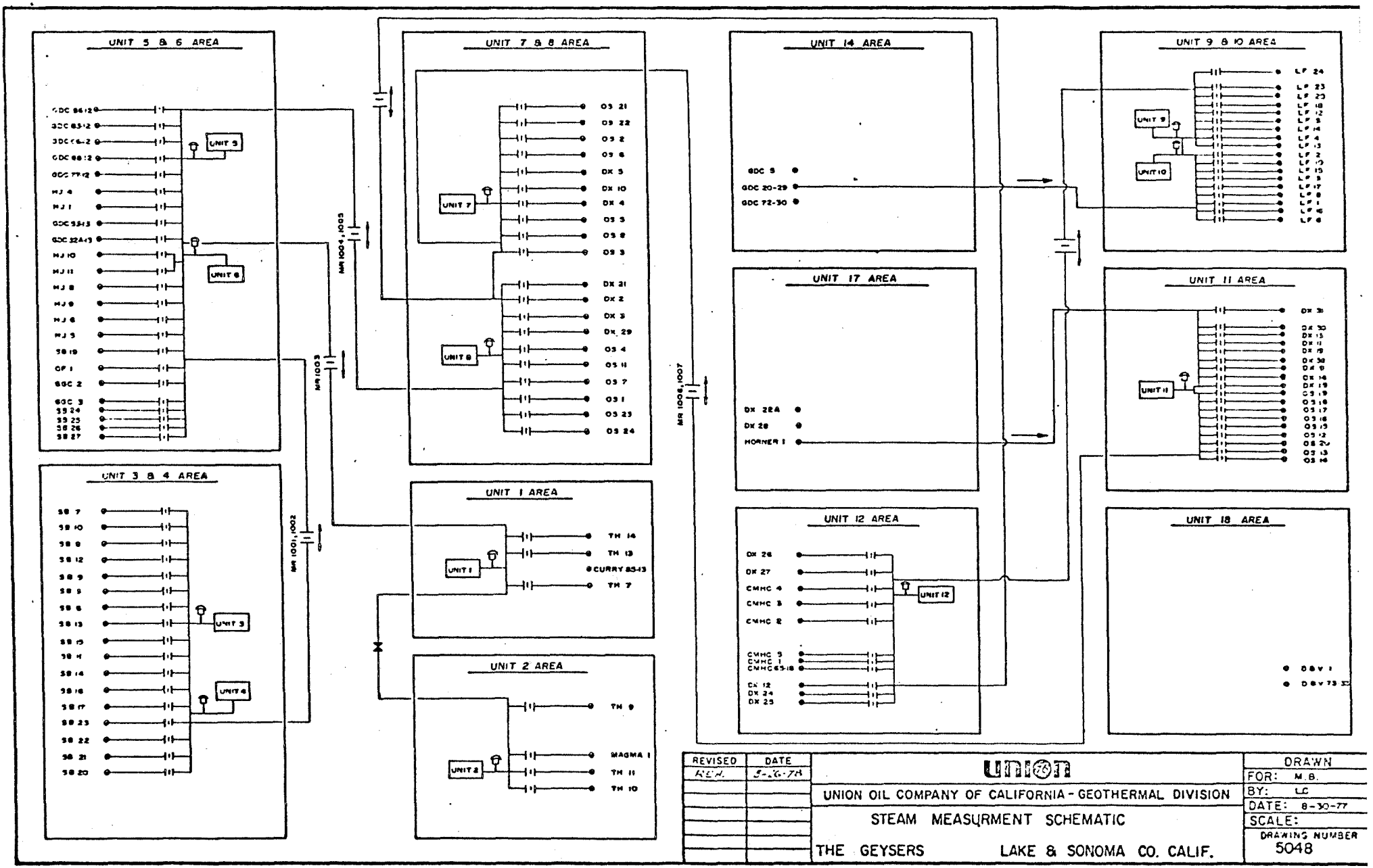
Two way crossovers are provided between generating unit areas. The metering orifice on each of these crossovers is considered a point source. Steam entering a unit area through the crossover is monitored continuously, accumulated daily, and is treated as a well in determining its proportional share of the generating unit revenue. This revenue is then credited back to the contributing unit area and is proportioned by flow rates among all wells in the supplying area.

In some instances, isolation valves are provided to direct steam from certain wells in one unit area to another area. When these valves are in service, the wells whose total steam production is positively directed to the new area are transferred to that new area and steam production is accounted for as if the wells were assigned to that unit area. Meters are calibrated monthly with master test gauges and orifice plates are pulled and inspected once every two years.

b. Operational Guidelines for Mixed Working Interest Steam Crossovers

The mixed working interest crossovers are defined as those which cross boundaries between different working interests in the project. The existing crossovers which fall into this category are those between Units 5 and 6 and Units 7 and 8 and between Units 7 and 8 and Unit 11.

The purposes of the crossovers are to maximize the utilization of available steam in the most



REVISED	DATE
R.E.H.	5-16-78

UNION OIL COMPANY OF CALIFORNIA - GEOTHERMAL DIVISION

STEAM MEASURMENT SCHEMATIC

THE GEYSERS LAKE & SONOMA CO. CALIF.

DRAWN
FOR: M.B.
BY: LC
DATE: 8-30-77
SCALE:
DRAWING NUMBER 5048

efficient manner, and to minimize the total amount of steam vented. The crossovers will be operated in a manner which best satisfies both purposes.

Generally, the crossovers will be used to transfer steam from supersufficient areas to deficient areas for the period of time that the deficiency exists. The operator will strive to maintain steam availability such that steam movement out of a unit area will eventually be balanced by steam movement into the area.

The crossover may be utilized for short periods of time to increase the back pressure in an otherwise sufficient adjoining system in the case where a unit trips out creating an instant surplus of steam.

This will serve to reduce flow rate from wells in both systems, thereby cutting down on total emissions. This condition will be allowed to exist only during the time necessary for analysis of the problem, and, if necessary, the time required to secure the wells in the tripped out unit area.

c. Steam Metering and Calibration Equipment Specifications

(1) Producing Well Meters

All producing wells are equipped with ITT Barton Differential Flow Recorders, Model No. 202A.

(a) 0-10 psig differential pressure range

(b) 0-250 psig static range

(c) 7 day clock rotation

(d) Chart No. P250-W10-S, Arcco Recording Charts

(e) Belilove Company model 1207, 7 valve manifolds

(2) Pipeline Crossover Meters

Crossovers are equipped with ITT Barton Differential Flow Recorders (2-way) Model No. 202A.

(a) 10-0-10 psig differential pressure range

(b) Two 0-250 psig static ranges

(c) 7 day clock rotation

(d) Chart No. F-61007, Arcco Recording Charts

(e) Belilove Company Model 1207, 7 valve manifolds with two static connections

(3) Meter Calibration and Inspection

(a) All meters are shop calibrated prior to initial service and when reconditioned.

-- Differential bellows calibration

Differential calibration is accomplished with a Meriam Instrument Company Model No. 33KB35 mercury monometer with a dual scale No. RC6379, ranges of 0-101 inches of mercury or 0-4942 psig.

-- Static spring calibration

Static calibration is accomplished with a Seegers Precision Pressure Transfer Gauge (Reference Standard) 0-800 psig calibrated for pneumatic use.

The Seegers gauge is calibrated with an Ashcraft Deadweight Tester, Serial No. 1HA-54695. The Testers Certification of Accuracy is traceable to N.B.S. Test No. 323.09/204651 dated October 21, 1971 and N.B.S. Test No. 38126 dated March 4, 1968. A Certification of Accuracy was issued for the Deadweight Tester dated October 20, 1972 by Dresser Industrial Valve and Instrument Division, Stratford, Connecticut.

Accuracy: 1/10th of 1% of indicated pressure.

(b) Field Meter Inspection

All charts are changed on Monday of each week. Recorders are inspected for malfunctions at this time and repaired if necessary.

All field recorders are inspected and calibration is checked with master test gauges once per month. Equipment used for calibration check is as follows:

-- Differential is checked with ITT Barton Model 227 Indicators, differential ranges, 0-20 psig and 0-25 psig, serial nos. 227-71850 and 227-84013 respectively.

-- Static check is made with Marsh Master Test Gauges, Type 210, 0-200 psig, (Deadweight proved).

Field error exceeding .1 psig differential or 2 psig static, requires removal of that instrument for reconditioning and installation of a re-calibrated recorder.

(4) Orifice Plates and Meter Runs

(a) All orifice plates are machined to the nearest thousandth of an inch.

(b) Meter run inside diameters are calipered to the nearest thousandth of an inch.

(c) All orifice flanges are flange-tapped.

(d) Inspection of equipment is as follows:

-- Orifice plates and meter runs are inspected for wear and are recalipered to the nearest thousandth of an inch during unit shutdowns.

-- Orifice plates are replaced or re-machined if wear is detected. Experience has indicated negligible wear.

-- Inspection period depends on unit and well production performance. All orifice plates and meter runs are inspected a minimum of once every two years.

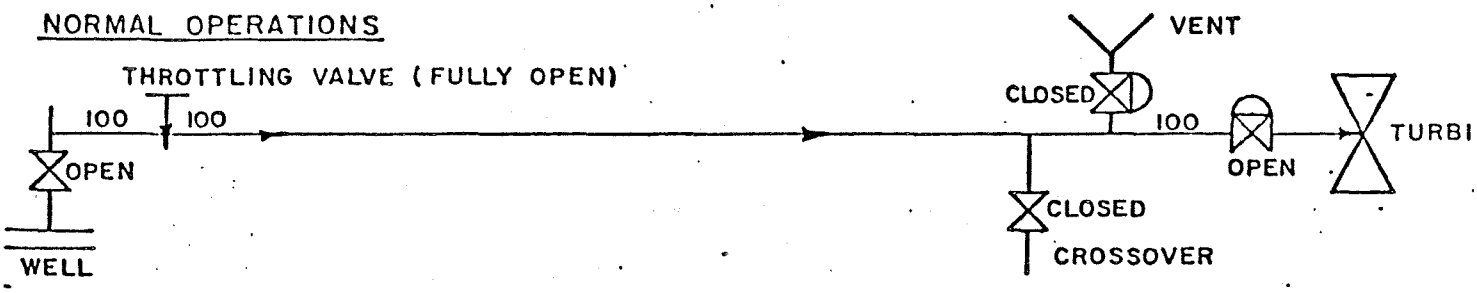
d. Guidelines for Curtailing Production from Geothermal Wells During Plant Outages

When an unscheduled outage occurs a determination is made of the cause of the outage and the estimated time of repair. In some cases the cause of failure can be quickly corrected and the unit brought back on line. When the outage is more extensive, the following procedures will be followed.

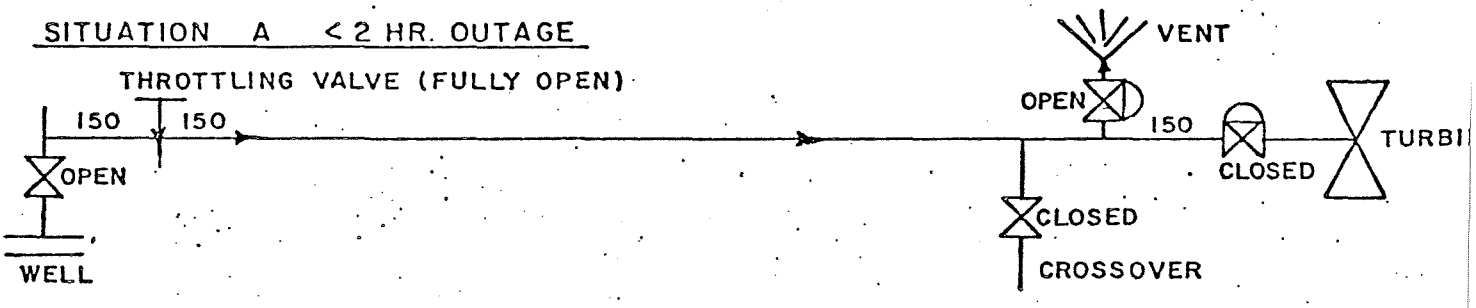
(1) Unit shutdown or curtailment of less than 2 hours.

-- Adjust steam supply system to maximum vent pressure.

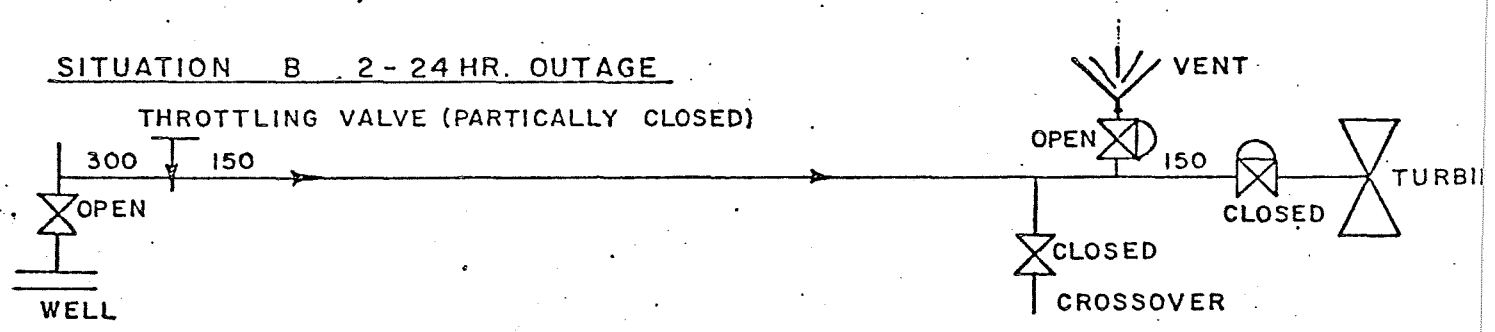
NORMAL OPERATIONS



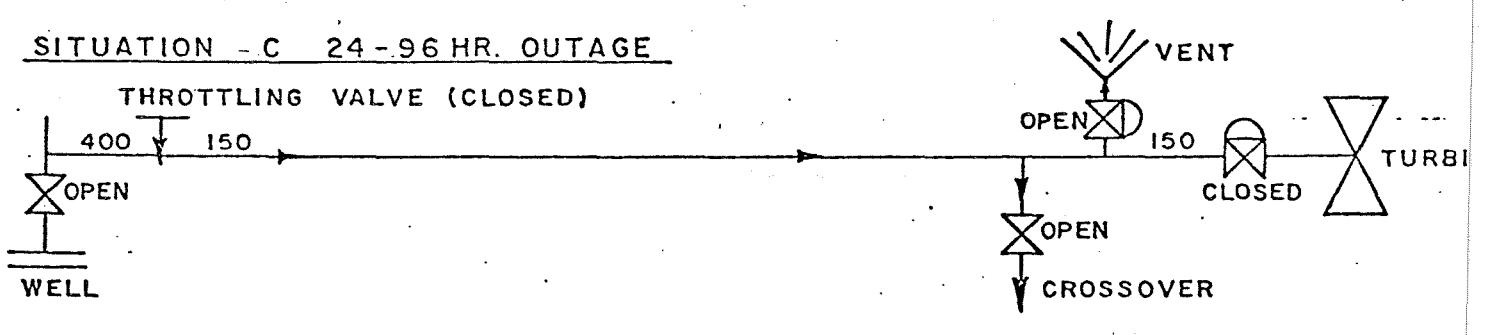
SITUATION A < 2 HR. OUTAGE



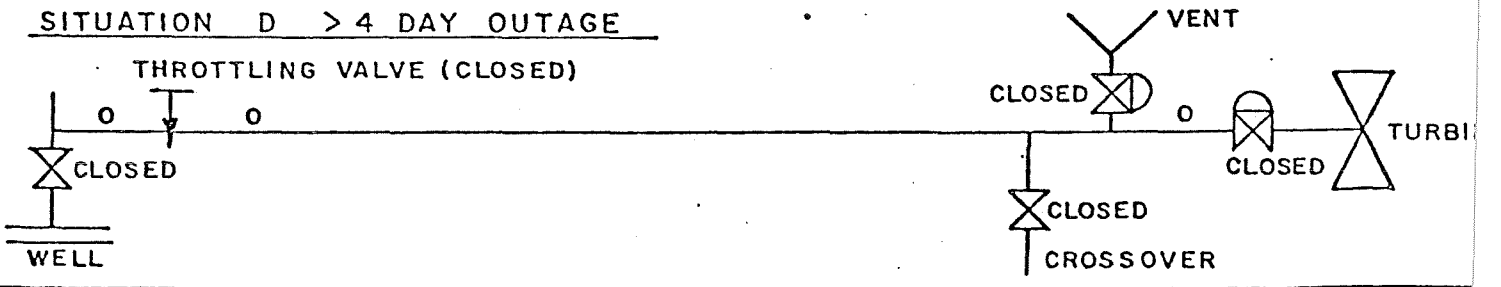
SITUATION B 2 - 24 HR. OUTAGE



SITUATION C 24 - 96 HR. OUTAGE



SITUATION D > 4 DAY OUTAGE



REVISED	DATE

UNION OIL COMPANY OF CALIFORNIA - GEOTHERMAL DIVISION

TYPICAL VALVING ARRANGEMENTS FOR VARIOUS UNIT OUTAGE SITUATIONS

DRAWN
FOR: O.W.
BY: V.T.
DATE: 12-1-7
SCALE: NONE
DRAWING NU

(2) Unit shutdown or curtailment of 2 to 24 hours.

-- Adjust steam supply system to maximum vent pressure.

-- Throttle wells equipped with vee-ball valves in unit area to a wellhead flowing pressure of 300 psig.

(3) Unit shutdown or curtailment of 24 to 96 hours.

-- Adjust steam supply system to maximum vent pressure.

-- Throttle wells equipped with vee-ball valves in unit area to fully closed position (this will reduce flow from well to approximately 20% of capacity).

-- Adjust crossover piping system to maximize steam transfer to adjacent unit areas.

-- Throttle wells equipped with vee-ball valves in adjacent unit area as required to balance steam supply with demand.

(4) Unit shutdown or curtailment in excess of 4 days.

-- All procedures as in situation (3) above shall be initiated.

-- Shut-in wells as required in affected and adjacent unit areas to eliminate steam venting.