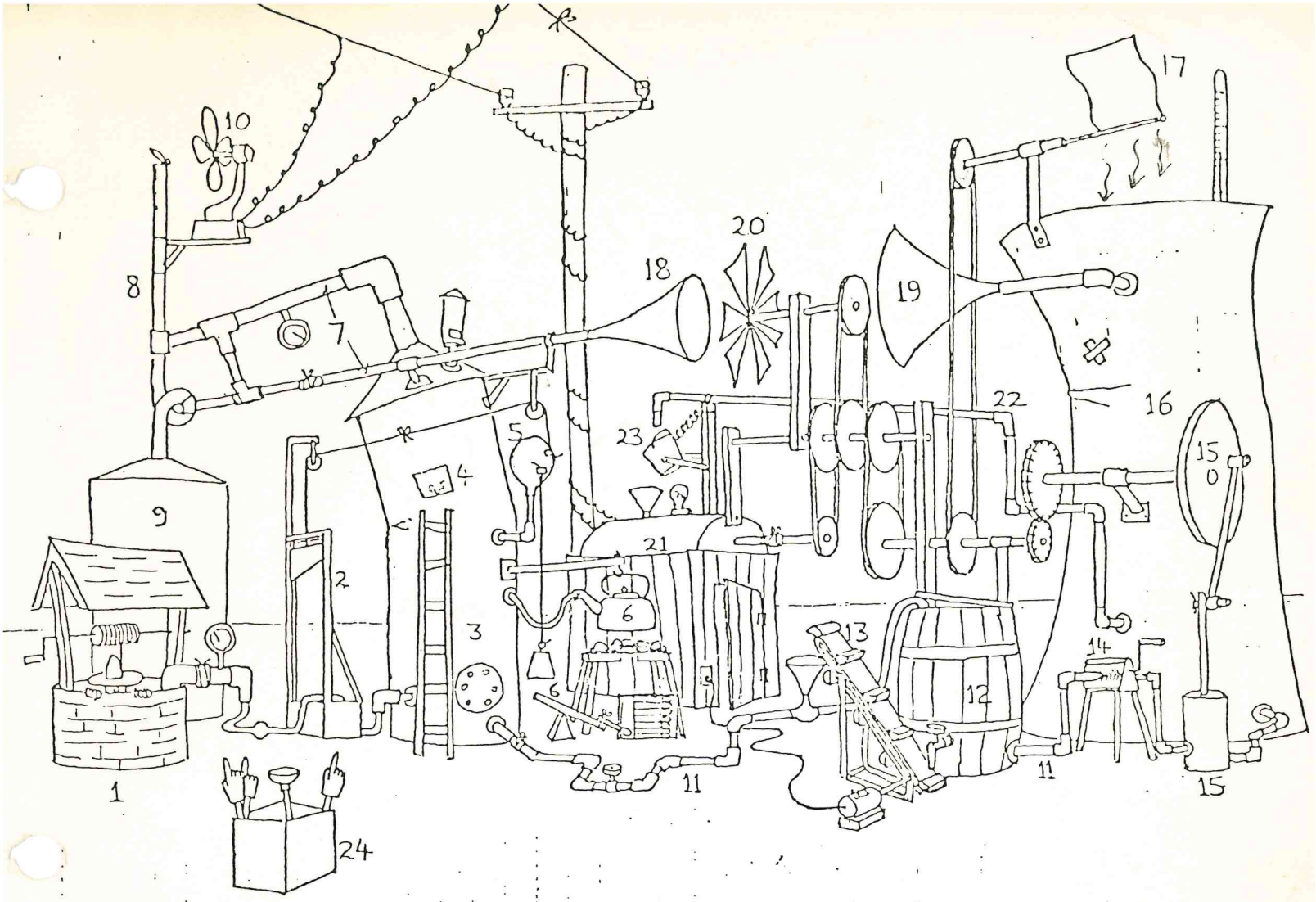
Union Oil Company of California



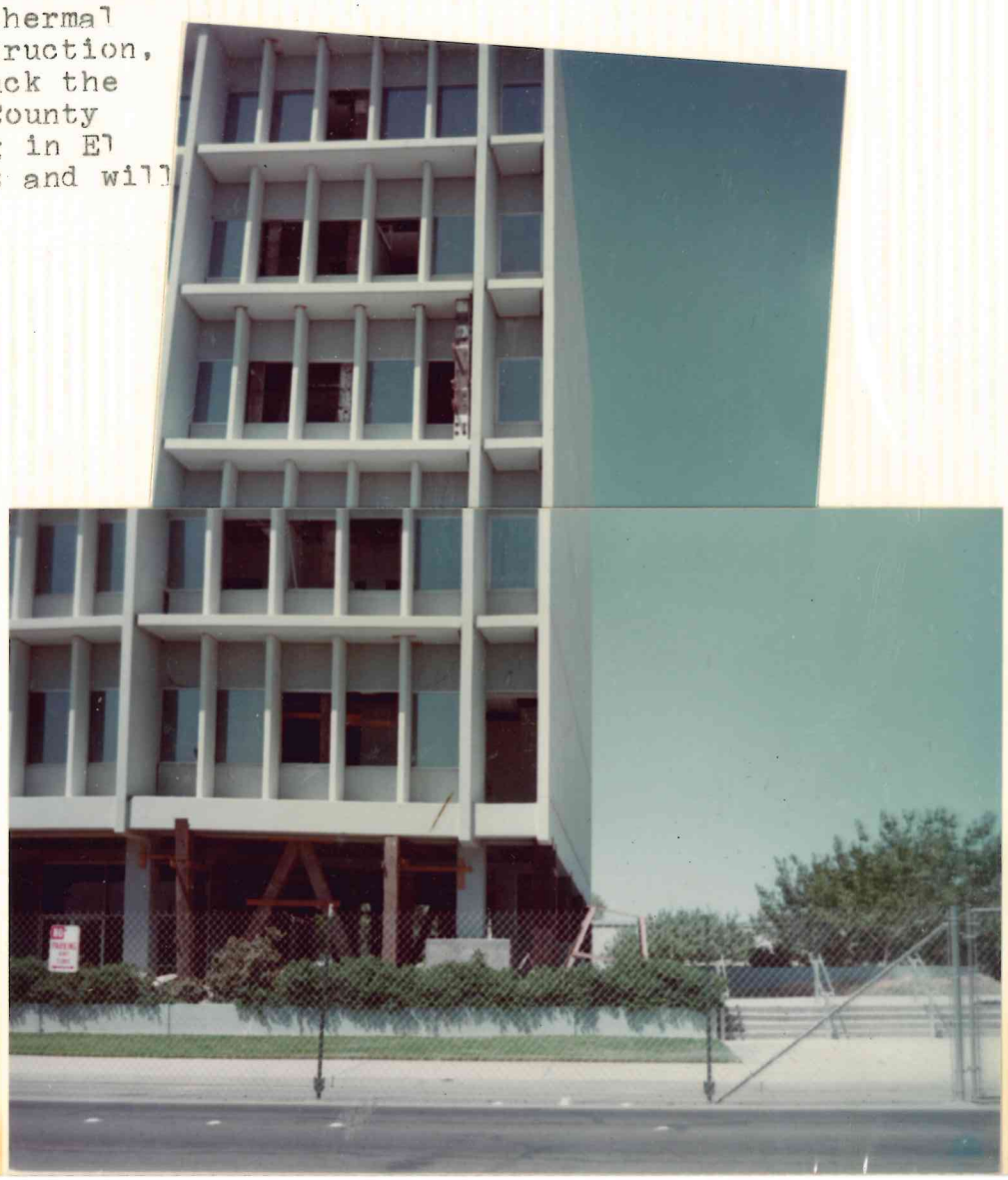
50 MW FLASHED STEAM PLANT — CONCEPTUAL DESIGN.

EXPLANATION:

1. PRODUCTION WELL W/INSPECTION CAPABILITY
2. AUTOMATIC CUTOFF VALVE
3. FLASH VESSEL
4. INSPECTION PORT
5. INFLATABLE PRESSURE RELIEF VALVE
6. AUTOMATIC COAL-FIRED BACKUP SYSTEM
7. STEAM LINE
8. EXHAUST GAS STACK
9. H_2S EMISSION CONTROL UNIT:- ALKA-SELTZER REACTOR VAT
10. PARASITIC LOAD
11. REJECT BRINE LINE
12. REACTOR-CLARIFIER
13. FRONT-END SLUDGE SEEDING MODULE
14. FILTER PRESS
15. INJECTION WELL AND PUMP
16. COOLING TOWER, DOWNDRAFT TYPE
17. DOWNDRAFT
18. HOT STEAM EMITTER
19. COLD STEAM COLLECTOR
20. TOTALLY UNENCLOSED TURBINE blades
21. GENERATOR HOUSE / CONTROL ROOM
22. COOLING WATER LINE
23. PULSED GENERATOR COOLING CAPABILITY
24. LEAK AND BLOCKAGE CONTROL UNIT

TWENTYFIRST-CENTURY TECHNOLOGY INC.
WHITESCARVER - NELLIS Proprietors

Useful geothermal energy sources are found in geologically active areas of the earth. A few weeks before the Brawley Geothermal Power Plant began construction, a major earthquake struck the Imperial Valley. The County Administration Building in El Centro was a total loss and will be taken down.



Construction of the Brawley Geothermal Power Plant Steam Gathering System began during November, 1979. Before the wells could be used for power production, they had to be worked-over. A drill rig was used to clean out the wells and check their production in sometimes awful conditions.

The main steam separators, known as V-3A and V-3B, were the largest single pieces of equipment used at the facility. The stands each weigh about 20 tons and each V-3 weighs about 60 tons. They were manufactured in Massachusetts and shipped to California by truck.

Here, V-3A's stand is set on its foundation. Upper left, Larry Hampshire shows how it is supposed to be done. Upper right, Jose Perez slips as he pushes in the mud. Lower left, Dave Wright (Valley Engineers), Howard Harvill (welder), Jose Perez (engineer), Greg Gritters (engineer), crane man, Larry Hampshire (engineer), and other crane man help adjust V-3A stand.

V-3A arrives in Brawley on a 38-wheel, 10 axle truck. The last trailing axle was added in Arizona in response to state law. The vessel was transferred to a smaller truck on Highway 111 in Brawley for delivery to the site.

Union's staff assists in rotating V-3B. They are standing on the flood light stands.

Dozens of welders, helpers, fitters, and other people helped weld miles of pipe together. Welds were both visually and X-ray inspected. Two types of pipe-road crossings are shown here.

As a demonstration facility, aesthetics are important. Here, a 4-inch air line is installed around a concrete foundation below ground level. Rain and mud (below) stopped work for about two weeks during construction.


Pair-A-Dice
Concrete
Const. Co
No Contract
With
Carpenters
Local

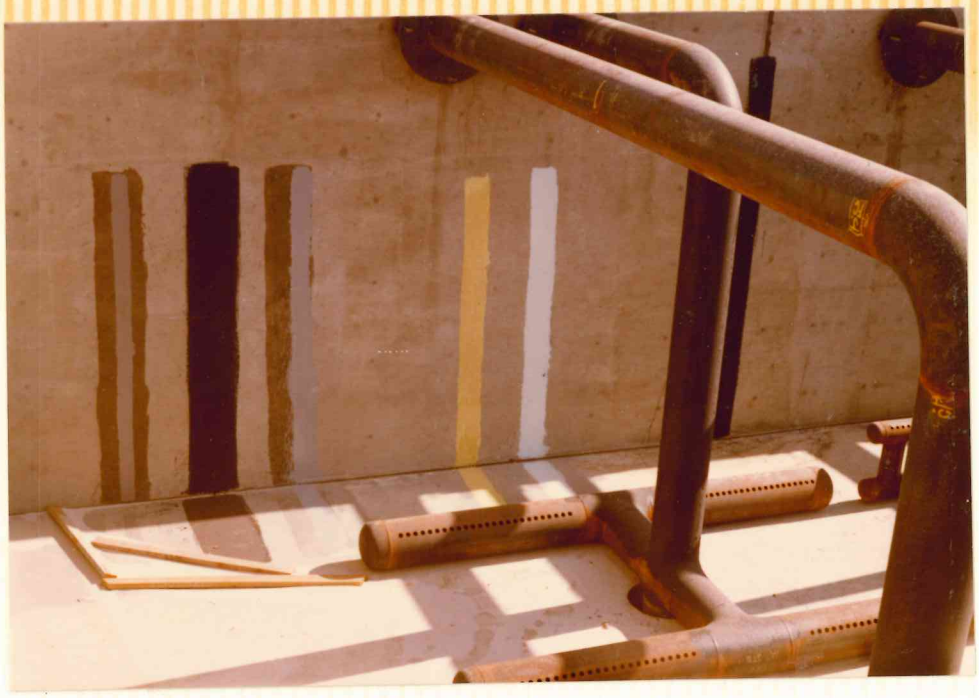

Pair-A-Dice
Concrete
Const. Co
No Contract
With
Carpenters
Local #1205

As a new major industry in the area, various unions fought one another for control of the jobs and the union dues. The first play of one-ups-manship was a single picket from a carpenters' union against a concrete subcontractor. Here, the single picket closed down the job for a day. The cement truck driver refused to enter the location.

The rock muffler is a structure which reduces the noise caused when steam is released to the atmosphere. The steam comes out of holes in a diffuser pipe in the bottom and then through layers of brick, large rock and small rock. At top left, the foundation is cleaned prior to setting forms for the walls. At bottom left, the inside forms are in and the reinforcing bar is being installed. At lower right, District Chemical Engineer Greg Gritters supervises pouring the floor of the rock muffler.

Southern Contracting Company installed the electrical work at the Steam Gathering System. Gene Lehotsky (left) supervised the job. The other two men in the picture at left formed Gene's crew for most of the job. Below, Gene and Bill Lindsay, the electrical engineer from Roger's Engineering discuss installation and wiring of the alarm panel.

At right, the tile man from Duggins Construction completes tiling the laboratory and office.
Below, the two main injection pumps arrive at the site.

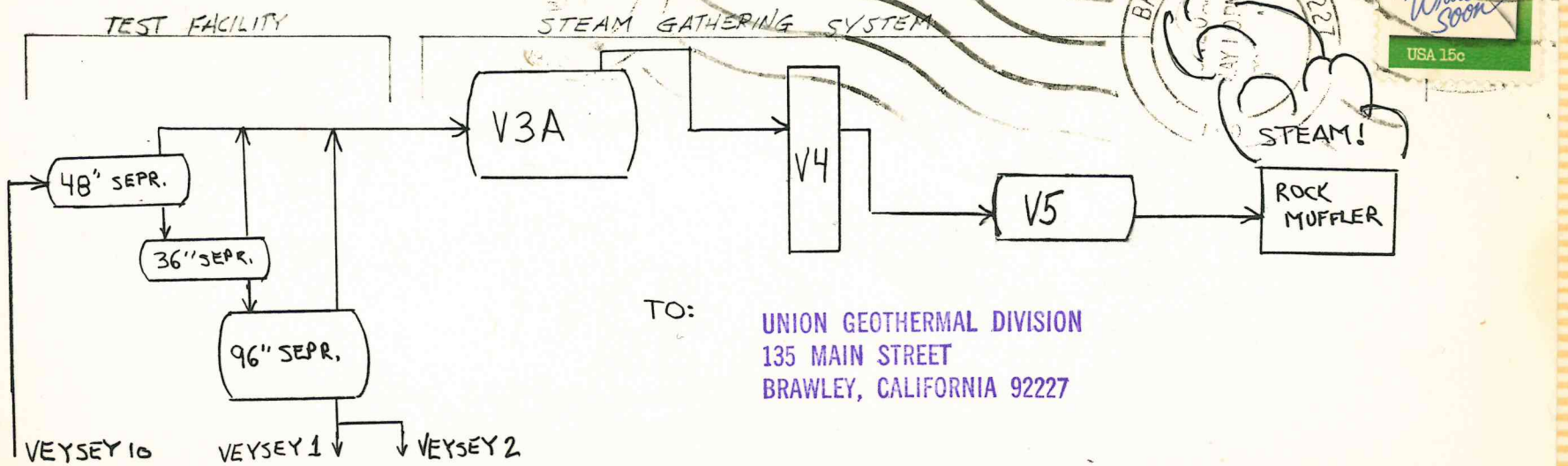


To see if any paint or coating could protect the concrete walls of the pond from the salty brine, several test strips were applied.
Scale is the biggest problem in geothermal hot water systems. Below, pipe that had been used to inject brine during test programs shows about one inch of scale.

Although the Imperial Valley gets only about two inches of rain each year, that rain turns dirt roads into impassible mud holes. The main access road to the steam gathering system could not be paved due to Imperial Irrigation District uses, so Typar was applied before gravel was brought in. The fabric keeps the rock from being lost in the mud and is often used for road construction in poor conditions.

4997A Highway 111

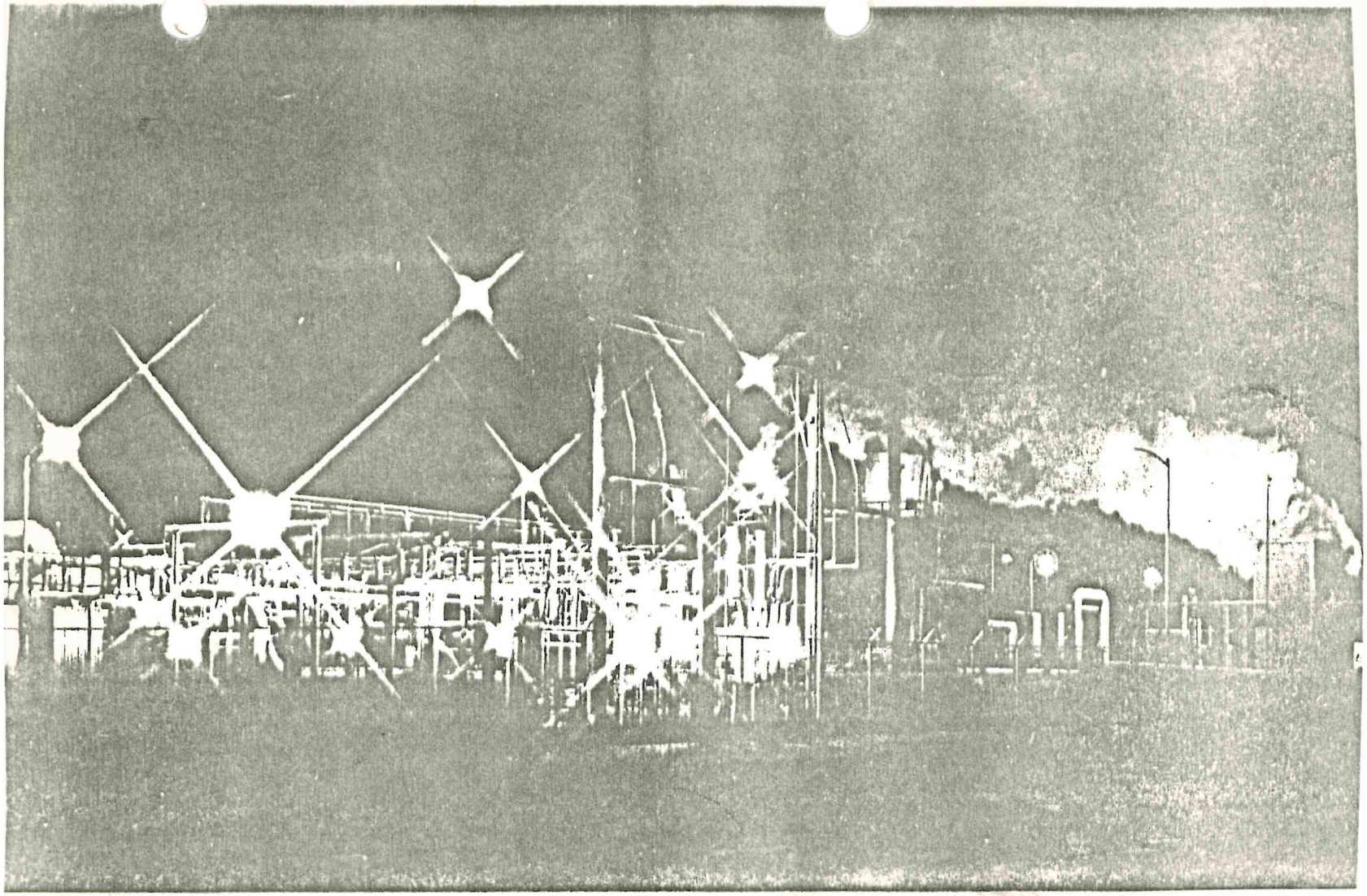
To test the system for leaks and to blow the pipelines clean, steam from the Test Facility was flowed through the system three times during May. Left, Walt Nellis (center) supervises the beginning of the first steam blow.



TO:

UNION GEOTHERMAL DIVISION
135 MAIN STREET
BRAWLEY, CALIFORNIA 92227

BRAWLEY 10 MW POWER PLANT STEAM GATHERING SYSTEM
FIRST STEAM BLOW — 10 MAY 1980



NIGHT-TIME DISPLAY — Lights enhance the geothermal power plant north of Brawley where the turbine Tuesday was turned for the first time by geothermal power. The plant is a $20-million joint venture by Union Oil Co. and Southern California Edison and will be generating 10 megawatts of electricity into the Imperial Irrigation District system in about two weeks, if the "shake-down" is deemed a success. Union began geothermal exploration in the area north of Brawley about seven years ago — now brilliant lights mark the spot. (Staff photo by Coleman Cecil)

THE BRAWLEY NEWS

SERVING NORTH IMPERIAL COUNTY SINCE 1903

BRAWLEY, CALIFORNIA WEDNESDAY, JUNE 18, 1980

Geothe

at Braw

By NADINE RIVERA
Staff writer

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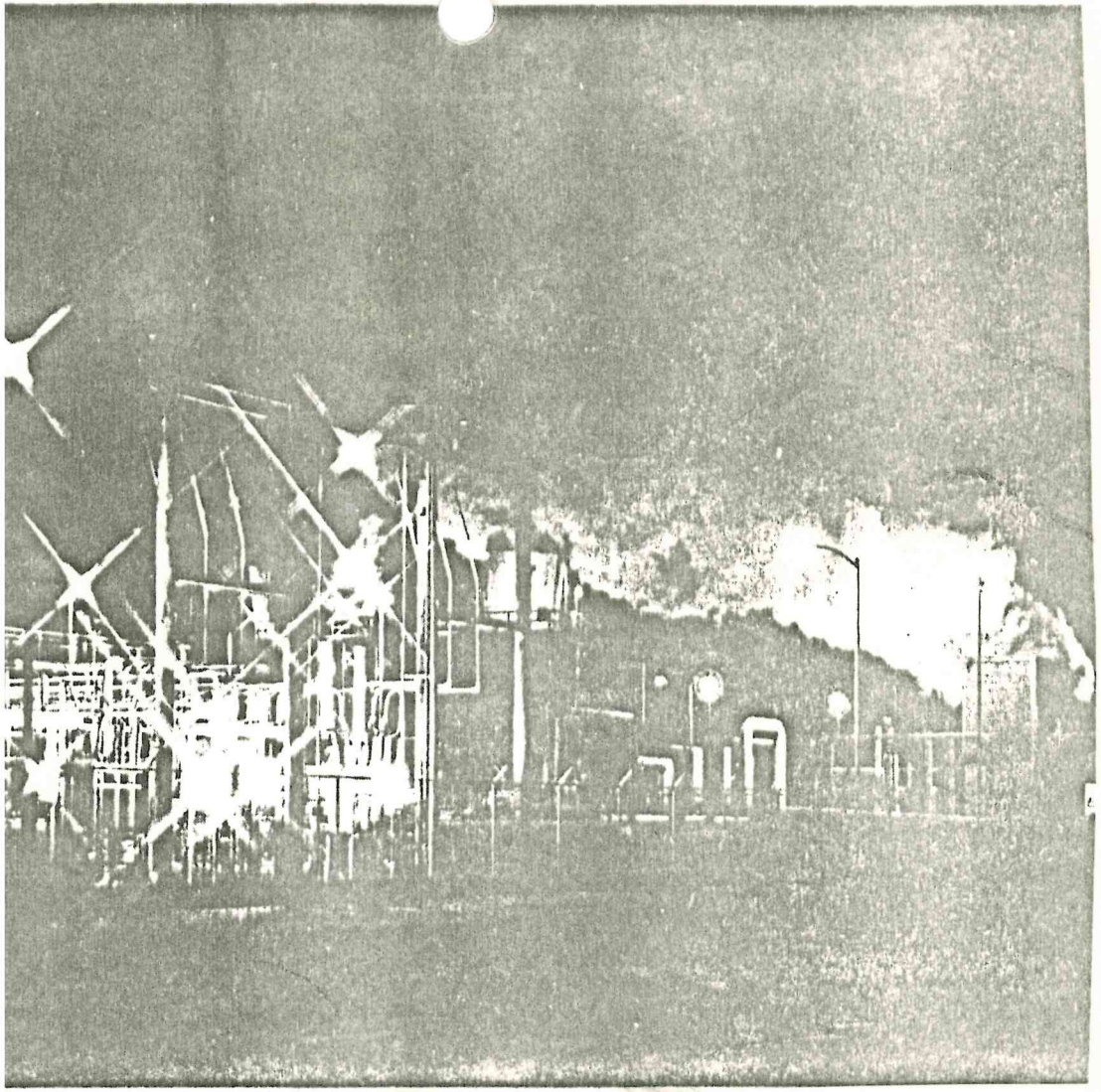

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RAWLEY NEWS

'ING NORTH IMPERIAL COUNTY SINCE 1903

RNIA WEDNESDAY, JUNE 18, 1980

Geothermal plant at Brawley tested

By NADINE RIVERA
Staff writer

The turbine was activated at 2:45 p.m. Tuesday at the geothermal power plant north of Brawley to mark several firsts for the Valley, the nation, Union Oil Company and Southern California Edison.

The test run represented:

—The first flash system in operation in the Valley.

—The first geothermal system in operation for Southern California Edison.

—And the first domestic hot water system for Union, which operates a similar facility in the Philippines.

This is the first time we've turned the turbine with steam," Amon Cedillo, SCE research engineer, explained, as he watched the guage rise to 500 RPM.

"We're not going to produce electricity today. We will in about two weeks; maybe sooner, if everything is OK."

Electricity was produced in January at the Magma-San Diego Gas and Electric geothermal installation on the East Mesa. However, the plant is now down for adjustments, according to Dutch Scholz, Imperial County geothermal co-ordinator. However, the East Mesa insallation utilizes a binary system.

Scholz predicted that the Brawley plant has a higher probability of success, as Union has tested the flash system (through which the steam is produced by lowering the temperature of the geothermal fluid, in the Geysers in Northern California.

Both Scholz and Union's district production superintendent, Walter E. Nellis believe the brine solids will be the biggest problem at the Brawley plant.

"We know we can make it work. But can we do it constantly?" Nellis asked. "We are aiming for the highest possible on-line efficiency." The plant is an experimental facility for this reason.

"We'll find out if it works after about three weeks of operation," Cedillo stated.

Union is counting on a system of back-ups to beat the brine build-up. If one unit is out of operation, the system is switched to another, Nellis explained.

Plans Tuesday were to run the turbine at about 500 RPM for about an hour and then to rev it up to 3,600. "This is just a 'shake-down'," Scholz explained, "as power plants aren't new." It's the use of geothermal energy that's being tested.

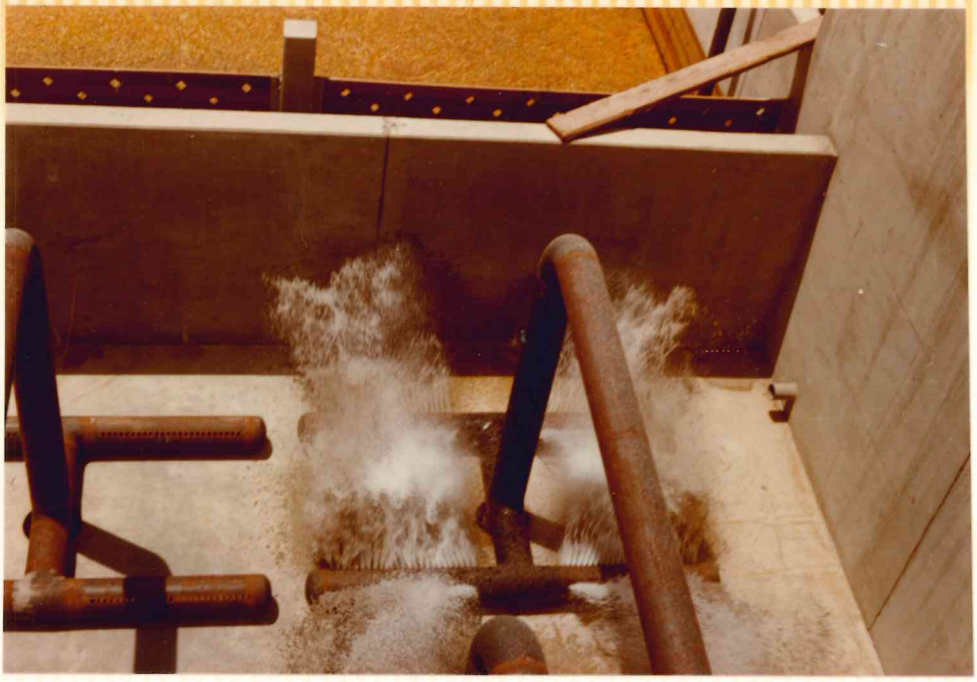
When in operation, the generator will feed about 10 megawatts of power into IID transmission lines from an adjacent switching station. Power generated will serve a city of approximately 10,000 — a little better now because of energy conservation."

Union has three on-site production wells with two reinjection wells and two stand-by injection wells for residue.

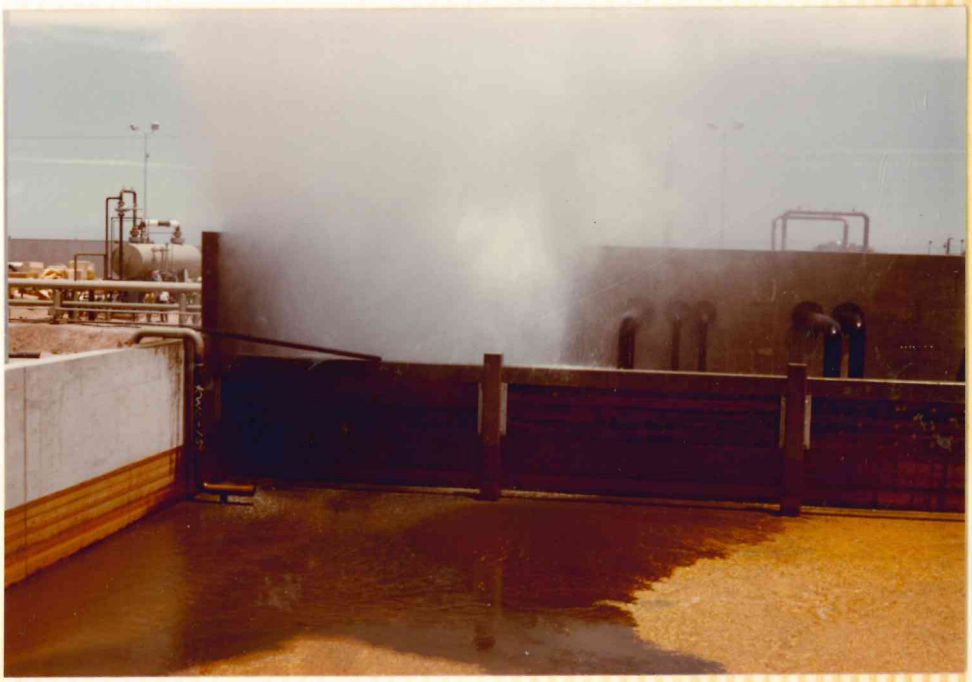
Union, which also has land leased in five or six major areas in the county, began exploration in the area north of Brawley about seven years ago. Cost estimates and design for the present installation were begun in September, 1978, Nellis explained.

Both Union and SCE have in the neighborhood of $10 million invested in the Brawley venture.

The first start-up with brine required extensive planning. Each valve had to be in its proper open or closed starting position. Then, valves had to be opened and closed in specific order. Above, the start-up crew goes over the check list. Below, the wellhead valve to Veysey 8 is opened. Steam Gathering System operation had begun!



The first brine to flow through the Steam Gathering System went to the brine storage pond. This allowed the pipelines to be warmed up slowly. Above, the first water enters the pon pond. Below, steam rises from the pond as additional brine flows from Veysey 8.



GEOTHERMAL POWER GIVING ITS ELECTRICITY TO VALLEY LINES

THE BRAWLEY NEWS

FRIDAY, JUNE 27, 1980

By NADINE RIVERA
Staff writer

Electricity generated by geothermal power is now being fed into Imperial Irrigation District lines from the geothermal test facility north of Brawley.

"We're hooked up and generating 1.5 megawatts," Ramon Cedillo, research engineer for Southern California Edison Co., said Thursday.

Both Cedillo and Walter E. Nellis, district production superintendent for Union Oil, which pioneered the geothermal installation, were cautious but enthusiastic about the testing.

"We've had minimal problems," Nellis said. "Nothing unexpected."

The electricity represents the first generated by a flash system in the United States and the first generated from geothermal power for SCE.

Emil Hutchins, SCE's customer service head for Riverside and Imperial counties didn't hold back his enthusiasm.

"It's terrific," he said. "The turbine generator is working better than we anticipated."

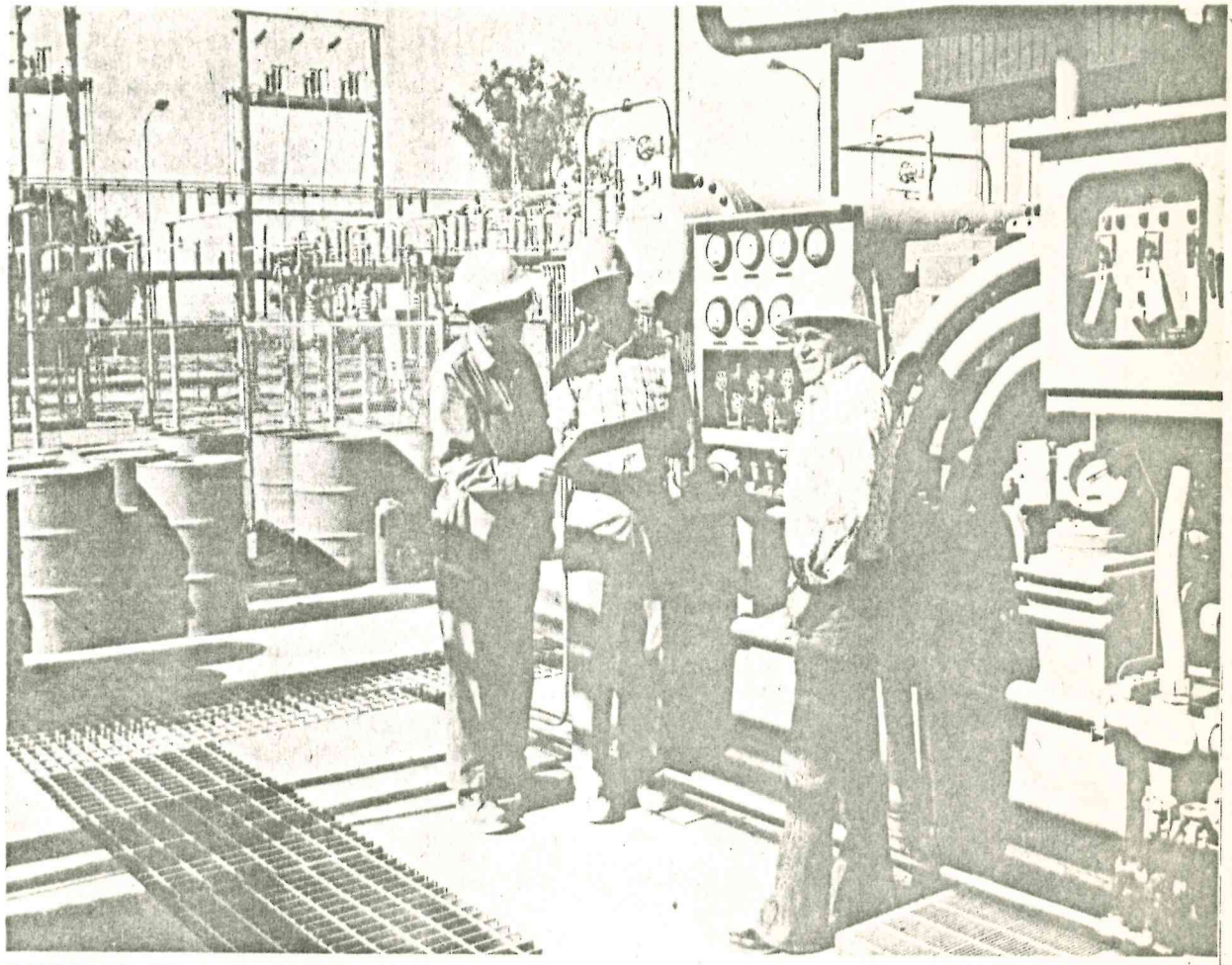
Hutchins explained, "We're staying at 1.5 megawatts right now. It will gradually be brought up to put out more megawatts during the 30-day test period."

The plant was designed to produce 10 megawatts, or enough to service approximately 10,000 persons.

"We're tentatively planning a dedication ceremony for July 31," Hutchins said.

"Everything is going just fine as far as we are concerned, too," Nellis reported this morning. "It's too early to be entirely confident, however.

"We still need to be cautious" he continued. "We're operating on a stop-and-start basis. You can't be totally optimistic until you're on a constant basis."



POWER TO IID — Experts at the Geothermal Test Facility north of Brawley watch and wait as the installation, the first to utilize a flash system in the U.S., feeds 1.5 megawatts of electricity into nearby Imperial Irrigation District lines. J.H. Stuart, (left) Rogers Engineering Construction manager, confers with W.A. Daniels, Union Oil project director, as Ray Cedillo, SCE research engineer, stands by.
(Staff photo by Coleman Cecil)

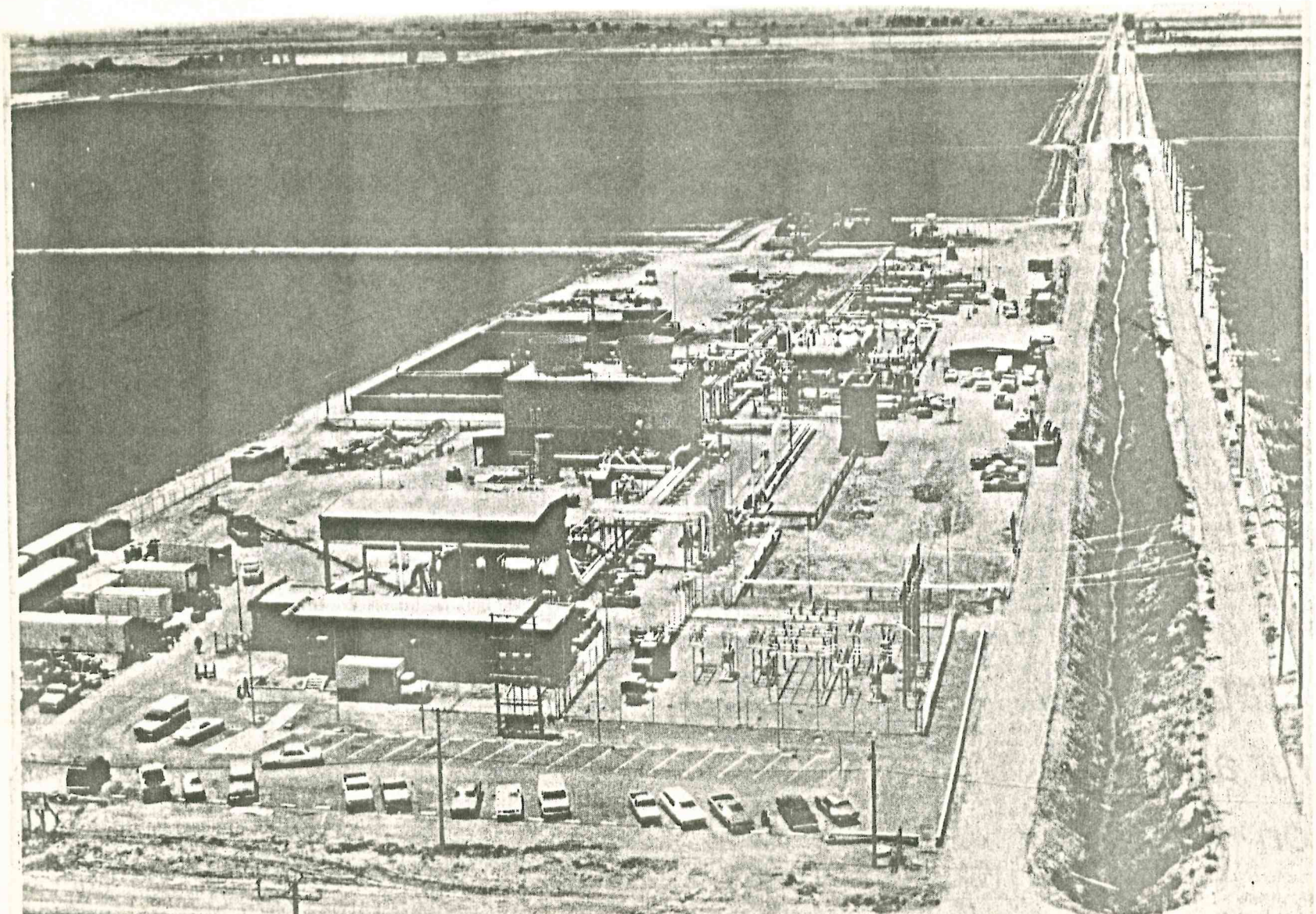
But, he enthused, "It sure looks good!"

The geothermal steam portion of the test project has been in operation since June 9. The SCE turbine was activated on June 17. The first electricity produced last Saturday.

Although the flash system has never been used in the U.S. before, it is operational in Mexico at Cerro Prieto, just south of Mexicali, and in the Philippines. The latter is a Union Oil venture.

The first electricity from geothermal power was fed into IID lines from the Magma Plant on the East Mesa in January. The Magma Plant utilizes a

Geothermal plant firms status



GENERATING ELECTRICITY — Operating on a firm status is the geothermal generating plant north of Brawley. "Firm operation," the point in time when the unit has achieved reliable operating status, was achieved at 1:50 p.m. Wednesday. The generating plant, constructed for experimental purposes by Southern California Edison, is supplied geothermal steam from Union Oil Co. wells and is now generating 7.5 megawatts into the Imperial Irrigation District electric grids. A milestone in geothermal experimentation which began in Imperial County in 1927 on Mullet Island in the Salton Sea, the plant will be dedicated Oct. 15. (Aerial photo by Coleman Cecil)

By NADINE RIVERA
Staff writer

The geothermal power plant north Brawley achieved firm operation stat at 1:50 p.m. Wednesday. This makes the first plant in Imperial Valley geothermal development to do so.

The announcemnt was made Ramon Cedillo, research engineer f Southern California Edison Co.

This has been the goal of geotherm research since it began in the Valley 1927.

Cedillo said today, "We are n generating 7.5 megawatts into t Imperial Irrigation District electr grids."

"This is what we've been shooti for!" Walter E. Nellis, distri production superintendent for Union Co. declared. The steam for the plant supplied by Union Wells; the plant operated by SCE.

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Nellis stated that Union Oil "tickled" that the operation has gone smoothly as it has. "We'll have lots problems, but now we're sure we c handle them."

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S. Gonzales

SEP 1990

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THE BRAWLEY NEWS

Thursday, July 31, 1980

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The delay, according to Emil Hutchins, Riverside, was primarily due to the hot weather; but "cosmetic" improvements at the plant are now underway. Hutchins is the SCE vice president's representative for Imperial and Riverside counties.

"We are extremely pleased at the way the generating is working at the Brawley plant. The steam delivery is working very well, too."

Hutchins pointed out that the plant was developed for experimental purposes. "We still have lots to find out about geothermal. Now we have the plant to do it with," Hutchins said. This is SCE's first geothermal venture.

"We have a conditional use permit for a 49-megawatt plant at Heber," Hutchins continued, "and what we learn at Brawley will be incorporated into the operation planned at Heber." The Heber plant is scheduled for operation in early 1983.

Nellis also sated that Union and SCE are in the process of firming up plans for a power plant in connection with wells near the Salton Sea.

In a related news story in today's San Diego Union, San Diego Gas & Electric Co. announced the company Wednesday completed arrangements to purchase seven megawatts of power from IID.

Rufus Ogilvie, IID's power chief, explained, "That's not the geothermal power we're getting from the Brawley plant."

There is a long-standing agreement between IID and SDG&E whereby IID supplies power for SDG&E when they have trouble in the Borrego desert and IID gets power from the San Diego company when there are problems with IID's San Felipe operation, Ogilvie said.

S. Gonzales

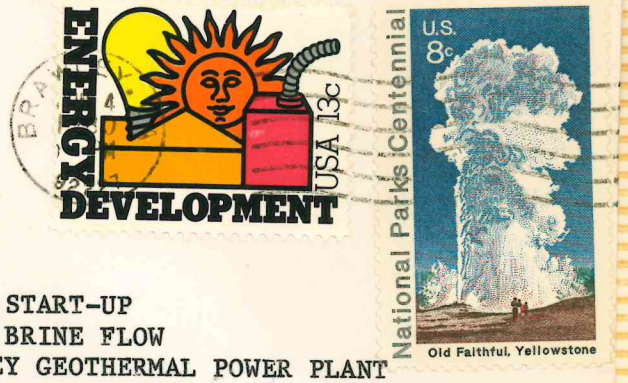
SEP 4 1980

Union Geothermal Division

Union Oil Company of California
135 Main Street
Brawley, California 92227

UNION 76

Brawley Geothermal



FIRST START-UP
FIRST BRINE FLOW
BRAWLEY GEOTHERMAL POWER PLANT
STEAM GATHERING SYSTEM
4 JUNE 1980

Union Geothermal Division

Union Oil Company of California
135 Main Street
Brawley, California 92227

UNION 76

Brawley Geothermal
Ten Megawatt
Power Plant
Steam Gathering System
4997A Highway 111
Brawley, California
92227

FIRST START-UP
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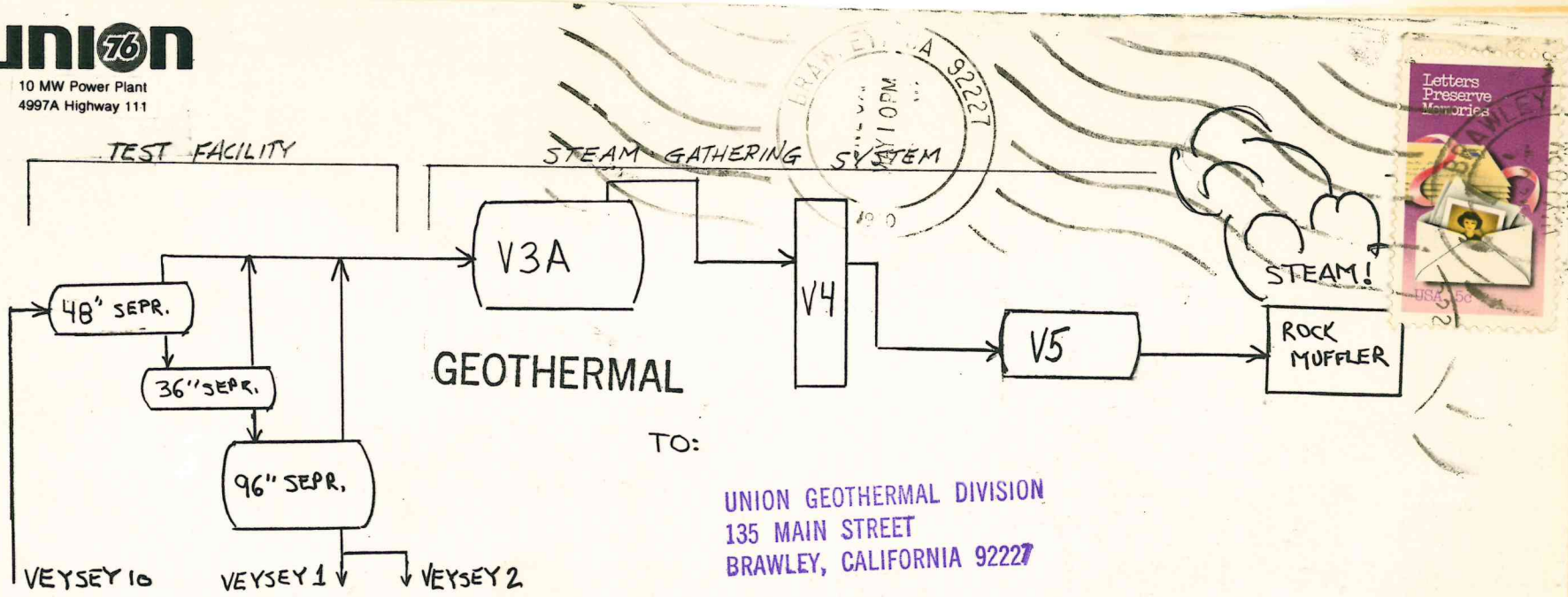
UNION 76

10 MW Power Plant
4997A Highway 111

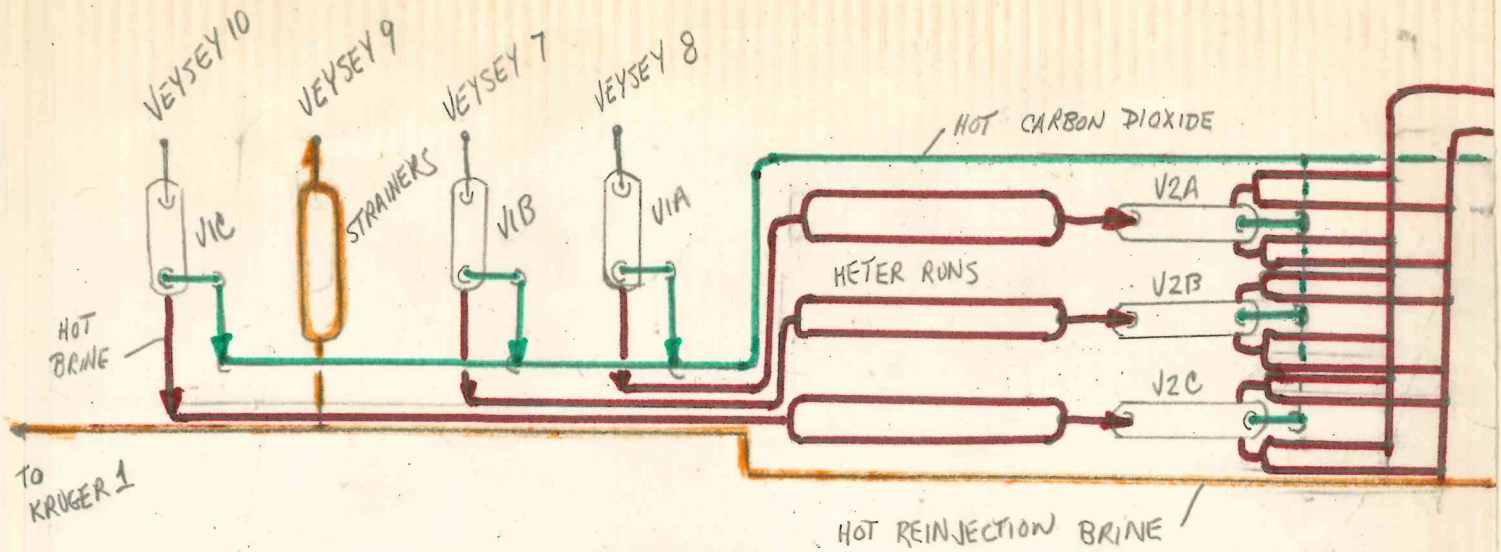


TO:

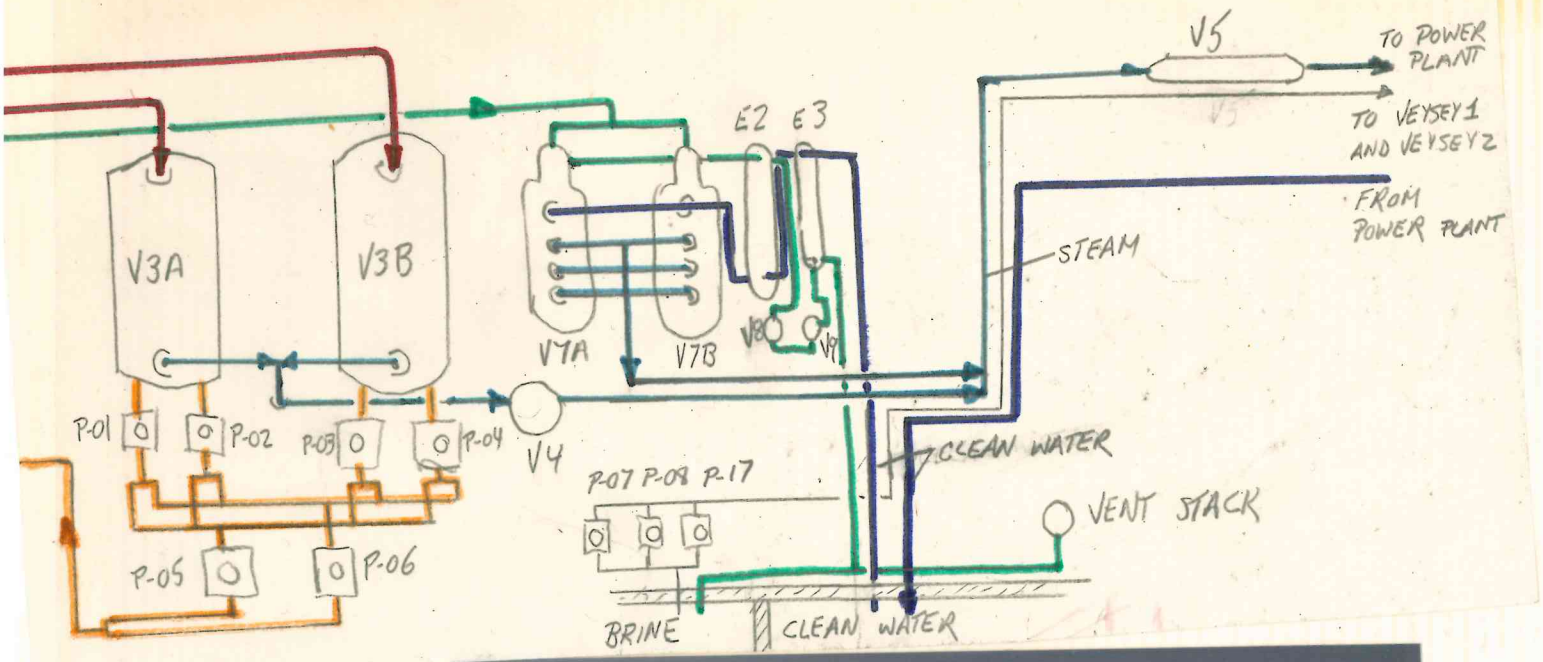
UNION GEOTHERMAL DIVISION
135 MAIN STREET
BRAWLEY, CALIFORNIA 92227

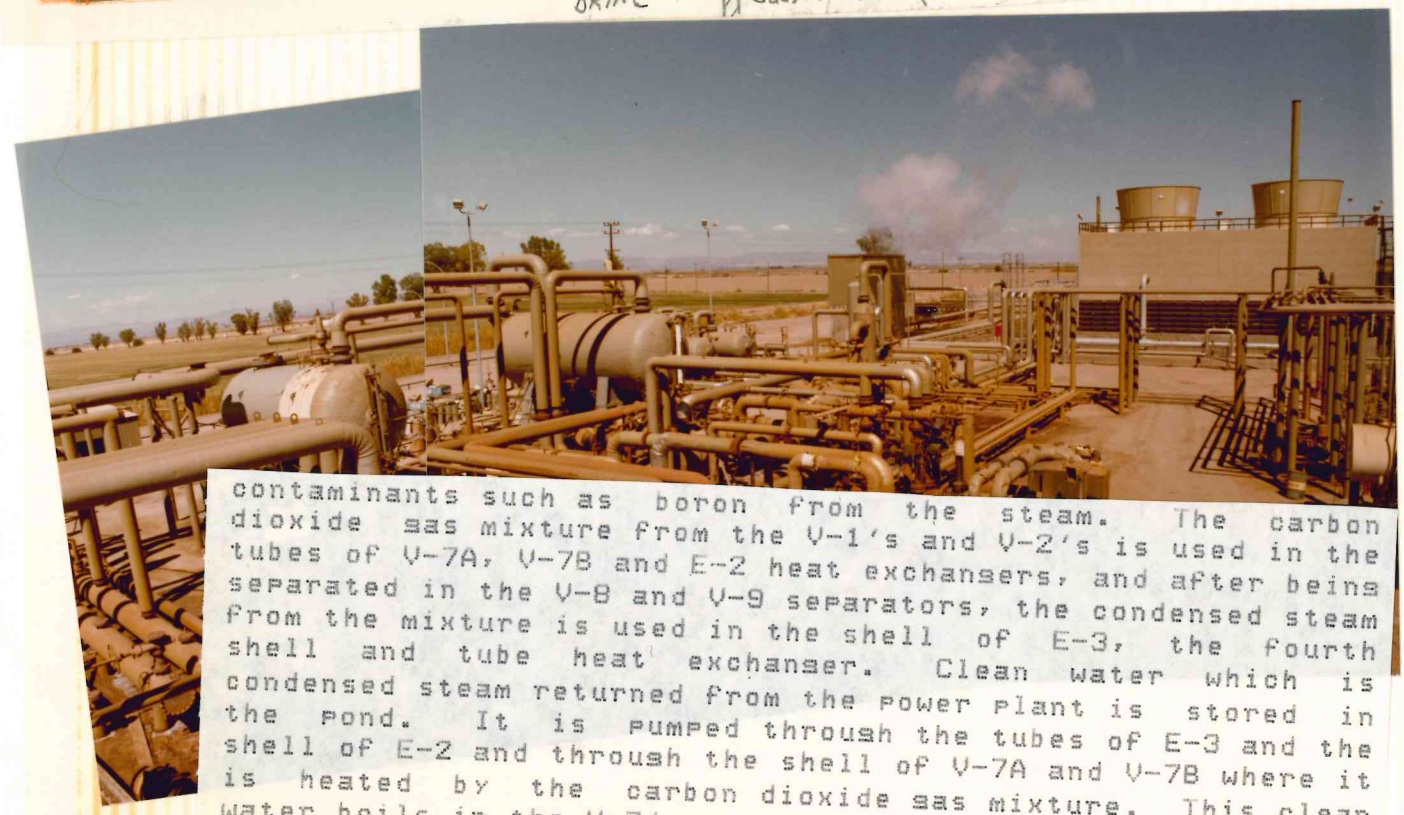
BRAWLEY 10 MW POWER PLANT STEAM GATHERING SYSTEM
FIRST STEAM BLOW — 10 MAY 1980

To prevent any materials in the pipeline from fouling the pumps, witch hat screens were installed in the upstream piping. Here, Greg Gritters examines some of the silica scale which formed.

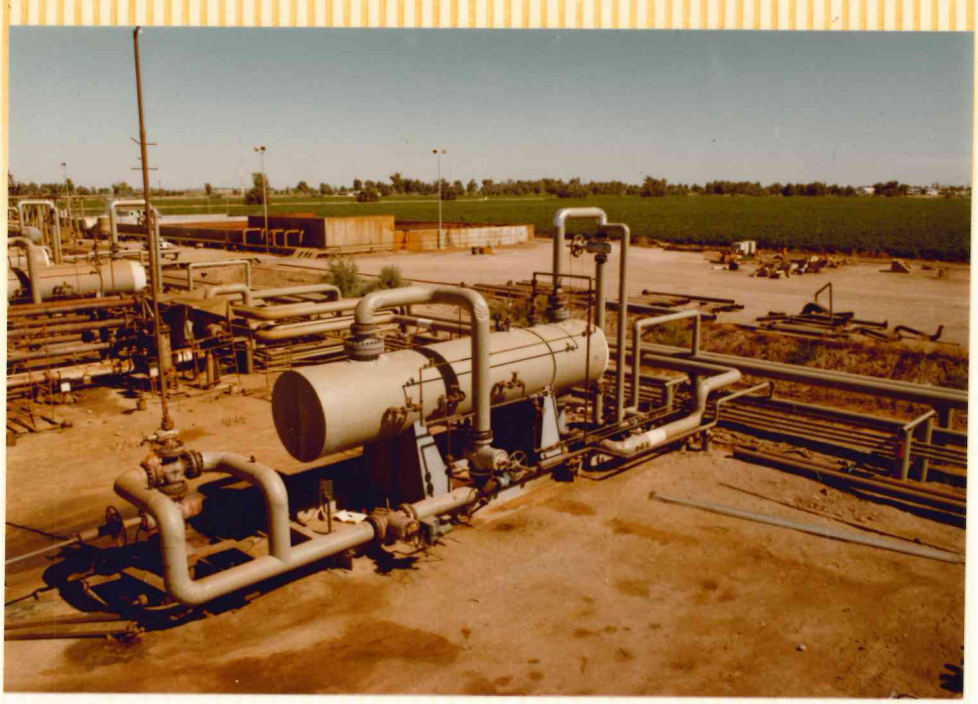


Brine from three wells, Veysey 1, Veysey 2, and Veysey 10 flows into the respective wellhead separators V-1A, V-1B, and V-1C at about 500 degrees Fahrenheit at about 400 PSIG. Within the V-1's the pressure is reduced about 50 PSI so some steam and carbon dioxide and other gasses can be separated from the brine. The brine flows to the V-2 vessels where a similar separation occurs. The brine combines and either enters V-3A or V-3B. There the pressure is reduced to about 150 PSIG. Steam exits the top of the V-3 and brine leaves the bottom. Brine is pumped by one booster pump (P-01 through P-04) to increase the brine pressure to about 200 PSIG. The brine is then pumped by one of the main injection pumps (P-05 and P-06) to a pressure of about 700 PSIG for injection in the injection wells Veysey 9 and Kruger 1. The steam leaves the top of the V-3 separator and travels through a scrubber, V-4, which removes

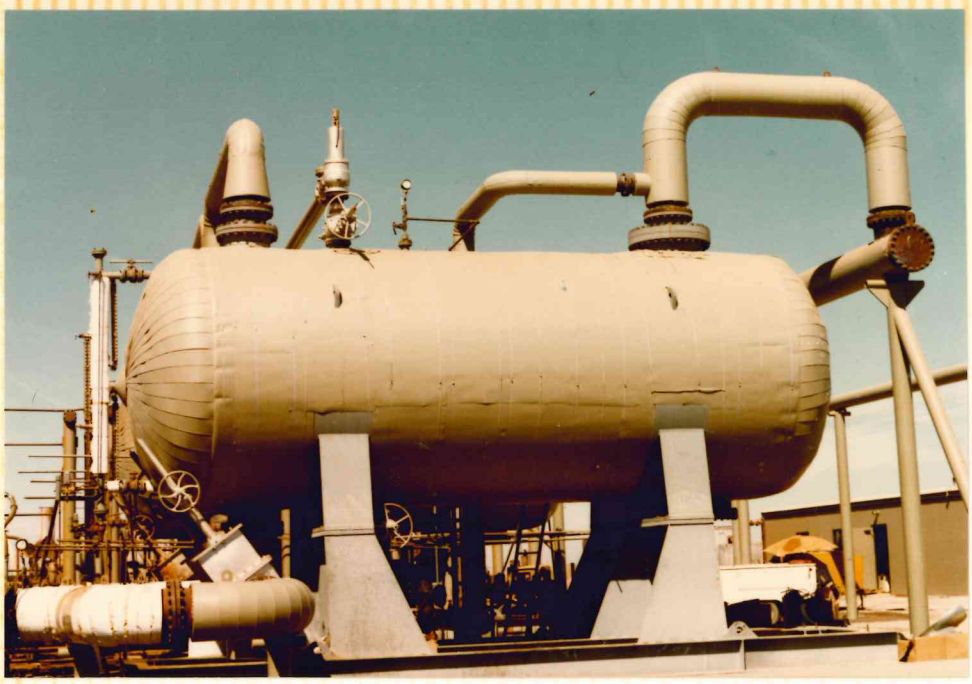




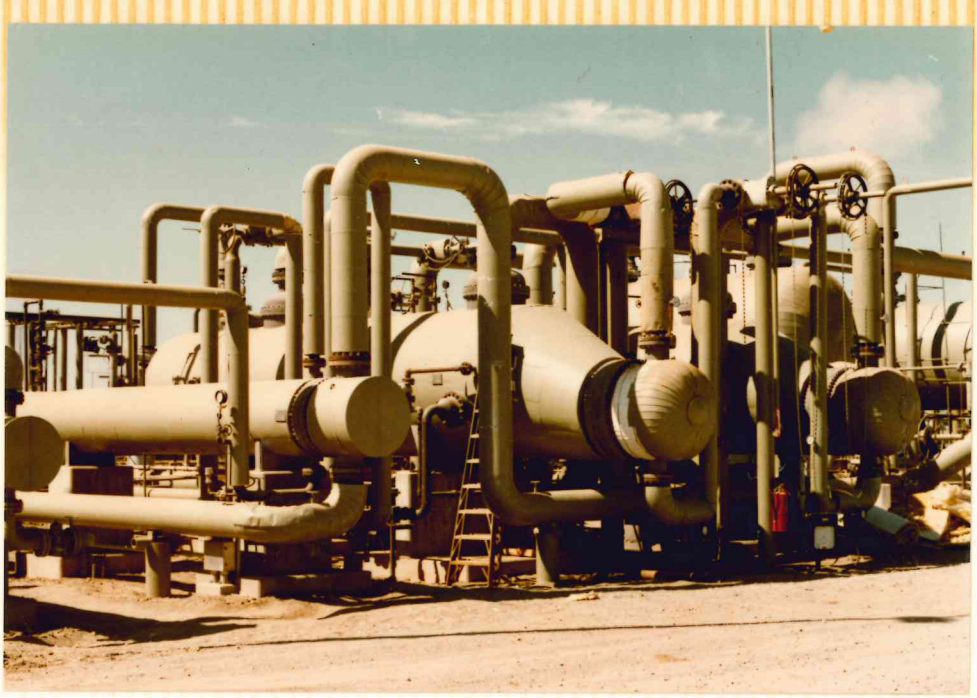
contaminants such as boron from the steam. The carbon dioxide gas mixture from the V-1's and V-2's is used in the tubes of V-7A, V-7B and E-2 heat exchangers, and after being separated in the V-8 and V-9 separators, the condensed steam from the mixture is used in the shell of E-3, the fourth shell and tube heat exchanger. Clean water which is condensed steam returned from the power plant is stored in the pond. It is pumped through the tubes of E-3 and the shell of E-2 and through the shell of V-7A and V-7B where it is heated by the carbon dioxide gas mixture. This clean water boils in the V-7's, generating additional steam. This steam combines with that from the V-3 which then runs through a separator (V-5) which removes any water remaining in the steam. Southern California Edison takes the steam to generate ten megawatts of electricity using conventional generation technology.



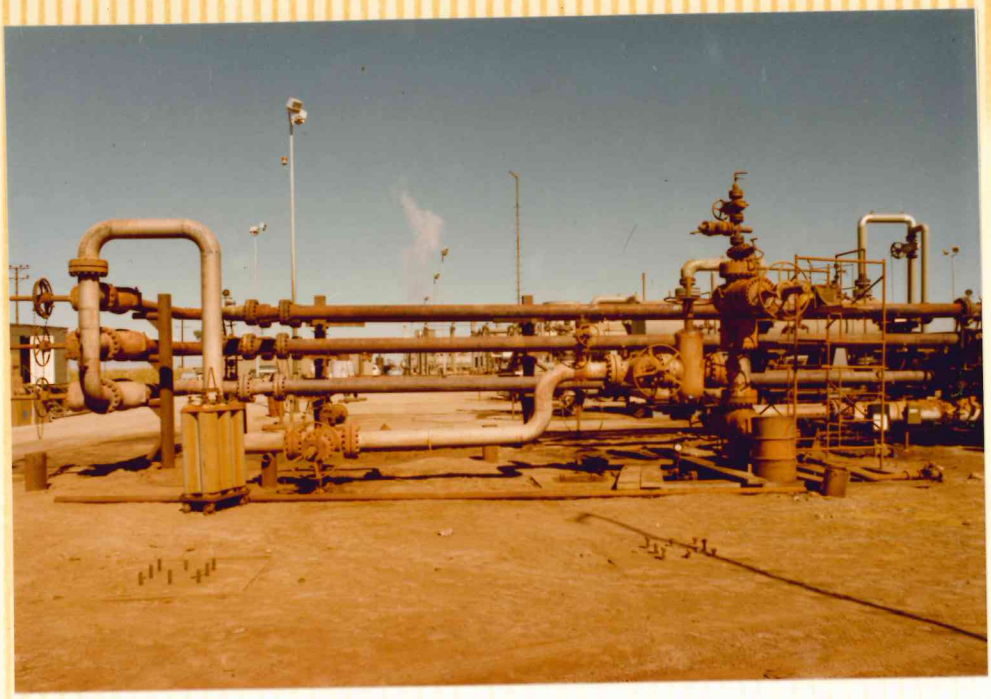
Above, Veysey 10, a typical production well with its wellhead separator, V-1C. The well itself is at left. Below, some of the miles of pipe installed for the Steam Gathering System. This pipe assembly joins the second and third stage separators.



V-3B, the largest vessel is eleven feet in diameter and weighs 60 tons. From above the heat recovery system (below), V-3B and its sister, V-3A, rise above the rest of the plant and the adjoining fields.



Above, the heat recovery system consists of four heat exchangers and three separators. The heat exchangers are visible here: E-2 (far left, only end visible), E-3, and the larger reboilers V-7A and V-7B. Below, the rock muffler silently vents excess steam.



The injection wells Veysey 9 above and Kruger 1 below are used to inject the used brine. Veysey 9 is on the plant location, but Kruger 1 is a mile away across fields often planted with alfalfa. The sets of horizontal pipes are strainers or cricket traps, so named when they were used for straining fluid which had been in open tanks which had attracted the common critters.

Above, the office building holds the control facilities, electrical switchgear, a shop and chemical laboratory. Below, Production Engineer Mike Von der Porten checks the morning operations.

The north side of the pond wall is where a dozen small pumps sit. These pumps move both cool brine and clean water throughout the plant (right). Looking east, the cooling tower of the power plant is visible beyond the steam gathering system (below).

At night, the lights of the Steam Gathering System and the power plant reflect off the roof of a Union Oil Company car.

Looking north from above the plant in the Southern California Edison helicopter, the New River runs from Mexico (in the distance), from right to left, into the Salton Sea. Beyond, the town of Brawley receives its new Geothermal energy.

FROM THE SANTA ROSA PRESS DEMOCRAT OCTOBER 15, 1980

Union oil opens geothermal plant

CEREMONY

BRAWLEY (UPI) — Union Oil Co. Wednesday formally opened the first U.S. commercial electricity plant powered by hot water from the earth, saying a major technical breakthrough may unlock "the Saudi Arabia of the world's geothermal energy resources" in California.

If the process proves economically sound at the end of a year's trial run, geothermal plants in the Imperial Valley could generate some 3 million kilowatts, providing 20 to 25 percent of California's electricity needs, said Union president Fred Hartley.

The $30 million plant was built by Union Oil and the Southern California Edison Co.

The trial run — the plant is now producing 7,000 watts of electricity in regular commercial operation — is to determine whether Union has solved the problem of extracting power from very salty water.

The heat resources in the earth of the Imperial Valley, just north of the Mexican border and about 100 miles east of San Diego, "have long been known to be huge," Hartley noted.

No Ticketron

The lack of a Ticketron outlet in Imperial County has made it difficult for Valley residents to obtain reservations and information concerning sporting events, theatrical performances, and campsite reservations throughout the state. Although mail-in reservations are available, they are not as convenient or easily obtained as would those obtained at a walk-in facility.

Assemblyman Dave Kelley has approached Ticketron concerning an Imperial County Ticketron outlet, and Ken Macker of Ticketron indicates the proposal is under review, although he has said, "There has been no evidence of even a small level of business to support a Ticketron outlet in your (Imperial) county."

Valley residents who would like to see a Ticketron outlet nearby, and those who would use this service should write Mr. Macker indicating that there is much more than a "small level of business" possible in the area.

Letters should be addressed to P.K. Macker, vice-president, Recreational Systems, Ticketron, China Basin Building, 161 Berry Street, San Francisco, Calif. 94107. A copy of each letter should be sent to Mr. Kelley in Imperial.

With a strong show of interest and the follow-up of Mr. Kelley, the Valley may be able to welcome its Ticketron outlet in the coming months.

MICHAEL VON DER PORTEN
Brawley

Ticketron study

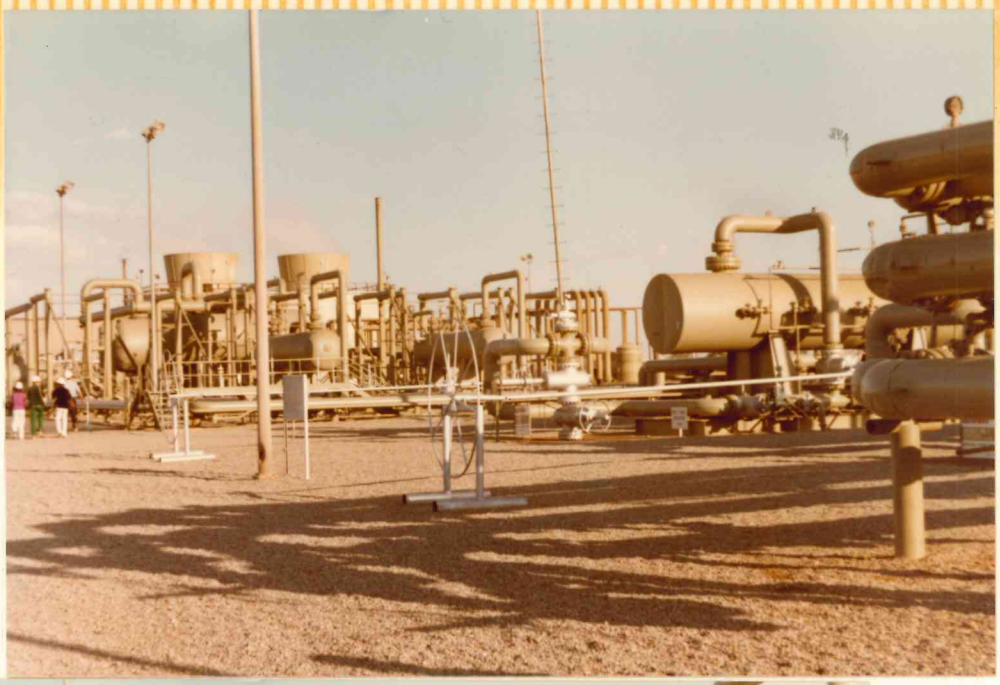
Judging from the mail, your newspaper's editorials are not ignored.

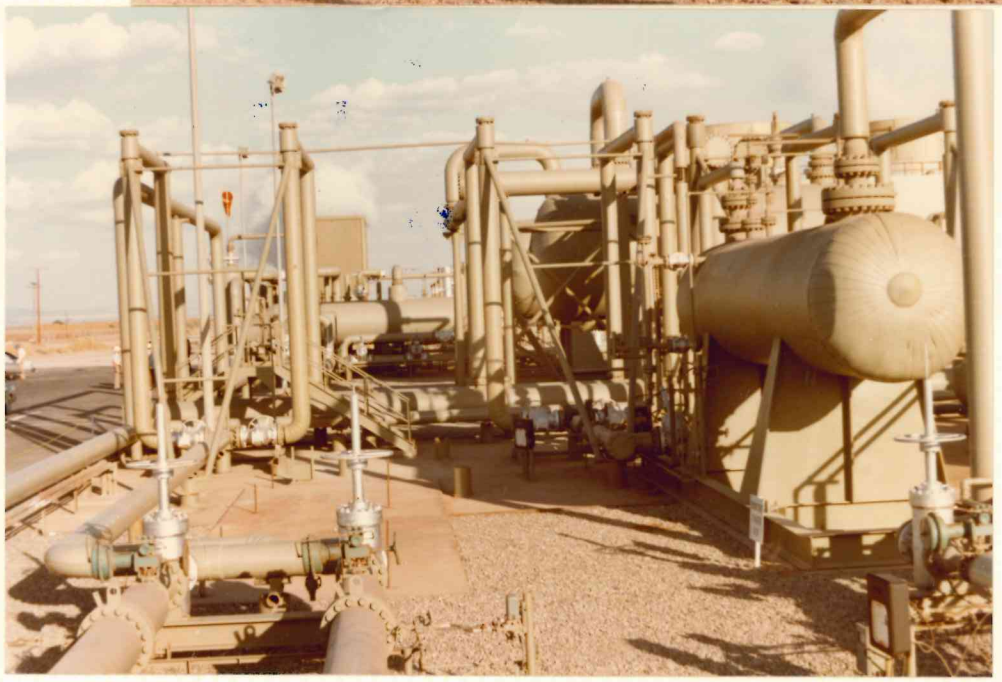
We have been researching the matter of an outlet that will add to the convenience of residents of your circulation area.

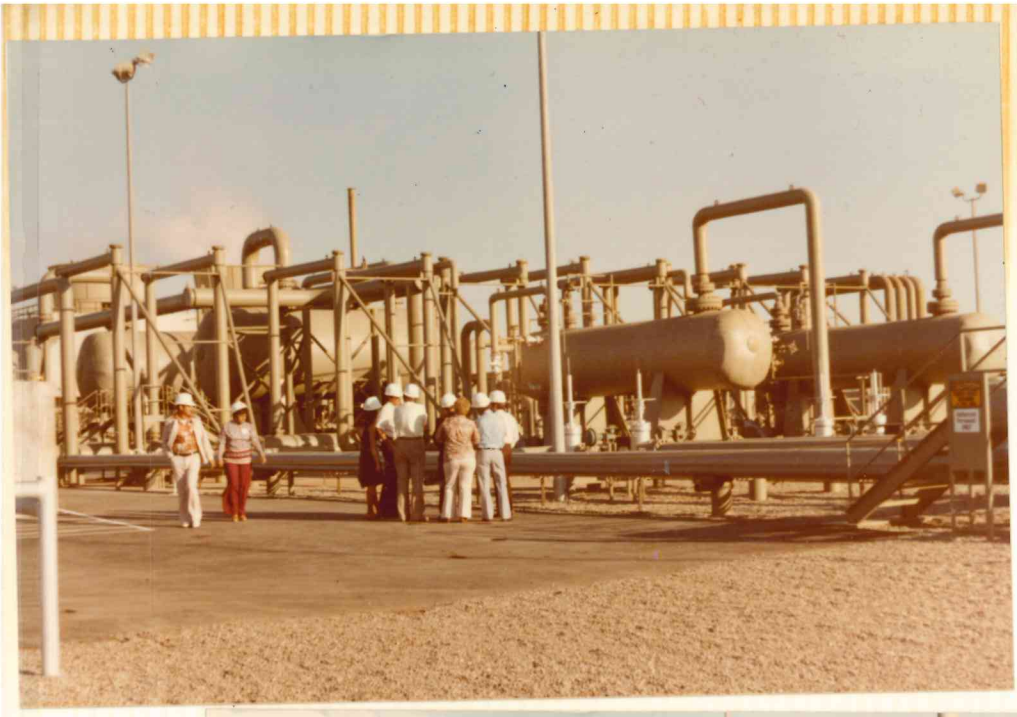
I will be happy to advise you of the conclusions at the earliest possible date.

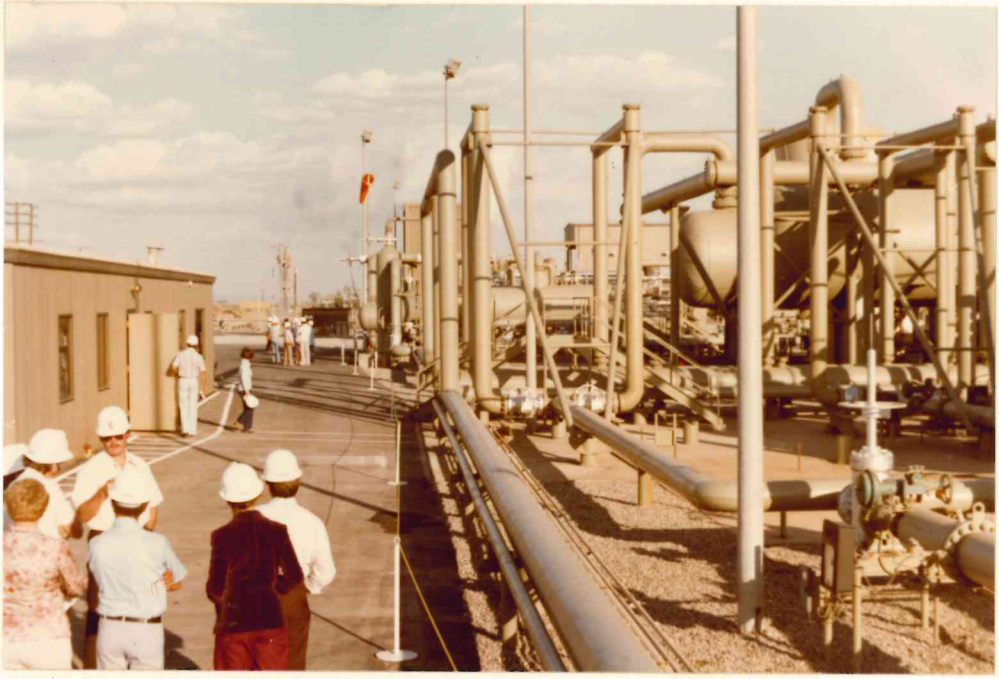
P.K. MACKER,
Ticketron
San Francisco

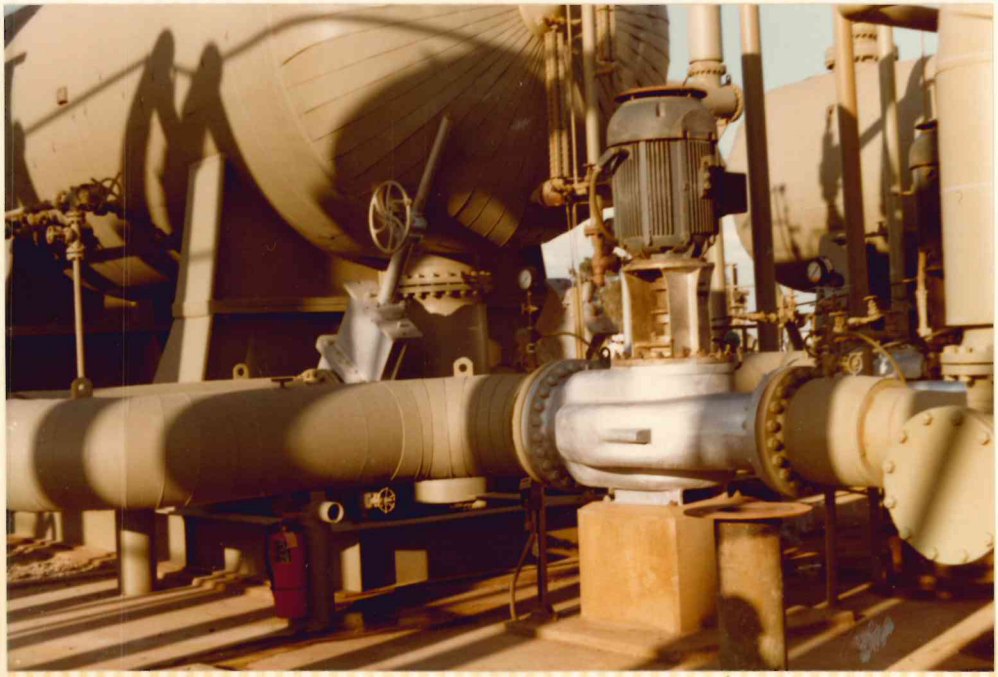
This page and next, the Steam Gathering System as it looked during the official dedication on 15 October 1980. Photos courtesy Bruce Blaikie.











Union Oil Company of California

Union Oil Center, Los Angeles, California 90017

UNION 76

Fred L. Hartley
Chairman and President

December 19, 1980

TO ALL EMPLOYEES:

I am pleased to announce that the Union Energy Mining Division has begun construction of the first phase of the nation's first major oil shale project. The oil shale mining and retorting complex, to be built on our property in Garfield County, western Colorado, ultimately will produce 50,000 barrels per day of shale oil.

The first phase of the project is a 12,500 ton-per-day room and pillar mine and surface retort employing a Union-developed process which will produce 10,000 barrels of shale oil per day. All necessary local, state and federal government permits have been obtained for this first mine and retort.

Union also plans to construct a 10,000 barrel per day raw shale oil upgrading facility. This plant will produce liquid syncrude essentially free of sulfur, nitrogen and residuals and of higher quality than conventional crude oil. A typical modern refinery could convert the synthetic crude into 100 percent transportation products.

Our plans call for the first 10,000 barrel a day retort and upgrading facility to start up in 1983. After a satisfactory commercial test, construction will proceed on additional mines and retorts to bring the facility up to 50,000 barrels per day output by 1987. The ultimate investment for the 50,000 barrel per day complex and allied upgrading facilities will be in the order of $2 billion (in 1980 dollars).

Our extensive research and careful planning assure that we will be able to build and operate this commercial shale oil complex in a manner compatible with the local environment. We will monitor our efforts closely in order to prevent any adverse environmental impact.

Union owns some 20,000 acres of oil shale lands in the Parachute Creek Valley of Garfield County, Colorado. These lands contain two billion barrels of recoverable oil in the high-yield Mahogany zone alone.

Because of the nation's urgent need for domestically produced energy, and in the belief that adequate financial assistance can be negotiated with the federal government, Union is moving ahead as rapidly as possible to construct the first phase.

(This letter, designed primarily for employees, also is distributed to shareholders and others who request it.)

GEOTHERMAL OPERATIONS BEGIN IN SOUTHERN CALIFORNIA

The Union Geothermal Division has begun delivering geothermal energy to Southern California Edison Company at Brawley, in southern California's Imperial Valley. With Edison leaders, government officials and citizens of the area, I had the privilege of participating in the recent start-up of the project along with Ray Burke, senior vice president for Energy Resources and Carel Otte, president of the Union Geothermal Division. This is the first venture to demonstrate the commercial utilization of the Imperial Valley's highly saline (22% solids in solution) geothermal fluids to power an electrical generating plant.

Union Oil produces the geothermal energy from the Brawley reservoir using advanced technology and methods developed by the company. For the account of Edison, we also built the 10,000 kilowatt electrical generating plant at Brawley to utilize the geothermal energy Edison purchases from Union.

The success of the Brawley project will mean that Union has unlocked the secret to harnessing the geothermal energy potential of the Imperial Valley, one of the world's largest resources of geothermal energy. It is potentially capable of powering more than three million kilowatts of electrical generating capacity. Before proceeding on a large scale at Brawley, Union must confirm methods of controlling the corrosion, scaling and injection-well plugging problems associated with the unique Imperial Valley fluids. It is a real challenge and the progress to date is a great credit to our Geothermal Division and the Science and Technology Division.

OFFSHORE TEXAS PRODUCTION BEGINS

Production of natural gas and condensate from the "A" platform on Union's 60 percent owned High Island Block 285 has commenced. Located 85 miles southeast of Galveston, Texas, in the Gulf of Mexico, initial production from seven wells is 60 million cubic feet of natural gas and 160 barrels of condensate per day. The platform is located in 190 feet of water on the 5,000 acre block, which was acquired in a 1977 federal lease sale.

UNION AWARDED GULF OF MEXICO TRACTS

Following the November 18 sale of federal leases offshore Texas in the Gulf of Mexico, Union and its partners were awarded leases on four potential oil and gas tracts for an aggregate lease bonus of $48.1 million. Union's interests in the tracts range from 50 to 100 percent and our share of the cost is $29.3 million.

STEGEMEIER ELECTED TO BOARD OF DIRECTORS

Richard J. Stegemeier was elected a senior vice president, director and member of the executive committee of the board at the December 4 meeting of the board of directors.

Stegemeier joined Union in 1951 as a research engineer following receipt of a Masters Degree in petroleum engineering from Texas

A & M. He has served in a wide variety of management positions including vice president and general manager of our Indonesian exploration and production activities. He was elected a corporate vice president in June 1978 and president of the Union Science and Technology Division in January 1979.

In his new capacity as senior vice president, corporate development, Stegemeier will have responsibility for the Union Science and Technology Division, the Union Energy Mining Division, corporate engineering and construction and a new strategic planning function.

DIVIDEND AND EARNINGS

On December 4, Union's board of directors declared a dividend of 20 cents per share on the company's common stock. The dividend will be payable February 10, 1981, to shareowners of record January 9, 1981.

For the third quarter of the year, Union reported earnings of $122 million, up 15 percent from $106 million in the same period the previous year. Per share earnings were 71 cents compared to 61 cents in 1979. Nine month earnings were $469.8 million, up 35 percent over $348.3 million last year. Per share earnings for the nine months were $2.71 in 1980 versus $2.00 in 1979.

OFFSHORE THAILAND GAS FIND

An exploratory well drilled in the Gulf of Thailand in October was followed in November by a successful confirmation well.

The discovery well, Satun No. 1, tested at a combined rate of 28 million cubic feet of natural gas and 700 barrels of condensate per day from three zones between 6,962 and 8,360 feet. Satun No. 2, five miles to the north, flowed at a combined rate of 18 million cubic feet of natural gas and 575 barrels of condensate from two zones between 5,730 and 6,206 feet. Log analysis indicated that several additional zones in the well will also be productive.

Satun No. 1 and No. 2 were drilled by Union's wholly-owned subsidiary, Union Oil Company of Thailand, on contiguous blocks in which we have 80 and 60 percent interests respectively. Located about 100 miles offshore, the discovery well is about eight miles northeast of the Erawan gas field where Union of Thailand is scheduled to commence production during the latter part of 1981.

A third well, located eight miles south of the discovery well, is currently being drilled to further evaluate the structure.

UNICRACKING/HDS TECHNOLOGY LICENSED IN TAIWAN

Union's Science and Technology Division has sold its Unicracking/HDS petroleum refinery process technology to the Chinese Petroleum Corporation in Taiwan.

The sale involves the licensing of a 30,000 barrel per day Unicracking/HDS plant at Chinese Petroleum's Kaohsiung refinery.

Continued . . .

Unicracking/HDS is a Union Oil-developed refinery process for the direct removal of sulfur from high sulfur, heavy feedstocks which have become an increasingly larger part of the available sources of crude oil worldwide. The plant for Chinese Petroleum is designed to convert the mixture of high sulfur residual stocks to low sulfur fuel oils which are more environmentally acceptable.

Including this new project, Union has now licensed four Unicracking/HDS projects in the United States and three foreign countries with a combined capacity of 231,000 barrels per day.

Union also has licensed to Chinese Petroleum technology for a Beavon Sulfur Removal Process unit which removes sulfur from refinery waste gas and two Popcorn Sulfur plants which convert molten sulfur into granular sulfur for agriculture use.

SEARCH FOR GEOTHERMAL ENERGY IN JAPAN

Union Geothermal Japan, Ltd., our wholly-owned subsidiary, has entered into a basic agreement to explore for and develop geothermal energy resources in certain areas of Japan. Union's subsidiary will be operator for the venture which includes two Japanese companies.

Union will explore for geothermal energy resources in the Dohtoh area, approximately 180 miles northeast of Sapporo on the island of Hokkaido. The agreement also provides for exploration by Union in another area to be determined by the venture participants. If the exploratory venture is successful, production facilities will be constructed and the geothermal energy resource will be sold to utilities for use in electrical generating plants.

HOLIDAY GREETINGS

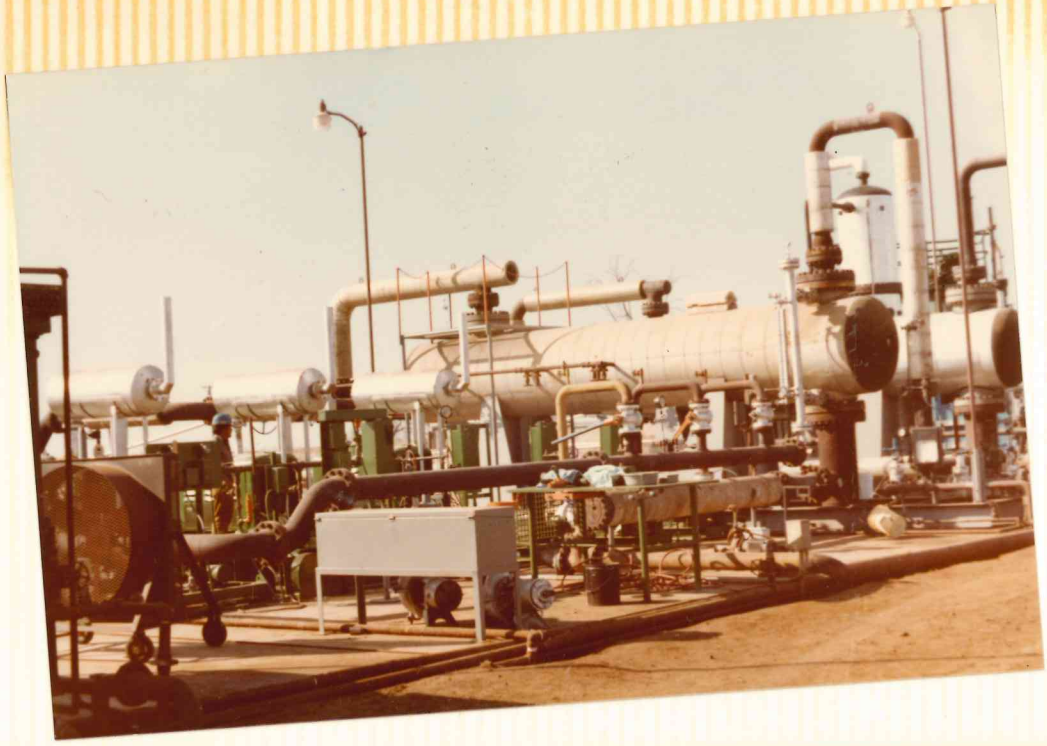
This is normally the time for review and projection--review of the year past and a projection of our hopes and desires in the year ahead. For Union Oil, 1980 was another year of growth and success for our company, due in large part to the dedicated efforts of all Union Oilers. For those efforts, I thank you.

More importantly, we look forward to another year of challenge--to our company and our country. These are disturbing times and I know that each of us will dedicate his and her talents and imagination toward successful resolution of the many problems.

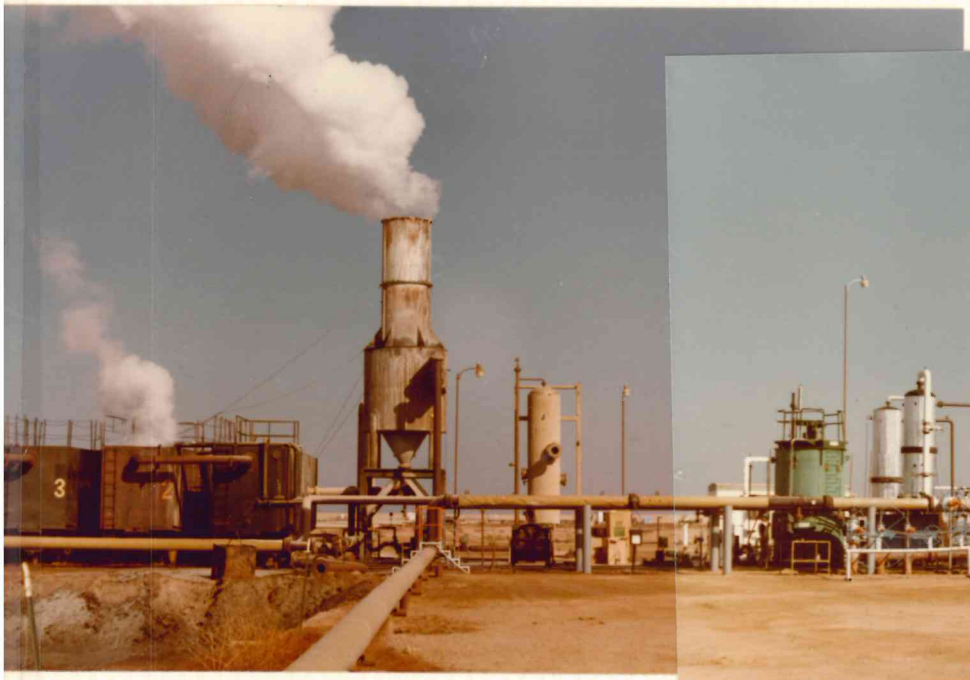
In the spirit of the season, I wish good health and happiness and fulfillment of dreams to all. May 1981 be a year of good cheer.

Sincerely yours,

Fred L. Hartley



The next Imperial Valley Geothermal development will be at the Salton Sea Field on the Southeast edge of the Salton Sea. These photos show the test facility in operation there during October, 1980. Photos courtesy of Bruce Blaikie.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2

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UNION 76

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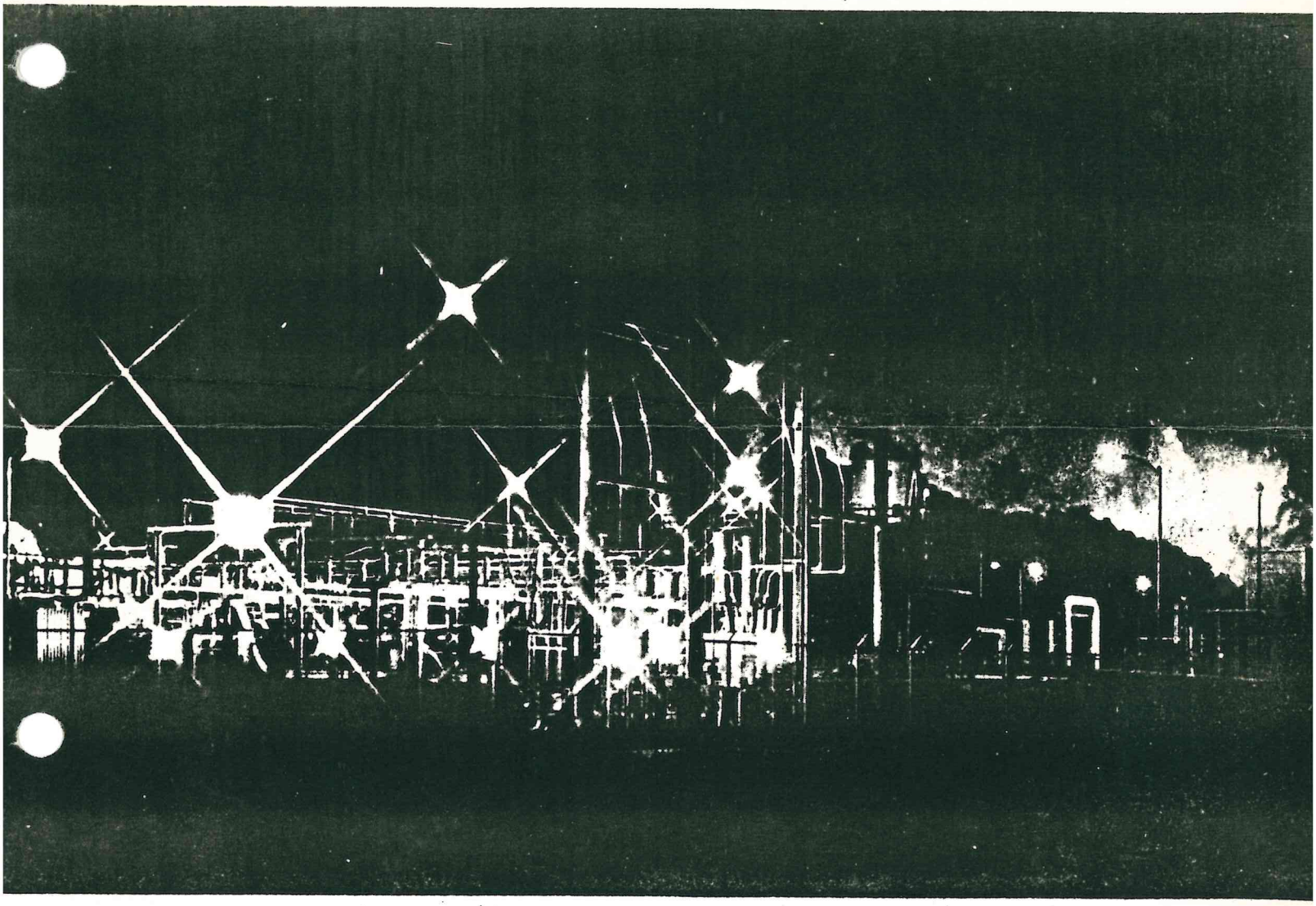

IGHT-TIME DISPLAY — Lights enhance the geothermal power plant orth of Brawley where the turbine Tuesday was turned for the first time y geothermal power. The plant is a $20-million joint venture by Union Oil o. and Southern California Edison and will be generating 10 megawatts of electricity into the Imperial Irrigation District system in about weeks, if the "shake-down" is deemed a success. Union began geotherr exploration in the area north of Brawley about seven years ago — r brilliant lights mark the spot. (Staff photo by Coleman Ce

Geothermal plant at Brawley tested

By NADINE RIVERA
Staff writer

The turbine was activated at 2:45 p.m. iesday at the geothermal power plant rth of Brawley to mark several firsts r the Valley, the nation, Union Oil ompany and Southern California dis

The test run represented:

—The first flash system in operation the Valley.

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—And the first domestic hot water stem for Union, which operates a milar facility in the Philippines.

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production superintendent, Walter E. Nellis believe the brine solids will be the biggest problem at the Brawley plant.

"We know we can make it work. But can we do it constantly?" Nellis asked. "We are aiming for the highest possible on-line efficiency." The plant is an experimental facility for this reason.

"We'll find out if it works after about three weeks of operation," Cedillo stated.

Union is counting on a system of back-ups to beat the brine build-up. If one unit is out of operation, the system is switched to another, Nellis explained.

Plans Tuesday were to run the turbine at about 500 RPM for about an hour and then to rev it up to 3,600. "This is just a 'shake-down'," Scholz explained, "as power plants aren't new." It's the use of geothermal energy that's being tested.

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PERIAL COUNTY SINCE 1903
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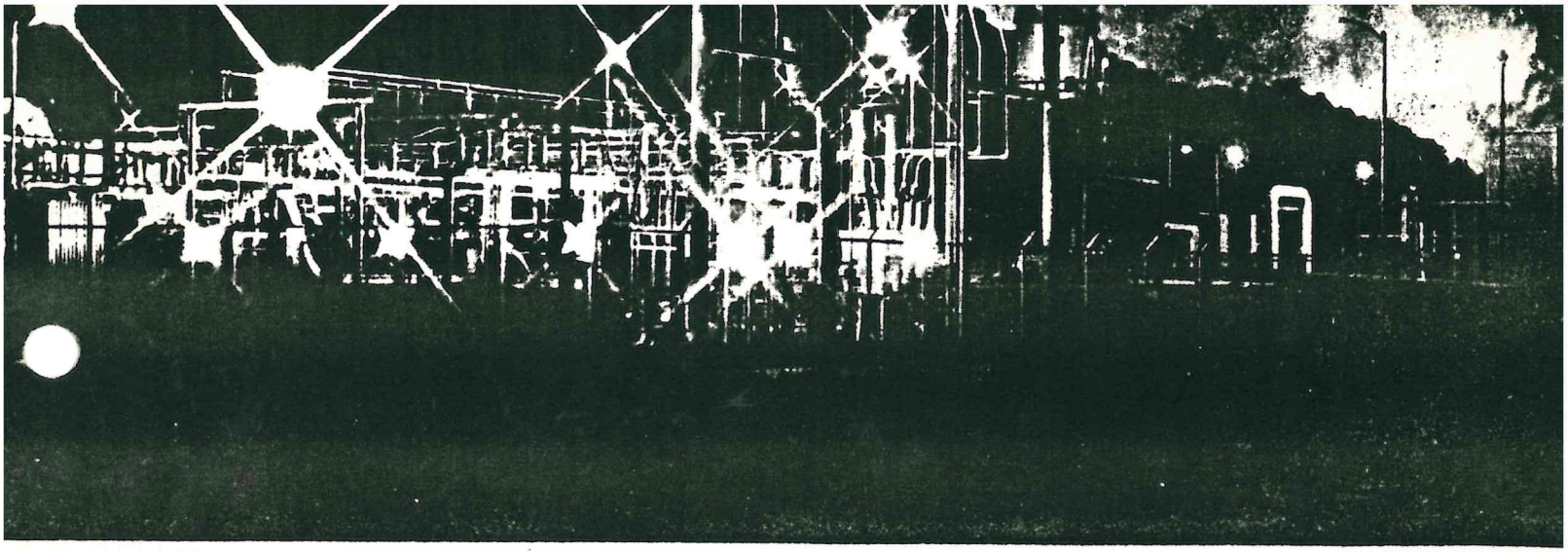
20 PAGE



NIGHT-TIME DISPLAY — Lights enhance the geothermal power plant north of Brawley where the turbine Tuesday was turned for the first time by geothermal power. The plant is a $20-million joint venture by Union Oil Co. and Southern California Edison and will be generating 10 megawatts of electricity into the Imperial Irrigation District system in about weeks, if the "shake-down" is deemed a success. Union began geother exploration in the area north of Brawley about seven years ago — brilliant lights mark the spot. (Staff photo by Coleman Ce

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El city was produced in January t Magma-San Diego Gas and lectric geothermal installation on the ast Mesa. However, the plant is now own for adjustments, according to utch Scholz, Imperial County eothermal co-ordinator. However, the ast Mesa insallation utilizes a binary ystem.

Scholz predicted that the Brawley lant has a higher probability of success, s Union has tested the flash system through which the steam is produced by owering the temperature of the eothermal fluid, in the Geysers in lorthern California.

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When in operation, the generator will feed about 10 megawatts of power into IID transmission lines from an adjacent switching station. Power generated will serve a city of approximately 10,000 — a little better now because of energy conservation."

Union has three on-site production wells with two reinjection wells and two stand-by injection wells for residue.

Union, which also has land leased in five or six major areas in the county, began exploration in the area north of Brawley about seven years ago. Cost estimates and design for the present installation were begun in September, 1978, Nellis explained.

Both Union and SCE have in the neighborhood of $10 million invested in the Brawley venture.

THE BRAWLEY NEWS
SERVING NORTH IMPERIAL COUNTY SINCE 1903
BRAWLEY, CALIFORNIA
WEDNESDAY, JUNE 18, 1980
20 PAG
UMBER 224

Union Geothermal Division

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UNION 76

Jan 29, 1981

Dearest Dickie,

We just had to send you this picture and tell you all about Sunday, the 25th of Jan.

The Board of Directors of Union Oil came down for another tour of the Steam Gathering System. Everything went well and as you can see, we, Sandra & I were the ones to greet everyone and serve the refreshments. It was in the morning hours, 10:30 AM, so the lay out was coffee, doughnuts, rolls etc.

Anyway, what we wanted to really tell you, is Fred Hartley took this picture of us and stayed and talked to us for awhile. Since we are now good friends with Fredie, (Ha! Ha! Sandra says this!) we just had to send you this and tell you that we sure miss you and hope to hear from you real soon. When you get ready to come back to Union Oil

Just tell us and we'll put in a good word for you with Jodie! HA! HA!

Miss ya always!

Linda
Sandra

P.S. Everything & everyone is okay here! Ok latest news Debbie Maxwell is a week pregnant she is due in the middle of Oct. so she says see what we have to put up with!

P.S.S. Hope you & Alan are fine and doing well!

where we work

The THUMS islands have been mistaken by some for plush, offshore apartments that afford a commanding view of Long Beach, Ca. Other visitors to the port have thought the islands to be a luxurious, first-class tourist spa. In actuality, however, THUMS is an acronym for Texaco, Humble (now Exxon), Union, Mobil and Shell, the companies which operate the offshore, man-made oil production facilities.

It was at THUMS that newly hired Union Oil technical employees assigned to either summer or permanent positions in California gathered during the second stop of an orientation day.

During the day-long program, the new employees first heard a welcoming talk at the Union Oil Center in Los Angeles by Fred L. Hartley, chairman and president of the company. Subsequently, they visited the Los Angeles Refinery before boarding buses that took them to the waterfront where they proceeded by boat to THUMS.

Among the highlights of the day were extensive explanations of all facets of the company's research operations by key research personnel. In the evening, the new employees attended a barbeque at A.C. Rubel Park in Brea, where they heard presentations and met with other key Union Oil executives and managers.

Ray A. Burke, senior vice president, energy resources, receives award lauding Union Oil's geothermal field at The Geysers from Marcelle Moreno, president of Geyserville Chamber of Commerce, in Sonoma County, Ca.

Geothermal Project Honored

MORE THAN 260 LOCAL BUSINESS and civic leaders honored Union Oil Company of California for the company's accomplishments and contributions over the past ten years as operator of The Geysers geothermal field in Sonoma County.

The tribute to Union was sponsored by the Chambers of Commerce of Santa Rosa, Cloverdale, Geyserville and Healdsburg.

Keynote speaker for the evening was Ray A. Burke, Union Oil Company senior vice president, energy resources. Dr. Carel Otte, president of the Union Geothermal Division, the company unit which operates The Geysers geothermal field, also spoke.

Burke was presented with a joint resolution from the sponsoring chambers, praising Union's record at The Geysers. It cited the company's technological and scientific achievements in developing The Geysers geothermal field, making it the world's largest producer of geothermal energy, and the source of many technical achievements now in use throughout the geothermal industry.

The resolution also noted that The Geysers project had grown to the point where in 1978 it will contribute nearly $40 million annually to the Sonoma County economy, providing a beneficial stimulus to employment, local commerce and public funds.

In his opening remarks, Burke paid tribute to the Chambers and the community, saying, "We are proud of our own skilled people who have increased the production level of this unique energy resource tenfold in the past ten years. But we also realize we owe a great deal to the business, civic and community leaders of Sonoma County who have made it possible for us to work in a friendly and supportive environment."

"Flash"

When are you going to leave that cold place and return to where it is warm?

How is school? Learning anything?

We tried to auction off your hard hat, but no one was buying.

They are getting ready to build the "SSP-S.G.S." - Do you want in on that?

Enough questions for now. Study hard and make us proud of you.

Your "Bird-Dog"

Paul E. Holmes

MAR 06 1981

PAUL E. HOLMES

3-6-81

Dearest Mike,

Sure wished you were around right now! Really could use your master mind to straighten Maxwell out. I know he can't be as dump as he acts, but if he is well! Walt, Maxwell, and I had a meeting Tuesday and I came out ahead on that did I. He has been trying to change everything in here, its not the change I minded, it was all wrong and I showed Walt & he ~~agreed~~ said so. You taught me well and I will always be internally greatful. Youre the greatest and I know I'm not alone in saying, we all miss having your person & personality around. I'm getting tired of keeping this place alive. A matter a fact I got call on the carpet a couple of times about it, but it did last long, because I always have my work done.

I'm going to school at nights now, because I don't have anyone to teach me anything so I better learn my self. I'm taking Math 1A

which is algebra + basic math and Computer programming in Cobol. They didn't offer Fortran this semester. I was taking Spanish, but Walt talk me out of that, because 3 nights a week + full time job + my son is alittle too much.

Well, Sandra says Hi! and tell you she isn't good a writing letters, so she leaves it up to me.

Say Hi to Alain and hope everything is going well for you both!

God Bless you!

Linda

your faithful student!

3/5/81

Mike & Elaine

It seems like you've only been gone a month or so but it's been Five Months. Things here aren't quite the same, especially in Linda's office. She & Ron have had sessions (closed door) with Walt twice and another by themselves this week. It's Thursday, that makes only one day without a confrontation and I'm not sure of that. — For the record - they're both stubborn and neither is faultless — The plant is being converted to a low temp.. injection system. First shut down (for cleaning, brine and...) I was in Jan. It was full of sludge. took 200 Vac trucks of the stuff to IT Dump at a cost of $75K or so — This time after 35 days of approx 7.5 MW, we had another 200 Vac trucks to haul - This time a cost of $50K — We now have an AFE for a Super duper pooper Scooper (ODW Design) to suck sludge off of the pond bottom. Greg is renting a thickner, We're getting a centrifuge, a hydro cyclone system a filter press. and lots more stuff to prevent 35 day periodic shutdowns -

We had a serious accident ~~last~~ two weeks ago - I was on the investigation committee. One of the good things we found was a remnent of MVdP - ~~taped~~ taped to the phone was a slip of paper with all the emergency numbers, nice & handy - The Ambulence took 8 min and the Fire dpt Rescue teame took 3 min - Oh by the way - Nick Wendell fell into some hot brine & will require extensive skin grafts on shins and ancles of both legs. Ramiro Garcia has had a graft to his left ancle.

Things have been real intresting - Construction of the SCE SS Plant has started. We've been testing crystalizers and a clarifier at the Salton Sea (last mo). Dave & Dennis are in Boisey Id Designing the SGS for SS. We now have a Sr. Engineer - from Chicago Refinery (65yrs or so), A Civil Engr $ Expect to get Dave Holligan this month. The land Dpt is moving to the Golden Que (after they remodle) they will have room for the geologests there too.

I'm enclosing some photos of the plant at dedication. It was beautiful and I know you'd never believe it without pictures. I've also got some pictures of the PBTF - Pilot Brine treatment facility at the SSP - Dove did a fine job putting it together.

Also enclosed will be the covers for the Brawley Plant. Hope you can do something with them.

I enjoy hearing from you. I'm a lousy letter writer. Let us know when we can expect you back - We'll start construction of the SS SGS in ~~October or~~ Nov or Dec - Should be getting the separators first this time.

Also enclosing the check I promised - for the wedding quilt if you're forgotten - Get yourselves some corell ware. I think $45 should cover it and I won't have to ship it.

Weather here is great.

Hope yours isn't too bad

Until the next time Bruce

UNION OIL COMPANY OF CALIFORNIA · 1980 ANNUAL REPORT

UNION

crude oil produced in Canada. Further, effective January 1, 1981, the tax is not a deductible expense for Canadian federal income tax purposes. As a result of this unbelievable taxation policy and other proposed provisions of the new federal budget and National Energy Program, Union of Canada is facing a drastic reduction in net earnings and cash flow. Exploration and production programs in Canada therefore have been reduced to an absolute minimum.

Union Geothermal Division

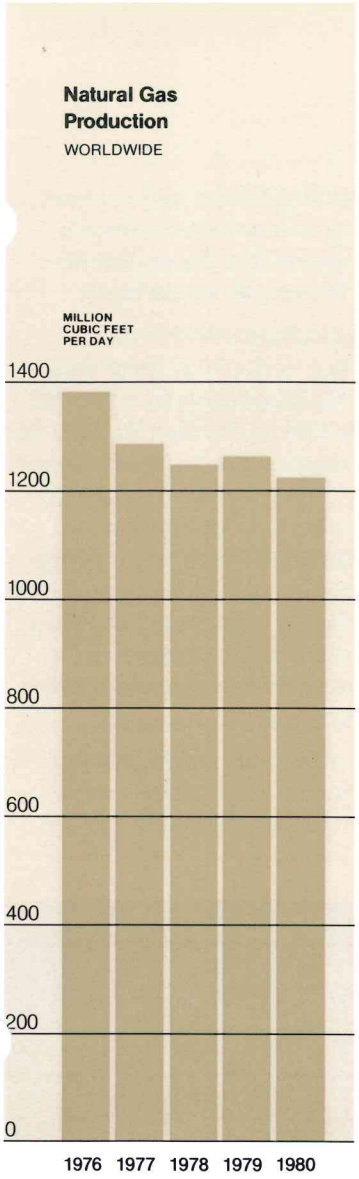
Union Oil Company is the largest producer of geothermal energy in the world. It supplies steam for 1.2 million kilowatts of electrical generating capacity on-line in the United States and the Philippines.

Union has a half interest in, and operates, a geothermal development project at The Geysers in northern California. Union-produced steam from The Geysers field powers 13 electrical generating units, operated by a public utility, with an aggregate capacity of 746,000 kilowatts. Two other Union-supplied plants, each to be 110,000 kilowatt capacity, are under construction with startup planned in 1982 and 1983.

Operating under an agreement with the Philippine government-owned National Power Corporation, Union is developing two major geothermal fields on Luzon Island. At Tiwi, four units have a current capacity of 220,000 kilowatts, with another 110,000 kilowatts under construction and more units planned. At Bulalo, present capacity also is 220,000 kilowatts, with more units planned.

A significant geothermal milestone was achieved in the Imperial Valley of California in 1980 with the completion of the 10,000 kilowatt Brawley geothermal-electric project. It is the first venture to demonstrate the commercial utilization of the Imperial Valley's highly saline geothermal fluids to power an electrical generating plant. In this project, geothermal fluids are brought to the surface under pressure, and the pressure reduced to allow a portion of the fluid to flash into steam. The steam is sold to a public utility to power its generators.

It is Union's first step in the development of the Imperial Valley geothermal resources.



Another 10,000 kilowatt demonstration project near the Salton Sea is currently under construction and scheduled to begin operations in 1982. Successful operation of these projects will mean that Union can harness the geothermal energy potential of the Imperial Valley, termed the "Saudi Arabia" of the world's geothermal energy resources. These are potentially capable of powering more than three million kilowatts of electrical generating capacity.

A geothermal resource at the Baca project in New Mexico is being developed by Union and a public utility in cooperation with the U.S. Department of Energy. The first plant of 50,000 kilowatts is scheduled for completion in late 1982, subject to the permitting process.

In November of 1980, Union Geothermal Japan, Ltd., a wholly-owned subsidiary, entered into an agreement to explore for and develop geothermal energy resources in certain areas of the island of Hokkaido, Japan, with two Japanese co-venturers.

Union Energy Mining Division

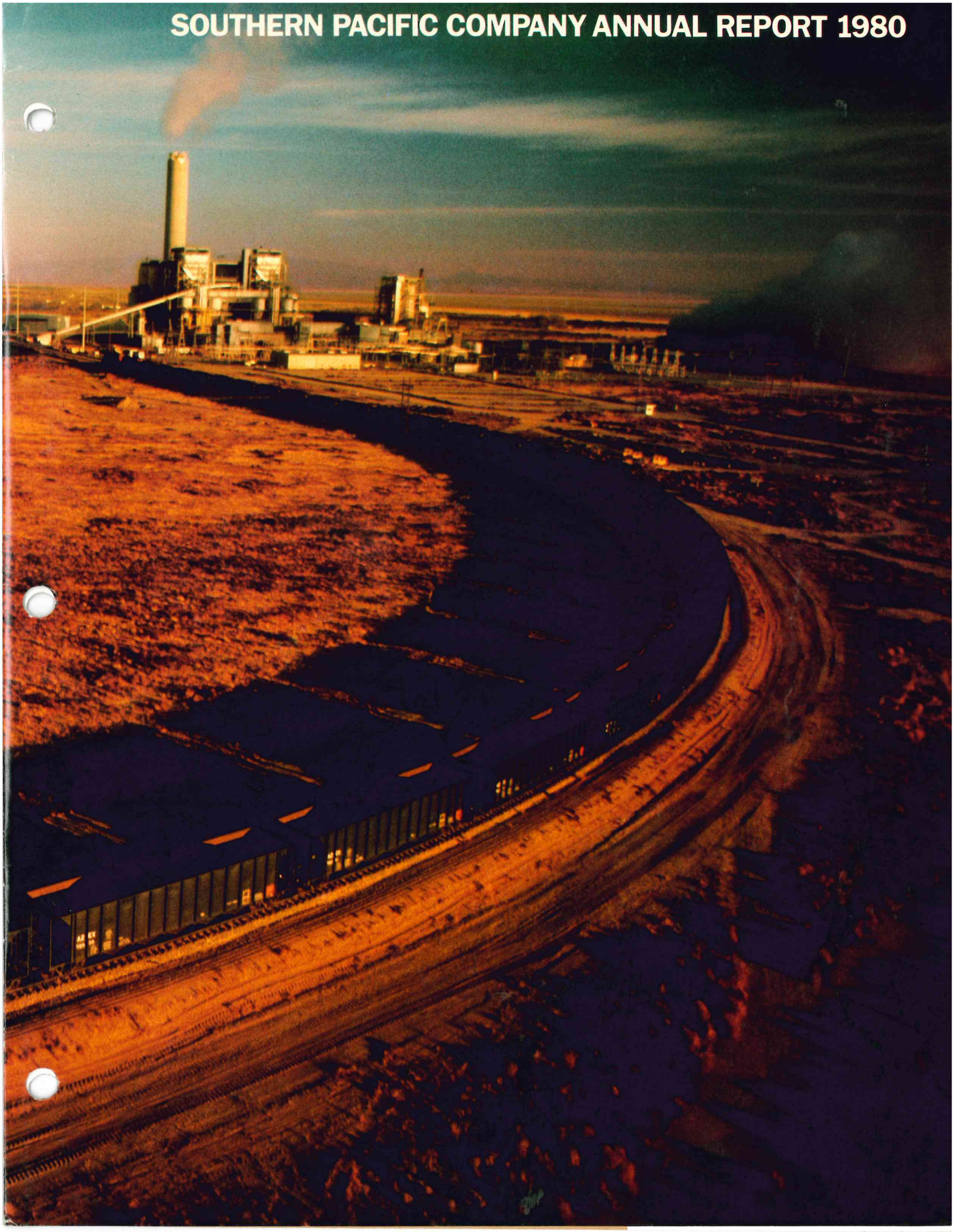
The Energy Mining Division is concerned with producing energy from sources other than conventional petroleum and geothermal. Primary interest is in oil shale, uranium and coal.

By far the largest and most important resource to Union is oil shale. During 1980, we began work on a 50,000 barrel a day shale oil production facility in Colorado. This is the first major shale project to get underway in the country. The project is being planned in two phases. Phase I will consist of a 12,500 ton per day mine and

The 10,000 kilowatt geothermal demonstration project at Brawley, California, (left) is the first commercial system in the United States to use concentrated geothermal brines to power electrical generators. A wellhead and a brine-steam separator are in the foreground.

The Alkylation Unit at Los Angeles Refinery (right) makes a main gasoline component. Improvements to this unit in 1980 enable Union to produce higher quality unleaded gasoline.

SOUTHERN PACIFIC COMPANY ANNUAL REPORT 1980



REAL ESTATE AND NATURAL RESOURCES

Last year Southern Pacific's land subsidiaries generated a record $62.4 million in operating income from the management of real estate and natural resources.

Since 1975 the land subsidiaries' combined operating income has multiplied at a compound annual rate of 22 percent. A significant portion of this income has been generated by the development and sale or lease of industrial park properties. Southern Pacific Industrial Development Company (SPIDC), which coordinates these activities, had another outstanding year in 1980, contributing $27 million in lease revenues and property sales. It added 324 new rail users to the thousands of customers already located on Southern Pacific's rail system. SPIDC manages 70 industrial parks, system-wide, and directed the expenditure of $12.9 million in "ready site" improvements to 1,120 acres of new or expanded industrial properties owned by the SP family.

Rental income from some 21,000 SP-owned commercial and industrial properties rose 16 percent to $34.1 million in 1980, which included $2.2 million generated by SPIDC. Most of the increase resulted from annual cost-of-living adjustments in lease payments. One of the Company's largest and busiest rental properties is the Los Angeles Union Terminal, located on 40 acres of SP land near downtown Los Angeles. The nine-building complex serves as the city's wholesale produce terminal and trading mart.

Southern Pacific Development Company (SPDC), co-owner and co-developer of the New Orleans Hilton Hotel and Los Angeles Pacific Design Center, commemorated its tenth year in business last July by breaking ground for the $68 million Pacific Gateway office building in San Francisco. SPDC is managing partner, leasing agent, operator and 50 percent owner of the 30-story high-rise. Although Pacific Gateway is not scheduled for completion and occupancy until 1982, its office floorspace is already fully leased.

Among the major projects under consideration by SPDC for 1981 is the construction of a shopping center in Fresno, development of a $45 million office complex in North San Jose, the addition of a 436-room waterfront annex to the New Orleans Hilton, and a proposed mini-village of condominiums, shops and parks on 38 acres of SP waterfront property in Tiburon, California.

Included in Southern Pacific's portfolio of properties are several million acres of agricultural, timber, and mineral resources—resources Southern Pacific Land Company is developing to the maximum extent consistent with sound conservation practices.

In 1980 SP's 160,000 acres of irrigated farmlands generated a record $16 million in rental income and crop receipts.

SP's 90 percent-owned Pacific Metzler vineyards, now in its seventh year of commercial production, produced 26,500 tons of wine grapes in 1980 compared to 18,200 tons in 1979.

Sales of scrap logs, or "culls," to paper manufacturers contributed $2 million of the $26.7 million in timber sales recorded by Southern Pacific Land Company in 1980. Prices paid for timber by loggers and lumber mills declined for the second straight year due to the continuing slump in housing construction. For the past several years, in good markets and bad, SP has harvested a "sustainable" 140 million to 150 million board feet annually, while embarking on an intensive forest management program in which approximately $10 million will be invested over ten years. As a result of this conservation program, the sustainable yield from our 450,000 acres of pine and fir is expected to reach about 165 million board feet by 1985.

GEOTHERMAL POWER
Near California's Salton Sea, Southern Pacific and its joint-venture partners, Union Oil Company and Mono Power Company, are researching environmentally sound techniques for harnessing one of the world's least utilized energy sources. At this test facility, superheated brine from geothermal wells is purified and "flashed" into high pressure steam. The steam, seen here being vented into the atmosphere, may eventually be used to drive the turbines of a 10-megawatt electric power plant, which is expected to be built by Southern California Edison Company in 1982.

YOU KNOW THAT YOU HAVE BEEN IN IMPERIAL VALLEY TOO LONG WHEN:

YOU EAT THE FISH THAT YOU CATCH IN THE NEW RIVER

YOUR IDEA OF GETTING SOME FRESH AIR IS A TRIP TO THE FEED LOT

YOU'RE CROSSING THE BORDER BACK FROM MEXICALI TO CALEXICO AND THE GUARD JUST WAVES YOU THROUGH

YOU VOLUNTEER TO PUSH THE FROGGING BOAT AND YOU AREN'T EVEN DRUNK YET

YOUR AIR CONDITIONER QUITS IN JULY AND YOU AREN'T IN ANY HURRY TO GET IT FIXED

THE TEMPERATURE DROPS TO 75 DEGREES AND GRAB FOR THE ELECTRIC BLANKET

YOU START TO COMPLAIN THAT THE HOT SAUCE IS TOO MILD

YOU REALIZE THERE IS A TELEPHONE COMPANY IN THE AREA

YOU BEGIN TO SPEND THE WEEKENDS AT HEBER BEACH SUNNING YOURSELF

YOU START TO BUILD A CRICKET FEEDER IN YOUR FRONT YARD

YOU DON'T MIND DRIVING YOUR NEW CAR TO MEXICALI

YOU STAY UP ALL NIGHT BECAUSE YOUR PET BLACK WIDOW SPIDER IS SICK

THE HIGHLIGHT OF YOUR DAY IS WATCHING THE SMUT CLOUDS FROM THE FEED LOTS ROLL IN

YOUR IDEA OF A GOOD TIME IS TO WATCH THE CARTOONS IN SPANISH

THE AMERICAN OFFICIALS ASK YOU TO ACT AS AN INTERPRETER TO THE MEXICAN GOVERNOR

YOUR IDEA OF RIGHT NOW IS SOME TIME IN THE NEXT EIGHT WEEKS

THE TEMPERATURE HITS 110 DEGREES AND YOU'RE THANKFUL FOR A COOL DAY

YOU COMPLAIN BECAUSE THE HUMIDITY IS UP TO 39%

YOU PLANT FLOWERS JUST TO SEE HOW LONG IT TAKES THEM TO DIE

YOU GIVE UP DUSTING FURNITURE ONCE A DAY AND START TO SHOVELING ONCE A WEEK

YOU NO LONGER WONDER WHY THE RADIO STATIONS ALL SIGN OFF AT SUNSET

YOU CARRY WATER TO THE MOUNTAINS BECAUSE THE WATER UP THERE TASTES FUNNY

YOU THINK SALTON SEA IS A GOOD PLACE TO SPEND THE WEEKEND

YOUR IDEA OF A GOOD BREAKFAST IS A BEAN BURRITO AND A CAN OF BEER

YOU WONDER WHY ANY COUNTY FAIR WOULD BE HELD IN MONTHS OTHER THAN JANUARY OR FEBRUARY.

Union Oil Company of California

Union Oil Center, Los Angeles, California 90017

UNION 76

Fred L. Hartley
Chairman and President

November 10, 1981

TO ALL EMPLOYEES:

Union Oil Company's net earnings for the three months ended September 30 were $193 million, a 58 percent increase over the $122 million earned in the third quarter of last year. Earnings per share were $1.11 compared with 71 cents in 1980.

Substantially improved domestic refining and marketing earnings resulted from improved margins and lower raw material costs. Higher domestic oil and natural gas revenues also were a major factor. And of course Union's accelerating investment program is basic to the growth of the company.

Earnings for the first nine months of the year were $555.4 million compared with $469.8 million in the same period last year, an increase of 18 percent. Per share earnings for the nine months were $3.20 in 1981 versus $2.71 in 1980. Nine months results in 1981 include an after tax capital gain of $24.4 million on the sale in early May of our stock interest in Magma Power Company.

Higher domestic oil, natural gas, geothermal and chemical revenues were principal contributors to the improved nine months earnings.

The company's earnings for the nine months registered the highest percentage gain among the 20 largest oil companies, and the second largest for the third quarter.

Total revenues for the third quarter were $2.87 billion this year, compared with $2.63 billion in 1980. For the nine months, revenues were $8.31 billion in 1981, compared with $7.76 billion last year.

Continued...

(This letter, designed primarily for employees, also is distributed to shareholders and others who request it.)

Hi Mike! 10-15-81

How are you doing? Just writing a short note while I have time. It's the same old thing around here. Guess what! Linda isn't working here anymore. She quit! Well She transferred. Her last day here was Sept 30. She got tired of the Imperial Valley & guess and her job. Well you know Bruce and General Austin. They were on her case all the time. She's now working in the San Diego office. We've got a new girl now her name is Jane. She just started on Monday.

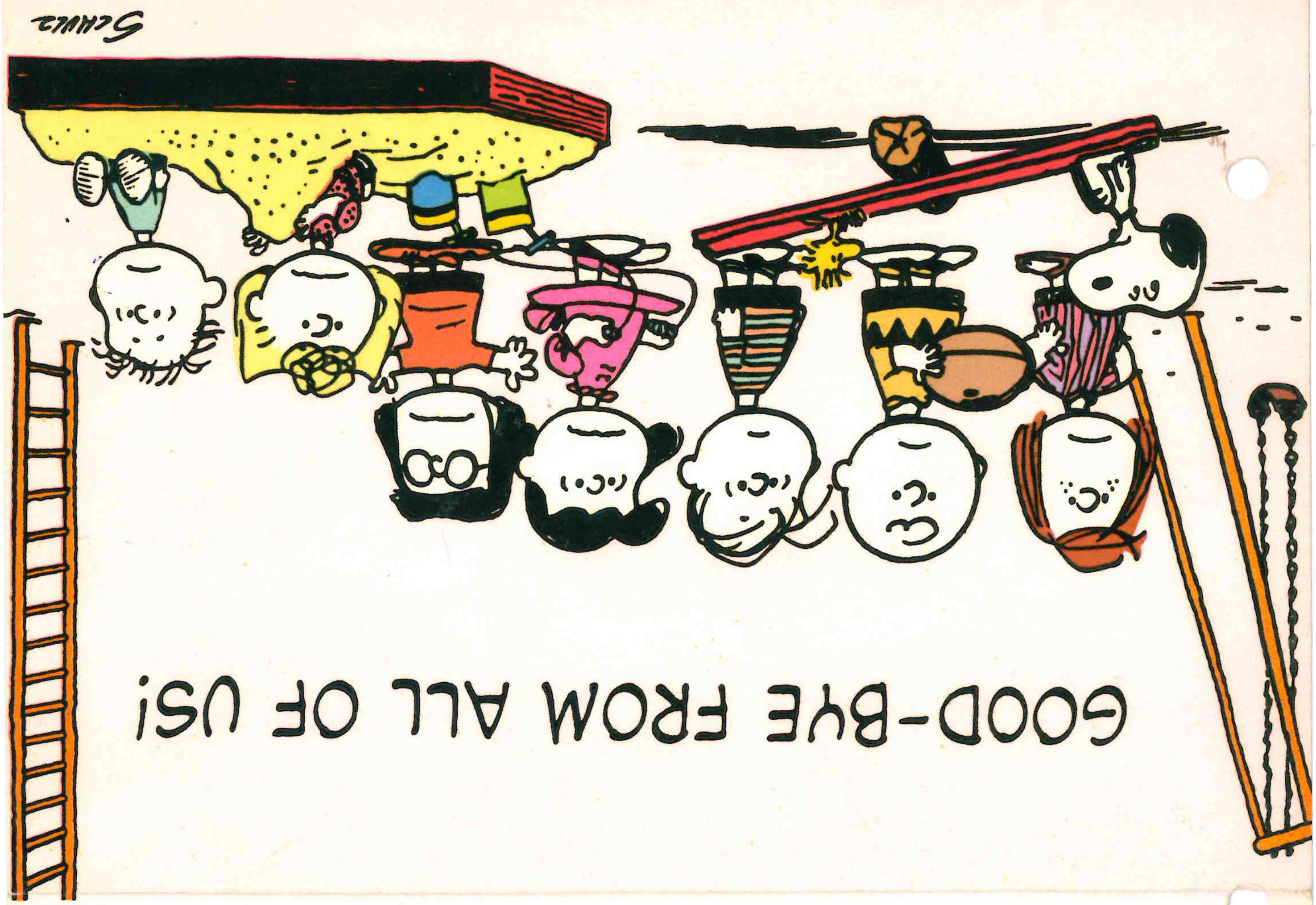
It's been terrible around here. No one to pay the bills. Sandy went on Vacation to Hawaii (life must be rough) just 2 weeks ago. (she's back now), Paul broke his hip about 3 weeks ago playing football (he should be back next week) and then Linda left. So there was no one to do all that work.

SGS has been down for at least a month because of a ruptured Valve or something. It blew up. And SS's new Office building should be done by next month. We're still waiting for our new building.

Well, take care & say hi to Elaine

Bye -

Sandra



TRIP & TRAVEL

Hallmark

75M 920-8
HALLMARK CARDS, INC.
MADE IN U.S.A.

Keep in touch. Best of luck. Larry

Good Luck
Pablo S. Gutierrez

Come 'n see my new stamps
Bruce

Best of Luck, study hard!
Ron Maxwell

Bart Grimm

THE OLD PLAYGROUND
JUST ISN'T THE SAME
WITHOUT YOU!

Take care,
Sandra Gonzales

Get well,
Paul

Best Wishes Mike,
Keep us posted on your
progress
Walt

Frank

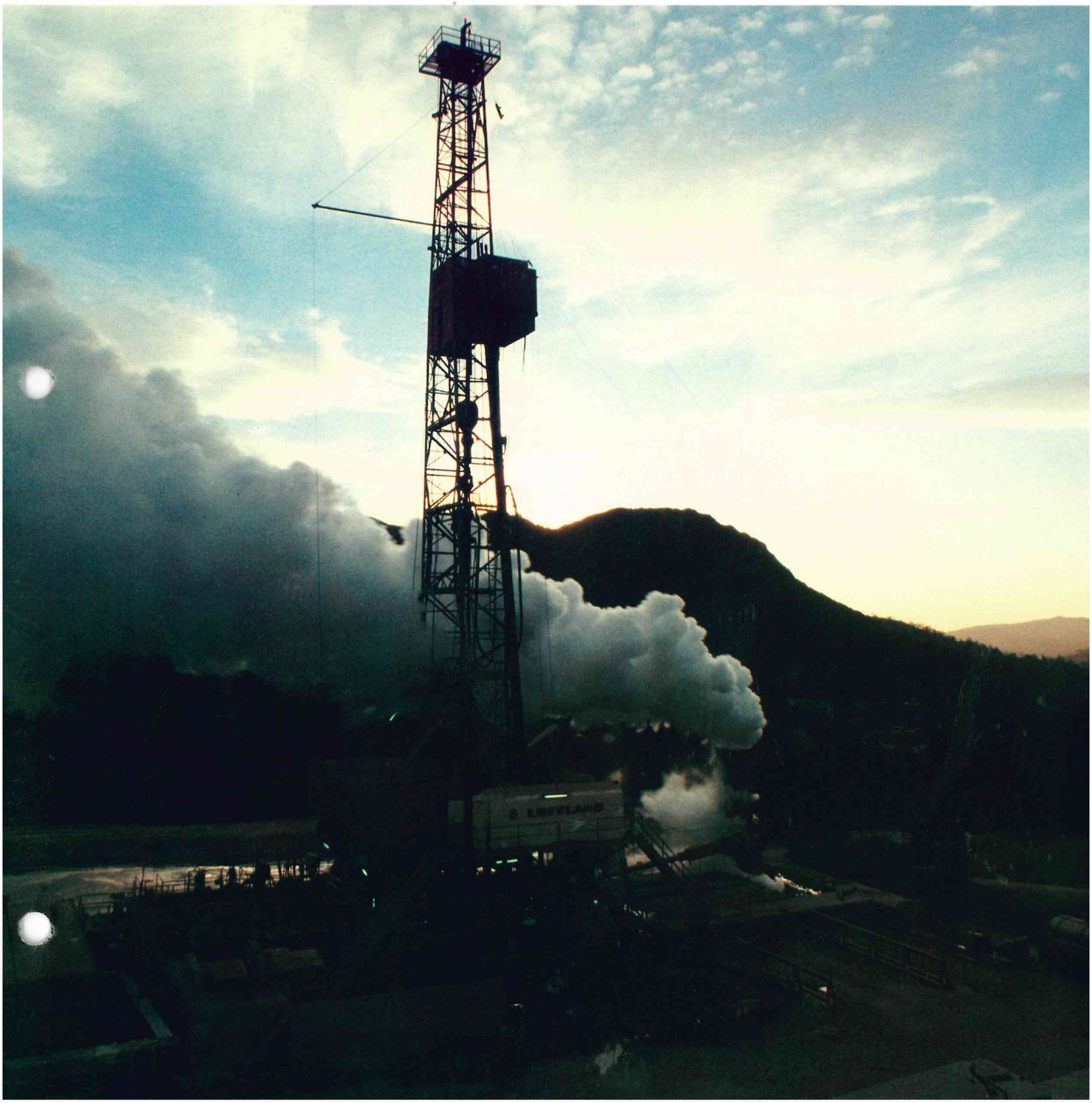
I'll really miss ya!
Linda Castaneda

SEE YOU BACK IN '82
JOSE PEREZ

Good Luck, from those
of us off the face of
the earth,
Greg Butler

Geothermal Energy

UNION 76



On the cover, a geothermal drilling rig at The Geysers encounters a productive steam zone. The muffler, at right, reduces the noise of the steam flow to acceptable levels during the testing of the well.

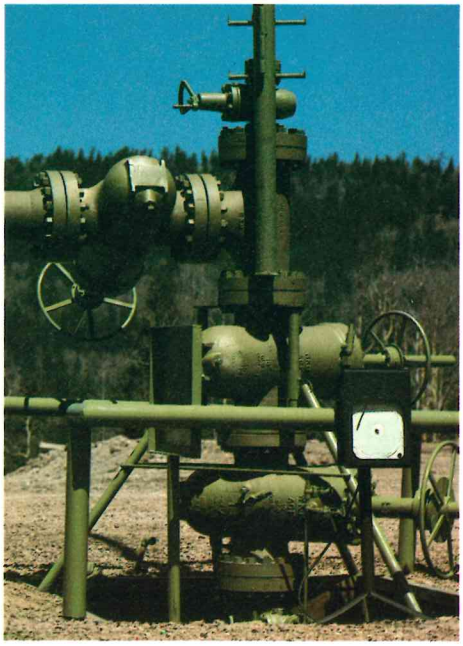
People have long been fascinated with the prospect of harnessing the heat energy beneath the earth's surface. Over the past twenty years, this prospect has become a reality as the development of geothermal energy technology has progressed from the stage of experimental projects to a position of important potential in the energy spectrum of many nations.

Today, more than 50 nations around the world are active or interested in developing their geothermal resources to power electrical generating plants. Such plants are now in operation or being planned in the Philippines, New Zealand, Japan, Mexico, El Salvador, Italy, Indonesia, Iceland, Turkey and the United States.

Geothermal energy can best be defined as the natural heat of the earth captured in fluids trapped in rock formations thousands of feet beneath the surface of the earth.

In most places around the world, the heat source—molten rock, or magma—lies too deep for its heat energy to be useful. There are a few areas, though, where the magma has worked itself closer to the surface, slowly transmitting heat to the layers of rock above it. Phenomena such as hot springs, geysers or fumaroles—wisps of steam rising from cracks in the ground—can occur if these heated fluids rise to the surface. Such manifestations can provide indications to earth scientists that an area may have geothermal potential.

The heat of geothermal systems is somewhat low by fossil fuel standards. Although the most efficient utilization of geothermal energy would be for process heat in industrial applications, it can only be transported short distances before there is too much heat pressure loss. Opportunities for such use are rare, such as space heating in Iceland, the paper industry in New Zealand and certain towns in the United States.



Valves control the flow of geothermal fluids which are brought to the surface through wells drilled deep into the earth. Pipeline and wellhead equipment is painted to blend with the local environment.

Therefore, the most practical use for geothermal energy is to power electrical generating plants. This electricity can then be transported to load centers where it is required. In the United States, a dense power grid now brings geothermal energy within the reach of every city and town.

On a worldwide basis, more than 1.75 million kilowatts of installed electrical generating capacity is powered by geothermal energy today.

On the following pages, this brochure discusses the different types of geothermal resources, the methods used to find them and the various production techniques which are utilized to harness this heat energy. The brochure also looks at some of the major geothermal energy projects which have been developed by Union Oil Company of California, the world's largest producer of geothermal energy.

Potential geothermal areas

The earth's crust is made up of large plates which are in relative motion. Areas with geothermal energy potential are most likely to be found along the boundaries of these plates.

In some places, such as California's Imperial Valley, the plates are moving apart, causing a thinning of the crust which allows an upwelling of the magma closer to the surface. In other areas, such as the Philippines, the plates are colliding with one another, causing frictional heating and development of magma relatively close to the surface of the earth.

This collision between plates can also cause a stretching and shattering of the plate. In The Geysers area of northern California, for example, this fracturing and faulting of the continental plate has allowed the magma to migrate closer to the surface.

The geothermal resource may be in the form of dry steam or hot water depending upon conditions which exist within the underground reservoir. This energy can be harnessed by drilling wells into the productive zones, much as is done for oil or natural gas, and bringing this steam or hot water to the surface. The most practical and beneficial use for geothermal energy yet found is to power turbo-generators which produce electricity for industry, agriculture and homes.

Different types of geothermal resources require different types of production systems. If the resource is a dry steam, or vapor-dominated,

Steam from geothermal wells at The Geysers passes through separators (center) which remove small dust and rock particles. The steam is then transported by pipeline to nearby electrical generating plants where it turns the turbines.

reservoir, the impurities and tiny rock particles are removed in a separator. Then the resulting clean steam is piped directly to an electrical generating plant where it turns the turbine in much the same way as steam produced in a boiler heated by burning oil or coal.

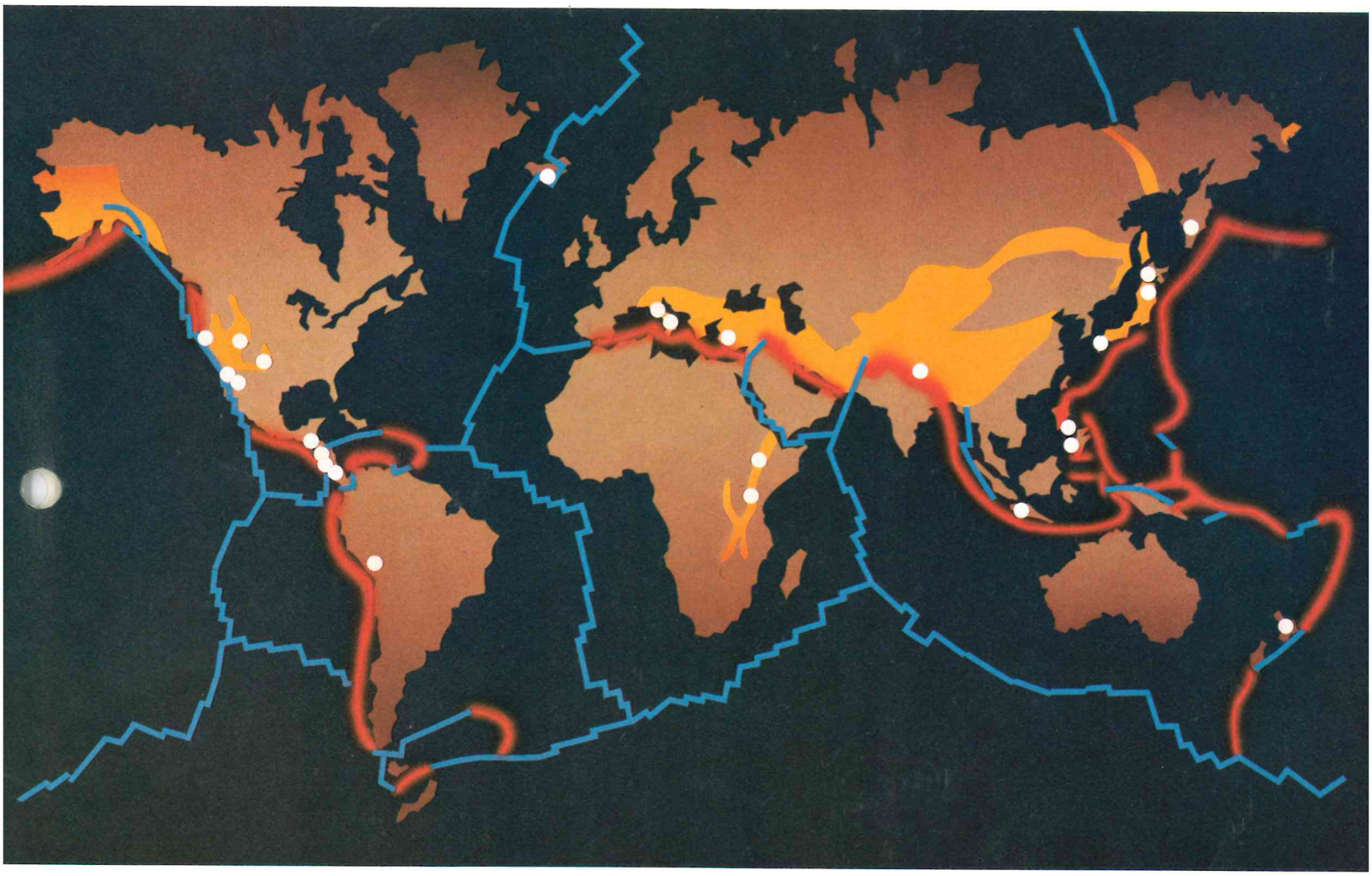
If the resource is a hot water, or liquid-dominated, reservoir, the heat energy can be utilized in two ways. The first is called the "flash" method. The hot water is brought to the surface and the pressure is reduced in special equipment, allowing a portion of the fluid to vaporize, or "flash," into steam.

The steam can be used in the same way as natural dry steam after this separation. The unflashed hot water is returned to the reservoir through injection wells.

A second type of hot water production system is called the vapor-turbine method, or binary cycle. Geothermal hot water is brought to the surface and contained in a closed system under pressure at its original temperature and its liquid condition. These geothermal fluids are pumped through heat exchangers where the heat gasifies a separate working fluid which circulates in a closed system and is used to drive a turbine. The geothermal fluids, after yielding their heat, are returned to the underground reservoir through injection wells.

The heat energy of most geothermal systems is normally well above the boiling point—in the range of 300 to 600 degrees Fahrenheit. To use this energy most efficiently, electrical generating plants must be built within the geothermal field, thus avoiding excessive heat and pressure losses which can occur if the resource is transported by pipeline much more than one mile.

Right, geothermal energy produced by Union from the highly saline geothermal fluids is used to power the 10,000 kilowatt electrical generating plant at Brawley in California's Imperial Valley. Below, map shows the boundaries of the earth's crustal plates where magma moves closer to the surface. Dots indicate geothermal energy projects.



Right, satellite separators at the Makiling-Banahao project in the Philippines are used to flash a high- and low-pressure steam fraction from the geothermal fluids. Far right, geothermal fluids produced at the Brawley project pass from the wellhead (foreground) into a series of vessels to reduce the pressure, allowing a portion to flash into steam.

Developing geothermal resources

Most of the technical accomplishments which have made geothermal energy a practical energy source have been adopted from the methods used by the petroleum industry.

The application of basic earth science disciplines such as petroleum geology, geophysics and reservoir and petroleum engineering have made it possible to solve the inescapable challenges of a new technology and move quickly from the research phase to commercial operations.

When earth scientists search for geothermal energy, their objective is to locate those areas with the potential for high temperature geothermal resources which can be used to power electrical generators.

Reservoir temperature and permeability are generally the most important physical properties which determine the chemical and physical processes at work within the reservoir and the production techniques to be used to develop the resource.

Various geological, geochemical and geophysical surveys and studies are conducted to provide critical data on an area and guide selection of a drillsite. However, the existence of a geothermal reservoir and its suitability for commercial production can only be determined with certainty by drilling wells.

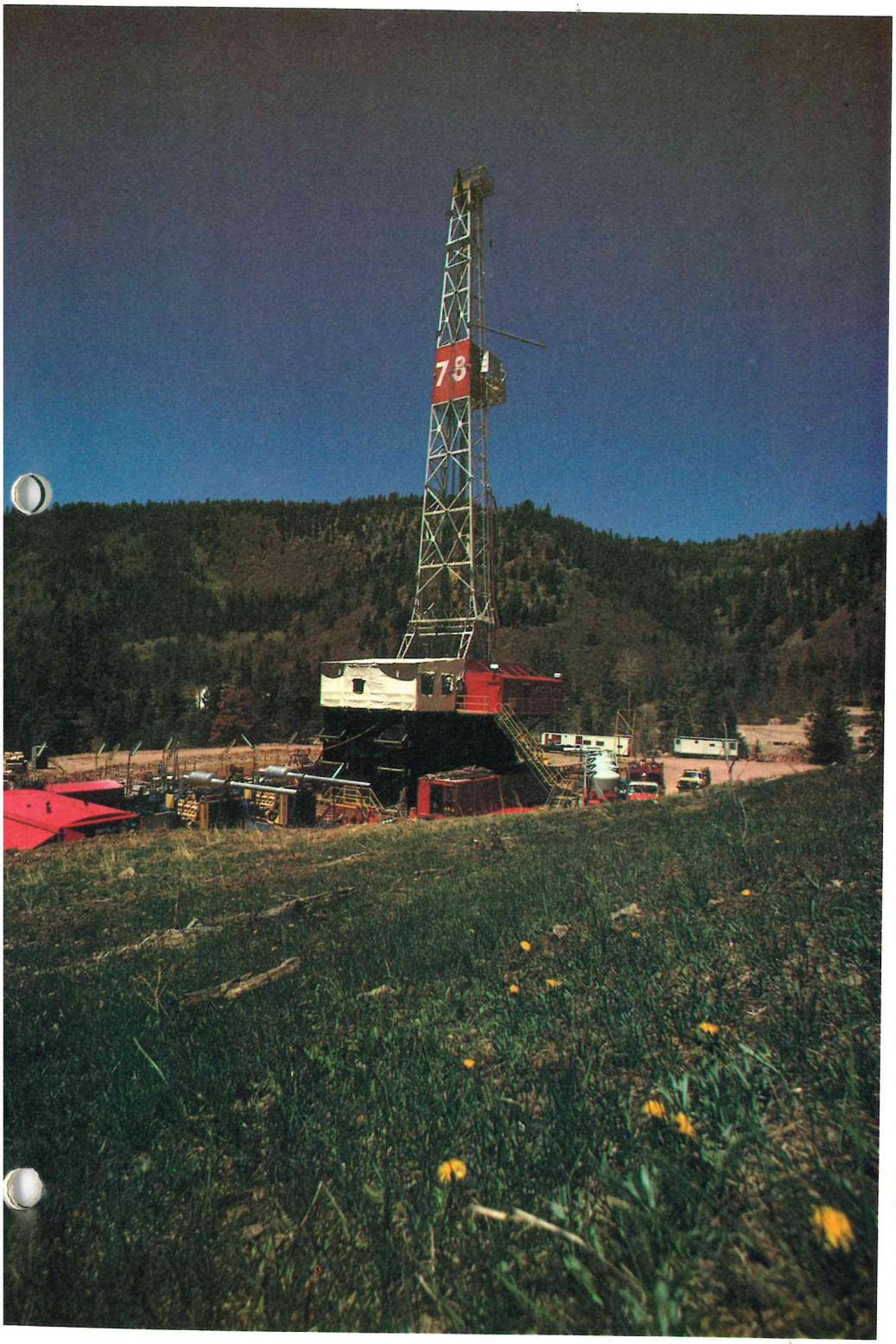
Specially-equipped rotary drilling rigs are used for geothermal wells with the size varying according to the projected depth and the specific geologic formation objective. The high temperatures and hard rock formations encountered, however, present unique challenges.

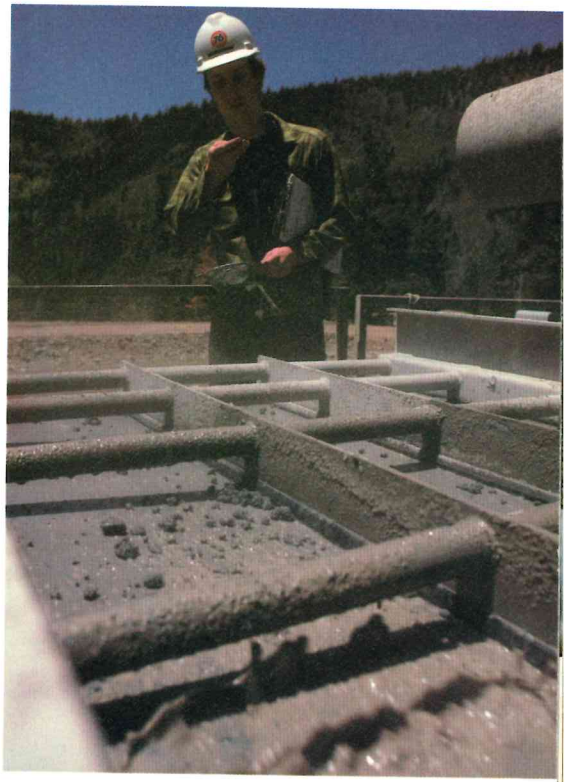
Drilling crew prepares to add pipe sections to the drillstring on a new well at The Geysers geothermal project in northern California.

High temperatures produce adverse effects on drilling fluids, cement and equipment, requiring the use of specially-formulated muds and cements. In addition, compressed air is often used as a circulating medium when the well reaches the producing zone in order to prevent damage to the formation.

A geothermal reservoir normally occurs in hard, igneous or metamorphic rock, unlike the softer sedimentary formations associated with petroleum deposits. This puts additional stress on drilling equipment and slows penetration rates. Special tools have been developed to meet the high-temperature, high-strength needs of the geothermal industry.

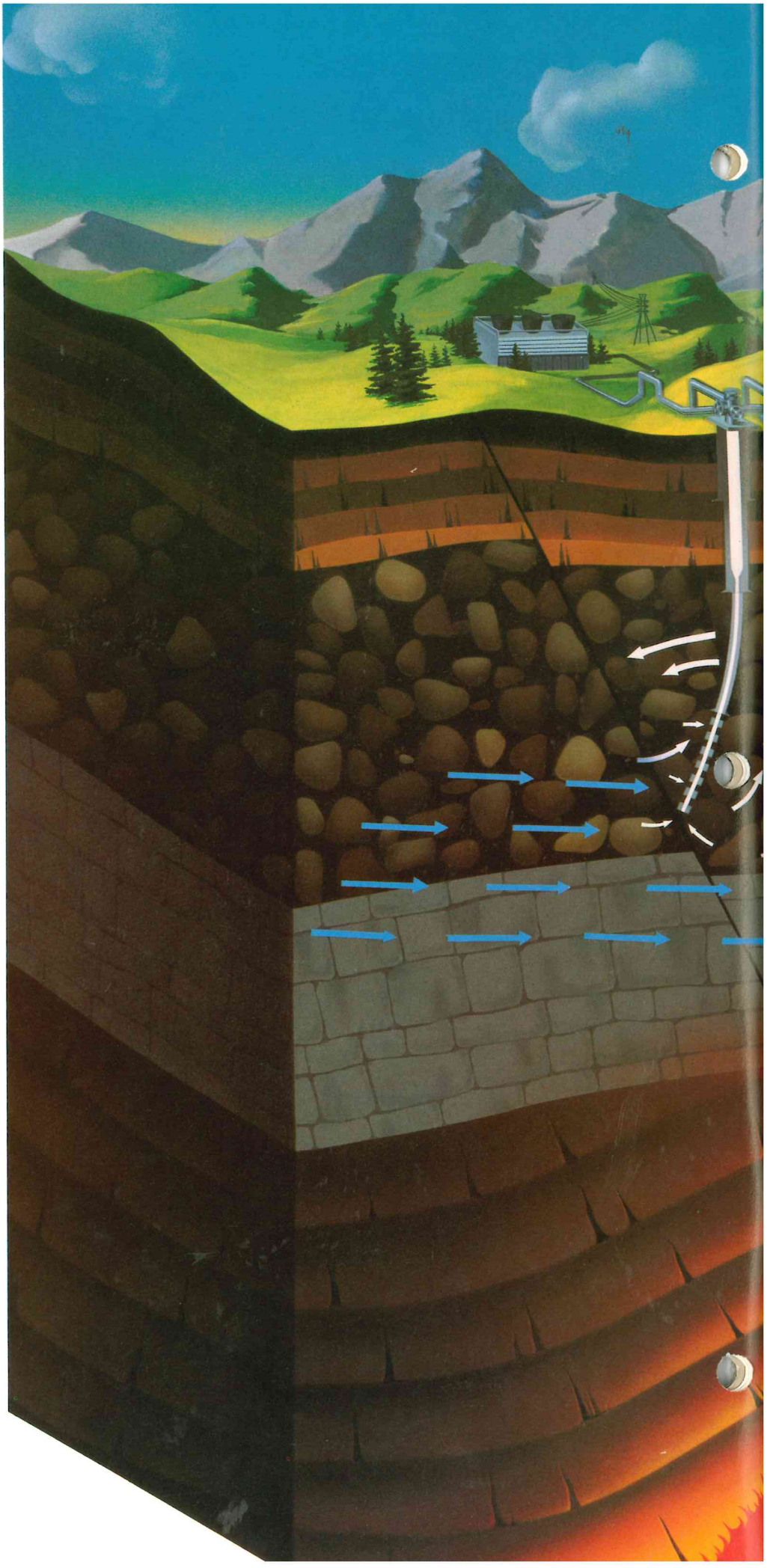
Left, computer plotting of a contour map of an area aids in determining the boundaries of a geothermal reservoir and selection of drilling locations.





Left, specially-equipped rotary drilling rigs such as this one in New Mexico are used to drill geothermal wells. Top, well cuttings brought to the surface by circulating fluids tell a geologist the types of formations which the drill bit is penetrating. Above, drilling foreman "reads" film which measures the deviation of the well bore from vertical.

The artist's sketch shows how geothermal energy is produced. Heat radiating upward from the magma raises the temperature of the porous reservoir rock above it. Any water present in the formation is heated and rises in the reservoir to where it can be reached by the drilling rig. The geothermal energy produced by the wells is piped to electrical generating plants where it can be used to turn the turbine.



The potential of geothermal energy

On a nationwide scale in the United States, experts believe that there is a geological opportunity to develop geothermal resources sufficient to power twenty million kilowatts of electrical generating capacity by the year 2000. This would be the equivalent of about 700,000 barrels of crude oil per day, or 8.5 percent of today's U.S. crude oil production.

In some parts of the nation, geothermal energy could make an even more significant contribution. In California, for example, studies indicate that geothermal energy resources could power a generating capacity sufficient to meet 25 percent of the state's electrical needs.

This amount of generating capacity powered by domestic energy sources would result in a foreign exchange savings of nearly $7.7 billion annually in 1981 dollars for the U.S., a significant move toward reducing dependency on foreign energy sources and improving America's balance of payments.

The interest in this vital energy source goes beyond the United States. Nations with the geothermal resource potential are becoming increasingly aware that geothermal energy is an attractive alternative to foreign oil for meeting their domestic energy needs.

Geothermal developments make major contributions to the local tax base and economy in general. They place small demands on public services and do not impose major changes on the lifestyle of a community. Another significant consideration is that geothermal energy can become an important source of energy to generate electricity while having minimal impact on the environment. As such, precious fossil fuels such as oil and natural gas, can be saved for higher uses such as transportation fuels and petrochemical feedstocks.

A field operator opens the valves on a geothermal well in New Mexico to test hot water flow rates.

Geothermal development projects

Union Oil Company of California is the world's largest producer of geothermal energy, supplying natural steam to power more than 1.2 million kilowatts of electrical generating capacity in the United States and the Philippines.

Over the past twenty years, Union has pioneered the development of new technology in drilling, production and reservoir engineering which has led to cost-effective and timely development of geothermal resources.

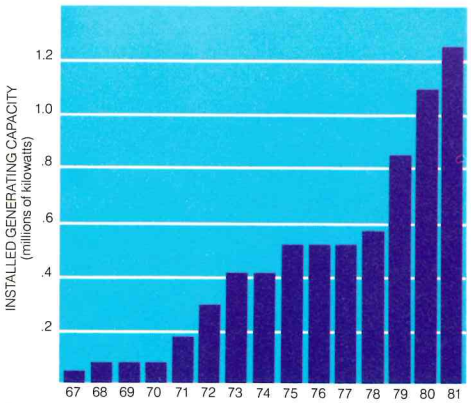
Following is a brief look at the specific projects where Union has applied its technical expertise in developing geothermal energy.

The Geysers. Union is the principal operator in The Geysers geothermal field, the world's largest and most successful geothermal development, located in California's Sonoma and Lake counties, about 90 miles north of San Francisco. There, Union supplies geothermal energy to power nearly 750,000 kilowatts of installed electrical generating capacity operated by Pacific Gas and Electric Company (PG&E). Production facilities are being expanded to supply steam for another 220,000 kilowatts of generating capacity which is under construction.

The Geysers resource is dry steam, produced from a fractured impermeable sandstone formation which occurs at widely-varying depths ranging from a few hundred feet to 10,000 feet or more. An average well at The Geysers produces about 150,000 pounds of steam per hour, sufficient to power 7,000 to 8,000 kilowatts of generating capacity.

Estimates indicate that when The Geysers field is fully developed during the 1980s, Union and others will be producing enough natural steam to power about two million kilowatts of generating capacity.

Union Oil Company Geothermal Production



The chart above shows the growth in electrical generating capacity powered with geothermal energy produced by Union Oil Company of California.

Left, a development well at The Geysers encounters a productive steam zone. Top, a field operator records flow measurements at Brawley on separator vessels where a portion of geothermal fluids "flash" into steam. Above, directionally-drilled wells reach out from central pads to produce steam for delivery to the generating plants which are built within the geothermal field.

Steam plumes rise from geothermal wells on test in the Baca Ranch exploration area in the Jemez Mountains of north-central New Mexico.

Loops in the steam pipeline from an Imperial Valley well in the Niland area are designed to accommodate expansion due to temperature changes.

Imperial Valley. Located in southeastern California, the Imperial Valley has been termed the "Saudi Arabia" of the world's geothermal resources. Beneath this rich agricultural land lie hot water geothermal reservoirs which may be capable of powering more than three million kilowatts of electrical generating capacity.

Union has been in the forefront in developing these resources. In 1980, The Brawley Geothermal-Electric Project, a joint effort between Union as the resource producer and Southern California Edison as the power plant operator, began commercial operation. It is one of the first projects to demonstrate the feasibility of producing the highly saline geothermal fluids in the Imperial Valley and extracting geothermal steam to power a generating plant.

Union is also developing the geothermal resource at Niland near the Salton Sea in the northern part of the valley. A generating plant, operated by Edison, is due to begin operation in 1982 using Union-produced steam.

The Imperial Valley presents unique challenges because of the high level of dissolved solids—ranging from 50,000 to 300,000 parts per million—in the geothermal fluids. Using small-scale pilot projects such as Brawley and Niland, Union's engineers are evaluating methods for controlling the scaling and corrosion associated with these geothermal fluids.

New Mexico. In the Jemez Mountains of north-central New Mexico, Union is developing a low-salinity hot water geothermal resource. The 550 degree Fahrenheit fluids have roughly 7,000 parts per million dissolved solids.

Union's geologists and engineers have been faced with unique reservoir conditions in the producing formation,

A Union Oil Company production foreman checks pressure readout on geothermal well in New Mexico.

and they are exploring new techniques for drilling and new chemical and mechanical methods of well stimulation to increase permeability and well productivity.

Union holds the geothermal lease on the 100,000-acre privately-owned Baca Ranch where the project is located. The results of the company's work will have broad application to many similar geothermal resource areas elsewhere in the United States.

The Philippines. Union has developed two major hot water geothermal areas—Makiling-Banahao and Tiwi on the island of Luzon. These are operated under an agreement with the National Power Corporation, an agency of the Philippine government.

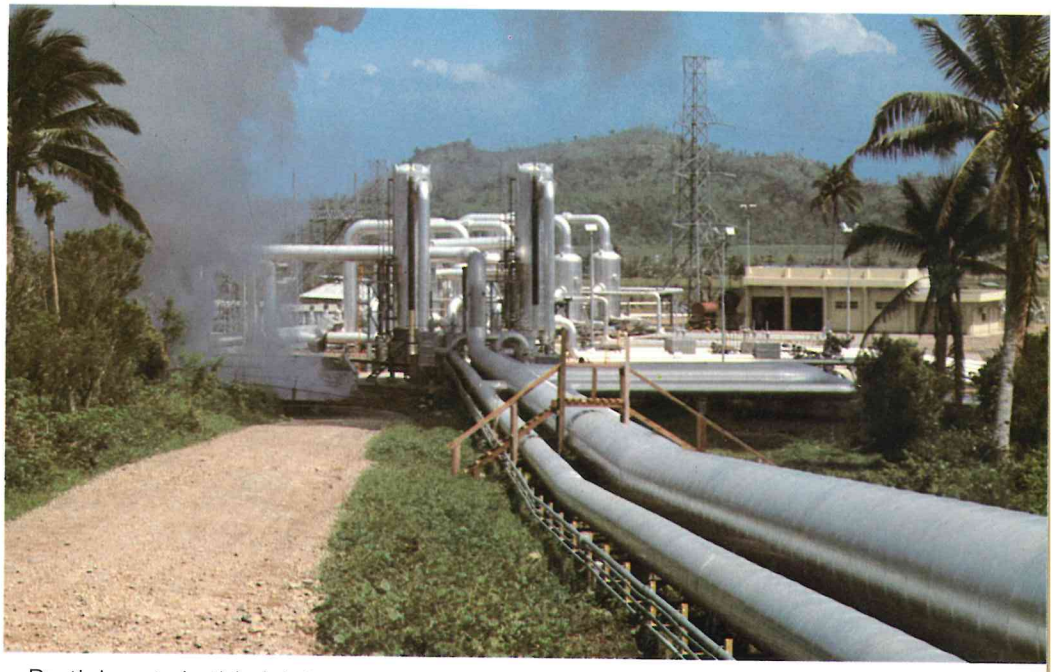
The Makiling-Banahao project is 35 miles south of Manila. A total of 220,000 kilowatts of generating capacity is supplied by Union wells and another 110,000 kilowatts of capacity is planned.

The Tiwi project is located 200 miles south of Manila. Union is supplying steam to power 220,000 kilowatts of generating capacity. Expansion of the steam production facilities is underway to supply an additional 110,000 kilowatts of capacity.

The Philippines is now the second largest producer of geothermal energy. Continued exploration of the resource could lead to a doubling of the electrical generating capacity in these two areas.

Geothermal development in the Philippines has reduced that nation's dependence upon expensive foreign oil supplies. The geothermal energy to power each 110,000 kilowatts of generating capacity represents a crude oil equivalent of about 1.5 million barrels of oil per year.

Japan. Union is the operator for a joint venture to explore for and develop geothermal resources on Japan's northernmost island of Hokkaido. The prospects being explored include the Dohtoh area, approximately 160 miles northeast of Sapporo, and the Esan area, 75 miles southwest of Sapporo.



Participants in this joint venture with Union include Japan Petroleum Exploration Company, Ltd., and Nissho Iwai Corporation.

Indonesia. Union is discussing a joint venture agreement with the Indonesian state oil company, Pertamina, to develop the geothermal resources on the slopes of Mt. Salak, approximately 40 miles south of Jakarta on the Island of Jawa.

Top, scrubbers eliminate small particles from the steam before it is delivered to the generating plant. Above, electrical generating plants are built within the geothermal field at the Makiling-Banahao area in the Philippines.

Considerable progress has been made in establishing a geothermal industry in a very short period of time. One technological advancement after another has been made over the past two decades as we have increased our understanding of the mechanics of geothermal systems and developed methods for harnessing their heat energy.

The advances in technology, coupled with the ever increasing price of fossil fuels, has made geothermal energy a commercially viable alternative energy source. In increments of 50,000 to 100,000 kilowatts of generating capacity, geothermal energy as a source of power is less expensive than comparable fossil fuel or nuclear power plants. Only hydroelectric power is less expensive.

The success of geothermal projects in the United States and other countries indicates that geothermal energy is no longer just a pipe dream. Nor is it a tempest in a teapot. The resource has come of age. It works and it works well.

Nature has supplied the heat of earth for us to capture as an energy source. It is up to people with skill and imagination to make it work for them. Through the combined efforts of skilled engineers, geologists and other managers in companies such as Union Oil Company of California, and the cooperative support of utilities, government and the business community, our modern society will be able to develop and utilize this vital energy source for the benefit of all.

Insulated pipelines transport geothermal steam from producing wells to electrical generating plants at The Geysers geothermal project.

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UNOCAL CORPORATION

1992 Annual Report

tion is expected to pass 500 million barrels in the spring of 1993; Unocal holds a 50 percent working interest in the field. Development is continuing in the Serang field, with production expected to start in late 1993. As of the end of 1992, Unocal's share of the cumulative production from five company-operated Indonesian offshore fields totaled 364 million barrels of oil and 658 billion cubic feet of natural gas. Much of Unocal's gas production is sold to LNG (liquefied natural gas) plants. Indonesia is the world's largest LNG exporter.

Exploration and development for long-term growth While Unocal's current emphasis is on increasing production, long-term growth also depends on an effective exploration effort. The company will continue to add to reserves in current producing areas through low-risk appraisal and step-out drilling, and continue to pursue low-cost wildcat drilling opportunities in areas where the company has significant exploration data and experience.

Selected higher-risk, high-reward exploration programs will focus on under-explored, high-potential basins, primarily overseas. Unocal initiated one such project in January 1993, with the signing of a petroleum exploration agreement with the Republic of Trinidad and Tobago. Over the next three years, Unocal plans to drill three wells and conduct an extensive 3-D seismic program to fully evaluate this offshore prospect.

High-potential exploration projects are also ongoing in Syria and Yemen. These countries are located in an historic oil-producing area that, although prolific, remains significantly under-developed. Unocal has identified this region as the "Greater Middle East"; it includes the Arabian Peninsula on the south and the Caspian Sea on the north. This is an important focus area for Unocal's future exploration and business development efforts.

In Azerbaijan, the company seeks to participate in the development of the Azeri field, located in the Caspian Sea about 90 miles southeast of Baku. Current estimates place Azeri field reserves at more than 1.8 billion barrels of oil. In January 1993, Amoco, as the operator for a group of companies, and the State Oil Company of the Azerbaijan Republic signed an agreement that defines the development area and states the participating interests. Unocal has a 25 percent share in the foreign interest; the division of foreign and domestic interests has not been formalized. A comprehensive agreement remains to be negotiated.

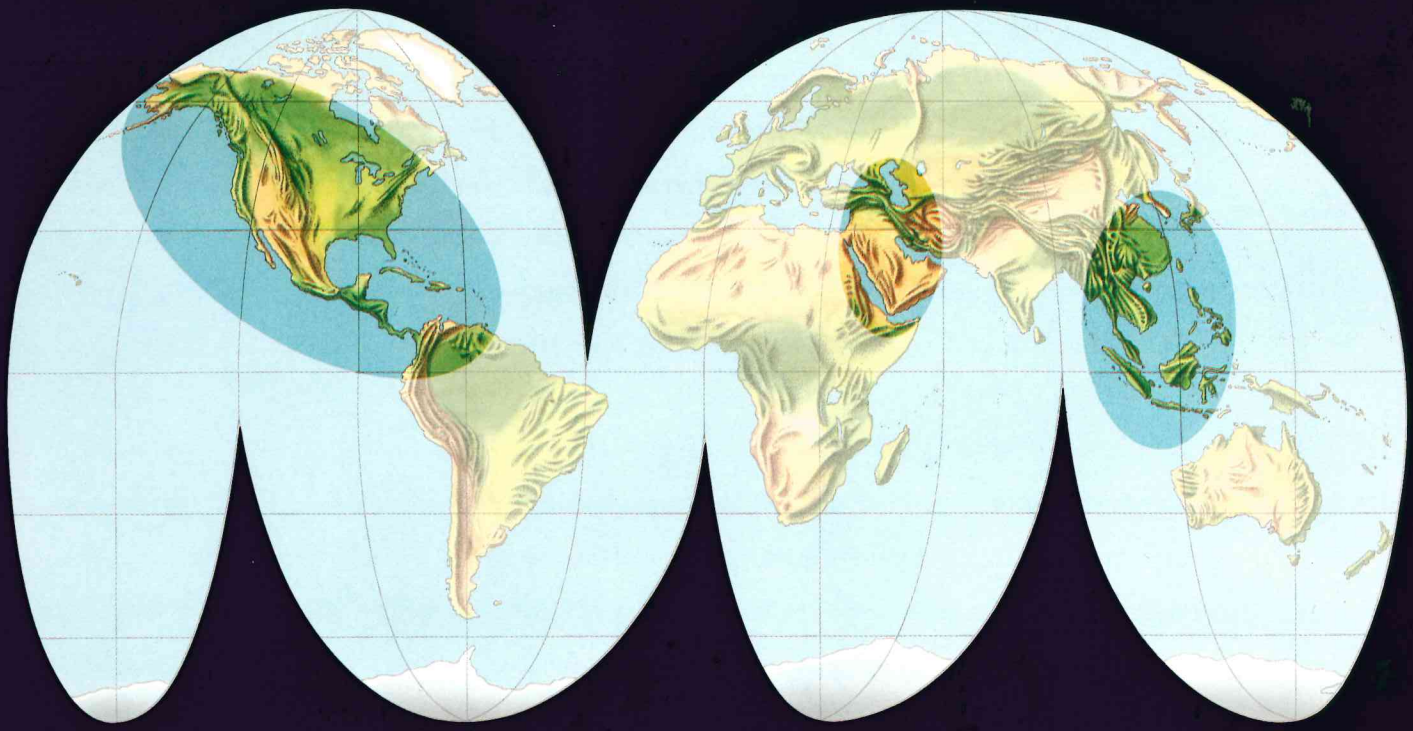
Geothermal energy — a core business The production of geothermal resources for power generation has been a core business for Unocal for more than 20 years. The business has expanded with the addition of a new group that seeks power generation and cogeneration opportunities throughout the company.

Unocal supplies geothermal steam in Northern California and in the Philippines to a total installed generating capacity of nearly 1,700 megawatts. Philippine operations continued to have strong production in 1992 from both the Tiwi and Mak-Ban fields, which supply electricity to the Manila area. California's Geysers geothermal field, which reached peak production in 1987, also continues to be a strong producer. In 1992, Unocal reduced the rate of decline of The Geysers' steam production through careful field management and the reinjection of water into the reservoir.

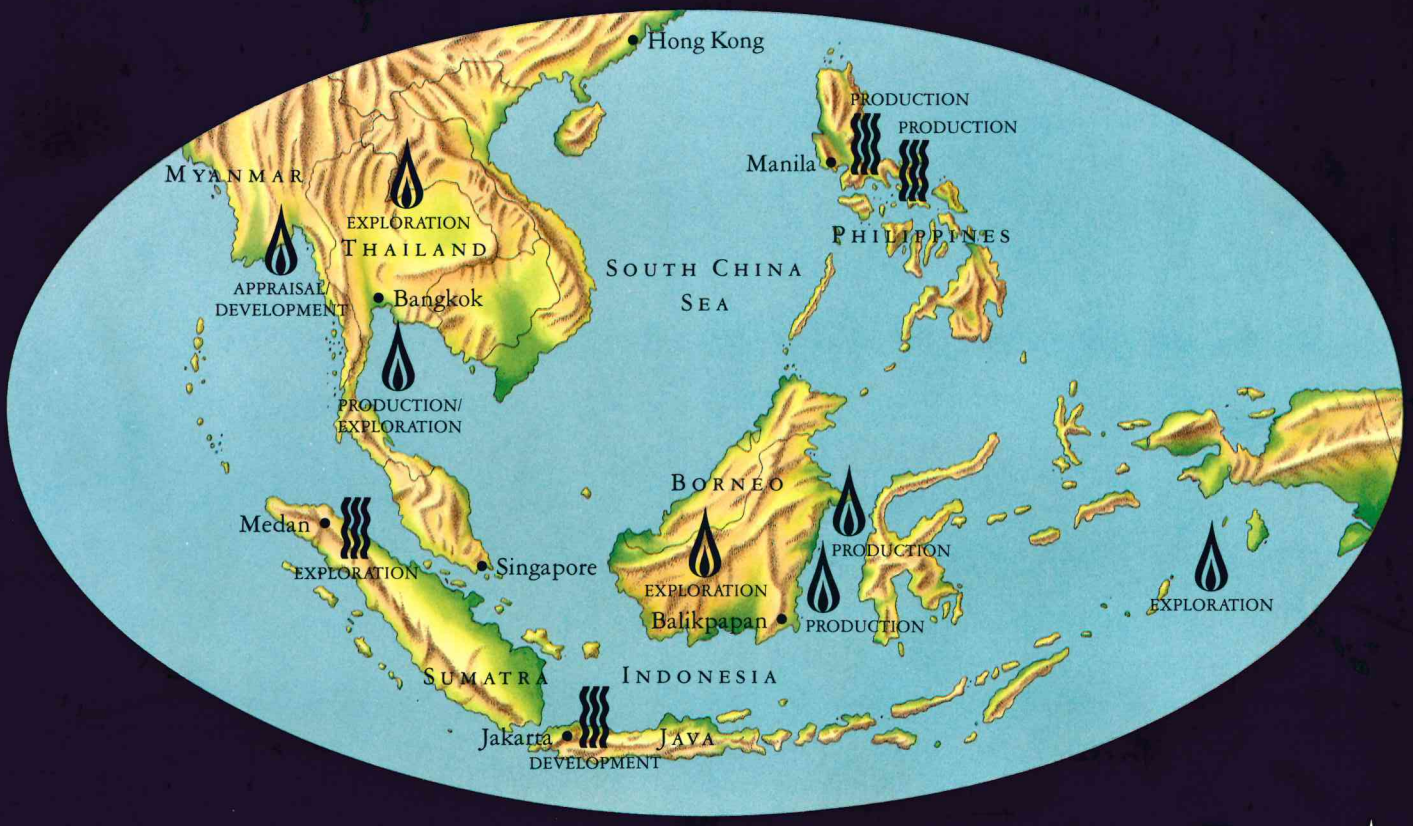
During 1992, Unocal reached agreement to sell its Imperial Valley holdings and certain other domestic geothermal exploration properties. The sale includes three power plants with a combined capacity of 80 megawatts, and about 43,000 net acres of leases and fee properties. Unocal has also reached agreement to sell its interests in the 41,000-acre Glass Mountain/Medicine Lake prospect in Northern California. Both sales are expected to close in March of 1993.

Development continues in the Gunung Salak field on the Indonesian island of Java. Unocal expects to begin steam test production in late 1993, with the first 110-megawatt generation plant scheduled for start-up in 1994.

In February 1993, Unocal signed agreements with Pertamina, the state oil company, and PLN, the state electricity company, to appraise and develop the Sarulla Block on Sumatra up to a full contract capacity of 1,000 megawatts for 30 years. This would be the energy equivalent of 315 million barrels of oil. If field delineation proves successful, the first power plant could be on line as early as 1998.



Energy Resources Focus Areas: North America, Greater Middle East, and Asia Pacific



Southeast Asia: Energy Resources Operations and Prospects

GEOTHERMAL OIL & GAS

For the first time, steam separated from the Imperial Valley's tremendous geothermal resources is being delivered for electricity generation. Union Oil Company of California, the world's most successful geothermal developer, is operating its Steam Gathering System just north of Brawley, California, where the steam is used to generate ten megawatts of power.

The geothermal energy is obtained from deep beneath the Imperial Valley's rich agricultural surface. There, many miles below, is a mass of hot molten rock called magma. Effective use of this heat has eluded man for thousands of years.

Most of the magma lies too deep for its energy to be useful, but in a few areas of the earth's crust, particularly around the rim of the Pacific Basin, the magma comes closer to the surface. In these locations, the magma heats the layers of rock above it. Underground water is heated and dissolves some of the salt and minerals in the rock. Where faults or cracks in the earth's crust occur, the hot water may be visible as hot springs or boiling mud pots.

To use the geothermal resource, Union has drilled several wells between 1,600 meters (5,200 feet) and 2,750 meters (8,900 feet) deep. Three of these wells are production wells which bring the brine from the reservoir to the surface. Two wells are injection wells which allow the used brine to be put back into the reservoir. One well is used as a pressure monitoring well which helps scientists determine what is occurring within the reservoir. Two additional wells serve as reserve injection wells. Several wells are drilled at a common surface location to minimize affects on agriculture. The wells are directionally or slant drilled, so the bottom hole locations are over 600 meters (2,000 feet) apart.

Each well takes several weeks to drill using techniques and equipment designed specially for the hot ground which must be penetrated. Costing nearly one million dollars, each well is protected by several layers or string of steel pipe called casing which run to the bottom of the well. The bottom sections have holes or perforations which allow the brine to enter or leave the well bore.

200°C (400°F) brine is produced from the wells at rates totaling nearly ~~1.5 million~~ 150,000 gallons of brine per hour. This is equivalent to about ~~3,500~~ 850 tanker truckloads each day. The brine has between 5% and 25% salt by weight. One gallon of the highly saline brine thus contains about two pounds of salt. Other components of the brine can also deposit in pipes and cause severe operational problems.

The brine passes through a wellhead separator (V-1) where the brine is allowed to expand. Some gases, mostly carbon dioxide and steam, separate from the liquid and are removed out the top of the vessel. The brine passes through a pipeline to a second stage separator (V-2) where the brine is allowed to expand again. Additional carbon dioxide and steam are separated out the top of this vessel and the brine exits the bottom. The brine from each well mixes in a pipeline and enters one of two main separators (V-3) where the brine again is allowed to expand. Steam is removed out the top and brine leaves from the bottom. The brine then is pumped by one of the booster pumps (P-01 through P-04) and one of the injection pumps (P-05 and P-06) to the injection wells. The steam is cleaned and any residual water is removed by the two vessels V-4 and V-5 and is then delivered to the utility which generates the electricity using conventional turbine generator technology. If the utility cannot use the steam, it is vented through the rock muffler which eliminates the noise usually associated with steam venting.

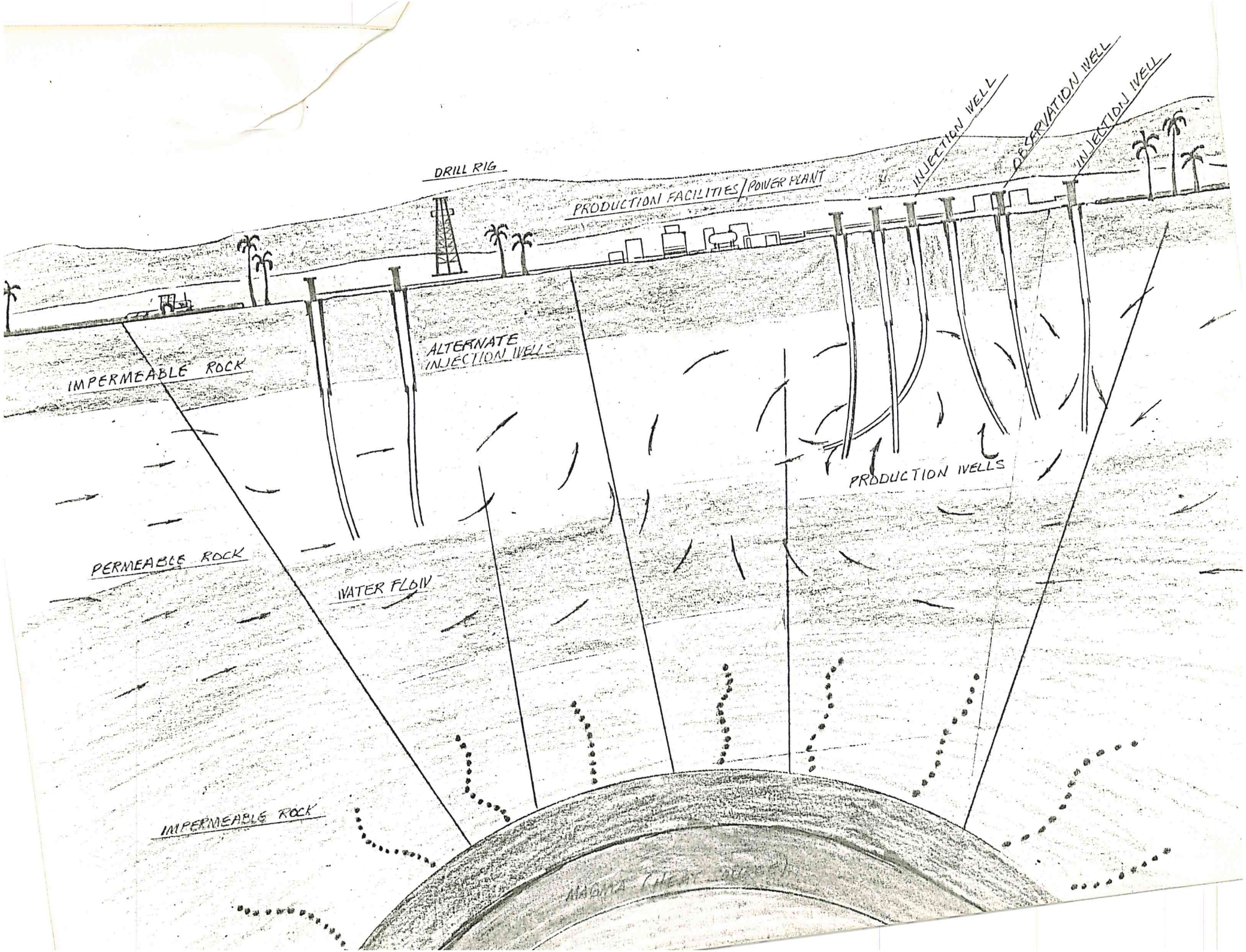
The carbon dioxide and steam removed from the V-1 and V-2

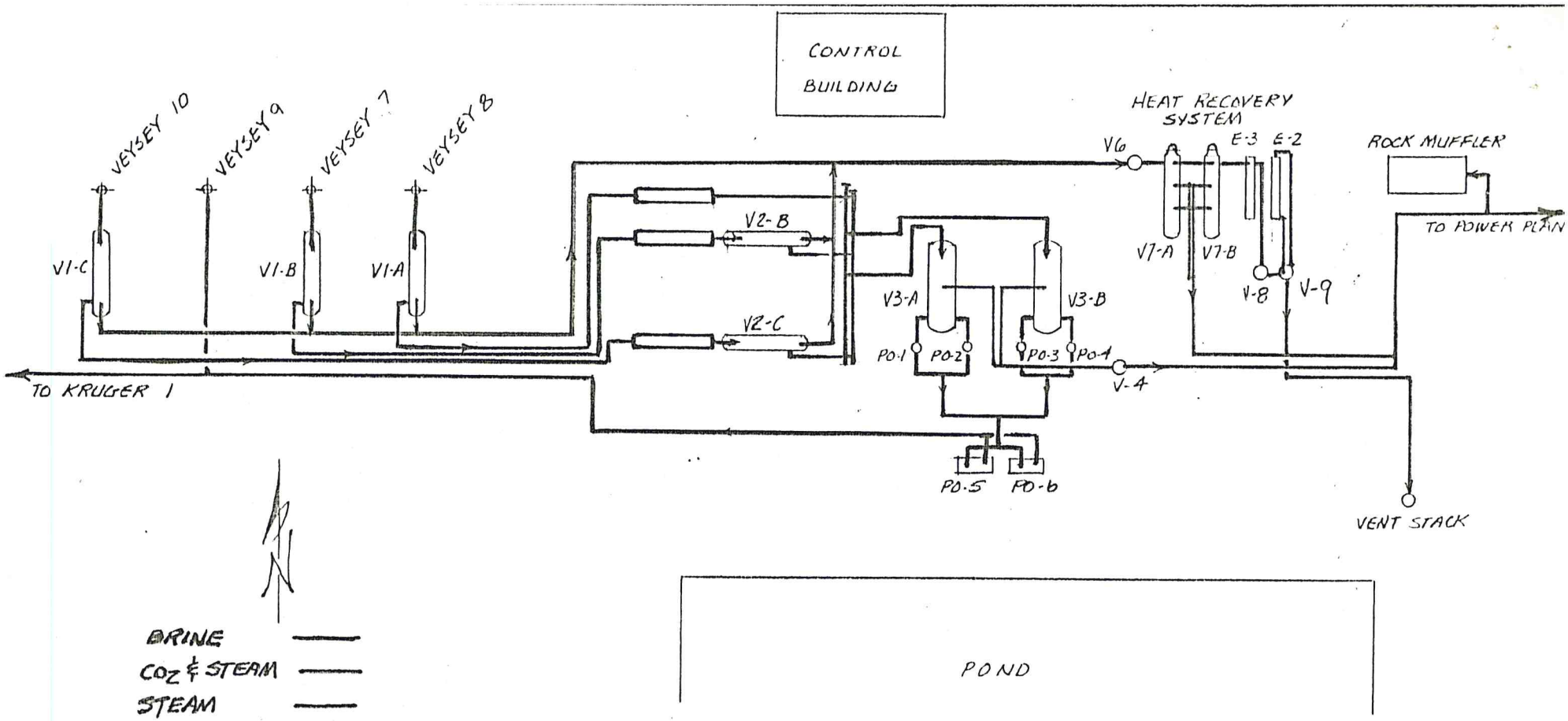
vessels is used in the Heat Recovery System. This is a series of six vessels (V-7A, V-7B, V-8, V-9, E-2 and E-3) which causes the heat in the steam and carbon dioxide mixture to heat clean water from the pond and create additional steam for electricity generation. This system makes use of the heat in the carbon dioxide mixture which cannot be used in the turbine. The harmless carbon dioxide is then released from the 18 meter (60 feet) high vent stack.

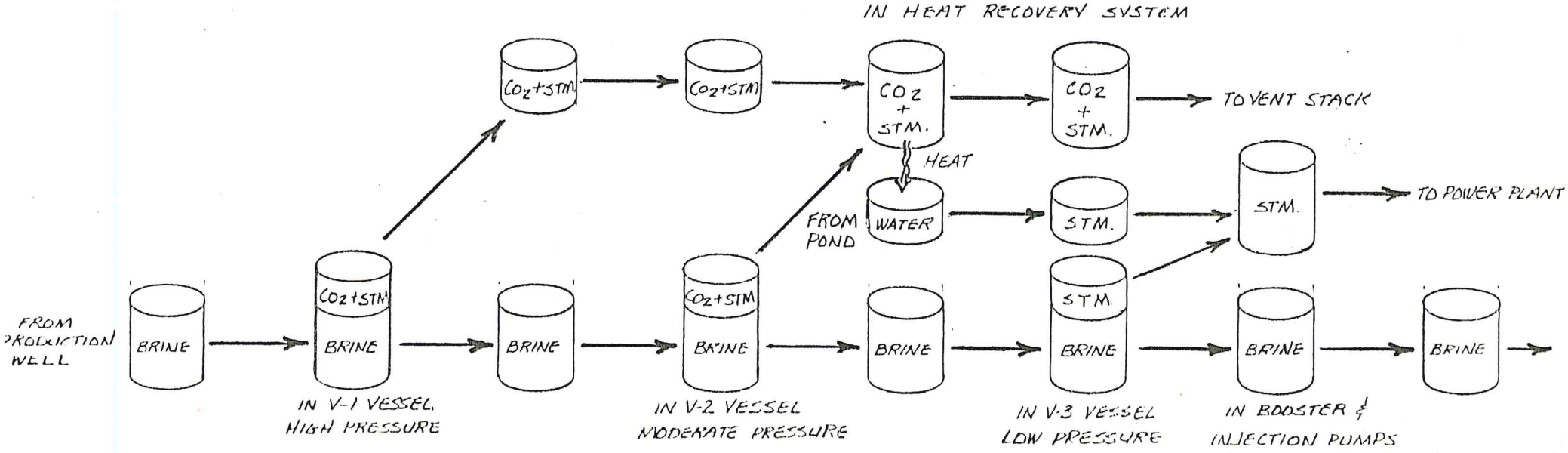
The Steam Gathering System's Brine Storage Pond has a capacity of 8 million liters (2 million gallons). Divided into six sections, the pond holds extra brine for re-injection as well as condensed steam recovered from the utility which is used in the Heat Recovery System. Several small pumps are used to move the water from the pond to where it is needed.

The Brawley ten megawatt facility generates enough electricity to supply about ten thousand people, about two-thirds of a city the size of Brawley. This power is equivalent to that produced using about 200,000 barrels of diesel fuel each year.

With nearly one hundred people working for Union in the Imperial Valley, geothermal development will expand quickly. Steam for an additional 10 megawatt power plant will be provided by Union starting in 1982, and future construction of several 50 megawatt plants is anticipated in the Brawley and Salton Sea areas. In addition, Union is a partner in the development of the Heber reservoir, 20 miles south of Brawley. Further exploration of the Imperial Valley is continuing, and development of other areas will occur as new resources are defined.


DRILL RIG
PRODUCTION FACILITIES / POWER PLANT
INJECTION WELL
OBSERVATION WELL
INJECTION WELL
IMPERMEABLE ROCK
ALTERNATE INJECTION WELLS
PRODUCTION WELLS
PERMEABLE ROCK
WATER FLOW
IMPERMEABLE ROCK
MAGMA CHAMBER


CONTROL BUILDING
VEYSEY 10
VEYSEY 9
VEYSEY 7
VEYSEY 8
V1-C
V1-B
V1-A
V2-B
V2-C
V3-A
V3-B
HEAT RECOVERY SYSTEM
V6
E-3
E-2
ROCK MUFFLER
TO POWER PLAN
V7-A
V7-B
V-8
V-9
PO-1
PO-2
PO-3
PO-4
V-4
TO KRUGER 1
PO-5
PO-6
VENT STACK
BRINE
CO2 & STEAM
STEAM
POND


IN HEAT RECOVERY SYSTEM
CO2+STM
CO2+STM
CO2 + STM.
CO2 + STM.
TO VENT STACK
HEAT
WATER
STM.
STM.
TO POWER PLANT
FROM POND
FROM PRODUCTION WELL
BRINE
CO2+STM
BRINE
BRINE
CO2+STM
BRINE
BRINE
STM.
BRINE
BRINE
BRINE
IN V-1 VESSEL HIGH PRESSURE
IN V-2 VESSEL MODERATE PRESSURE
IN V-3 VESSEL LOW PRESSURE
IN BOOSTER & INJECTION PUMPS

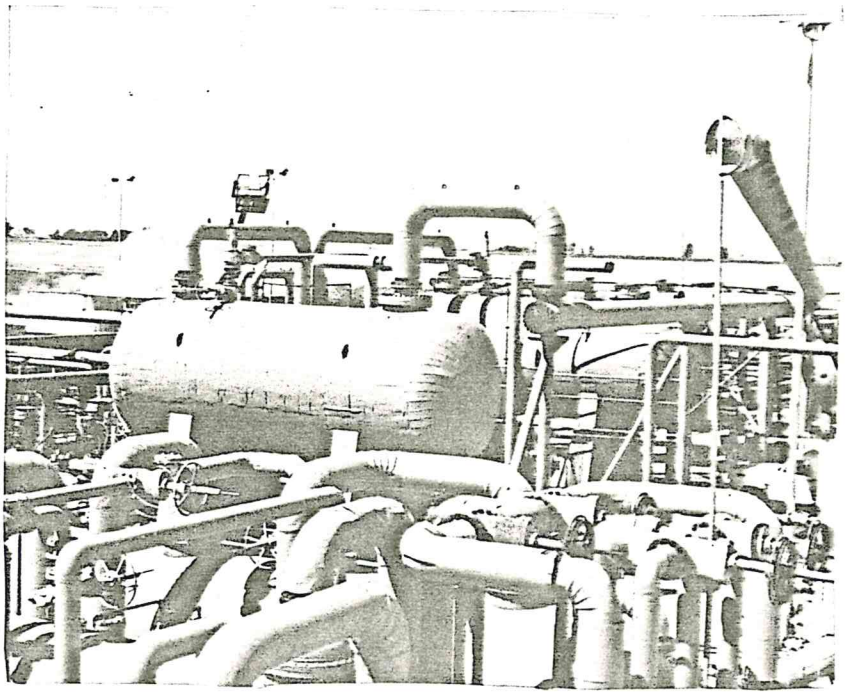


photo no. 1: Beyond the maze of pipes that comprise Union's Steam Gathering System's Heat Recovery System sit the two main steam separators. This is the heart of the system which provides steam to generate 10 megawatts of electricity.

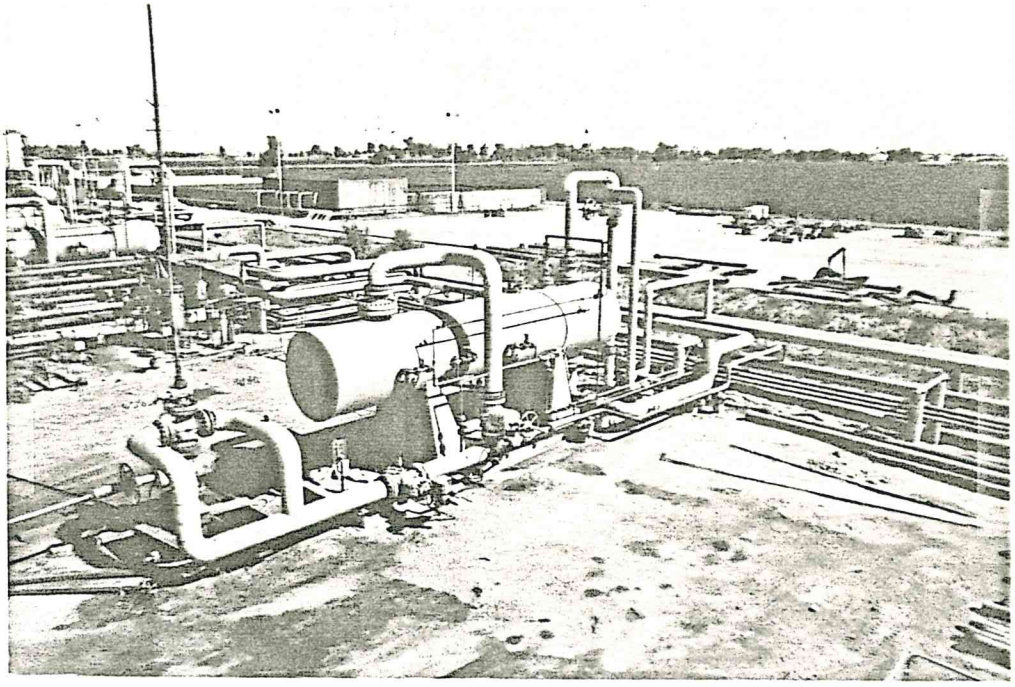


Photo Number 2: Production well Veysey 10 produces over one-half million pounds of brine per hour through its wellhead separator V-1C. The brine and steam/ condensible gas mixture then flow to the left down the rack of pipes.

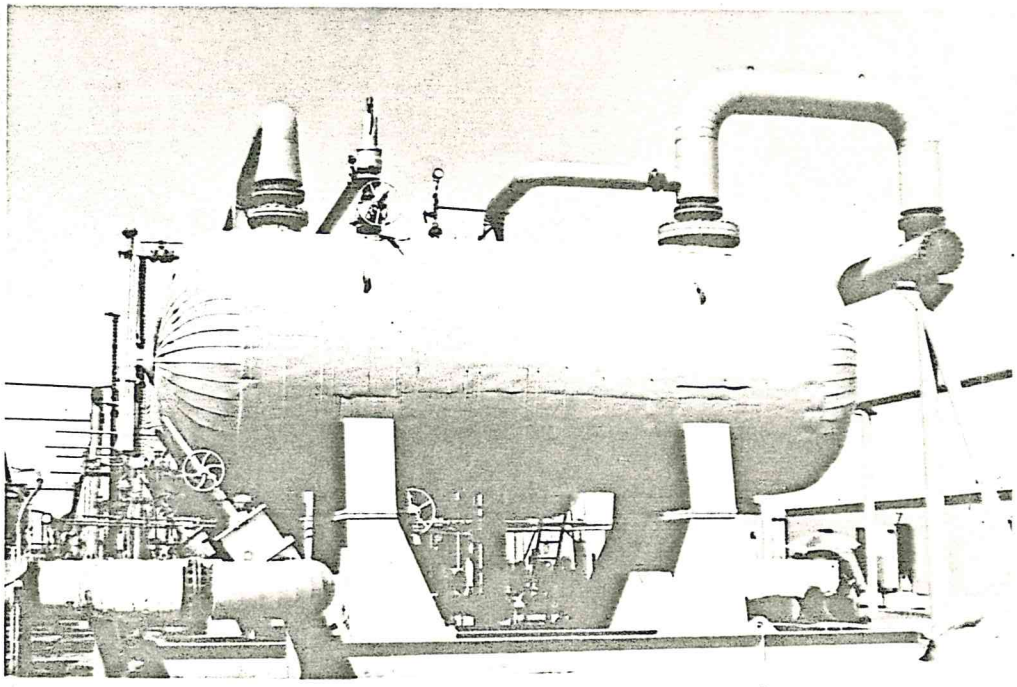


Photo Number 3: This main steam separator, V-3B, is eleven feet in diameter and weighs about 60 tons. Two main steam separators have been installed although only one is used at a time. This allows continuous operation and prevents costly downtime.