Seventy Six

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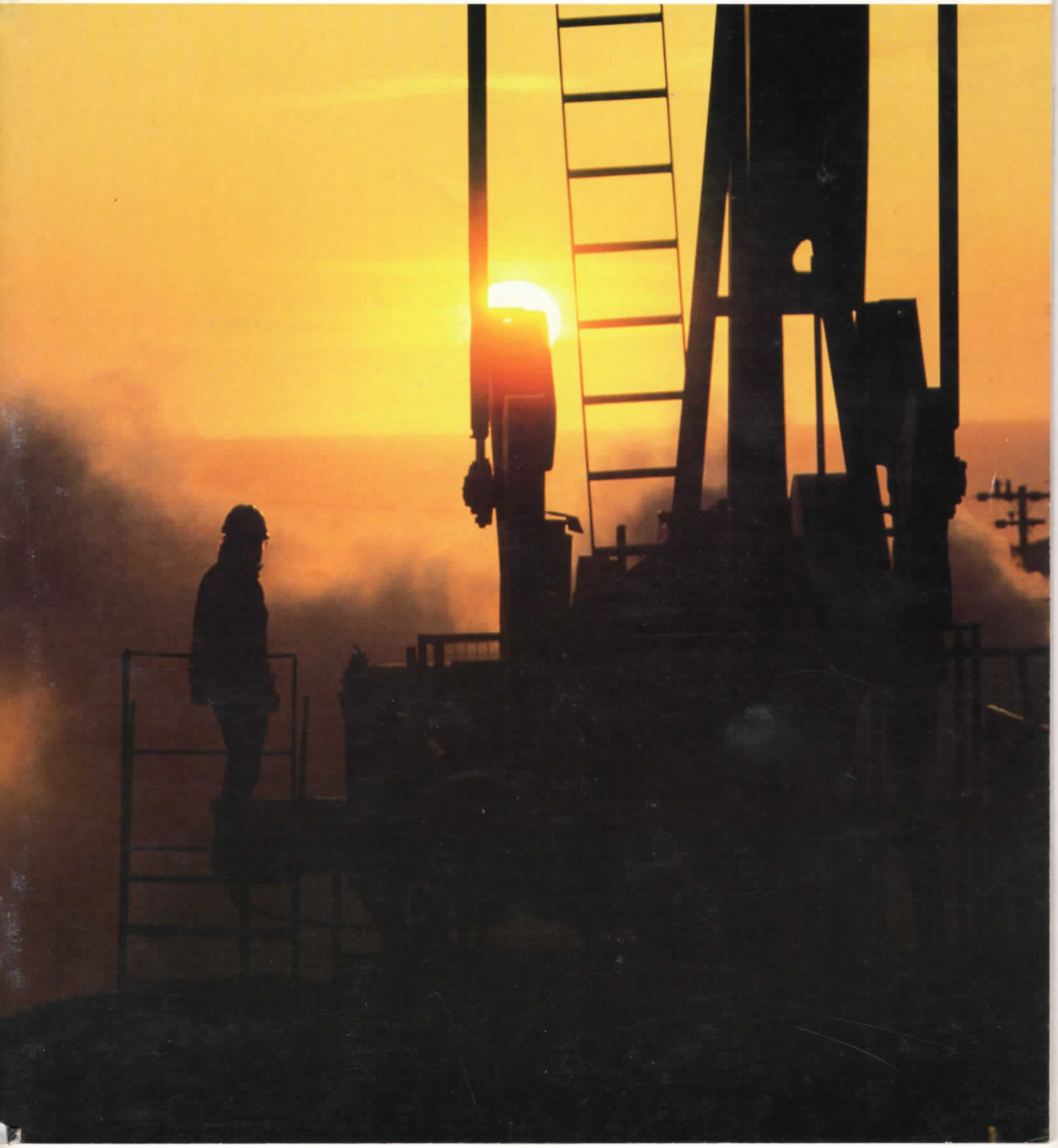


Oil in the Strategic Petroleum Reserve is stored in caverns excavated in huge underground salt domes. Each cavern holds about 10 million barrels of crude oil.

THE STRATEGIC PETROLEUM RESERVE:

AMERICA'S HEDGE AGAINST OIL IMPORT DISRUPTIONS

by James H. Bray

One of the most visible signs of America's struggle to lessen the impact of a future oil disruption has been the creation of a Strategic Petroleum Reserve (SPR). Union Oil views the SPR as a national security program and has supported the concept and implementation of a Strategic Petroleum Reserve from the first discussion of the idea 10 or more years ago. But what is this "reserve" of which so few Americans have heard and even fewer know the location or purpose?

The SPR is a network of six huge underground sites that provide for the storage of large quantities of crude oil. The SPR was authorized by the Energy Policy and Conservation Act (EPCA) signed into law on December 22, 1975. Its purpose is to provide an effective mechanism for reducing the impact of any future oil supply interruption. At the time of the Arab embargo in late 1973, the U.S. was importing 35 percent of its oil. This embargo jolted the country into an awareness of the critical need to enhance our energy security. The SPR is one of the ways the U.S. is protecting itself against future disruptions.

When the first oil was delivered to the SPR in 1977, the U.S. was importing 8.6 million barrels a day. Storage of 750 million barrels in the SPR was determined to be the total amount necessary to provide adequate insurance against an oil disruption. Over the last several years, the U.S. has cut its oil imports and dependence on foreign oil. For the first 10 months of 1983, imports of crude oil and refined products have averaged 4.5 million barrels a day.

While we have made progress towards energy independence, it is important to note that one-fourth of the free world's total oil supply moves through the Persian Gulf and the narrow Strait of Hormuz. Cutting off that supply could set off worldwide competition for supplies that affect the United States. That is why the SPR is still very important even at today's lower levels of import.

If the level of imports were to remain at the level of the first seven months of 1983, the 375 million barrels now in the SPR would replace about 90 days of our average net imports to the U.S. There's also enough oil in the reserve to replace about 1,500 days of our net imports from the Persian Gulf or 240 days from all OPEC nations.

The SPR sites are located along the Gulf Coast, where 50 percent of the crude oil imports enter the U.S. It is here that SPR crude can be moved rapidly into the normal crude oil pipeline distribution system and disseminated to refineries in the south, central and midwest areas of the country. The first five SPR sites are located at Bryan Mound in Texas and at West Hackberry, Sulphur Mines, Bayou Choctaw, and Weeks Island in Louisiana. These specific sites were chosen because of a series of geologic structures located there called "salt domes." Millions of years ago, sections of an extensive layered salt deposit were forced upward through the overlying sedimentary rocks forming underground domes. Sometimes the tops of these salt intrusions, which generally measure one to three miles across, are right at the surface or a few feet below. Other salt domes have several thousand feet of cap rock and surface sediments above them.

Salt dome storage, either in solution-mined caverns or mechanically excavated mines, is the most cost-effective approach for storing large amounts of crude oil. Each dome may contain as many as 32 man-made caverns, some reaching heights of 2,000 feet. The caverns are placed about 700 feet apart to maintain structual integrity. Each holds approximately 10 million barrels of crude oil.

The storage sites are filled with a number of different crude oils which are purchased through long term and spot contracts by the Department of Energy (DOE). The stored oil is segregated into several categories by sulfur content and gravity, so the specific crude oil needs of refiners can be met.

The Energy Policy and Conservation Act calls for a total SPR of 750 million barrels. To accomplish this goal, the SPR program is being developed in three phases with each phase increasing the overall storage capacity and drawdown capability of the reserve. The phases as designed are:

- **Phase I** — Development of five underground oil storage facilities on the Gulf Coast with a capacity of approximately 260 million barrels and a marine terminal. This phase was completed in 1980.

- **Phase II** — Expands three of the Phase I sites by 290 million barrels and is scheduled for completion in 1986.

- **Phase III** — Expands the remaining two Phase I sites and adds a sixth site at Big Hill, Texas, to accommodate an additional 200 million barrels of oil.

On December 7, 1983, the U.S. reached the mid-point in filling the SPR to its planned capacity of 750 million barrels when the reserve received its 375 millionth barrel. The current minimum fill rate as called for in the 1984 Interior Department budget is 186,000 barrels a day. The fill rate prescribed by the EPCA is a minimum of 300,000 barrels per day. However, the President has transmitted to Congress his finding that the 300,000 barrel fill rate is not in the national interest. Wishing to reduce federal expenditures, the President requested a 145,000 barrel-a-day fill rate while Congress wanted a fill rate of 220,000 barrels a day. A compromise resulted in the current rate of 186,000 barrels a day. As of June 30, 1983, total outlays from the SPR Petroleum Account for the government's fiscal year (beginning October 1, 1982) totaled $1.2 billion.

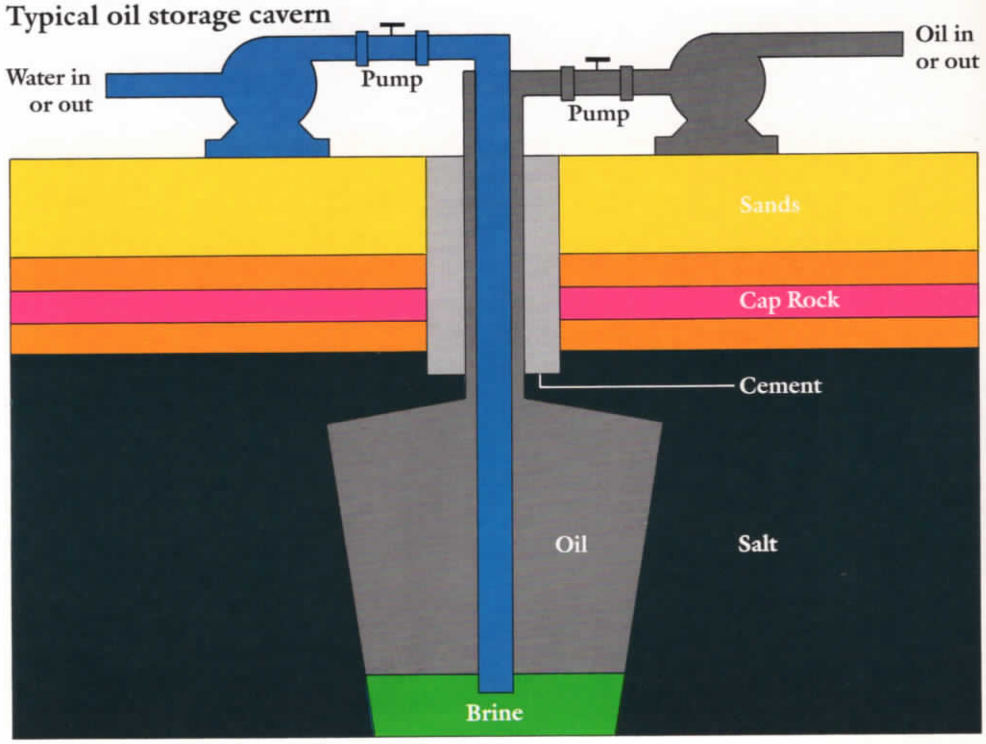
Oil to be stored is pumped into each salt cavern, forcing out brine (saltwater). The oil floats on top of the brine. To withdraw the oil, water is injected under pressure and the oil is displaced as the water level rises.

Currently, the SPR is capable of shipping 1.7 million barrels of oil per day. This drawdown capability will increase to 3.5 million barrels per day at the end of Phase II, and to 4.5 million barrels per day upon completion of the project, currently scheduled to be in 1991. The actual completion date will depend upon the annual fill rate agreed to by Congress and the President.

Oil storage terminals, like this one at St. James, Louisiana, provide access from SPR sites to major oil pipelines, and hence to refineries.

Source: U.S. Department of Energy

Typical oil storage cavern



Source: U.S. Department of Energy

While the SPR has been authorized since 1975, and the first underground storage facilities have been in existence since 1980, the SPR is still not a fully workable and proven project. The Department of Energy must still resolve several critical issues, including:

- What type of regulations are necessary to provide for the sale, drawdown and distribution of SPR oil during an actual crisis.
- Whether to await an emergency, or to implement a "forward sales" program, whereby DOE would allow purchases of SPR oil or rights to the oil in advance of an actual supply crisis.
- Whether the current language of the EPCA precludes DOE from conducting a test sale (after a test drawdown) of SPR crude; and if so, what legislative and regulatory language would provide such tests.

The EPCA requires that the President submit a report to Congress containing, among other things, a description of the strategy to determine the price and distribution of reserve petroleum products in the event of an emergency. On December 1, 1982, that requirement was met and the Administration's strategy for the SPR program established. As the basis for its strategy, the Administration chose to rely on the marketplace and not government regulation during a disruption. Competitive sales or auctions will be the mechanism by which the rights to drawdown quantities are established. Among the other provisions of the drawdown plan as it is currently proposed:

- At least 90 percent of the SPR petroleum sold in any month must be awarded to the highest bidders in competitive sales.
- The Secretary of Energy may establish minimum sales prices.
- Any interested buyers may make offers, including domestic or foreign refiners (who supply U.S. consumers), crude traders and end users.
- Disposal of the remaining 10 percent of the oil would be at the discretion of the Secretary of Energy.

The DOE must still work out details of a drawdown sale, including contract clauses, terms and conditions of sales, and financial responsibility measures, before the framework for competitive sales is fully in place. To that end, the DOE has asked for public comment on these and other drawdown sale and contract questions. However, the agency has yet to publish final rules on these provisions.

The agency has conducted several successful test drawdowns of the SPR, but these did not include test sales to the public. It is still questionable as to whether DOE can conduct test sales legally. On November 3, 1983, the DOE conducted a test drawdown over a 24-hour period at the Bryan Mound, Texas site. At the close of the drawdown exercise, site meters indicated a gross cumulative total of 1,006,870 barrels of crude oil had been drawn down. This crude was pumped to other DOE storage areas. But there is still some question as to the DOE's ability to successfully transfer this crude into the country's distribution and refining system.

This concern was reiterated by E. P. Barnett, vice president, refining & transportation, Union 76 Division's Western Region. Barnett, who currently serves as chairman of the Manufacturing Committee of the National Petroleum Refiners Association (NPRA), visited the Bayou Choctaw and Saint James terminal sites in May, 1983 as a participant in the NPRA's review of the SPR program.

"I was impressed with the quality of the facilities and capability of the personnel," he said, adding that he did not believe there would be serious problems getting the crude out of the ground and to the St. James terminal in the event of an emergency.

"The principal problem right now is political. The government still is not clear on how the crude would be sold and delivered to refiners. I think there is great merit in having the DOE conduct a test drawdown and test sale of the SPR to insure that the whole system works," Barnett said.

The SPR, the decontrol of crude oil and petroleum product prices, and the Synthetic Fuels Corporation programs for developing shale oil and other alternative energy sources all have led to real progress in reducing this nation's vulnerability to energy supply disruptions. Great strides have been made in energy conservation, total energy efficiency has increased, domestic energy reserves are being developed and our dependence on foreign energy supplies has been cut sharply. America is implementing policies to protect its energy economy from major supply disruptions and to prevent such disruptions from dictating its domestic or foreign policy.

EOR technology taps 'unreachable' crude oil

Since Edwin L. Drake's first successful oil well was drilled in Pennsylvania in 1859, oil explorers have discovered some three to four trillion barrels of oil. But we cannot use most of it. Two-thirds of those barrels cannot be produced by conventional methods. This gigantic, but so far "unreachable" reserve provides a tantalizing target for industry scientists, engineers and technicians who, beginning as early as the close of World War II, have been developing sophisticated technologies for "enhanced oil recovery" (EOR).

Despite the common belief, an oil reservoir consists not of an underground lake, but of porous rock that contains oil and gas in microscopic connecting channels. When a well is first drilled, natural reservoir pressure is usually enough to send the crude oil and gas racing up the well bore. This explains the dramatic gushers of years past before drilling techniques were perfected and blow-out preventers used. As more primary oil is produced from a reservoir, normally the pressure declines.

To offset that decline, oil producers have learned to pump water or natural gas back into the ground to keep the pressure high enough to continue oil production. While these "secondary" recovery techniques allow a well to continue producing for a period that ranges from 10 to 25 years or more, they still cannot displace all the oil.

On average, only about 35 percent of the oil in a reservoir can be produced by primary and secondary (so-called "conventional") methods.

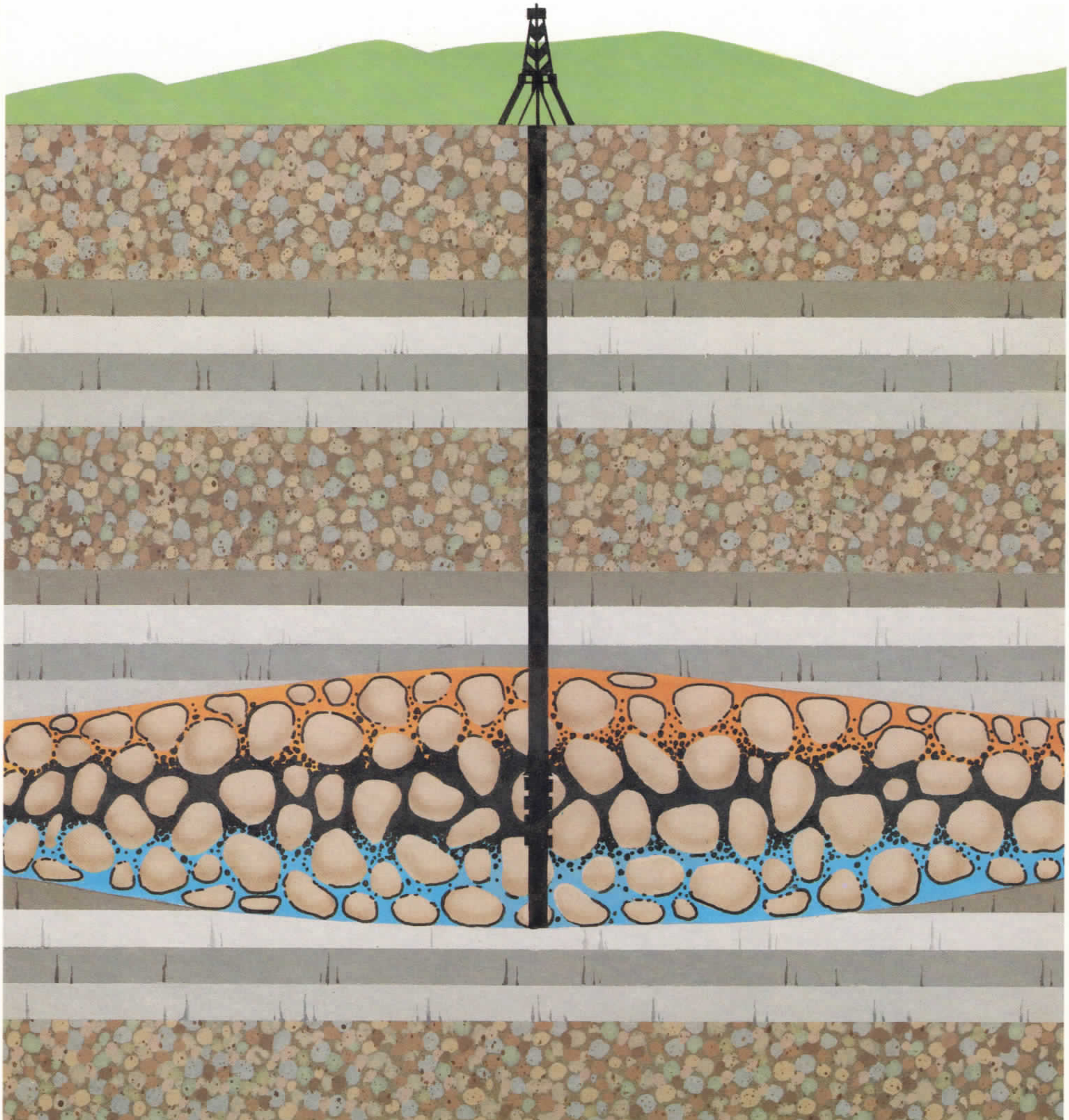
At the end of 1982, the United States had reserves of almost 28 billion barrels that could be produced by conventional methods. The U.S. Department of Energy has estimated that "enhanced" or "tertiary" techniques could reach as much as another 35 billion barrels that are not accessible by conventional means.

Enhanced recovery methods are just that—enhancements of secondary methods, according to Dr. Leo J. O'Brien, supervisor of recovery methods, Union Science and Technology Division. Heat is added by air or steam injections (for "thermal" oil recovery), different gases and higher pressures are used for gas injections, and chemicals are added to waterfloods.

EOR is risky. While there is no doubt that the oil is in the ground in a known reservoir, enhanced oil recovery results cannot be guaranteed. "Good laboratory data may support the probability of recovery, but practice in the field does not always conform to laboratory results," said Allyn T. Sayre, Jr., division petroleum engineer for the Union Oil and Gas Division. "There are just too many variables in any given reservoir. Pilot projects to evaluate field application of recovery techniques may or may not bring up enough oil to justify continuation of an experimental program or expansion on a field-wide basis."

No producer can afford to spend more money bringing oil up than he can expect to see a fair return on. So, in addition to the technological challenge, the feasibility of an enhanced oil recovery project also depends on the current market price of oil and the cost of chemical additives that may be necessary for the EOR effort. These factors vary greatly from project to project and reservoir to reservoir.

PRIMARY OIL PRODUCTION is the result of natural forces. Oil is found in the company of natural gas and water. Gas can occur both in solution with the oil, or as a gas cap that is trapped above the oil. A gas cap will seek to expand, so as oil escapes up the well bore the gas provides the push. Gas in solution with oil will expand and rise to the surface, carrying oil with it. Sometimes an oil reservoir is in contact with a water-bearing formation called an "aquifer." If the conditions are right, this formation will provide a "water drive" to help push oil. Very often, a combination of these three forces—solution gas drive, gas cap drive and water drive—exists in the same reservoir.

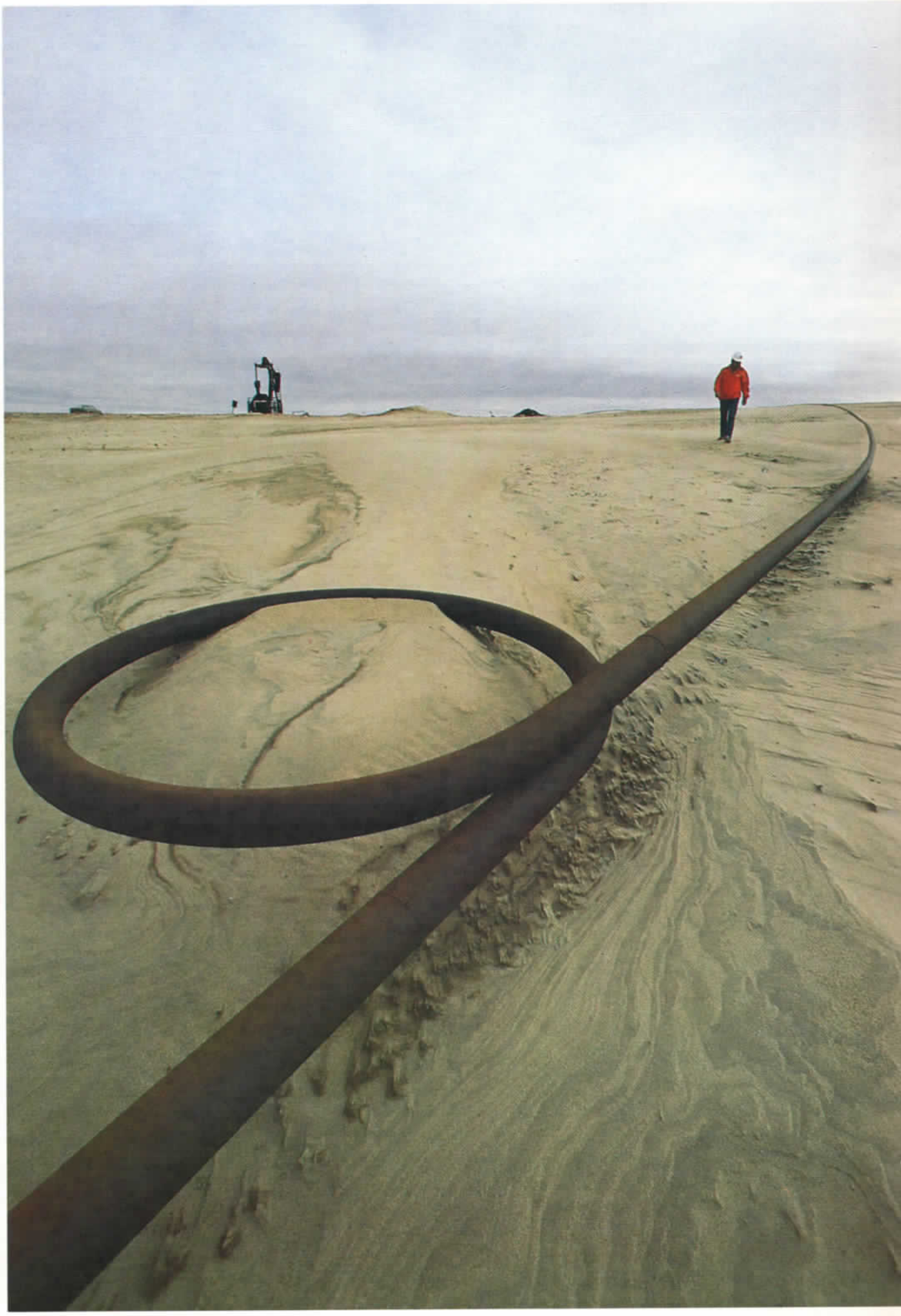


Before the operating divisions begin programs to evaluate tertiary recovery methods, the Science and Technology Division does a lot of preliminary investigation. This includes thorough analysis of the reservoir and the crude oil to determine which enhanced recovery method will be best for a certain set of conditions. Every reservoir, and the crude oil it contains, has its own set of distinctive characteristics that will respond differently to EOR techniques.

Thermal recovery methods involving the injection of heat into a reservoir are one approach to producing sluggish crude oil, particularly the heavy crudes of California. Both steam injection and in situ (in place) combustion add heat to the reservoir resulting in a reduction in the viscosity of the oil so that it flows more easily to the production wells.

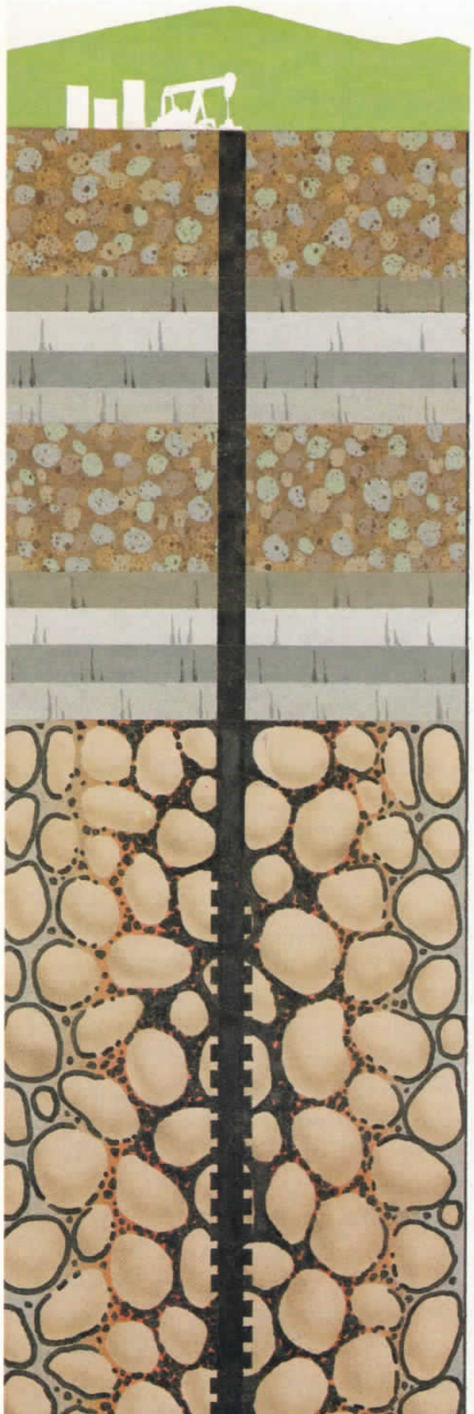
Steam can be injected in a continuous drive which will push oil to surrounding producing wells. Or, it can be injected on a cyclic basis, also called "huff and puff," into one well, which alternately injects steam and produces oil.

In situ combustion is a process in which air is injected into the reservoir. Under the right temperature and pressure conditions, the oxygen in the air will ignite the crude oil. This radiates heat and forms some chemical solvents which serve to mobilize the oil and push it toward production wells.

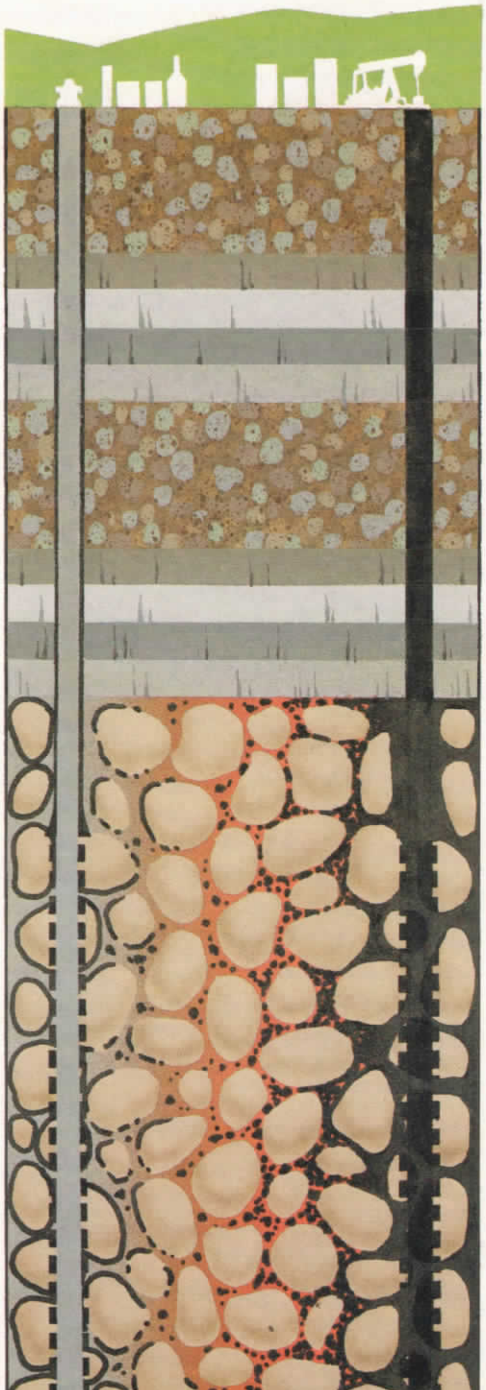


The loop allows the pipe to expand and contract as it carries steam to a well for a thermal enhanced oil recovery project.

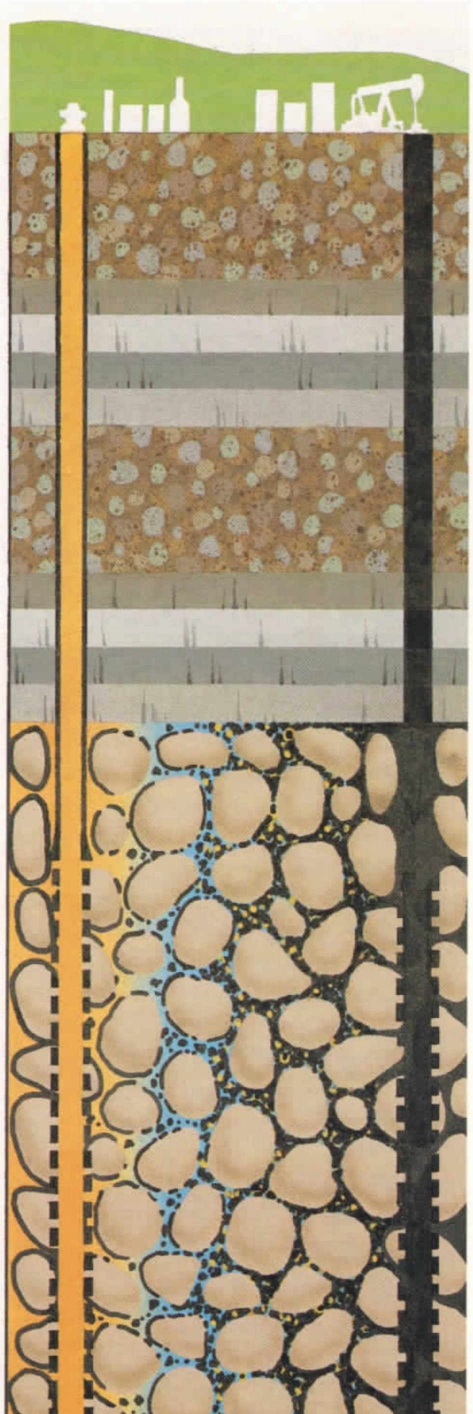
HUFF AND PUFF—In thermal oil recovery, heat is added to the oil reservoir. This is very successful in reducing the viscosity of heavy oils so that they flow more easily. In a cyclic or "huff and puff" injection, steam is injected into the producing well for a time, then the heated oil is produced from the same well.

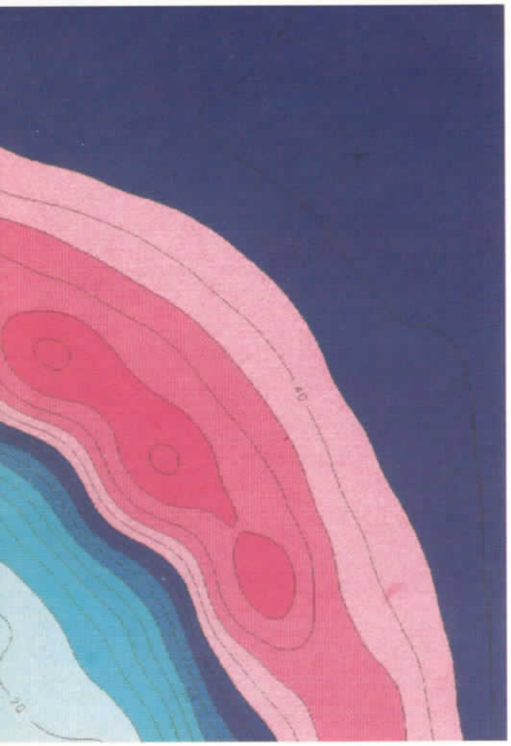


STEAM DRIVE is another successful thermal oil recovery technique. Steam is injected continuously into wells spaced at intervals around the producing well. The heat thins down the oil and, as the steam condenses into hot water, it provides an effective push toward the producing well.



MISCIBLE GAS INJECTION—Hydrocarbon or non-hydrocarbon gases (such as carbon dioxide and nitrogen) are injected into the reservoir at high pressure, extracting hydrocarbon solvents from the crude oil contacted. The resulting solution of enriched gas then pushes oil toward producing wells.





This computer generated oil saturation profile shows the projected course of a caustic waterflood through a reservoir that has been "watered out" by a secondary waterflood. The caustic flood (blue) moves away from an injection well, pushing an oil bank (pink) toward production wells.

In the last 10 years, the Union Oil and Gas Division has proven the commercial success of steam as a recovery method on numerous California leases. The normal procedure is to start with a huff and puff operation, and this has been successful primarily in the Midway-Sunset and McKittrick areas of the San Joaquin Valley, the Guadalupe field in the Santa Maria Valley, the South Tapo field in the Simi Valley—and also in South Casper Creek, Wyoming. When huff and puff has been successful and other conditions are right, steam drives are started. Steam drives are now in operation on some properties in the Midway-Sunset, Guadalupe and South Casper Creek fields with others being considered. If these projects continue they could result in an additional recovery of 10 to 20 percent of the oil in place, according to Sayre.

The company's impressive record in applying enhanced oil recovery techniques to the production of heavy oils has led the government of Argentina to invite Union Oil to be the operator of a thermal recovery project now underway in that country's Llancanello field in the Mendoza Province. The project, operated by the International Oil Division, started up in 1983 and is still in the experimental stages.

The California heavy oils that respond well to thermal recovery methods are very thick with a consistency like molasses. Union Oil Company of Canada has an even stickier problem in a massive field in northeastern Alberta. There the oil is called "bitumen" and is practically solid. But, the initial results from a huff and puff steam pilot project are very encouraging, and very exciting if the potential can be realized.

Another promising EOR technique is miscible gas injection. "Gases are injected at pressures from 3,000 to 6,000 pounds per square inch, even higher for nitrogen," O'Brien said.

"Miscible" means that the injected gas or liquid mixes completely without separation in the crude oil, forming a zone of enriched hydrocarbons that will then push crude oil to a producing well. Fluids used for miscible injections include natural gas, propane, liquid hydrocarbons, carbon dioxide and nitrogen.

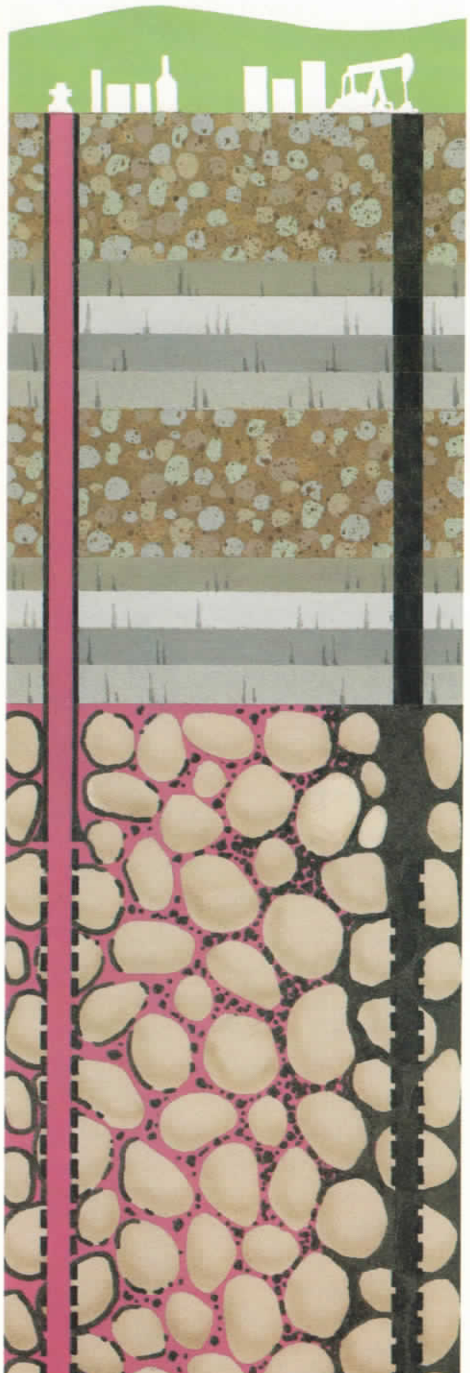
The Oil and Gas Division is currently conducting a natural gas miscible injection at West Poison Spider in Wyoming, and a second miscible project using natural gas and nitrogen at the Chunchula field in Alabama. "These miscible injections work well with the lighter, mid-continent crudes," said O'Brien.

Immiscible gas injection projects are more appropriate with the heavier oils and lower pressure reservoir conditions found in some western oil fields. Under these conditions the injected gas displaces the oil, much as it does in secondary recovery projects, but nitrogen or carbon dioxide is substituted for natural gas. Union has met with promising results using nitrogen in an immiscible injection project in the Lisbon field in Utah, and using carbon dioxide at Hualde Dome in California.

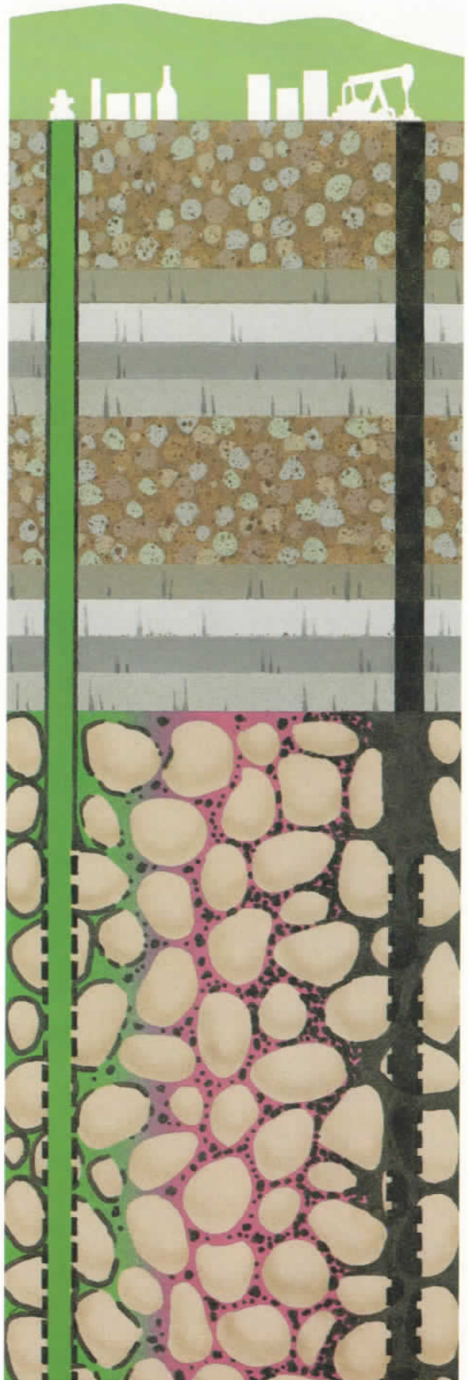
SURFACTANT WATERFLOOD—Interfacial tension is the scientist's term for the force that holds an oil droplet together when it is suspended in water. A surfactant, which is a kind of detergent, breaks down this tension so that very small oil drops are formed. Adding surfactant to a waterflood makes the oil move through the microscopic pores in the reservoir rock more easily so that it can be produced.

CAUSTIC WATERFLOOD—In some oil reservoirs, low-cost caustic chemicals will serve the same function as surfactants. If the crude oil contains enough of certain petroleum acids, these acids will combine with the caustic to form insitu surfactants.

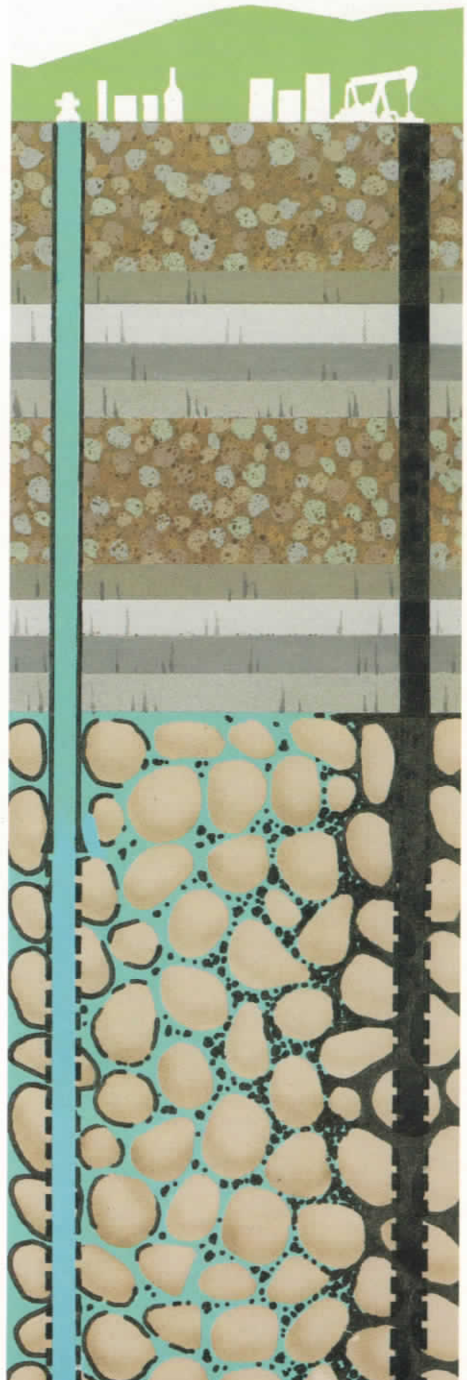
POLYMER WATERFLOOD—When polymers are added to a waterflood, they thicken the water so that it moves more evenly through the reservoir pushing oil ahead of it.



SURFACTANT **OIL**



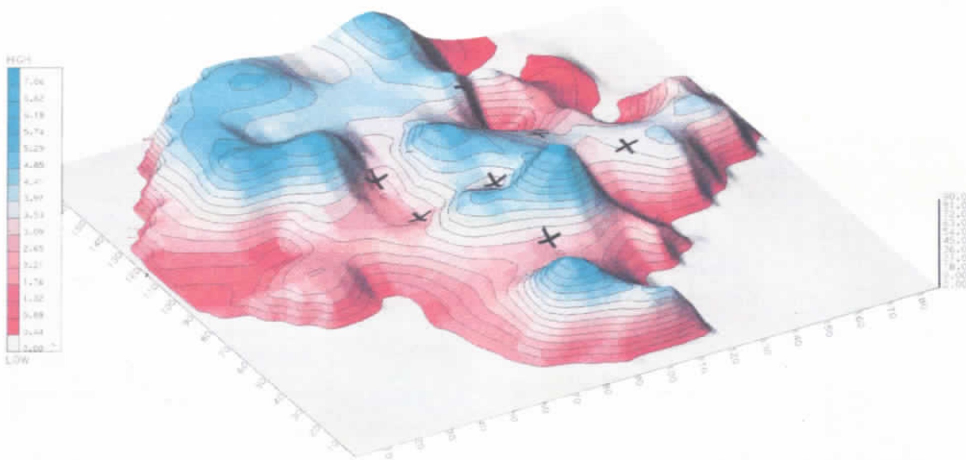
CAUSTIC **SURFACTANT** **OIL**



POLYMER **OIL**

Computer generated print-outs developed from well core data give researchers and reservoir engineers a "look" underground to help them evaluate EOR techniques. This print-out shows porosity variations in the Chunchula field in Alabama where Union is currently conducting a miscible gas flood in which nitrogen and natural gas are being injected (top).

Well cores provide EOR specialists with valuable information concerning reservoir characteristics (bottom).



"We try to use the lowest cost materials available in enhanced recovery projects because we cannot apply a process unless it can generate a profit," O'Brien said. "This concern for economy led us to explore ways to improve waterflooding, which has been a successful secondary recovery method for more than 50 years."

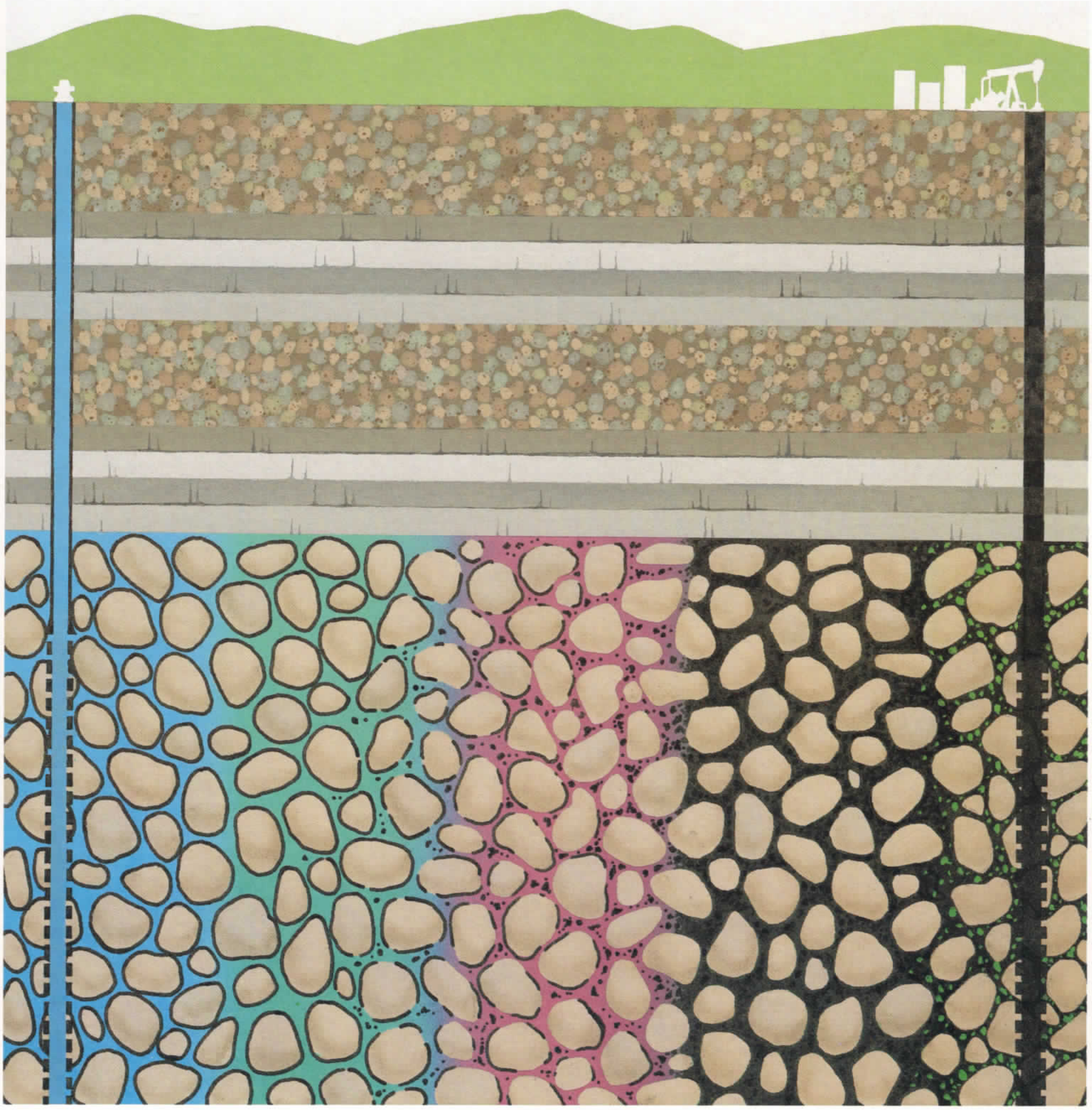
The addition of low-cost caustic chemicals, such as sodium hydroxide, sodium silicate or sodium carbonate, creates a detergent effect in the reservoir. If certain petroleum acids are present, caustics will react with them to form "surfactants," which are detergents and act to break down oil droplets so that they will squeeze through the microscopic pores of the reservoir rock more easily. If the composition of the crude oil is such that caustics will not produce the desired detergent effect, slightly more expensive surfactants may be added to the waterflood.

Union is currently conducting caustic waterfloods at Orcutt in California and at three sites in the Van field in Texas. It is too early to report results.

A waterflood may also be enhanced with the addition of polymers. This makes the water more viscous, or thicker, so that it moves more evenly through the reservoir and displaces more oil. "Under proper conditions, enhanced waterfloods cause a measurable increase in recovery. Polymers are more expensive than caustics, but you can use relatively less to get the desired effect," O'Brien said.

The best features of waterflooding have been combined in Union Oil's patented Uniflood process. A project using Uniflood is now underway in a field near Coalinga in California's San Joaquin Valley.

UNIFLOOD—Union's patented Uniflood process combines enhanced waterflood methods. In the first of four steps, a chemical preflush slug is injected into a reservoir. The term "slug" refers to a specific amount of material injected over a definite period of time, usually four to six months. Next, a surfactant slug is injected, followed by a polymer slug to push along the mixture of chemicals, water and oil. Finally, "unenhanced" water is injected. This is an economy measure, adding pressure but assuring that only the smallest amounts of chemicals necessary are used.



WATER | POLYMER | SURFACTANT | OIL | CHEMICAL PREFLUSH

Uniflood is a four-step process that begins with the injection of a chemical preflush "slug," which means a specific amount of material to be injected over a specific period of time (probably four to six months). This is followed by a "micellar" (surfactant) slug, and these two injections have the effect of scrubbing the oil from the parts of the reservoir they contact. Next comes a polymer slug to push the oil toward producing wells.

"At the end we switch to water as an economy measure. In this way, we use the smallest amounts of chemical additives necessary to do the job," O'Brien said. It is not uncommon in the industry to combine enhanced recovery methods, but Uniflood is unique—as evidenced by the patents, which cover the composition of the chemical preflush and micellar slugs.

In the lab, Uniflood has succeeded in total recovery of the oil in a simulated reservoir—a pressurized tube of densely packed sand. Estimates are that Uniflood will raise field recovery rates to 40 to 45 percent of the oil left after a conventional waterflood.

Union's researchers are now looking into a new area for enhanced recovery possibilities as they seek to find ways to reduce "channeling" of injectants such as water, gas or steam. As an injectant moves oil through a reservoir it follows the paths of least resistance, forming channels. Subsequent fluids move through the same channels, picking up some residual oil but leaving a lot behind. To increase the contact of enhanced waterfloods with the remaining oil, O'Brien's team is working on the use of foam and polymer gels to block channels and force injected fluids into areas where there may yet be untouched oil.

"It has taken a long time to develop many of our enhanced recovery methods," O'Brien said. "The first patent for the Uniflood process was granted in 1962. That patent has since expired and the process has changed."

Research and field experiments for a specific EOR project consume from three to five years on average, making it an expensive front-end proposition. Until recently, crude oil has been as effectively locked underground by economics as by natural causes. Ten years of domestic oil price controls (1971—1981) and 25 years of cheap foreign imports made application of many EOR techniques unfeasible.

The turning point came in 1979. "The necessity of stimulating domestic supply to lessen our dependence on foreign oil was made obvious by events of the 1970s," said Francis J. Barker, vice president of operations for the Oil and Gas Division. "So, Congress gave the oil industry tax relief and other economic incentives to spur activity in enhanced recovery."

The Department of Energy's Front-end Recoupment Program of 1979 allowed producers to recoup up to $20 million for each enhanced oil recovery project. Recoupment was almost immediate, resulting from the authorized sale of price-controlled oil at higher market-level prices.

Shortly after crude oil price decontrol occurred in January 1981, the Front-end Recoupment Program was ended. EOR project activity declined somewhat nationally, although the Windfall Profits Tax Act of 1980 offered tax incentives on incremental oil from certified EOR projects. This incremental oil is taxed at a 30 percent rate, rather than the usual 60 or 70 percent rate.

"Some projects are uneconomical even with the tax incentive, but others can be pursued with an expectation of a reasonable return," Sayre said. "The reduced tax translates to an average of $5 per barrel for the oil producer, but it does nothing to help defray our large front-end development costs. The financial incentive is obtained during the remaining life of the project after development work has been completed and production has begun."

Under the Front-end Recoupment Program, Union Oil began 30 projects and, under the Windfall Profits Tax incentive program, has initiated an additional 16. Plans call for 12 more enhanced recovery projects to begin in the next two years.

Estimates are that these projects will increase Union's oil recovery by five to 15 percent of the original oil in place, which could add millions of barrels of oil to the company's future reserve base, according to Sayre. EOR technology can mean a significant increase in domestic oil reserves, as well as more industry jobs, expanded markets for chemicals and higher government tax revenues.

Thermal methods are appropriate for the production of very heavy oils. Other enhanced oil recovery methods have been developed to match other types of crude oil and the conditions of their reservoirs, all with the purpose of getting more of the 65 percent of the crude oil that is left behind after conventional production (opposite page).

The Spirit of '76 Wins the Anniversary Trophy

Union Oil Company's entry in the 95th Tournament of Roses was honored by the judges as the best depiction of life in America. More than one million people gathered in Pasadena on January 2 to watch the world famous parade, whose theme was "A Salute to the Volunteer." Union's float, the company's 42nd entry, saluted those courageous volunteers of 1776, the Minutemen, who fought for America's independence.

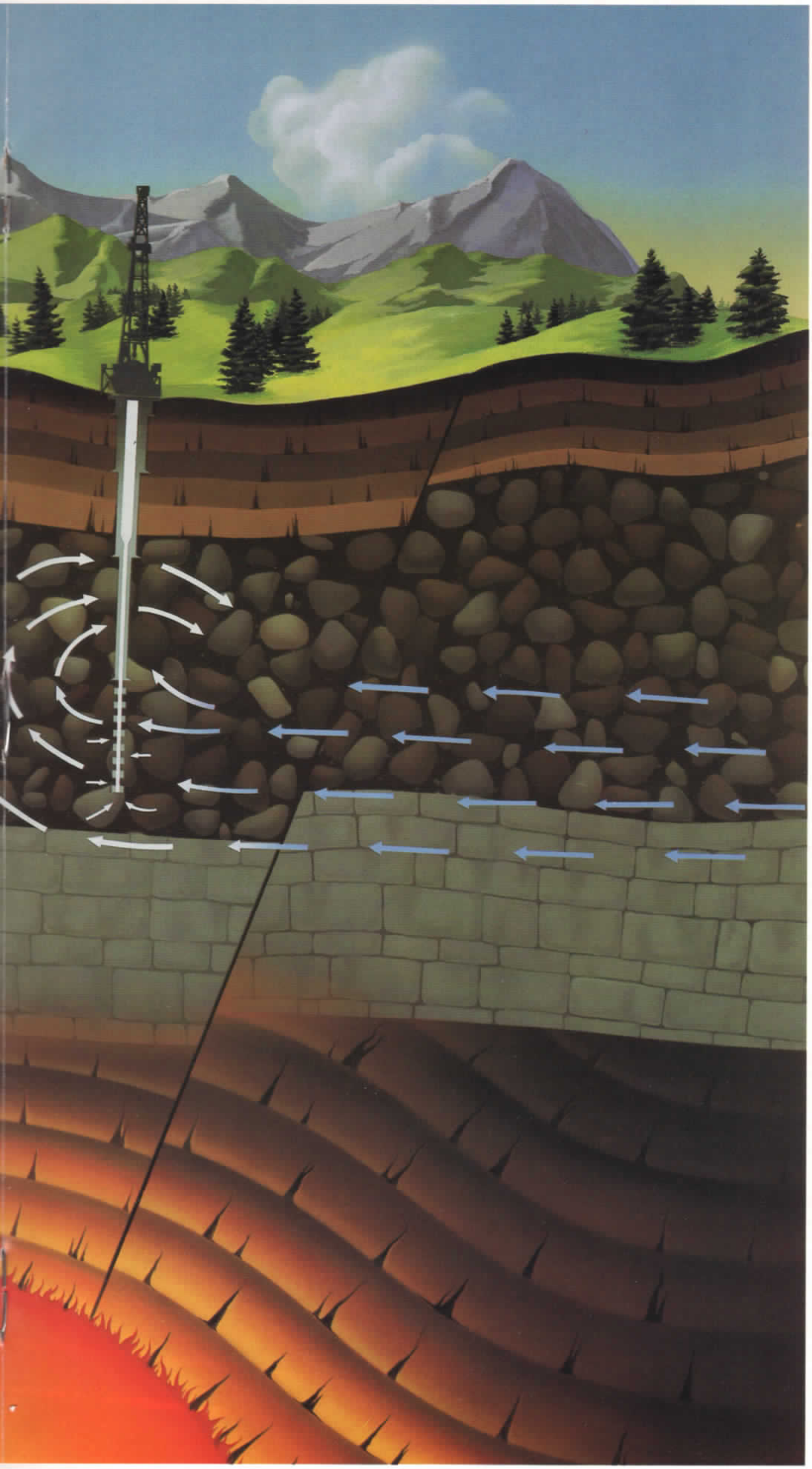
More than 100 other volunteers proved valiant in a different struggle—getting the float covered in flowers in time. Working two eight-hour shifts daily, youth groups from the Cupertino Presbyterian Church and Glendora's Glenkirk Presbyterian Church put every petal, flower and seed in place in six days. The float was covered with poinsettias, gladiola, statice, chrysanthemums, strawflowers, carnations, cattleya orchids, clover and onion seed, melaleuca bark, cornhusks and, of course, roses.

Raul Rodriguez designed the float and Fiesta Floats built it.


The Spirit of '76


PLURIBUS


The Spirit



GEOTHERMAL UNION'S ENERGY ICEBERG

Persistence in a new industry—especially one rife with technical problems—has made Union Oil the world's largest producer of geothermal energy. The achievement is more remarkable for having been done in less than 20 years. From the desert region of the Salton Sea, to the rolling hills of northern California, to the tropical jungle of the Philippines, and elsewhere, Union has developed the technology to harness power from different geothermal sources, each presenting tough, new problems in exploration, drilling and production.

Geothermal energy is the natural heat of the earth contained in reservoirs of steam or hot water deep below the earth's surface. Magma or molten rock deep in the earth rises towards the surface, heating the fluids trapped in the porous rock above. The steam or fluids from these areas can be recovered by a method similar to that used in drilling oil and gas.

The Geysers in Sonoma and Lake counties, California, is the world's largest developed geothermal project. In a joint venture with Natomas, which had acquired the assets at The Geysers of Magma Power and Thermal Power, Union is the principal operator of expanding projects on over 21,000 acres in this volcanic area about 75 miles north of San Francisco.

Heat radiating upward from magma deep in the earth raises the temperature of the porous reservoir rock above it. Any water present in this formation is heated and rises to where it can be reached by drilling rigs. The steam produced by the wells is piped to electrical generating plants to turn the turbines.

The beautiful Geysers countryside is spotted throughout with fumaroles, natural breaks in the earth's surface from which steamy vapors rise.

The area had become one of California's most popular mineral hot springs resorts by the early 1900s, a favorite haunt of presidents, famous writers, royalty and, yes, oil magnates. Little did they know that half a century later the underground heat source for the waters they were bathing in would be part of a complex that provides electricity to well over one million Californians.

The first power from The Geysers was drawn in 1922 by Healdsburg contractor, John Grant, who drilled two steam wells into the fumaroles to generate electricity for the resort buildings. However, a temporary overabundance of hydroelectric energy on the West Coast, similar to the one we are now experiencing, forced him to abandon his venture as uneconomical. His makeshift drilling rig came to be known as Grant's Folly. But, like Seward's purchase of Alaska, this "folly" eventually turned out to be a major source of energy for the western United States.

Not until 1955 did activity at The Geysers resume when Magma Power Company employed modern drilling equipment to find commercial quantities of steam. Thermal Power Company joined Magma in 1956, and in 1958 the two companies entered into a steam sales agreement with Pacific Gas & Electric Company. PG&E's 12,000 kilowatt unit No. 1 was the precursor to today's area total of 19 plants generating 1,366,000 kilowatts.

Union's involvement in the project began in 1965 at the time of its merger with Pure Oil. Dr. Carel Otte, who had been in charge of Pure's geothermal operation, then came on board to direct Union Oil's geothermal activities.

When Union came to The Geysers, the drilling activity was shallow and situated close to the fumaroles. "Dick Dondanville, now our district exploration manager, and Dr. Otte suspected there was a deeper, more extensive steam reservoir. So we drilled at different locations and much greater depths," said Steve Lipman, current district operations manager of Union's Santa Rosa office. "The outcome was that Union proved that the primary Geysers resource was a lot bigger than had been thought."

Since that beginning, the story has been one of expansion, increased production, and profitability. "Our success at The Geysers keeps compounding," continued Lipman. "During 1983, we reached record electrical generation and we see nothing but further expansion in the next few years to come."

Union now supplies steam power to 15 PG&E generating units at The Geysers. Recent growth includes the start-up of commercial production on two units, one in late 1982 and one in early 1983. Construction began on another unit last summer which should be operating at the end of 1985. Union and PG&E are now preparing the documents for permitting another unit, scheduled to start construction in 1985, and Union has already discovered the reserves for an additional unit.

"We will likely see The Geysers field fully explored by 1990," said Lipman. "Union currently produces energy for 984,000 kilowatts of electricity. We're looking at a potential development of more than two million kilowatts for the entire field."

The success spreads to the community as well. In 1983 alone, the Union/Natomas venture paid property taxes of $13,700,000. Roughly $4 million more was paid by other operators and utilities. And during the construction season, with the added crews, employment on The Geysers hill can reach as high as 2,500. During the winter employment levels off at around 1,000.

The Geysers is the world's showplace for geothermal development. "We're visited by researchers and scientists from all over the world. These experts want to see firsthand the methods we've developed to take the energy from deep within the earth and turn it into a profitable business venture," said Lipman.

Even Italy, which developed its geothermal resource long before anyone else, recently sent representatives to The Geysers to learn Union's methods for injecting the condensate back into the earth. Injection is a process by which the fluids brought to the surface, after being used for power generation, are used for cooling water and the residue is put back into the earth through injection wells. These fluids get reheated in the earth and can be recycled as long as they last. The fluids would also present a disposal problem if not re-injected.

"Injection is an integral part of our process," said Lipman, "but one the Italians had never had to use until recent environmental legislation required them to do so."

The Geysers, located about 75 miles north of San Francisco near California's famed wine country, is the world's largest geothermal development. Nineteen plants generate 1,366,000 kilowatts of electrical energy.

Long before Union became involved at The Geysers, the company had been considering the development of another California geothermal resource: the Imperial Valley. The fluids from this resource have an extremely high saline content though, which causes problems in production. Since the dry steam from The Geysers presented fewer technical problems for an initial, full-scale venture, the Imperial Valley project was postponed and the company concentrated on developing The Geysers in this country and the hydrothermal resources in the Philippines.

With the knowledge and confidence gained from its technological successes elsewhere, Union decided to go back to the Imperial Valley to tackle the problems and develop the resource.

The salty brine and high level of solids in the Imperial Valley fluids cause severe corrosion and scaling (buildup of solids) in the pipes. Working with such a resource is expensive and time-consuming, requiring experimentation with a number of chemicals and special metals and processes to reduce the scaling and corrosion. The problems defy easy solution.

Olin Whitescarver, Union's district operations manager in the Imperial Valley, who earlier had been with The Geysers project, knows the true meaning of perseverance in research from his five years in the valley: "There are no tried and true ways to solve the problems," said Whitescarver. "And there is no substitute for experimentation in the field. We've got to try out everything under actual production conditions."

Union's Imperial Valley projects are within 45 minutes driving time of each other: one at Brawley, one at the Salton Sea, and one at Heber.

When the Brawley plant came on line, it was the first venture to prove that the Imperial Valley's saline fluids could be used to produce energy successfully and continuously. Since the potential resource is vast, Union's expenditure of time and money to build up expertise and develop the resource has been worthwhile. "As Mr. Hartley [Union's chairman and president] has stated," said Whitescarver, "the valley is the 'Saudi Arabia' of geothermal energy resources. We're up and running here, but we are also committed to improving the efficiency and economy of our operations. We're now in the 'perfecting' phase."

Located on the shores of this country's own version of the Dead Sea, the Salton Sea plant is adjacent to the Salton Sea National Wildlife Refuge and bordered on two sides by the verdant agricultural fields of the Imperial Valley, the southwest's breadbasket. The plant opened in late 1982 and has been providing enough energy to Southern California Edison to generate 10,000 kilowatts of electricity.

Again capitalizing on our own experience, Union incorporated many of the technological breakthroughs learned at the nearby Brawley plant into the Salton Sea operation. "What we learn in one place helps us in another," said Whitescarver.

The geothermal resource of California's Imperial Valley has vast potential, although the salty brine and its high level of solids present special technological problems. On the facing page, insulated pipes carry brine from wellhead separators to the Salton Sea plant.

Despite the technical problems involved, geothermal is competitive with other energy sources and, in many cases, is less expensive to produce. Countries that don't have indigenous fossil fuels but do have a geothermal resource consider the development of that resource as an insurance policy against the volatility of world oil prices. Geothermal development is also a way to boost employment at home and protect foreign currency reserves.

One of the first countries to recognize the benefits of developing its geothermal resources was the Philippines. In the early 1970s, Union entered into an agreement with the Philippine National Power Corporation to explore and develop the resource on the island of Luzon.

Operating under a wholly owned subsidiary called Philippine Geothermal, Inc., Union has developed the Makiling-Banahao and Tiwi fields into the world's second largest geothermal operation. This is also Union's first development of a hydrothermal resource, as distinguished from a dry steam field like The Geysers.

There have been unique technological challenges in the Philippines, too: special problems in separating the steam from the brine and in transporting the steam to the power plant. But the geothermal fields of the Philippines are reservoirs of low salinity and moderate temperature, so production problems have been fewer than in the Imperial Valley.

"Our operations have grown quickly over the years and we now supply steam to 10 Philippine National Power Corporation units which provide a total of 550,000 kilowatts to the Luzon electrical grid. That's enough geothermal energy to supply about 25 percent of the island's electricity needs, reducing the Philippines' dependence on foreign crude oil imports by almost 7½ million barrels a year, a savings of roughly $200 million," said Chet Budd, vice president of Union's foreign geothermal operations.

Union's other foreign operations include a contract to explore and develop a geothermal field on the island of Java in Indonesia. On Hokkaido, Japan's northernmost island, Union has just finished its third season of drilling temperature gradient wells in preparation to drill a deep production test well.

Union is looking elsewhere, too. There are any number of areas around the world with the right geological conditions for geothermal production.

The methods for identifying these areas grow more sophisticated all the time. Union now relies on remote sensing devices and computer-generated satellite maps for bird's-eye views of fault areas where the earth's heat is close to the surface.

"Union's geological and production expertise has grown impressively in a very short time because of the intensity and scope of our worldwide operations. Our willingness as a company to take the risks inherent in developing a new resource, combined with the knowledge we've accumulated over the years, enables us to continue to lead the geothermal industry," said Dr. Otte, president of the Geothermal Division. "We now know how to structure a plant and develop a resource under the absolute toughest of circumstances. I guess you could say we wrote the book—and we'll keep on writing it as we learn more from each new project.

"We have every reason to believe that the world's geothermal resources are vast. We're sitting on top of an energy iceberg...a hot one, but one we know best how to develop."

Union's Philippine geothermal projects supply about one quarter of the electricity for the island of Luzon. As with all geothermal developments, power generating plants are located near the resource to reduce heat and pressure losses that would result from long-distance transportation of the steam. On the facing page, loops in the insulated piping allow for expansion of the pipe as the steam travels to the electrical generating plant.

ICE MELTS ENERGY COSTS

While much of the nation is suffering from below freezing temperatures this winter, Union's Fred L. Hartley Research Center in Brea, California is actually making ice to keep cool.

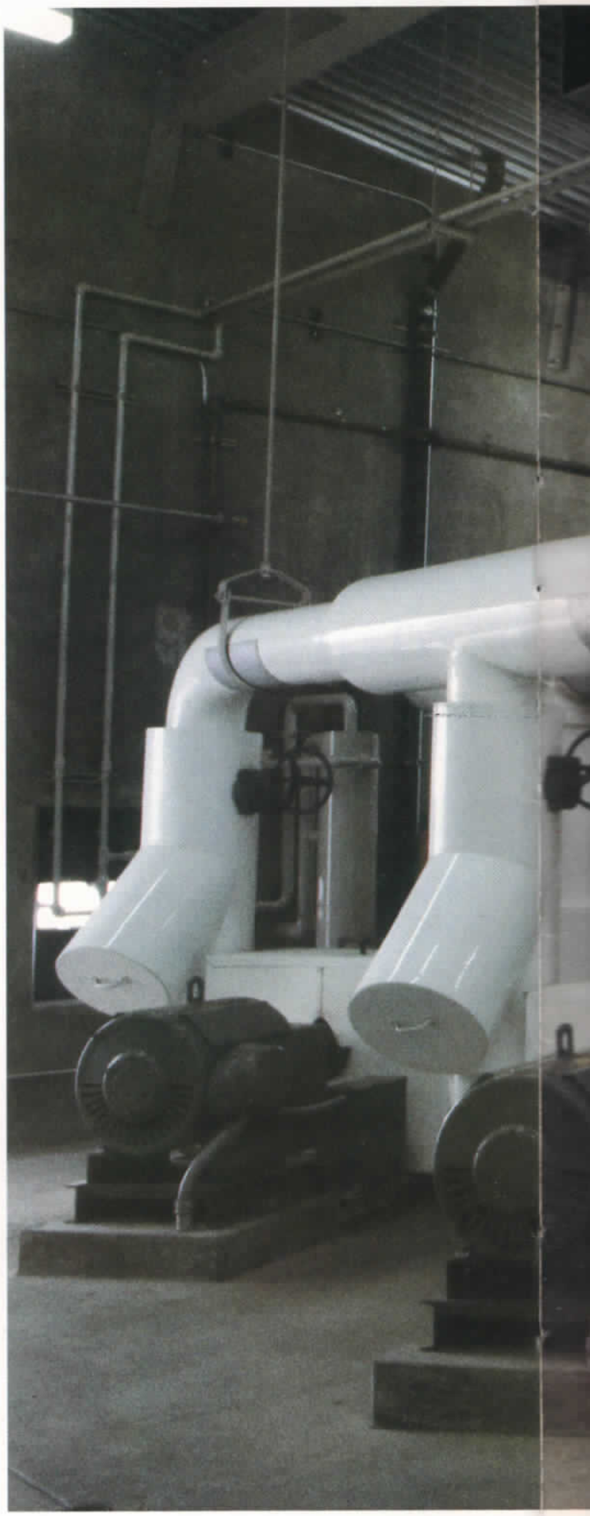
The largest ice-bank cooling system in the state, and possibly in the world, can make up to 1.1 million pounds of ice a day to keep the nearly one thousand people who work at the research center comfortable. The system is economical, drawing power at night and in the early morning when the demand on regional supplies is light and the cost of energy is lowest.

"The ice-bank system has been one of the most cost effective of the energy management programs at the research center," said Hugh Haven, senior research engineer. "When we were planning the ice bank, we estimated annual energy savings for the new system as compared to a conventional system of some $103,000. The system cost an estimated $300,000 more to install than a conventional refrigeration system would have, so we were able to predict that it would pay for itself after the first three years of operation."

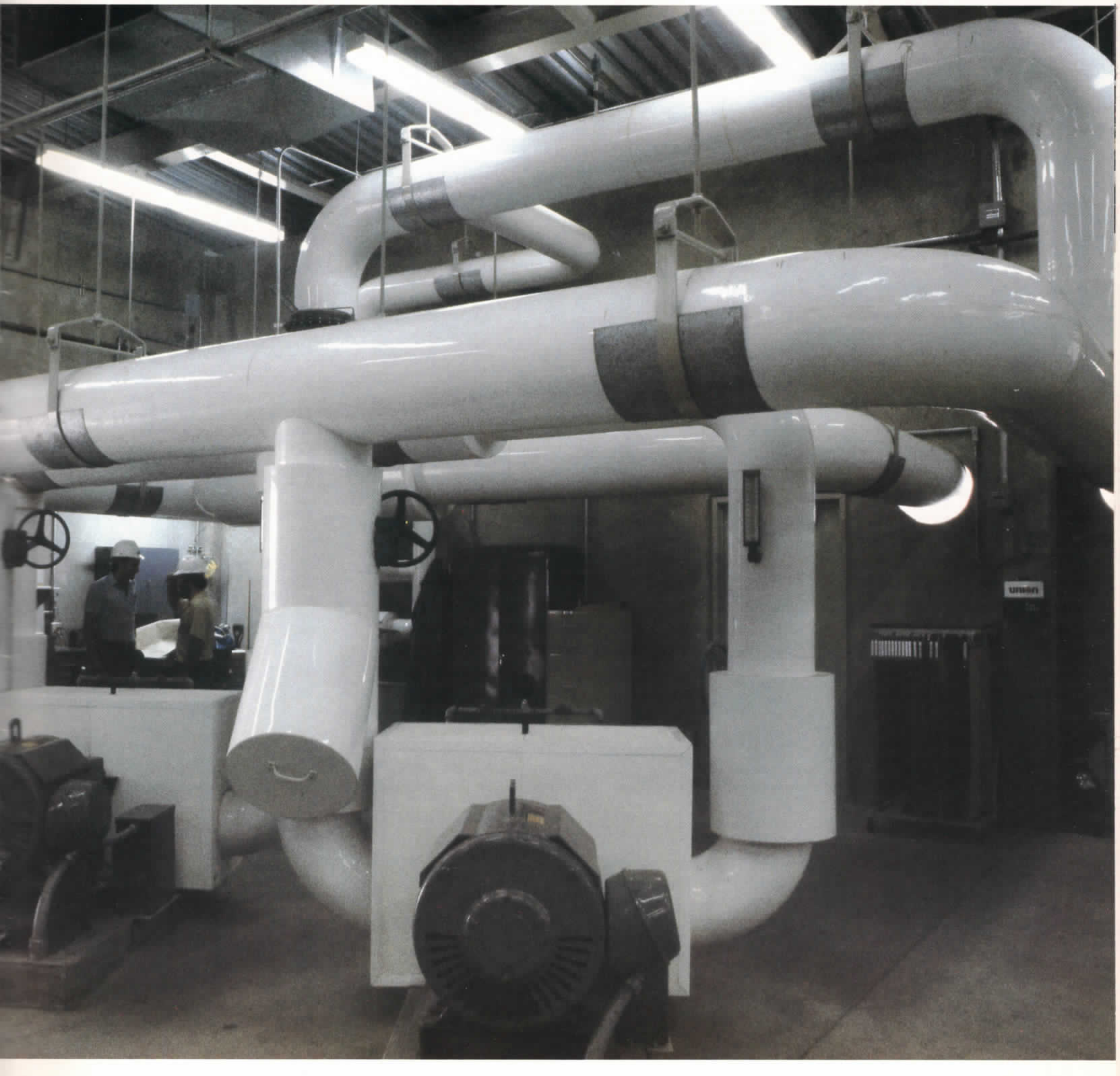
The ice-bank system is part of the $32-million expansion of the research facility that was completed in September of 1982. The expansion added 156,000 square feet to an existing 265,000 square feet of offices and laboratories. The existing air conditioning system was due for replacement, and the new system would have to meet a greater demand for air conditioning.

The architects for the research expansion, William L. Pereira Associates, designed the additions for energy efficiency. For example, the new administration building features reflective glass, overhangs above large windows, careful placing of windows to avoid direct glare from the sun, high efficiency lighting, and good insulation. While these measures serve to keep outside conditions from heavily influencing interior conditions, they also help contain heat produced by lighting, machinery, direct sunlight and the human occupants.

So, as is often the case in moderate climates, air conditioning is nearly a year-round necessity in Brea—and not just for people. The computer facility alone requires 50 tons of air conditioning capacity to remain operational. (A ton of refrigeration is equivalent to the heat absorption capacity of one ton of ice melting in a 24-hour period.) Air that is circulated to cool the computer and its related equipment begins at 55 degrees Fahrenheit and emerges 30 degrees hotter.



Water circulation pumps send cold water from the ice bank throughout the research center buildings. The cold water passes through air handlers in every location, absorbing heat from the air and returning to the ice bank to be rechilled.



Hugh Haven (left) *and Mike Brewer would not be standing between the ice-bank compressors without ear protection if the machines were operating. The noisy machines are housed in a concrete building, insulating them from both the research center's employees and neighbors. The compressors run during late night and early morning hours when the cost of energy is lowest.*

To meet the projected demands of the research center, the new air conditioning system is designed to deliver 1,900 tons of refrigeration. The careful reader will note that the 1.1 million pounds of ice that the system can produce daily is equal to only 550 tons of ice. However, this can be made to melt in much less than 24 hours, absorbing enough heat in the process to deliver 1,900 tons of refrigeration.

One of the keys to achieving energy economy is to draw power during "off-peak" periods of usage late at night and early in the morning. Large customers in Southern California Edison Company's 50,000-square-mile territory are subject to time-of-day rate structures. During the summer, defined by Edison as June through October, the greatest demand for energy occurs midday when everyone turns on their home air conditioners. In the winter, as the days grow shorter and colder, demand shifts to evening—between 5 and 10 p.m.

In an effort to manage the load and delay the need for construction of more power plants, Edison charges its large customers more for energy used during periods of high demand. In this way, Edison encourages conservation and new approaches to energy management. It works with its customers to develop conservation programs, including the use of energy storage systems to meet large air-conditioning needs.

So, how can you create "cold" during the off-peak hours and then store it for use? There are several ways, but Union wanted a new system that would be compatible with the chilled water distribution system that was already in place throughout much of the complex.

"I had some familiarity with an ice storage system and, in our initial discussions with the Edison representatives, it was one of the most promising alternatives. We could continue to use our water circulation system, and an ice bank would take up one-eighth the volume of a chilled water storage system," Haven said. "Edison referred us to a commercial refrigeration firm experienced with such systems."

Union Oil asked its consulting engineer to evaluate the alternatives. The utility rate structure, combined with projections of operating and construction costs, added up to an advantage for ice storage over both water storage and a conventional system for "on-demand" refrigeration.

The phrase "ice storage system" calls up visions of ice blocks stacked in a warehouse—but that's nothing like the real picture. The ice bank is enclosed in two huge steel tanks, each measuring 60 feet long, by 40 feet wide, by 11 feet high. Together they contain 11 ice-making coils with room for one more when the expanded capacity is needed.

The coils twist back and forth in the tanks for a combined distance of more than 16 miles. Each coil is made of steel pipe that is 1⅝ inches in diameter and 7,700 feet long. The two tanks hold three million pounds (360,000 gallons) of water.

The ice bank's two huge steel water tanks are located above ground for easy maintenance and reduced potential of earthquake damage (top).
Circulation pumps continuously recycle chilled water, which leaves the ice-bank tanks at about 34 degrees Fahrenheit and returns some 18 degrees warmer (bottom).

Joe Oliverio (left) *and Forrest Duddles measure the ice formation on coils in one of the ice bank's steel tanks. The small tanks to their left hold the ice-forming refrigerant, ammonia.*

In order to lower the temperature of the water to form ice, it must be put in contact with something colder, a refrigerant. The Second Law of Thermodynamics puts it simply: "Heat is always transferred from a hot body to a cooler one."

Ammonia is the refrigerant used in Union's ice bank because of its high efficiency and low cost. Ammonia boils (changes from a liquid to a gas) at very low temperatures, lower than the 32-degree temperature at which water freezes.

Heat is required to turn a liquid into a gas, an obvious conclusion to anyone who has boiled water. So, when ammonia is caused to boil inside the steel coils in the water tanks, it takes the necessary heat from the water surrounding the coils. Since the ammonia boils at below water's freezing point, the water loses enough heat to freeze. Each coil becomes encased in a layer of ice one to 2½ inches thick and weighing up to 100,000 pounds.

To stop the formation of ice, the ammonia is returned to a stable (non-boiling) state in which very little heat exchange occurs. The ice is stored on the coils until it is needed.

The ammonia is caused to boil by the creation of a vacuum inside the steel coils. A vacuum lowers the pressure, thus allowing the ammonia to boil at a lower temperature. This can be compared to the phenomenon of water boiling at lower temperatures at very high altitudes where atmospheric pressure is lower than at sea level.

Compressors function in the refrigeration system as vacuum pumps, drawing ammonia out of the coils to lower the pressure and promote boiling. The ammonia, which is mostly gas as it leaves the coils, is drawn to the compressors and condensers. Here, higher pressure and evaporative cooling turn it back into a liquid. It is stored under pressure until it is recycled in the system to make more ice.

Not all of the water in the tanks freezes. Some 1.9 million pounds, or 228,000 gallons, gets very cold, but air is continuously bubbled through it to keep it moving. The movement mixes the warmer water farthest from the coils with the almost freezing water near the coils, keeping the temperature even throughout the tanks and preventing the formation of too much ice. As the water leaves the tanks, its temperature is about 34 degrees Fahrenheit. Warmer water is added to raise its temperature to about 42 degrees before it circulates throughout the research facility.

This very cold water passes through air handlers in each building. Here, heat from the warmer air flows into the cooler water. By the time the water gets back to its starting point, its temperature has been raised to 52 degrees. At the same time, the temperature of the air in the various lab buildings has been lowered.

The ice is melted off the coils by the circulation of returning 52-degree water into the tanks. When one set of four coils is ice free, the system automatically moves on to the next set. During the winter, ice need only be made once in every three or four nights. In summer, typically hot in Brea, ice-making goes on every night.

By operating the ice-bank compressors in off-peak hours only, Union can minimize its energy costs. Edison charges its large customers in two ways for their electrical energy. First, there is a charge for the amount of energy used, about 6¢ per kilowatt hour. There is a second demand charge for the level of energy used, measured in kilowatts, during on-peak and mid-peak times of day. This demand charge is $5.05 per kilowatt during on-peak hours, 65¢ per kilowatt during mid-peak hours and nothing during off-peak hours.

Edison monitors the level of usage (how many kilowatts are being drawn at any one time) at 15-minute intervals during the day, basing its monthly demand charge on the highest level of usage during the specified on-peak and mid-peak periods. Because there is no demand charge during off-peak times, it is no wonder that Union and many other companies have devised ways of shifting their power demands to the late night and early morning hours.

When Union's air conditioning system is making ice in off-peak hours, it draws almost 1,100 kilowatts. During mid-peak and on-peak hours, the system draws as little as 75 kilowatts, primarily to operate the water circulation pumps.

The large pipes carry water and the small ones carry ammonia to and from the steel ice-bank tanks. At a juncture of pipes (left), *water leaving the ice bank is mixed with warmer water to raise its temperature to 42 degrees Fahrenheit before it is circulated to the research offices and laboratories.*

By comparison, a conventional system that chills water as needed to cool air would draw approximately 1,900 kilowatts during on-peak times. So every month, the ice bank saves Union the demand charges on as much as 1,825 kilowatts.

Operational efficiencies also save Union money. The two 600-horsepower compressor motors operate at peak efficiency at design load. Since the compressors operate constantly over a 12- to 14-hour period of time, they need only about half the horsepower that would be needed in a conventional installation.

"Thanks to Bob Switzer, our former manager of engineering services who retired in June 1983, and two dedicated technicians, Mike Brewer and Bob James, we got through the rockier moments of installation and start-up of the ice bank. We have arrived at a point where the system is operating very smoothly," Haven said.

The system can be operated during on-peak or mid-peak hours in case of emergency. And, the center's conventional system remains operational as a back-up. This gives the air conditioning system a great deal of flexibility to meet the demands made on it.

Still not completely satisfied, Union is now computerizing the time clocks that control the air handlers. "This computer clock will regulate the hours that air conditioning is used throughout the complex to make the system even more efficient," said Carl McAuley, senior research engineer.

"The ice storage air conditioning system exemplifies Union's commitment to the creative use of technology in the service of public as well as private goals, in this case the need for better energy management and conservation," Haven said.

The World At Work

Fourth annual Seventy Six magazine photo contest

This year's theme will be people at work—on the job or at home, for money, love or both.

The contest will be limited to color photographs. Employees and retirees of Union Oil (its subsidiaries and divisions), and their spouses and children, are eligible. The seven award-winning photos will be published in the May/June issue of *Seventy Six.*

HOW TO ENTER:

Number of entries. There will be one category—color. You may submit up to three entries. For example, one color transparency and two color prints add up to three color entries.

Mounting and labeling. Full 8 x 10 prints can be submitted unmounted, 5 x 7 prints must be attached to 8 x 10 single-weight mounting boards. No framed prints will be accepted. For your protection, slides should be mailed in the boxes that come with developed film, glassine envelopes or plastic mounts. Fill out the entry form; then tape it to the back of each print. Do not write on the back of prints. Write your name and title of the entry on each slide mount. Each entry must be accompanied by a completed entry form or a facsimile of the form.

Mailing. Mail entries in Manila clasp envelopes, including your return address and entry forms. Include any cardboard necessary to protect photographs.

Liability. All entries are to be submitted with the understanding that neither Union Oil Company nor any of its employees will be responsible or liable for loss or damage. Entries may be held beyond the publication date of the contest, but we will attempt to return all entries.

Right to publish. Union Oil retains the right to publish or republish any photograph submitted in the contest. Entrants waive any claims for royalty payments or copyright infringement.

Model release. Contestants must be able to furnish a written "consent to use" statement upon request for recognizable people appearing in the photographs.

Judging. Three professional photographers from outside the company will judge the contest. Their decision will be final.

Deadline extended! Because this issue was mailed later than usual, the contest deadline is extended to April 1, 1984.

Awards.

Grand Prize	$400
1st place	$200
2nd place	$100
3rd place	$ 50
Honorable Mention	$ 50
Honorable Mention	$ 50
Honorable Mention	$ 50

Entry Form

Send to: Editor, M-17
Union Oil Center
Los Angeles, CA 90051

Name:

Title or relationship to employee:

Division/Subsidiary:

Office Location:

Home Address: Zip Code:

Phone: (Network)

Title of Entry: Print Slide

I have read and agree to the official rules of the contest.
Signature: Date:

If under 18, signature of parent or guardian:

UNION 76

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January 1984

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5 YEARS
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Christene Brown, San Francisco, Ca.
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Billy B. Creech, Beaumont Refinery
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Raymond H. Herkenhoff, Minneapolis, Mn.
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Jack A. Schuster, Atlanta, Ga.
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Floyd L. Oliver, Bakersfield, Ca.
Jimmie D. Stoffer, Tallmadge, Oh.
John E. Weir, Schaumburg, Il.

20 YEARS
William F. Driscoll, Seattle, Wa.
Ronald L. Erickson, Minneapolis, Mn.
Carol J. Friend, Columbus, Oh.
Leonard E. Hanley, Beaumont Refinery
Bobby D. Hooper, Los Angeles Terminal
Berlie H. Jones, Jr., Memphis, Tn.
Claus G. Junge, Schaumburg, Il.
Paul W. Manning, Jr., Schaumburg, Il.
Curtis J. Marsolek, Denver, Co.
Donald A. Putts, Schaumburg, Il.
S. D. Strickland, Beaumont Refinery

15 YEARS
Fred D. Brown, San Francisco Refinery
Alfred G. Castro, Santa Paula, Ca.
Gary Cote, Los Angeles Refinery
Clarence W. Crenshaw, Los Angeles Refinery
Harold Crossman, San Francisco Refinery
Sheryl A. Curkovic, San Francisco, Ca.
Karen A. Eblen, Schaumburg, Il.
Marlene A. Hagopian, Schaumburg, Il.
Raymond M. Halbrook, Pure Transportation Co., Patoka, Il.
James C. Halligan, Tampa, Fl.
Thomas R. Horn, Schaumburg, Il.
Alton Hyde, Birmingham, Al.
Melvin D. Jackson, Los Angeles Refinery
Richard W. Laughridge, San Francisco Refinery
Raymond A. Lerma, San Francisco, Ca.
Larry W. McElroy, Beaumont Refinery
Gary F. Morgan, Los Angeles Terminal
Wayne E. Norton, Santa Maria Refinery
Frank A. Pfister, San Francisco Refinery
George Rieve, Beaumont Refinery
Randolph Veil, Schaumburg, Il.
Karen A. Walker, Schaumburg, Il.
Harold D. Weinrich, San Luis Obispo, Ca.

10 YEARS
Robert W. Deprat, Schaumburg, Il.
Bonnie L. Duncan, Schaumburg, Il.
Carol L. Holm, Los Angeles, Ca.
Roger W. Jahnke, San Francisco, Ca.
Theodore T. Kelley, Beaumont, Tx.
Rosalie R. Nolan, Schaumburg, Il.
Barbara D. Offord, San Francisco, Ca.
Juliet T. Parpan, San Francisco, Ca.
H. L. Stanley, Beaumont, Tx.
Paython Veazie, Los Angeles Terminal

5 YEARS
Cheryl A. Ardisana, Schaumburg, Il.
Carolyn A. Beck, San Francisco Refinery
Kyndl S. Buzas, San Francisco Refinery
John A. Combs, San Francisco Refinery
Robert S. Dahle, San Francisco Refinery
Alberto R. Deharo, Los Angeles Refinery
Gail A. Dolan, Schaumburg, Il.
Rudy Estacio, Honolulu, Hi.
Holger Fahrenholz, Miami, Fl.
Monique J. Fredriksen, Edmonds Terminal
Elaine M. Gatt, Schaumburg, Il.
Leslie W. Gilbert, Dayton, Oh.
George W. Harmeling, Memphis, Tn.
Anthony B. Lyons, San Francisco Refinery
Gordon D. Rogers, South Holland, Il.
Alfonso Sanroman, Los Angeles Refinery
Gloria J. Sterling, Bakersfield Terminal
Phillip L. Whitney, San Francisco Refinery

76 Service Awards

UNION OIL AND GAS DIVISION

January 1984

45 YEARS
Lloyd A. Pringle, Olney, Il.

35 YEARS
Margaret J. Bennett, Midland, Tx.

30 YEARS
William L. Duhon, Lafayette, La.
Walter C. Lam, Oklahoma City, Ok.

25 YEARS
Emile J. Aucoin, Houma, La.
William B. Flint, Jr., Casper, Wy.
Inez D. Turner, Union Oil Center

20 YEARS
Stephen Broussard, Mobile, Al.
Samuel J. Cullen, Orcutt, Ca.
V. Frank Hinson, Lafayette, La.
Ann Mathis, Houston, Tx.
Anthony J. Testa, Santa Fe Springs, Ca.

15 YEARS
Carleton S. Babb, Casper, Wy.
Raymond L. Clark, Lafayette, La.
Mary L. McKew Harrison, Houston, Tx.
Jimmie L. Rose, Midland, Tx.
Larry G. Vavra, Anchorage, Ak.
Paul T. West, Anchorage, Ak.

10 YEARS
Neal W. Canter, Anchorage, Ak.
William R. Choate, Jr., Lafayette, La.
Clark B. Done, Ventura, Ca.
David D. Goodrich, Olney, Il.
Delbert L. Hankins, Anchorage, Ak.
Terrance L. Hildebrand, Clay City, Il.
Michael T. Reblin, Ventura, Ca.
Bonnie A. Sabott, Union Oil Center
Theophilus H. Thomas, III, Houma, La.
Carl H. Wetzel, Kenai, Ak.

5 YEARS
Joseph P. Aguilar, Santa Fe Springs, Ca.
Thomas M. Boepple, Jr., Ganado, Tx.
Aubin P. Buquet, Lafayette, La.
Denese G. Burton, Casper, Wy.
Brian P. Choate, Lafayette, La.
John D. Collins, Houma, La.
Patrick F. Correll, W. Liberty, Il.
Thomas G. Dahlgren, Orcutt, Ca.
Juan F. Gutierrez, Jr., Santa Fe Springs, Ca.
Bernard T. Landeis, Houston, Tx.
John W. Larson, Santa Paula, Ca.
Gary M. Mayard, Lafayette, La.
Lloyd A. Morgan, Houma, La.
Richard R. Rea, Lafayette, La.
Donna J. Schramm, Lafayette, La.
William A. Simas, Orcutt, Ca.
Daniel Simmons, Jr., Houma, La.
Darren W. Small, Houma, La.
Robert H. Strong, W. Liberty, Il.
W. Vance Thompson, Santa Fe Springs, Ca.

February 1984

35 YEARS	**Robert J. Hoyt,** Pasadena, Ca.
30 YEARS	**Elie Courville,** Houma, La. **Charles C. Heinbach,** Lafayette, La. **C. D. Kozlowski,** Coalinga, Ca. **Roderick D. McLennan,** Houston, Tx. **Margaret E. Vincze,** Union Oil Center
25 YEARS	**Alvin A. Almgren,** Ventura, Ca. **Donald J. Durham,** Pasadena, Ca.
20 YEARS	**Hollis W. Clifton,** Van, Tx. **Johnson J. Hedges,** Houma, La. **Charles W. Leboeuf,** Lafayette, La.
15 YEARS	**Leslie A. Dedeke, Jr.,** Houston, Tx. **Gerard Green, Jr.,** Lafayette, La. **Clarence L. Myles,** Houston, Tx.
10 YEARS	**Linda L. Carson,** Lafayette, La. **Albert J. Ciallella,** Bakersfield, Ca. **Ernest C. Corral,** Orcutt, Ca. **Aquilla O. Fleetwood, Jr.,** Andrews, Tx. **Bennie J. Gipson,** Van, Tx. **Santiago J. Romero, Jr.,** Andrews, Tx. **Victor J. Rosato,** Ventura, Ca. **Mary W. C. Y. Shih,** Houston, Tx.
5 YEARS	**Lonny J. Babin,** Houma, La. **Blaine P. Bourg,** Houma, La. **Charles Broussard,** Lafayette, La. **Truett E. Enloe,** Lafayette, La. **Marier A. Flowers,** Houston, Tx. **Linda R. Hedrick,** Oklahoma City, Ok. **Dwayne M. Manceaux,** Lafayette, La. **Jimmy D. Martinez,** Orcutt, Ca. **Sheila K. O'Connor,** Ventura, Ca. **James T. Paul,** Olney, Il. **Autum C. Record,** Taft, Ca. **Joseph W. Sellers, Jr.,** Lafayette, La. **Jeffrey R. Tenzer,** Pasadena, Ca. **Elliott J. Theall,** Lafayette, La.

UNION GEOTHERMAL DIVISION

January 1984

10 YEARS	**Larry D. Clark,** Santa Rosa, Ca. **Ronald W. McMahan,** Big Geysers, Ca.
5 YEARS	**Carol A. Blaszczynski,** Union Oil Center **Norman L. Johnson,** Big Geysers, Ca. **Michael S. Martinez,** Big Geysers, Ca. **Nickolas Voegtly,** Big Geysers, Ca.

February 1984

20 YEARS	**Ronald E. Hedges,** Santa Rosa, Ca.
15 YEARS	**Mae L. Wong,** Union Oil Center
5 YEARS	**Laura L. Maccianti,** Santa Rosa, Ca.

UNION CHEMICALS DIVISION

January 1984

30 YEARS	**Charles Dow,** Union Oil Center **Joseph H. Kettyle,** Conshohocken, Pa.
25 YEARS	**Ronald S. Krupa,** Carteret, N.J. **Philip Martinez,** Arroyo Grande, Ca. **Jack Swanburg,** Brea, Ca.
15 YEARS	**Charles J. Barnes,** Tucker, Ga. **Margaret T. Haggard,** Charlotte, N.C. **Donald W. Hilliard,** Baltimore, Md. **Robert A. Marino,** Carteret, N.J. **Lewis E. Patton,** Charlotte, N.C. **Roger G. Stanek,** St. Clair Shores, Mi.
10 YEARS	**Ronald R. Brown,** Charlotte, N.C. **Michael D. Martin,** Lemont, Il.
5 YEARS	**Patricia J. Clapeck,** Schaumburg, Il. **Duane Ellis,** Fresno, Ca. **Frederick S. Fine,** Bridgeview, Il. **Richard M. Gredler,** Houston, Tx. **Alphard G. Holland,** Bridgeview, Il. **Robert Jackson,** Arroyo Grande, Ca. **Anthony C. Lee,** Rolling Meadows, Il. **Frank Lung,** Union Oil Center **Leonard Mortimer,** Brea, Ca. **Steven Oberts,** Kenai, Ak. **Kim F. Owen,** Charlotte, N.C. **Mary J. Sedlak,** Bridgeview, Il. **Roberta Treviranus,** Union Oil Center

February 1984

30 YEARS	**Loren Hillman,** Portland, Or. **Edwin Johnson,** Union Oil Center
20 YEARS	**R. S. Mulkiewicz,** Brea, Ca.
15 YEARS	**Henry F. Dupea,** La Mirada, Ca. **Frances G. Kare,** Schaumburg, Il. **Bland T. Moser,** Charlotte, N.C.
10 YEARS	**Burl E. Cline,** Charlotte, N.C. **T. J. Hinkle,** Kenai, Ak. **Andrew R. Hoinacki,** Lemont, Il. **John P. Scott,** Newark, Ca. **David A. Simon,** La Mirada, Ca. **Deborah A. Smith,** Clark, N.J. **Jackie L. Teale,** La Mirada, Ca. **Barbara J. Wagner,** Schaumburg, Il.
5 YEARS	**Richard Aber,** Kenai, Ak. **David Haring,** Kenai, Ak. **Gail W. Maske,** Charlotte, N.C. **Robert Piatt,** Portland, Or. **Debra J. Schaeffer,** Schaumburg, Il. **Ronald P. Wright,** Beaumont, Tx.

UNION INTERNATIONAL OIL DIVISION

January 1984

40 YEARS	**Norman B. Clark, Jr.,** Los Angeles, Ca.
30 YEARS	**William C. Barton, Jr.,** Los Angeles, Ca.
10 YEARS	**David Butt,** Los Angeles, Ca. **Bernard W. Pace,** Norway **Daniel T. Tutak,** London, England
5 YEARS	**John T. Coleman,** Thailand **Rosemary Espinosa,** Los Angeles, Ca. **Allan G. Snyder,** Los Angeles, Ca.

February 1984

20 YEARS	**Tomas H. Blanco, Jr.,** Los Angeles, Ca.
15 YEARS	**John R. Hime,** Thailand
10 YEARS	**Bruce S. Davis,** Thailand **Edmund D. Haube,** Argentina **Michael J. Hursey,** London, England **James R. Isham,** Thailand **Donald H. Wotring, Jr.,** Balikpapan, Indonesia
5 YEARS	**Douglas M. Kypfer,** London, England

UNION OIL CO. OF CANADA LTD.

January 1984

15 YEARS	**Lois A. A. Kesler,** Calgary, Alberta
10 YEARS	**John DeKuyper,** Calgary, Alberta **Lou A. Sylvestre,** Calgary, Alberta
5 YEARS	**Carol A. Arenburg,** Calgary, Alberta **Connie J. Ferschweiler,** Calgary, Alberta

February 1984

30 YEARS	**Don B. Jarrett,** Calgary, Alberta
10 YEARS	**John N. Abramchuk,** Calgary, Alberta
5 YEARS	**Brian J. MacDonald,** Calgary, Alberta

PHILIPPINE GEOTHERMAL, INC.

January 1984

5 YEARS	**Rodolfo M. Andrade,** Manila **Ma. Cecilia A. Limson,** Manila

February 1984

5 YEARS	**Efren O. Abrigo,** Manila **Anacleto G. Adviento, Jr.,** Manila **Benedicto O. Alarcon,** Manila **Edgardo A. Anacay,** Manila **Emma F. Aquino,** Manila **Benito B. Banluta,** Manila **Amelia A. Casera,** Manila **Celso D. Claveron,** Manila **Rodrigo C. Cuebillas,** Manila **Cynthia C. Custodio,** Manila **Eduardo F. Eugenio,** Manila **Anacleto D. Ignacio,** Manila **Carlito R. Mariscal,** Manila **Edgardo M. Mojado,** Manila **Rey E. Reyes,** Manila **Dionisio T. Roxas,** Manila

UNION ENERGY MINING DIVISION

January 1984

5 YEARS	**Casey A. Conway,** Parachute, Co. **Howard B. Finley,** Parachute, Co. **Floyd J. Hewitt,** Rawlins, Wy.

MOLYCORP, INC.

January 1984

20 YEARS	**Elmer Archuleta,** Questa, N.M. **Jose Gallegos,** Questa, N.M. **Ramon Gallegos,** Questa, N.M. **Alfonso Gonzales,** Questa, N.M. **Adelmo Herrera,** Questa, N.M. **Epimenio Leon,** Questa, N.M. **Owen Lundy,** Questa, N.M. **Uvaldo Sandoval,** Questa, N.M. **Ben Santistevan,** Questa, N.M. **Tony Tafoya,** Questa, N.M. **Roy Varela,** Questa, N.M. **Warren Warhol,** Union Oil Center
15 YEARS	**Ernest Aragon,** Questa, N.M. **George Aragon,** Questa, N.M. **Glen Archuleta,** Questa, N.M. **Luis Cardenas,** Questa, N.M. **Randolph Cisneros,** Questa, N.M. **Alfonso Cordova,** Questa, N.M. **Maurice Duran,** Questa, N.M. **Pat Garcia,** Questa, N.M. **Charles Hokanson,** Questa, N.M. **Lawrence Jaramillo,** Questa, N.M. **James Lundy,** Questa, N.M. **Gasper Martinez,** Questa, N.M. **Francisco Medina,** Questa, N.M. **Ramon Medina,** Questa, N.M. **Patricio Mondragon,** Questa, N.M. **Augustin F. Montoya,** Questa, N.M. **Augustine A. Montoya,** Questa, N.M. **Jose Montoya,** Questa, N.M. **Beres Romero,** Questa, N.M. **Julian Romo,** Questa, N.M. **Jimmy Salazar,** Questa, N.M. **Arthur Sanchez,** Questa, N.M. **Andrew Velasquez,** Questa, N.M. **Dickie Yuma,** Questa, N.M.
10 YEARS	**Carlos Chavez,** Questa, N.M. **Rudy Cisneros,** Questa, N.M. **Roland Herrera,** Mt. Pass, Ca. **Joseph Zapolski,** Mt. Pass, Ca.
5 YEARS	**Bonifacio Fresquez, Jr.,** Questa, N.M. **Douglas Gapen,** Washington, Pa. **Phil Howard,** Questa, N.M. **Mark Koestel,** Englewood, Co. **Robert Mankowski,** Mt. Pass, Ca.

February 1984

40 YEARS	**Dwight Berson,** Englewood, Co.
25 YEARS	**David Burns,** Washington, Pa. **Robert Clutter,** Washington, Pa. **Raymond Doak,** Washington, Pa. **John Farrar,** Washington, Pa. **Norman Horner,** Washington, Pa. **Allen Keirs,** Washington, Pa. **James King, Jr.,** Washington, Pa. **Duane McMullen,** Washington, Pa. **Melvin Yeager,** Washington, Pa.
20 YEARS	**Esequiel Arellano,** Questa, N.M. **Norbert Cisneros,** Questa, N.M. **Paul Gallegos,** Questa, N.M. **Andres Gonzales,** Questa, N.M. **Joe Martinez,** Questa, N.M. **Tobias Romero,** Questa, N.M. **Emilio Valerio,** Questa, N.M.

Service Awards

15 YEARS	**Juan DeHerrera,** Questa, N.M. **Joe Espinoza,** Questa, N.M. **Arsenio Fernandez,** Questa, N.M. **Floyd Garcia,** Questa, N.M. **Larry Gutierrez,** Questa, N.M. **Clarence Mares,** Questa, N.M. **Horacio Martinez,** Questa, N.M. **Jose Mondragon,** Questa, N.M. **Claudio Montoya,** Questa, N.M. **Epimenio Montoya,** Questa, N.M. **Rubaldo Ortega,** Questa, N.M. **Bill Patterson,** Mt. Pass, Ca. **Joe Santistevan,** Questa, N.M. **Gilberto Vigil,** Questa, N.M.
10 YEARS	**Gerald Culbertson,** Questa, N.M. **Bernabe Garcia,** Questa, N.M. **Rafael Reyna,** Questa, N.M.
5 YEARS	**Harvey Judges,** Questa, N.M. **Marshall Kibbe,** White Plains, N.Y. **Charles Kirk,** Mt. Pass, Ca. **Paul Manzanares,** Questa, N.M. **John Miller,** Englewood, Co. **Alan Whitchurch,** Mt. Pass, Ca.

POCO GRAPHITE INC.

February 1984

10 YEARS	**Kenneth Cooper,** Decatur, Tx.
5 YEARS	**Francisco Amador,** Decatur, Tx. **Jess Shook,** Decatur, Tx.

JOBBERS AND DISTRIBUTORS

January 1984

45 YEARS	**Noble Oil Co.,** Dyersburg, Tn.
30 YEARS	**J. D. Sellers, Distributor,** Yuma, Az.
25 YEARS	**Lawley Oil Co.,** Goodwater, Al. **Morson & Sterling Oil Co.,** Leland, Ms. **Shankle Oil Co.,** Athens, Ga.
20 YEARS	**Haugabook Oil Co.,** Monteguma, Ga.
15 YEARS	**Appel Oil Co., Inc.,** Carmel, In.
10 YEARS	**Steiner Oil Co.,** Wooster, Oh.
5 YEARS	**Crenshaw Oil Co.,** Lancaster, S.C.

February 1984

45 YEARS	**Burke, Inc.,** Valdese, N.C.
15 YEARS	**Robin Hood Oil Co., Inc.,** Benson, N.C. **Sanders Oil Co.,** Columbus, Ms.
10 YEARS	**Jim St. Clair Oil Co., Inc.,** Inverness, Fl.
5 YEARS	**Stuart M. Corey,** Coupeville, Wa.

RETIREMENTS

October 1983

George M. Ausbrook, Union 76 Division, Eastern Region, Noble, Il. April 30, 1967

November 1983

John W. Anderson, Union 76 Division, Western Region, Long Beach, Ca. September 23, 1955
C. Robert Arth, Corporate, Arcadia, Ca. August 24, 1959
Jimmie L. Bond, Oil and Gas Division, Buchanan Dam, Tx. December 12, 1950
Joe N. Cawdell, Oil and Gas Division, Mills, Wy. July 23, 1942
Arthur Clark, Union 76 Division, Eastern Region, Savannah, Ga. December 27, 1960
George Henderson, Molycorp, Questa, N.M. July 12, 1965
Melvin L. Ingalls, Union 76 Division, Western Region, Klamath Falls, Or. September 20, 1950
Abraham P. Iona, Union 76 Division, Western Region, Honolulu, Hi. November 23, 1947

December 1983

Earle R. Atkins, Jr., Science and Technology, Whittier, Ca. June 11, 1946
Donald E. Craggs, Union 76 Division, Western Region, Los Alamitos, Ca. September 22, 1947
Bernard G. Curtis, Oil and Gas Division, Coalinga, Ca. August 28, 1948
Reece G. Davis, Jr., Union 76 Division, Eastern Region, Silsbee, Tx. February 17, 1947
Eugene J. Domayer, Union 76 Division, Western Region, Long Beach, Ca. January 30, 1953
Donald F. Driver, Jr., Union 76 Division, Eastern Region, Marietta, Ga. June 23, 1947
Barbara E. Felling, Oil and Gas Division, Lompoc, Ca. November 1, 1966
Ruth E. Fischer, Union 76 Division, Western Region, New Richland, Mn. June 11, 1947
David L. Hooks, Union 76 Division, Eastern Region, Nederland, Tx. January 2, 1951
Rose A. Klein, Union 76 Division, Eastern Region, Schaumburg, Il. May 9, 1960
Walter R. Losier, Union 76 Division, Western Region, Lakewood, Ca. December 3, 1947
Edna M. Marlar, Union Chemicals Division, Glendale, Ca. October 8, 1958
Donald G. Probst, Union 76 Division, Overseas, Long Beach, Ca. August 31, 1942
James C. Sheffield, Union 76 Division, Eastern Region, Port Neches, Tx. August 18, 1952
Wilda M. Sposato, Union 76 Division, Eastern Region, Arlington Hghts., Il. December 13, 1954
Richard I. Sullivan, Union 76 Division, Eastern Region, Minneapolis, Mn. November 28, 1950
Virgil O. Watts, Poco Graphite, Alvord, Tx. July 9, 1976
Curtis G. Whitman, Union 76 Division, Eastern Region, Port Neches, Tx. February 28, 1949

January 1984

Raymond M. Bancroft, Union 76 Division, Eastern Region, Lemont, Il. April 17, 1947
Daniel B. Barra, Union 76 Division, Western Region, Huntington Beach, Ca. September 5, 1952
Raymond L. Bartlett, Union 76 Division, Eastern Region, Diamond Bar, Ca. December 6, 1947

William L. Bewley, Science and Technology, Fullerton, Ca. July 3, 1949
Willard B. Bozych, Union 76 Division, Eastern Region, Lockport, Il. March 6, 1941
Albert A. Brisson, Union 76 Division, Eastern Region, Rolling Meadows, Il. October 10, 1945
Thomas H. Busch, Union 76 Division, Western Region, Long Beach, Ca. December 4, 1950
Harold E. Carver, Corporate, Los Angeles, Ca. June 29, 1943
James O. Chamblee, Union 76 Division, Eastern Region, Nederland, Tx. August 19, 1949
Stanley R. Chmielewski, Union 76 Division, Eastern Region, Lockport, Il. June 30, 1952
Robert S. Cooke, International Division, Cornville, Az. July 28, 1952
Richard F. Coward, Union 76 Division, Eastern Region, Nederland, Tx. September 29, 1952
Jack A. Deardurff, Union 76 Division, Eastern Region, Plainfield, Il. January 24, 1946
Herman E. Dicus, Poco Graphite, Decatur, Tx. July 23, 1956
Elmer E. Edwards, Union 76 Division, Western Region, Camp Verde, Az. August 16, 1944
Horace Epperhart, Union 76 Division, Eastern Region, Port Neches, Tx. December 28, 1948
Alice K. Forster, Union 76 Division, Eastern Region, Columbus, Oh. February 5, 1951
Gage H. Goodemote, Union 76 Division, Eastern Region, Sunrise, Fl. April 13, 1961
John W. Gorman, Union 76 Division, Western Region, Avila Beach, Ca. March 7, 1947
Loren F. Grandey, Union 76 Division, Western Region, Downey, Ca. September 23, 1940
William C. Griffiths, Union 76 Division, Eastern Region, Hoffman Estates, Il. July 29, 1943
Henry J. Grodecki, Union 76 Division, Eastern Region, Bolingbrook, Il. June 23, 1952
Elbert L. Hale, Jr., Science and Technology, Brea, Ca. August 25, 1967
Allen E. Harmon, Union 76 Division, Eastern Region, Jacksonville, Fl. January 15, 1962
Roy R. Harper, Union 76 Division, Eastern Region, Tucker, Ga. August 18, 1947
Walter E. Haupricht, Union 76 Division, Eastern Region, Bolingbrook, Il. April 30, 1942
Callie F. Hines, Union 76 Division, Eastern Region, Apple Springs, Tx. January 2, 1951
Charles A. Johnson, Union 76 Division, Eastern Region, Nederland, Tx. October 10, 1945
Howard M. Jungles, Union 76 Division, Eastern Region, Lockport, Il. May 26, 1947
Michael S. Kocsis, Union 76 Division, Eastern Region, Crest Hill, Il. June 30, 1952
Joseph A. Manuel, Jr., Union 76 Division, Eastern Region, Beaumont, Tx. April 26, 1948
John Mazur, Union 76 Division, Eastern Region, Lockport, Il. August 27, 1951
Loyd McDonald, Corporate, Harbor City, Ca. November 25, 1940
Eddie J. McNulty, Jr., Union 76 Division, Eastern Region, Nederland, Tx. February 24, 1948
Milton O. Miller, Union 76 Division, Eastern Region, Olney, Il. October 9, 1950
Carl B. Morris, Union 76 Division, Eastern Region, Nederland, Tx. June 22, 1953
Norbert H. Nagel, Union 76 Division, Eastern Region, Lemont, Il. June 23, 1952
Richard C. Neuman, Corporate, Seattle, Wa. September 22, 1947
Keith E. Niehaus, Union 76 Division, Eastern Region, Lemont, Il. September 1, 1943
William E. Norris, Union 76 Division, Eastern Region, Beaumont, Tx. April 6, 1942
Donald J. Obert, Union 76 Division, Eastern Region, New Burlington, Oh. July 18, 1949
Albin A. Plut, Union 76 Division, Eastern Region, Joliet, Il. August 28, 1950
Alex A. Plut, Union 76 Division, Eastern Region, Lockport, Il. April 9, 1940
Harold D. Potts, Oil and Gas Division, Saraland, Al. April 4, 1950
Laurence S. Richards, Oil and Gas Division, Bakersfield, Ca. July 12, 1946
Walter H. Schwarz, Union 76 Division, Eastern Region, Lockport, Il. July 7, 1952
Allan Seigler, Oil and Gas Division, Perryton, Tx. December 1, 1936
Edward J. Shay, Union 76 Division, Eastern Region, Crest Hill, Il. July 29, 1963
Grady M. Singleton, Jr., Union 76 Division, Eastern Region, Wilsonville, Al. December 16, 1943
Arthur T. Spier, Oil and Gas Division, Coalinga, Ca. February 7, 1946
Blanche E. Terrell, Oil and Gas Division, Midland, Tx. August 23, 1943
Jon D. Tippett, Union 76 Division, Eastern Region, Gladstone, N.J. June 5, 1961
Arthur D. Weaver, Union 76 Division, Eastern Region, Fremont, In. April 19, 1948
Chester E. Witkowski, Union 76 Division, Eastern Region, Lemont, Il. March 31, 1949
Donald E. Young, Union 76 Division, Eastern Region, Vidor, Tx. May 4, 1953

IN MEMORIAM

Employees

Joanne M. Berggren, Union Chemicals Division, Streamwood, Il. October 4, 1983
Joseph J. Christensen, Union Chemicals Division, Franktown, Co. October 22, 1983
Orville Linz, Union 76 Division, Eastern Region, Cincinnati, Oh. November 2, 1983
Alyce Malone, Oil and Gas Division, Houston, Tx. October 5, 1983
Wilbert C. Schilling, Oil and Gas Division, Cut Bank, Mt. October 18, 1983
Ernest L. Tuxhorn, Oil and Gas Division, Van, Tx. October 30, 1983
Leonard J. Wojtecki, Union 76 Division, Eastern Region, Cary, Il. October 22, 1983
Donald W. Wright, Oil and Gas Division, Olney, Il. October 2, 1983

Retirees

George S. Baker, Union 76 Division, Western Region, Honolulu, Hi. October 25, 1983
Charles Barlagio, Union 76 Division, Western Region, San Luis Obispo, Ca. October 25, 1983
John A. Barnes, Union 76 Division, Eastern Region, St. James City, Fl. October 18, 1983
Lois J. Beckman, Union 76 Division, Western Region, Magalia, Ca. September 2, 1983
Rudolph R. Beyersdorf, Union 76 Division, Western Region, Seattle, Wa. November 6, 1983
Jerry D. Cole, Union 76 Division, Eastern Region, Cabin Creek, W.V. October 17, 1983
Raymond E. Cumming, Union 76 Division, Eastern Region, Toledo, Oh. September 22, 1983
Carl W. Dowling, Union 76 Division, Eastern Region, Laguna Hills, Ca. September 23, 1983
Jarrell R. Dunson, Union 76 Division, Eastern Region, Jacksonville, Fl. November 13, 1983
Hubert C. Ferry, Corporate, Fullerton, Ca. September 22, 1983
Connor J. Gentry, Oil and Gas Division, Van, Tx. October 23, 1983
Julius J. Gould, Union 76 Division, Eastern Region, Lockport, Il. October 5, 1983
Arnold I. Holden, Union 76 Division, Western Region, Long Beach, Ca. October 29, 1983
Robert Hominda, Union Chemicals Division, Walnut Creek, Ca. November 13, 1983
George B. Johnson, Union 76 Division, Eastern Region, Sartell, Mn. September 2, 1983
Doyle Kenney, Oil and Gas Division, Santa Maria, Ca. October 4, 1983
Clinton F. Knitz, Union 76 Division, Eastern Region, Perrysburg, Oh. October 11, 1983
Joseph P. LaCroix, Union 76 Division, Eastern Region, Deerfield Beach, Fl. October 6, 1983
Sidney R. LeBleu, Oil and Gas Division, Lafayette, La. November 5, 1983
Kathryn M. Lee, Corporate, Mission Viejo, Ca. October 31, 1983
Sigel M. Leeper, Union 76 Division, Eastern Region, Fulton, Mo. October 14, 1983
Walter Lindquist, Union 76 Division, Eastern Region, Ormond Beach, Fl. November 12, 1983
Eris J. McIntire, Oil and Gas Division, Edmond, Ok. October 30, 1983
George H. Miller, Union 76 Division, Eastern Region, Paulding, Oh. October 27, 1983
Clyde O. Moore, Union 76 Division, Eastern Region, Clendenin, W.V. October 20, 1983
Mary K. Myers, Union 76 Division, Eastern Region, Columbus, Oh. October 25, 1983
Fred G. Pearce, Union 76 Division, Western Region, Riviera, Az. August 22, 1983
Jennings Peterson, Union 76 Division, Western Region, Bakersfield, Ca. November 16, 1983
John W. Pretzer, Union 76 Division, Western Region, Riviera, Az. October 21, 1983
Albert R. Quenelle, Union 76 Division, Eastern Region, Anniston, Al. August 21, 1983
Arthur K. Robbins, Union 76 Division, Eastern Region, Homewood, Al. October 2, 1983
Harry J. Robinson, Oil and Gas Division, Whittier, Ca. October 3, 1983
Foster R. Scales, Union 76 Division, Eastern Region, Nederland, Tx. November 16, 1983
George Sellman, Union 76 Division, Western Region, Colusa, Ca. October 15, 1983
Floyd Sharp, Union 76 Division, Western Region, Rodeo, Ca. November 26, 1983
Harvey B. Sharp, Oil and Gas Division, Coarsegold, Ca. November 12, 1983
Dewey L. Shepherd, Sr., Corporate, Van Nuys, Ca. October 29, 1983
Fred D. Stratton, Oil and Gas Division, San Bernardino, Ca. October 2, 1983
Robert Tessalone, Union Chemicals Division, Rutherford, N.J. November 1, 1983
Milton L. Varner, Oil and Gas Division, Lynwood, Ca. October 15, 1983
Jodie H. Webb, Union 76 Division, Eastern Region, Gonzalez, Fl. September 28, 1983
Carl O. Whitson, Union 76 Division, Western Region, Redondo Beach, Ca. October 12, 1983

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COVER: Union has proved the viability of steam injection as an enhanced method to recover heavy oil, such as that produced in the Guadalupe field in California's Santa Maria Valley. **Story on page 6.**

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