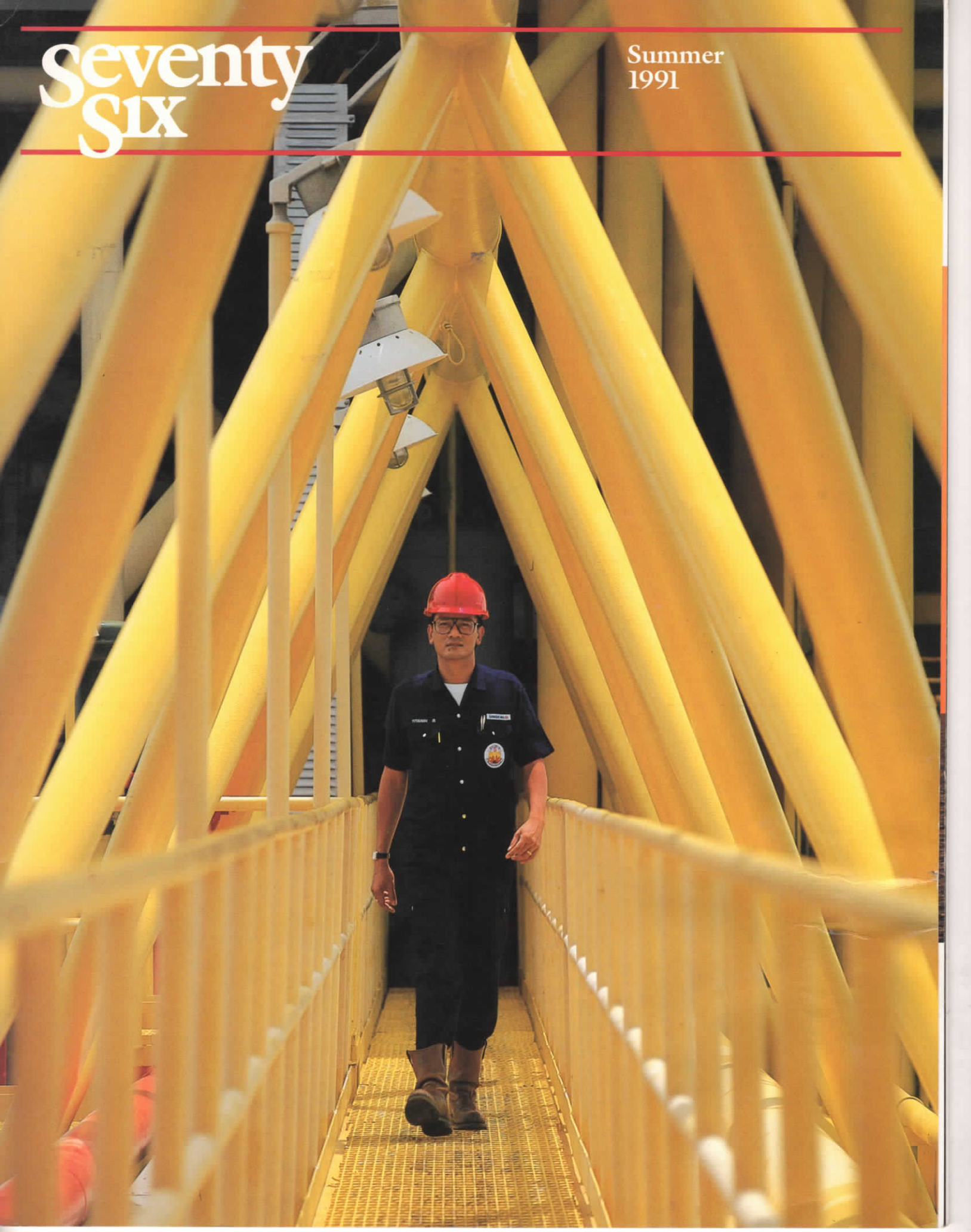


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# UNOCAL THAILAND: STILL ON THE UPSWING

Viewed from the air, Unocal Thailand's Erawan field platform complex appears as a tiny speck of bright yellow perched upon an endless turquoise sea. It's not until the helicopter you're riding in descends that the true size of this offshore installation becomes apparent. Consisting of five separate platforms connected by bridges, the Erawan complex—centerpiece of the company's Gulf of Thailand natural gas project—extends a quarter of a mile from end to end.

"I've been offshore many times, but the scale of our facilities here still amazes me," Rich Keller says as he disembarks and walks across the helipad atop one of Erawan's two massive living quarters platforms. "It's hard to believe we're 125 miles from shore."

Keller, vice president of operations for Unocal Thailand, has witnessed a good portion of the company's impressive growth. Today, Erawan—the first natural gas field discovered by Unocal in Thailand—is the hub of what has become a sprawling offshore development. Four other Unocal Thailand fields—Satun, Platong, Kaphong and Baanpot—are now producing natural gas in the Gulf. A network of 56 platforms extends over 50 miles from north to south, connected by 300 miles of underwater pipelines. At any given time, more than 1,000 workers are stationed offshore to tend these facilities and provide contract services.

"Combined, our five producing fields yield an average of 678 million cubic feet of natural gas and 22,400 barrels of condensate per day," Keller says. This level of production—an all-time high for Unocal Thailand—will be further boosted by year's end when a sixth field, Funan, comes on stream.

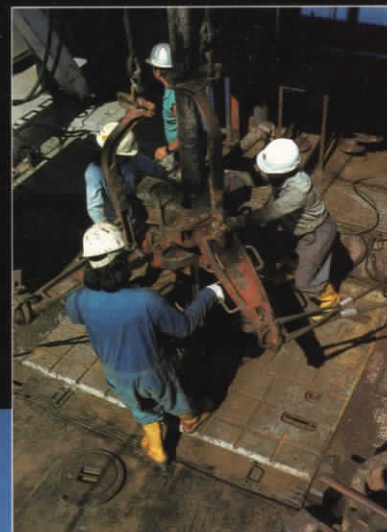
"We've accomplished a great deal here in Thailand—and we are still on the upswing," says Graydon Laughbaum, Unocal Thailand's president. "Our level of activity has never been higher." The excitement is readily apparent both out in the field, where development work is proceeding, and at Unocal Thailand's headquarters in Bangkok, where explorationists and engineers, together with operations and administrative staffs, are busier than ever.







*The Erawan field platform complex, centerpiece of Unocal's Gulf of Thailand natural gas project, extends a quarter of a mile from end to end. The facilities include a central processing platform, two living quarters platforms, a wellhead platform and a compression platform.*



*Top, drilling underway in the Funan field, the sixth Gulf of Thailand gas field to be developed by Unocal. Above, the Satun field central processing platform. Left (left to right), Harry Weatherspoon, Erawan offshore installation manager; Graydon Laughbaum, president, Unocal Thailand; and Rich Keller, vice president of operations, inspect the Erawan complex.*





he energy level parallels that of Thailand itself, a booming Southeast Asian nation of 55 million spread over an area roughly the size of France. In recent years, the country has boasted one of the world's most vibrant economies, with an annual growth rate above 10 percent. This ongoing economic expansion, and the improved standard of living that it brings, have been fueled in large measure by Unocal's development of Thailand's natural gas resources.

Just a decade ago, the story was quite different. In 1980, one year before gas production commenced from Unocal Thailand's Erawan field, the nation was almost completely dependent on imported oil and petroleum products to fill its energy requirements. Fully 80 percent of Thailand's electricity was produced by burning imported fuel oil. Today, the Kingdom's own natural gas reserves—largely discovered and developed by Unocal Thailand—are used as fuel to generate a significant portion of the nation's electricity.

The growth of Thailand's natural gas industry has also improved the nation's balance of trade, reduced energy costs, provided jobs and expanded business opportunities. Natural gas is now used by a growing number of small industries in Thailand which produce everything from cement and petrochemicals to liquid petroleum gas for use in homes and vehicles.

Dozens of petroleum support and service companies have become established in Thailand, many of which got their start doing business with Unocal. Several of these have grown into large-scale operations. A Thai joint-venture company, for example, now builds many of the well platforms that the company installs offshore. Unocal Thailand itself has over 1,000 employees, 92 percent of whom are Thai nationals.

Although development of Thailand's natural gas resources has been a success story for both Unocal and the nation, the road to success has not always been smooth. "We've been through some difficult times, and have overcome many obstacles and challenges along the way," says

Laughbaum. "But we've always persevered, and worked diligently to follow through on our commitments."

Unocal's history in Thailand dates back to 1962, when it became the first oil company granted exploration rights in the Kingdom. After years of seismic work and several exploratory dry holes—both on and offshore—Unocal discovered the Erawan gas field in the Gulf of Thailand, about 300 miles south of Bangkok, in 1972. Development of Erawan began in 1978 after Unocal and two Japanese co-concessionaires, MOECO and SEAPEC (which has since merged into MOECO), signed a gas sales agreement with the Thai government.

While Unocal drilled development wells and installed Erawan's infrastructure, the Petroleum Authority of Thailand (PTT) took charge of laying a 270-mile pipeline from the field to shore at Rayong, south of Bangkok. Meanwhile, the Electricity Generating Authority of Thailand (EGAT)—the ultimate consumer of most of Unocal's produced gas—began to create gas-fired generating capacity by building new power plants and converting existing ones to gas.

In the midst of this activity, however, the project was threatened by some unexpected and serious problems. "After initial development drilling got underway, it became apparent that the field's geologic structure was far more complex than was previously believed," explains Chuck Williamson, Unocal Thailand's vice president of exploration. "We discovered that the gas-bearing sand beds in the Gulf are fragmented by intense faulting, which in essence has created a large number of generally small, disconnected reservoirs."

As it turned out, meeting the company's production commitments would require three times as many wells as initially planned—and each well would have to hit multiple targets. In addition, drilling crews encountered extremely high reservoir temperatures and pressures, which conventional downhole equipment could not withstand.

"Faced with these problems, some companies might have thrown in the towel," Laughbaum says. "But Unocal Thailand's employees rose to the challenge and kept the project moving forward."





Success has been achieved through a combination of technology, innovation and operational expertise. Applying the most sophisticated 3-D seismic interpretation techniques available, geologists and geophysicists learned how to map the Gulf's fragmented sand beds. Using this data, they were able to design wells to intersect the isolated pockets of gas.

Drilling crews also crossed new technological frontiers by experimenting with innovative directional drilling techniques, advanced drilling fluids, and new equipment that could withstand the harsh downhole conditions. As they gained experience, the time and expense required to drill these difficult production wells in a safe and efficient manner were steadily reduced—from 68 days and \$5.3 million per well in 1980 to 13 days and \$1.3 million by 1990.

Experience also paid off in more efficient and economic development of subsequent gas fields. In May 1982, nine months after Erawan came on stream with an initial production rate of 28 million cubic feet of gas per day (mmcf), Unocal signed a second gas sales contract with PTT. This agreement covered four additional Gulf of Thailand gas fields Unocal had discovered—Baanpot, Satun, Platong and Kaphong. Baanpot began production in October of 1983, and Satun and Platong came on stream in early 1985. By the end of that year, total Unocal Thailand gas production approached 330 mmcf.

By mid-1988, production had climbed to 530 mmcf—nearing the capacity of the PTT pipeline to Rayong. With the Kaphong field ready to come on stream—and Thailand's gas demand continuing to rise—it was evident that action had to be taken.

Working together, Unocal and PTT designed a compression system that would boost capacity of the line, which is owned and operated by PTT, to 800 mmcf. Installed on a new platform at the Erawan complex, the facility—whose \$31 million cost was shared by Unocal and PTT—began operation in August of 1990. Gas production steadily increased, and by January 1991 was averaging 670 mmcf.

"When our sixth field—Funan—comes onstream later this year, Unocal Thailand's production will top 700 million cubic feet per day," Laughbaum says. "We expect to maintain this level to the end of the century and beyond."







*Clockwise from top: A view of the Satun central processing platform, workers about to begin a two-week stint offshore exit a helicopter, geologists confer at Unocal Thailand's Bangkok headquarters, production operators compare notes offshore.*



*Top, offshore workers review production figures. Middle, the jacket for the Funan central processing platform—here being towed to its Gulf of Thailand location—was set in March. Production from the field is scheduled to begin in November. Right, development drilling at Funan has proceeded simultaneously with installation of the field's infrastructure.*







his long-term production goal is reflected in Unocal Thailand's ambitious exploration and development program. Most of the work currently underway is in the Funan field, southeast of Erawan, where platform installation and development drilling began in mid-1990. Six wellhead platforms have already been installed in the field. Fabrication of the two main structures (the central processing and living quarters platforms) is nearing completion, and a pipeline has been laid to tie Funan gas production into the Erawan complex.

As with previous fields Unocal Thailand has developed, drilling at Funan is proceeding simultaneously with construction. "As soon as a wellhead platform is set, we can begin drilling production wells from that location using a tender rig," Keller explains. "Completing the wells in advance will allow us to start producing the field as soon as the central processing platform comes on line."

A total of 72 development wells are planned initially for Funan. Construction and drilling are also taking place in the Satun field, where two additional wellhead platforms are being installed and seven new wells are planned this year.

In addition to Funan, the company's third gas sales agreement with PTT (signed in October of 1989) covers five other undeveloped gas fields contained in the remaining acreage of Unocal's original Gulf of Thailand concessions. The sales agreement—an amendment to the second gas sales contract—triples the total acreage that Unocal Thailand has under contract.

Work has already commenced in one of these new fields, Surat, where a platform has been set and a production test involving four wells will begin by year's end. The test will help evaluate the field's reserves before development proceeds.

"Surat has slightly different geology than our other fields, and may have some oil potential in addition to gas," says Tara Tiradnakorn, manager of production engineering. "We won't know how much oil is recoverable until the test is completed next year." Along with Funan, the Surat field is expected to begin production by year's end.

Supporting all of this development activity are the efforts of Unocal Thailand's geologists, geophysicists, engineers and other technical specialists based in Bangkok. "In order to continue our success here, we've got to remain on the leading edge of exploration, drilling and production technology," Laughbaum says. "Unocal Thailand's specialists in these areas have developed a lot of expertise over the years, which we continue to build on. Our seismic interpretation and directional drilling techniques, for example, are state of the art."

Because the subsurface structures in the Gulf are so highly faulted, precise mapping of the formations is critical before drilling can begin. "Most of our producing zones—the gas-bearing sands—are small in area," Williamson explains. "Our geologists and geophysicists have to design wells to hit several of these reservoirs. They do this by employing sophisticated 3-D seismic interpretation to construct accurate computer models of the subsurface."

Drilling the wells requires equal skill and precision. "Our typical development well is designed to intercept 15 producing zones—each averaging just 15 feet of pay," says Bruce Davis, Unocal Thailand's director of drilling. "To hit these small targets, we have to drill highly deviated wells that snake all over the place. We call them '3-D' wells."

To drill such wells accurately and efficiently, Unocal crews in the Gulf use the latest steerable top-drive drilling systems. Specially formulated oil-based muds help maintain stable hole conditions. "We're continually looking at new, innovative equipment and ideas to help us improve our performance, and enhance our level of efficiency and safety," Davis says.

One of the newest innovations applied by Unocal Thailand is a high-tech piece of downhole equipment called a variable stabilizer. Installed just above the drill bit, it gives crews the ability to change angles while drilling is in progress. In the past, drilling would have to stop in order to replace the stabilizer in use with one designed for a different drilling angle.





*Clockwise from top: A Unocal Thailand trainee receives language instruction at the company's Settapat Training Center, the Erawan field control room, a production operator makes his rounds, the Funan CPP under construction, explorationists plot well log data, offshore workers conduct a safety inspection.*



“**N**

ot all of the new techniques we try are effective,” Davis says. “But we learn a little more from each attempt—the failures as well as the successes. The goal is to be creative and keep improving.”

District drilling engineer John Liput, currently working on the Funan field development, agrees.

“Creativity is highly valued here because it’s crucial to our success,” he says. “There is also a strong feeling of teamwork among Unocal Thailand employees. We have good communication, and we all try to draw on each other’s expertise.”

The importance of teamwork and communication is especially evident offshore. Because they are located so far from land, Erawan and the other manned Gulf of Thailand installations must function largely as self-contained, self-reliant communities. “Everyone stationed out here is highly trained—not only in their individual technical specialties, but in working together as a team,” says Yutadanai Sangduen, Erawan production superintendent. “A team approach is essential for us to maintain a safe, reliable offshore operation.”

Emergency evacuation drills and other safety exercises are held regularly aboard all of Unocal Thailand’s offshore installations. All offshore employees also must attend an intensive, two-day fire-fighting and first-aid training program each year.

As part of its safety effort, Unocal Thailand has installed an advanced weather radar station on the Satun field living quarters platform. This facility, the first offshore weather station in Thailand, helps the Thai Meteorological Department (Thai Met) monitor changing conditions in Gulf. The station, whose radar system can track storms within a 300-mile radius, is manned by Thai Met on a 24-hour basis. The weather information collected is incorporated into Thai Met’s national forecasting network.

The new facility will help prevent a repeat of the events of November 1989, when Typhoon Gay—the first typhoon ever known to have formed in the Gulf—struck Unocal’s facilities and the coast of southern Thailand.

The surprise storm capsized the drillship Seacrest with 97 people on board, only six of whom survived. It went on to cause widespread destruction in southern Thailand, killing more than 2,000 people at sea and on land, and destroying hundreds of boats and buildings.

Unocal Thailand also uses the International Loss Control Institute (ILCI) safety system in its operations. ILCI’s International Safety Rating System (ISRS) focuses on prevention as the key to safety, and emphasizes correcting the causes and symptoms of trouble.

“The ISRS is an excellent way to reinforce and formalize our commitment to safety,” says Ben Van Amelsvoort, Unocal Thailand’s director of safety and environmental protection. “The system codifies safety procedures, sets tough standards and provides up-to-date measurements of safety performance.”

ISRS also has a standardized auditing system that includes quarterly visits of top management to each offshore installation. “In addition to conducting safety inspections, managers meet with workers at each location to discuss their concerns,” Van Amelsvoort says. “Good communication is essential to making the system work.”

Communication is also one of the elements stressed at the company’s Settapat Training Center, located in the town of Songkhla on the coast of southern Thailand. Opened in 1980, the center is a comprehensive instruction facility for the training of Thai nationals to staff Unocal Thailand’s offshore facilities.

The center was given its name “Settapat” in April of 1990 by Thailand’s crown princess, Her Royal Highness Princess Maha Chakri Sirindhorn, during her visit there as part of a tour of Unocal Thailand’s facilities. (The name derives from two Thai words meaning “economic” and “development.”) A total of 538 Thai trainees have now graduated from Settapat and been placed in various work assignments offshore with Unocal Thailand. Competition is keen for enrollment in the center, whose pool of trainees is drawn primarily from graduates of Thailand’s top technical schools.





“Our training program begins with intensive instruction in English, the international language of the oil and gas industry,” says Dangtoi Thaitun, manager of Settapat. “After completing a course covering basic petroleum technology, trainees advance into one of three technical specialties—mechanics, electronics or instrumentation—or they may be trained as production operators.”

When classroom instruction is complete, Settapat trainees move on to specialized on-the-job training offshore. After beginning their work assignments, graduates can upgrade their skills through the center’s development program. “One of our goals is to help qualified Thai nationals advance into supervisory positions offshore,” Dangtoi says. “A large number of Settapat graduates have attained high levels of authority and responsibility within Unocal Thailand over the years.”

Unocal Thailand’s talented work force will have plenty to keep it busy in the years ahead. In addition to the daily operation of its producing properties, the company has an ambitious work agenda planned for the future.

“Our development activity will continue at a high level even after Funan comes onstream,” says Keller. “In order to meet our production goals, which are responsive to PTT’s needs, we have to keep drilling new development wells. We plan to set at least four new wellhead platforms each year in our producing fields. We will also be performing a large number of redrills and recompletions on existing wells to help extend their productive lives.”

An active exploration program is also on the boards for Unocal Thailand. “There is still a lot of potential for field extensions and new discoveries in our current contract areas,” says Williamson. “We have also farmed-in to another offshore block south of the Baanpot and Funan fields called B12/27, where we are now operator. We feel this area has a lot of exploration potential. Two discoveries there in late 1990 had encouraging flow rates, and four exploratory wells are scheduled for 1991.”

More than one dozen additional exploration and delineation wells are planned for this year—one at Platong, one at Erawan, three in Funan, and eight in the nearby Jakrawan field area. Unocal Thailand will also conduct seismic work on several gas prospects in B12/27, and in the Gomin field, another gas structure covered under the third gas sales agreement. And the company is poised to begin exploration work in the Khorat Plateau, a new onshore concession area in northeast Thailand. Unocal was awarded four blocks there by the Thai government in a concession round held last April.

“We’re very excited about the Khorat Plateau area,” says Williamson. “It’s a different kind of geologic play than our offshore concessions. The gas prospects are in carbonate rocks, rather than the sandstones we produce from offshore. The carbonate formations are more difficult to decipher through seismic methods. But natural gas deposits in such formations, if you do find them, can be very large.”

Unocal will conduct extensive seismic surveys and drill four exploration wells in Khorat over the next three years, after the concessions are officially granted. Drilling is scheduled to commence in 1993.

“Ironically, we drilled a wildcat well in the same general area back in 1971, before we had made any discoveries in Thailand,” Williamson says. “That well was a dry hole. But given what we’ve learned since then, we hope to have a different result this time.”

However Khorat turns out this time around, one thing is certain. When Unocal Thailand celebrates its 30th anniversary next year, the company will have a lot to be proud of—and a lot to look forward to. “We’ve achieved more here in Thailand than we ever dreamed of back in 1962,” Laughbaum says. “And we’re optimistic that the next 30 years will bring an equal measure of success.” T.S. 76





*Top, a semi-submersible rig performs exploratory drilling in block B12/27, southwest of the Baanpot and Funan fields. Above, a portion of the Erawan complex. In addition to the daily operation of its producing properties, Unocal Thailand has an ambitious work agenda planned for the future. "Our level of activity has never been higher," says Graydon Laughbaum.*



# Guardians of Occupational Health

To workers at the company's Los Angeles refinery, it's definitely a healthy sign when Tom Thomson doesn't find what he's looking for. As one of eight industrial hygienists on the Unocal payroll, Thomson's daily routine takes him among the rank and file in search of hazards associated with the array of chemicals and heavy machinery used at the refinery and various other company facilities. Simply stated, he represents a worker's first line of defense against overexposure to health-threatening conditions in the workplace.

Industrial hygienists like Thomson are specifically trained to recognize, assess and control occupational health hazards, known as "stresses," in the work environment. Though they are considered specialists, industrial hygienists apply a broad range of scientific disciplines—including chemistry, engineering, physics, biology and medicine—to their research and evaluations.

Members of Unocal's industrial hygiene team are charged with monitoring all domestic and international operations for a variety of workplace stresses. Operating under the aegis of the Corporate Health, Environment & Safety Department, industrial hygienists are an integral part of the company's Health Services group.

Thomson's workday is well underway by 6:30 a.m. Toting a clipboard and metallic briefcase, he strides into the control room of the L.A. refinery's Unit 100 and greets the handful of workers on duty. This morning, Thomson explains, he will monitor the average sound levels and chemical exposures that employees encounter as they work amidst the unit's tanks, towers and pipes.

Though the Unit 100 catalytic reformer and hydrotreating equipment allow refinery workers to produce high-octane fuel, the machinery also processes potentially harmful substances and generates noise. Having long ago made worker health and safety a top corporate priority, Unocal closely monitors its facilities to guard against inadvertent leakage of vapors, dusts or liquids that might otherwise emanate undetected from industrial processes like those at the L.A. refinery. Mindful of this, Thomson unlatches his case and withdraws several different detectors from among a variety of portable devices. "Okay, who's first?" he asks.

Marco Pacheco, a unit operator, steps forward to be outfitted with the appropriate monitoring equipment. "This won't hurt a bit," Thomson jokes. He proceeds to clip an organic vapor monitor to Pacheco's collar, attach an audio dosimeter to his belt, and equip him with a hydrogen sulfide gas data logger that fits snugly in the breast pocket of his coveralls.

As Pacheco goes about his normal work routine of operations maintenance, the unobtrusive devices simultaneously monitor the presence of any harmful gasses or vapors in his work environment, as well as sound levels near operating machinery. Capable of functioning for up to 16 hours at a time, the devices yield cumulative and average measurements of potential hazards.

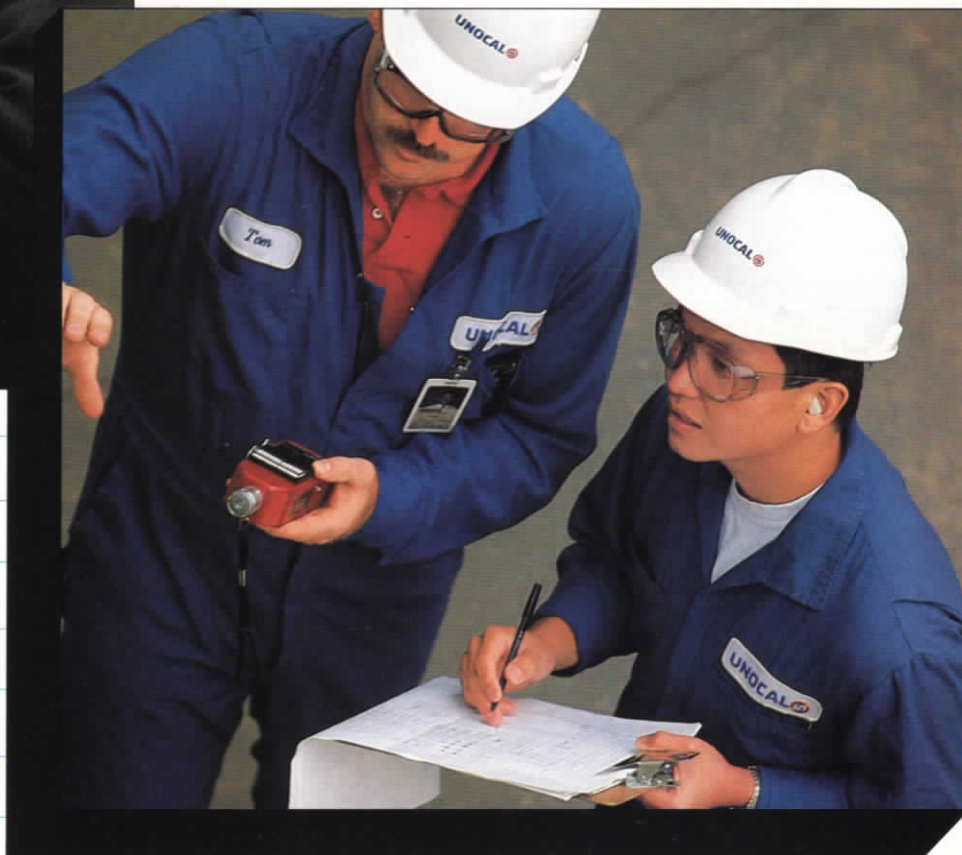
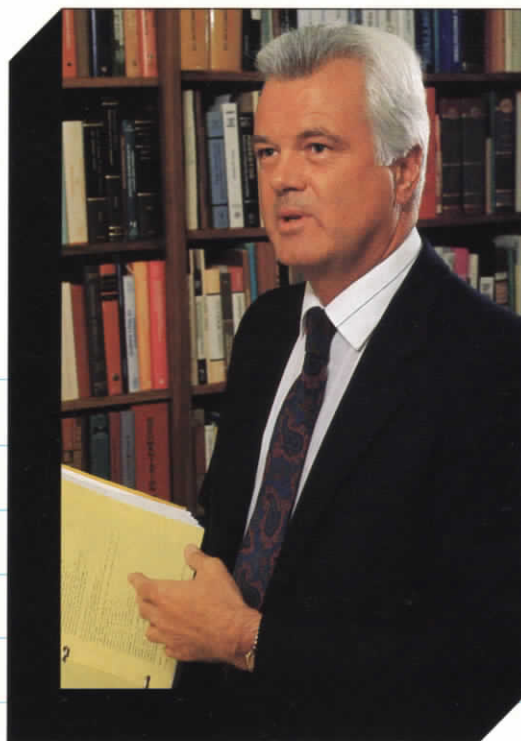
When Pacheco's shift ends, Thomson simply retrieves the detectors to ascertain the extent of exposures. Much of this information is immediately processed by the monitoring devices. Data from the organic vapor monitor, however, must be sent to a laboratory for further analysis. The refined information is then entered on a standardized form for future reference and interpretation.



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tional health hazards.**



*Clockwise from top right: "Our objective is to prevent occupational health problems through a process of routine monitoring," says Dr. Rainer Beck, manager of Unocal's Industrial Hygiene Department; using a sound level meter, Tom Thomson (left) and industrial hygiene intern Mike Mendoza record decibel readings around heavy machinery at the company's Los Angeles refinery; Marco Pacheco, an operator at the refinery's Unit 100, briefs Thomson on his work itinerary for the day.*



*Top, besides presenting workers with their greatest potential for exposure to refinery stresses, periods of unit maintenance and overhaul also allow Unocal's industrial hygienists to complete in-depth monitoring surveys without disrupting ongoing operations. Bottom, sporting an organic vapor monitor on his collar, Unit 100 operator Les Charles provides Thomson with background information regarding his unit's operations.*

**" We are always  
on call to handle  
occupational  
health problems."**







"Marco's readings were well within the acceptable range," Thomson says after reviewing data from the three devices. "This indicates that there are no leaks around the unit — everything appears to be in order. Generally speaking, no news is good news to an industrial hygienist."

True as Thomson's assertion is, it's old news to Dr. Rainer Beck, manager of Unocal's industrial hygiene department. The core emphasis of the industrial hygiene team hasn't radically changed since Beck founded the department in 1974.

"The primary objective of the company's industrial hygiene program has always been to prevent occupational health problems through a process of routine monitoring," he says from his office at Unocal Center in Los Angeles. "This strategy has been quite successful. Our record has been, and continues to be, very good in terms of maintaining employees' health."

As part of the routine monitoring process, Beck's group of industrial hygienists annually, or even more frequently, conduct on-site occupational health inspections at most of Unocal's major facilities. "We also perform a 'needs assessment' for every major company operation to determine the frequency and character of monitoring required for each one," Beck says. "In chemical plants and mining operations, for example, workers are more likely to be exposed to potentially dangerous materials than those who work here at Unocal Center.

"So, we do monitor some operations more frequently than others," he continues, "but we are always on call to handle occupational health problems regardless of where they occur."

Of particular interest to Unocal's industrial hygienists are worker exposures to chemical, physical, biological and ergonomic stresses. In the work environment, chemical stresses are most often found in the form of liquids, dusts, vapors and gasses, while physical health hazards are classified as radiation, noise, vibration and temperature. Biological hazards include viruses, bacteria, fungi, insects and rodents. Ergonomic stresses relate to worker body position, repetitive motion and fatigue.

If health risks are identified, the industrial hygienist works with operations management to reduce them. This can be accomplished through engineering and administrative controls, personal protection and substitution.

In a case where hazardous vapors accumulate in the work environment, for example, engineering control might require redesign or alteration of existing ventilation systems. An administrative control might call for modification of work assignments to reduce employee exposures. If substitution is chosen as a remedy, new materials, methods or equipment would be used in place of hazardous ones. Finally, personal protection equipment such as gloves, respirators or ear plugs might be distributed to workers to minimize exposure to occupational health hazards. Sometimes, a combination of these methods is implemented.

“Usually, there’s more than one way to remedy an occupational health problem,” Beck explains. “At Unocal, management usually opts for an engineering control to alleviate the hazardous situation. Personal protection, such as respirators or ear plugs, is used in the interim.”

Indeed, management’s desire to avoid occupational health problems before they occur has made Unocal’s industrial hygiene department a much more pro-active group than they were just a decade ago. “Increasingly, we are asked to review plans for proposed facilities, or new production processes, so that potential health problems can be identified up-front,” Beck says. “Management is well aware that it’s quite costly to correct design deficiencies after they are already in place.”

But, Beck adds, actions taken to prevent design-caused hazards indicate more than a simple concern for dollars and cents. “Unocal workers depend on us to look out for their health,” he says, “and that’s a responsibility that we, as industrial hygienists, never take lightly. Our company policy is to safeguard the occupational health of our employees at every opportunity.”

Despite good intentions and the steps taken to prevent design deficiencies, occupational health hazards can develop at company facilities. When they do, it’s up to people like Thomson to identify them and mitigate their impact on employees.

“My primary responsibilities are here at the L.A. refinery,” Thomson says. “I check every unit of the refinery at least twice per year—even more often during maintenance periods. In addition, I regularly go into the field to monitor more than 35 smaller Unocal operations throughout California, Arizona and Alaska.”

Given the extensive monitoring requirements of Unocal’s international and domestic operations, Thomson and his seven fellow industrial hygienists can be spread thin at times. To maintain a consistent monitoring regimen, Unocal’s occupational health professionals regularly enlist the aid of operations personnel.

These workers, known as “contacts,” are trained by the industrial hygiene staff to operate monitoring devices identical to those used in the field by Thomson and his colleagues. Contacts take measurements of workplace stresses and forward the data to the industrial hygiene department for subsequent analysis and reporting.

“The contact concept started with Unocal operations in Alaska because it was often difficult for an industrial hygienist to get out to the more remote locations,” Beck recounts. “Since then, it’s become a fixture of our industrial hygiene program.”

Today, 120 operations employees double as industrial hygiene contacts. Their presence enhances the overall effectiveness of Unocal’s full-time industrial hygiene staff. “Without our employee contacts, we couldn’t monitor operations nearly as frequently as we do,” says Beck. “The contacts are on the scene immediately if a problem should crop up.”

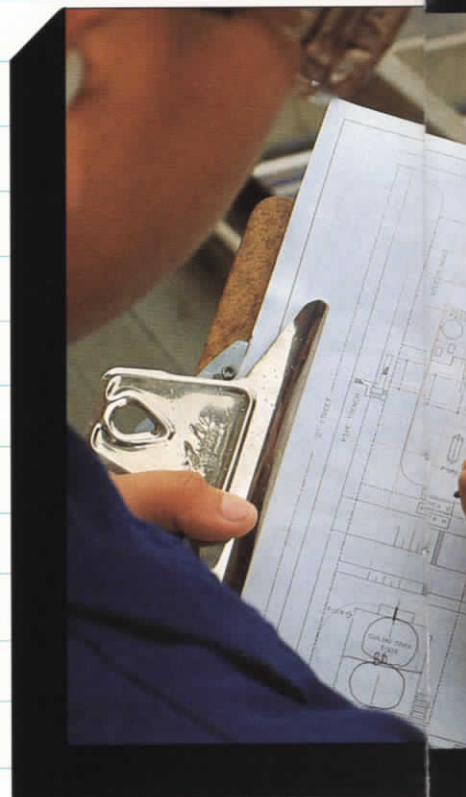
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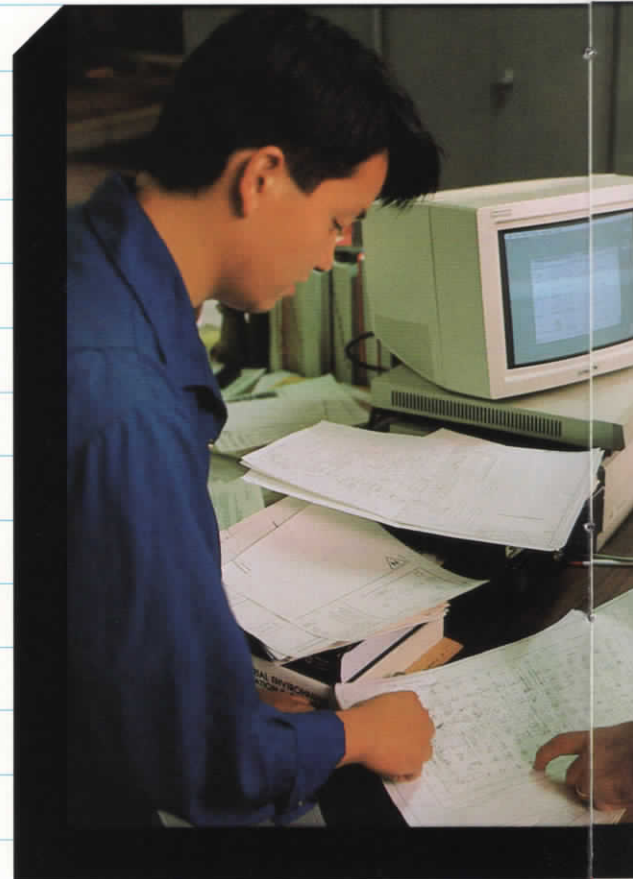


No nook or cranny of a facility escapes monitoring by the industrial hygiene team. Left, Thomson maneuvers into a tight spot to meter ambient sound levels. Bottom left, a grid pattern superimposed on a schematic diagram of a refinery unit guides industrial hygienists to optimal locations for accurate data collection. Below, back in his refinery office, Thomson demonstrates the operation of a wet bulb globe thermometer, just one of the high-tech devices in his stress-detection arsenal.





Once readings are collected from monitoring equipment and recorded on standardized data forms (top left), the information is entered into the refinery's industrial hygiene computer data base for future reference (below). Bottom left, Emilie Oishi, senior staff industrial hygienist, monitors the fumes traveling up an exhaust hood in the new geochemistry laboratory at Unocal's Science & Technology center in Brea.



"Usually, there's more than one way to remedy an occupational health problem."





Though the contacts have grown adept at routine monitoring procedures, a higher level of expertise is required if Unocal is to effectively recognize and preempt occupational health hazards in the making. At times like these, company management has found that an experienced industrial hygiene staff can pay prescient dividends.

"During the 1970s, industrial hygiene's major emphasis was on toxic chemicals. In the 1980s, it was on carcinogens. We still monitor for these hazards, but today concern is growing about the occupational health of white collar workers," Beck explains. "For this reason, I believe ergonomics will be a primary emphasis of the '90s."

As the industrial hygienists turn their attention to the office environment, increasing scrutiny is being directed toward computer video display terminals (VDTs) and their orientation to existing office furniture. "Initially, companies just put computers on employees' desks and let them go to work," Beck explains. "But as workers began spending more and more hours in front of VDTs, we began to see reports of occupational health problems linked to eyestrain or the repetitive motions of typing."

These workplace stresses of the computer age have been linked to back ailments, visual fatigue and even a painful wrist condition known as Carpal-Tunnel Syndrome. Fortunately, the causes of such ailments, and their remedies, are becoming better understood by industrial hygienists.

"These problems are caused by poorly designed workstations—chairs that exacerbate posture problems; office lighting that casts glare on VDT screens; desks that offer inadequate support for the wrists of computer keyboard users," Beck says. "Our aim is to make the furniture complement the equipment."

Currently, the industrial hygiene team is conducting company-wide VDT reviews to determine the best ways of minimizing ergonomic problems in the office environment. Poorly designed or obsolete office furniture, Beck believes, will likely be replaced on a gradual basis.

"It's more expensive to buy an integrated, ergonomically efficient workstation than to simply put a computer on a desk," he says. "But the company is determined to furnish its employees with office furniture that's comfortable, compact and ergonomically designed."

Regardless of how industry's occupational health focus changes over the years, the overriding emphasis of Unocal's industrial hygiene department—prevention of job-related sickness—will remain constant. Whether they work in an office, an oil field, a laboratory, or any other facility, Unocal employees can point to the industrial hygiene team as proof that their company doesn't gamble with the health of its workers. *M.B.* 76

## PUTTING TOXIC WASTE IN ITS PLACE

Like many of his constituents, Los Angeles Mayor Tom Bradley stores a variety of house paints, garden fertilizers, household pesticides and other potentially dangerous substances in his garage. But, in light of worsening hazardous waste statistics, the mayor recognizes what many L.A. residents fail to consider—the negative environmental ramifications of improperly disposing of these household products.

The gravity of improper household waste disposal has not escaped the attention of Unocal Senior Vice President Roger Beach, either. “Each year, Californians dump 50 to 70 million gallons of waste motor oil into the environment,” he noted during a July 22 press conference held in front of Bradley’s garage. “This is the equivalent of a Valdez-sized oil spill every 60 days.”

Beach and Bradley were both on hand at the mayor’s residence to announce Unocal’s pledge of up to \$1 million to help the city fund nine Household Hazardous Waste Roundups throughout the Los Angeles area.

The roundups—which will be conducted periodically through June of 1992—offer area residents a convenient, safe and environmentally benign means of ridding their homes of used motor oil, corrosive household cleaners and other waste products. (For the benefit of Los Angeles-area employees, a schedule of upcoming roundups appears on page 25.)

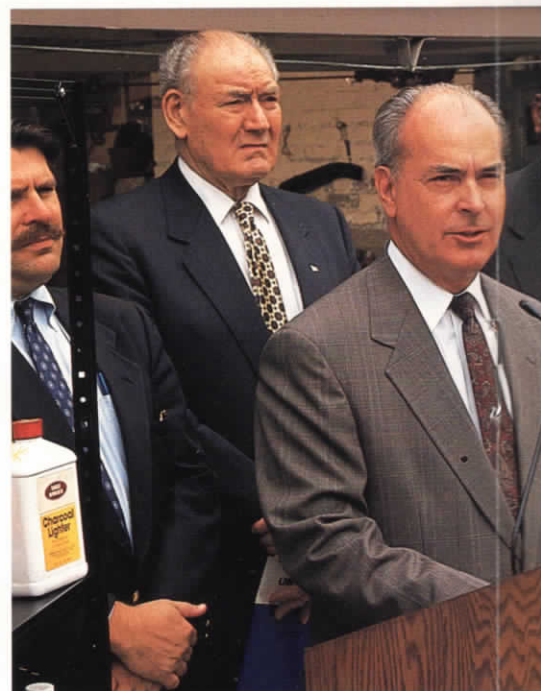
“By helping to underwrite the city-wide collection program, we can prevent hazardous household products from entering our landfills, or sewers, and harming our environment,” Beach said. “Unocal is proud to provide this important community service to all the people of Los Angeles as part of our continuing commitment to preserve and protect our environment.”

During the press conference, Bradley lauded Unocal’s sponsorship of two previous roundup events held at the company’s Los Angeles refinery, and thanked the corporation for its continuing financial support of the additional nine roundups.

“Unocal has already sponsored hazardous waste roundups at their own facilities at considerable expense,” said the mayor, who displayed a shelf-full of household products that are harmful to the environment when disposed of improperly. “We are grateful that companies such as Unocal have chosen to step forward with such a solid commitment. Certainly, the need for these organized efforts is obvious.”

Whether through ignorance or apathy, many people rid their homes of environmentally dangerous materials—substances that are labeled as flammable, toxic, corrosive, poisonous or irritant—simply by pouring them down drains or by discarding them with their regular household trash. Environmentally hazardous products commonly found in the home range from drain openers, floor waxes and discharged batteries to pesticides, pool chemicals and automotive antifreeze.

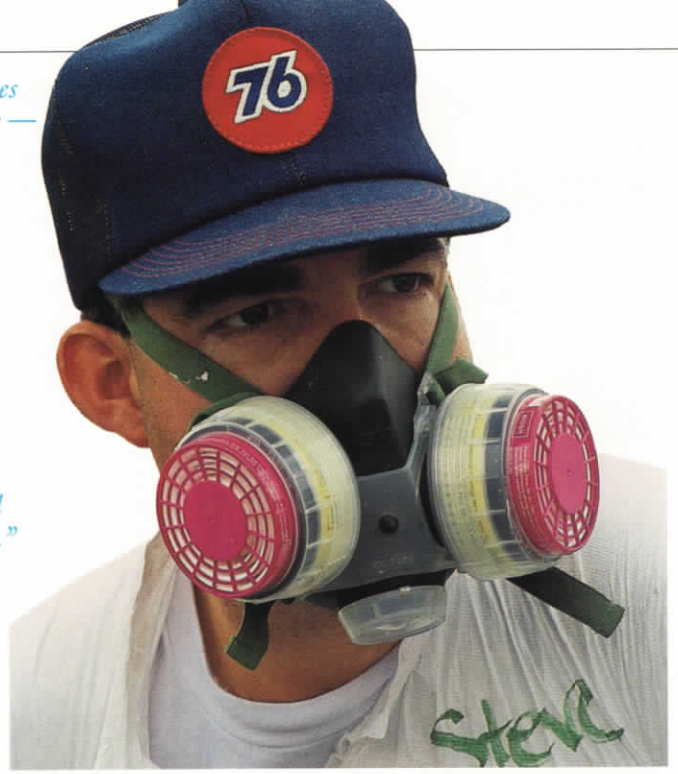
Once in a landfill, such products can break down, leach into the soil and contaminate nearby groundwater. If deposited down a city storm drain, the hazardous substances eventually flow into the Pacific Ocean as untreated pollutants.







*"All hazardous waste does not come from industry — a great deal of it comes from the home," said Senior Vice President Roger Beach (left) in announcing Unocal's financial support for nine Household Hazardous Waste Roundups in the Los Angeles area. "People need a convenient, safe and legal means for disposal of dangerous materials."*



*Co-sponsored with the city of Los Angeles, the first hazardous waste roundup was conducted in August at Exposition Park, site of the Los Angeles Memorial Coliseum.*



*During the event, more than 1,000 participating motorists were directed to any of a dozen drive-through unloading stations. Teams of specially trained waste handlers removed the toxic materials. Including a short wait in line, most participants were relieved of their accumulated hazardous household products in fewer than 15 minutes.*

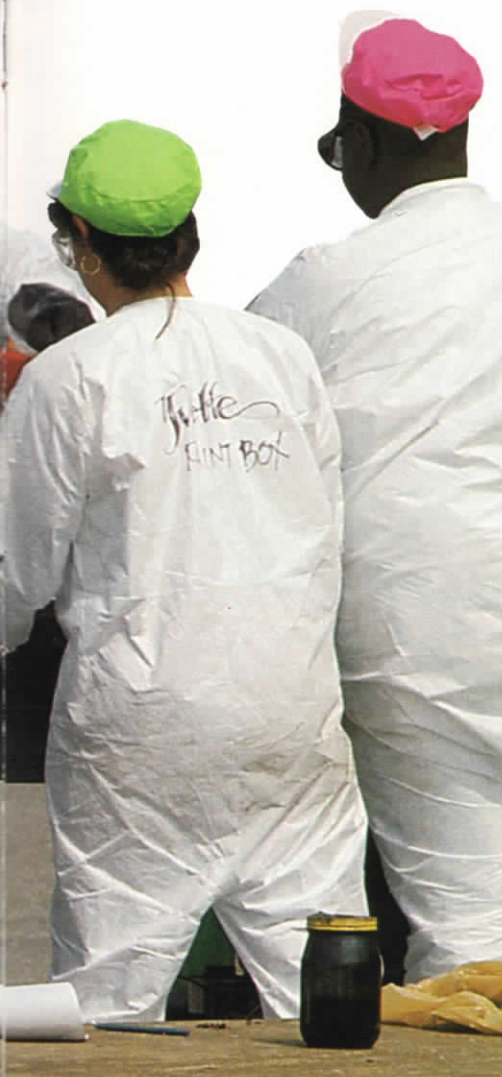




*Working under the supervision of the Los Angeles Police Department's Hazardous Materials Unit, protectively clothed waste handlers isolated reusable substances—including motor oil and latex paints—from products earmarked for incineration or other methods of safe disposal.*







Poured down a kitchen sink, the materials enter the normal sewage waste stream and put undue strains on city water treatment facilities and the health of sanitation workers.

In August, Unocal and the city conducted the first of their nine jointly sponsored Household Hazardous Waste Roundups at Exposition Park, site of the Los Angeles Memorial Coliseum. Drivers of the 1,060 vehicles which came to the free-of-charge roundup discovered that proper disposal of their hazardous household wastes need not be a cumbersome chore. The process was well-organized, speedy and safe.

Los Angeles city traffic police routed participants into the stadium parking lot, where they slowly maneuvered their vehicles through serpentine lanes marked by small orange cones. As the lines of traffic advanced, drivers were greeted by roundup personnel who distributed waste disposal literature and directed them to one of 12 drive-through collection points set up on the lot.

Instructed to remain in their vehicles for reasons of safety and efficiency, motorists simply rolled up to the collection stations and popped their trunks to allow protectively clothed waste handlers access to their accumulated stores of hazardous substances.

Though the motorist's role in the roundups typically is completed within minutes, actual disposal of the hazardous materials requires expert analysis and substantially longer amounts of time. Unless a given hazardous material can be immediately identified by visual examination, it is forwarded to an on-site technician for chemical analysis called "hazcatting."

Once identified, the hazardous materials are separated according to type by specially trained waste handlers. Used motor oil is transported off-site to be recycled into lubricants, asphalt coatings and fuels. Usable latex paints are donated to the city's "Operation Clean Sweep" anti-graffiti program.

Some wastes are incinerated to generate electricity, while those that cannot be effectively reused are treated, packaged and safely transported to approved facilities for disposal or incineration.

The August roundup at Exposition Park resulted in the collection of almost 149,000 pounds of hazardous waste. The recyclable portion of this total included an estimated 2,180 gallons of used motor oil, 11,000 gallons of paint and 240 old automobile batteries.

Including previous roundups held at the company's Los Angeles refinery in April of 1990 and July of 1991, Unocal helped to spare conventional landfills—and the local environment—of more than 235 tons of household hazardous waste. Altogether, the recyclable portion of this total included in excess of 36,000 gallons of paint, 18,000 gallons of motor oil and more than 800 discharged auto batteries.

By all accounts, the Household Hazardous Waste Roundups held thus far—which marked the first time that the private sector has joined with the City of Los Angeles to address household waste disposal—were overwhelmingly successful. Unocal's contribution to the effort has drawn numerous plaudits from a variety of quarters.

According to Jackie David of the Los Angeles Department of Public Works, Unocal's \$1 million funding pledge is one of the largest private-company donations ever given to the city over the course of a single fiscal year. In fact, Dana Duxbury, president of the Boston-based Hazardous Waste Watch Center, says that the company's contribution ranks as the largest, one-year financial gift ever given to any community in the United States specifically for purposes of household hazardous waste disposal.



"Clearly, Unocal's role in joining forces with the city sets a precedent for others in private industry," David says. "Together we are providing a solution to the problem of household toxic waste in our landfills, waste water treatment plants and groundwater."

The eight subsequent Unocal-funded roundups will be held at a variety of locations in the Los Angeles Basin and San Fernando Valley. The next event is scheduled to take place at California State University in Los Angeles on Saturday, September 14.

As at previous roundup events, participants are asked to limit their waste drop-offs to five gallons, or 50 pounds, because the U.S. Department of Transportation restricts the transfer of greater amounts. Explosives, radioactive materials, infectious substances and wastes generated by businesses will not be accepted.

Rather than being arbitrary prohibitions, such rules are designed to address a single, but immense, source of dangerous waste products. "Believe it or not, all hazardous waste does not come from industry," said Roger Beach at the July press conference. "A great deal of it comes from the home. That's why Unocal is supporting these free Household Hazardous Waste Roundups—people need a convenient, safe and legal means for disposal of these many dangerous materials." M.B. 76

*After being grouped by type, non-recyclable household products were packed into sealed drums and labeled for proper disposal in an approved hazardous waste landfill.*



*Altogether, the Exposition Park roundup resulted in the collection of almost 75 tons of household hazardous waste. Of this total, nearly 2,200 gallons of used motor oil, 11,000 gallons of paint and 240 discharged automobile batteries were recycled.*





## PRODUCTS AND THEIR SAFER ALTERNATIVES

SUBSTANCE	HAZARDOUS PROPERTIES	ALTERNATIVE
Disinfectants	toxic, corrosive	1/2 cup borax in 1 gallon water
Drain Cleaners	toxic, corrosive	apply plunger; flush with boiling water, 1/4 cup baking soda, and 2 oz. vinegar
Oven Cleaners	toxic, corrosive	clean with baking soda
Toilet Bowl Cleaner	toxic, corrosive	clean with baking soda or detergent
Upholstery and Rug Cleaners	toxic, corrosive	sprinkle dried corn starch or baking soda, then vacuum
Laundry Bleach	toxic, corrosive	1/2 cup white vinegar, baking soda or borax
Abrasive Cleaners or Powders	toxic, corrosive, irritant	rub area with 1/2 lemon dipped in borax, then rinse and dry
Aerosol Sprays	flammable, irritant, explosive	pump-type sprays
Mothballs	toxic	cedar chips or lavender flowers
House Plant Insecticide	toxic	spray leaves with a mixture of bar soap and water, then rinse
Ant Control Products	toxic	pour a line of cream of tartar, red chili powder, paprika or dried peppermint at point of entry
Pool Chemicals	toxic, corrosive, irritant	ozone or ultraviolet light systems
Household Batteries	toxic, corrosive	solar-powered or windup products, rechargeable batteries, AC adaptors

## HOUSEHOLD HAZARDOUS WASTE ROUNDUP SCHEDULE

September 14, 1991  
**Northeast Los Angeles**

October 12, 1991

**Van Nuys**

November 9, 1991

**Westchester**

January 18, 1991

**Reseda**

February 8, 1992

**Sylmar**

March 14, 1992

**West Los Angeles**

May 9, 1992

**Granada Hills**

June 13, 1992

**Downtown Los Angeles**

Consult local newspapers for specific roundup sites and times in each area, or call the Household Hazardous Waste Hotline at (213) 237-1634 for additional information.



# AN UNLIKELY OIL PATCH

Northern Michigan isn't exactly considered the oil patch. You won't find a Texas-sized contingent of pump jacks or drilling rigs in this land of pristine lakes and pine forests. But unlikely as it seems, Unocal has quietly been producing oil and gas here for decades. The operations have been a profitable segment of Unocal (and its predecessor, Pure Oil) since 1928.

Last year, however, Unocal's Michigan production was augmented by a significant discovery. Early in the winter of 1990, a well drilled near Grayling, Michigan, located in the company's State Garfield tract, struck a large accumulation of natural gas.

Tapping a deep, massive sandstone formation called the Prairie du Chien (PdC), the State Garfield 1-8 well currently produces 14 million cubic feet (mmcf) of gas per day. At that rate of production, industry analysts consider this a major find. According to the *Mich-*

*igan Oil and Gas News*, the well is "the best well drilled in Michigan in 1990, and possibly one of the best ever drilled in the state."

Natural gas couldn't be found in a better place. In general, Michigan offers certain economic advantages to natural gas production. Most importantly, the price of natural gas has not fallen as precipitously here as it has in other parts of the country. Numerous gas storage facilities exist, which help producers respond to fluctuations in the market. Cold northern winters, and the large nearby metropolises of Detroit and Chicago, help ensure that demand remains high.

"The Prairie du Chien carries a good probability for yielding large amounts of natural gas," says John Forbes, northern district exploration manager. "The formation forms the core of much of the exploration work we're doing in Michigan."

"Our excitement about the PdC is reflected in the profit potential of the play," adds Bob Meyer, exploration manager of the Mid-Continent Region. "When you combine the statistical chance of discovery with the economics of the play, the PdC becomes the most attractive exploration venture in the Region and one of the top few in the North American Oil and Gas Division."

Until a few years ago, the company's focus in the state was on oil, not gas. Most of Unocal's work concentrated on the Devonian Richfield formation, an oil-bearing dolomite reservoir under the company's Beaver Creek property, just east of State Garfield. In operation for almost 50 years, Beaver Creek has produced a total of 18.9 million barrels of oil, and currently produces an average of 460,000 barrels each year. Unocal operates about 140 producing oil wells in the field.

In addition to bearing primarily gas, the 450-million-year-old Prairie du Chien sandstone lies several stratigraphic layers beneath the Richfield zone, and stretches under the northern two-thirds of the state.

"The Prairie du Chien formation was deposited during a 50-million-year span known as the Ordovician Period," explains Carl Babb, a northern district development geologist, based in the company's district office in East Lansing, Michigan. "Rivers and streams emptied into an inland sea, depositing sand reworked by micro-organisms on the bottom. Over time these deposits built up, eventually becoming the Prairie du Chien sandstone."





Unocal began expanding its exploration efforts to include the Prairie du Chien formation in 1982. A well drilled by another company had found natural gas in the top of the PdC several miles south of the State Garfield-Beaver Creek area, confirming Unocal's belief that the deep formation had potential.

"At that time, we began looking at the PdC more carefully," says Dave Buthman, an exploration adviser based in the Oklahoma City office, the regional headquarters responsible for the Michigan district. "Significant differences between the east and west deposits of the formation became apparent. Consequently, we divided the state into two main areas, and decided to concentrate our efforts in the west."

By 1985, a deep well drilled on Unocal's holdings in the western segment had proved successful, producing 7 mmcf of gas per day. Competition in the area intensified dramatically, as other companies began to bid for nearby leases.

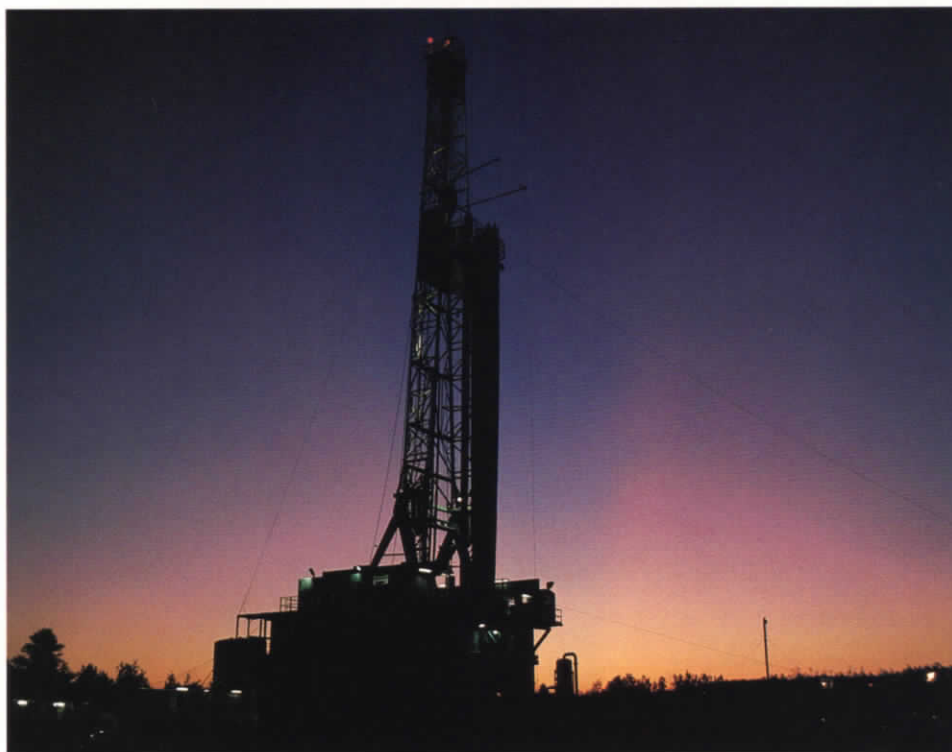
"At that point we interpreted and mapped everything you could think of," says Forbes. "We used water wells, surface stream patterns, Landsat imagery, seismic data, any scrap of information that could identify exploration opportunities and give the company a competitive advantage."

Believing that larger deposits existed, the Unocal team shifted efforts to the eastern part of the basin. In 1988, the company's activities began to bear fruit with a discovery in the Santiago field, producing both oil and gas, but primarily oil.

Initially, the well produced 368 barrels of oil, and 1.6 mmcf of gas per day — enough to justify commercial development, but not the major discovery the company had hoped for. It took another find, a year later — beneath the company's producing Richfield oil fields at Beaver Creek — to point the Michigan team in the right direction. Using this well and seismic information, Unocal drilled in the nearby State Garfield exploratory acreage and struck pay dirt.

To find the gas deposit, company geologists had to contend with formations unlike those found anywhere else. "The geology of the area is simple yet difficult to interpret," says Buthman, smiling at the apparent paradox. "We understand the geological formations in the basin — they're pretty basic. However, the nature of these structures creates difficulties in interpreting the data we use to find oil and gas deposits."

The glacial drift which overlays most of the Michigan basin presents the main obstacle. Ten thousand years ago in the Pleistocene Epoch, when the earth's climate warmed enough to melt the snow and ice spread over much of North America, receding glaciers left a layer of rocks and sand, called drift. The debris covers the area like a patchy blanket — up to 900 feet thick in some places. This chaotic composition of boulders, pebbles and sand, and the variable thickness of the layer, hinder exploration techniques aimed at mapping the geological structures that lie underneath.



*Unocal has produced oil in Michigan for decades. Currently, the company operates five fields in the state (left), and maintains a district office in East Lansing. The State Garfield 1-8 well, being drilled above, produces 14 million cubic feet of gas per day.*

Until recent technical advancements, the primary exploration method of seismic surveying produced poor results in areas of Michigan covered by thick glacial drift. Such a layer will distort seismic reflections and add considerable "background noise" to the data. "In an area without drift, seismic profiles generally present a clearer image of the subsurface," says Gerry Phillips, an Oklahoma City-based geophysicist.

The glacial drift causes a problem called static errors or distortions. To correct these errors a special seismic computer processing procedure called "first break refraction statics" is performed. If the static distortions are properly removed, geophysicists can correctly interpret the subsurface structure.

"Many of the distortions are particular to this region," says Julie Staggs, another Unocal geophysicist based in Oklahoma City. "The more familiar you are with the formations in the Michigan basin, the better."

Unocal's exploration team also relies extensively on more fundamental sources of geological information, such as logs from previously drilled wells, aerial photography and gravity data. Probably the single most important source of information in the region, leading to the most prospects, comes from the logs of wells drilled not for oil or gas, but for water. Dave Buthman has developed the interpretation of such data to a fine art. He has spent years compiling bits of information from hundreds of these wells located throughout the basin.

"Michigan water wells usually go down only a couple hundred feet at the most, so people tend to overlook them as potential sources of geological information," says Buthman. "The formations we're most concerned with lie much deeper. But because so many water wells have been drilled, we can learn a lot from them by piecing the data together."

Composing an entire tableau from small components forms the key to finding oil and gas deposits in the Michigan basin. "Instead of a big puzzle with six pieces, the basin consists of a small puzzle with 200 pieces," says John Hidore, an East Lansing-based development geologist. "This makes the area fascinating to work on, but also poses quite a challenge in finding petroleum-bearing formations."





Though the recent discovery of the gas deposit locked within the Prairie du Chien formation attests to a successful interpretation of the area's geological structures, some qualities of the formation remain mysterious.

"There don't seem to be any modern corollaries to the Prairie du Chien," says Hidore. "We know the formation is 1,100 feet thick, and is 95-percent sand. But the internal structures and textures are varied and extremely complex."

If the internal nature of the formation remains unclear, the location of gas deposits within it becomes better understood with every well drilled into the structure. Just one mile east of the first State Garfield well, Unocal completed another well in July. To prevent leaks of valuable information, Unocal logged the well in an atmosphere of secrecy.

Still, not every piece of information can be kept hidden. The size of the flare produced when crews test a gas well, for example, can indicate future performance. The higher a well's flare reaches, the greater the underlying pressure. High pressure usually promises excellent flow rates. The flare of this most recent well reached more than 40 feet high, noteworthy by any standards.

"The first State Garfield well was so good that people came expressly to see the flare of the field's second well," says Bernie Pottorff, field superintendent. "It's difficult to prevent anyone from seeing that." Current estimates for Garfield-added reserves replace district production by about 300 percent. The company's share of total reserves discovered in the PdC thus far accounts for about 38 percent of Unocal's total reserve base in the Northern Mid-Continent District.

Because the Prairie du Chien lies at a deeper level than the oil-producing formations, wells drilled into it cost more than the oil wells drilled in Beaver Creek. But on the other hand, fewer wells are usually needed to produce such a field.

"As a rule, the deeper the reservoir, the more pressure exists to push the oil or gas out," says James Alexander, northern district production engineer. "As a result, wells drilled in the Prairie du Chien drain a larger area than the shallower Beaver Creek wells."

The State Garfield gas wells reach an average of 6,000 feet deeper than the oil wells of Beaver Creek — and just a few wells may be all that are needed to produce the deep PdC reservoir in one field. Currently, the Michigan group must evaluate the area to determine if additional wells need to be drilled.



*Above, one of 140 oil wells in Unocal's Beaver Creek field, which produces an average of 460,000 barrels of oil per year. Left, clockwise from top: the State Garfield wells, such as the one being drilled here, extend to an average depth of 11,000 feet; drilling proceeds on a well in the Beaver Creek field; dense underbrush and woodlands characterize much of northern Michigan; Bernie Pottorff (left), field superintendent, and Glen Edwards, the district production engineer, check the State Garfield 1-8 wellhead.*



"We're in the process of deciding whether the two wells already drilled in State Garfield will suffice," says Carl Babb. "The economics have to be carefully balanced, taking into account the cost of more wells, and the reserves left in the ground."

Operating successfully in Michigan also entails contending with environmental concerns, a severe winter climate, and the remoteness of the well sites. The drive there from Unocal's district office in East Lansing takes just over two hours. As one progresses northward, farmlands give way to thick forests, which line the highway on both sides.

To reach the site of the new discovery well, a visitor must leave the highway and follow progressively narrower dirt roads through woods and dense underbrush. Few indications of any activity prepare visitors for their arrival — a last turn of the steering wheel, and the wellsite comes abruptly into view.

Inconspicuous presence has become a kind of hallmark for Unocal's operations in the state. The company makes an extra effort to blend into the surroundings, as well as to safeguard the environment and its wildlife. To quiet pump jack engines, for example, mufflers with extra baffling are standard. "Deer roam all over these fields," says Pottorff. "Even in Beaver Creek, where oil wells have been operating for more than 50 years, we see deer all the time. Our wells don't seem to disturb them."

The environment ranks high on the state's list of important issues. Apart from Detroit's auto industry, Michigan is well known for its lakes and woodlands. Lakes Huron and Michigan gird the state on two sides, attracting tourists to their shores for swimming and water skiing, while the state's many forests beckon to campers and backpackers seeking weekend refuge from near-by Detroit and Chicago. "This kind of tourism has become a major source of revenue here," says Babb, "and the state's agencies take environmental regulations very seriously."

So does Unocal. Existing operations undergo a rigorous maintenance program to ensure that any problems are caught and remedied immediately. Each well is checked twice a day. When pipelines must be installed, the company makes an effort to place them next to existing roadbeds, to avoid marring the woods.

"The cleanness of our operations has drawn positive responses from state officials," says James Alexander. "Our environmental performance has also helped ease the process of obtaining necessary operating permits."

Unocal goes a step further in taking environmental precautions. One of the company's fields has become a last nesting site for the Kirtland Warbler, an endangered species of bird. Just a few hundred still exist.



*Left, a worker checks drilling progress on a rig in the company's Beaver Creek field. Right, winters in Michigan tend to be long and cold. Annual snowfall averages 120 inches, at times impeding production. "We run a snow plow every day in the winter," says Glen Edwards, district production engineer. "And even then some wells get snowed in until we can clear access." At bottom, District Exploration Manager John Forbes at work in Unocal's regional headquarters in Oklahoma City.*



“**T**he Warbler nests only in a small area, located near several of our operating wells,” says Pottorff. “During nesting season, we shut down operations to avoid disturbing the bird.”

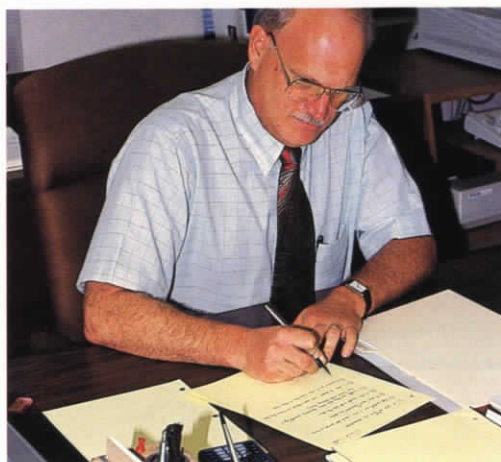
If environmental considerations regulate some aspects of production, weather and geology impose their own restrictions. Winters are long and cold in Michigan, with an average annual snowfall of 120 inches. “Water injection lines have to be buried to a depth of at least six feet to get beneath the frost line,” says Glen Edwards, the district’s production engineer. “We also have to run a snow plow every day in the winter. And even then, some wells get snowed in until we can clear access. To prevent freeze-ups and halts in production, our wells must have backup fuel supplies on power-generation systems. All of this adds cost and difficulty to production.”

Getting the resource out of the ground is not the end of the story, of course. Transporting the product to market is equally important — and here the difficulties lessen. Although the State Garfield and Beaver Creek fields are remote, they have ready access to an extensive pipeline network. Coupled with the area’s high demand for natural gas, the relative ease of transporting the product adds up to a big advantage.

“The faster you can get a pipeline connection made, the faster you can begin selling gas,” says Edwards. “Our constant goal is to transport the product to the buyer as fast as possible. We installed a connecting pipeline from the State Garfield field in record time during the winter — taking only two months to go through permitting, construction and environmental procedures.”

Like the area’s geology, the challenges of developing Michigan’s earth resources encompass many small pieces. Unocal must consider all of them to assess the area’s long-term potential. But given the significant “piece” represented by the Prairie du Chien gas discovery, the company’s future in this unlikely oil patch appears bright.

“We feel that we have clear competitive advantages in exploring and developing the Prairie du Chien,” says Russ Briggs, vice president of Unocal’s Mid-Continent Region. “We have amassed more than 90,000 exploratory acres in the PdC play, while some of our major competitors have lessened activity or even pulled out of Michigan entirely. For us, the formation has become a primary exploration venture.” 76







Not all that long ago, cowpokes rhapsodized about the diversity of wildlife that distinguished much of America's western frontier. This was a pristine land of grand expanse, where—as the old cowboy song recounts—buffalo roamed beneath a canopy of cloudless blue skies, and deer and antelope played.

But for many areas of the once "wild" West, such lyrics no longer offer an entirely accurate description. Unlike the cowboy of yesteryear, a modern-day conservationist might utter a discouraging word or two about the decline of several native animal species that once thrived in this land of mountains and wide-open range.

Pronghorn antelope, considered the swiftest of North American mammals, comprise just one of the animal populations adversely impacted during the headlong rush to settle and develop the West. Before ranchers, prospectors and settlers arrived, antelope grazed from the California Coast to Missouri; from Southwestern Canada down into the mountains of Mexico. But by the 1940s, antelope herds and habitat—then relegated to just a handful of Rocky Mountain states—had dwindled to a fraction of their sizes a century earlier.

Today, human hands are again exerting a fateful impact on the pronghorn antelope. But this time around, the effect is expected to spur a resurgence of the species. Among the concerned parties currently involved with this effort are the people of Unocal's Southwest Region oil and gas operations.

Initially, what brought antelope and oil company together was a mutual interest in an area of Northwest New Mexico known as Ensenada Mesa. The 53-square-mile mesa, located in the petroleum-rich San Juan River basin, is home to both the Southwest Region's Rincon gas production unit and a herd of nearly 80 pronghorn antelope.

As a whole, the Rincon unit currently produces 20 million cubic feet of natural gas daily. Cumulatively, Unocal's 281 wells on Ensenada Mesa have produced in excess of 270 billion cubic feet of gas. Though no antelope lived on Ensenada Mesa when most of these wells were drilled during the 1950s and 1960s, the animals do have roots in the area.

"Historically speaking, antelope lived on Ensenada Mesa years ago. They died out—primarily as a result of hunting and predation—sometime around the turn of this century," says Paul Colbert, wildlife biologist with the U.S. Bureau of Land Management (BLM). "Today, the area still possesses all of the environmental qualities necessary to be an excellent habitat for antelope. That's why the BLM decided to re-introduce the species to Ensenada Mesa."

In January 1989, Colbert recounts, almost 100 antelope were captured in eastern New Mexico and subsequently released on the mesa. The following year, Unocal—which had long held rights to develop natural gas prospects on Ensenada Mesa—notified the BLM of its intention to drill more than 60 new wells. Bureau officials feared that drilling operations, and resulting truck traffic, might disrupt herd grazing patterns and inhibit breeding activity.

"Obviously, we were concerned," Colbert says. "Antelope are sensitive animals by nature, and this herd was in a particularly fragile state from the strains of relocation."

Apprised of the antelope's delicate condition, Unocal worked with the BLM to temporarily limit drilling operations in grazing areas frequented by the herd. Over the course of days and weeks, the animals roam widely across Ensenada Mesa in search of the sagebrush and broad-leaf vegetation that comprises their diet. As a result, individual drilling operations typically were not delayed for long periods of time.

"Everything worked out perfectly," Colbert continues. "Unocal ran their operations around the needs of the antelope. They didn't intrude or disturb anything any more than they had to."

But the people of Unocal's Southwest Region went even further to aid the herd's revival. First, the company improved two existing water wells and drilled a third to ensure that the antelope of Ensenada Mesa have access to year-round supplies of water. Also, to help the BLM monitor the herd's progress, the company hired an independent wildlife biologist to observe the animals on a consistent basis.

Finally—and perhaps most importantly—Unocal volunteered to suspend all mesa drilling operations for one full week during the most critical period of the antelope's breeding cycle. Though not all of them survived beyond infancy, Colbert estimates that 20 to 30 antelope kids were born during the herd's second year on Ensenada Mesa.

"I'm sure Unocal went to a good deal of trouble to shut down drilling for a week, but it made a difference," Colbert says. "To me, this shows that the company really wanted to do the right thing."

"This was something we felt we needed to do," says Bobby Bryan, district drilling superintendent based at the Southwest Region's Midland, Texas office. "Our crews noticed that the animals seemed skittish. They feared that our drilling activities might be spooking the herd."

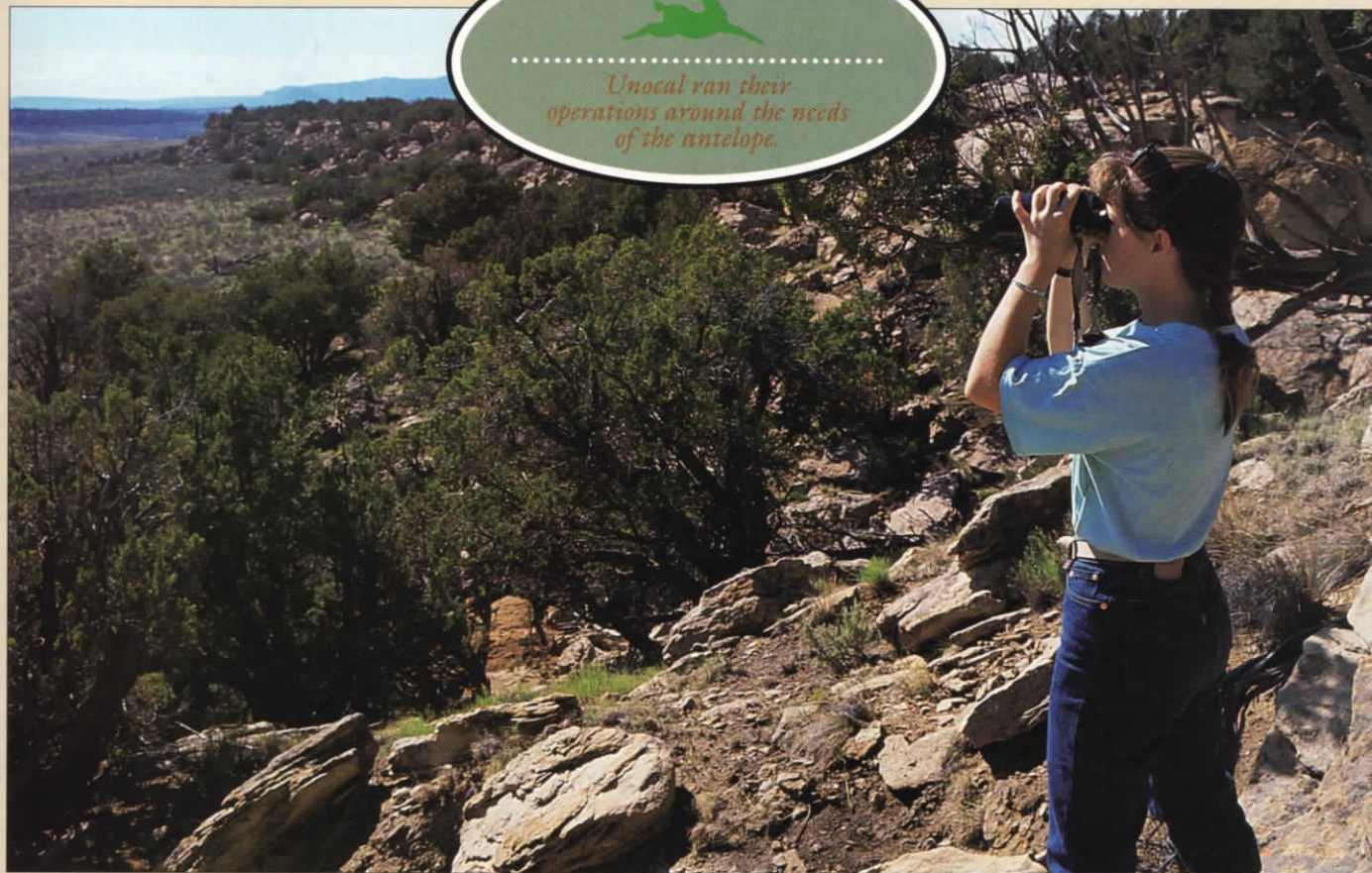
"The antelope population was already struggling to survive," Bryan continues. "At the time, with so many of the females getting ready to bear kids, we felt that Unocal should probably stay out of their way for a little while. It seemed like the best thing—really, the only thing—to do."

These efforts on the part of Southwest Region employees have garnered official commendation. In May, Unocal earned the 1991 Annual Environmental Initiatives Award from the New Mexico Bureau of Land Management for the company's contribution to the pronghorn's continued survival.





Unocal ran their  
operations around the needs  
of the antelope.

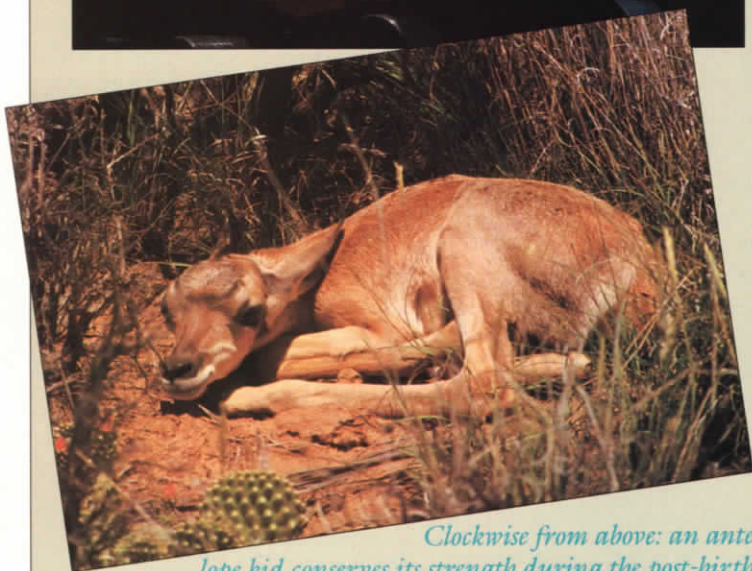
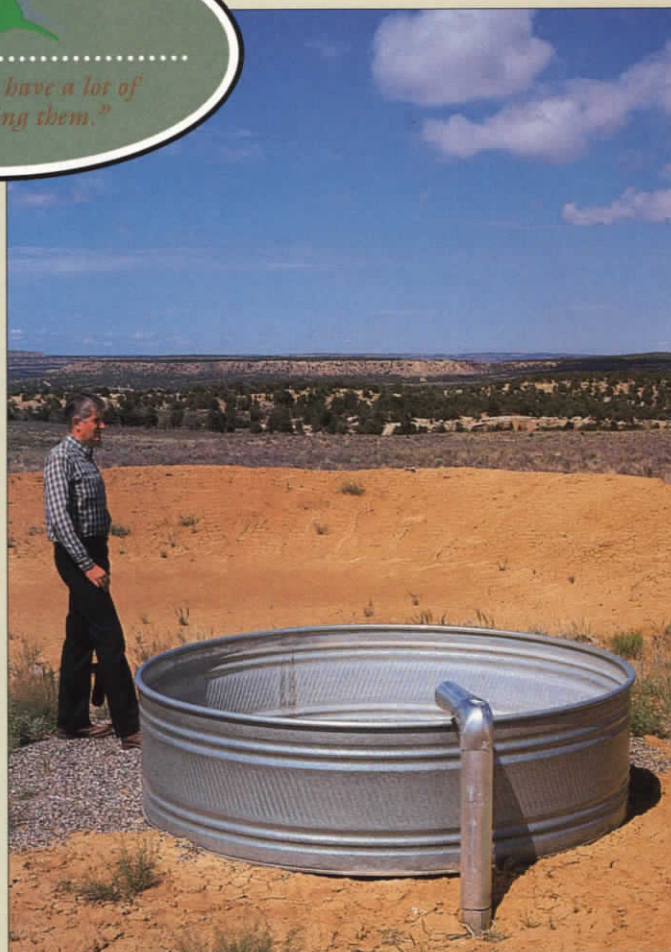


Top, Camela Hooley, a wildlife biologist hired by Unocal, scans a ridge line on Ensenada Mesa for signs of pronghorn antelope. Left, a male member of the herd pauses from grazing just long enough to be captured by the camera.





.....  
*"Those critters have a lot of  
 people backing them."*



*Clockwise from above: an antelope kid conserves its strength during the post-birth "lying low" period; drilling operations proceed atop Ensenada Mesa at the Southwest Region's Rincon unit; Paul West checks the condition of a water trough installed by the company to provide for the herd's water requirements; (from left) Hooley, Bill Hering and West look for pronghorn in the vicinity of a Unocal-drilled water well frequented by the animals.*





"Unocal has been an active partner working with us to improve the antelope habitat on Ensenada Mesa," says Larry L. Woodard, director of the BLM's New Mexico office. The company's efforts to aid the herd, he adds, "are excellent examples of industry and the BLM working together to solve complex multiple-use problems."

Production manager Paul West and petroleum engineer Bill Hering have seen firsthand the fruits of this working relationship between the BLM and Unocal. Based in the Southwest Region's Farmington District office—about 50 miles from Ensenada Mesa—West and Hering periodically monitor drilling operations at the Rincon Unit. It's not difficult, they concur, to spot antelope near isolated wellheads or on distant hills—that is, if you know how to look for them.

"Their natural coloration helps them blend into the surrounding landscape," West explains while Hering steers his four-wheel-drive truck along the sparse network of gravel roads that runs across the mesa. "But the primary defenses of pronghorn antelope are their keen eyesight and considerable speed. Even though they can run 60 miles per hour for short distances, antelope usually don't let you get too close—they like to keep about a quarter-mile between you and them."

On this summer morning, the two men have endured the bumpy ride to Unocal's Lowry Camp—a small field warehouse on Ensenada Mesa—to meet with Camela Hooley. Hooley, the wildlife biologist hired by Unocal to monitor antelope activity, has agreed to take West and Hering along with her as she observes the herd.

"I'm not sure how much success we'll have locating antelope today," she tells them. "When I was here last week, I found that the herd had dispersed into small groups." Undaunted, the three hop into Hering's truck to begin canvassing the mesa for signs of antelope.

The azure skies above Ensenada Mesa are punctuated by cottony clouds that materialize almost imperceptibly in the thin air. The view from atop the mesa is a grand panorama of rocky buttes, craggy canyons and low-slung escarpments which stretch for miles around.

Flowering cactus and lime-colored lichen spring from patches in the crumbly orange-brown soil not already occupied by sagebrush and wild grasses. Lizards scurry for shaded cover, meadowlarks whistle their jaunty song and buzzards glide overhead in circular patterns. If not for the scattered wellheads, criss-crossing network of dirt roads, and stone-built ruins of Indian lookout posts, one might never guess that human beings have been frequent visitors to this remote area.

"For the most part, it's not man who poses the biggest threat to the herd's survival on Ensenada Mesa," Hooley explains. "At this point, natural predators like the coyote are limiting the growth of the antelope population."

Suddenly, Hering interrupts her to point out some movement on a nearby ridge line. Scanning the horizon through a pair of binoculars, Hooley confirms his sighting. "It looks like a female pronghorn," she says.

Hering slows his vehicle and maneuvers it cautiously toward the ridge. "Hey, I see two more to the left of that one," West adds. The three animals stand stock-still, sniffing the air and watching the truck as it approaches to within a few hundred yards of them. Then, as if heeding some silent cry of alarm, the antelope scatter helter-skelter to the other side of the ridge. Survival instincts apparently do not help the animals distinguish between dangerous predators and a few curious human beings.

But ironically, human beings are perhaps the staunchest allies the Ensenada Mesa antelope have today. Even as the herd suffers attrition at the jaws of hungry coyotes, people are taking steps to help increase the population of the herd.

"Between predation and the stress of moving to a new habitat, we didn't really expect to see much breeding activity in

the herd during its first few years on the mesa," says Colbert. "However, in 1993 the BLM plans to supplement the antelope population with another 30 relocated animals. By law, they'll be protected from hunters until their number exceeds at least 100 animals."

As before, the BLM is not alone in its effort to revive the species on Ensenada Mesa. Unocal employees are also suggesting additional ways of improving the antelope habitat to increase the herd's odds of survival.

"Unocal has offered to shut down some of their access roads and alter existing fences to allow antelope greater freedom of movement. They've also indicated their willingness to consider implementation of other projects to aid wildlife," Colbert says. "I can do nothing but congratulate Unocal for their attitude and actions—they've really set a positive precedent for other companies to follow."

Time will tell whether or not the pronghorn antelope population becomes firmly re-established on Ensenada Mesa. Colbert, for one, is optimistic. "Between Unocal's contributions and the continuing efforts of the BLM, I think the antelope are going to survive," he says. "Those critters have a lot of people backing them."

Despite the damage wrought during early attempts to settle and develop the West, people today have begun to understand the fateful influence they exert on the environment. But as evidenced on Ensenada Mesa, the activities of men need not conflict with the needs of wildlife. In fact, as the employees of Unocal's Southwest Region continue to prove, oil companies and antelope can both be at home on the range. *M.B.* 76



# LET THE GAMES BEGIN!

The Games were sponsored entirely by Los Angeles-based businesses. Unocal, along with Pepsi-Cola, were the primary contributors.

"As a good corporate citizen, Unocal wants to help find ways to fight the problems of juvenile crime, drugs and gang involvement in Los Angeles," says Richard J. Stegemeier, chairman, president and CEO. "The Hollenbeck-Alatorre Games give the city's young people an alternative that can help them build solid values and become good citizens."

Opening day began with the Munchkin Mile, and a 5K run for older participants. The races, held in the Boyle Heights neighborhood of East Los Angeles, finished where they had started—adjacent to a fair set up by sponsors of the Games.

At the fair, the Los Angeles Police Department showed off a Mobile Emergency Response Vehicle, a SWAT van, and one of the specially trained horses used by its mounted police patrols. The Red Cross displayed an ambulance and distributed literature about its services. Pepsi supplied free soft drinks, while Unocal volunteers awarded medals to the Munchkins.

After the races, buses transported the contestants and fairgoers to the Games' official opening ceremonies, held at the California State University/Los Angeles stadium. By the time the kickoff got underway, the youthful crowd was waiting eagerly for Schwarzenegger's scheduled appearance.

After a rousing fanfare by the Santa Ana Marching Winds, Schwarzenegger stepped to the stage, right on schedule. "I wouldn't be where I am today if I hadn't stayed in school and worked hard," he said.

"Without the efforts of my coaches, teachers and parents, who supported me and kept after me, I wouldn't have made it. I encourage you to say no to drugs, study hard, and stay involved with a program of physical fitness."

After remarks by Councilman Alatorre and Laker Coach Mike Dunleavy, local schools put on flamboyant stage shows. Performances included Olympic style ribbon dancers, choreographed dance numbers and a karate demonstration. The Latin group Que Pasa concluded with a rap song.

To close the ceremony, sky divers trailing plumes of smoke leaped from planes high above the stadium, glided earthward and landed next to the stage. The children rushed over to the aerialists as they touched down.

"I want to learn how to do that!" one youth exclaimed. "Is that a camera on your helmet?" asked another.

From the high level of enthusiasm evident, some were already benefitting from the sports program. The Games,

first of what is planned to be an annual event, comprise an ambitious addition to the Hollenbeck Youth Center's ongoing efforts to help young people build moral values and learn self-reliance.

Founded in 1976, the organization serves more than 6,000 disadvantaged youths annually, offering social, recreational and educational programs. About 800 volunteers from the Hollenbeck Police Business Council and the L.A. community augment the center's full-time staff of 12. In addition, the Hollenbeck precinct of the LAPD maintains a contingent of supervisory personnel who act as coaches and role models for the youngsters.

"At Unocal, we are concerned about the problems faced by America's youth," says Stegemeier. "The high school dropout rate, drugs and gangs are matters of grave concern. Constructive alternatives do exist for our youth in organizations like the Hollenbeck Youth Center. We support its efforts whole-heartedly." V.A. 76

A huge ribbon of gaily colored balloons arched over the starting line. Underneath, an excited pack of children jostled for position. Antennas tipped with miniature orange-and-blue 76 balls bobbed on some contestants' heads, and taped to each child was a sign with the words "Munchkin Mile."

No, it's not the set for a Wizard of Oz remake. The "Munchkins" were participating in the first event of the Hollenbeck-Alatorre Inner City Games, which began July 28. The week-long series of sporting events was developed by Los Angeles City Councilman Richard Alatorre and the Hollenbeck Youth Center to offer inner-city youth meaningful alternatives to drugs and gang violence.

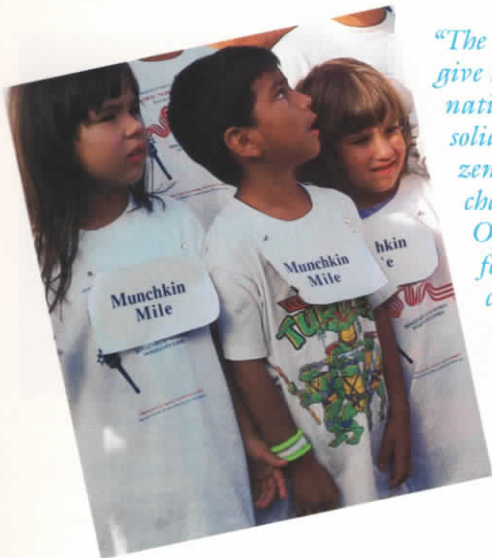
As executive commissioner of the Games, film star Arnold Schwarzenegger—who serves as chairman of the President's Council on Fitness and Sports—was on hand to speak to the participants and officially launch the competitions. The Council supports the Hollenbeck-Alatorre goal to extend the Games across the nation in future years, as a way of promoting youth fitness.

About 30,000 children and young adults from inner-city neighborhoods throughout Los Angeles competed in portions of the games, which included baseball, basketball, gymnastics, tennis, badminton, swimming and boxing.

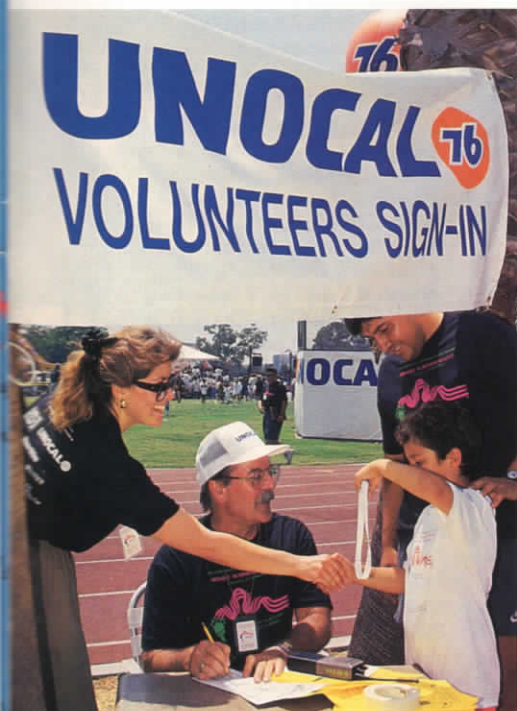


*Unocal co-sponsored the Games with other Los Angeles-based businesses, and also organized the Munchkin Run, above.*





*"The Hollenbeck-Alatorre Games give the city's young people an alternative that can help them build solid values and become good citizens," says Richard J. Stegemeier, chairman, president and CEO. Opening ceremonies of the Games featured a marching band, choreographed stage shows and an appearance by film star Arnold Schwarzenegger, who supported the Games as their executive commissioner.*





## UNOCAL 76

## CORPORATE

- 35 YEARS W.E. Branstrom, Los Angeles, Ca.  
Nyla J. Munsterman, Los Angeles, Ca.  
Rufus P. Van Zandt, Los Angeles, Ca.
- 25 YEARS Carolyn Bayes, Los Angeles, Ca.  
Norma J. Broussard, Los Angeles, Ca.  
James A. McCullough, Los Angeles, Ca.  
Jack K. Russell, Los Angeles, Ca.
- 20 YEARS Darrell D. Chessum, Los Angeles, Ca.  
Michael J. Dougherty, Los Angeles, Ca.  
Reynold T. Schmidt, M.D., Los Angeles, Ca.
- 15 YEARS Maria T. Arangure, Los Angeles, Ca.  
James H. Bray, Los Angeles, Ca.  
Ross H. Denton, Los Angeles, Ca.  
John M. Westrup, Los Angeles, Ca.
- 10 YEARS William G. Baker, Los Angeles, Ca.  
Leticia O. Castillo, Los Angeles, Ca.  
George S. Griffiths, Los Angeles, Ca.  
Steven R. Holt, Santa Rosa, Ca.  
Harvey H. Klee, Los Angeles, Ca.  
Daniel D. Lim, Los Angeles, Ca.  
Nancy E. Poloske, Antioch, Ca.  
Irene Romo, Los Angeles, Ca.  
Patty C. Santistevan, Los Angeles, Ca.  
Jennifer C. Stettner, Sacramento, Ca.  
Richard J. Vroom, Schaumburg, Il.  
James V. Weese, Kenai, Ak.

## ENERGY MINING

- 20 YEARS William D. Pasma, Parachute, Co.
- 10 YEARS Thomas J. Bassetti, Parachute, Co.  
Rodney W. Prow, Parachute, Co.

## SCIENCE &amp; TECHNOLOGY

- 30 YEARS Richard D. Tait, Brea, Ca.
- 25 YEARS Harlan G. Gray, Brea, Ca.  
Gary W. Sjogren, Brea, Ca.  
Carl F. Snyder, Brea, Ca.
- 20 YEARS Douglas E. McCorkell, Brea, Ca.  
John F. Miranda, Brea, Ca.  
Leland S. Nylander, Brea, Ca.  
Howard D. Simpson, Brea, Ca.  
Frank Z. Trejo, Brea, Ca.
- 15 YEARS Allan W. Perry, Brea, Ca.  
Mark D. Steinmeyer, Brea, Ca.  
Judith C. Ware, Brea, Ca.
- 10 YEARS Suheil F. Abdo, Brea, Ca.  
Patricia J. Arriola, Brea, Ca.  
Bruce W. Bromley, Brea, Ca.  
Cary C. Chen, Brea, Ca.  
Chau M. Ha, Brea, Ca.  
Patricia A. Herrera, Brea, Ca.  
David Hopgood, Brea, Ca.  
David C. Jacobs, Brea, Ca.  
Jeff J. Jetter, Brea, Ca.  
Thor A. Johnson, Brea, Ca.  
Garry D. Jones, Brea, Ca.

- Eugene C. Lin, Brea, Ca.  
Gary D. McDonald, Brea, Ca.  
Sandra H. Minner, Brea, Ca.  
William M. Neill, Brea, Ca.  
Marie A. Nixon, Brea, Ca.  
Thomas R. Ralston, Brea, Ca.  
Todd G. Ririe, Brea, Ca.  
Alice Tang, Brea, Ca.  
Vernon T. Taniguchi, Brea, Ca.  
Donald C. Van Slyke, Brea, Ca.  
Ramon D. Vera, Brea, Ca.  
Arthur F. Walden, Brea, Ca.

## ENERGY RESOURCES

## NORTH AMERICAN OIL &amp; GAS

- 35 YEARS Gail Lowe Burke, Houston, Tx.  
Darrel A. Redfern, Orcutt, Ca.  
Glen E. Roberts, Ventura, Ca.
- 30 YEARS Byron L. Barclay, Houston, Tx.  
Auvie A. Bailey, Jal, N.M.  
Raymond E. Criswell, Taft, Ca.  
Calvin R. Owens, Bakersfield, Ca.  
Jack E. Pelloat, Freeport, Tx.  
Harold W. Rodges, Bakersfield, Ca.  
Gloria A. Tekampe, Houston, Tx.
- 25 YEARS William U. Edwards, Brea, Ca.  
Gilbert J. Gonzales, Placentia, Ca.  
Don B. Hayden, Brea, Ca.  
Duane E. Mesh, Mobile, Al.  
Alan R. Peck, Santa Paula, Ca.  
James D. Schlottach, Orcutt, Ca.  
Johnnie J. Summerford, Santa Paula, Ca.  
Jimmy D. Thompson, Oklahoma City, Ok.  
Dennis L. Vener, Placentia, Ca.
- 20 YEARS Ernest D. Barbee, Clay City, Mi.  
Randy W. Barnhill, Cocodrie, La.  
James W. Benson, Liberty, Il.  
Ronald D. Burt, Liberty, Il.  
William J. Cessnun, Jr., Kenai, Ak.  
Virgil R. Cochran, Houston, Tx.  
Charles D. Cooper, Kenai, Ak.  
Arthur J. Guillotte, Mobile, Al.  
Richard B. Gomez, Kaplan, La.  
Dennis L. Groboske, Oklahoma City, Ok.  
Jerry J. Hough, Clay City, Mi.  
Tom Y. Joe, Oklahoma City, Ok.  
Ollie L. Johnson, III, Lafayette, La.  
Steven K. Meyer, Kenai, Ak.  
Antoinette Ross, Bakersfield, Ca.  
Paul Ben Sellers, Jr., Houston, Tx.  
William A. Soares, Kenai, Ak.  
Billy R. Thompson, Jal, N.M.
- 15 YEARS Gregory H. Blake, Ventura, Ca.  
Scott M. Bush, Taft, Ca.  
Jacqueline L. Campbell, Bakersfield, Ca.  
Sean M. Carey, Santa Fe Springs, Ca.  
Ramon B. Cerda, Midland, Tx.  
John P. Chance, Snyder, Tx.  
Alfred Chavez, Taft, Ca.  
David B. Collier, Orcutt, Ca.  
Patrick R. Collins, Clinton, Ms.  
Richard L. Dunham, Los Angeles, Ca.

- Grady E. Fowler, Van, Tx.  
Roy W. Fulwider, Ventura, Ca.  
Cyrena R. Hellman, Oklahoma City, Ok.  
William L. Hightower, Kenai, Ak.  
Dwight E. Johnson, Kenai, Ak.  
Sandy E. Jones, Lovington, Tx.  
Stephen C. Leaf, Taft, Ca.  
David W. Mautz, Ventura, Ca.  
Daniel L. McDonald, Mobile, Al.  
Ruben H. Perez, Coalinga, Ca.  
Gary L. Smith, Taft, Ca.  
Michael F. Spier, Orcutt, Ca.  
Robert S. Taylor, Jr., Kenai, Ak.  
Jack M. Timmerman, Jr., Kenai, Ak.  
Linda F. Williams, Midland, Tx.

- 10 YEARS Tom H. Allen, Ardmore, Ok.  
Donald D. Beier, Midland, Tx.  
Gerard P. Bellaart, Ventura, Ca.  
David M. Buckley, Coalinga, Ca.  
Priscilla A. Bufford, Lafayette, La.  
Edward Cantu, Ventura, Ca.  
Keith H. Carlton, Midland, Tx.  
Charles D. Cavit, Ventura, Ca.  
Herbert D. Chisum, Ventura, Ca.  
Christopher J. Cihal, Ganado, Tx.  
Paul E. Clifton, Chunchula, Al.  
Paul D. Close, Ventura, Ca.  
John K. Collier, Orcutt, Ca.  
Jane D. Deblieux, Lafayette, La.  
H. Ron Dennett, Ventura, Ca.  
E.H. Dever, III, Snyder, Tx.  
Charles L. Drake, Taft, Ca.  
Terry P. Duhon, Lafayette, La.  
Benny G. Duncan, Van, Tx.  
Janet L. Eisert, Anchorage, Ak.  
Matthew J. Evans, Santa Fe Springs, Ca.  
Robert G. Fay, Grayling, Mi.  
Albert K. Frowiss, Orcutt, Ca.  
Jack W. Fulford, Snyder, Tx.  
Peter J. Gerend, Midland, Tx.  
Frank E. Gillespie, Oklahoma City, Ok.  
Michael A. Glassey, Huntington Beach, Ca.  
Tommy E. Goodman, Chunchula, Al.  
Roger K. Hamson, Lansing, Mi.  
Thomas J. Harris, Lafayette, La.  
Gary L. Heath, Taft, Ca.  
Michael S. Honaker, Anchorage, Ak.  
Owen M. Hubbard, Ventura, Ca.  
Raul Jimenez, Ventura, Ca.  
Jerry W. Johnson, Ventura, Ca.  
George D. Johnston, Ventura, Ca.  
John W. Kaikainahaole, IV,  
Huntington Beach, Ca.  
Lesley J. Lege, Lafayette, La.  
Susan A. Lewis, Ventura, Ca.  
Ralph A. Lilburn, Oklahoma City, Ok.  
Terri M. Lindquist, Houston, Tx.  
Amy Jo Lynn, Houston, Tx.



Lawrence Mancini, Ventura, Ca.  
 George Y. Martinez, Snyder, Tx.  
 Thomas Young Mathis, Van, Tx.  
 John P. McKee, Anchorage, Ak.  
 Linda R. Naas, Lafayette, La.  
 Nick A. Newland, Midland, Tx.  
 Myron L. Nicholson, Jr., Orcutt, Ca.  
 John H. Noll, Houston, Tx.  
 Larry W. Patridge, Clay City, Il.  
 Russell R. Petereon, Kenai, Ak.  
 Robert A. Pettit, Ventura, Ca.  
 David D. Phillips, Houston, Tx.  
 Jeffrey S. Porter, Ventura, Ca.  
 Dwayne H. Robichaux, Dulac, La.  
 Daniel R. Roybal, Cut Bank, Mt.  
 Ruth A. Rushing, Chunchula, Al.  
 Stanley F. Rusk, Ventura, Ca.  
 David M. Sager, Healdton, Ok.  
 Roger M. Saxton, Grayling, Mi.  
 Jimmy Sheppard, Comfort, W.V.  
 Chamalie Singh, Houston, Tx.  
 John C. Sowell, Huntington Beach, Ca.  
 James P. Sweeney, Ventura, Ca.  
 Jeffery J. Tokarsky, Midland, Tx.  
 Dale R. Troyer, Cisc, Il.  
 Coy E. Turner, Jr., Chunchula, Al.  
 Dixie A. Walters, Houston, Tx.  
 Christopher D. Whitney, Houston, Tx.

#### Unocal Canada, Ltd.

25 YEARS Russell M. Mason, Calgary, Alberta  
 15 YEARS Howard M. Boyle, Fort St. John, B.C.  
 John W. Schanck, Calgary, Alberta  
 10 YEARS Kerry W. Pitt, Fort St. John, B.C.  
 James R. Ressler, Calgary, Alberta  
 Randy A. Woolston, Slave Lake, Alberta

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35 YEARS Robert J. Corsaro, Los Angeles, Ca.  
 30 YEARS Edward L. Marker, Los Angeles, Ca.  
 25 YEARS Afif E. Kaddoura, Syria  
 Barry G. Wilson, Los Angeles, Ca.  
 20 YEARS Gerald L. Beebe, Los Angeles, Ca.  
 Clara G. Healy, Los Angeles, Ca.  
 15 YEARS Becki Benavidez, Los Angeles, Ca.  
 Weldon B. Hatcher, Aberdeen, Scotland  
 John R. Underhill, Netherlands  
 10 YEARS David G. Candey, Los Angeles, Ca.  
 Easing C. Chen, Los Angeles, Ca.  
 Mitchell G. Elkins, Balikpapan, Indonesia  
 Trevor D. Gauld, Sunbury, England  
 Richard A. Gubitosa, Los Angeles, Ca.  
 Richard A. LeVeque, Los Angeles, Ca.  
 William T. McClung, Syria  
 Jennie A. Ruiz, Los Angeles, Ca.  
 Jack B. Schneider, Los Angeles, Ca.  
 Kenneth M. Sevinski, Bangkok, Thailand

#### Unocal Thailand, Ltd.

20 YEARS Rachanee Na-Nakorn  
 15 YEARS Chavanut Vongsayan  
 10 YEARS Duangrat Bhumichitr  
 Vera Kaewsonthi  
 Phayao Klinboon  
 Supaporn Kongthong  
 Boonprong Kongyuth  
 Lamom Lumpupornprasith  
 Verasak Prasertvattanakul  
 Rapeeporn Suksavang  
 Tara Tiradnakorn

#### Unocal Indonesia, Ltd.

15 YEARS Kaeran  
 Kamaruddin  
 Sarwanto  
 Sjamsiar  
 Sugiman  
 Syamsudin  
 Wandowo  
 Wiranto  
 Johnny Marthin Affidon  
 Muh. Alwi Ar.  
 Wellem Aru  
 Firman As  
 Ilhard Badal  
 Suwarno Badrus  
 M. Hairy  
 Alexander Kabe  
 Arsyad La Ressa  
 Zainal Mashuri  
 Jusuf Misi  
 Bambang Mudjiono  
 Thamrin P.  
 Mum. Sikri Halki Rahman  
 Anthony Rawuno  
 Evie Rumampuk  
 Yohanis Tappang Sarira  
 Pandjiasmara Saroetomo  
 Jusuf Sarong  
 Masdari Seman  
 M. Ndur Sinaga  
 M. Sirajuddin  
 Julien Siswojo  
 Fredy Sulawesiyanto  
 Andi Bakri Sultan  
 Andi Herman T.  
 Benyamin Talebong  
 Jefriet Johannis Tampi  
 Ishak Bibang Tandilo  
 Daud Toding Tiranda  
 Baba Toding  
 Totok Trinyoto  
 James Marshall Wensen  
 Hadi Arief Wijaya

10 YEARS Maryanto  
 Zainul Arif  
 Achmad Herdany  
 Igkandar Mahmud  
 Palmer Marbun  
 Jusuf Pasereng

#### Unocal U.K., Ltd.

15 YEARS Sheila Ewen, Aberdeen, Scotland  
 10 YEARS Calum Cordiner, Aberdeen, Scotland  
 Trevor Gauld, Sunbury, England  
 William Moir, Aberdeen, Scotland  
 James Savage, Aberdeen, Scotland

#### Unocal Suez, Ltd.

15 YEARS Maher Gamal  
 10 YEARS Desouky Khattab  
 20 YEARS Jerry D. Scarbrough, Santa Rosa, Ca.  
 15 YEARS Stephen A. Davis, Santa Rosa, Ca.  
 James V. Vantine, Santa Rosa, Ca.  
 Michael W. Woodall, Santa Rosa, Ca.

10 YEARS Douglas P. Bouche, Imperial Valley, Ca.  
 Myron W. Burr, Santa Rosa, Ca.  
 Barry R. Carlson, Santa Rosa, Ca.  
 Peter Cocova, Imperial Valley, Ca.  
 Harrison R. Crecraft, Santa Rosa, Ca.  
 Larry W. Keyser, Santa Rosa, Ca.  
 John F. Matthew, Imperial Valley, Ca.  
 Michael T. Moore, Imperial Valley, Ca.  
 Eric D. Steger, Santa Rosa, Ca.  
 Bennie C. Walkup, Santa Rosa, Ca.  
 Debra A. Wheeler, Santa Rosa, Ca.  
 Kenneth H. Williamson, Santa Rosa, Ca.  
 Richard M. Wilson, Jr., Imperial Valley, Ca.

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 Pio G. Baldo, Bulalo  
 Ma. Mila L. Bernal, Bulalo  
 Romeo O. Buenafior, Tiwi  
 Jose C. Ceriola, Tiwi  
 Domingo B. Clutario, Tiwi  
 Gil C. Competente, Tiwi  
 Julito C. Competente, Tiwi  
 Antonio A. Jayme, Makati  
 Leonardo O. Policarpio, Tiwi  
 Racquel C. Salazar, Tiwi  
 Leocadio V. San Jose, Bulalo  
 10 YEARS Ma. Imelda P. Amador, Tiwi  
 Rodolfo R. Dorosan, Jr., Tiwi  
 Ernesto A. Bingayen, Tiwi  
 Bienvenido B. Bron, Tiwi  
 Antonio C. Calmada, Tiwi  
 Felicisimo B. Cantes, Tiwi  
 Efren C. Cerio, Tiwi  
 David B. Claudio, Tiwi  
 Nepthalie C. Climacosa, Tiwi  
 Tito C. Consuelo, Tiwi  
 Oriel C. Credo, Tiwi  
 Reyes C. Deocareza, Tiwi  
 Salvador C. Deocareza, Tiwi  
 George M. Espinosa, Tiwi  
 Mary Flor G. Hernando, Makati  
 Arthur C. Jaromamay, Tiwi  
 Jessie C. Kallos, Tiwi  
 Manolito M. Manipol, Bulalo  
 Danilo A. Pablo, Makati  
 Felix C. Trinidad, Tiwi  
 Andres R. Victoria, Makati  
 Ma. Fe L. Villadolid, Makati

#### REFINING & MARKETING

40 YEARS Kenneth R. Barton, II, Schaumburg, Il.  
 Richard D. Dolan, Schaumburg, Il.  
 Bryan M. Harrah, San Francisco Refinery  
 35 YEARS John F. Kaczmarek, Los Angeles Refinery  
 Glenn E. Kline, Tallmadge, Oh.  
 Sharon R. Rodriguez, San Francisco, Ca.  
 Alice B. Sorrels, San Francisco Refinery  
 Richard K. Stewart, Los Angeles, Ca.  
 Donald E. Terry, San Ramon, Ca.  
 30 YEARS Louis E. Burdge, Macon, Ga.  
 John L. Dealy, Sacramento, Ca.  
 Julius C. Herklotz, Wildwood, Fl.  
 Roy M. Hester, Charlotte, N.C.  
 John S. Rossiter, Los Angeles, Ca.  
 Arthur K. Shozuya, Honolulu, Hi.  
 Marian D. Tumpa, Schaumburg, Il.  
 25 YEARS Jerry R. Barnhart, San Francisco Refinery  
 Edward E. Bonds, San Ramon, Ca.  
 Sally Crabb, Schaumburg, Il.



Carol J. Greenawalt, Schaumburg, Il.  
 Darryl L. Hamilton, Santa Maria Refinery  
 Emmett E. Harper, San Francisco Refinery  
 Terry L. Hopkins, Los Angeles, Ca.  
 Harry W. Kairys, Schaumburg, Il.  
 James H. Knopp, Los Angeles, Ca.  
 Jimmy C. Meek, Los Angeles Refinery  
 Alexander L. Miller, Honolulu, Hi.  
 Louis B. Nobbe, San Francisco Refinery  
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20 YEARS John W. Bair, Los Angeles, Ca.  
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 Leonard S. Martinez, Los Angeles Refinery  
 Charlene Matson, Schaumburg, Il.  
 John H. Meeker, Houston, Tx.  
 Gregory L. Morris, Los Angeles, Ca.  
 Vickie A. Norwood, Los Angeles, Ca.  
 Ethelene S. Poston, Los Angeles Refinery  
 Robert J. Reinartz, Los Angeles Refinery  
 David C. Schuhmann, Los Angeles Ref.  
 Larry E. Shafer, San Francisco, Ca.  
 Darrell S. Smith, Nederland, Tx.  
 Remedios B. Soriana, San Francisco, Ca.  
 Stephen J. Sorvetti, San Francisco Refinery  
 Charles F. Sullivan, San Francisco Refinery  
 Joann R. Watanabe, City of Industry, Ca.  
 Richard Whitman, Los Angeles Refinery  
 Keith J. Wiljamaa, Los Angeles, Ca.  
 Thomas R. Winstrom, Hayward, Ca.  
 Jerry D. Yagher, Los Angeles Refinery

15 YEARS David E. Allen, Portland, Or.  
 Betty L. Brooks, Los Angeles, Ca.  
 Linda P. Carpenter, San Francisco Refinery  
 Gerald F. Chesney, Schaumburg, Il.  
 Graciela Contreras, Schaumburg, Il.  
 Lorraine G. Gillund, Los Angeles, Ca.  
 Carole L. Glenn, Schaumburg, Il.  
 Bruce T. Hamilton, Los Angeles, Ca.  
 Hans P. Herting, Los Angeles Refinery  
 Pam G. Holmes, Taft, Ca.  
 Christopher L. McKinney, San Francisco Ref.  
 Brian L. Martin, San Francisco Refinery  
 Albert S. Matsuda, Honolulu, Hi.  
 Jimmie R. Maxwell, Nederland, Tx.  
 Delfina R. Moses, Schaumburg, Il.  
 Susan R. Ott, San Francisco, Ca.  
 William V. Padillas, Portland, Or.  
 Kirk T. Peregoy, Los Angeles, Ca.  
 Don W. Rieschick, City of Industry, Ca.  
 Thalia A. Roberts, Schaumburg, Il.  
 Garry D. Rooney, Schaumburg, Il.  
 Michael W. Stephens, San Francisco Ref.  
 Vincent R. Torres, Honolulu, Hi.  
 John A. Weaver, Los Angeles Refinery  
 Virginia S. Woo, San Francisco Refinery  
 Jess H. Woodfin, Bloomington, Ca.  
 Antonio A. Ybarra, Los Angeles Refinery

## SERVICE AWARDS



10 YEARS James M. Agee, Los Angeles Refinery  
 Craig W. Andridge, Los Angeles Refinery  
 Daniel E. Broguiere, Los Angeles, Ca.  
 Thomas J. Carroll, San Francisco Refinery  
 Curtis C. Carter, Wildwood, Fl.  
 Glenda H. Carter, Houston, Tx.  
 Jose C. Catalasan, Los Angeles Refinery  
 Raymond M. Chavez, Los Angeles, Ca.  
 Paul A. Clark, Los Angeles Refinery  
 Christina V. Coyle, Los Angeles Refinery  
 Bradford L. Craig, Los Angeles, Ca.  
 Thomas G. Creery, Los Angeles, Ca.  
 Barry A. Duffin, Los Angeles, Ca.  
 George H. Dunning, S.F. Refinery  
 Eric Erga, Honolulu, Hi.  
 Maritza S. Eyzaguirre, San Francisco, Ca.  
 Michael J. Flores, San Francisco Refinery  
 Daniel B. Folk, Torrance, Ca.  
 Charles W. Foote, Jr., San Francisco Ref.  
 Sheery L. Frankovich, Eugene, Or.  
 Howard V. Gardner, Los Angeles, Ca.  
 Patricia L. Gough, Honolulu, Hi.  
 Russell G. Graham, Los Angeles, Ca.  
 Gerald W. Gulick, San Francisco Refinery  
 Gary E. Gunderson, Seattle, Wa.  
 Mitchell B. Harmon, Los Angeles, Ca.  
 Lynda J. Holiday, Sacramento, Ca.  
 Steven D. Holley, Torrance, Ca.  
 David J. Hoover, Los Angeles, Ca.  
 Nash A. Jaramillo, Santa Paula, Ca.  
 Clarence O. Jessie, Santa Fe Springs, Ca.  
 George W. Johnson, Los Angeles, Ca.  
 Christopher R. Leuthold, Santa Maria Ref.  
 Daniel P. Loewer, Nederland, Tx.  
 Darryl F. Matthews, City of Industry, Ca.  
 Loran W. McKee, Memphis, Tn.  
 Ted A. Panagiotaros, San Luis Obispo, Ca.  
 Lilianna Z. Paulsen, Schaumburg, Il.  
 Charles M. Peniche, San Francisco Refinery  
 Javier G. Prado, Los Angeles, Ca.  
 Elizabeth Schlemer, Los Angeles, Ca.  
 David E. Sparks, San Francisco Refinery  
 Clyde J. Trombetta, S.F. Refinery  
 James M. Watkins, Los Angeles Refinery  
 Ken W. Wilkins, Los Angeles Refinery

### MARKETERS & DISTRIBUTORS

65 YEARS J.E. Wilson & Son, Inc., Belle Glade, Fl.  
 55 YEARS Sampson-Bladen Oil Co., Clinton, N.C.  
 40 YEARS Don Bretthauer Oil Co., Hillsboro, Or.  
 30 YEARS Combs Oil Co., Naples, Fl.  
 Elk River Oil Co., Elk River, Mn.  
 Saluda Tire & Oil Co., Saluda, S.C.  
 25 YEARS Alpine Oil Co., Gaylord, Mi.  
 Union Products of Kona, Kailua-Kona, Hi.  
 20 YEARS Appleton Oil Co., Inc., Appleton, Wi.  
 Carolina Oil, Inc., Orangeburg, S.C.  
 Mille Lacs Oil Co., Inc., Cambridge, Mn.  
 Don Miller Dist., Inc., Vicksburg, Ms.  
 10 YEARS Davis Bros. Oil Co., Clarksville, In.  
 Home Oil, Inc., New Richmond, Wi.  
 Matthews Oil Co., Inc., Shreveport, La.

### CHEMICALS & MINERALS

25 YEARS F.S. Bartholomew, Schaumburg, Il.  
 Luis Cervantes, Jr., Los Angeles, Ca.  
 Donald A. Kay, East Providence, R.I.  
 Richard A. March, Fairfield, Ca.  
 Daniel Marlatt, Baltimore, Md.  
 Fred Snowball, Newark, N.J.  
 20 YEARS Sue Bowen, Fresno, Ca.  
 Stasha J. Gorzelnik, Los Angeles, Ca.  
 Thomas Jankowsky, Carteret, N.J.  
 Gregory D. Salo, Arroyo Grande, Ca.  
 Nobuo Tsukada, Kenai, Ak.  
 David A. Whitney, La Mirada, Ca.  
 Ronald L. Wilkinson, Lemont, Il.  
 Franklyn M. Williams, Lemont, Il.  
 15 YEARS Joseph E. Adolf, Kenai, Ak.  
 Donald J. Bulian, Lemont, Il.  
 Brian G. Cotman, Kenai, Ak.  
 Boyd P. Crouch, Charlotte, N.C.  
 Mark D. Esping, Brea, Ca.  
 David E. Freer, Arroyo Grande, Ca.  
 Robert L. Gardiner, Middletown, Oh.  
 Donald J. Goodwin, Arroyo Grande, Ca.  
 Woodrow A. Heselius, Kenai, Ak.  
 Patricia Malanowski, Schaumburg, Il.  
 Gary W. Miller, Kenai, Ak.  
 Theresa T. Morris, Charlotte, N.C.  
 William Nancarrow, La Mirada, Ca.  
 Alan L. Pedersen, Lemont, Il.  
 Paul E. Schneider, Kenai, Ak.  
 George L. Spence, Kenai, Ak.  
 Robert D. Stamer, Kenai, Ak.  
 Lyle E. Winter, Jr., Kenai, Ak.  
 James W. Ziehler, Kenai, Ak.  
 Larry L. Zuelke, Rodeo, Ca.  
 10 YEARS Elise B. Archer, Los Angeles, Ca.  
 Nancy A. Cossitt, Newark, N.J.  
 Bruce K. Easterday, Yuma, Az.  
 Charles Edmondson, Schaumburg, Il.  
 Keith L. Gelman, Los Angeles, Ca.  
 Rodney Gilge, Brea, Ca.  
 James M. Goforth, Charlotte, N.C.  
 Lisa N. Hanson, Lemont, Il.  
 Mark A. Koneski, Conshohocken, Pa.  
 Roy J. Lopez, Newark, N.J.  
 Ronald A. Miller, Birmingham, Al.  
 James V. Nardone, Brea, Ca.  
 Ronald F. Rover, St. Paul, Mn.  
 Vincent E. Shelby, Lemont, Il.  
 Pamela S. Swanson, La Mirada, Ca.  
 James S. Watson, Charlotte, N.C.

### MOLYCORP, INC.

40 YEARS Leonard Y. Tarman, York, Pa.  
 25 YEARS Edwin J. Tomasi, Louviers, Co.  
 20 YEARS Lawrence S. Jaramillo, Questa, N.M.  
 10 YEARS Glen L. Bridges, Mountain Pass, Ca.  
 Bonifacio Fresquez, Jr., Questa, N.M.  
 Barry T. Kilbourn, White Plains, N.Y.  
 Margaret J. Klein, Mountain Pass, Ca.  
 Larry Sanchez, Questa, N.M.  
 William L. Waterman, Mountain Pass, Ca.

### POCO GRAPHITE, INC.

10 YEARS Nasra Farhatziz, Decatur, Tx.  
 Elma Mayfield, Decatur, Tx.  
 Evelio Zamora, Decatur, Tx.

### RETIREMENTS

#### Corporate

Joseph F. Cornett, March 9, 1970  
 Ronald Ricchio, May 1, 1972



## Oil & Gas

Daniel D. Cooper, November 7, 1966  
Janie R. Morris, April 16, 1956  
Faye J. Norton, February 16, 1981

## Geothermal

Warner A. Rushing, July 13, 1974

## Refining & Marketing

Larry N. Buss, June 6, 1955  
John G. Cameron, January 18, 1971  
Donny S. Dick, November 19, 1951  
Monique J. Fredriksen, February 5, 1979  
Ethel Ann Hagen, July 1, 1969  
Kenneth H. Mangels, October 27, 1958  
Patricia A. McFarlin, March 2, 1981  
Ralph M. Parker, November 1, 1968  
Keith L. Shurtz, October 6, 1960  
Daniel J. Tucker, July 10, 1972  
Charles H. Werre, July 25, 1966

## Chemicals & Minerals

Joseph B. Blanchard, February 26, 1951  
Vincent J. Caldas, April 5, 1955  
Robert C. Krimminger, April 8, 1968 v  
Raymond F. Ortell, July 14, 1980  
Lloyd A. Osborne, February 14, 1956  
Delores J. Stevens, September 20, 1962

## IN MEMORIAM

### EMPLOYEES

#### Corporate

Elizabeth Ellison, June 9, 1991  
Eunice E. Wilson, April 6, 1991

#### Oil & Gas

Anthony Gonzales, May 22, 1991  
Johnson J. Hedges, June 5, 1991  
Tony Jones, April 19, 1991  
David L. Neely, May 18, 1991

#### Refining & Marketing

Dennis Cook, May 10, 1991  
Donald W. Fox, April 14, 1991  
Marvin Gifford, June 9, 1991

### RETIREES

#### Corporate

Henry B. Chandler, April 18, 1991  
George E. Mayer, May 12, 1991  
Malcolm McAllaster, March 13, 1991  
Margaret Osteraas, May 8, 1991  
Olga M. Wright, March 17, 1991

#### Oil & Gas

F.H. Billington, April 24, 1991  
Robert L. Bourne, April 29, 1991  
Gerald M. Goldrick, May 26, 1991  
Gerald E. Hall, June 6, 1991  
Carl Hills, March 26, 1991  
James R. Hooper, April 17, 1991  
Hobart H. Hopkins, April 30, 1991  
Jesse I. Kisling, March 29, 1991  
Maurice E. McInnis, March 10, 1991  
Thomas R. McIntyre, February 3, 1991  
Miles McJohnson, Jr., December 21, 1990  
Jared Lloyd Michael, January 3, 1991  
Wilfred B. Myers, April 22, 1991  
Rollie Plaugher, March 11, 1991  
Stockton Quirey, November 15, 1990  
Clyde V. Redmond, May 11, 1991  
Gladys R. Shira, March 4, 1991  
Elmer L. Smith, Sr., April 17, 1991  
John A. Swanson, March 14, 1991  
Ernest K. Treat, May 8, 1991  
Anton I. Trojo, May 8, 1991  
Glen C. Wood, April 25, 1991

## SERVICE AWARDS



#### Refining & Marketing

John V. Ahearn, May 27, 1991  
Kenneth R. Amspaugh, April 21, 1991  
Raymond W. Barnes, April 25, 1991  
Frank Taylor Barrineau, November 23, 1990  
Cameron C. Bates, April 11, 1991  
Maureen J. Beatty, February 18, 1991  
Charles G. Blankenship, Jr., April 6, 1991  
William L. Bowler, April 14, 1991  
Larry L. Carder, April 21, 1991  
Margaret M. Cargo, May 11, 1991  
Don Cassle, May 1, 1991  
Whitmel P. Comeaux, May 15, 1991  
Charles David Deems, March 16, 1991  
Stanley Delahoussaye, May 26, 1991  
Julius Detammelaere, April 24, 1991  
John T. Dillman, March 24, 1991  
John T. Dowden, April 25, 1991  
Allen D. Edwards, March 23, 1991  
Herbert Edwardsen, March 10, 1991  
Roger Eisenmann, May 17, 1991  
Leo W. Grybas, February 16, 1991  
Wilbur L. Idle, March 8, 1991  
Waldo W. Jarvis, March 11, 1991  
Charles C. Josephs, May 19, 1991  
Joseph C. Kmiec, April 26, 1991  
Kenichi Kuwada, June 12, 1991  
Helen R. Lavender, May 22, 1991  
Norman Meserve, May 9, 1991  
James T. Mohan, March 1, 1991  
Stanley Murray, May 10, 1991  
Velma G. Murray, April 10, 1991  
Howard C. Nicholson, April 25, 1991  
LaVerne Olson, June 6, 1991  
William H. Orens, April 30, 1991  
Edgar Paris, April 22, 1991  
John T. Patrick, April 21, 1991  
Bernie C. Quick, March 9, 1991  
Maynard S. Reynolds, March 29, 1991  
Philip R. Riegel, May 9, 1991  
Roy L. Rowlett, April 14, 1991  
Harry Schaeffer, March 9, 1991  
Donald Schofield, April 29, 1991  
David S. Sligh, June 12, 1991  
Cecil W. Stephens, April 7, 1991  
Harry L. Thomas, May 26, 1991  
Randall G. Wentrup, April 19, 1991  
George R. Wilhelm, May 21, 1991

#### Science & Technology

Louis M. Dvoracek, May 11, 1991  
Gerald Rickels, May 19, 1991

#### Chemicals & Minerals

Clifford Hamilton, May 28, 1991  
Harry W. Sibert, March 27, 1991  
Patricia T. Wurm, March 14, 1991



GARY L FOY  
16823 LIGGETT STREET  
SEPULVEDA CA 91343

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