

P R O J E C T facts

DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY

OIL recovery
P R O G R A M

HIGH-RESOLUTION 3-D SEISMIC LAGUNA'S FIELD PROJECT IN WEST TEXAS

PRIMARY PROJECT PARTNER

**Laguna Petroleum
Corporation**
Midland, TX

FOSSIL ENERGY PROGRAM

**Oil Recovery Field
Demonstration**

MAIN SITE

**Foster and South Cowden
Fields**
Ector County,
near Odessa, TX

TOTAL ESTIMATED COST

\$3.30 million

COST SHARING

DOE - \$1.45 million
Non-DOE - \$1.85 million

DE-FC22-93BC14982

Project Description

Laguna Petroleum Corporation is planning one of the first public demonstrations of high-resolution three-dimensional (3-D) seismic surveys to improve the understanding of carbonate reservoirs. This project also demonstrates the multi-disciplinary team approach to resolving producibility problems—combining seismic information with computer technology.

Seismic waves generated by vibrating the earth's surface travel through the earth at different frequencies in response to changes in the rock layers. Some of the energy is reflected back and recorded by sensitive instruments (geophones) arranged in a grid on the surface. The interpreted data provides a 3-D picture of the subsurface rock layers.

High-resolution 3-D seismic surveys have generally not been performed by independent operators of small leases because of the perceived high cost of imaging shallow reservoirs. This 3-D survey is designed to properly image the Grayburg/San Andres strata at depths of 3,700 to 5,000 feet in the Foster and Cowden fields. The improved imaging of the reservoir strata will be combined with other engineering and geologic data and computer simulation to investigate fluid flow patterns and possible barriers to fluid movement. The improved understanding of the reservoir will enable Laguna to produce over 2.5 million barrels of oil by optimizing new well locations, improving the "sweep" of the oil to producing wells.

The 3-D survey has been acquired, processed, and is being interpreted. Cores and logs have been digitized and analyzed. A reservoir simulation model integrating seismic, rock, and log data is being designed to better understand the movement of water and oil in the reservoir.

Program Goal

A major goal of DOE's Oil Program is to apprise oil producers, particularly independents, of available, affordable technology that can be applied to the oil field to lower operating costs and increase production. Many independents lack the capital to perform research, and do not know what technologies are available or believe them to be too expensive.

In this project DOE is teaming with Laguna Petroleum to demonstrate that 3-D seismic surveying, modern computing technology and improved reservoir management can provide improved knowledge of the oil reservoir. The operator can then plan more effective drilling patterns to tap isolated or bypassed areas of oil, and can design waterflooding processes that are more efficient in "sweeping" oil through the reservoir to a producing well.

Demonstration of available, affordable and effective technologies will provide operators throughout the oil-producing states with new methods of lowering costs and increasing production. The potential for additional production is significant—as much as 2.5 million barrels in the project area alone, and application of the successful technology to reservoirs throughout the U.S. could result in incremental production of more than 1.5 billion barrels.

Project Partners

LAGUNA PETROLEUM CORPORATION
Midland, TX

DAWSON GEOPHYSICAL COMPANY
Midland, TX

PHILLIPS PETROLEUM CORPORATION
Odessa, TX

**UNIVERSITY OF TEXAS OF THE
PERMIAN BASIN**
Odessa, TX

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Project Benefits

Approximately 15% of the original oil in place in the Permian Basin Grayburg/San Andres reservoirs has been recovered by primary production. Productivity problems, including variations in rock properties, barriers in the reservoir to fluid movement, and cycling of water from injectors to producers, have limited production. More than 13 billion barrels of mobile oil and 17 billion barrels of residual oil will remain in Grayburg and San Andres reservoirs in the Permian Basin at abandonment, if current development practices continue to be followed. An additional 10% of these reserves can be recovered using infill drilling and waterflooding.

Without price increases or improved recovery methods, new development wells to produce these large volume of remaining oil are difficult to justify. Continued property divestment and shifting focus on international operations by major oil companies results in a loss of jobs and tax revenue for the area. Small independent operators are fast becoming the dominant producers in the area.

The independent operator can tolerate lower operating margins, but does not have the resources to spend on expensive enhanced recovery operations. Cash flow is devoted to equipment repairs and operating costs to keep marginal wells producing. Wells are often plugged and abandoned following primary production or minimal waterflooding.

In this project, the Laguna Petroleum Corporation is demonstrating that low-cost, readily available technologies can be utilized by independent operators to improve production and recover reserves on mature, waterflooded oil properties. Laguna is combining 3-D seismic surveying with affordable computer hardware and software packages to improved knowledge of the reservoir. Simulation of reservoir conditions can then be used to determine infill drilling locations and design optimal waterflood processes.

Successful application of these technologies could lead to commercial impact by 1996. Added reserves from the project alone could be as much as 2.5 million barrels. If this reservoir analysis approach can be successfully applied by independents to other shallow shelf carbonate reservoirs throughout the United States, potential reserves should be greater than 1.5 billion barrels.

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Cost Profile (Dollars in Millions)

	Budget Period 1		Budget Period 2	
	08/02/94	02/02/96	02/02/98	02/02/98
Department of Energy*	\$0.15		\$1.30	
Private Sector Partners	\$0.21		\$1.64	

* Obligated Funding

Key Milestones

