

eye on environment

Low Impact Natural Gas and Oil (LINGO)



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Calendar8



The Department of Energy’s latest effort to support environmentally responsible oil and gas exploration and production is the program known as Low-Impact Oil and Natural Gas (LINGO). The objective of a new solicitation for this program, announced on December 21, 2005, is to develop designs for onshore oil and gas Exploration and Production (E&P) projects in the United States. The projects will integrate technologies and practices in ways that minimize adverse environmental impacts from oil and gas recovery over the life of the projects.

U.S. DEMAND AND RESOURCES

The United States has become a mature oil and gas province in which oil and gas E&P is increasingly difficult and more expensive. As available resources are depleted, exploration moves into more environmentally sensitive areas.

DOE seeks to overcome the public prejudice against oil and gas development by promoting research on scientifically grounded, risk-based land management decisions. The goal is to demonstrate that low-impact technologies and practices are possible and compatible with good environmental performance. Improved environmental performance over time can give the public confidence that oil and gas development can be accomplished without undesirable impacts. This will lead to acceptance of exploration and development and reduction of the barriers that limit access, increase costs, and cause delays.

The Rocky Mountain region is the fastest-growing onshore oil and gas production province in the United States (**Figure 1**). Estimates by Federal agencies are that the region’s oil and gas production will continue to grow for the next 20 years.

Much of the prospective oil and gas acreage in the Rocky Mountain region is on Federal land. In these areas, land management decisions are driven by

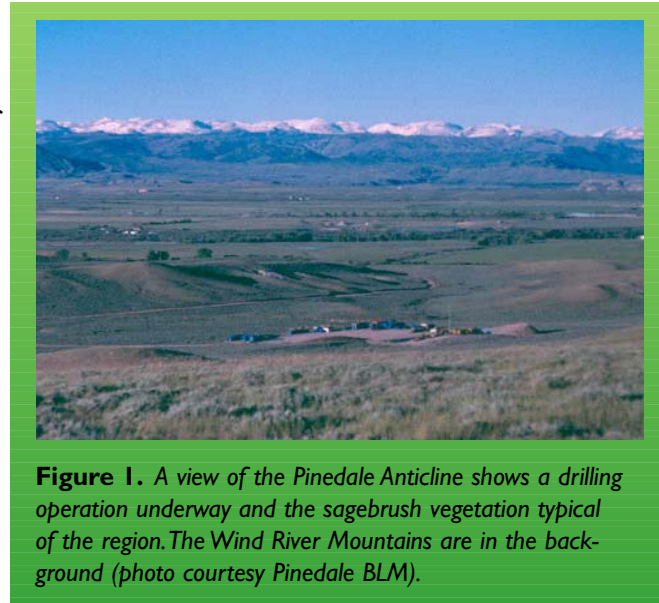


Figure 1. A view of the Pinedale Anticline shows a drilling operation underway and the sagebrush vegetation typical of the region. The Wind River Mountains are in the background (photo courtesy Pinedale BLM).

stringent environmental considerations and regulations. The National Petroleum Council estimates that 125 trillion cubic feet of natural gas is either effectively off-limits or significantly constrained due to added costs and delays resulting from Federal lands restrictions in the Rocky Mountain region. This restricted acreage holds 53 percent of the undiscovered recoverable natural gas resource in the region, where natural gas predominates. Most of these restrictions are driven by environmental concerns.

Oil and gas development is becoming increasingly limited by fears of adverse environmental impacts on air, water, land use, wildlife habitat, cultural (archaeological) sites, recreational areas, and suburban/urban development. Whether on Federal, State, Tribal, or private land, the public views oil and gas development as potentially harmful to the environment. Public perception is not based on scientific evidence or experience, but this apprehension and consequent resistance have delayed or even prohibited oil and gas E&P in many areas of the western United States.

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WHAT IS LINGO?

LINGO is an approach to minimize adverse environmental impacts on onshore oil and gas E&P operations by:

- Considering the whole operation over its life.
- Creatively combining and applying current technologies and practices.

- Developing new science and technologies.

DOE's LINGO solicitation seeks to address the first two items. Development of science and new technologies will be addressed through other DOE program activities.

DOE's OBJECTIVES

The objective of the LINGO solicitation is to develop designs for U.S. onshore oil and gas E&P projects that integrate technologies and practices in ways that minimize adverse environmental impacts from oil and gas recovery over the life of the projects. DOE plans to sponsor projects that will analyze key factors in both E&P operations and environmental protection and make trade-offs. The benefits will include minimizing adverse life-cycle environmental impacts while at the same time advancing economic production of oil and gas by making use of state-of-the-art technologies and innovative practices.

Applications under LINGO should be relevant to a specific region or geographic area in the United States. The Pinedale region is given only as an example and does not indicate restricting efforts to the Rocky Mountain region or on Federal Lands. For the region selected, all key environmental issues should be discussed, including how the E&P activities will impact the environmental resources (air, water, wildlife, habitat) and the methods proposed to mitigate any adverse impacts.

DOE's LINGO initiative fits in well with the Energy Policy Act passed by Congress and signed into law by President Bush in August 2005. The Energy Policy Act calls for a pilot project in the Rocky Mountain region. BLM recently announced a pilot project involving seven of the agency's field offices: Miles City, MT, Buffalo and Rawlings, WY, Vernal, UT, Glenwood Springs, CO, and Farmington and Carlsbad, NM. The pilot's objective is to wipe out a 2-year drilling permit backlog and increase production, thereby helping to moderate high gas prices. Both the BLM pilot project and DOE's LINGO

solicitation ultimately would increase natural gas reserves and production, promote sound economic and environmental development, and provide job benefits in the Rocky Mountain region and other regions where low-impact technologies may be applied.

LOW-IMPACT TOOLS

In addition to the task on analysis of technologies and practices to mitigate adverse environmental impacts, the LINGO solicitation addresses the development of tools that will help producers design and implement low-impact projects. Tools that can be used by small to medium size companies to help implement low-impact projects include: development of software; flow diagrams and site plans on how to minimize wastes, emissions, surface footprint or recycle waste; and compilation of databases of performance and cost information on recommended technologies and practices. Practical handbooks to explain the use of technologies and practices for implementing low-impact production will be considered a valuable tool.

PRODUCT GOALS

Products for the LINGO solicitation should include reports detailing the analysis of the technologies and practices to minimize adverse environmental impacts covering the impact levels, costs, efficiencies, and recommendations of how a research project will achieve low impact goals in the chosen region. Plans, diagrams, charts, handbooks, and templates that will allow producers to apply the recommendations will be an important part of each research project. Software and databases for use in implementing low impact designs are the final products desired.

LOW-IMPACT EXAMPLES

An excellent example of the potential for low-impact E&P exists in the Pinedale Anticline and Jonah fields in western Wyoming (**Figure 2**). The producers there face seasonal limitations on drilling due to concerns about its impacts on large game and



gamebird species. Drilling is prohibited for several months of each year, which causes delays and increased costs.

Several producers in the region have applied for—and some have been granted permission—to drill year-round in exchange for efforts that mitigate environmental impacts. Environmentally responsible technologies and innovative practices include:

- Directional drilling to reduce the number of drilling pads.
- Use of natural gas-fired drilling rigs to reduce air emissions.
- Installation of water pipelines to eliminate truck traffic.
- Deployment of mat systems on drilling pads to reduce surface impact.
- Elimination of gas flaring during well tests and completions to reduce air emissions and noise.
- Development of centralized fracturing and production facilities.
- Partial site restoration during the production phase.
- Low-impact road construction.
- Recycling of produced water.

Implementation of these measures reduces the duration of drilling operations by one third to one half.

Pinedale Anticline operations showcase low-impact E&P

Department of Energy environmental staff members toured producers' facilities in the Pinedale Anticline area of western Wyoming in October 2005 to see firsthand the implementation of low-impact exploration and production practices. Encana Corp., Shell Oil Co., and Questar Market Resources are the major producers in the Pinedale area.

The target formations are at about 14,000 feet and hold an estimated 30-40 trillion cubic feet of natural gas. Multi-pad wells are being used to mitigate surface disturbance and allow the companies to drill year round by using directional drilling techniques to drill multiple wells. Although these techniques cost more and take longer resulting in higher expenses and greater time—as well as increasing the risk of stuck pipe—they significantly reduce environmental impacts. Directional drilling of wells not only cuts down the number of well pads used, it also minimizes the installation of roads, pipelines, and power lines, resulting in a smaller footprint and reduced overall environmental impact. Another technique for reducing pad size is to use a closed-loop drilling mud system. This eliminates the use of mud pits, and the drilling mud is cleaned and recycled.

As a further environmental protection, hydraulic fracturing of the low-permeability (“tight” sands) formation is completed from a central point located away from the well pad. The frac pipe is brought to the pad, and the wells are fractured from a central location. This helps to keep the well pad as small as possible and reduces the movement of the frac trucks, which saves fuel, provides dust mitigation, and reduces driving time for the frac crews.

The companies at Pinedale Anticline and Jonah fields are working on their air emission issues with improved equipment. They are moving to diesel electric motors with lower emissions. Encana has built a natural gas-electric, self-moving, top-drive drilling rig. Natural gas from the field will fuel the engines that power the electric motors on this new rig. This not only reduces air emissions, but also cuts fuel costs by two-thirds.

All three companies have stopped blowing down wells after a frac job before they put it on production. Blowing down a well entails clearing well perforations and the wellbore, which previously resulted in some natural gas being vented to the atmosphere. Now the practice is to install a separator to separate the sand, water, and natural gas, letting the natural gas go into the production line while clearing the well. This halts emissions from natural gas venting and allows the well to go on line more quickly, and increases the amount of natural gas that can be sold.

Many of these techniques for low-impact operations are derived from lessons learned from Alaskan North Slope experience and enhanced technology.



An aerial view of Jonah field in Wyoming. The well pads are small and compact in the development area, which has seen a natural gas boom since the 1990s (photo courtesy Pinedale BLM).

Year-round drilling provides stability for the local community and the workers, as the families are able to move to the area rather than have the employees commute seasonally.

BLM APPROVES WINTER DRILLING

On November 14, 2005, Questar Market Resources released a statement that the Bureau of Land Management (BLM) had announced approval of the company's winter drilling proposal. Questar's proposal is intended to increase gas production from the Pinedale Anticline. The plan will allow previously approved winter drilling (see **Figure 2**) to be expanded and let Questar implement limited completion operations during the 2005-2006 winter. Work under the new proposal is expected to produce an additional 8 billion cubic feet of natural gas. This is equivalent to the amount of natural gas needed to heat 96,000 homes for one year.

Questar's previous drilling plan, approved by BLM in November 2004, allowed the company to use six drilling rigs operating on three drilling pads in the Pinedale leasehold. The new proposal will give Questar credit for additional environmental mitigation measures and enable the company to add another drilling rig to complete three new wells during the 2006 winter drilling season. Questar made the proposal to BLM in response to government requests to increase natural gas production due to the tight gas market caused by the hurricanes in the Gulf of Mexico in third quarter 2005.

Some of the low-impact measures that Questar will implement include:

- Continued use of single pads for multiple-well horizontal drilling.
- Addition of 250 acres to the 1,500 acres of existing habitat enhancement research project in the Pinedale leasehold.
- Creation of a 250-acre study area to determine the best way to enhance habitat to offset development activities.
- Implementation of a scientific study on the response

of local mule deer to winter completion operations.

In addition, winter development activities tend to lessen the damage to vegetation and soils, as they are partially protected by snow cover. Questar's plan is a model of the kind of low-impact oil and gas development that DOE seeks to sponsor through the LINGO solicitation.

ENVIRONMENTALLY FRIENDLY DRILLING SYSTEMS

Texas A&M University, in conjunction with Maurer Technology and the Houston Advanced Research Center, in the fall of 2005 began a DOE-funded research project aimed at adapting new E&P technologies to reduce emissions to air and water. The goal is to incorporate current and emerging technologies into a clean drilling system with no or very limited environmental impact (**Figure 3**). The project is geared to developing a viable ultralow-impact drilling system for use in exploration and exploitation of oil and natural gas in the United States, primarily the Lower 48 states.



Figure 3. This drill platform is designed for ease of mobilization and demobilization to create a "disappearing well" when the platform is removed following drilling operations (photo courtesy Maurer Technology).

The project will focus on implementation of new methods of transporting goods and materials; new compact, removable drilling platforms; innovative

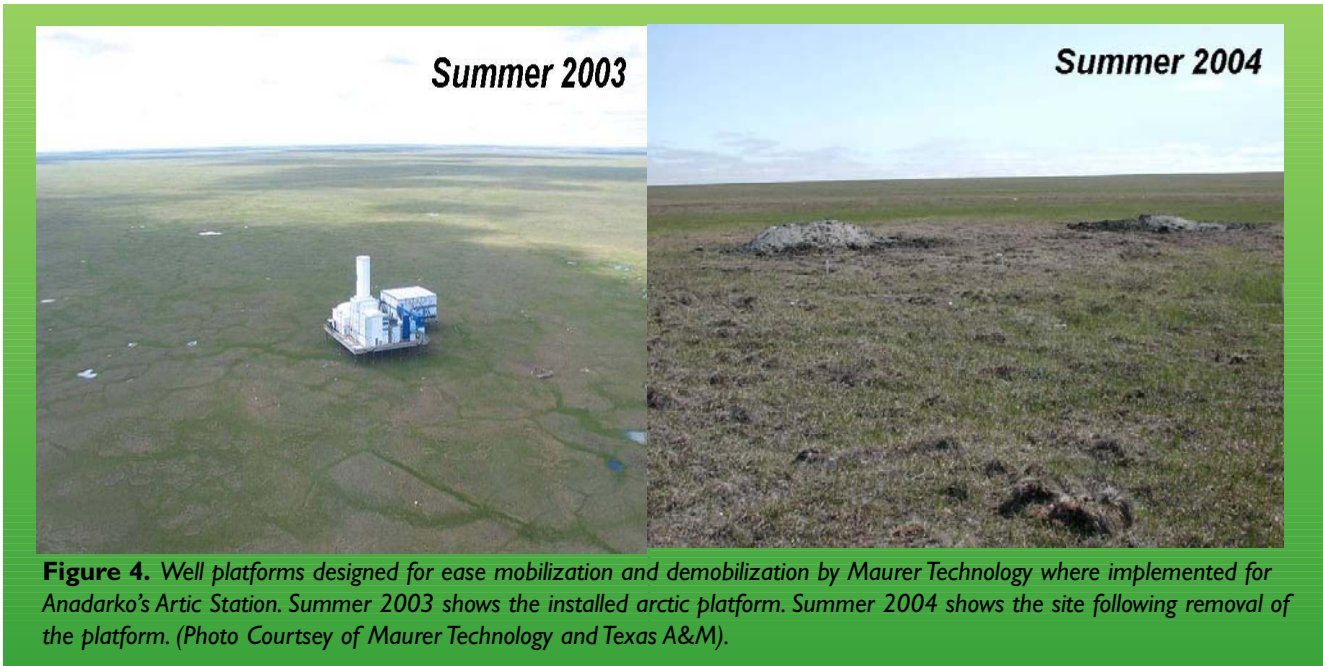


Figure 4. Well platforms designed for ease mobilization and demobilization by Maurer Technology where implemented for Anadarko's Arctic Station. Summer 2003 shows the installed arctic platform. Summer 2004 shows the site following removal of the platform. (Photo Courtesy of Maurer Technology and Texas A&M).

drilling practices; new multiphase fluid-transport practices; and new remediation practices. The objective is to develop a drilling system that can reduce impacts and emissions on land forms by up to 90%. The key to reduced drilling impacts is to identify technologies that will allow “roadless” access to remote sites, pad-free drilling and self-contained operations at sites to minimize air and water emissions, and the ability to demobilize equipment easily at the remediation stage.

Many of the emerging technologies to be reviewed by Texas A&M and its partners for application to onshore domestic fields are based on innovations for offshore and arctic operations (**Figure 4**). The great advances in extended-reach drilling are expected to expand the limit from the current seven miles to 15-20 miles in the future. Lightweight drillpipe, floating drillpipe, and rotary-steerable tools have been developed to reduce friction and allow greater-length horizontal drilling. More-efficient, lower-impact rigs (**Figure 5**) also have been promoted through DOE's Microhole Initiative. Modifications in drilling fluids have led to lightweight, gasified, and hollow-sphere drilling fluids that will improve borehole cleaning and reduce lost circulation problems.

Research and testing of expandable casing shows that both the casing diameter and weight can be

greatly reduced—making smaller holes possible, reducing environmental impacts, and lowering costs. Dual-gradient drilling systems have been developed that will reduce bottomhole pressures. Innovations of drilling equipment include development of retractable bits and motors, long-life bits, and drilling systems that allow drilling with casing. These practices will eliminate trips in and out of the hole, allow longer-reach drilling, and significantly reduce drilling time. Reduced drilling time means that drilling operations can be completed in shorter seasons, and demobilization and habitat remediation can proceed quickly.



Figure 5. A hybrid coiled tubing drilling rig developed for small-footprint drilling (Photo courtesy Tom Gipson, New Force Energy Services, Inc. and Texas A&M).

EoE Briefs

Longer Operating Season on the North Slope

State of Alaska Natural Resources Commissioner Michael Menge released a statement that “the Department of Natural Resources opened the east and west coastal areas of State-owned land on the North Slope to oil and gas exploration activity December 6, 2005 based on measurement standards developed in a scientific study completed in 2004 by the department's Division of Mining, Land and Water. The winter oil exploration seasons have become shorter because of warming weather and changes in measuring techniques, causing the winter exploration season to have been effectively cut in half since the early 1970s. This winter's opening is the earliest since 1995. In 2002 the winter season was 104 days; last year, based on standards from the study, the winter season was 161 days.” This gain of 20-30 days is attributed to the adoption of new standards based on DOE’s Tundra Travel Model.

The new standard, based on results of the tundra travel study sponsored by NETL’s Arctic Energy Office, is based on snow cover and subsurface temperature measured by thermistors at 16 North Slope sites. New snow depth and soil temperature standards developed through the study allow the Department of Natural Resources to lengthen the oil and gas exploration winter season without increasing the impact to the tundra. The study found that snowfall is more important in protecting the tundra than previously understood while ground hardness, previously the determining factor in opening the tundra is relatively less important after a certain point.

New DOE Projects

DOE’s Access to Federal Lands and Produced Water Management initiatives have resulted in funding of seven new projects in late 2005, including the Texas A&M/Maurer project discussed on page 5.

Argonne National Laboratory will conduct an evaluation of *Sagebrush and Sagebrush Obligate Species: A Program for Strategic Monitoring*. The goal is to provide technical support on a key energy-environment issue that must be addressed by Western U.S. Federal land managers: maintaining the sagebrush vegetation complex and associated obligate wildlife species while allowing energy development to proceed.

Argonne National Laboratory will also *Develop a GIS-based Decision Support System for Land Use Planning Activities*. The goal is to assist the Bureau of Land Management in the development of a geographic information system (GIS) for land use planning activities.

Lawrence Berkeley National Laboratory will conduct a study on *Seasonal Modeling of Central California for Year 2000*. The goal is to use CMAQ, EPA's Community Air Quality Model, with state-of-the-art emissions, meteorological, and chemical inputs to model air quality in Central California for the summer of 2000 to better understand and mitigate air quality issues.

Argonne National Laboratory will evaluate *Produced Water Management and Beneficial Use* in association with a continuing study at Colorado School of Mines on coalbed methane produced water.

BC Technologies LTD will study *Coalbed Methane Produced Water Treatment Using Gas Hydrate Formation at the Wellhead*.

The Pacific Northwest Laboratory will work with DOE Arctic Center Office on a *Characterization of Wettability States of Alaskan Reservoirs*. The goal is to improve performance and increase production.

Calendar of Events Winter/Spring 2006

Feb. 2-3

NEPA and Federal Land Development (Rocky Mountain Mineral Law Foundation)

Denver, CO
Contact: **303-321-8100**

Feb 7-8

North American Prospect Exposition (NAPE),

Houston, TX
Contact: **nape@landman.org**

Feb. 7-8

IADC/SPE Health, Safety, Environment & Training Conference & Exhibition, Houston, TX.
Contact: **www.iadc.org.**

Feb. 21-23

IADC/SPE Drilling Conference, Miami, FL.
Contact: **www.iadc.org.**

Apr. 9-12

AAPG Annual Convention, Houston, TX.
Contact: **www.aapg.org.**

Apr. 22-26

SPE/DOE Improved Oil Recovery Symposium, Tulsa, OK.
Contact: **www.ior2006.org.**

May 1-3

IOGCC Midyear Issues Summit
Point Clear, AL.
Contact: **405-525-3556.**

Eye on Environment is a publication of the U.S. Department of Energy's National Energy Technology Laboratory, Office of Petroleum. It features highlights of DOE's Oil and Gas Environmental Research Program.

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