Technology limits environmental impact of drilling

John Kennedy, Contributing Editor

UPSTREAM AND DOWNSTREAM, new technologies are not only helping the petroleum industry's bottom line, they are significantly reducing the impact of oil and gas operations on the environment.

These technologies are proving that a steadily growing demand for energy can be met while reducing the threat to air and water quality.

That's the conclusion of a report issued recently by the **US Department of Energy Office of Fossil Energy**.

Benefits to environmental quality are especially noticeable in oil and gas exploration, says the report.

"Across the E&P spectrum, new technology is delivering:

- More efficient recovery of oil and gas resources;
- Smaller footprints;
- (And) cleaner, safer operations."

The report focuses on the US, of course, but today's sophisticated technology and improved operating practices benefit all parts of the globe.

DOE backs up the conclusions of the report with three dozen detailed fact sheets on specific technologies and operations in exploration, drilling and completion, production, and site restoration.

Interestingly, the DOE reports that state spending on oil and gas regulatory activities nearly tripled during the 1980s in the largest oil producing states. Of course, industry's spending on environmental protection also climbed dramatically into the mid 1990s.

KEY E&P ADVANCES

Despite the fact that oil and gas exploration and production take place in ever more remote regions and more difficult environments, technology has improved environmental protection.

It takes fewer wells today to find the same amount of reserves; increased drilling efficiency has lowered the volumes of mud and cuttings for each barrel of oil found; and emerging downhole separation technology can reduce produced water volumes, the largest waste stream associated with oil and gas production.

Modular and slimhole rigs reduce the drilling footprint; directional drilling can help protect sensitive environments; and greenhouse gas emissions have been dramatically reduced.

Just as important, new drilling and completion equipment has signficantly improved worker safety.

Advanced technology makes drilling operations steadily more efficient in recovering oil and gas resources, cleaner, and safer.

DRILLING

Drilling companies have taken advantage of a broad range of technologies to help protect both people and places.

Despite the challenges—deeper water and high pressure/high temperature formations, for example—drilling grows ever safer, faster, more efficient, and less costly.

New exploration and drilling technology has, on average, doubled the amount of oil or gas developed per well since 1985, according to the DOE report.

That means finding today's reserves in the US would have taken 22,000 more wells annually with the technology of 1985.

Among other environmental benefits, reducing the number of wells reduces the amount of waste. DOE estimates waste at 1.2 bbl/ft drilled.

Horizontal, directional, and multilateral drilling have helped avoid sensitive surface areas and still reach valuable resources. These techniques also permit recovering more—often much more—from a single well.

An earlier DOE report in 1995 estimated horizontal drilling could increase reserves in the US by 10 billion bbl. Average production ratio is 3.2 to 1 for horizontal wells compared with vertical, while the average cost ratio is 2 to 1.

While assembling an expanding range of tools to lessen the environmental impact of oil and gas drilling, the march of technology has sometimes posed a challenge to drilling contractors and makers of drilling equipment.

Fewer wells are needed, meaning fewer rigs are needed. Bits and other equipment lasts much longer.

In the past, a forecast of fewer wells, whatever the cause, was not good news. But the modern drilling contractor no longer relies on raw numbers of wells or footage for success. Today's contractor knows his client is not interested in drilling a hole, but in finding oil and gas.

Drilling contractors have met market challenges by taking full advantage of technology and by using innovative organizations and partnership arrangements to lower their cost and improve their service.

SLIMHOLE DRILLING

Slimhole drilling decreases drilling waste volumes and requires smaller operational footprints.

DOE cites the example of a slim hole drilled to 14,760 ft ending with a 4 ⅛-in. hole. The volume of cuttings produced in such a well is one third less than that of a standard well at the same depth.

Since equipment used for slimhole drilling can be smaller than conventional rigs, the area cleared for a location can be as small as 9,000 sq ft, including mud pits. That's about one-fourth the size of a conventional location.

Coiled tubing technology has similar

environmental benefits: reduced waste and smaller footprints. And because the joint connection operations of a conventional drill string are not required, noise levels are reduced as well.

Of course, like any technology that permits drilling highly deviated wells, slimhole drilling can be used to avoid environmentally sensitive areas by using directional drilling techniques.

Saving weight and space is a never-ending challenge for designers and operators of all types of rigs. The latest advance in this quest is lighter modular rigs that make use of lighter, stronger materials.

They can be especially useful in remote locations.

MWD TECHNOLOGY

Downhole pressure detection has long been critical to well control and blowout prevention. The technology has steadily—sometimes dramatically—improved over the past three decades and now contributes significantly to better well control and faster drilling times.

Those benefits mean less time on location and more valuable information from each well drilled.

Some of the most dramatic uses of measurement while drilling technology have been in steering a relief well on those occasions when control of the primary well has been temporarily lost.

Accurate pressure measurement and analysis greatly reduce the risk of blowouts and fires, increasing safety and decreasing environmental risk.

NEW BITS

Any technology that improves drilling efficiency means less time on location and less impact on the environment. Not only is it important for bits to drill faster, they must also last longer. Since much of the time spent on location is spent tripping pipe to replace worn bits, bits that last longer offer significant financial and environmental benefits.

Advances in materials technology and bit hydraulics have brought great improvement in drilling efficiency. The DOE report says, for example, that a 15,000-ft well in Roger Mills County, Oklahoma takes an average of about 39 days to drill today, compared with more than 80 days in the 1970s.

Advances in materials technology are not limited to bits.

New alloys and composites are also finding a home in drill pipe and coiled tubing, especially for deep, high-temperature wells.

They reduce the risk of equipment failure and lower maintenance requirements.

DRILLING FLUIDS

Synthetic drilling fluids combine the higher drilling performance of oil-based muds with the lower environmental impact of water-based fluids. They can be recycled and generate less waste than water-based muds. Synthetic fluids also enhance worker health and safety, says the DOE report.

Synthetic fluids can also lower drilling costs. DOE cites an unnamed operator in the Gulf of Mexico who drilled eight wells under comparable conditions to the same depth.

Drilling time on the three wells drilled with synthetic fluids averaged 53 days, compared with an average of 195 days/well on the five wells using water-based fluids.

Cost of the wells drilled with synthetics averaged $5.5 million; those drilled with water-based fluids averaged $12.4 million.

In those wells where pressure conditions permit the use of air drilling techniques, waste and environmental impact are further reduced.

Air drilling can often be used in mature fields, in formations with low pressures, and in fluid-sensitive zones.

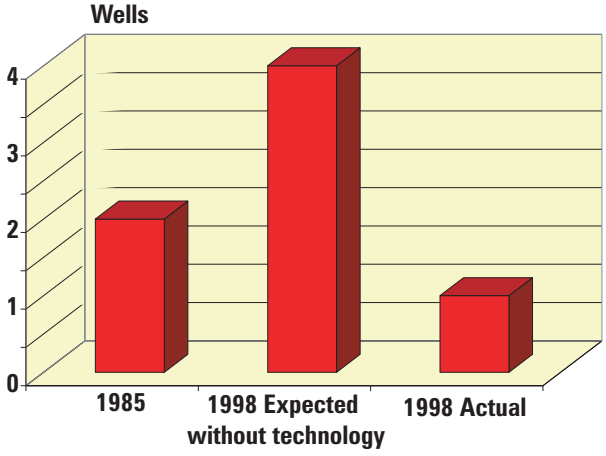
OFFSHORE

The improvement in safety, well control, and environmental impact as a result of technological development has been great in offshore drilling operations.

Offshore drilling rigs are more stable, can drill in much greater water depths, and are equipped with sophisticated control systems to prevent spills and blowouts

Subsea completion systems allow multiple wells to be drilled and completed from one location, reducing the number of production risers and lowering the risk of environmental impact.

Figure 1: Fewer wells add same reserves



CHALLENGES

DOE notes that every facet of the petroleum business—from new ways to find oil and gas to today's clean fuels formulations—has been transformed by the use of technology.

"Now the bar is being raised," says DOE. It cites the following challenges:

- Remaining successful in an evolving and volatile marketplace;
- Sustaining science and technology progress;
- Minimizing and controlling greenhouse gases;
- Ensuring responsible development. ■