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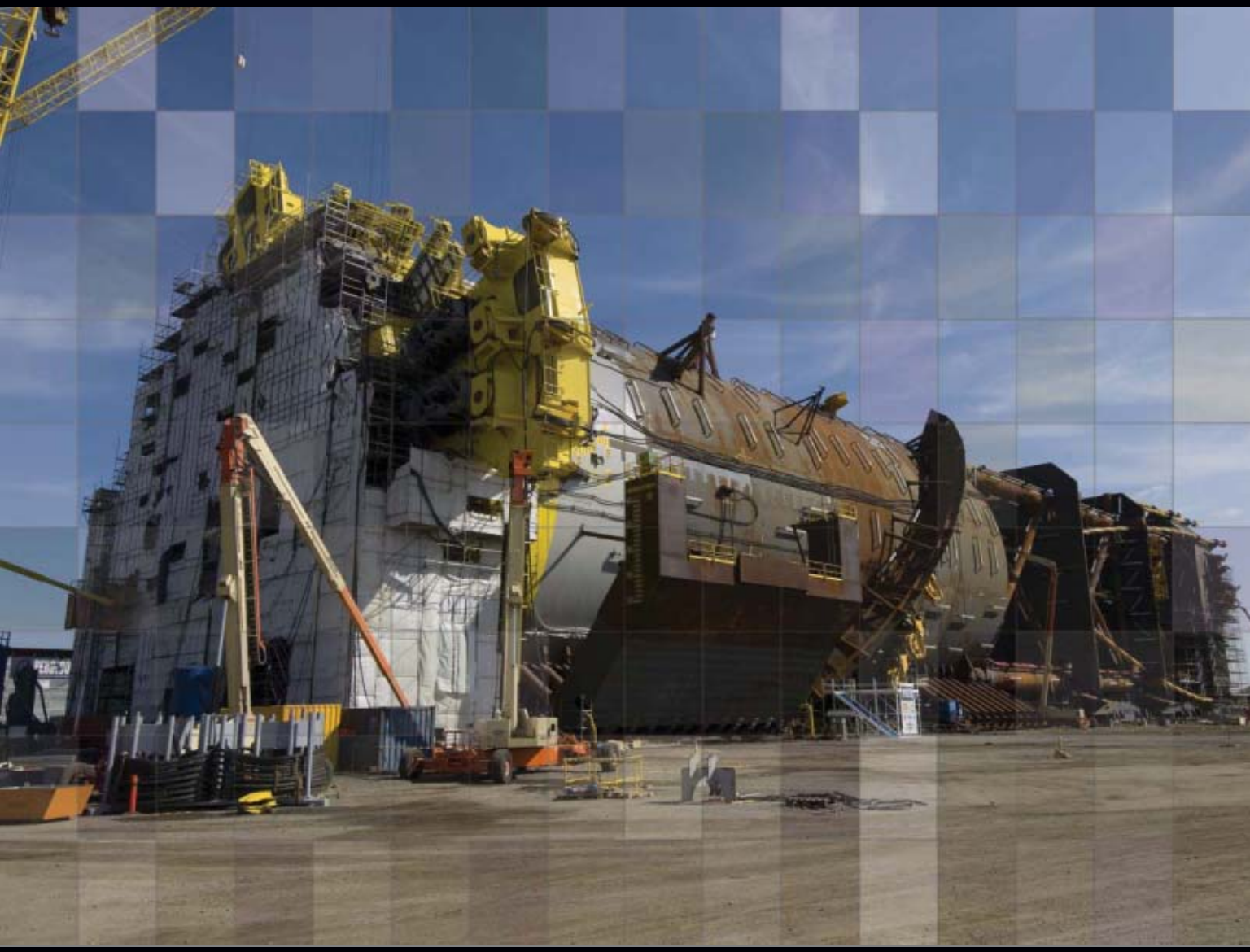

Major Upstream Projects

Futures trading: What role in the price of oil?
Early velocity integration vital in subsurface interpretations
Innovative method solves catalyst pinning problem
Argentine NGL case study applies economic procedure

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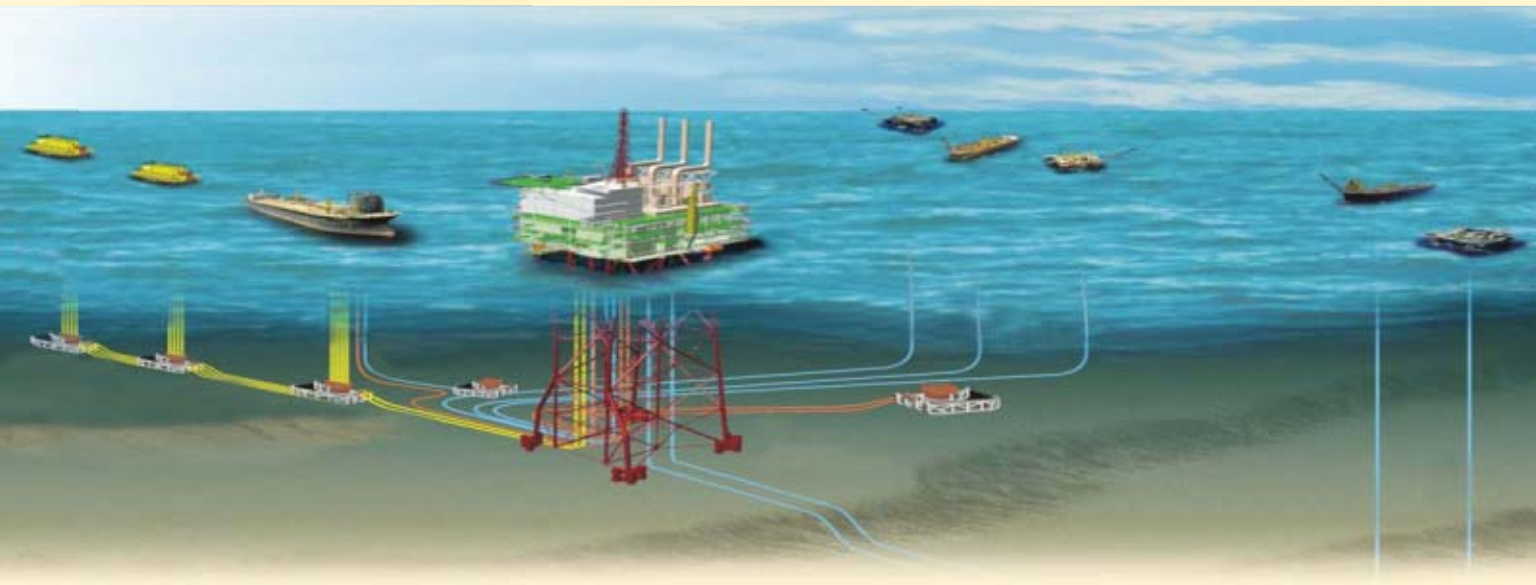
MAJOR UPSTREAM PROJECTS



REGULAR FEATURES

COVER

In late May, Technip Offshore Finland Oy's Pori yard finished fabricating the hull of the Perdido spar. The 555-ft long, 118-ft in diameter, 19,000-tonne hull then was loaded on a barge that transported it to Kiewit Offshore Services Ltd.'s yard at Ingleside, Tex., for outfitting. Once moved to Alaminos Canyon Block 857 in the Gulf of Mexico, the Shell Offshore Inc.-operated spar, moored in 7,817 ft of water, will receive production from Great White, Silvertip, and Tabago fields (photo from Shell). The illustration above shows the Petrobras PRA-1 pump platform that receives oil from several producing fields in the Campos basin off Brazil and then offloads the oil to tankers. The deep water off Brazil and the Gulf of Mexico has numerous development projects under way, as seen in OGJ's special report on Major Upstream Projects starting on p. 54.

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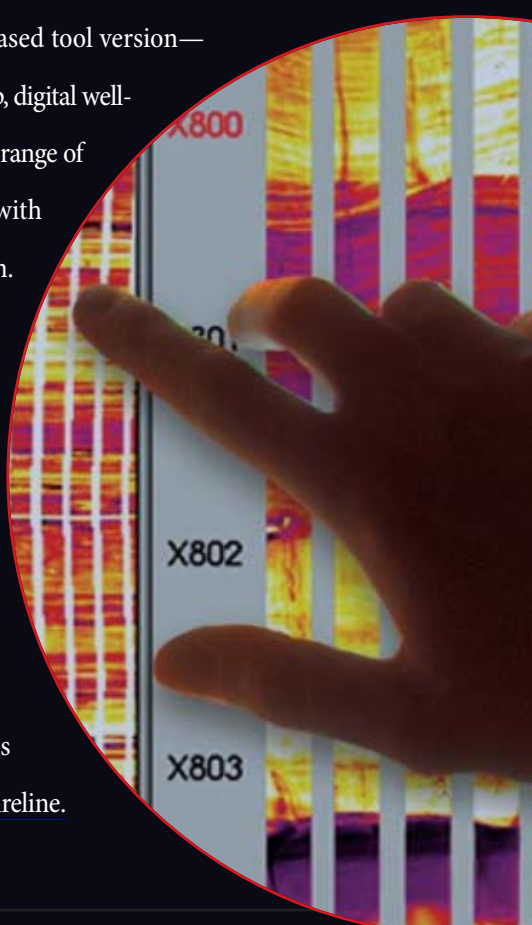

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OGJ Newsletter

June 9, 2008

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General Interest — Quick Takes

Study assesses threats to oil market stability

Even as oil prices climb, threats to market stability are starting to abate, Amy Myers Jaffe told an energy forum last month at Rice University's James A. Baker III Institute for Public Policy in Houston.

The institute's new study, "The Global Energy Market: Comprehensive Strategies to Meet Geopolitical and Financial Risks—The G8, Energy Security, and Global Climate Issues," identifies a series of policy frameworks that can be used to strengthen the current market system and ensure that it can respond flexibly to an array of possible threats.

The study assesses the US economy, financial markets, resource nationalism, terrorism, and climate change, as well as Iran's nuclear standoff, risk scenarios for Russian natural gas, dynamics in China and Iraq, the militarization of energy, and growth in transportation fuel demand.

Jaffe, an energy fellow at the Baker Institute, said the key finding in the study is that many of the risks driving today's oil price premium may be less catastrophic than they seem at first glance. And to achieve energy security—here defined as reducing the vulnerability to a reduction or cut-off of energy supplies—consumers must increase their elasticity of demand by increasing their flexibility and using alternative fuels.

Looking at cheap and available fuel supplies, the study says that while fuel subsidies in many countries are often justified on the grounds that they address income inequality and assist the poor, they mostly benefit the largest consumers of oil products, who are not society's poorest members.

It's in the US's interest to work with international institutions such as the International Monetary Fund to help oil states liberalize their domestic energy markets and begin to foster energy efficiency by easing subsidy programs, replacing them instead with more sound fiscal policies to aid their poor, the study says.

Regarding energy security issues, the study says that consuming countries benefit when global oil production comes from as diverse a base as possible. "Active policies that attempt to use bilateral influence, aid, conflict resolution assistance, and other diplomatic leverage to remove some of the barriers to investment and technology transfer to oil producers in Indonesia, Central Asia, Russia, Asia, and Africa could dramatically reduce the pressure on oil markets in the years to come," according to the study.

UK prime minister, oil leaders discuss challenges

UK Prime Minister Gordon Brown and his chancellor Alastair Darling have met with oil industry leaders in Aberdeen to discuss methods of controlling soaring fuel prices.

Brown warned that high oil prices were here to stay because global demand was outstripping supply over the long term. Members of the British legislature and the general public have called for policy changes on road and fuel taxes to help families and to thwart protests by the haulage industry that have disrupted traffic and increased pressure on Brown to address the problem.

The oil group focused on how investment decisions are made for projects on the UK continental shelf and analyzed various measures for advancing oil and gas developments and enhancing recovery from existing fields.

Oil and gas production in 2007 was 2.8 million boe/d, down from production of 4.2 million boe/d in 2001. The UK is estimated to have as much as 25 billion boe left to produce.

Malcolm Webb, chief executive of offshore trade association Oil & Gas UK, which met with Brown and Darling, said, "This was a highly constructive engagement, and the proposals discussed could have a significant impact on the near-term production. We look forward to continuing our discussions with government to develop these ideas."

But the subsea operators also called on Brown to acknowledge their contribution to developing and producing the country's resources. David Pridden, chief executive of Subsea UK, said, "With almost half of North Sea production now coming from subsea wells, the subsea sector has a significant role to play in more efficiently extracting the remaining hydrocarbons in the UKCS."

Pridden said more government support was needed for the offshore industry, which he said could add "a further 10-15%" of reserves from the UKCS in the next few years, "i.e., a further 2-3 billion boe." Last year the UK subsea industry generated £4.3 billion in revenues.

Brown wants the issue of high oil prices on the agenda for the Group of Eight summit in Japan. He's also pressing the Organization of Petroleum Exporting Countries to increase its production.

The Department for Business, Enterprise, and Regulatory Reform (BERR), which grants licenses for the UK North Sea, has unveiled changes in its licensing regime to increase production. Secretary of State John Hutton said another 20,000 b/d of peak oil could be produced from 30 fields that would be created by carving them out from unprofitable areas of some existing fields.

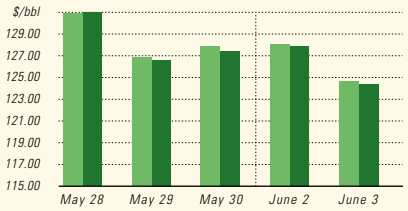
"The change will mean production from these new fields would be unaffected by Petroleum Revenue Tax," BERR said.

BERR received 193 applications covering 277 blocks in its 25th Offshore Licensing Round, the highest number since 1974. The round closed on May 22. The government has also just launched 97 new licenses—a record number—through the 13th Onshore Round.

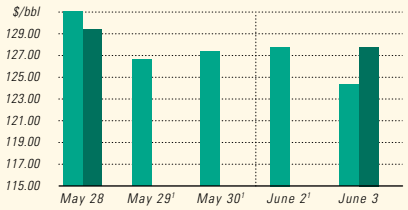
A spokeswoman from OGUK told OGJ that the association has been talking to the Treasury for the past year seeking reform of the tax regime to attract investment. Talks are expected to close by the end of June. "We have been looking at targeted incentives

Industry Scoreboard

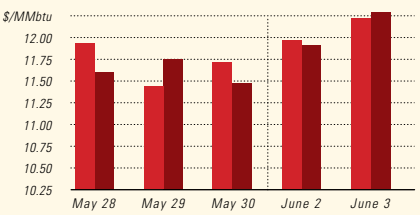
IPE BRENT / NYMEX LIGHT SWEET CRUDE



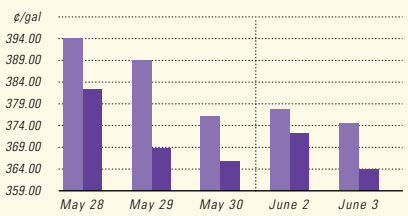
WTI CUSHING / BRENT SPOT



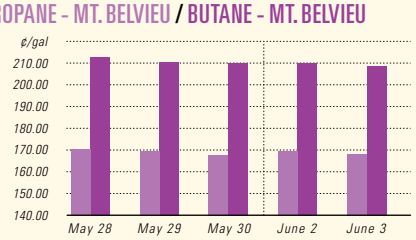
NYMEX NATURAL GAS / SPOT GAS - HENRY HUB



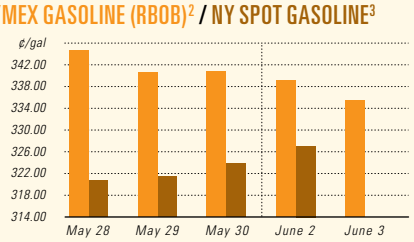
IPE GAS OIL / NYMEX HEATING OIL



PROPANE - MT. BELVIEU / BUTANE - MT. BELVIEU



NYMEX GASOLINE (RBOB)[2] / NY SPOT GASOLINE[3]



[1]Not available [2]Reformulated gasoline blendstock for oxygen blending.
[3]Non-oxygenated regular unleaded.

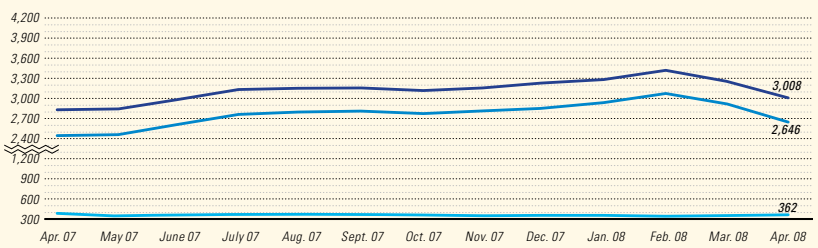
US INDUSTRY SCOREBOARD — 6/9

Latest week 5/23	4 wk. average	4 wk. avg. year ago[1]	Change, %	YTD average[1]	YTD avg. year ago[1]	Change, %
Demand, 1,000 b/d						
Motor gasoline	9,347	9,387	–0.4	9,077	9,134	–0.6
Distillate	4,144	4,093	1.2	4,215	4,302	–2.0
Jet fuel	1,575	1,622	–2.9	1,566	1,613	–2.9
Residual	716	743	–3.6	669	785	–14.8
Other products	4,699	4,775	–1.6	4,866	4,872	–0.1
TOTAL DEMAND	20,481	20,620	–0.7	263	708	–2.1
Supply, 1,000 b/d						
Crude production	5,100	5,235	–2.6	5,100	5,194	–1.8
NGL production[2]	2,522	2,449	3.0	2,343	2,347	–0.2
Crude imports	9,689	10,268	–5.6	9,721	10,010	–2.9
Product imports	3,320	3,838	–13.5	3,296	3,523	–6.4
Other supply[3]	1,368	1,025	33.5	1,335	879	51.9
TOTAL SUPPLY	21,999	22,815	–3.6	21,795	21,953	–0.7
Refining, 1,000 b/d						
Crude runs to stills	14,713	15,644	–6.0	14,713	14,939	–1.5
Input to crude stills	14,908	15,596	–4.4	14,908	15,279	–2.4
% utilization	85.2	89.4	—	85.2	87.5	—

Latest week 5/23	Latest week	Previous week[1]	Change	Same week year ago[1]	Change	Change, %
Stocks, 1,000 bbl						
Crude oil	311,559	320,422	–8,883	342,233	–30,674	–9.0
Motor gasoline	206,155	209,413	–3,258	198,027	8,128	4.1
Distillate	109,431	107,790	1,641	120,415	–10,984	–9.1
Jet fuel-kerosine	39,581	40,122	–541	40,885	–1,304	–3.2
Residual	39,185	40,930	–1,745	37,006	2,179	5.9
Stock cover (days)[4]			Change, %		Change, %	
Crude	20.7	21.5	–3.7	22.1	–6.3	
Motor gasoline	22.1	22.5	–1.8	21.0	5.2	
Distillate	26.4	25.9	1.9	28.8	–8.3	
Propane	36.9	36.5	1.1	37.9	–2.6	
Futures prices[5] **5/30**			**Change**		**Change**	**%**
Light sweet crude, $/bbl	128.46	130.46	–2.00	65.03	63.43	97.5
Natural gas, $/MMbtu	11.72	11.50	0.22	7.76	3.97	51.1

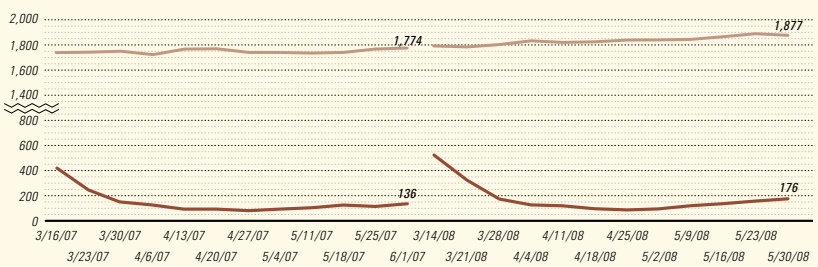
[1]Based on revised figures. [2]Includes adjustments for fuel ethanol and motor gasoline blending components. [3]Includes other hydrocarbons and alcohol, refinery processing gain, and unaccounted for crude oil. [4]Stocks divided by average daily product supplied for the prior 4 weeks. [5]Weekly average of daily closing futures prices.
Sources: Energy Information Administration, Wall Street Journal

BAKER HUGHES INTERNATIONAL RIG COUNT: TOTAL WORLD / TOTAL ONSHORE / TOTAL OFFSHORE



Note: Monthly average count

BAKER HUGHES RIG COUNT: US / CANADA



Note: End of week average count

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to promote the West of Shetlands, for example, which is remote and technically challenging. Right now the group can't develop it because it isn't commercially viable," the OGUK spokeswoman said. ✦

Exploration & Development — *Quick Takes*

UK announces winners of onshore licenses

The UK government has awarded 54 companies onshore licenses in its 13th licensing round designed to encourage investment in the mature basin.

It awarded 97 petroleum exploration and development licenses to a variety of independent companies, including Northern Petroleum, Providence Resources, and IGas.

Northern Petroleum will operate PEDL240 in partnership with EnCore Oil on Blocks SZ38 South and SZ48 West South on the Isle of Wight.

Operator Providence Resources and its partner NP Weald will examine the Baxter's Copse oil discovery and the Burton Down exploration prospect on Block SU91.

IGas, a coalbed methane developer in the UK, will explore seven blocks in northwestern England with its partner Nexen Exploration UK. The acreage is within 15 km of existing drilling operations.

Egdon Resources was offered six licenses covering eight blocks or partial blocks in the round in the East Midlands and Wessex basin. They expand the company's acreage and opportunity base within core areas.

The government awarded Europa Oil & Gas an exploration license in North Lincolnshire. Europa will operate the license and hold a 50% working interest; Valhalla Oil & Gas Ltd. will hold the remainder.

The block is in the Humber basin, which contains Europa's Crosby Warren oil field and the 90 bcf Saltfleetby gas field. One well has been drilled on the license area to date.

Long sidetrack appraises gulf's Pony find

A 33,362-ft sidetrack well in Green Canyon Block 468 has successfully appraised Hess Corp.'s 2006 Pony discovery in the deepwater Gulf of Mexico.

The Pony-2 sidetrack, drilled from a surface location 7,400 ft northwest of the discovery well, encountered the same objective Miocene sands as the Pony-1 and Pony-2 wells. The main pay sand was oil filled throughout the interval drilled.

Hess is evaluating development concepts before making a final investment decision for Pony, which it now says has 200 million boe recoverable and is 100% owned by the company. It had previously estimated 100-500 million boe.

The acreage, just north of the Knotty Head area, is in 800-1,599 m of water (OGJ, July 24, 2006, Newsletter).

New Brunswick gas shale under evaluation

Corridor Resources Inc., Halifax, NS, plans a $32 million program this year and next to step up economic assessment of the Mississippian Frederick Brook shale near Elgin, NB.

Corridor will drill three widely spaced vertical wells on 2D seismic to obtain log and core data for full analysis followed by a horizontal well with a lateral as long as 1,000 m in the most prospective part of the shale and multiple fracs in all wells. It plans a 65 sq km 3D seismic program over the most promising area.

Corridor's Elgin licenses, excluding McCully field area holdings, cover 118,000 acres.

Meanwhile, the company has a $14.4 million plan to drill a horizontal development well to the overlying Hiram Brook sands in northeastern McCully field and horizontal wells in the Hiram Brook A sand in the most productive part of the field to hike production in its central part. ✦

Drilling & Production — *Quick Takes*

Shell launches Perdido spar production facility

Royal Dutch Shell PLC is transporting by barge its enormous Perdido spar production facility from the shipyard in Pori, Finland, to Ingleside, Tex., to prepare for installation in the ultradeep Gulf of Mexico on Alaminos Canyon Block 857.

Perdido, which has the capacity to produce 130,000 boe/d, will float on the surface in nearly 8,000 ft of water. "The spar will be secured in place by nine chain and polyester rope mooring lines, spanning an area of the seafloor roughly the size of downtown Houston," Shell said. Production will start by 2010.

On the Alaminos Canyon seafloor, 22 wells, each drilled to more than 14,000 ft below the water's surface, will be linked to the Perdido spar above. Oil will be brought to the surface against the extreme pressure of the deep water by 1,500-hp electric pumps, and gas will be separated on the sea floor to rise naturally to the production unit on the surface.

"The remotest producing platform in the entire Gulf of Mexico region, Perdido will float 220 miles from Galveston, Tex., and will provide living quarters for 150 industry personnel. The helicopter landing deck also will set new industry records, simultaneously accommodating two long-range Sikorsky S92 helicopters, each holding as many as 24 passengers and crew," the company said.

Shell, the 35% shareholder of the Perdido Regional Development Spar, is operator on behalf of partners BP PLC 27.5% and Chevron Corp. 37.5%.

Gupco starts output from Egypt's Saqqara field

Gulf of Suez Petroleum Co. is delivering more than 30,000 b/d of oil from offshore Egyptian Saqqara field in the Gulf of Suez and will start gas production shortly.

Saqqara is 12.5 m in the central Gulf of Suez and was discovered in mid-2003 (OGJ Online, May 13, 2005).

The technically complex field was developed via a jacket and unmanned topsides, four wells, and a 13 km pipeline to a new dedicated onshore separation and gas processing plant at Ras Shukeir, Gulf of Suez.

It began production May 15 and has been ramped up to its current output following commissioning.

Gupco is a joint venture of BP PLC and Egyptian General Petroleum Corp.

Kambuna gas flow to start off Indonesia

Serica Energy PLC, London, plans to start production by yearend from Kambuna gas field in the Malacca Straits 40 km off North Sumatra, Indonesia.

The company, operator of the 380-sq-km Glagah Kambuna Technical Assistance Contract with a 65% working interest, has installed a wellhead platform in 40 m of water and is completing production tests of three development wells.

Bow Valley discovered Kambuna field in 1986 south of the undeveloped 1985 Glagah oil discovery by Caltex. Serica began Kambuna development drilling in 2005 (OGJ, Oct. 24, 2005, p. 56).

Serica expects plateau production 50 MMscfd of gas and 5,000 b/d of condensate from proved reserves estimated at 19 million boe.

A 14-in., two-phase pipeline to be laid in the fourth quarter will carry production to an onshore gas plant and tie into pipelines to a power plant at Belawan and to the city of Medan.

The Serica Kambuna-2 and Kambuna-3 wells tested at a combined rate of 73 MMscfd from Early Miocene Belumai sandstone at 7,152-7,342 ft below mean sea level.

Serica is completing the Kambuna-4 deviated well and expects to test it within a few weeks.

GFI Oil & Gas Corp., Calgary, holds the other 35% of the block. ✦

Processing — *Quick Takes*

StatoilHydro lets contracts for refinery simulator

StatoilHydro has let a contract to Honeywell International Inc. for a plant process simulator and operator training system that will be used at the company's Kalundborg refinery in Denmark.

The refinery is Denmark's largest, with an annual throughput capacity of 5.5 million tonnes of oil, and its oldest dating back to the early 1960s.

The new simulator, using Honeywell's trademarked simulation technology, will be installed in three phases, with final delivery planned for yearend 2009. StatoilHydro will use the simulator to train new plant operators and provide refresher courses and self-training modules.

The simulator also will be used as a design, development, and implementation platform for advanced process control in order to improve operational efficiency at Kalundborg.

In addition, Honeywell will supply tools that allow process and system data to be imported into the simulator, thereby supporting alignment with any future configuration changes at the refinery. The value of the deal was not reported.

North West Upgrading awards LCFining prefab

Privately owned North West Upgrading Inc., Calgary, has awarded KBR a $275 million (Can.) contract to construct and fabricate an LCFining processing system for the heavy-oil upgrader it is building 45 km northeast of Edmonton in Sturgeon County, Alta.

KBR will prefabricate 40 modules to be assembled later. This phase of the project is expected to take 30 months.

The LCFining technology is being supplied by Chevron Lummus Global LLC (CLG)—a 50-50 joint venture of Chevron USA Inc. and ABB Lummus Global. CLG is providing the engineering package, including reactor design, follow-up technical support during detailed engineering design, training prior to start-up, ICR catalysts, and start-up support during commissioning of the upgrader (OGJ, Nov. 27, 2006, Newsletter).

The upgrader, which will produce light, low-sulfur products such as ultralow-sulfur diesel and diluent, will have a total processing capacity of 231,000 b/d of blended feedstock over three phases. It will have an initial design capacity to process 77,000 b/d of bitumen blend, with two subsequent 77,000 b/d expansions planned for the future.

Site preparation has begun for the $2.4 billion first phase. All three phases are expected to be operating by 2016.

UOP LLC, Des Plaines, Ill., was awarded design and licensing of a hydroprocessing unit for the facility (OGJ, Aug. 15, 2005, Newsletter). This integrated distillate Unionfining and Unicracking unit will produce a synthetic crude oil blend. It will have parallel reactors for hydrotreating naphtha and distillate-range feedstock and partial conversion hydrocracking of distillate and vacuum gas oil-range feedstock. A common section will stabilize reactor effluent and compress recycle gas.

"An important element of [the upgrader is its] use of gasification to make hydrogen from the heaviest components of the bitumen, and its carbon capture-ready design," said North West.

The company also said it has concluded a commercial arrangement to sell carbon dioxide for enhanced oil recovery, thereby sequestering most of its greenhouse gas emissions.

Aramco taps Axens for Jubail refinery units

Saudi Aramco and Total SA have awarded a contract to Axens, Paris, to design a 32,000 b/d vacuum gas oil fluid catalytic cracker and other units for the planned 400,000 b/d refinery in Jubail, Saudi Arabia.

Aramco and Total recently confirmed plans to construct the refinery under a joint venture company, whereby Aramco will supply Arabian heavy crude and both companies will share marketing responsibilities.

Axens will also produce an aromatics complex with a capacity of 700,000 tonnes/year of paraxylene and 143,000 tonnes/year of benzene. The refinery will start operations in 2012.

Axens said the technology suite comprises a 68,000 b/d naphtha hydrotreater and continuous catalytic regeneration reformer to produce gasoline blend stock and mixed xylenes.

The FCC unit is designed to produce more than 10 wt % propylene. ✦

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Petrobras plans ethanol export pipelines

Jose Sergio Gabrielli, president of Petroleo Brasileiro SA (Petrobras), said the state-owned firm plans to have its first ethanol pipeline operating by yearend 2009.

"We are currently working on several phases of this pipeline and believe that the first phases should be operating by the end of 2009," said Gabrielli, who explained that the line is part of a larger export strategy.

"Petrobras has a very clear strategy of becoming a great international player in the trade and logistics of ethanol," he said. "We are establishing an export program, mainly to Japan, establishing logistics chains to take the product from the new areas to ports, through two large ethanol pipelines."

Petrobras announced plans to construct the two lines last year: an ethanol line from Goias state to Sao Sebastiao, Sao Paulo state port, and a line for both ethanol and biodiesel, to run from Cuiaba, Mato Grosso, to Paranagua in Parana state (OGJ, June 11, 2007, p. 31).

Of the two, Gabrielli said this week, the most advanced is the $1 billion, 1,150-km line that will connect Senador Canedo in the state of Goias to the Paulinia Terminal in the state of Sao Paulo.

The line will pass through the cities of Uberaba, Ribeirao Preto, Guararema, and Sao Sebastiao, as well as the Ilha d'Agua terminal in Rio de Janeiro. The project also includes a stretch connecting the Tiete-Parana Waterway to the Paulinia Terminal.

The project is based on a joint venture agreement signed between Petrobras, Mitsui & Co., and Brazilian construction company Camargo Correa, creating PMCC Ethanol Transport Projects SA (OGJ, Mar. 24, 2008, Newsletter).

Regarding the second planned line, connecting Cuaiba and Paranagua, Brazilian Energy Minister Edison Lobao announced in March the development of viability and environmental impact studies.

The studies, to be undertaken by Petrobras and technicians from the states of Mato Grosso do Sul and Parana, are expected to be completed in June 2008.

Meanwhile, in April, Brazil Renewable Energy Co. (Brenco) said it plans to invest $1 billion to build a 1,100-km, 4 million l./year ethanol pipeline extending from Alto Taquari in Mato Grosso state to Santos—the country's largest port—in Sao Paulo state on the country's south Atlantic seaboard (OGJ Online, Apr. 29, 2008).

Pipeline would ship gas from Bakken play

A proposed 100-mile, 16-in. pipeline in northwestern North Dakota would transport associated gas from the Mississippian-Devonian Bakken oil play in the Williston basin.

Capacity would be 100 MMcfd expandable to double that volume. The pipeline would be in service in mid-2010 subject to shipper commitment and regulatory approvals, said Williston Basin Interstate Pipeline Co., a subsidiary of MDU Resources Group Inc. affiliate WBI Holdings Inc. An open season is to run from June 16 through July 11.

The Bakken pipeline would originate at an interconnect with Williston Basin's existing pipeline in Mountrail County, ND, near Tioga, and extend to the Alliance Pipeline in Bottineau County.

The pipeline will provide producers the option to deliver certain natural gas liquids out of the Bakken play in Montana and North Dakota, reduce gas processing requirements, and provide market opportunities for NGLs that do not currently exist.

FERC authorizes Rockies Express for REX-East line

The US Federal Energy Regulatory Commission authorized Rockies Express Pipeline LLC to construct and operate its planned 1.8 bcfd REX-East interstate natural gas pipeline. REX-East will have a 42-in. OD and extend 639 miles from the eastern terminus of Rockies Express' REX-West pipeline in Audrain County, Mo., to an interconnection with the Dominion Transmission Inc., Dominion East Ohio, and Texas Eastern Transmission LP pipelines at the Clarington Hub in Monroe County, Ohio.

The REX-East project also will entail the construction of two compressor stations on Rockies Express' already existing facilities; one in Carbon County, Wyo., the other in Phelps County, Neb.

REX-East is the third leg of a project to bring Rockies gas to Midwestern and Eastern markets. REX-Entrega, which extends 327 miles from Colorado and Wyoming to the Cheyenne Hub in Weld County, Colo., at a capacity of as much as 1.1 bcfd, entered service Feb. 14, 2007. REX-West consists of 717 miles of pipeline between the Cheyenne Hub and Audrain County, Mo., with a capacity of as much as 1.5 bcfd, Its first 503 miles entered service in January at a rate of 1 bcfd (OGJ, May 12, 2008, p. 68), with the balance authorized for service on May 16.

FERC ordered work on REX-East to be completed in time for the pipeline to enter service within 18 months.

Independence Trail pipeline resumes operations

Enterprise Products Partners LP has completed repairs to the flex-joint assembly of the Independence Trail natural gas pipeline, the source of a leak that occurred Apr. 8, and had forced production to be halted since. Dive teams successfully replaced the flex-joints' o-ring gasket. Initial test results showed the flex-joint operating normally.

The flex-joint, in about 85 ft of water, allows the pipeline to withstand movements of the Independence Hub platform. Reduced volumes began moving through the line while final testing was under way, with the pipeline's 1 bcfd full capacity expected to be reached during the first half of June.

The gas trading community had been expecting a mid-May restart of the pipeline and production hub, consistent with the outside edge of Enterprise's own initial predictions that service would be restored in 1-4 weeks. However a mid-May announcement that repairs would take until mid-June prolonged the current gas price upsurge, which began in September 2007 (OGJ Online, May 14, 2008).

Independence Hub, stationed in Mississippi Canyon Block 920 in 8,000 ft of water, produces its 1 bcfd from 10 initial anchor fields. The 24-in. Independence Trail pipeline extends 134 miles on the seafloor from the hub to an interconnect with Tennessee Gas Pipeline at West Delta Block 68. ✦

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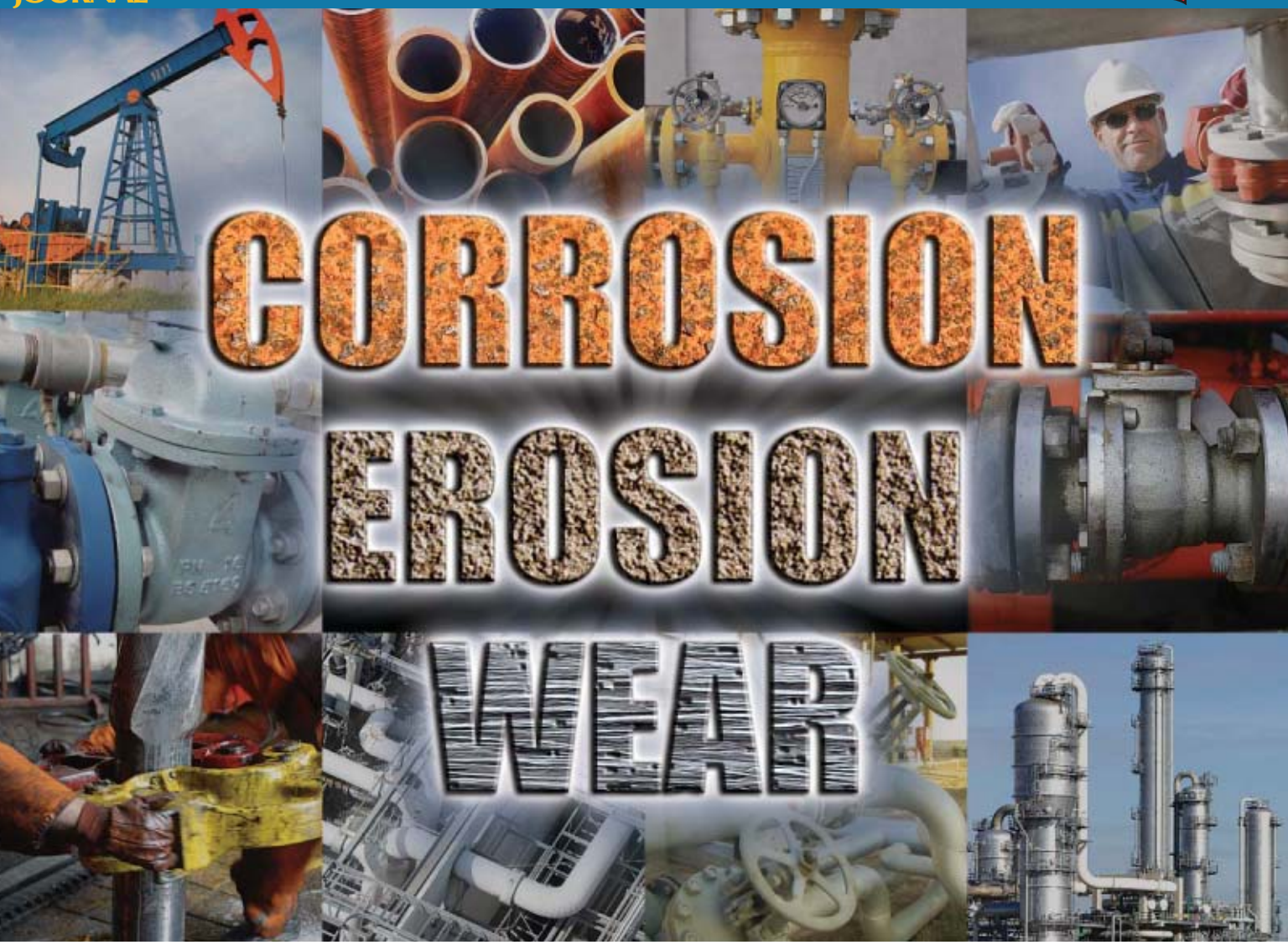

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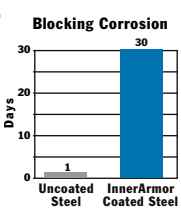
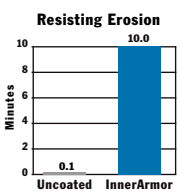


While uncoated steel only lasted a single day!

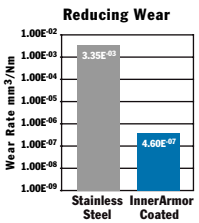
Standing up to erosion
In the ASTM-standard G76 abrasive air-jet test, again, InnerArmor was easily able to go the full ten minutes—with *zero* surface damage.



By comparison, on uncoated steel the surface erosion began after only a few seconds.

Minimizing wear, extending service life
InnerArmor coatings can be created from a wide range of materials, and also in layers, for unprecedented sliding-wear properties and exceptional wear resistance.

For example, the wear rate on InnerArmor-coated stainless steel (with a 25N load) is less than *half* that of uncoated stainless!



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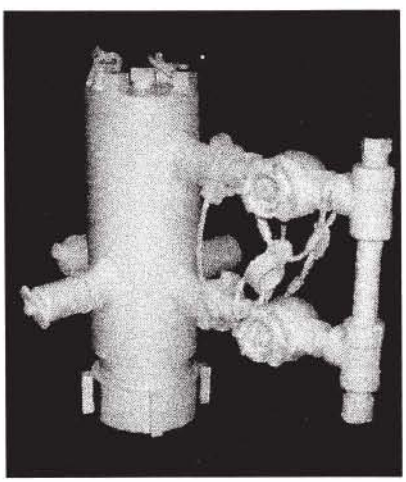

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✦ Denotes new listing or a change in previously published information.

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2008

JUNE

PIRA Scenario Planning Conference, London, (212) 686-6808, (212) 686-6628 (fax), e-mail: sales@pira.com, website: www.pira.com. 9.

Asian Geosciences Conference & Exhibition, Kuala Lumpur, +44 (0) 20 7862 2136. +44 (0) 20 7862 2119, e-mail: geoasia@oesallworld.com, website: www.geo-asia.com. 9-11.

Independent Liquid Terminals Association (ILTA) Annual Operating Conference & Trade Show, Houston, (202) 842-9200, (202) 326-8660 (fax), e-mail: info@ilta.org, website: www.ilta.org. 9-11.

SPE Tight Gas Completions Conference, San Antonio, (972) 952-9393, (972) 952-9435 (fax), e-mail: spedal@spe.org, website: www.spe.org. 9-11.

EAGE/SPE EUROPEC Conference & Exhibition, Rome, +31 30 6354055, +31 30 6343524 (fax), e-mail: eage@eage.org, website: www.eage.nl. 9-12.

ASME Turbo Expo, Berlin, (973) 882-1170, (973) 882-1717 (fax), e-mail: infocentral@asme.org, website: www.asme.org. 9-13.

PIRA London Energy Conference, London, (212) 686-6808, (212) 686-6628 (fax), e-mail: sales@pira.com, website: www.pira.com. 10.

Asian Oil, Gas & Petrochemical Engineering Exhibition, Kuala Lumpur, +44 (0)20 7840 2100, +44 (0)20 7840 2111 (fax), e-mail: oga@oesallworld.com, website: www.allworldexhibitions.com. 10-12.

Global Petroleum Show, Calgary, Alta., (403) 209-3555, (403) 245-8649 (fax), website: www.petroleumshow.com. 10-12.

IADC World Drilling Conference & Exhibition, Berlin, (713) 292-1945, (713) 292-1946 (fax); e-mail: conferences@iadc.org, website: www.iadc.org. 11-12.

PIRA Understanding Global Oil Markets Conference, London, (212) 686-6808, (212) 686-6628 (fax), e-mail: sales@pira.com, website: www.pira.com. 11-12.

Asia's Subsea Conference & Exhibition, Kuala Lumpur, +44 (0)20 7840 2100, +44 (0)20 7840 2111 (fax), e-mail: subsea@oesallworld.com, website: www.subseaasia.org. 11-13.

Russia and CIS Oil & Gas Investment and Finance Forum, London, +44 (0)20 7878 6888, website: www.C5-Online.com/OilGasFinance. 16-17.

CIPC/SPE GTS Joint Conference, Calgary, (972) 952-9393, (972) 952-9435 (fax), e-mail: spedal@spe.org, website: www.spe.org. 16-19.

American Association of Professional Landmen (AAPL) Annual Meeting, Chicago, (817) 847-7700, (817) 847-7704(fax), e-mail: aapl@landman.org, website: www.landman.org. 18-21.

LNG North America Summit, Houston, (416) 214-3400, (416) 214-3403 (fax), website: www.lngevent.com. 19-20.

IPAA Midyear Meeting, Colorado Springs, Colo., (202) 857-4722, (202) 857-4799 (fax), website: www.ipaa.org. 19-21.

PIRA Scenario Planning Conference, Houston, (212) 686-6808, (212) 686-6628 (fax), e-mail: sales@pira.com, website: www.pira.com. 23.

API Tanker Conference, San Diego, (202) 682-8000, (202) 682-8222 (fax), website: www.api.org/events. 23-24.

Purvin & Gertz Annual Asia LPG Seminar, Singapore, (713) 331-4000, (713) 236-8490 (fax), e-mail: glrodriguez@purvingertz.com, website: www.purvingertz.com. 23-26.

API Exploration & Production Standards on Oilfield Equipment & Materials Conference, Calgary, Alta., (202) 682-8000, (202) 682-8222 (fax), website: www.api.org/events. 23-27.

PIRA Understanding Global Oil Markets Conference, Houston, (212) 686-6808, (212) 686-6628 (fax), e-mail: sales@pira.com, website: www.pira.com. 24-25.

Russian Petroleum & Gas Congress, Moscow, +44 207 596 5016, e-mail: oilgas@ite-exhibitions.com, website: www.ite-exhibitions.com/og. 24-26.

NEFTEGAZ Exhibition, Moscow, +44 207 596 5016, e-mail: oilgas@ite-exhibitions.com, website: www.ite-exhibitions.com/og. 24-26.

PIRA's Globalization of Gas Study Conference, Houston, (212) 686-6808, (212) 686-6628 (fax), e-mail: sales@pira.com, website: www.pira.com. 25.

PIRA Understanding Natural Gas Markets Conference, Houston, (212) 686-6808, (212) 686-6628 (fax), e-mail: sales@pira.com, website: www.pira.com. 26-27.

Russian Oil and Gas Exports International Forum, Amsterdam, +44 (0)20 7878 6888, website: www.C5-Online.com/OilGasExport. 26-27.

World Petroleum Congress, Madrid, +34 91 745 3008, +34 91 563 8496 (fax), e-mail: info@19wpc.com, website: www.19wpc.com. June 29- July 3.

JULY

International Offshore & Polar Engineering Conference, Vancouver, (650) 254 2038, (650) 254 1871 (fax), e-mail: meetings@isope.org, website: www.isope.org. 6-11.

Annual Rocky Mountain Natural Gas Strategy Conference & Investment Forum, Denver, (303) 861-0362, (303) 861-0373 (fax), e-mail: conference@coga.org, website: www.coga.org. 9-11.

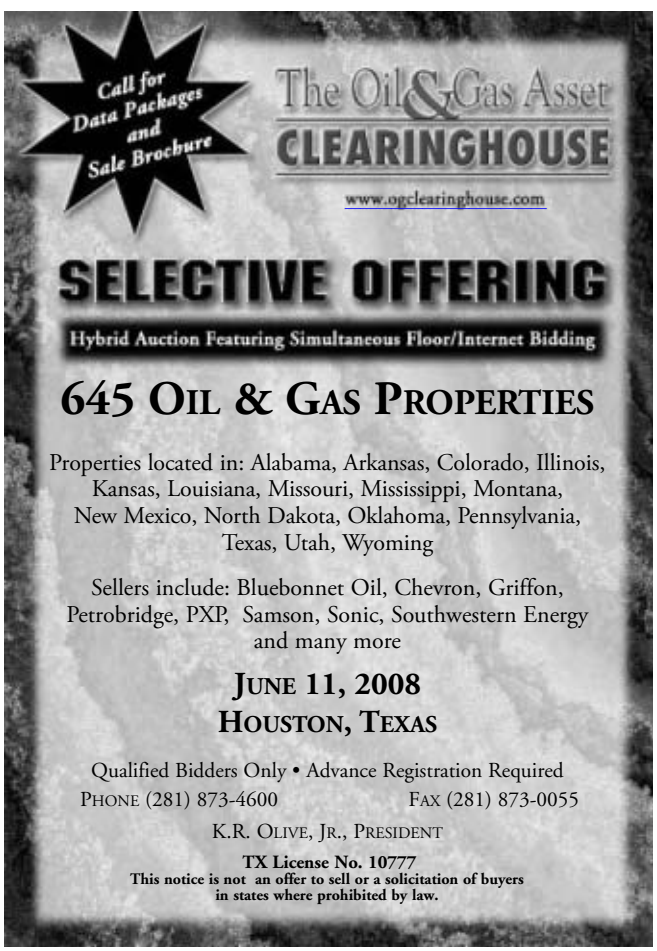
AAPG/SPE/SEG Hedberg Conference, Casper, Wyo. (918) 560-2630, (918) 560-2678 (fax), e-mail: debbi@aapg.org, website: www.aapg.org. 14-18.

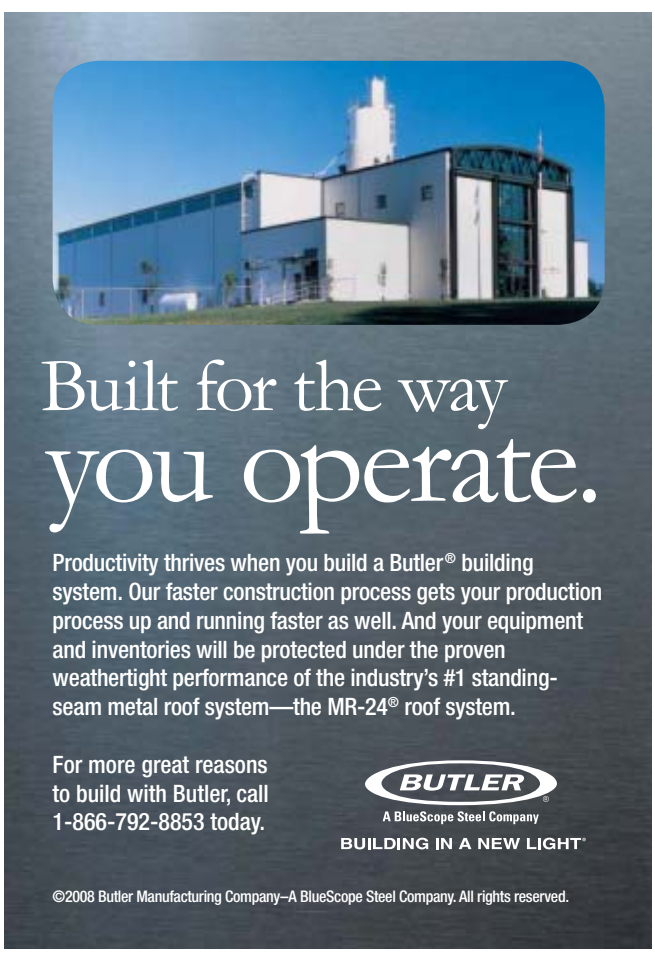
IADC Lifting & Mechanical Handling Conference & Exhibition, Houston, (713) 292-1945, (713) 292-1946 (fax); e-mail: conferences@iadc.org, website: www.iadc.org. 15-16.

Oil Sands and Heavy Oil Technology Conference & Exhibition, Calgary, Alta., (918) 831-9160, (918) 831-9161 (fax), e-mail: registration@pennwell.com, website: www.oilsandstechnologies.com. 15-17.

AUGUST

SPE Nigeria Annul International Conference & Exhibition, Abuja, (972) 952-9393, (972) 952-9435 (fax), e-mail: spedal@spe.org, website: www.spe.org. 4-6.





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Calendar

ACS National Meeting & Exposition, Philadelphia, 1 (800) 227-5558, e-mail: natlmtgs@acs.org, website: www.acs.org. 17-21.

IADC/SPE Asia Pacific Drilling Technology Conference, Jakarta, (713) 292-1945, (713) 292-1946 (fax); e-mail: conferences@iadc.org, website: www.iadc.org. 25-28.

✦Deep Water India Summit, New Delhi, +31 (0)26 3653 444, +31 (0)26 3653 446 (fax), e-mail: workshops@energywise.nl, website: www.energywise.nl. 26-27.

Offshore Northern Seas Exhibition & Conference, Stavanger, +47 51 59 81 00, +47 51 55 10 15 (fax), e-mail: info@ons.no, website: www.ons.no. 26-29.

Summer NAPE Expo, Houston, (817) 306-7171, (817) 847-7703 (fax), e-mail: info@napeexpo.com, website: www.napeonline.com. 27-28.

SEPTEMBER

Annual India Oil & Gas Review Symposium & International Exhibition, Mumbai, (0091-22) 40504900, ext. 225, (0091-22) 26367676 (fax), e-mail: oilasia@vsnl.com, website: www.oilasia.com. 1-2.

China Power, Oil & Gas Conference & Exhibition, Guangzhou, (918) 831-9160, (918) 831-9161 (fax), e-mail: registration@pennwell.com, website: www.chinasenergyfuture.com. 2-4.

ECMOR XI-European Mathematics of Oil Recovery Conference, Bergen, (972) 952-9393, (972) 952-9435 (fax), e-mail: spedal@spe.org, website: www.spe.org. 8-11.

IADC Drilling HSE Europe Conference & Exhibition, Amsterdam, (713) 292-1945, (713) 292-1946 (fax); e-mail: conferences@iadc.org, website: www.iadc.org. 9-10.

Rocky Mountain GPA Annual Meeting, Denver, (918) 493-3872, (918) 493-3875 (fax), email: pmirkin@gasprocessors.com, website: www.gasprocessors.com. 10.

API Fall Refining & Equipment Standards Meeting, Los Angeles, (202) 682-8000, (202) 682-8222 (fax), website: www.api.org/events. 15-17.

Rio Oil & Gas Conference & Expo, Rio de Janeiro, 55 21 2112 9078, 55 21 2220 1596 (fax), e-mail: riooil2008@ibp.org.br, website: www.riooilegas.com.br. 15-18.

API/NPRA Fall Operating Practices Symposium, Los Angeles, (202) 682-8000, (202) 682-8222 (fax), website: www.api.org/events. 16.

GEO India South Asia's Geosciences Conference & Exhibition, New Delhi, +44 (0)20 7840 2100, +44 (0)20 7840 2111 (fax), e-mail: geo@oesallworld.com, website: www.geo-india.com. 17-19.

SPE Annual Technical Conference & Exhibition, Denver, (972) 952-9393, (972) 952-9435 (fax), e-mail: spedal@spe.org, website: www.spe.org. 21-24.

ERTC Petrochemical Conference, Cannes, +44 1737 365100, +44 1737 365101 (fax), e-mail: events@gtforum.com, website: www.gtforum.com. Sept. 29- Oct. 1.

International Pipeline Exposition, Calgary, Alta., 403) 209-3555, (403) 245-8649 (fax), website: www.petroleumshow.com. Sept. 30-Oct. 2.

Unconventional Gas International Conference & Exhibition, Ft. Worth, Tex., (918) 831-9160, (918) 831-9161 (fax), e-mail: registration@pennwell.com, website: www.unconventionalgas.net. Sept. 30-Oct. 2.

OCTOBER

NPRA Q&A Forum, Orlando, Fla., (202) 457-0480, (202) 457-0486 (fax), e-mail: info@npra.org, website: www.npra.org. 5-8.

GPA Houston Annual Meeting, Kingwood, Tex., (918) 493-3872, (918) 493-3875 (fax), e-mail: pmirkin@gasprocessors.com, website: www.gasprocessor.com. 7.

KIOGE Kazakhstan International Oil & Gas Exhibition & Conference, Almaty, + (44) 020 7596 5000, + (44) 020 7596 5111 (fax), e-mail: oilgas@ite-exhibitions.com, website: www.ite-exhibitions.com/og. 7-10.

IADC Drilling West Africa Conference & Exhibition, Lisbon, (713) 292-1945, (713) 292-1946 (fax); e-mail: conferences@iadc.org, website: www.iadc.org. 8-9.

International Gas Union Research Conference, Paris, +31 50 521 30 78, +31 50 521 19 46 (fax), e-mail: igrc2008@gasunie.nl, website: www.igrc2008.com. 8-10.

ERTC Lubes and Additives Conference, Berlin, +44 1737 365100, +44 1737 365101 (fax), e-mail: events@gtforum.com, website: www.gtforum.com. 13-15.

Middle East Plant Maintenance Conference, Abu Dhabi, +44 207 067 1800, +44 207 430 0552 (fax), e-mail: d.michalski@theenergyexchange.co.uk, website: www.theenergyexchange.co.uk. 13-15.

API Fall Petroleum Measurement Standards Meeting, Long Beach, (202) 682-8000, (202) 682-8222 (fax), website: www.api.org/events. 13-17.

Central and Eastern European Refining & Petrochemicals Roundtable, Warsaw, +44 207 067 1800, +44 207 430 0552 (fax), e-mail: c.taylor@theenergyexchange.co.uk, website: www.theenergyexchange.co.uk. 14-16.

ISA EXPO, Houston, (919) 549-8411, (919) 549-8288 (fax) website: www.isa.org. 14-16.

Oil & Gas Transportation in the CIS & Caspian Region Conference, Moscow, +44 (0) 207 067 1800, +44 207 430 0552 (fax), e-mail: j.golodnikova@theenergyexchange.co.uk, website: www.theenergyexchange.co.uk/cispipes10register.html. 14-16.

PIRA New York Annual Conference, New York, (212) 686-6808, (212) 686-6628 (fax), e-mail: sales@pira.com, website: www.pira.com. 16-17.

Petchem Arabia Conference, Abu Dhabi, +44 207 067 1800, +44 207 430 0552 (fax), e-mail: c.verma@theenergyexchange.co.uk, website: www.theenergyexchange.co.uk. 20-22.

SPE Asia Pacific Oil & Gas Conference & Exhibition, Perth, (972) 952-9393, (972) 952-9435 (fax), e-mail: spedal@spe.org, website: www.spe.org. 20-22.

SPE International Thermal Operations & Heavy Oil Symposium, Calgary, Alta., (972) 952-9393, (972) 952-9435 (fax), e-mail: spedal@spe.org, website: www.spe.org. 20-23.

Permian Basin International Oil Show, Odessa, Tex., (432) 367-1112, (432) 367-1113 (fax), e-mail: pbioilshow@pbioilshow.org, website: www.pbioilshow.org. 21-23.

AAPG International Conference & Exhibition, Cape Town, (918) 560-2679, (918) 560-2684 (fax), e-mail: convene@aapg.org, website: www.aapg.org. 26-29.

Biofuels Conference, Berlin, +44 207 067 1800, +44 207 430 0552 (fax), e-mail: c.taylor@theenergyexchange.co.uk, website: www.theenergyexchange.co.uk. 28-30.

SPE Russian Oil & Gas Technical Conference & Exhibition, Moscow, (972) 952-9393, (972) 952-9435 (fax), e-mail: spedal@spe.org, website: www.spe.org. 28-30.

Arab Oil & Gas Show, Dubai, +971 4 3355001, +971 4 3355141 (fax), e-mail: info@icedxb.com, website: www.ogsonline.com. 28-30.

IADC Contracts & Risk Management Conference, Houston, (713) 292-1945, (713) 292-1946 (fax); e-mail: conferences@iadc.org, website: www.iadc.org. 29-30.

NOVEMBER

ASME International Mechanical Congress & Exposition, Boston, (973) 882-1170, (973) 882-1717 (fax), e-mail: infocentral@asme.org, website: www.asme.org. 2-6.

Abu Dhabi International Petroleum Exhibition & Conference (ADIPEC), Abu Dhabi, website: www.adipec.com. 3-6.

Deepwater Operations Conference & Exhibition, Galveston, Tex., (918) 831-9160, (918) 831-9161 (fax), e-mail: registration@pennwell.com, website: www.deepwateroperations.com. 4-6.

North African Oil and Gas Summit, Vienna, +44 (0) 207 067 1800, +44 207 430 0552 (fax), e-mail: c.brown@theenergyexchange.co.uk, website: www.theenergyexchange.co.uk/nas3register.html. 4-6.

Mangystau International Oil & Gas Exhibition, Aktau, + (44) 020 7596 5000, + (44) 020 7596 5111 (fax), e-mail: oilgas@ite-exhibitions.com, website: www.ite-exhibitions.com/og. 5-7.

GPA North Texas Annual Meeting, Dallas, (918) 493-3872, (918) 493-3875 (fax), email: pmirkin@gasprocessors.com, website: www.gasprocessors.com. 6.

IADC Annual Meeting, Paradise Valley, Ariz., (713) 292-1945, (713) 292-1946 (fax); e-mail: conferences@iadc.org, website: www.iadc.org. 6-7.

SEG International Exposition and Annual Meeting, Las Vegas, (918) 497-5542, (918) 497-5558 (fax), e-mail: register@seg.org, website: www.seg.org. 9-14.

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THE RIGHT ANSWERS START WITH THE RIGHT QUESTIONS

IT'S A STATEMENT OF THE OBVIOUS, BUT IN OUR EXPERIENCE, IT'S ONE THAT OFTEN GETS OVERLOOKED – PARTICULARLY WHEN THE QUESTIONS BEING TACKLED MAY BE HIGHLY COMPLEX. OUR GETTING TO THE HEART OF SOMETHING COMES FROM BEING ABLE TO PUT TOGETHER AN INTEGRATED TEAM FROM DIFFERENT BACKGROUNDS – ONE THAT SPECIALISES IN ASKING THE RIGHT QUESTIONS. THIS PRETTY MUCH SUMS UP HOW WE WORK, BOTH AMONG OURSELVES AND WITH OUR CLIENTS.

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Calendar

IPAA Annual Meeting, Houston, (202) 857-4722, (202) 857-4799 (fax), website: www.ipaa.org. 10-12.

Houston Energy Financial Forum, Houston, (918) 831-9160, (918) 831-9161 (fax), e-mail: registration@pennwell.com, website: www.accessanalyst.net. 11-13.

American Institute of Chemical Engineers (AIChE) Annual Meeting, Philadelphia, (212) 591-8100, (212) 591-8888 (fax), website: www.aiche.org. 16-21.

ERTC Annual Meeting, Vienna, +44 1737 365100, +44 1737 365101 (fax), e-mail: events@gtforum.com, website: www.gtforum.com. 17-19.

IADC Well Control Middle East Conference & Exhibition, Muscat, (713) 292-1945, (713) 292-1946 (fax); e-mail: conferences@iadc.org, website: www.iadc.org. 24-25.

Annual European Autumn Gas Conference (EAGC), Cernobbio, Italy, +44 (0) 1737 855281, +44 (0) 1737 855482 (fax), e-mail: vanessahurrell@dmgworldmedia.com, website: www.theeagc.com. 25-26.

DECEMBER

IADC Well Control Middle East Conference & Exhibition, Muscat, (713) 292-1945, (713) 292-1946 (fax), e-mail: conferences@iadc.org, website: www.iadc.org. 2-3.

Annual Refining & Petrochemicals in Russia and the CIS Countries Roundtable, Prague, +44 207 067 1800, +44 207 430 0552 (fax), e-mail: e.polovinkina@theenergyexchange.co.uk, website: www.theenergyexchange.co.uk. 2-4.

Downstream Asia Refining & Petrochemicals Conference, Singapore, +44 (0) 207 067 1800, +44 207 430 0552 (fax), e-mail: a.ward@theenergyexchange.co.uk, website: www.wraconferences.com/FS1/dalregister.html. 3-4.

IADC Drilling Gulf of Mexico Conference & Exhibition, Galveston, Tex., (713) 292-1945, (713) 292-1946 (fax); e-mail: conferences@iadc.org, website: www.iadc.org. 3-4.

Deep Offshore Technology International Conference & Exhibition, Perth, (918) 831-9160, (918) 831-9161 (fax), e-mail: registration@pennwell.com, website: www.deepoffshoretechnology.com. 3-5.

International Petroleum Technology Conference (IPTC), Kuala Lumpur, +971 (0)4 390 3540, +971 (0)4 366 4648 (fax), e-mail: iptc@iptcnet.org, website: www.iptcnet.org. 3-5.

PIRA Natural Gas Markets Conference, New York, (212) 686-6808, (212) 686-6628 (fax), e-mail: sales@pira.com, website: www.pira.com. 8-9.

PIRA Understanding Global Oil Markets Conference, New York, (212) 686-6808, (212) 686-6628 (fax), e-mail: sales@pira.com, website: www.pira.com. 10-11.

Seatrade Middle East Maritime Conference & Exhibition, Dubai, +44 1206 545121, +44 1206 545190 (fax), e-mail: events@seatrade-global.com, website: www.seatrade-middleeast.com. 14-16.

AAPG Annual Convention & Exhibition, San Antonio, 1 (888) 945 2274, ext. 617, (918) 560-2684 (fax), e-mail: convene@aapg.org, website: www.aapg.org/sanantonio. 20-23.

XSPE Improved Oil Recovery Symposium, Tulsa, (972) 952-9393, (972) 952-9435 (fax), e-mail: spedal@spe.org, website: www.spe.org. 20-23.

XSPE Progressing Cavity Pumps Conference, Houston, (972) 952-9393, (972) 952-9435 (fax), e-mail: spedal@spe.org, website: www.spe.org. 27-29.

2009

JANUARY

Oil & Gas Maintenance Technology Conference & Exhibition, Manama, (918) 831-9160, (918) 831-9161 (fax), e-mail: registration@pennwell.com, website: www.oilandgasmaintenance.com. 19-21.

Pipeline Rehabilitation & Maintenance Conference & Exhibition, Manama, (918) 831-9160, (918) 831-9161 (fax), e-mail: registration@pennwell.com, website: www.piipeline-rehab.com. 19-21.

SPE Hydraulic Fracturing Technology Conference, The Woodlands, Tex., (972) 952-9393, (972) 952-9435 (fax), e-mail: spedal@spe.org, website: www.spe.org. 19-21.

FEBRUARY

SPE Reservoir Simulation Symposium, The Woodlands, Tex., (972) 952-9393, (972) 952-9435 (fax), e-mail: spedal@spe.org, website; www.spe.org. 2-4.

IADC Health, Safety, Environment & Training Conference & Exhibition, Houston, (713) 292-1945, (713) 292-1946 (fax), e-mail: conferences@iadc.org, website: www.iadc.org. 3-4.

Deep Offshore Technology International Conference & Exhibition (DOT), New Orleans, (918) 831-9160, (918) 831-9161 (fax), e-mail: registration@pennwell.com, website: www.dotinternational.net. 3-5.

IADC/SPE Managed Pressure Drilling & Underbalanced Operations Conference & Exhibition, San Antonio, (713) 292-1945, (713) 292-1946 (fax), e-mail: conferences@iadc.org, website: www.iadc.org. 12-13.

ASEG International Conference & Exhibition, Adelaide, +61 8 8352 7099, +61 8 8352 7088 (fax), e-mail: ASEG2009@sapro.com.au. 22-26.

MARCH

GPA Annual Convention, San Antonio, (918) 493-3872, (918) 493-3875 (fax), e-mail: pmirkin@gasprocessors.com, website: www.gasprocessors.com. 8-11.

Middle East Oil & Gas Show & Conference (MEOS), Manama, +973 17 550033, +973 17 553288 (fax), e-mail: aeminfo@batelco.com.bh, website: www.allworldexhibitions.com/oil. 15-18.

SPE/IADC Drilling Conference & Exhibition, Amsterdam, (972) 952-9393, (972) 952-9435 (fax), e-mail: spedal@spe.org, website; www.spe.org. 17-19.

SPE Americas E&P Environmental and Safety Conference, San Antonio, (972) 952-9393, (972) 952-9435 (fax), e-mail: spedal@spe.org, website; www.spe.org. 23-25.

Asian Biofuels Roundtable, Kuala Lumpur, +44 (0) 207 067 1800, +44 207 430 0552 (fax), e-mail: a.ward@theenergyexchange.co.uk, website: www.wraconferences.com/FS1/AB1register.html. 24-25.

SPE Western Regional Meeting, San Jose, (972) 952-9393, (972) 952-9435 (fax), e-mail: spedal@spe.org, website; www.spe.org. 24-26.

APRIL

IADC Drilling HSE Middle East Conference & Exhibition, Abu Dhabi, (713) 292-1945, (713) 292-1946 (fax), e-mail: conferences@iadc.org, website: www.iadc.org. 21-22.

MAY

ACHEMA International Exhibition Congress, Frankfurt, +1 5 168690220, +1 5 168690325 (fax), e-mail: amorris77@optonline.net, website: http://achemaworldwide.dechema.de. 11-15.

IADC Environmental Conference & Exhibition, Stavanger, (713) 292-1945, (713) 292-1946 (fax), e-mail: conferences@iadc.org, website: www.iadc.org. 12-13.

IADC Drilling Onshore Conference & Exhibition, Houston, (713) 292-1945, (713) 292-1946 (fax), e-mail: conferences@iadc.org, website: www.iadc.org. 21.

Gastech International Conference & Exhibition, Abu Dhabi, +44 (0) 1737 855000, +44 (0) 1737 855482 (fax), website: www.gastech.co.uk. 25-28.

JUNE

AAPG Annual Meeting, Denver, (918) 560-2679, (918) 560-2684 (fax), e-mail: convene@aapg.org, website: www.aapg.org. 7-10.

Oil and Gas Asia Exhibition (OGA), Kuala Lumpur, +60 (0) 3 4041 0311, +60 (0) 3 4043 7241 (fax), e-mail: oga@oesallworld.com, website: www.allworldexhibitions.com/oil. 10-12.

IADC World Drilling Conference & Exhibition, Dublin, (713) 292-1945, (713) 292-1946 (fax), e-mail: conferences@iadc.org, website: www.iadc.org. 17-18.

AUGUST

IADC Well Control Conference of the Americas & Exhibition, Denver, (713) 292-1945, (713) 292-1946 (fax), e-mail: conferences@iadc.org, website: www.iadc.org. 25-26.

SEPTEMBER

IADC Drilling HSE Europe Conference & Exhibition, Amsterdam, (713) 292-1945, (713) 292-1946 (fax), e-mail: conferences@iadc.org, website: www.iadc.org. 23-24.

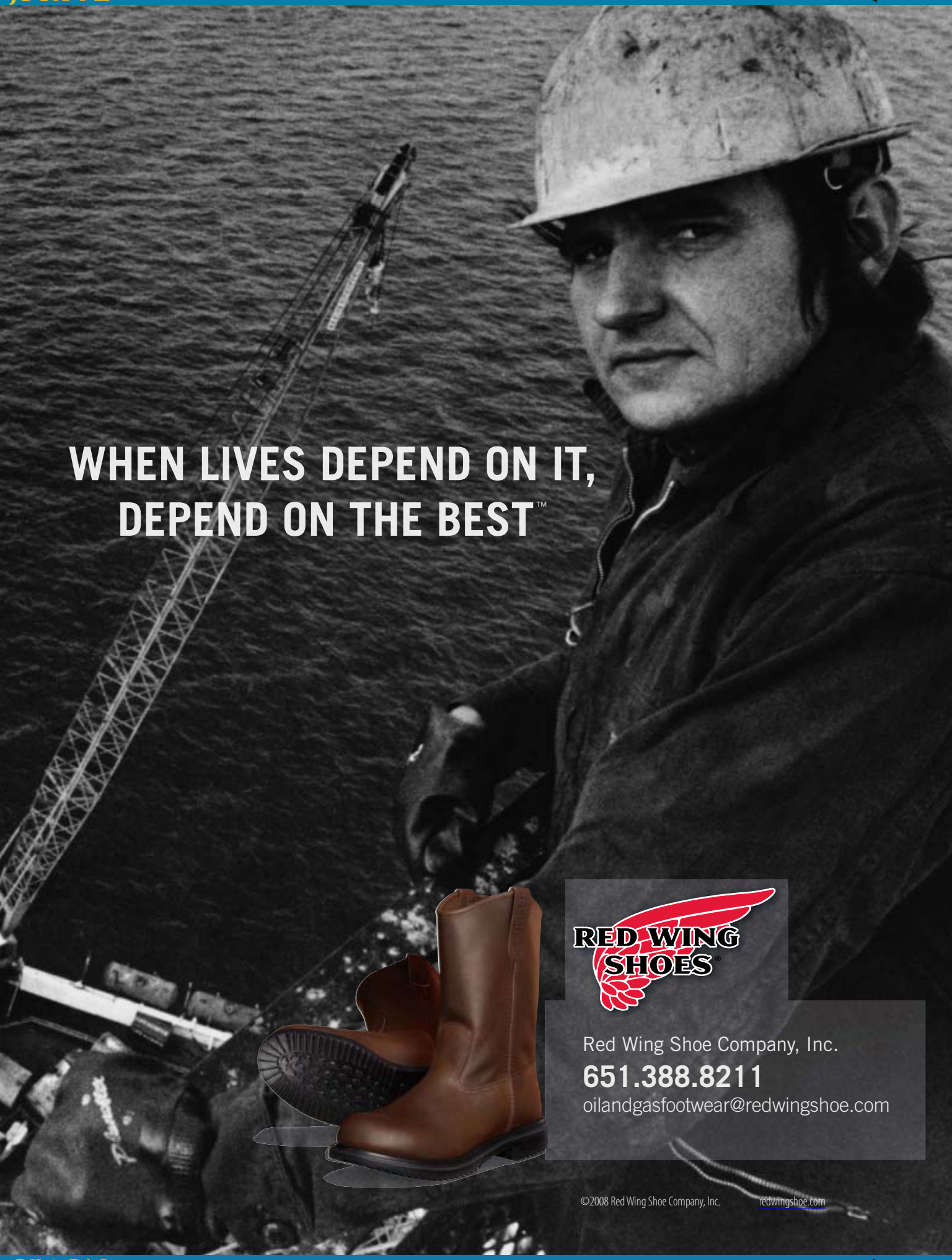
OCTOBER

International Oil & Gas Exploration, Production & Refining Exhibition, Jakarta, +44 (0)20 7840 2100, +44 (0)20 7840 2111 (fax), e-mail: ogti@oesallworld.com, website: www.allworldexhibitions.com. 14-17.

NOVEMBER

IADC Annual Meeting, Miami, (713) 292-1945, (713) 292-1946 (fax), e-mail: conferences@iadc.org, website: www.iadc.org. 9-10.

IADC Well Control Asia Pacific Conference & Exhibition, Bangkok, (713) 292-1945, (713) 292-1946 (fax), e-mail: conferences@iadc.org, website: www.iadc.org. 18-19.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Testing production technology

Guntis Moritis
Production Editor

Developing oil and gas fields often involves testing technology over years to ensure that it will function as expected when installed in a field. Lengthy tests are expensive and may delay start of production, but the cost of failures may far exceed the cost of testing. Failures in deep water are particularly expensive, but operations on land also may require extensive pilot tests to ensure that the technology is optimized for the resource.

A recent media tour of the Shell International E&P Inc. Gasmer prototype facility described tests on technologies for producing in two very different environments.

The facility currently has tests with in situ electric heaters for producing unconventional heavy oil and other tests with a subsea caisson electric submersible pump (ESP) for producing from ultradeep waters of the Gulf of Mexico and off Brazil.

Gasmer facility

Shell purchased the Gasmer site in 1960 and developed it initially to test riser tensioners for semisubmersibles. Over the years, various Shell companies have used the facility.

The facility is on a 30-acre site in southwest Houston. About 120 people are employed at the location.

The site is in a part of Houston that has seen better times. But redevelopment on three sides of the site is taking place in the form of a storm-water detention basin for Brays Bayou.

Shell notes that it has actively contributed to the Willow Waterhole Stormwater Detention Basin Project, which will add about 280 acres of green space to this part of Houston.

Electric heaters

During the tour, Shell kept the electric heater tests out of view but noted that the testing involved evaluation of different heaters for in situ upgrading of bitumen found on its leases near Peace River, Alta. Since 2004, Shell has had an ongoing pilot at Peace River with electric heaters placed in tightly spaced horizontal wells.

The heaters raise the temperature of the bitumen to lighten the produced fluid gravity to the mid-30° or lighter range from its initial 8-10° range. From the pilot, Shell has produced about 150,000 bbl of the upgraded fluid, leaving the heavier bitumen constituents in the ground.

Shell has plans to start another in situ upgrading pilot with electric heaters in its Grosmont carbonate leases, on the far-west side of the Athabasca oil sands region, which it acquired in 2006. The company expects to begin construction in 2009.

Also since 2000, Shell has conducted an in situ electric heater test for recovering liquids and gas from the Mahogany oil shales in Rio Blanco County, Colo.

Caisson ESP

The Gasmer facility has a full-scale installation for testing the subsea caisson ESP technology planned for the Perdido project in the Gulf of Mexico and the BC-10 project off Brazil (OGJ, May 5, 2008, pp. 53-64). Because of the water depths (7,500 ft at Perdido and 5,000-6,500 ft at BC-10) and the low reservoir pressures involved, both projects require pressure-boosting liquids at the seabed.

The boosting technology involves installing a ±330 ft, 42-in. diameter caisson in the seabed that contains an 8-10 in., 1,500-hp ESP. The multiphase produced fluid flows into the caisson's top, where the associated gas separates out and flows up, while the liquid flows down and receives pressure boosting from the ESP.

Risers that allow direct vertical access connect the caissons to the Perdido regional host spar. At BC-10, the caissons connect to a floating, production, offloading (FPSO) vessel with flowlines and risers. Perdido will have five caissons for producing the three fields in the projects, while BC10 will have seven caissons for boosting production from the initial three fields. Expected production through each ESP is 25,000-30,000 b/d.

Shell began assessing the type of technology needed for the projects in 2003. During 2005, it did component testing and built the Gasmer test installation during 2006. In January 2007, it began the full-scale tests, and in 2008 it will start field implementation, although the company will continue running addition tests at Gasmer.

The full-scale test facility at Gasmer cost about $30 million, which includes about $14 million for the construction and $7 million for the testing. ✦

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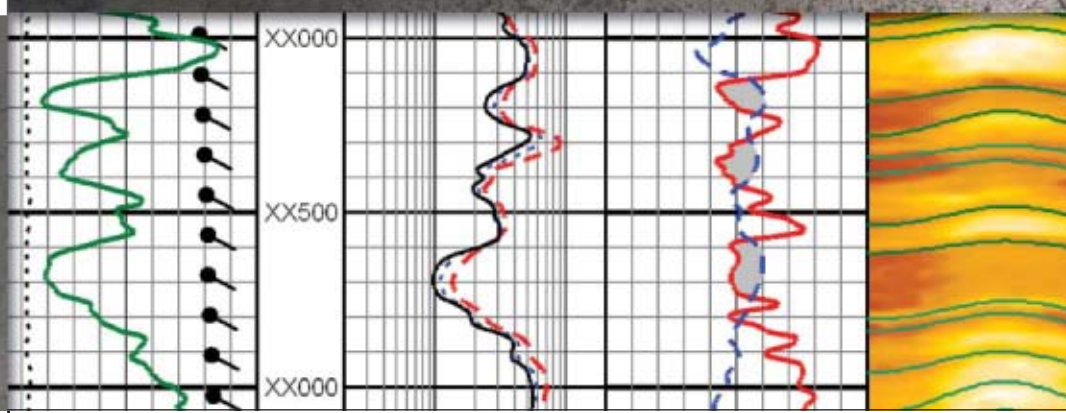

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Editorial

Attention to cost

As lawmakers debated whether to raise US energy prices last week, a new government report reminded Americans how much governmental misjudgment costs. The Senate began deliberation of the Climate Security Act, a complex bill that would cap emissions of greenhouse gases and foster trading of emission allowances. That the measure should come up while energy prices are setting records and the economy is tottering testifies to the political influence of fear about global warming. That serious people think the US might implement an aggressive cap-and-trade scheme without hurting energy consumers testifies to the power of alarmist propaganda.

In April, the US Energy Information Administration estimated costs of the legislation: motor gasoline prices higher than a reference-case forecast by 22-49¢/gal in 2020 and by 41¢-$1.01/gal in 2030; average annual, nontransport energy bills up $30-325/household in 2020 and $76-723/household in 2030. EIA estimated the measure would lower US gross domestic product during 2009-30 by $444 billion-1.308 trillion (0.2%-0.6%).

Who pays?

Most Americans probably don't want their government to raise energy costs and limit economic growth. But many Americans apparently think—erroneously—that "cap-and-trade" means someone else pays. While external factors certainly are at work, much of the extraordinary elevation in prices of oil products relates to costs of past such action—and inaction—by the federal government.

Large in the category of inaction is leasing of a small part of the Arctic National Wildlife Refuge in Alaska. Thought to contain the largest untested onshore structures in the US, the ANWR coastal plain encompasses a resource estimated by the US Geological Service at 5.7-16 billion bbl of technically recoverable oil, with a mean value of 10.4 billion bbl.

ANWR is an old story and, in view of recent stresses, a sad one. The coastal plain resource can't be assessed until it's drilled, and it can't be drilled until it's leased, which requires approval by Congress, which isn't considering it. Along with moratoriums on the leasing of 85% of federally owned offshore, ANWR embodies consistent US refusal to act against environmental opposition on behalf of energy supply.

Last month, responding to a request by Sen. Ted Stevens (R-Alas.), EIA produced a report showing what the US may be missing. The report surmises ANWR production on the basis of each USGS resource estimate, assuming coastal-plain leasing is approved this year and production starts 10 years hence.

Under the USGS mean estimate, EIA projects that ANWR production would peak in 2027 at 780,000 b/d. Cumulative production during 2018-30 would be 2.6 billion bbl. The boost to domestic supply, EIA estimates, would cut the cumulative US expenditure on foreign oil during the period by $202 billion (2006 dollars). The extra supply would lower the price of light, sweet crude from reference-case projections by a maximum 75¢/bbl in 2025.

Benefits like these might now be in full force if Congress had approved ANWR leasing 20 years ago. It was then, in fact, as close as it had been in years to doing so. But the Exxon Valdez oil spill in March 1989 spoiled the politics. A shipping accident thus thwarted leasing and whatever oil and gas supply might have resulted.

Governmental habit

Opponents to ANWR leasing will say EIA's projections are too small to warrant risks to the bleak coastal plain. They're the same politicians and interest groups who make similar claims while opposing leasing off the East and West Coasts. They're the politicians and groups arguing in Washington, DC, last week that the US must implement sacrificial warming precautions that might not affect global average temperature at all. Their cumulative triumph is a governmental habit of erring on the side of environmental caution and ignoring costs—including those of forgone supply—in decisions ranging from fuel chemistry to federal permitting.

Decisions made this way add costs in steps that, viewed in isolation, can seem minor. Yet the accumulated effects constitute a large and overlooked part of the economic load now crushing fuel consumers. Congress needs to change its decision-making habits. Environmental protection shouldn't mean economic strangulation. ✦

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Algeria's natural gas reserves represent nearly 3% of total world reserves. As a pioneer in the LNG industry, Sonatrach has since its inception successfully cleared all major hurdles to develop its gas fields and maintain its leader position in the LNG production and marketing.

The world's first natural gas liquefaction facility, the GL4Z (formerly, the Camel), was built in 1964 in the region of Arzew. Today, Sonatrach has 4 LNG facilities.

Its 7,459 km-long gas pipeline network includes two transcontinental gas pipelines:
- Pedro Duran Farell (Algeria-Spain via Morocco).
- Enrico Mattei (Algeria-Italy via Tunisia).

This network will expand to deliver gas to Europe after the completion of major gas pipeline projects such as Medgaz (to Spain), Galsi (to Italy via Sardinia) and the Trans Sahara Gas Pipeline (TSGP, which will link Nigeria to Europe via Niger and Algeria).

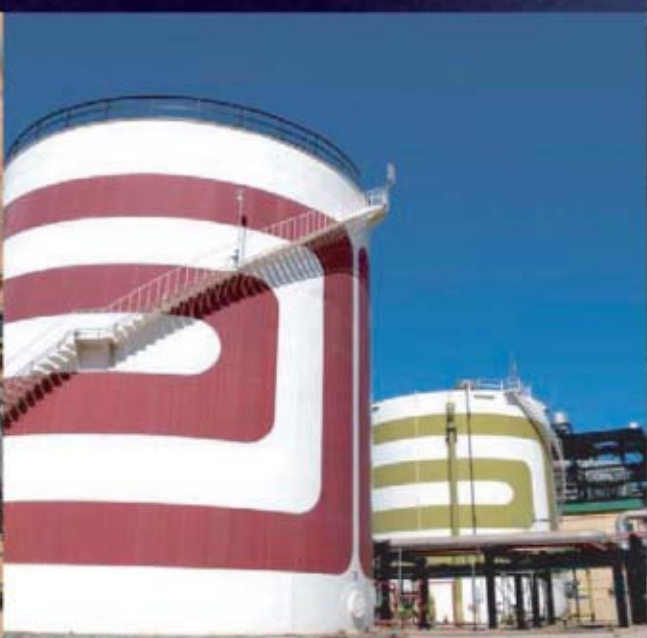
The group's gas transportation system includes a fleet of 9 methane carriers. In 2007, Sonatrach took delivery of a methane carrier Medmax I (Mediterranean Maximum Size), named "Cheikh El Mokrani", with a capacity of 75,500 cm. The group will receive its second carrier, Medmax II, "Cheikh Boumama", in 2008. These acquisitions will help the group to supply distant/ remote markets such as America and Asia with gas. In addition, they will give Sonatrach the proprietary resources required to transport hydrocarbons, 35% of its exports by 2010 and 50% by 2015.

SONATRACH, A MAJOR NATURAL GAS OPERATOR

RESOURCES

✱ The Algerian mining industry is particularly rich in natural gas deposits.
Nearly, 66% of the 80 billion cm of gas currently sold by Algeria comes fromthe gigantic Hassi R'Mel gas field.
Several fields are currently mined with proprietary resources or in association, such as In Salah, Tin Fouyé Tabankort, In Aménas, Gassi Touil, Rhourde Nouss, Hamra and Alrar.

In Aménas, Gassi Touil.



INTERNATIONAL

✱ Algerian gas fields provide a long-term, reliable supply source of gas with an export capacity of nearly 38 billion cm by gas pipeline and nearly 27 billion cm in liquefied form (LNG).

ENVIRONMENT

✱ In order to participate in the global effort to protect the ozone layer and use natural resources sparingly, Sonatrach has been actively phasing out flaring on all its sites.
Even though production volume has increased fourfold in the last 30 years, the ratio of flared associate gas over produced gas has tumbled from 80% in 1970 to 7% in 2005.
We expect to totally phase out flaring by 2010. In addition, the association Sonatrach, BP and Statoil has initiated a procedure of CO_2 re-injection into the In Saleh gas field.
This is the largest of the only two such projects in the world.

Futures trading: What is excessive?

Ronald D. Ripple
Macquarie University
Sydney

COMMENT

Recently there has been much in the press and in Congress regarding the deleterious effects of excessive energy futures trading.[1] In relation to these claims speculators are blamed for increasing energy prices and price volatility. This is not the first time such arguments have been presented. However, these claims appear to be based on an unfortunate view of the size of energy futures trading activity relative to physical commodity usage, among other misunderstandings.

It is reputed that the daily trading volumes for natural gas futures exceed daily physical usage by 12-30 times:

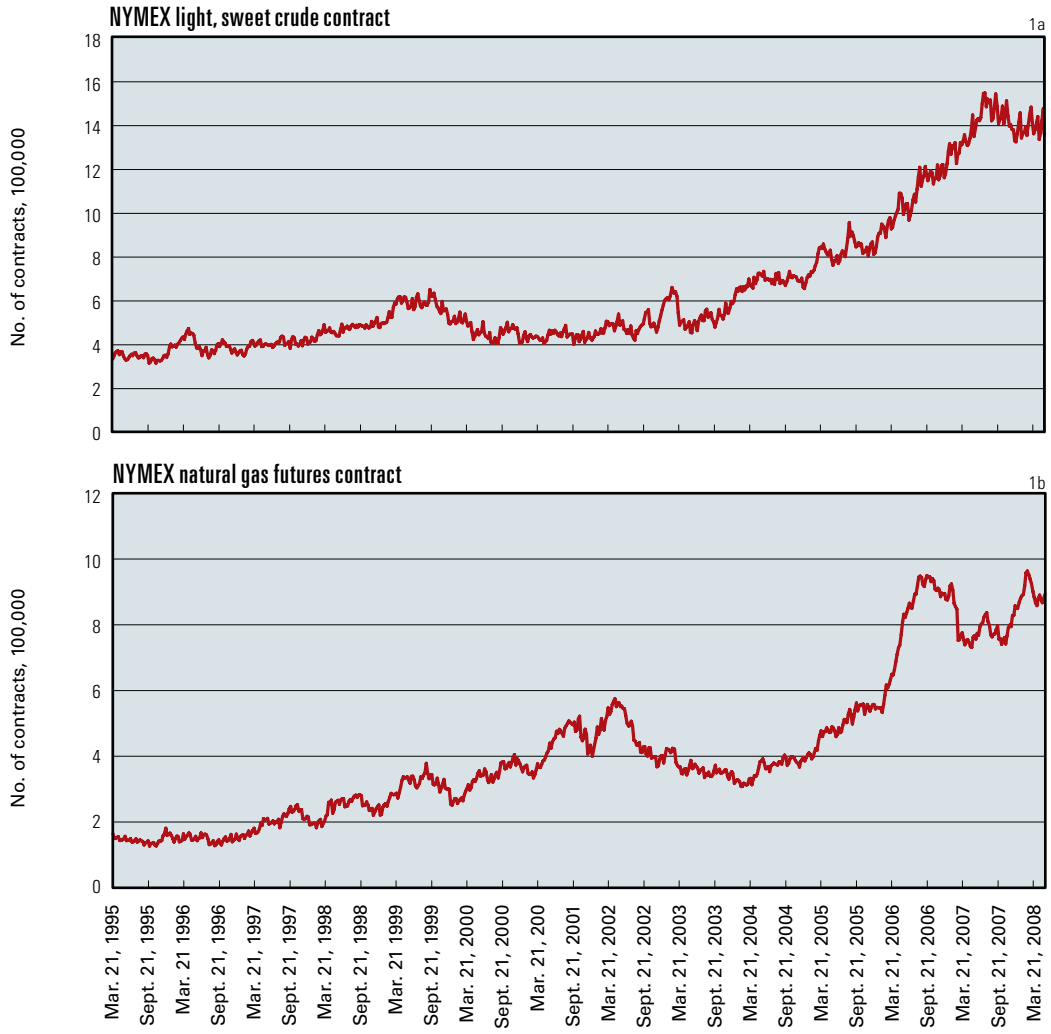
"Volumes traded each day are estimated to be over 12 times the actual physical volumes consumed," said Paul N. Cicio in a letter to US Sens. Saxby Chambliss (R-Ga.) and Tom Harkin (D-Ia.), regarding Commodity Futures Trading Commission (CFTC) reauthorization legislation, on Apr. 5, 2006. The statement refers to the natural gas futures and physical markets.[2]

Average daily trading volume in 1997 was more than 47,000 contracts, the equivalent of almost 20 times US gas consumption, according to the New York Mercantile Exchange (NYMEX) in 2001.[3]

And Mark N. Cooper, research director, Consumer Federation of America, said, "Natural gas may be traded over 30 times before it is consumed (i.e., the volume of trading exceeds the volume consumed by 30 times), fueling the suspicion that this trading drives up transactions costs and increases volatility." Cooper's report has been critiqued elsewhere (FERC,

HISTORY OF NYMEX CONTRACTS, OPEN INTEREST POSITIONS

Fig. 1



Source: Commodity Futures Trading Commission (CFTC)

2006, pp. 33-59), but not on the issue of this multiple.[4]

Similar claims are made regarding crude oil futures trading. NYMEX in 2006 said: "The futures contract is the most liquid trading instrument for crude oil, with daily trading volume averaging the equivalent of 230 million bbl of crude, approximately three times physical daily output." The multiple of three times appears to refer to total global crude oil production, not just that for the US.[5]

These large multiples are presented by participants from both sides of the energy market manipulation debate. On the one hand, it is argued that the multiples indicate a high degree of liquidity that helps lower the costs faced by participants in the physical markets, who are interested in both risk mitigation and price discovery services.

On the other hand, it is argued that these multiples have the appearance, or are given the appearance, of hedge ratios, and hedge ratios of these magnitudes are quite unlikely to be optimal. Optimal hedge ratios rarely exceed a value of one, so a multiple of, say, 12, assessed in terms of hedge ratios, would likely suggest excessive, nonoptimal trading. These multiples are not hedge ratios and should not be interpreted as such.

The multiples are argued to be indicative of the excessive amount of energy trading activity carried out in the energy markets by noncommercial parties (often referred to as speculators or, more recently, as a lump called hedge funds), which subject the markets to manipulation. Each of these positions is wrong.

The cited large trading multiples are devoid of meaning and are the result of miscalculation. The multiples amount to comparing the average daily consumption to quantities to be delivered over the next 3,100 plus days. Comparing 1 day to 3,100 days clearly violates the "apples-to-apples" analyses that would carry economic and common sense meaning.

However, since these claimed multiples in the energy markets are repeatedly introduced into the policy debate regarding the role of speculators, and the potential for increased prices and price volatility, the basis for the calculations should be analyzed and corrected where wrong.

If observations regarding the relation between futures trading and physical usage are to provide meaningful input into new policy development, they must be based on correct analysis. And a correct analysis of these relationships shows that futures trading volumes actually account for only a fraction of physical usage.

The numbers

The multiples are typically calculated by converting the total volume of contracts traded for the commodity of interest on a given day (or an average or maximum for some time period) into the units used to discuss consumption of the underlying commodity. For example, gas is discussed in terms of daily consumption in billions of cubic feet. A single gas futures contract on the NYMEX represents 10,000 million btu. At 1,000 btu/cu ft, a single contract accounts for 10 MMcf of gas, or 0.01 bcf.

Oil is discussed in terms of barrels per day, with daily usage in millions of barrels per day, and each NYMEX oil contract represents 1,000 bbl.

A summary of US average daily oil and gas usage in 2007 is reported in section 1a of Table 1 along with a summary of the daily trading volumes for futures contracts on the NYMEX for oil and gas. Section 1a of Table 2 reports similar information for 2008 through May 20.

The average oil consumption is typically stated as about 18 million b/d. The "correct" number to use for the average daily crude oil consumption is not a simple issue. The refinery feed in the US is about15-16 million b/d, but the futures contracts on the NYMEX are employed to hedge positions beyond just the US. Global crude oil use currently is about 87 million b/d, but not all of that will attract hedging interest through the NYMEX contract.

The units specified by each contract imply that the highest trading volume for oil in any single day during 2007, for all contracts open, amounted to 880 million bbl. When this total trading volume number is used, it includes contracts covering maturities through December 2016—roughly 3,130 days into the future.

Average gas consumption amounts to about 64 bcfd. For gas, the highest daily futures trading volume represents 2,230 bcf. The average trading amounted to 485 million b/d of oil and 1,200 bcfd of gas. These daily values are reported in the first three rows of Table 1a.

The results of the "typical" method used to compare the futures traded volumes with physical use are shown in rows 4 and 5, where on average this method suggests that 27 times the physical use of oil is traded on the NYMEX and 19 times for NYMEX gas. The maximum trading volumes lead to calculations of 49 times and 35 times for oil and gas, respectively.

As noted, this approach compares the average consumption for a single day to traded volumes for delivery over more than 3,100 days.

Alternatively, we may calculate the relationship between futures trading volume for the near-month (spot) contract to that of the average daily use volumes, and these figures are reported in rows 8 and 9. This approach suggests multiples of 13 for oil and 9 for gas for 2007. This approach shows significantly reduced multiples for both traded commodities.

Nevertheless, while this analysis has adjusted the focus to the near-month contract, where just under 50% of the daily trading activity typically occurs, this approach is still deeply flawed and produces misleading, meaningless results, because we have simply traded a comparison of one day to 3,100 days for one day versus 30 days—still not "apples-to-apples." This still does not reflect actual traded futures contract characteristics.

2007* US OIL, GAS USE VS. NYMEX TRADING VOLUMES

Table 1

	Oil, million bbl	Natural gas, bcf
		1a
Trading volumes, "multiple" calculations		
Average daily use	18	64
Average daily total trading volume	485	1,200
Maximum daily total trading volume	880	2,230
Typical "multiple"—average	27	19
Typical "multiple"—maximum	49	35
Average daily near-month trading volume	235	560
Maximum daily near-month trading volume	503	960
Typical "multiple" near-month—average	13	9
Typical "multiple" near-month—maximum	28	15
		1b
30-day delivery-month basis—near-month contracts		
Average daily near-month trading volume	8	19
Maximum daily near-month trading volume	17	32
Real "multiple" near-month—average	0.44	0.29
Real "multiple" near-month—maximum	0.93	0.50

*Data are rounded.
Source: New York Mercantile Exchange

2008* US OIL, GAS USE VS. NYMEX TRADING VOLUMES

Table 2

	Oil, million bbl	Natural gas, bcf
		2a
Trading volumes, "multiple" calculations		
Average daily use	18	64
Average daily total trading volume	550	1,510
Maximum daily total trading volume	852	2,421
Typical "multiple"—average	31	24
Typical "multiple"—maximum	47	38
Average daily near-month trading volume	273	728
Maximum daily near-month trading volume	415	1,222
Typical "multiple" near-month—average	15	11
Typical "multiple" near-month—maximum	23	19
		2b
30-day delivery-month basis—near-month contracts		
Average daily near-month trading volume	9	24
Maximum daily near-month trading volume	14	412
Real "multiple" near-month—average	0.51	0.38
Real "multiple" near-month—maximum	0.77	0.64

*Through May 20. Volumes are rounded.
Source: New York Mercantile Exchange

Alternative methodology

The trading activity each day for gas and oil futures contracts, as well as that for gasoline and heating oil, is for delivery over an entire month, not any one specific day. For example, near-month futures contracts traded during any trading day in May—up to the last trading day, which differs across commodities—are for quantities of the commodity to be delivered throughout the month of June.

The last trading day for the crude oil contract is the third business day prior to the 25th calendar day of the month before the delivery month.

For natural gas, the last trading day is 3 business days before the first business day of the delivery month.

For gasoline and heating oil, the last trading day is the last business day of the month preceding the delivery month.

To gain meaningful insight into the relative volumes traded under futures contracts relative to actual physical requirements or consumption, the daily volumes of the commodity represented by the traded futures contracts must be divided by the number of days in the delivery month. That is, observing daily trading volume representing contracts that account for 13 times the daily usage, but for delivery into a month consisting of 30 days, actually implies trading activity that represents just 43% of the requirements for that month.

The large multiples, therefore, are an artifact of aggregating the trading volume for all contracts traded on a given day, including those for many months and years into the future. The analysis of the near-month trading activity, the month that typically carries the largest trading volume, results in much smaller multiples, but these values also fail to reflect the actual nature of the trading activity.

Sections 1b and 2b of Tables 1 and 2 report values for near-month contracts for delivery into a 30-day month. The volumes in rows 10 and 11 are derived by dividing the corresponding volumes in rows 6 and 7 by 30. It is immediately obvious that large multiples of the physical commodity usage in the US are not represented by the daily traded volumes on the futures exchange when both are put in comparable terms—when apples are being compared to apples.

Even if the highest volume trading day is evaluated for either commodity during 2007, the volumes of the underlying commodity accounted for by the traded contracts amount to 93% of the daily usage for oil and just 50% of the daily usage for gas.

The average daily futures trading activity during 2007 represented volumes of roughly 44% of actual daily usage for oil and 29% for gas. For 2008, through May 20th, the averages are 51% for oil and 38% for gas.

Assessment

These results do not support the large multiples typically claimed, but they also do not suggest that the futures trading activity represents an insignificant share of the market. To assess the significance of futures trading activity it is also useful to observe the open interest associated with the near-month contract.

The open interest on futures contracts represents the number of contracts, and therefore the volumes of the underlying commodity, that are active and still constitute obligations on the part of buyers and sellers.

According to NYMEX, "The exchange's core energy contracts...stipulate physical delivery, although deliveries usually represent only a minuscule share of trading volume—less than 1% for energy—overall." That a very small share of the traded volumes goes to delivery is not indicative of speculation. The majority of contracts (i.e., open interest) are held by commercial traders who are likely hedging the price risk they face on the physical units bought or sold in separate transactions.[6]

By itself, trading volume for futures contracts provides only a partial picture because trading volume may add to, decrease, or leave unchanged the number of open contracts. Thus, a more complete picture is gained by also examining the volumes of the commodity represented by the open interest

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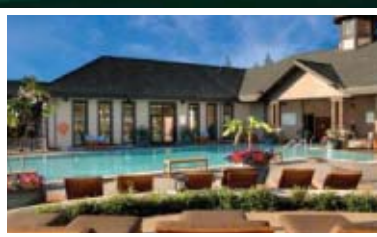

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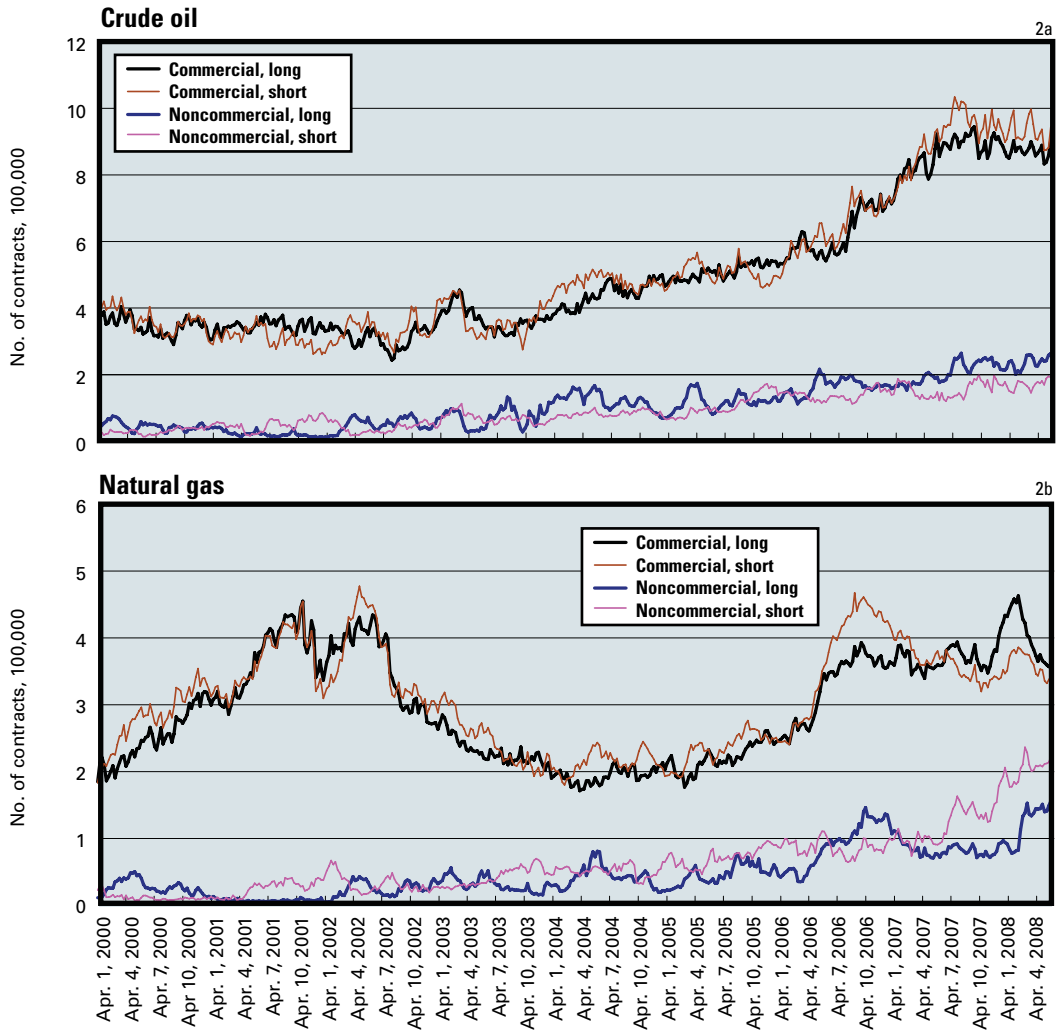
COMMERCIAL, NONCOMMERCIAL OPEN INTEREST POSITIONS

Fig. 2



Source: Commodity Futures Trading Commission (CFTC)

positions in the futures market.

Tables 3 and 4, for 2007 and 2008, respectively, present the average and maximum daily open interest for the two commodities. When assessing the relation between near-month contract open interest and daily usage of a commodity, it is reasonable to focus on the maximum, rather than the average. This is because open interest, by definition, rises and falls during the life of the contract, beginning at zero just before the contract is listed for trading and declining back to zero at the maturity of the contract. The maximum open interest typically occurs during the near-month trading period. The open interest for the near-month contract is also typically the largest for any traded contract maturity, just as is the case for futures contract trading volume.

For oil, the maximum open interest for a near-month contract during 2007 was 442,000 contracts, and for gas it was 181,350 contracts. These maximum open interest positions represent 442 million bbl of oil and 1,814 bcf of gas. Because these volumes were for delivery over an entire month, on a 30-day month basis the oil maximum open interest represents average daily volumes of 15 million bbl, and the gas maximum open interest represents average daily volumes of 60 bcf.

These open interest positions, therefore, represent roughly 82% of the average daily usage for oil and 94% for gas. These clearly account for a substantial share of the US physical commodity market that underlies the futures market. Comparable values for 2005 show 50% for both commodities. Because open interest is the measure of market activity that represents positions held open, one interpretation of this change is that the energy sector is hedging a larger share of its exposure in 2007 and 2008 than it was in 2005.

Trading activity

Energy futures trading activity on regulated exchanges such as the NYMEX has expanded remarkably, contrary to recent claims. For example, in recent congressional testimony, Tyrone Slocum argued that "[As] a result of the Commodity Futures Modernization Act, trading in lightly regulated exchanges like NYMEX is declining as more capital flees to the completely unregulated OTC [over the counter] markets.[7]

Figs. 1a and 1b show the history of NYMEX futures contract open interest for oil and gas, respectively. Since January 2001, immediately following the enactment of the Commodity Futures

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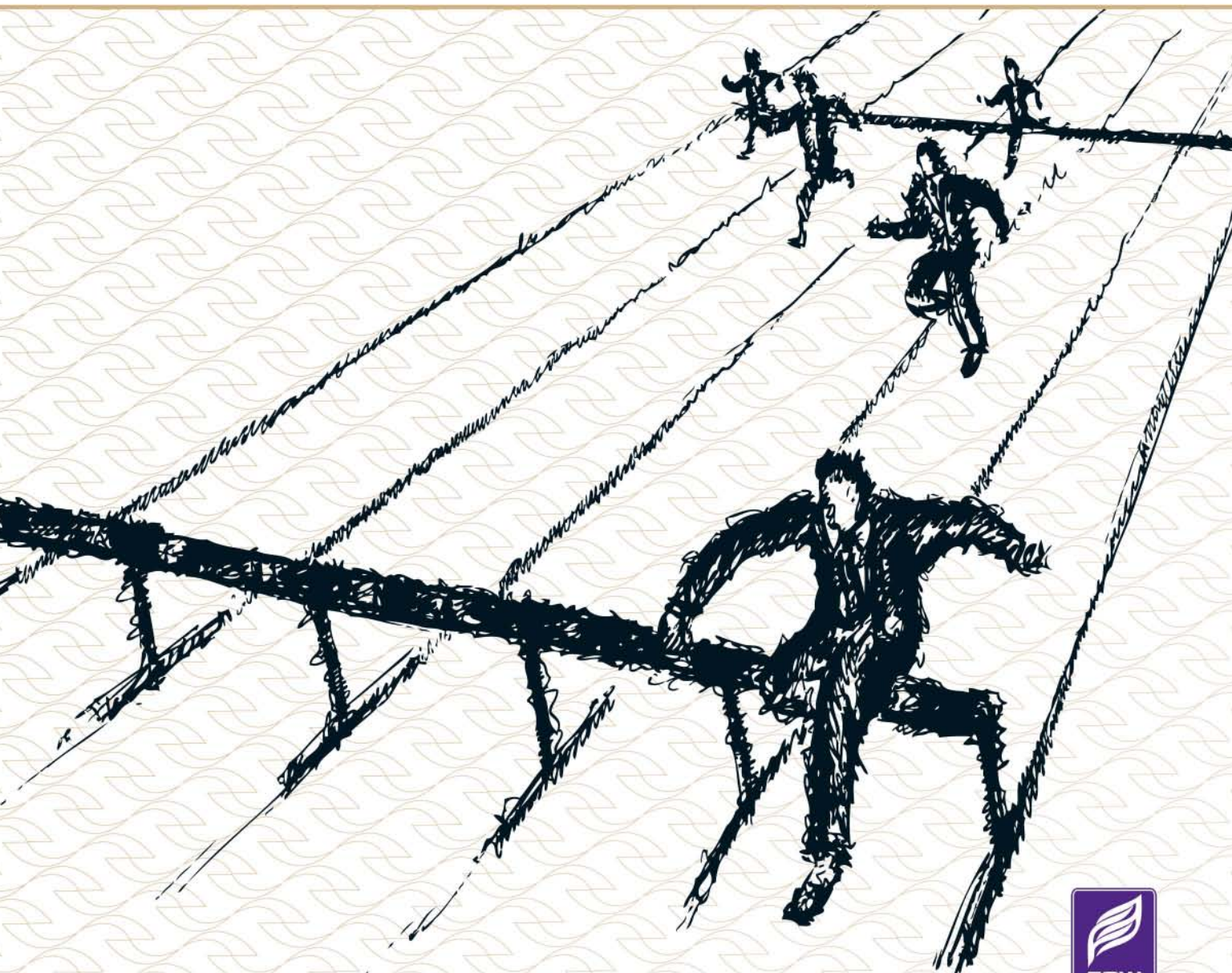

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2007 OPEN INTEREST* TRADES VS. OIL, GAS DAILY USAGE

Table 3

	Oil, million bbl	Gas, bcf
Average daily use	18	64
Average open interest, 30-day basis	8	24
Maximum open interest, 30-day basis	15	60
	No. of contracts	
Average open interest	247,360	71,050
Maximum open interest	442,000	181,350
	Share, %	
Average share of daily use	0.46	0.37
Maximum share of daily use	0.82	0.94

*Near-month contracts, 30-day delivery-month basis.

2008* OPEN INTEREST TRADES VS. OIL, GAS DAILY USAGE

Table 4

	Oil, million bbl	Gas, bcf
Average daily use	18	64
Average open interest, 30-day basis	8	31
Maximum open interest, 30-day basis	13	55
	No. of contracts	
Average open interest	250,000	92,650
Maximum open interest	385,700	166,330
	Share, %	
Average share of daily use	0.46	0.48
Maximum share of daily use	0.71	0.87

* Through May 20. Near-month contracts, 30-day delivery-month basis.

Modernization Act, oil open interest increased by nearly 230%, while gas open interest increased by more than 150%. Trading volumes in these energy futures markets have grown commensurately.

Placing trading volume in the context of the open interest positions may be instructive as an indicator of what may or may not be excessive trading. On a monthly basis, for 2007 the total trading volume relative to the average daily open interest for near-month (the most active contract) oil was 20 trades/month. Because typically there are about 21 trading days/month, this implies fewer than 1 trade/day relative to open interest. For gas the comparable number is 17 trades/month. The values for 2008 through May 20 are 22 and 16 trades/month, respectively.

Price discovery occurs only through transactions and trades that allow the market to incorporate new information into the price. While there is no unambiguous theoretical number of trades that could be designated as excessive, 1 trade/day does not seem excessive for the purpose of providing both price discovery and liquidity in the market.

Speculators dominating?

It frequently is said that in recent times speculators have taken over the market. They are said to dominate otherwise commercial traders in the market. This is not the place to argue the importance of the role of speculators who bring liquidity to the market and reduce the cost of risk mitigation faced by hedgers.

Without these participants it is likely that energy prices would be even higher due to higher costs associated with risk mitigation if such mitigation services were still available. However, it is worth a few words to correct the image of an overwhelming speculator class in these trading activities.

CFTC produces weekly reports on the activities of all futures exchanges under its jurisdiction, differentiated by trader type. Figs. 2a and 2b report open interest for oil and gas traded on the NYMEX for the 2000-08 (through May 20) period. The dominance in these industries is fairly clear, even while the roles of the traders have evolved.

Commercial traders are those deemed to have an interest in actually acquiring the physical commodity, while noncommercial traders do not have such an interest. Historically, commercials have been associated with hedgers, while noncommercials have been associated with speculators.

Clearly, however, commercial traders have dominated, even in the recent past associated with the run-up in prices. For 2000-08, as much as 53% of the increase in long positions is attributable to commercial traders. So, more than half of the growth on the long side—the side typically associated with pushing prices higher—has been from commercial traders rather than noncommercials.

Moreover, of the 44% of the long positions' growth attributable to noncommercials, 20% represents one side of an offsetting calendar spread position. This suggests that commercial participants, not the noncommercials, have been leading the markets rather than being whipsawed or manipulated.

Gas, shown in Fig. 2b, has had a different evolution. While commercials dominate the market in both long and short open interest positions, noncommercials have been responsible here for most growth in open interest in the recent past.

Nevertheless, in terms of outright long positions (those not associated with a calendar spread), the commercials lead noncommercials with 28% of the growth vs. 23%. Noncommercials, however, were responsible for 43% of the growth in long positions through spread trading. However the increased role of spread trading may be viewed both as a representation of increased risk aversion on the part of noncommercials and an enhancement of their role as liquidity providers in the market.

Typically it is found that the volatility of returns to a calendar spread position is less than that for an outright position. Therefore, increased reliance on spreads over outrights may be seen as a shift toward safer assets. The enhanced liquidity comes from the fact that a spread has two legs—a long and a short—but in different maturities. That means that a single noncommercial entering into a spread position may provide both a long and a short position to offset the hedging positions of two commercials.

So one interpretation of this phenomenon is that noncommercials are providing increased market liquidity through a shift to lower risk positions. We should not be introducing policies that will diminish this type of activity.

False claims

Claims of large multiples over actual commodity usage in trading on the energy futures markets are the result of

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miscalculations and incorrect analyses, which do not properly allocate the trading volumes over the delivery month. The proper allocation of futures trading volume over the delivery month demonstrates that this activity represents but a fraction of the daily US oil and gas usage, not a multiple.

The share of the average usage represented by the maximum open interest leads to the conclusion that the energy futures markets provide the basis for transparent price discovery and risk mitigation. Moreover, the number of open interest positions provides no indication of excessive trading. Commercial traders remain the dominant players in these markets, and noncommercial traders appear to be providing the liquidity that allows for both risk mitigation at relatively low cost and transparent price discovery.

No level of trading has been identified such that surpassing it implies a state of excessive trading, but the results presented herein refute claims of currently or recently excessive trading on the energy futures exchanges. ✦

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US CFTC to examine crude oil market, derivatives

Nick Snow
Washington Editor

The US Commodity Futures Trading Commission broke with its tradition of not disclosing current investigations and announced on May 29 that its enforcement division is continuing a crude oil market and derivatives inquiry that began in December 2007.

The investigation announcement was one of three measures that also involve expanded international surveillance of crude oil trading and increased domestic energy market trading transparency.

"Today, the commission is taking important steps to ensure that the US energy futures markets function properly and operate free from manipulation and abuse. With these initiatives, we are improving our oversight capabilities and bringing greater sunshine to these markets," said CFTC Acting Chairman Walter L. Lukken and commission members Bart Chilton, Michael Dunn and Jill E. Sommers in a joint statement.

The CFTC's announcement came 2 days after US Senate Energy and Natural Resources Committee Chairman Jeff Bingaman (D-NM) sent Lukken a letter asking it to dig deeper for more information about oil commodity trading on foreign exchanges. "The steps announced today by the commission should help it answer the detailed questions I sent to the acting chairman earlier this week on oil trading in dark markets, regulatory loopholes for swap dealers, and lack of transparency requirements," Bingaman said on May 29.

He said he planned to invite Lukken to appear before the committee to describe how the initiatives address Bingaman's concerns "that the commission lacks a robust understanding of the

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WATCHING GOVERNMENT

Nick Snow, Washington Editor

Illinois objections to Indiana permit

US Sen. Richard J. Durbin (D-Ill.) and three US House Democrats from Illinois asked a US Environmental Protection Agency Region 5 official to object to a construction permit BP Products North America Inc. seeks for its Whiting, Ind., refinery.

Durbin and Reps. Melissa L. Bean, Rahm Emanuel, and Janice D. Schakowsky said in a May 30 letter to Bharat Mathur, acting administrator at EPA's Region 5, they are concerned about possible additional flaring if the BP America division is allowed to proceed with a $3.8 billion modernization.

The project would allow the plant to process more Canadian heavy crude oil and increase motor fuel production by about 1.7 million gpd, a BP America spokeswoman said. The 4-year project is designed to shift crude inputs at the 405,000 b/d refinery to 90% from 30% Canadian heavy crude.

The Indiana Department of Environmental Management issued a permit for the project in May which overlooks flaring and possible increases in carbon dioxide and other emissions above previous permit levels, the federal lawmakers charged.

Alleged assumptions

The project includes three new flares and increased use of existing flares, they told Mathur. "Yet the permit essentially assumes that the new flares will, for the most part, never be used" and in other ways miscalculates flare emissions, they said.

IDEM indicated in its technical support document addendum that unplanned flaring does not need to be accounted for in a US Clean Air Act netting analysis.

That view, Durbin and the House members said, is wrong and contrary to the federal law, which does not allow a permitting agency to remove a large emissions category from its calculations entirely, to make an unsupported assumption that such emissions would be netted out based on narrative assurances that the emissions would be minimized, or to completely exclude emissions from unplanned events.

"The applicable regulations expressly specify that all (not just planned) startup, shutdown, and malfunction emissions must be factored into netting calculations. Particularly in light of EPA Region 5's issuance of a notice to BP's Whiting refinery for flaring violations, we believe that flaring at the expanded Whiting site must be accounted for in the permit," the lawmakers said.

Notice given

EPA's Region 5 office notified BP Products North America on Nov. 29 that the company violated New Source Performance Standards in the Clean Air Act at the refinery by modifying flares without complying with requirements, exceeding sulfur dioxide emissions limits, and failing to monitor emissions from several sources.

The notice also said BP did not get a permit when it modified the FCC unit or conduct timely performance tests of hydrogen chloride emissions from its catalytic reforming units. An EPA Region 5 spokesman would not comment on the matter because it is an ongoing investigation. ✦

oil market. I will continue to press for the increased regulation and transparency needed to ensure that oil markets are functioning properly."

'Rampant speculation'

US House Energy and Commerce Committee leaders said the commission's announcement was encouraging but fell short of what is needed. "Unfortunately, the CFTC has not proposed how to close off the loopholes that allow commodity index funds and others to take such massive positions that possible distort oil futures markets. The failure to corral this rampant speculation is not only ravaging consumers, but harming businesses such as airlines, trucking, and auto manufacturers," chairman John D. Dingell (D-Mich.) said.

Bart Stupak (D-Mich.), who chairs the committee's oversight and investigations subcommittee, said the announcement was welcome but added, "There is much more that needs to be done to improve transparency and ensure that futures markets are not turned into a cash machine for speculators. Our subcommittee is identifying the driving forces that have caused excessive speculation in the oil markets, which has inflated oil prices to the point that they are no longer tied to underlying supply and demand."

Pete V. Domenici (R-NM), the Senate Energy and Natural Resources Committee's ranking minority member, said that it was appropriate for CFTC to take steps to increase oil market transparency and investigate whether market manipulation is occurring. "While it is clear that fundamental supply and demand issues are mostly to blame for the current high price of gasoline, it is certainly worth examining whether speculators are also having an impact. I look forward to the results of this investigation, which should help Congress decide if any legislative action on market manipulation is warranted," he said.

Federal lawmakers have said that some futures traders are making deals for US crude oil commodities on overseas markets to escape domestic

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exchanges' disclosure requirements. One of those foreign exchanges, the International Commodities Exchange (ICE), recently agreed to supply information about contracts that are identical to commodities traded in the US. Stupak and other congressional critics have suggested that the CFTC's jurisdiction needs to be extended further. They do not accept arguments that regulation may not be appropriate for riskier energy commodity positions.

Unprecedented conditions

In its announcement, CFTC said its enforcement division in December 2007 launched a nationwide investigation into practices surrounding the purchase, transportation, storage, and trading of crude oil and related derivatives. It said that while it normally conducts enforcement investigations on a confidential basis, it decided to disclose this inquiry because of current unprecedented market conditions. Specific aspects of the investigation will remain confidential, it indicated.

CFTC also said it has outlined terms under which Britain's Financial Services Authority (FSA) and ICE Futures Europe will share more information about West Texas Intermediate (WTI) crude oil and other futures contracts that trade on both New York Mercantile Exchange (NYMEX) and ICE. While the ICE contract is a cash-settled instrument that does not allow physical oil delivery in the US, its price is linked to the NYMEX contract's settlement price, the federal commodities regulator said.

The agreement includes expanded information-sharing to give the CFTC daily large trader positions in the British WTI contract, large trader positions for all and not just the near contract months, near-term commitments to supply more-detailed market end-user identifications and improved data formats so information can be integrated more quickly into the CFTC's data system, and a commitment by ICE Futures Europe to notify CFTC when traders on the foreign exchange exceed position levels that are established on US markets for WTI crude oil contracts.

CFTC said that since 2006, Britain's FSA has supplied weekly trading information to the US regulator and daily trading information during the final week to facilitate rigorous oversight of trading in related contracts on the two countries' exchanges, specifically the linked crude oil contracts on both NYMEX and ICE. It said NYMEX currently maintains about 75% of the open interest in these contracts, while ICE accounts for about 25%.

The increased transparency initiative mainly involves index trading, which CFTC said is relatively new to futures markets. The commission said it will use its existing special call authority to immediately begin to require

energy market traders to provide it with monthly index trading reports. It also plans to develop a proposal to routinely require more-detailed information from index traders and swaps dealers, and to review whether classification of such traders can be improved for regulatory and reporting purposes.

Finally, CFTC said it would review index traders' practices to determine whether this type of trading is not adversely affecting the price discovery process, and to determine whether different practices should be employed. ✦

Senate to FTC, CFTC: police markets more aggressively

Nick Snow
Washington Editor

Two federal regulatory agencies are moving too timidly in response to record crude oil prices, US Sen. Maria Cantwell (D-Wash.) said during a Senate committee hearing on energy market manipulation and federal regulatory regimes.

Cantwell will press both the Federal Trade Commission (FTC) and the Commodity Futures Trading Commission (CFTC) to regulate oil and commodity markets more aggressively, Cantwell said following the June 3 Commerce, Science, and Transportation Committee hearing, which she chaired.

She wants FTC to issue an interim rule under the oil market investigation and regulation authority it received under the 2007 Energy Independence and Security Act while it completes its formal regulatory rulemaking process.

She also intends to continue pressuring CFTC to revoke "no action" letters issued by its staff that allow electronic exchanges operating outside US borders to continue trading West Texas Intermediate crude oil and related commodities without being directly regulated, Cantwell said. "Our oil futures markets were substantially deregulated by CFTC staff decisions that were made behind closed doors," she said in her opening statement.

London, Dubai loopholes

Such decisions created loopholes for exchanges based in Britain and Dubai to continue operating in the US, Cantwell said. "This is no different than when US businesses take out a post office box in the Cayman Islands to avoid US business laws...," she said.

Cantwell and 21 other senators wrote CFTC on May 23 demanding that it revoke the no-action letters and start policing all US oil markets. The commission responded on May 29 that it has been investigating oil markets since December and that Britain's Financial Service Authority intends to supply it with more information about trades under its jurisdiction.

That response was unsatisfactory, she said: "First, there are still no large speculation limits that are critical to preventing fraud, manipulation, and excessive speculation. Second, the CFTC will not collect the same kind of information that it would collect from other fully regulated exchanges. The information will be unaudited and unverifiable. Third, unlike fully regulated US exchanges like [the New York Mercantile Exchange], there are no enforcement mechanisms. And fourth, the CFTC approach is partly just an agreement to agree—there are no firm commitments—so all of these measures may not even be put in place," Cantwell said.

Other committee Democrats agreed that speculation has become rampant. Crude oil prices jumped at about the same time hedge funds and institutional investors moved into commodity markets, said Byron L. Dorgan (ND). Many trades occur in unregulated, or "dark," markets, he said.

Republican support

Committee Republicans also supported more-aggressive oversight. "It's essential that all regulatory agencies understand what's happening and stop any manipulation that's taking place, said John E. Sununu (NH). "We also must make certain that agencies have the right regulatory authority. If we want our exchanges to be world leaders, they have to be transparent."

David Vitter (La.) added, "I am looking for solutions that work in accordance with basic healthy economics but rein in and enforce any potential abuse from artificial price escalation in the speculation market."

Witnesses held varied assessments of the impact of speculators on crude oil prices: George Soros, chairman of Soros Fund Management LLC in New York, said speculators are a factor but declining production from maturing oil fields and growing demand in China, India, and other expanding economies are bigger influences. "I find commodity index buying eerily reminiscent of a similar craze for portfolio insurance, which led to the stock market crash of 1987. In both cases, the institutions are piling in on one side of the market, and they have sufficient weight to unbalance it. If the trend were reversed and the institutions as a group headed for the exit as they did in 1987, there would be a crash," he said.

An oil market crash is not imminent, Soros quickly added. "The danger currently comes from the other direction. The rise in oil prices aggravates the prospects for a recession. Only when a recession is well and truly in place is a decline in consumption in the developed world likely to outweigh other factors I have listed. That makes it desirable to discourage commodity index trading while it is still inflating the bubble," he said.

Unintended consequences

The case for taking regulatory action is less clear cut because regulations may have adverse, unintended consequences such as pushing investors further into unregulated markets, which are less transparent and offer less protection, Soros continued. "Raising margin requirements would have no effect on the commodity index buying strategy of financial institutions because they use cash. Nevertheless, it would be justified in the current circumstances because it would discourage speculation, and speculation can distort prices," Soros said.

But other witnesses said aggressive regulation is needed. "The CFTC has abdicated its responsibility to regulate 30% of the total US crude oil futures traded to regulatory authorities in Dubai and the United Kingdom," said Michael Greenberger, a University of Maryland School of Law professor who directed CFTC's trading and markets division in the late 1990s.

Greenberger said FTC could use the Federal Energy Regulatory Commission's template to regulate oil futures markets as aggressively as FERC regulates natural gas and electricity markets. "All the questions FTC has asked have been answered by FERC." He said, "As it is, we can't expect regulations before sometime this fall."

Lee Ann Watson, deputy director of the investigations division in FERC's enforcement office, agreed, saying FERC's experience implementing authority it received under the 2005 Energy Policy Act to prevent manipulation in wholesale electricity and natural gas markets might prove helpful. FERC used the prohibited activity in Section 10(b) of the Securities Exchange Act as a model to provide guidance and certainty to electricity and gas market participants operating under the Federal Power Act and Natural Gas Act, she said.

Gerry Ramm, president of Inland Oil Co. in Ephrata, Wash., testifying on behalf of the Petroleum Marketers Association of America, said Congress should push CFTC to revoke the no-action letters, raise margin requirements for noncommercial entities in energy commodity markets and require them to have the ability to take physical delivery of at least some of the product, and greatly increase CFTC funding, which has had to cut staff as commodity trading has grown.

Mark Cooper, research director at the Consumer Federation of America, said, "Large traders should be required to register and report their entire positions in those commodities across all markets. Without comprehensive reporting, there will always be room for mischief that is out of sight of the regulator. Registration and reporting should trigger scrutiny to ensure the good character, integrity, and competence of traders," Cooper said. "Failure to comply should result in mandatory jail terms. Fines are not enough to dissuade abuse in these commodity markets because there is just too much money to be made," he added. ✦

NGC: Lieberman-Warner bill would drive up gas demand

Nick Snow
Washington Editor

A recent study from the Natural Gas Council concluded that legislation to be debated this week in the US Senate is likely to increase natural gas demand without addressing the need for increased supply.

American Gas Association Pres. David N. Parker was one of several council members to respond to the study's findings. "We take global climate change seriously and believe that natural gas will be a key part of any effective climate change initiative," he said.

"Our analysis suggests that achieving the carbon reductions required under S. 3036 [the Lieberman-Warner Climate Security Act] requires a mix of technologies and energy sources. Our study also found that demand for natural gas could increase by more than 30% by 2030," Parker said.

NGC, whose member organizations also include the Independent Petroleum Association of America (IPAA), Interstate Natural Gas Association of America (INGAA) and Natural Gas Supply Association (NGSA), released its study as two major national business organizations announced their opposition to the bill.

Officials from the US Chamber of Commerce and National Association of Manufacturers separately said the bill could lead to the loss of up to 4 million jobs by 2030, increase electricity prices by as much as 129% and gasoline prices by up to 145%, and reduce the average US household income by as much as $6,752/year.

Importance of offsets

NGC's study noted that offsets in the legislation would allow a regulated source, such as an electric power plant, to meet some of its compliance obligations by reducing an equal amount of carbon emissions from sources that have not been capped.

"The importance of offsets really jumped out at us," said NGSA Pres. Skip Horvath. "Congress needs to carefully think through the role of domestic and international offsets, because this mechanism significantly affects the United States' ability to achieve the legislation's carbon-reduction targets. The global market for offsets is going to be competitive as foreign nations move

to meet their own carbon reductions," he added.

Under S. 3036, a company could meet as much as 15% of its compliance obligations with specified domestic offsets, while another 15% could come from Europe and other areas of the world.

The study found that in addition to driving up gas demand, the legislation would increase electricity production from nuclear power plants, wind, and solar power units. The bill also includes incentives to install carbon sequestration technology, now under research and development, which would remove carbon from emissions and sequester it underground.

"Given the uncertainties surrounding new energy technologies and implementation of the cap and trade program, we suggest that Congress incorporate a strong natural gas supply and infrastructure portfolio that will allow us to achieve the goals of a climate-change bill," INGAA Pres. Donald F. Santa said.

Higher gas demand, costs

NGC's study echoes previous studies by the federal government and other groups—studies that also indicate that the demand for, and cost of, gas could increase substantially if the legislation becomes law.

"What concerns us is that while some studies show natural gas use going up, perhaps dramatically under S. 3036, other studies found that the same legislation would cause the supply of natural gas to decline. That's a collision course for consumers," said IPAA Pres. Barry Russell.

"If Congress does not hamper existing production and allows more exploration, our industry could ensure a more-robust supply of natural gas, which would reduce price pressure. That supply increase would provide an economic relief valve if there are problems with sequestration or offsets," he said.

The analysis was conducted by Science Applications International Corp. (SAIC) using the National Energy Model System (referred to as NEMS-NGC version). NEMS-NGC used alternative input assumptions provided by the council.

An American Petroleum Institute official noted that NGC's study follows one that API issued in May, which concluded that the legislation would likely reduce US natural gas production.

'Troubling questions'

"Taken together, the two studies raise troubling questions," said API policy analyst Lou Hayden. "The high cost of allowances could lead to less US production of clean-burning, low-carbon, natural gas just when consumers are demanding more. The legislation appears designed to work at cross purposes." API's study, which ICF International conducted, estimated that the cost of allowances could lead to a US gas production decline of 12% by 2030. It also estimated a shift overseas of 3 million b/d of petroleum refining capacity.

"Lieberman-Warner fails to meet the criteria essential to a sound national climate policy: balancing reasonable cost burdens, encouraging low-carbon technologies, providing a uniform national policy, and finding the most cost-effective ways to reduce emissions without choosing winners and losers," Hayden maintained.

William Kovacs, vice-president of environment, technology, and regulatory affairs at the US Chamber of Commerce, said the bill fails to address global climate change realistically because it does not promote development and deployment of new technologies.

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"The business community wants to be a leader in crafting a logical plan to address climate change. This is why the Chamber believes a major focus of any climate change strategy must be the development and rapid deployment of new energy technologies, not burdening businesses and consumers with new taxes," he told reporters at a June 3 briefing.

No technology funds

While Congress has discussed addressing climate change, it has failed to seriously fund development of the 64 nonfossil fuel technologies that the 2005 Energy Policy Act said were needed to address the issue, Kovacs said.

He said that the current bill, which Sens. Joseph I. Lieberman (I-Conn.) and John W. Warner (R-Va.) introduced in October and Sen. Barbara Boxer (D-Calif.) amended before it was brought to the floor on June 2, does not recognize the importance of technology in addressing global climate change.

"If we are to truly move away from fossil fuels, we must be able to replace these fuels with low or zero-carbon alternatives," Kovacs said. "A great deal of the technology isn't commercially available yet, and several of these technologies don't even exist."

In a June 3 letter to all 100 senators, National Association of Manufacturers Executive Vice-Pres. Jay Timmons said the organization and its members are committed to reducing greenhouse gas emissions provided any US action is mirrored by comparable commitments by trading partners, is based on sound science and cost-effectiveness, and is applied equally throughout the economy.

He said S. 3036 fails this test because its nationwide cap-and-trade program does not pre-empt conflicting state and local climate change laws and regulations, imposes new requirements without adequately protecting US competitiveness or funding research and development of essential new technologies, and unnecessarily increases natural gas demand, among other reasons. ✦

NGSA: US natural gas supplies strong now, in foreseeable future

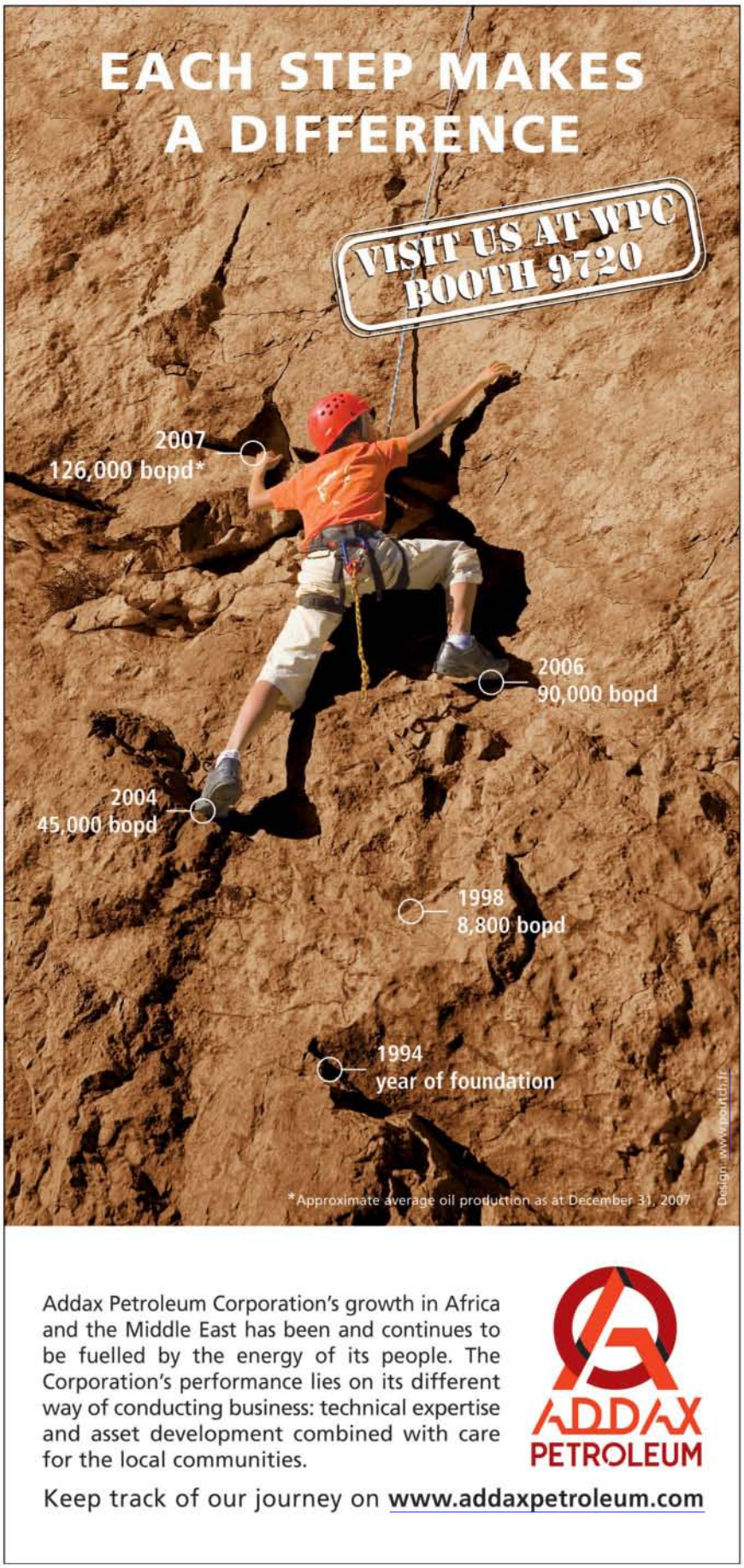
US natural gas supplies are strong and will remain that way for the foreseeable future, according to an association of gas producers and marketers.

The amount of gas in storage is on track to meet this year's expected winter demand, which should help lower prices, said Jenny Fordham, director of energy markets and government affairs for the Natural Gas Supply Association (NGSA).

Fordham said that while gas production from the Gulf of Mexico has been dropping in recent years, producers have met consumer demand by developing new gas finds in unconventional shale fields in Texas and in Marcellus shale field, which stretches from New York to West Virginia. NGSA also expects US LNG imports to strengthen in future years, although competition from world demand will continue to limit imports in the near term.

Separately, in a research report to clients this week, Raymond James & Associates analyst Marshall Adkins said the bank's gas model shows that the US will be on the verge of shutting in gas production—resulting in a gas price collapse—if it experiences normal summer weather, based on the recent 10-year average.

Raymond James expects domestic gas production growth to continue to grow at a 4-5 bcfd rate throughout 2008, as drilling activity ramps up, potentially offsetting production decline rates for several years. "We put the odds of a natural gas price collapse at 50%," the report said. "If summer weather is warmer than normal, incremental cooling demand should eat away at storage levels, bolstering double-digit natural gas prices. If the weather is milder than normal (i.e., colder than the 10-year average), then natural gas storage could exceed 3.65 tcf, and late summer natu-



ral gas prices could fall to $6/Mcf," the report said.

On May 22, the contract for June delivery of gas on the New York Mercantile Exchange closed at a recent high of $11.697/MMbtu. That is the highest closing price since the post-Hurricane Katrina rally in late 2005 and early 2006. This week's EIA natural gas storage release showed an 85 bcf stockbuild, putting working gas in storage at 1,614 bcf, down from a year ago but little changed from the 5-year average. ✦

WoodMac: Alberta oil sands triggers investment wave

The projected growth of Alberta oil sands production, which has in place some 1.75 trillion bbl of resources, is triggering a wave of investments, said Wood Mackenzie Ltd., Edinburgh.

Pipeline companies and refiners plan to invest more than $31 billion by 2015 to export and distribute oil sands products and to process them in the US refining system, based on disclosed project costs. That's not counting investments in internal pipelines in Alberta, the Canadian refining and upgrading system, or undisclosed refining investment, officials said.

"Overall planned investments are well positioned to ensure sufficient pipeline and refinery capacity to 2015, but any delays to key pipeline projects could result in significant bottlenecks," warned Lindsay Sword, global refinery research manager for Wood Mackenzie.

The Gateway and Texas Access pipeline developments "could determine the destination of oils sands products in the US and outside North America and influence US import patterns," Wood Mackenzie reported. Texas Access is a 768-mile, 30-in. diameter pipeline system being built by Enbridge Inc. and ExxonMobil Pipeline Co. from Patoka, Ill., to the Texas Gulf Coast to transport crude from the Canadian oil sands region in Alberta and from the upper US Midwest to refiners in Nederland and Houston, Tex.

The Gateway Pipeline is to be built by Enbridge to transport some 400,000 b/d of oil sands crude from near Edmonton, Alberta, to a tanker terminal in British Columbia for shipment to China, other parts of Asia, and to California.

The report forecasts that production of synthetic crude oil and Canadian heavy blends will grow by 2 million b/d during 2008-15, with half to be heavy blends. Wood Mackenzie said incremental pipeline capacity will exceed the new supply through 2015, and new US refinery capacity will keep pace with the expected new volumes.

US Gulf vs. Midwest

According to the report, by 2015 only small volumes of oil sands products will reach the US Gulf, where the vast majority of heavy oils are now processed. "There are two reasons for this: pipeline limitations and the new capacity being built in the Midwest aimed specifically at processing Canadian heavy blends," said Agustin Prieto, senior downstream analyst for Wood Mackenzie and primary author of the report. "Canadian heavy blends are only likely to reach the US Gulf if projects in the Midwest do not proceed as planned," he said.

This raises a question over future supply of heavy crude oil in the US Gulf, where a large number of projects are targeting the processing of additional volumes of heavy oils, and where there likely will be strong price competition for Canadian heavy blends, the report said. Pipeline investments are focused on expanding the export capacity to Petroleum Administration for Defense District (PADD) 2, which encompasses the US Midwest, and to the Pacific Coast as well as expanding the domestic US network to new markets in the US Gulf.

"We forecast new and incremental pipeline projects to provide an additional 2.1million b/d of capacity between 2008 and 2015," Prieto said. "The majority of new refinery capacity to process Canadian heavy blends will be located in PADD 2. Companies are investing in processing oil sands not only because of the new supply but also the attractive price differential vs. conventional light crude oils. BP, ConocoPhillips, and Marathon lead investment plans to process Canadian heavy blends in US refineries: these three companies and their JV partners plan to invest about $13 billion by 2015," Prieto said.

The report said Canada ranks as having one of the world's largest oil reserves, behind only Saudi Arabia and potentially Venezuela. Strong growth in oil sands production over the past few years has been an important contributor to global supply and has provided the US with the prospect of a secure source of supply from its neighbor and ally. ✦

Oil industry main target for Nigerian pirate attacks

Eric Watkins
Senior Correspondent

Nigeria has become the world's leader in piracy attacks, primarily targeting the oil industry in that country, according to the International Maritime Bureau.

"Violent attacks are carried out by pirates on board vessels at anchor and vessels carrying out ship-to-shore operations," IMB said. "Mariners are

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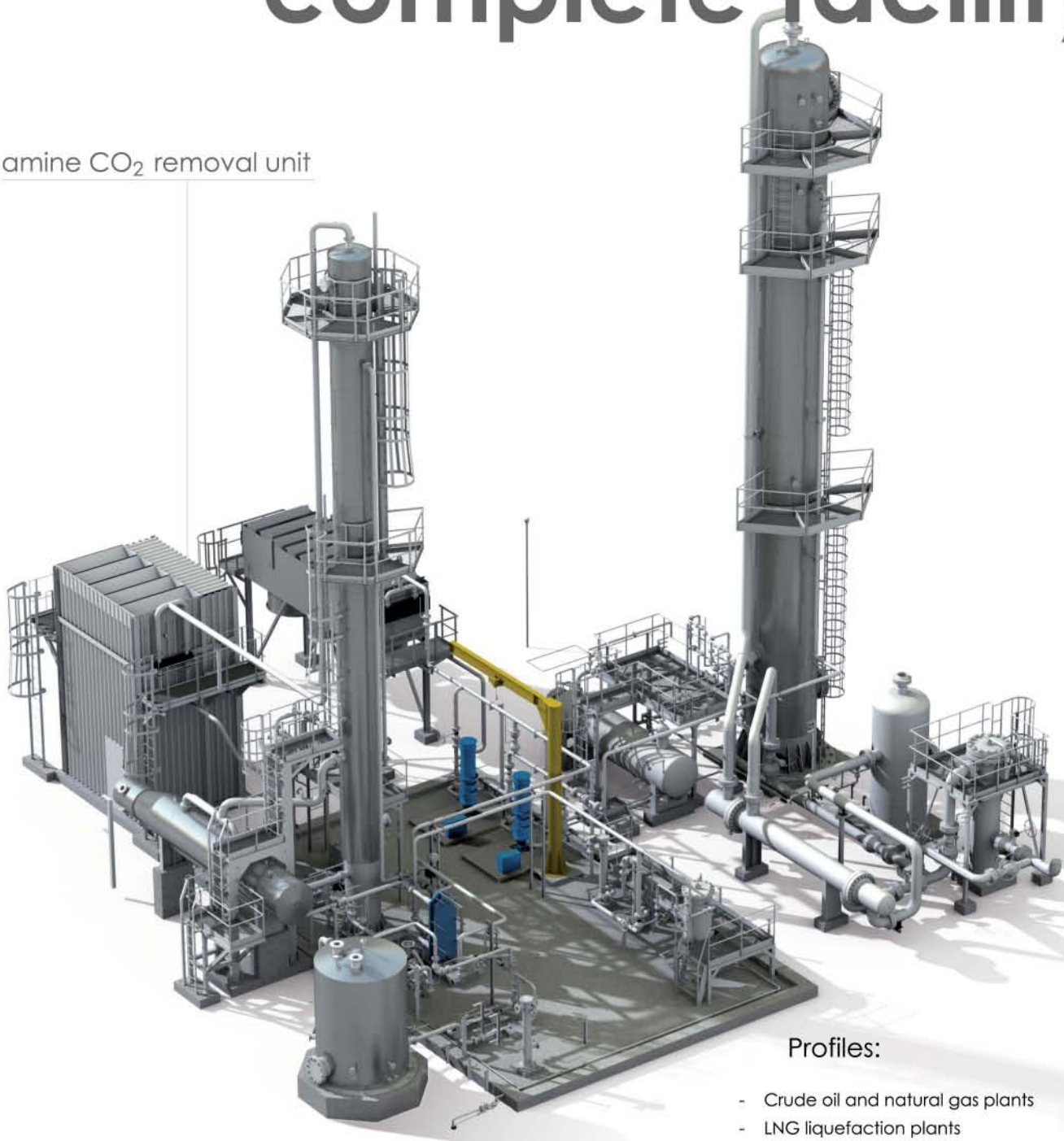

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WATCHING THE WORLD

Eric Watkins, Senior Correspondent

The Saudi view of speculators

Saudi Arabia's oil officials will doubtlessly feel exonerated—if not downright pleased—by a report last week blaming speculators for the steep rise in global oil prices over the past year or two.

KBC Market Services last week said that rather than market fundamentals, investors—who seem to brush aside news regarding the physical oil balance—are responsible for today's high oil prices.

"The greed and mismanagement that led to the credit crisis in the US and caused economic weakness has spilled over to the crude markets, with high oil prices imposing a further burden on the global economy and leading to major concerns over inflation," KBC said in its Monthly Oil Market Outlook.

KBC also took issue with some high oil price predictions issued by large investment banks, saying that they helped to increase prices by issuing bullish possible future price ranges that seem to be based on little more than extrapolations and herd mentality.

Deja vu

The news is not altogether new.

Flash back to last November when Saudi Oil Minister Ali al-Naimi said that the price of crude should be closer to $60/bbl than $100/bbl, pointing specifically to the lack of any connection between underlying market fundamentals and the price of crude oil.

"The price today really has no relation whatsoever with the fundamentals," said al-Naimi, adding that "the fundamentals do not support the current price."

At the time, Toronto's Globe and Mail newspaper did not seem to take to al-Naimi's view of things, mocking his "expansive thoughts" on the volatile oil market and the "pessimists," "gurus," and "experts" preaching Peak Oil that are "agitating the speculators."

But Newsweek magazine, writing at the same time, took a different tack: "Al-Naimi's view has lately been echoed by oil-company executives and Wall Street analysts," the magazine said. "Indeed, hedge funds, investment banks, program traders, and ordinary investors have been piling billions into oil futures, gas options, and complicated energy derivatives."

Money players

Investment banks like Morgan Stanley have made up to a quarter of their recent profits from energy trades, Newsweek said, citing hedge-fund tracker Peter Fusaro.

"While the oil analysts polled by Newsweek last week differ on the extent of the impact, they all agreed that the money players have helped drive up the price," it said.

"The market is no longer about physical supply and demand for oil," Ben Dell, energy analyst at Sanford Bernstein in New York, told the magazine. "The Saudis could be pumping another million barrels and it wouldn't change a thing."

At the time, Dell estimated that "the oil-price spike could hit $140 before coming down, in large part thanks to speculators."

Back in Riyadh, Al-Naimi must certainly be trying very hard to resist saying, "I told you so." ✦

advised to exercise extreme caution in these waters," it warned.

Nigeria accounted for 10 of the 49 pirate attacks registered worldwide in first-quarter 2008, making it "the number one hotspot" for piracy, IMB said. It marked the first time in 16 years of reporting that another country has surpassed Indonesia for that position. The most pirate-infested zones are around Nigeria's economic capital, Lagos, and in the oil-rich waters of the southern Niger Delta.

Nigerian officials say their country is ill-equipped to combat pirates, who operate in the nation's waterways with speedboats, machine guns, and radios to target tankers, trawlers, barges, and other oil industry support vessels. "Between Bayelsa and Delta (two oil-rich southern states) there are some 3,014 creeks leading to the ocean. With just 11 [operational Nigerian navy] vessels, it's extremely difficult to control these zones," said Nigerian navy spokesman Henry Babalola.

Meanwhile, Nigerian security forces located the MV Lourdes Tide, a supply vessel owned by Tide Waters firm and working for Chevron Corp. that was hijacked May 13 by armed militants in route from Onne in Rivers state to Escravos in Delta in southern Nigeria.

Authorities are said to be drawing up a strategy to free the vessel's 11-man crew after Chevron opposed an initial plan by security forces to storm the vessel. Military Joint Task Force spokesman Lieutenant Colonel Musa Sagir said the attackers asked for a ransom of $260,000 for the hostages' release.

In January, French maritime company Bourbon suspended activities on the Bonny River after an attack on one of its vessels, the Bourbon Leda, which was chartered by Royal Dutch Shell.

The Movement for the Emancipation of the Niger Delta (MEND), said to be the best-armed group in the region, claimed responsibility for the attack. A year ago, MEND claimed responsibility for an attack on Chevron's Oloibiri FPSO off Bayelsa state that resulted in

the death of one Nigerian sailor and the kidnapping of six foreign oil workers (OGJ, May 7, 2007, p. 35).

The US and French governments, deeply concerned about attacks on oil tankers, recently introduced a draft United Nations resolution that would allow countries to pursue pirates from the high seas into territorial waters to arrest them (OGJ, May 12, 2008 p. 36). ✦

Petrobras signs two LNG purchase deals with BG Group

Eric Watkins
Senior Correspondent

Brazil's Petroleo Brasileiro SA (Petrobras), in an effort to reduce its dependence on imports from neighboring Bolivia, has announced the signing of two contracts for the purchase of LNG from Britain's BG Group PLC.

"This is one more step toward setting up infrastructure to guarantee greater flexibility in the Brazilian gas market," said Petrobras Pres. Jose Sergio Gabrielli de Azevedo in announcing the agreements.

Analyst Global Insight said the agreements, which mark Brazil's conversion to an importer of LNG, also will give the country more flexibility to meet demand for gas from an electric power network that is predominantly hydroelectric.

Under the agreements, BG will supply the import terminals being built by Petrobras at Pecem in the state of Ceara and at Guanabara Bay in the state of Rio de Janeiro. Initially, Petrobras expects volumes to range 75,000-130,000 cu m/day.

The first agreement will provide the first LNG cargo ever to be delivered into Brazil and it will be used for the commissioning of the Pecem terminal in July. The second agreement will enable LNG to be supplied to either the Pecem or Guanabara terminals in Brazil. Petrobras will define, load-by-load, which terminal the LNG will be delivered to. This will be dependent on the gas demand in the local markets.

Brazil has been looking to buy LNG since Petrobras was forced out of Bolivia in 2006 after President Evo Morales nationalized the country's gas industry.

Petrobras still depends on Bolivia for 60% of the gas it uses, but due to lack of investment, La Paz's nationalized industry has been struggling to satisfy domestic demand growth as well as export commitments to Brazil and Argentina.

In March, reports said Bolivia's gas industry was operating near capacity. With output of less than 42 million cu m/day, Bolivia was hard-pressed to supply domestic demand and meet its contracts of 30 million cu m/day to Brazil and 7 million cu m/day—rising to 27.7 million cu m/day by 2010—to Argentina.

At the time, Carlos Alberto Lopez, a consultant with Cambridge Energy Research Associates and a former Bolivian energy minister, said the Latin American country had been unable to fulfill its commitments since September and that it seemed extremely unlikely for it to meet them in the medium term.

Meanwhile, Companhia de Gas de Santa Catarina June 2 presented its new $1.5 billion reais project to supply natural gas to the south of Brazil by 2012, making use of the existing Brazil-Bolivia gas pipeline between Araucaria and Canoas. ✦

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High oil, diesel prices cause protests in Europe

Doris Leblond
OGJ Correspondent

The soaring price of diesel oil, which is jeopardizing fishermen's already meager profits, has led to protests in France that are spreading to Spain, Portugal, and Italy. Truckers and farmers are joining the protest movement.

In France, the protest actions are fluctuating and sporadic. Total spokeswoman Christine de Champeaux told OGJ that product depots and ports are blocked for short periods and that demonstrations occur irregularly and in varied areas.

"Refineries, she said, must take different measures to supply service stations or see that refineries are supplied despite blocked ports. But, so far, the protests have been a hindrance rather than doing actual harm to oil companies." Protests are nevertheless being monitored on a daily basis.

French President Nicolas Sarkozy said he is standing by his request that the European Union lower the value-added taxes (VAT) on oil, a decision that requires unanimous approval of the 27 EU member countries. France's Finance and Economy Minister Christine Lagarde said May 29 that the EU should be more flexible in adjusting its policies to "exceptional circumstances," including the current soaring price of oil.

Lagarde also asked her colleagues within the Group of Seven richest countries to discuss the issue of high oil prices "among consumer nations," the outcome to be then presented to oil-producing countries.

France's Agriculture and Fisheries Minister Michel Barnier would like a "direct European subsidy" to keep Europe's fishing industry alive. He said at a meeting in Brussels that the EU should lift the ceiling on aid that a country can provide without referring to the EU Commission. It currently allows €30,000/fishery. Many countries, including Italy, consider this too low.

However, there is no consensus in Brussels on this proposal; governments fear that such a subsidy would have a domino effect on other economic areas also hit by high oil prices.

Meanwhile regarding production increases, Total CEO Christophe de Margerie confirmed to OGJ that he had indeed said on a recent visit to Angola accompanying President Nicolas Sarkozy that he "hoped that in 2-3 years" Total would become "the leading operator on the Angolan market" with its production reaching 700,000 b/d, up from the current 290,000 b/d. ✦

Early velocity integration vital in subsurface interpretations

R.J. Miller
Md. Seruddin Salleh
S. Levy
C.E. Guzman
Shell Exploration & Production Co.
New Orleans

This is the second of two parts on the critical role of accurate seismic velocity measurements in subsurface imaging.

The next example illustrates the link between the interpretation of seismic velocity trends and geologic interpretation of subsurface depth structures.

The example is taken from the Perdido fold belt in US territorial waters. A series of southwest-northeast trending compressional folds is the norm; however, a nearly circular anticline is apparent in the middle of the trend (see Figs. 13 and 14). The central circular structure has been drilled on its flank, confirming a good tie between ground or well velocities, and processing velocities.[3]

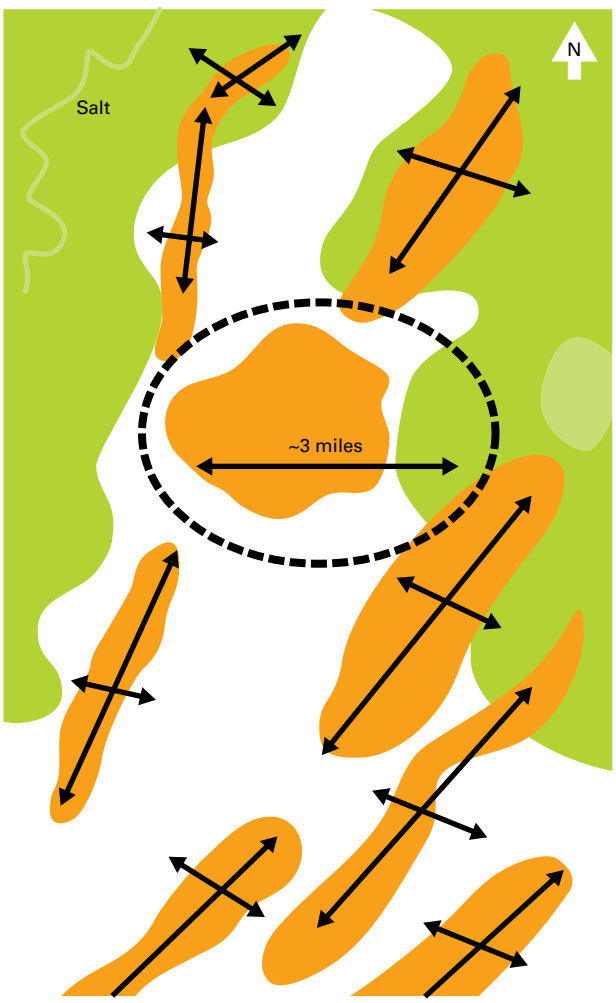
The area, including the circular structure, was vertically depth converted using semblance based seismic velocities with variable smoothing. As will be shown, the depth conversion and velocity diagnostics indicate that the observed circular anticline results from using a single or overly smoothed velocity that fails to account for the lateral velocity variations measured in the data. Diagnostics include 2D depth gathers of PSDM velocity models.

We focus on the circular anticline and show a time map (Fig. 14) followed by vertically depth converted maps using different velocities. We begin with a single function that removes water bottom variations (very minor changes, see Fig. 15) and evolve to laterally varying seismic velocities (Figs. 16 and 17). The PSTM semblance based maximum coherency seismic velocities were interpreted at 1,000 ft by 1,000 ft and 500 ft by 500 ft grids (Figs. 16 and 17).

Fig. 15 displays a depth map made using a single velocity function which removes

PERDIDO FOLD BELT

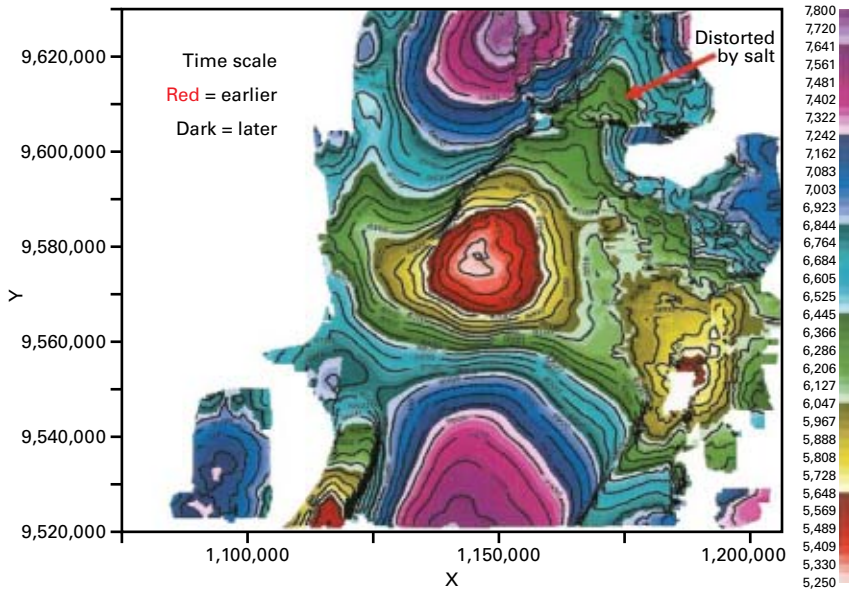
Fig. 13



Map shows southwest-northeast trending compressional folds of the Perdido fold belt, Gulf of Mexico, US territorial waters. Nearly circular anticline is apparent in the center of the trend. Green solid outlines are of salt masses that overlay some of the folds. The map was created using 2D lines acquired on a 1 mile by 1 mile grid. The trend has been confirmed by 3D mapping.

TIME MAP NEAR TOP CRETACEOUS STRONG SEISMIC MARKER

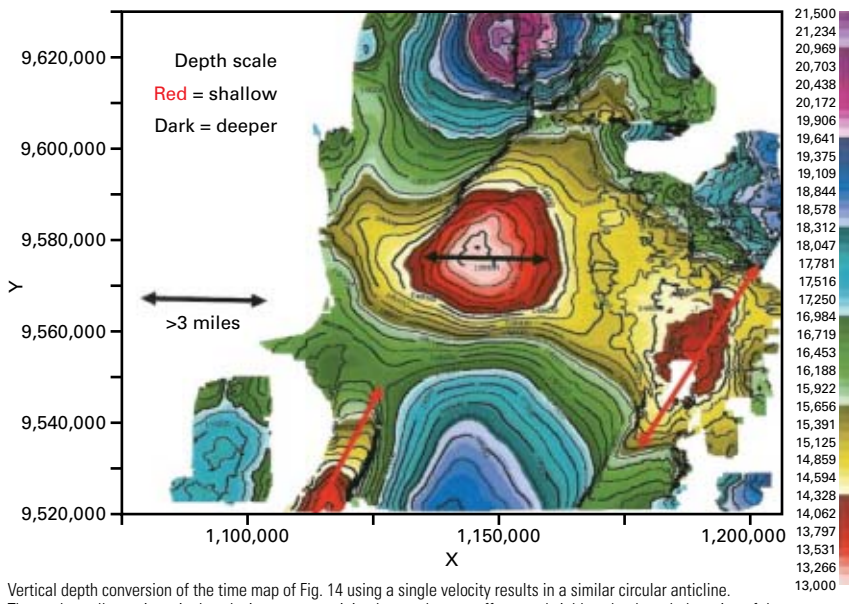
Fig. 14



The fold to the right of the figure and the fold to the north are distorted by salt. The anticline in the center is illuminated by sedimentary paths only. The vertical depth conversion is a good approximation.

DEPTH SCALED VERSION OF THE TIME MAP

Fig. 15



Vertical depth conversion of the time map of Fig. 14 using a single velocity results in a similar circular anticline. The nonlaterally varying, single velocity removes minimal water bottom effects and yields a depth scaled version of the time map. The long axes of the adjacent folds are indicated for reference; they were present in the time map of Fig. 14.

the water bottom variations. There is negligible change to the circular shape of the anticline.

The circular anticline begins to elongate when the velocity field is allowed to vary laterally. Fig. 16 shows a vertical depth conversion of the time map using a laterally variant but smoothed velocity field from the PSTM seismic velocities interpreted at 1,000 ft by 1,000 ft spatially. The Dix interval velocities are shown in color with darker colors representing faster velocities. Note that the anticline has begun to elongate along the southwest-northeast direction, starting to resemble the neighboring folds shown in Fig. 13.

Fig. 17 displays a vertical depth conversion of the time map made with finer sampled and less smoothed PSTM semblance based velocities. The PSTM velocities were sampled at a 500 ft by 500 ft spatial grid. Note that the circular anticline has now split into two folds that trend in the same direction as the neighbor structures shown in Fig. 13. The Dix interval velocity is shown in color.

Note that the circular structure of the time map (Fig. 14) has translated into two southwest-northeast trending folds, a significant change in our view of the subsurface. One may argue that it is not plausible for the seismic velocity to change in such a manner that disguises two folds as a single circular feature and prefer greater smoothing of the seismic velocity. However, it is evident that the smoothed velocities produce a feature that is anomalous in the geologic setting. Increasing the smoothing of the measured velocity trends towards a nonlaterally varying ground velocity results in a scaled version of the time image such as shown in Fig. 15.

To test the hypothesis that the circular anticline is in reality two folds, we investigate a 2D prestack depth migrated line oriented across the structure, as shown by the line depicted in blue in Fig. 17. This line was processed and migrated independently of the 3D PSTM analysis. The PSDM using a smoothed velocity function is shown in Fig. 18. The interval velocities are overlaid in color. As can be seen, the coherency of the reflectors over the circular anticline is poor. Depth gathers for this image are shown in Fig. 19. Note that the gathers are not flat at the horizon of interest, confirming that inappropriate velocities were used.

The velocities were refined using an updated velocity model that honors the shorter velocity variations present in the data. The resulting PSDM section is shown in Fig. 20, with the interval velocity overlaid using the same color

scale of Fig. 18. Some depth gathers used to create Fig. 20 are shown in Fig. 21; they come from the same location as those of Fig. 19. These depth gathers demonstrate flatter events at the horizon of interest, indicating that these velocities are more appropriate. Note that the depth image shows the presence of two folds, similar to those present in the depth map of Fig. 17. The 2D seismic velocity trend is similar to the time migration velocity trend—each preserved more of the lateral variations by employing less smoothing of the velocity data. Smoothing can be reduced simply by sampling at finer increments, in both time and space. The twofold concept has not been tested as only one well has penetrated the structure.

Summary

The examples presented illustrate the power of integrating seismic velocity information with subsurface interpretations at an early stage.

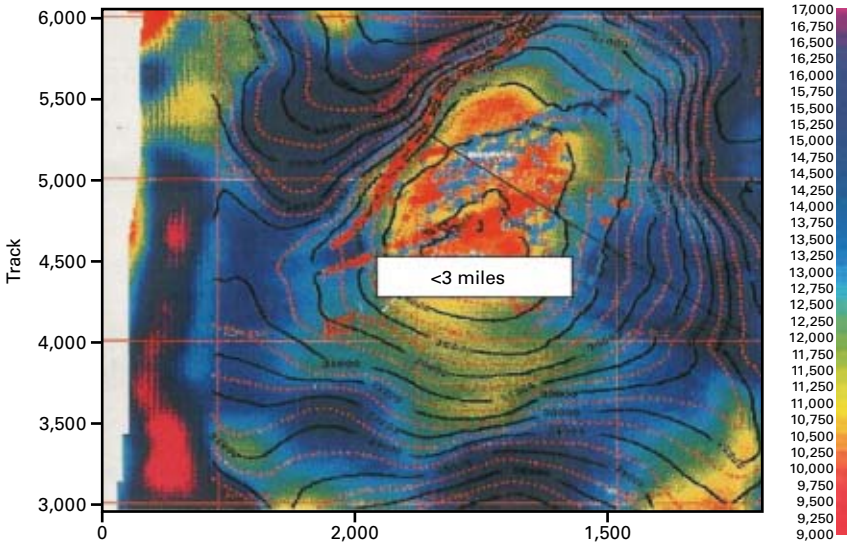
For instance, we presented an example demonstrating a lateral variation in velocity that can be attributed to lateral thinning of sand bodies. Hence, using the velocity information as part of the interpretation process can lead to valuable insights in the lithologic setting. Lithological information may be extracted from simple, densely sampled, maximum coherency seismic velocity measurements using time migrated data, as illustrated by the subsurface channel clearly visible in a Dix interval velocity slice (Figs. 1 and 2).

With other examples, we demonstrated a good fit between proven hydrocarbon pay and slow seismic interval velocities (Figs. 5, 7, and 8), suggesting that accurate seismic velocity measurements can be used to help evaluate the potential for pay.

The velocities slow near hydrocarbon accumulations due to changes in rock properties that result from the presence of hydrocarbons, and as there is no perfect seal and the accumulation is a dynamic system over geologic time, areas near the pay zone may also display slower velocities.

3D DEPTH MAP NEAR TOP OF CRETACEOUS

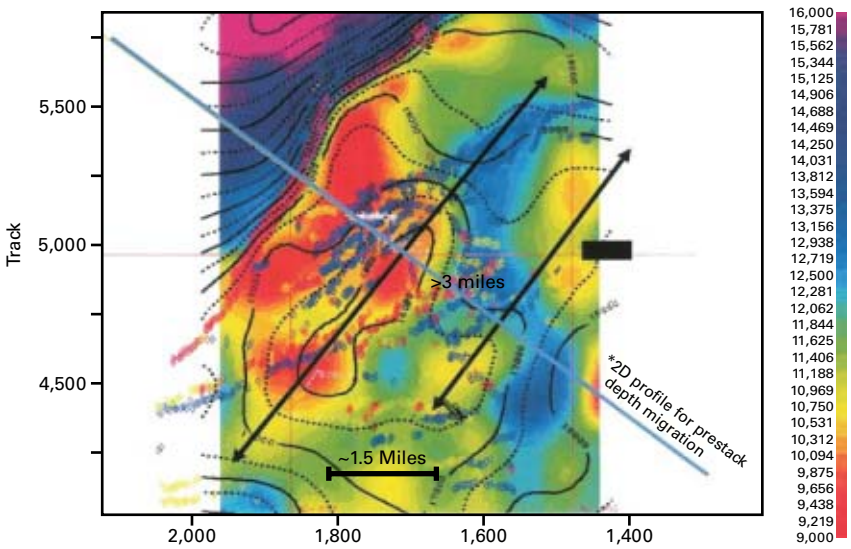
Fig. 16



The time map was converted to depth vertically using a smoothed, laterally varying, velocity obtained from measurements made in prestack time migrated data. Semblances were interpreted on a 1,000 ft by 1,000 ft spatial grid. Note that with this smoothed, laterally varying field, the circular anticline begins to elongate along the southwest-northeast trend similar to the neighbor folds (Fig. 13). The Dix interval velocity is shown in color with the darker, blue colors, indicating faster velocities.

VERTICAL DEPTH CONVERSION OF TOP CRETACEOUS TIME MAP

Fig. 17



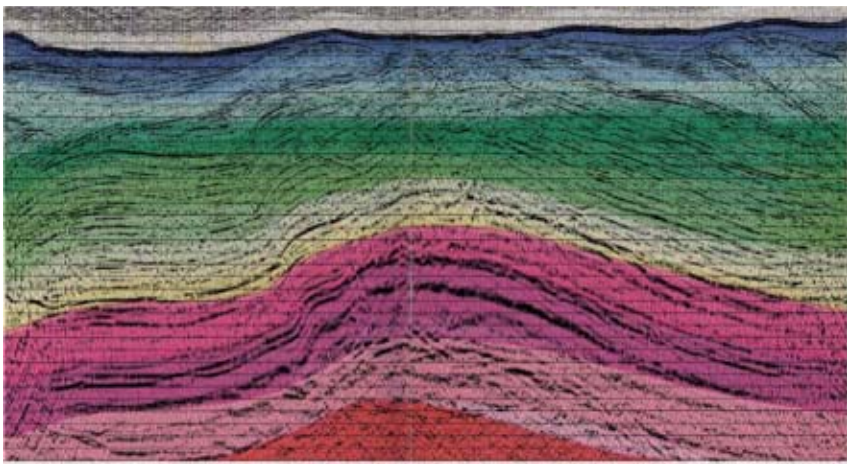
This conversion uses a seismic velocity that preserves detail of the 500 ft by 500 ft interpreted grid. Outliers have been removed but this smoothing preserves shorter wavelengths variations measured in the data. The circular time anticline has begun to split into two folds. Depth contours are shown together with the Dix interval velocity; the red color corresponds to the slowest interval velocities.

In Fig. 8, the depth contours did not fit the pay zone, whereas the seismic interval slow velocity fit well. All information available, such as compaction, burial history, well information, and lithology components need to be taken into account when using velocities to identify hydrocarbon bearing targets, as all slow velocity zones are not pay.

We demonstrated that velocity trends are not overly sensitive to acquisition geometry (Figs. 9-11), but the information available in the velocity field can be lost by oversmoothing the data set (Fig.

2D PRESTACK DEPTH MIGRATION ACROSS INTEREST AREA WITH VELOCITY MODEL

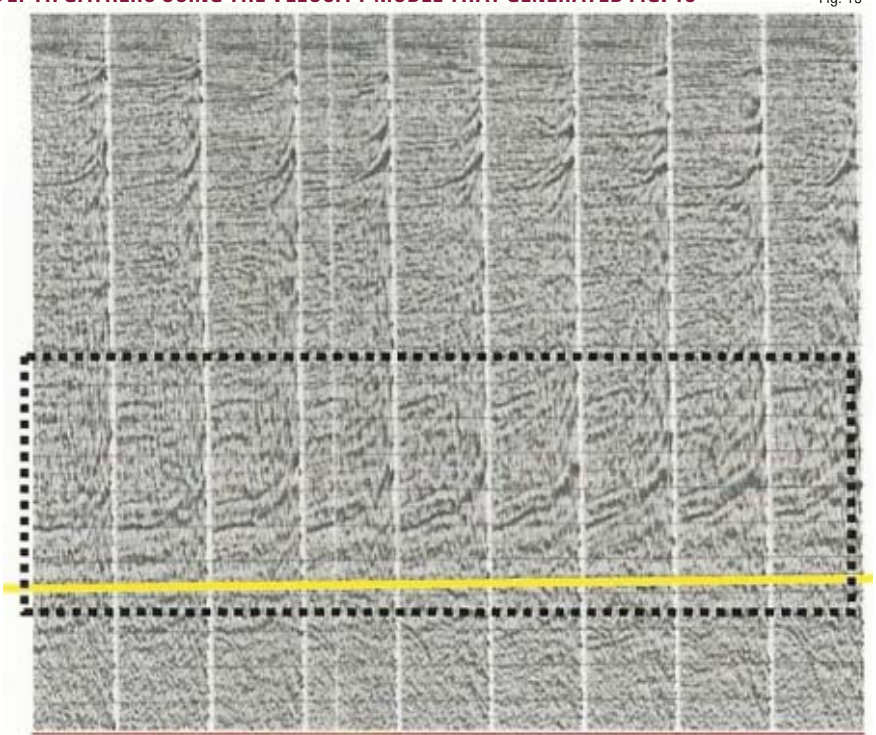
Fig. 18



The velocity model is overly smoothed, and the depth gathers of Fig. 19 indicate the model does not fit the data.

DEPTH GATHERS USING THE VELOCITY MODEL THAT GENERATED FIG. 18

Fig. 19



Flatness of the gathers is a diagnostic for validation of the velocity model. A flat line is used for reference.
The velocity model is unacceptable because of its poor quality; the image generated does not honor the data.

12). Here, oversmoothing can result simply by using too gross an interval between velocity samples, both in time and space.

As shown by the two orthogonal 3D survey velocities, the time velocities from both surveys showed similar trends, but the depth velocities used in the depth migrations for the two surveys varied. Valid information was lost in one survey's depth velocity model due to oversmoothing and coarse sampling. Because the time and depth velocity trends complement each other, both types of velocity information should be examined to ensure that valid information is preserved when transforming between domains.

Another example from the Perdido fold belt, deepwater US Gulf of Mexico, demonstrated the variation in the structural picture when converting to depth using smooth velocities vs. finely sampled, less smoothed seismic velocities. The depth maps that incorporated finer velocity detail better fit the expected geologic structural features found in the area.

In addition to impacting the imaged structures and other attributes based directly on seismic velocities, such as seismic based pore pressure estimation, undersampling and smoothing of the seismic velocity trends can lead the interpreter to miss valuable information that should be integrated into the interpretation.

As the examples demonstrated, smoothing the velocity trends should be done with care, as oversmoothing can destroy useful information while undersmoothing can result in unwanted noise. The interpreter should provide guidance on the degree of smoothing to be used, including guidance on the sampling intervals.

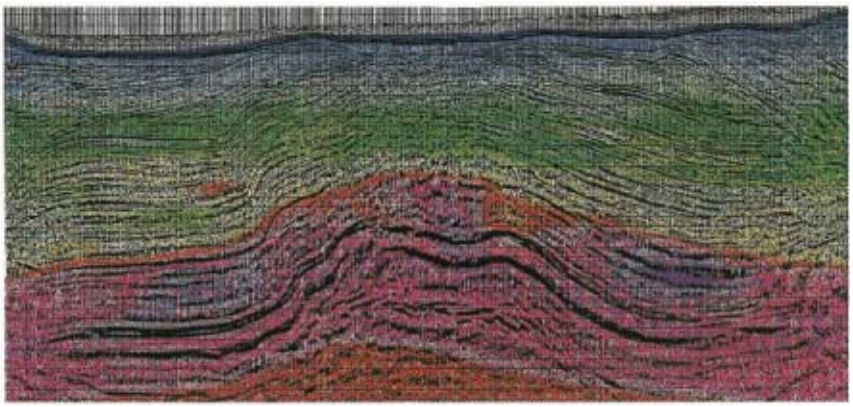
We have obtained excellent results with dense sampling, and in critical areas, we recommend velocity measurements be considered at every subsurface location. Smoothing of the data should take into account geological boundaries, loss of velocity resolution with depth, the quality of the data, maximum recorded offset, etc.

In cases where salt or salt welds separate younger synclinal basins from older basins with structure, many velocity models incorrectly force the seismic velocity to be laterally invariant across the salt boundary by extrapolating the young basin's velocity into the subsalt region. The inability to make travel time vs. angle measurements under the salt indicates that the problem needs to be addressed at the acquisition stage.

If the subsalt velocity model cannot be validated by the data, this fact

2D PRESTACK DEPTH MIGRATION WITH UPDATED VELOCITY MODEL

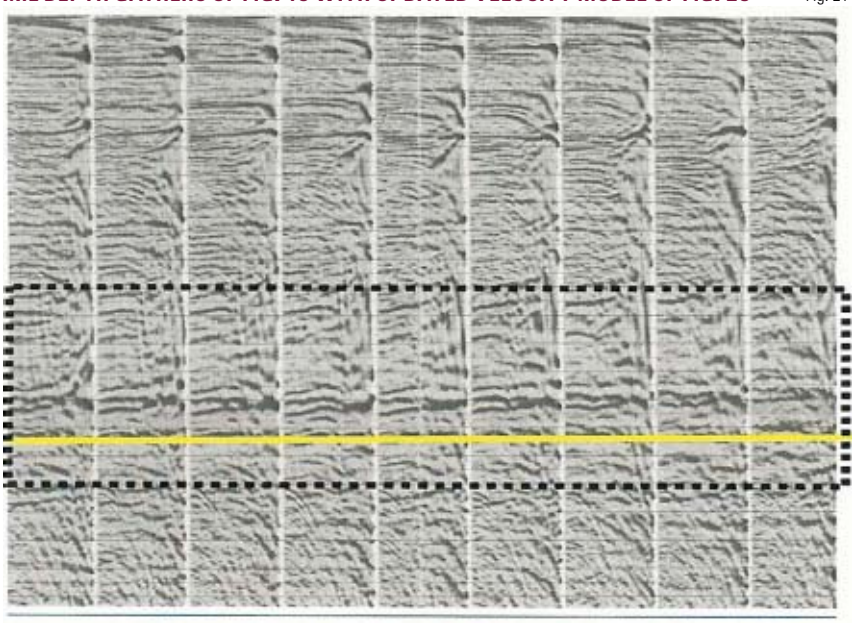
Fig. 20



The updated velocity model honors shorter velocity variations and results in properly corrected depth gathers. The depth image shows similar structural picture independently derived by the depth map shown in Fig. 17. Essentially, the 2D PSDM seismic velocity trend matches the time migration velocity trend that preserved more detail with finer sampling and lesser smoothing. The interval velocity color scale is the same as that used in Fig. 18. Darker colors correspond to faster interval velocities.

SAME DEPTH GATHERS OF FIG. 19 WITH UPDATED VELOCITY MODEL OF FIG. 20

Fig. 21



Note the flatness of gathers near the horizon of interest indicative of a better velocity model.

should be taken into account in risking the prospect and in deciding whether to commit additional reprocessing resources testing velocity models that cannot be validated by the recorded data.

The interpreter should guide the smoothing based upon knowledge of the area and of the data.

Acknowledgments

We appreciate the support of the management of Shell Exploration & Production Co. We have benefited from discussions with present and former Shell colleagues. Although we do not all share the same position on the topics discussed, we share the same enthusiasm for seismic velocity interpretation. In this article we present our interpretation of the seismic velocity trends and recognize there are alternate views. We thank our colleagues involved in the acquisition and processing of the data. The authors are indebted to Bernard Meroney, with the firm Jones & Walker, for his suggestions and technical revisions to this paper. ✦

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Albania

The DWM Petroleum AG subsidiary of Manas Petroleum Corp., Baar, Switzerland, let a contract for acquisition of 400 line-km of Vibroseis and dynamic 2D seismic surveys on Manas-held acreage in Albania.

The survey, to be shot starting in July, is to refine the definition of nine prospects identified in the Albanian fold thrust belt. Drilling is planned in 2009. Blocks A, B, D, and E cover more than 3,000 sq km.

The seismic shoot will augment the 679 km of data recently processed by GeoConcept, Denver.

China

Zhong Yuan Ltd. of Xinjiang Province signed a memorandum of understanding with TrueStar Petroleum Corp., Vancouver, BC, that provides the structure for partnering to exploit coalbed and coal mine methane in the Chinese province.

The MOU sets up a framework for the companies to seek needed regulatory approvals to implement field projects.

Zhong Yuan provides electricity to the province's central power grid and holds interests in more than 2,800 sq km of coal acreage in the Zhunggar and Tuha basins.

Bankruptcy court approved TrueStar's sale of most of its Barnett shale assets in Texas for $17.8 million, to close May 30, which will allow the company to proceed with its Guatemala and China projects.

Colombia

Petro Vista Energy Corp., Vancouver, BC, plans to take a farmout from New Horizon Exploration Inc. of a 25% working interest in the 68,473-acre La Maye Block in Colombia's Lower Magdalena basin.

Completion is subject to Petro Vista receiving TSX Venture Exchange accep-

tance and Agencia Nacional de Hidrocarburos approval of the assignment of the 25% interest to Petro Vista.

The block, east of Cicuco oil and gas field, has four to five large prospects identified. Drilling could start in October.

Phase 1 of the exploration and production contract is for 12 months and requires reprocessing 138 line-km of seismic data, already completed, and drilling one exploration well to at least 5,000 ft.

Iraq

WesternZagros Resources Ltd., Calgary, spud its Sarqala-1 wildcat in early May on the 2,120 sq km Kalar-Bawanoor Block in Iraqi Kurdistan.

The well, first of a multiwell program scheduled for the next 3 years, is projected to 4,800 m to evaluate four potential reservoirs.

Meanwhile, the company continues to shoot seismic. By shooting more than 1,265 line-km, it has exceeded its seismic commitment under the production-sharing contract.

WesternZagros is operator with 40% working interest, and it carries the Kurdistan Regional Government for 20%. The KRG is to allocate the other 40% to a third party by August 2008.

Louisiana

Goodrich Petroleum Corp., Houston, is boosting its net exposure in the Jurassic Haynesville shale to 30,000 net acres by acquiring from a private party 3,250 net acres in Longwood field, Caddo Parish, La.

The acquisition, for $32 million in stock, includes 12.3 bcf of proved reserves, 75% developed, associated with the shallower Cretaceous Hosston and Jurassic Cotton Valley formations. The company obtains interests in 25 gross wells with 1.2 MMcfed of net output.

Goodrich plans to drill two new vertical wells and reenter one well to test the Haynesville shale at Longwood.

The company's first vertical Haynesville shale well in Bethany-Longstreet field, Cook-1, tested just over 1 MMcfd from the shale. Its second well, Brown-1, cut 230 ft of net shale with extensive gas shows throughout and is being completed. The first horizontal well should spud in 90 days.

Utah

An undisclosed large public company will pay $8.4 million to buy from Pioneer Oil & Gas, South Jordan, Utah, a 15% working interest in 199,000 acres in Pioneer's Central Utah Overthrust acreage position.

Pioneer will retain a 3.75% working interest and various overriding royalty interests and is participating in a large geophysical survey covering much of the acreage.

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Projects being developed encompass a diverse mix

Guntis Moritis
Production Editor

A wide variety of oil and gas projects will start producing in next the few years.

The accompanying table lists projects in 47 countries that will have a peak production in 2008 or after. If all the projects' peak production rates occurred in the same year, world production capacity would increase by 28.5 million b/d of liquids and 74.7 bcfd of gas.

The list includes individual fields and in some cases the required infrastructure. Listed are:

- Discoveries that have announced publicly available development plans.
- Field redevelopments for recovering bypassed oil.
- Stranded-gas projects and projects to eliminate gas flaring. These projects often include new infrastructure such as pipelines for transporting the gas to end users or facilities for producing LNG and GTL.
- Heavy-oil projects that may include new infrastructure such as pipelines, crude oil upgraders, and mines.
- Deepwater projects, some of which rely on long flowline tiebacks and hub facilities.
- Unconventional resources such as tight sands, shale gas, and coalbed methane gas.

Although joint ventures operate some projects listed in the table, for simplification, the table only includes name of one company in each joint venture (see accompanying table listing the parent companies' full names).

The year shown in the project list is when production may peak or enter a peak production plateau that could last for several years.

Asia-Pacific

LNG projects continue to dominate the Asia-Pacific region with Australia having several. Greater Gorgon will develop fields containing about 40 tcf of gas. The proposed Gorgon project will have two 5-million tonne/year LNG trains and a domestic gas plant on Barrow Island. The project also includes reinjection and sequestration of carbon dioxide on Barrow Island. Gorgon may start shipping LNG in 2013.

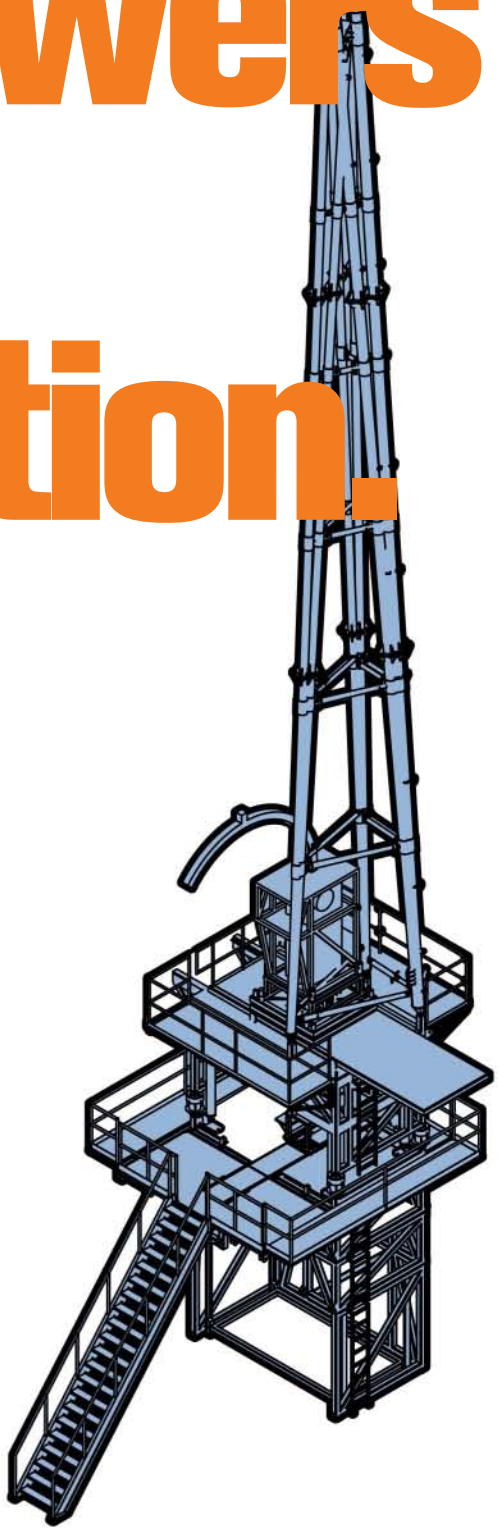
Development of the Sunrise and Troubadour projects off East Timor and Australia may again start after being on hold for a number of years. The projects would involve development of about 8 tcf of gas that an expansion of the Bayu Udan LNG plant would process.

Ichthys is a large 9.5-tcf deepwater gas and condensate project off northwest Australia that may include a semi-submesible production facility with a flowline to shore connected to a new gas liquefaction plant.

Others projects in Australia that involve LNG include Wheatstone in the Carnarvon basin, Crux in the Northwest shelf, a fifth train for the North West Shelf LNG plant, and Pluto field in the Burrup Park LNG project.

In Indonesia, several new fields will supply gas to existing and new LNG plants and power stations. The largest

DEVIN towers over the competition.



DEVIN's new Track Stack Coiled Tubing Drilling (CTD) Tower allows for a viable alternative for workover rigs. This tower is conveniently rigged up and ready for operation in under six hours with two platform levels and guard railings meeting OSHA requirements, demonstrating DEVIN's commitment to safety.

Versatility is the key to the Track Stack CTD Tower, whether you are re-entering the well using coiled tubing or jointed pipe, or working with bottom hole assemblies, the ease of deploying the necessary equipment is what makes this tower a benefit.

The Track Stack CTD Tower contains a 10,000 lb. capacity gin pole allowing for bottom hole assemblies to be completely assembled on the ground and then deployed, or the swing arm crane and false rotary, with the capability to handle tongs, can be used to make and break jointed pipe while setting the slips. When coiled tubing is being used to re-enter, the tower has a designated position for the injector head.

This multifunctional tower is designed to eliminate unnecessary down time and labor intensive equipment. DEVIN remains committed to finding new innovative ways to increase production safely and economically.

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COMPANY NAMES

ADCO	Abu Dhabi Co.
Addax	Addax and Oryx Group
ADNOC	Abu Dhabi National Oil Co.
AED	AED Oil Ltd.
Anadarko	Anadarko Petroleum Corp.
Apache	Apache Corp.
Aramco	Saudi Arabian Oil Co.
ATP	ATP Oil & Gas Corp.
Avarasya	Avrasya Technology Engineering and Construction Inc.
Barrett	Barrett Resources LLC
BHP	BHP Billiton Ltd.
BlackRock	BlackRock Ventures Inc.
BP	BP PLC
Cairn	Cairn Energy PLC
Chevron	Chevron Corp.
CNOOC	China National Offshore Oil Corp. Ltd.
CNPC	China National Petroleum Corp.
CNRL	Canadian Natural Resources Ltd.
Connacher	Connacher Oil and Gas Ltd.
ConocoPhillips	ConocoPhillips
Coogee	Coogee Resources Ltd.
Daewoo	Daewoo International Corp.
Devon	Devon Energy Corp.
DNO	DNO ASA
DPS	DPS Ltd.
El Paso	El Paso Corp.
EnCana	EnCana Corp.
Enerplus	Enerplus Resources Fund
Eni	Eni SPA
ExxonMobil	ExxonMobil Corp.
First Calgary	First Calgary Petroleums Ltd.
Gazprom	OAO Gazprom
Helix	Helix Energy Solutions Group
Hess	Hess Corp.
Hunt Oil	Hunt Oil Co.
Husky	Husky Energy Inc.
Inpex	Inpex Holdings Inc.
Imperial Oil	Imperial Oil Ltd.
Ivanhoe	Ivanhoe Energy Inc.
JACOS	Japan Canada Oil Sands Ltd.
KNPC	Korean National Oil Co.
KOC	Kuwait Oil Co.
KPC	Kuwait Petroleum Corp.
Lukoil	OAO Lukoil
Maersk	Maersk Group
Marathon	Marathon Oil Corp.
MEG Enegy	MEG Energy Corp.
Murphy	Murphy Oil Corp.
Nexen	Nexen Inc.
Nexus	Nexus Energy Ltd.
NIOC	National Iranian Oil Co.
Occidental	Occidental Petroleum Corp.
Oilexco	Oilexco Inc.
OGI	OGI Group
Origin Energy	Origin Energy Ltd.
OMV	OMV AG
Pan American	Pan American Energy LLC
PDO	Petroleum Development Oman LLC
Pdvsa	Petroleos de Venezuela SA
Pemex	Petroleos Mexicanos
Pertamina	PT Pertamina (Persero)
Petrel	Petrel Resources PLC
Petrobank	Petrobankl Energy and Resources Ltd
Petrobras	Petroleo Brasileiro SA
PetroCanada	PetroCanada
Petrodar	Petrodar Operating Co.
Petrofac	Petrofac Group
Petrom	Petrom SA
Petronas	Petroliam Nasional Berhad
Petrovietnam	Vietnam Oil & Gas Corp.
Pioneer	Pioneer Natural Resources Inc.
Pluspetrol	Pluspetrol Peru Corp.
PTTEP	PTT Exploration & Production PLC
Qeshm	Qeshm Energy Oil Industries Development Co.
QP	Qatar Petroleum Corp.
Reliance	Reliance Industries Ltd.
Repsol	Repsol YPF SA
Rosneft	OAO Rosneft
Santos	Santos Ltd.
Shell	Shell Group
Sinopec	Sinopec Corp.
Soco	Soco International Ltd.
Sonangol	Sonangol
Sonatrach	Sonatrach
Soyuzneftegaz	Soyuzneftegaz Ltd.
StatoilHydro	StatoilHydro ASA
Suncor	Suncor Energy Inc.
Syncrude	Syncrude Canada Ltd.
Synenco	Synenco Energy Inc.
Talisman	Talisman Energy Inc.
Toreador	Toreador Resources Corp.
TPAO	Turkish Petroleum Corp.
Total	Total SA
Tullow	Tullow Oil PLC
Value Creation	Value Creation Inc.
Venture	Venture Production PLC
Verenex	Verenex Energy Inc.
Woodside	Woodside Petroleum Ltd.

new LNG project is Tangguh that will start shipping LNG in 2009 and process gas from new fields in Papua Bintuni Bay.

Indonesia's largest new oil development is Banyu Urip field in the Cepu block on Java. The field will go onstream in 2010 and the project calls for exporting the oil from a floating storage vessel moored off Tuban in the Java Sea.

ExxonMobil Corp. and the government of Indonesia are still discussing terms for proceeding with the development of Natuna D-Alpha field in the South China Sea. The field, discovered several decades ago, contains about 40 tcf of gas. Delaying and complicating field development is the large presence of carbon dioxide.

India has both onshore oil and gas discoveries. The gas off the eastern coast will be produced through subsea-completed wells brought ashore with long flowlines.

New projects will develop fields off China in both the South China Sea and Bohai Bay.

Development of gas fields in the Southern Highlands of Papua New Guinea includes construction of a gas liquefaction plant. As now proposed, gas from reserves in the PNG Southern and Western Highlands would go to a 6.3 million tonnes/year, two-train LNG liquefaction and storage facility near Port Moresby. The gas would come from Hides, Angore, Juha, Gobe, Moran, and Kutubu fields.

Western Europe

Oil and gas developments continue off the UK and Norway. Many of these developments will tie into the extensive existing infrastructure.

In Italy, the onshore Tempa Rossa project will develop an estimated 200 million bbl of heavy oil reserves.

Eastern Europe, FSU

Phased development of Tengiz field, in Kazakhstan, continues with a $9.5 expansion project that will increase oil production by 260,000 b/d after 2010. Also in Kazakhstan, an expansion of Karachaganak field will increase production by 1.6 bcfd in 2012.

Because of delays, the first phase of the 13-billion bbl Kashagan field, off Kazakhstan, is now slated to start producing not before 2012. With future phases, the field's production may surpass 1 million b/d.

The largest proposed development in Russia is the 130-tcf Shtockman field in the Barents Sea. The first phase of the Shtockman field may start producing gas in 2011 at a rate 2.1 bcfd. Subsequent phases may increase production to 8.7 bcfd in 2014-19.

Another large field under development is the 70-tcf Kovykta in eastern Russia. Gazprom now operates the field that will require new pipelines for moving the gas to potential users, such as in China.

Middle East

Iran continues to develop light and heavy oil resources, including the phased development of the offshore South Pars gas field, which is an extension of Qatar's giant North field.

Iraq has been slow in developing its considerable potential. The table lists some of the potential fields that might be developed, possibly with assistance from international oil companies listed.

Kuwait continues to redevelop several fields that will increase its production capacity by 450,000 bo/d in 2012.

In Oman, several enhanced oil recovery projects will improve recovery factors from several fields. The main

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process includes steam injection and sour-gas injection.

Phased development of 900-tcf North field off Qatar continues with additional LNG trains and a GTL plant. Saudi Arabia is adding production capacity, such as the Khurais expansion with a designed 1.2 million bo/d peak production capacity.

ADCO in Abu Dhabi is expanding production capacity in various fields by 560,000 b/d. Also ExxonMobil is involved in the Upper Zakum redevelopment that will increase production by about 250,000 b/d from the field.

Africa

Redeveloping of fields in Algeria continues, including Rhounde El Baguel field, the largest oil field in Algeria, which went on stream in 1962. Sonatrach expects production from this redevelopment to peak at 100,000 bo/d in 2009.

Deepwater Angola and Nigeria remain very active. Projects mostly involve installation of floating production, storage, and offloading (FPSO) vessels and subsea wells.

Also being built in Angola is a one-train LNG plant that will receive associated as well as nonassociated gas.

Nigeria also has several new LNG projects that will monetize primarily associated gas, some of which is now flared.

Western Hemisphere

Petrobras, besides its phased development of several giant fields in the Campos basin, also has several substantial discoveries particularly in the Santos basin, such as Tupi and Carioca. These new fields will add several billion bbl of reserves and may provide oil production rates greater than 1 million b/d when fully delineated and developed.

Although Petrobras is the main producer in Brazil, new companies with development projects include units of El Paso Corp., Chevron Corp., StatoilHydro ASA, Devon Energy Corp., and the Shell Group.

Phased development of the heavy oil sands in Alberta continues. These phased projects will add about 2 million b/d by 2016 to the current 1.2 million b/d being produced from the oil sands.

Operators and the Canadian government are still negotiating an agreement for the proposed $6-billion (Can.), 760-mile McKenzie Delta pipeline that would allow for producing the large stranded gas resources in the Northwest Territories. First gas may flow after 2014.

Deepwater developments in the Gulf of Mexico will continue to add substantial new production capacity. The largest is the much-delayed Thunder Horse, scheduled to start production in late 2008 with design capacity of 210,000 bo/d and 185 MMscfd of gas.

Operators and the government of Alaska still have not reached agreement on construction of a $20-billion Alaska gas pipeline that would allow producing an estimated 40-tcf of gas currently stranded on the North Slope.

Technological advances as well as higher gas prices have made feasible many tight gas, shale gas, and coalbed gas developments, such as the Piceance tight-gas projects in Colorado, the coalbed methane in the San Juan basin, and the Barnett shales of Texas.

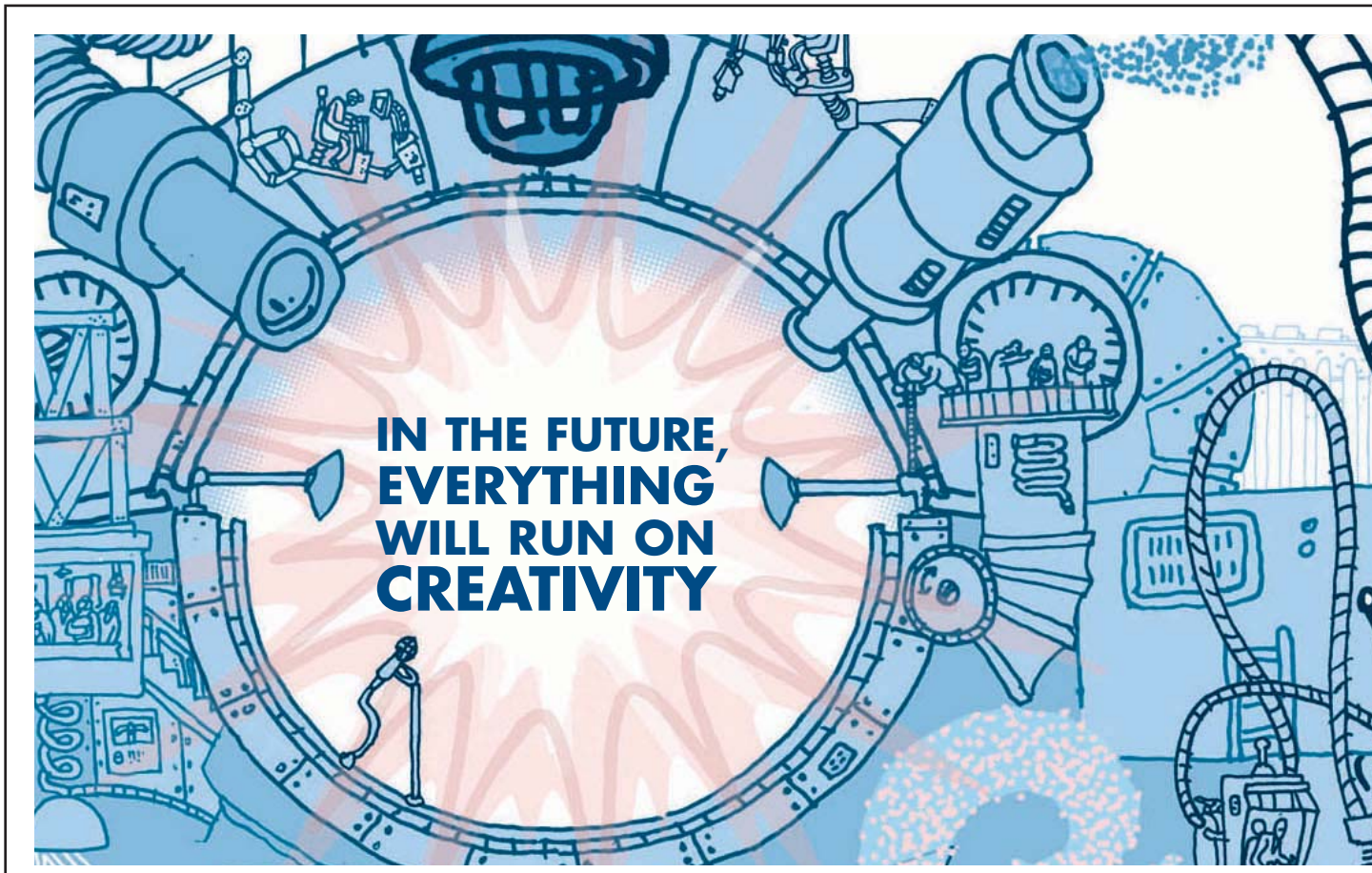
Venezuela has many potential development projects, but its government's actions have created uncertainty as to their completion. ✦

MAJOR PROJECTS

Project	Peak year	Liquids, 1,000 b/d	Gas, MMscfd	Operator	Development type
Algeria					
Block 208-EKT, EMK, EMN, EME	2010	155		Anadarko	$2 billion, oil and condensate
Berkine Block 405b	2009		40	First Calgary	Condensate
El Gassi, El Agreb, Zotti	2009		15	Hess	$500 million redevelopment
Skikda condensate splitter	2008		125	Sonatrach	$0.5 billion
Rhourde El Baguel	2009		100	Sonatrach	Redevelopment of one of Algeria's largest oil fields
Zarzaitine	2010		15	Sinopec	$500 million redevelopment
Angola					
Plutonio, Paladio, Platina, Galio, Cromio, and Cobalto	2008	240	330	BP	Block 18, FPSO spread-moored, 2 million bbl storage, 1,350-m water, production started Oct. 2007
Plutao, Saturna, Venus, Marte (PSVM)	2010+	150		BP	Block 31, 500 million bbl of oil, FPSO, 150,000 bbl storage, 5,900-6,730 ft water
Platino, Chumbo, Cesio	2010+			BP	Block 18, FPSO, 1,600-m water
Palas, Ceres, Juno, Astrea, Hebe, Urano, Titania	2012+			BP	Block 31 discoveries
Terra Miranda, Cordelia, Portia	2012+			BP	Block 31 discoveries
Lucapa	2010+			Chevron	Block 14 discovery
Negage	2010+	75	100	Chevron	Block 14, FPSO 1.5 million bbl storage, 1,500-m water
LNG various fields	2012+		1,000	Chevron	Onshore, one train, 5.2 million LNG tonnes/year, 10 tcf of reserves in associated gas from Blocks 15, 17, 18, 0, and 14, and nonassociated gas from Blocks 1 and 2
Tombua, Landana	2009	100	210	Chevron	Block 14, compliant tower in 400-m water
Kizomba C-Mondo	2008	100		ExxonMobil	Block 15, 600 boe from all three C fields, FPSO, 2 million bbl storage, 1,000 m water, production started Jan. 2008
Kizomba C-Saxi, Batuque	2008	100	300	ExxonMobil	Block 15, FPSO, 1.6 million bbl storage, 1,000 m water, production started Jan. 2008
Kizomba Satellites	2010+	125		ExxonMobil	Block 15, FPSO, 1,000-m water
Gimboa	2008	60	20	Sonangol	Leased FPSO, 1.8 million bbl storage
Cravo-Lirio-Orquidea-Violeta (CLOV)	2012+	150		Total	Block 17, FPSO
Pazflor-Perpetua, Zinia, Hortensia, Acacia	2011+	200	150	Total	Block 17, FPSO, 1.9 million bbl storage in 2,500 ft of water, three subsea separation stations, 25 subsea oil wells, 2 gas injection wells, and 22 water injection wells
Gindungo, Canela, Gengibre (GCG), Mostarda	2012+	120		Total	Block 32, 300 million bbl of oil, FPSO, 4,600-5,900 ft water
Cola, Salsa, Manjericao, Caril Louro, Caminhos, Colorau, Alho	2012+			Total	Block 32 discoveries
Argentina					
Cerro Dragon	2009+			Pan American	$550 million IFC field development loan, Golfo San Jorge basin, Chubut province
Australia					
Puffin SW	2008	40	12	AED	FPSO, 70-m water
Van Gogh	2008	60	80	Apache	FPSO, 600,000 bbl storage, 350-m water
Pyrenees	2010	100	60	BHP	FPSO, 1 million bbl storage, 200-m water
Stybarrow	2009	80		BHP	FPSO, 800 million bbl storage, 825-m water
Gorgon, Jansz, Io, Chandon, Geryon, Maenad, Orthrus	2013+	10	1,575	Chevron	Greater Gorgon two million tonnes/year LNG trains on Barrow Island to development about 40 tcf of gas, subsea wells tied back to shore
Wheatstone	2013+		1,000	Chevron	Carnarvon basin gas field in 650-ft water, 4.5 tcf reserves, 5 million tonne/year LNG train
Montara, Skua, Swift-Swallow	2008	40		Coogee	Platform, FPSO, subsea wells in 80-m water
Blacktip	2009		180	ENI	$325 million, Northwest shelf, platform in 50-m water and 108-km pipeline
Kipper, Tuna	2010+	20	150	ExxonMobil	Gippsland basin gas, Kipper includes initially two subsea completed wells tied back to West Tuna platform
Scarborough	2010+		965	ExxonMobil	10 tcf of gas
Ichthys	2012+	100	1,200	Inpex	Northwest shelf, semisubmersible in 230-m water, onshore LNG plant, 6 million tonnes/year, 200-km flowline, 9.5-tcf gas, 312 million bbl condensate
Crux	2010	35		Nexus	$540 million, Browse basin condensate, leased FPSO, 190-m water
Bass Gas Project-Yolla field	2007	17	46	Origin Energy	Fixed platform off Victoria, 400 bcf of reserves
Angel	2008	50	800	Woodside	$1.6 billion (Aus.), Northwest shelf gas-condensate field, processing platform, 80-m water
North West Shelf Train 5	2008		800	Woodside	$2.6 billion (Aus.), 4.2 million tonnes/year
North Rankin 2	2013			Woodside	$5 billion (Aus.), new platform for low pressure gas from North Rankin and Perseus gas fields
Pluto	2010		800	Woodside	$12 billion (Aus.), LNG, 4.1 tcf offshore development, 5-6 million mt/year
Vincent	2008	120	100	Woodside	$720 million, FPSO, 1.2 million bbl storage, 8 subsea wells, 350-m water
Azerbaijan					
ACG Phase 3-Deepwater Gunashli	2008	300		BP	Production started Apr. 2008
Shah Deniz FF	2012+		2,600	BP	$10 billion gas-condensate project
Bangladesh					
Bibiyana	2010		500	Chevron	Onshore, production started in 2007

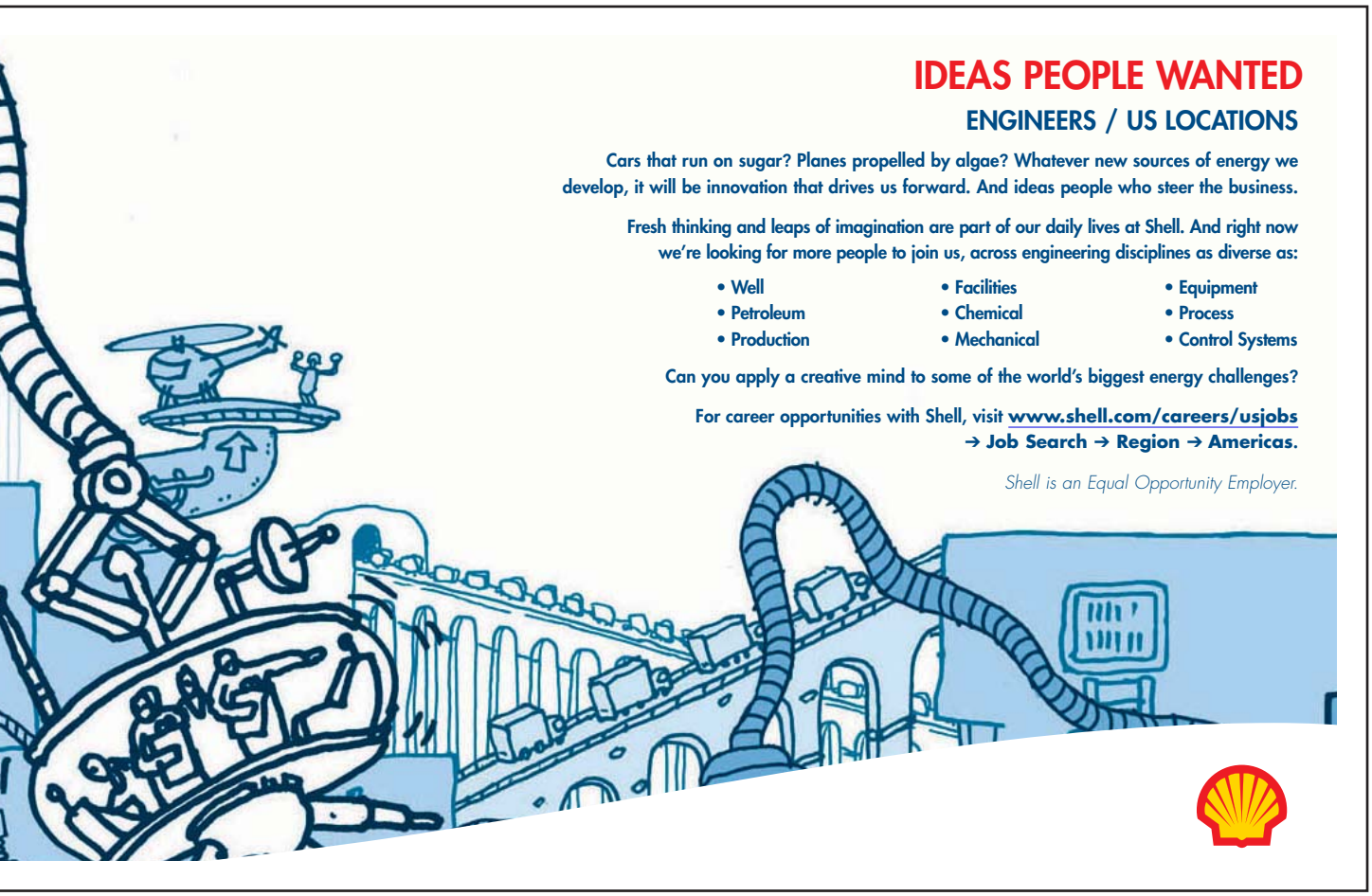
MAJOR PROJECTS—(CONTINUED)

Project	Peak year	Liquids, 1,000 b/d	Gas, MMscfd	Operator	Development type
Brazil					
Frade	2009	90	20	Chevron	$2.8 billion, 200-300 million bbl, FPSO, 1.5 million bbl storage, 18-20° oil, 3,500-ft water, production start in 2009
Pinauma	2008	30		El Paso	$90 million, 50 million bbl of light oil in Camamu basin, off Brazil's northeastern Bahia state,
Peregrino	2010	100		StatoilHydro	$2.5 billion, 300-600 million bbl heavy oil, Campos basin, BM-C-007, leased FPSO, two fixed platforms, 30 horizontal producers, 7 water injection wells
Baleia Azul	2013+			Petrobras	BC-60 heavy oil
Cachalote and Baleia Franca	2013+			Petrobras	Espirito Santo basin, heavy 19° oil, 1,400 m water
Camarupim	2008	36	350	Petrobras	FPSO Cidade de Sao Mateus, 700,000 bbl storage, 760-m water
Carioca	2014+			Petrobras	Santos basin, subsalt discovery, 2,140-m water
Caxareu	2013+			Petrobras	Campos basin subsalt discovery, 30° gravity oil
Espadarte Module 3	2012	100		Petrobras	FPSO
Golfinho Module 3 (ESS-130)	2008	100	100	Petrobras	Espirito Santo basin
Jubarte Phase 2 P-57	2012	180	20	Petrobras	FPSO, 1,8 million bbl storage, 1,250-m water, 17° oil
Marlim Leste P-53 Cidade Niteroi Jabuti	2008	180	210	Petrobras	FPSO, turret-moored, 2 million bbl storage, 1,080-m water, 15-27° oil
Marlim Sul P-51	2008	180	210	Petrobras	Semisubmersible spread-moored, 28° oil, 1,255-m water
Marlim Sul P-56	2011+	100		Petrobras	Semisubmersible spread-moored, 1,700-m water
Mexilhao	2009	20	600	Petrobras	Fixed platform, 172-m water, FPSO
Papa-Terra Modules 1 and 2	2013+	80		Petrobras	BC-20, 1,200-m water, 14-17° gravity oil, 700-1,000 million bbl
Pirambu	2013+			Petrobras	Subsalt discovery, 29° gravity oil
Roncador P-55	2013+	180	20	Petrobras	Semisubmersible, 22° oil, 1,800-m water
Urugua-Tambau	2010	35	350	Petrobras	Santos basin gas development tied into Mexilhao platform
Tupi	2010	100		Petrobras	Extended well test of 5-8 billion bbl discovery in subsalt, Santos basin, 2,200-m water



MAJOR PROJECTS—(CONTINUED)

Project	Peak year	Liquids, 1,000 b/d	Gas, MMscfd	Operator	Development type
Parque das Conchas-Abalone, Argonauta, Nautilus, Ostra	2009+	100	150	Shell	BC-10, FPSO, 2 million bbl storage, 1,500-2,000 m water
Peregrino	2010	100		StatoilHydro	FPSO 1.5 million bbl storage,
Canada					
Noel	2008+			BP	BC Unconventional tight gas developed over 10 years with 130 fractured-horizontal wells
Hebron	2012+	140		Chevron	$5 billion offshore heavy oil, 300 km off Newfoundland in North Atlantic
Elk River	2015	100		Chevron	Thermal project
Birch Mountain Phase 1	2013	30		CNRL	SAGD
Birch Mountain Phase 2	2015	30		CNRL	SAGD
Gregoire Lake Phase 1	2016	30		CNRL	SAGD
Gregoire Lake Phase 2	2018	30		CNRL	SAGD
Gregoire Lake Phase 3	2020	30		CNRL	SAGD
Gregoire Lake Phase 4	2023	30		CNRL	SAGD
Horizon Phase 1	2008	135		CNRL	Mine and upgrader, 6 billion bbl resource, 500,000 b/d in 2017
Horizon Phase 2	2011	45		CNRL	Mine and upgrader
Horizon Phase 3	2011	90		CNRL	Mine and upgrader
Horizon Phase 4	2015	145		CNRL	Mine and upgrader
Horizon Phase 5	2017	162		CNRL	Mine and upgrader
Primrose East	2009	30		CNRL	Cyclic steam, Primrose upgrader Phase 1, 2012, 145,000 b/d, Phase 2, 2019, 58,000 b/d
Great Divide Pod 2	2009	10		Connacher	SAGD, 60 million bbl
Parsons Lake	2014+			ConocoPhillips	Northwest Territories, 1.8 tcf gas, awaiting $7.8 billion (Can.) 760-mile, 1.2 bcfd Mackenzie Delta pipeline, $3.5 billion (Can.) gas-gathering system, $4.9 billion (Can.) anchor fields
Surmont Phase 2	2012	85		ConocoPhillips	SAGD, $1.1 billion (Can.) four phase project with Phase 1 production starting in 2007
Surmont Phase 3	2012+	85		ConocoPhillips	



MAJOR PROJECTS—(CONTINUED)

Project	Peak year	Liquids, 1,000 b/d	Gas, MMscfd	Operator	Development type
Surmont Phase 4	2014	25		ConocoPhillips	
Jackfish Phase 1	2008	35		Devon	SAGD, $450 million (Can.)
Jackfish Phase 2	2010	35		Devon	SAGD, $500 million (Can.)
Borealis Phase 1	2010	35		EnCana	SAGD
Borealis Phase 2	2011	35		EnCana	SAGD
Borealis Phase 3	2012	35		EnCana	SAGD
Christina Lake Phase 1B	2008	9		EnCana	SAGD
Christina Lake Phase 1C	2009	30		EnCana	SAGD
Christina Lake Phase 1D	2010	30		EnCana	SAGD
Christina Lake expansion 1	2011	30		EnCana	SAGD
Christina Lake expansion 2	2012	30		EnCana	SAGD
Christina Lake expansion 3	2013	30		EnCana	SAGD
Christina Lake expansion 4	2014	30		EnCana	SAGD
Christina Lake expansion 5	2015	30		EnCana	SAGD
Foster Creek Expansion 1	2009	30		EnCana	SAGD, $440 million (Can.)
Foster Creek Expansion 2	2011	30		EnCana	SAGD
Panuke Deep	2010		300	EnCana	Production jack up (MOPU), 44-m water
Kirby Phase 1	2013	10		Enerplus	SAGD, 244 billion bbl of reserves
Kirby Phase 2	2017	25		Enerplus	SAGD
Kearl Phase 1	2010+	100		ExxonMobil	$8 billion (Can.) mine, 4 billion bbl resource developed in three phases
Kearl Phase 2	2012+	100		ExxonMobil	Mine
Kearl Phase 3	2014+	100		ExxonMobil	Mine
Mackenzie gas project	2014+	10	830	ExxonMobil	
Sunrise Phase 1	2012	50		Husky	SAGD, 40-year phased project with expected recovery of 3.2 billion bbl
Sunrise Phase 2	2014	50		Husky	SAGD
Sunrise Phase 3	2016	50		Husky	SAGD
Sunrise Phase 4	2018	50		Husky	SAGD
Taglu	2014+			Imperial Oil	Northwest Territories, 1.8 tcf gas, awaiting $7.8 billion (Can.) 760-mile, 1.2 bcfd MacKenzie Delta pipeline, $3.5 billion (Can.) gas-gathering system, $4.9 billion (Can.) anchor fields
Hangingstone Phase 1	2010+	25		JACOS	SAGD, pilot on production
Hangingstone Phase 2	2012+	25		JACOS	SAGD
BlackGold Phase 2	2010	10		KNPC	SAGD
BlackGold Phase 1	2012+	20		KNPC	SAGD
Christina Lake	2008+	24		MEG Energy	SAGD, 3,000 b/d pilot approved, 2 billion bbl estimated recoverable
Long Lake Phase 2	2014	72		Nexen	SAGD
Long Lake Phase 3	2016	72		Nexen	SAGD
Long Lake Phase 4	2018	72		Nexen	SAGD
Long Lake South	2010	70		Nexen	SAGD
Long Lake South	2012	70		Nexen	SAGD
Card Phase 1	2010+	40		PetroCanada	SAGD
Fort Hills Phase 1	2011	165		PetroCanada	Mine, upgrader, 2.8 billion bbl
Fort Hills debottlenecking	2014	25		PetroCanada	Mine, upgrader
Lewis Phase 1	2010+	40		PetroCanada	SAGD, 3 billion bbl
Lewis Phase 2	2010+	40		PetroCanada	SAGD
MacRiver expansion	2009+	40		PetroCanada	SAGD
Meadow Creek Phase 1	2010+	40		PetroCanada	SAGD, $800 million (Can.), 1.3 billion bbl
Meadow Creek Phase 2	2010+	40		PetroCanada	
May River Phase 1	2009	10		Petrobank	Toe-to-heel air injection (THAI)
May River additional phases	2012+	90		Petrobank	Toe-to-heel air injection (THAI)
Carmon Creek Phase 1	2009	37		Shell	Cyclic steam
Carmon Creek Phase 2	2015	50		Shell	Cyclic steam
Muskeg mine debottlenecking	2010	115		Shell	Albian Oil Sands project, with Scotford upgrader expansion of 135,000 b/d by 2009
Jackpot mine Phase 1	2010	100		Shell	Albian Oil Sands project
Jackpot mine Phase 2	2012	100		Shell	Albian Oil Sands project
Jackpot mine Phase 3	2014	100		Shell	Albian Oil Sands project
Niglintgak	2014+			Shell	Northwest Territories, 1.8 tcf gas, awaiting $7.8 billion (Can.) 760-mile, 1.2 bcfd Mackenzie Delta pipeline, $3.5 billion (Can.) gas-gathering system, $4.9 billion (Can.) anchor fields
Orion Hilda Lake Phase 2	2009	10		Shell	SAGD $115 million (Can.) expansion
Pierre River Phase 1	2018	100		Shell	Mine
Pierre River Phase 2	2021	1	100	Shell	Mine
Kai Kos Dehseh Phase 1 (Leismer)	2010	10		StatoilHydro	SAGD pilot
Leismer commercial	2010+	10		StatoilHydro	SAGD with upgrader
Leismer expansion	2011	20		StatoilHydro	SAGD with upgrader
Comer	2012	40		StatoilHydro	SAGD with upgrader
Thornbury	2013	40		StatoilHydro	SAGD with upgrader
Comer expansion	2014	40		StatoilHydro	SAGD
Hangingstone	2016	20		StatoilHydro	SAGD
Thornbury expansion	2017	20		StatoilHydro	SAGD
Northwest Leismer	2018	20		StatoilHydro	SAGD
South Leismer	2020+	20		StatoilHydro	SAGD
Firebag Phase 3	2008	68		Suncor	SAGD
Firebag Phase 4	2009	68		Suncor	SAGD
Firebag Phase 5	2012	68		Suncor	SAGD
Firebag Phase 6	2013	68		Suncor	SAGD
Steepbank mine and upgrader expansions Voyageur project	2011+	250		Suncor	$6 billion (Can.) [Mine, $350 million (Can.), upgrader $2.1 billion (Can.)]
Syncrude expansion Stage 3	2011	46		Syncrude	Mine and processing

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MAJOR PROJECTS—(CONTINUED)

Project	Peak year	Liquids, 1,000 b/d	Gas, MMscfd	Operator	Development type
Syncrude Stage 4	2015	140		Syncrude	Mine and processing
Northernlights Phase 1	2010+	50		Synenco	Mine and upgrader, recover 1 billion bbl over 28 years
Northernlights Phase 2	2012	50		Synenco	Mine and upgrader
Joslyn Phase 3A	2009	15		Total	SAGD
Joslyn Phase 3B	2011	15		Total	SAGD
Joslyn Mine Phase1	2012	50		Total	Mine and upgrader, 100 b/d upgrader
Joslyn Mine Phase 2	2013	50		Total	
Joslyn Mine Phase 3	2016	50		Total	
Joslyn Mine Phase 4	2019	50		Total	
Terre de Grace Phase 1	2011	10		Value Creation	SAGD
Terre de Grace Phase 2	2012+	40		Value Creation	SAGD
China					
Wenchang II	2008	106		CNOOC	FPSO, 1 million bbl storage, 125-m water
Chuandongbei area, Tieshanpo, Dukouhe-Qilibei, and Luojiazhai fields H2S, 5-10% CO2	2010+		740	Chevron	Sichuan province gas fields with 5 tcf of gas, 8-17%
Peng Lai	2008	190		ConocoPhillips	Bohai Bay, well platforms and FPSO turret moored, 2 million bbl storage, 30-m water. 800 million bbl of oil
Liwan	2012+		500	Husky	South China Sea gas, deep water
Puguang	2008		390	Sinopec	9 tcf gas, Sichuan province, southwestern China
Puguang expansion	2010		390	Sinopec	
Tahe expansion	2009+			Sinopec	1 billion bbl oil
South Sulige	2012+			Total	Unconventianal tight gas sands, Ordos Block, Inner Mongolia, 18.85 tcf gas, discovered 2002, production started in 2002
Colombia					
La Cira-Infantas redevelopment	2010	20		Occidental	New wells, waterflooding, steam, gas injection, horizontal drilling
Congo (Brazzaville)					
Azurite discoveries made in 2006	2009	40	18	Murphy	FPSO, 1.3 million bbl storage, 1370-m water, 400 boe
Moho, Bilondo	2008	80	45	Total	12 subsea wells tied back to a barge-based floating production unit in 800-m of water
Moho North	2012+			Total	
East Timor					
Sunrise and Troubadour fields	2013+			Woodside	$7 billion (Aus.), 8 tcf of gas, and 300 million bbl of condensate, 90-550 m of water, tied into Bayu Undan LNG expansion
Egypt					
Saqqara	2008			BP	Gulf of Suez, gas, 9-slot platform
Ghana					
Jubilee	2010	60	80	Tullow	FPSO, 1 million bbl storage, 1,500-m water
Gabon					
Olowi	2008	25	85	CNRL	FPSO spread moored, 1.3 million bbl storage, 100-m water
Anguille redevelopment	2013	0	30	Total	$2 billion, new wells and facilities to add 150 million bbl, field on production since 1966
India					
Aishwariya	2008+	10		Cairn	Onshore, 29-32° oil
Bhagyama	2008+	20		Cairn	Onshore, 21-30° oil
Raageshwari and Saraswati	2008+			Cairn	Onshore, 32-42° oil
Dhirubhai field, Krishna-Godavari Block D6	2009+		2,800	Reliance	$5.2 billion, 12 tcf; 40-60 km southeast of Kakinada, 400-2,700-m water
MA-D6	2008	60	100	Reliance	FPSO, 1.3 million bbl storage, 1,150-m water
Indonesia					
Tangguh LNG liquefaction project	2009		1,400	BP	$2.2 billion project, 7 million tonnes/year of gas from Papua Bintuni Bay fields, 225-ft water
Banka, Gendalo, Gehem	2013			Chevron	Kutei basin, deepwater gas
North Duri	2008			Chevron	$1.3 billion, steamflood on Sumatra Island
Sadewa	2010			Chevron	Kutei basin gas, 150-600 bcf reserves
Kerisi-Hiu	2008			ConocoPhillips	Tied into Belanak, 59,000 boe/d
North Belut	2009+			ConocoPhillips	Tied into Belanak, 54,000 boe/d
Banyu Urip	2010+	165	20	ExxonMobil	$2.6 billion, Cepu block, onshore Java, 50 wells drilled from four wellpads, 60-mile pipeline to 2 million bbl FSO moored off Tuban
Natuna D-Alpha	2014+		1,100	ExxonMobil	46 tcf of gas, 70% carbon dioxide, South China Sea
Podok Tengah	2007	12		Pertamina	Onshore Java, production started Aug. 2005 at 4,000 bo/d
Jeruk	2008+			Santos	50 million bbl oil discovery off Madura island, project downgraded and under reevaluation
Iran					
Azadegan North Phase 2	2012	110		NIOC	Heavy oil
Azadegan South	2009	125		NIOC	$3 billion, heavy oil
Kushk-Hosseinieh	2009	300		NIOC	Heavy oil
South Pars Phases 9 and 10	2009	80		NIOC	$1.9 billion, condensate, gas

MAJOR PROJECTS—(CONTINUED)

Project	Peak year	Liquids, 1,000 b/d	Gas, MMscfd	Operator	Development type
Yadavaran	2011	300		NIOC	Medium oil
Azar				Norsk Hydro	Anaran Block, western Iran, 2 billion bbl in carbonates
Iraq					
Subba-Luhais expansion	2010+	240		Petrel	1.3 billion bbl, southern Iraq
West Qurna expansion	2010+	600		Lukoil	21 billion bbl, west of Basra
Khurmala	2010+	70		DPS	Near Kirkuk
Hamrin	2010+	60		OGI	1.3 billion bbl
Majnoon	2010+	500		Total	12.6 billion bbl, 28-35° API, 30 miles north of Basra
Al-Ahdab	2010+	30		CNPC	Southern Iraq
Chemchamal, Jaria Pika, Khashm al Ahmar, and Mansuriya	2010+				10 tcf gas fields
Al-Qayyarah	2010+	120		Ivanhoe	Heavy 17.1° oil, 0.8 billion bbl
Halfaya	2010+	250		BHP	5 billion bbl
Amara	2010+	60		Petrovietnam	0.1 billion bbl
Nahr Umar	2010+	440		Total	6 billion bbl
Radidain	2010+	100		Soyuzneftegaz	0.3 billion bbl
Gharraf	2010+	100		TPAO	0.3 billion bbl
Ireland					
Corrib	2009		320	Shell	Subsea wells in 350-m water tied back to shore with 83 km, 20-in. flowline
Italy					
Tempa Rossa	2011+	50	20	Total	$700 million, 200 million bbl of heavy oil
Kazakhstan					
Karachaganak Expansion III	2012+		1,600	BG	$8 billion expansion
Tengiz expansion	2010+	260		Chevron	$9.5 billion expansions to develop 3.3 billion bbl of oil with Phase 1
Kashagan Phase 1	2012+	450		Eni	$29 billion, 13 billion bbl of oil, carbonate reef, 10-30 ft of water, 45° gravity oil, 19% H2S, production start in 2011, 1.2 million bo/d from all phases
Kashagan future phases	2011+	1,000		Eni	
Vladimir Filanovsky	2009+	100		Lukoil	Caspian Sea, 600 million bbl of oil and 1.2 tcf of gas
Komsomolskoe	2010	10		Petrom	Onshore $190 million project
Kuwait					
Kuwait North redevelopment	2012	450		KPC	
Libya					
Amal	2008	40		NOC	Oil
Sirte basin redevelopment	2012+	200		Oxy	$5 billion over 5 years, increase to 300,000 bo/d from 100,000 bo/d, develop 2.5 billion bbl of oil
Area 47 Phase 1	2010	50		Verenex	Oil discoveries in the Ghadames basin
Malaysia					
Jerneh B	2008		150	ExxonMobil	
Gumusut-Kakap	2011	150		Shell	Semisubmersible, 1,250-m water
SK8	2010+		90	Shell	
PM-3 CAA Northern fields	2008+	40	270	Talisman	Oil and gas reserves
Mauritania					
Tiof	2010	75		Petronas	TLP, 1,200-ft water
Mexico					
Ku-Maloob-Zaap	2008+	450	150	Pemex	Kumaza FPSO, 2 million bbl storage, 85-m water
Myanmar					
Shwe, Shwe Phyu, Mya	2009+			Daewoo	4.8-8.6 tcf recoverable
Namibia					
Kudu	2012			Tullow	Offshore, 170-m water, 4 tcf gas reserves, initial for power plants, later for possible 5 million/tons/year LNG train
Netherlands					
Waddenzee	2007		195		
New Zealand					
Kupe	2009	7	60	Origin Energy	$980 million (NZ), 400 bcf, gas, NGL, condensate offshore in Taranaki basin, 35-m water, wellhead platform with six wells
Maari	2008	35		OMV	$360 million FPSO, 650,000 bbl storage, gravity-based platform 100-m water, five producers, three injectors
Nigeria					
Ofrima North	2009			Addax	OML 137, oil and gas discovery, FPSO, 75-m water depth
Agbami	2009	250	450	Chevron	$5.4 billion, FPSO, 2.3 million bbl storage, 1,460-m water, production start mid-2008
Nigeria GTL	2010	35		Chevron	$2.9 billion
Escravos gas project 3 (EGP3)	2009		800	Chevron	$2.8 billion
Nsiko	2012+	100		Chevron	OPL 249
Olokola LNG	2010+		2,200	Chevron	$7 billion first stage to produce 11 million tonnes/year of LNG

MAJOR PROJECTS—(CONTINUED)

Project	Peak year	Liquids, 1,000 b/d	Gas, MMscfd	Operator	Development type
Brass LNG	2012+		1,300	Eni	$7 billion, two trains LNG associated gas and gas from OML 60 and 61 gas fields
Oyo	2009	40		Eni	$600 million, FPSO, 300-ft water
Bosi	2011+	135		ExxonMobil	$2 billion, FPSO, 2 million bbl storage, 1,700-m water
East Area NGL II	2008	40		ExxonMobil	
LNG IPP Project	2010+		700	ExxonMobil	
Satellite projects	2010+	125		ExxonMobil	
Bonga Ullage	2009+	70	50	Shell	Oil deepwater
Bonga North, Northwest	2010+	150	80	Shell	FPSO in 4,000-ft water
Bonga Southwest	2012+	140	105	Shell	FPSO
NLNG 7	2012+		1,600	Shell	Bonny Island, 8 million tonnes/year
Egina	2012+	200		Total	OML 130, 1,500-m water depth
Akpo	2009	175	320	Total	$2.3 billion, OML 130, FPSO 2 million bbl storage, 1,314-m water, gas to Bonny NLNG, 620 million bbl of 53° gravity condensate, 1 tcf gas, 44 subsea wells
Ofon 2	2010		400	Total	OML 102 gas for LNG
Usan	2011+	160	175	Total	$2 billion, OPL 138, FPSO, 2 million bbl storage, 23 producing well, and 19 water and gas injection wells, 2,395-2,790 ft of water. 500 million bbl reserves
Ukot, Togo	2010			Total	$4 billion, FPSO in 2,600-ft water
Norway					
Skarv-Idun	2011	90	665	BP	Skarv FPSO oil and gas development, Idun subsea tie-back to Skarv in 390-m water, reserves of 105 million bbl liquids and 1.7 tcf gas
Valhall redevelopment	2010	150	175	BP	New platform
Goliat	2008+			Eni	250 million bbl field in Barents Sea, 380-m water
Freja	2008+			Hess	70-m water, subsea wells tied in to existing infrastructure
Trym	2008+			Shell	Gas and condensate tied in to Harald field off Denmark
Dagny	2008+			Statoil	Subsea completions tied in to Sleipner
Gjoa	2010	50	350	Statoil	60 million bbl of oil, 35 bcf gas, semisubmersible, 360 m water
Tyrihans	2010	80	330	Statoil	$2.2 billion, 460 million boe, two subsea completed fields tied into Kristin semisubmersible platform
Valemon	2008+	50	30	Statoil	Subsea wells tie-in to Kvitebjorn
Volve	2008	55	15	Statoil	2.3 billion Norway krone, jack up and FSO, 90-m water, 70 million bbl oil and 1.5 billion cu m gas
Yme redevelopment	2009	60	20	Talisman	Production jack up with subsea storage tank (MOPU Stor), 95-m water
Oman					
Mukhaizna steamflood	2008+	150		Occidental	Block 53, 16-18° oil, 1 billion bbl potential with steam
Harweel Phase 2, Harweel, Zalzala, Rabab, and other fields	2010+	100	70	PDO	$1 billion, facilities and gas injection in oil fields in southern Oman
Qarn Alam steamflood	2010+	30		PDO	Thermally assisted gas-oil gravity drainage (TAGOGD), 16° gravity oil, fractured carbonate with 1 billion bbl initially in place
Papua New Guinea					
PNG gas	2014+	20	570	ExxonMobil	$10-11 billion, gas from fields in Southern Highlands to LNG plant at Port Moresby,
Peru					
Corvina	2008+		40	BPZ	Refurbished offshore platforms, gas to power
Camisea expansion	2009		720	Pluspetrol	Blocks 56 and 88,
Block 67	2010	100		Perenco	Three fields, 12-21° gravity oil, 248 mile pipeline
Qatar					
Al Rayyan	2008	50		Anadarko	0.2 billion oil
Al Khaleej gas Phase 2	2009	70	1,140	ExxonMobil	$1 billion, gas to local markets
Barzan Phase 1	2010+	135	1,500	ExxonMobil	1.5 bcfd for local markets
Qatargas 2 Train 4	2008	80	1,250	ExxonMobil	7.8 million tons/year
Qatargas 2 Train 5	2009	80	1,250	ExxonMobil	7.8 million tons/year
RasGas Train 6	2008	75	1,250	ExxonMobil	7.8 million tons/year
RasGas Train 7	2009	75	1,250	ExxonMobil	7.8 million tons/year
Al-Shaheen expansion	2009	285		Maersk	$3 billion, production increase to 525,000 b/d in 2009 from 240,000 b/d in 2006
Idd al Shargi North and South Dome	2007	65		Occidental	$0.7 billion, oil
Maydan Mazham	2008	15		QP	$0.3 billion, oil
Pearl GTL	2009+	133		Shell	$7 billion
Russia					
Uran, Ust-Tegus	2008+			BP	First fields in UVAT project with 450 million bbl oil discovered and 1 billion bbl potential
Verkhnechnonskoye	2015+	100		BP	1 billion bbl resource
Sakhalin-1	2007	250		ExxonMobil	Started production in 2005 and reached peak production in Feb. 2007
Sakhalin-1 Future Phases	2010+		800	ExxonMobil	Gas pipeline from offshore 17-tcf Chayvo, Odoptu, and Arkutun-Dagi
Kovykta	2015+		2,500	Gasprom	70 tcf gas, awaiting pipelines for regional sales and sales to China

MAJOR PROJECTS—(CONTINUED)

Project	Peak year	Liquids, 1,000 b/d	Gas, MMscfd	Operator	Development type
Sakhalin-2	2008	50	1,356	Gazprom	$20 billion, three platforms off Sakhalin for oil and gas fields with 4.5 billion boe reserves, LNG
Prirazlomnoye	2009+	150		Gazprom	560 million bbl reserves in Pechora Bay 35 miles offshore, 60 ft water
Shtokman	2011+		2,100	Gazprom	130 tcf Barents Sea
Shtokman additional phases	2019		6,600	Gazprom	
Yuzhno-Russkoye	2010		3,900	Gazprom	21 tcf of reserves, involves completing a pipeline to Germany, first production in 2008
Yuzhno-Russkoye	2013			Gazprom	2nd pipeline to Germany completed
Khvalynskoye	2011		1,000	Lukoil	Caspian Sea, Russian sector, 12 tcf gas, 265 million bbl oil, and 148 million bbl NGL, production start in 2009
Vankor	2013+	120		Rosneft	900 million bbl 2P; Krasnoyarsk Kray, western East Siberia
West Salym, Western Siberia	2013	143		Shell	Started production in late 2004
Kharyaga Phase 3	2011	30		Total	Yamal-Nenets, under production since 1986
Saudi Arabia					
Karan			1,000	Aramco	Offshore Khuff gas field
Nuayyim expansion	2008	100		Aramco	$0.4 billion, light oil
Shaybah Expansion 1	2008	250		Aramco	$1.4 billion, extra light
Shaybah Expansion 2	2008+	250		Aramco	
Hawiyah NGL, ethane	2008	370		Aramco	$3 billion, NGL
Khurais expansion, Abu Jifan, Mazalij	2009	1,200		Aramco	$8 billion, light oil
Manifa	2010+	900		Aramco	$1.0 billion, Arab heavy
Nuayyim	2008	100		Aramco	Light oil
Dammam	2010+	1,000		Aramco	
Sudan					
Melut basin Blocks 3 and 7, Palogue, Adar-Yale, Agordeed	2008	300		Petrodar	$1.9 billion, 1,349-km, 32-in. pipeline, expansions may increase production to 500,000 bo/d, production start in 2006 at 150,000 bo/d

MAJOR PROJECTS—(CONTINUED)

Project	Peak year	Liquids, 1,000 b/d	Gas, MMscfd	Operator	Development type
Thailand					
Platong II	2011		420	Chevron	$3.1 billion, processing platform, 12,000 ton topsides, five wellhead platforms, 320 km from shore, 200-ft water
Arthit	2008	10	150	PTTEP	FPSO, 80-m water, six wellhead platforms
Bongkot South	2011+		330	PTTEP	$1 billion, 17,000 tonne topsides and 5,000 tonne steel jacket for central processing platform. High H_2S gas
Trinidad					
Starfish	2010+			BG	Blocks E and 5a, 1998 discovery, 427-ft water
Savonette	2009			BP	Standardized Cannonball platform, gas to Mahogany B for processing
UAE					
ADCO expansions	2012	5	560	ADCO	
Upper Zakum redevelopment	2012+	250		ExxonMobil	$2 billion, light oil
UK					
Alder	2011	9	80	Chevron	West of Britannia field
Ettrick	2008	30	35	Nexen	UK Blocks 20/2a and 20/3a, leased Aoka Mizu FPSO
Huntington	2010+			Oilexco	UK Blocks 22/14b, 39-41° gravity oil
Shelly	2008	30		Oilexco	Cylindrical FPSO spread-moored, leased, 0.3 million bbl storage, 120-m water
Starling	2008	5	140	Shell	$350 million, subsea well tied back to Shearwater, started producing Jan. 2008
Laggan-Tormore	2011+	90		Total	West of Shetlands, gas-condensate fields, 600-m water, Block 205/5a
Pilot	2009	30		Venture	Cylindrical FPSO spread-moored, leased, 0.3 million bbl storage, 120-m water
US					
Telemark	2008	25	50	ATP	Spar in 1,200-m water., six dry tree wells
Shenzi	2009+	100	50	BHP	$4.4 billion, Green Canyon Block 653, TLP in 4,400-ft water, 350-400 million boe
Atlantis North Flank	2009			BP	Green Canyon blocks, 4,500-6,900 ft water
Dorado	2009			BP	Viosca Knoll Bock 915, 3,500-4,000 ft water
King South	2009			BP	Mississippi Canyon Block 129, tie-in to Marlin
Liberty	2011	15		BP	Alaska light oil discovered in 1997, wells with record departures of 34,000-44,000 ft
San Juan CBM	2011			BP	$2 billion in next 13 years to develop 2.7 tcf gas
Thunder Horse	2008	210	185	BP	Semisubmersible in 6,050-ft water on Mississippi Canyon Block 778
Tubular Bells	2012+			BP	Mississippi Canyon Block 725, 4,334-ft water
Wamsutter tight gas	2010		250	BP	$15 billion during next 15 years developing 450 million boe gas
Big Foot	2012+			Chevron	Walker Ridge Block 29, 5,268-ft water
Blind Faith	2008	40	35	Chevron	$900 million, Mississippi Canyon Blocks 695-696, semisubmersible in 6,500 ft water
Jack	2012			Chevron	Walker Ridge Block 759, 6,962-ft water
St. Malo	2012+			Chevron	Walker Ridge Bock 678, 6,996-ft water
Tahiti	2009	125	70	Chevron	$3.5 billion, truss spar, 1,220-m water
Longhorn	2009		200	ENI	$580 million, Mississippi Blocks 502 and 546, three subsea wells tied back 32 km to Crystal platform, 2,400-ft water
Piceance tight gas Phase 1	2008		200	ExxonMobil	Colorado
Piceance tight gas future phases	2010+	10	870	ExxonMobil	Colorado
Phoenix	2008	45	70	Helix	FPU, to restore production from Typhoon field
Thunder Hawk	2009	45	70	Murphy	Semisubmersible, 5,700-ft water
Oooguruk	2008	20		Pioneer	$500 million project on gravel island built in 4-ft water off Alaska North Slope in the Beaufort Sea
Cascade, Chinook	2010	80	16	Petrobras	FPSO, 600,000 bbl storage, Walker Ridge blocks, 8,300-ft water
Perdido, Great White, Tobago, Silvertip	2010	100	200	Shell	Spar hub, subsea separation, boosting Alaminos Canyon blocks, 2,440-m water
Alaska Gas/Point Thomson	2015+	70	4,500		Unresolved operatorship, awaiting the $20 billion, 3,400-mile, 4.6-bcfd Alaskan pipeline
Venezuela					
Loran				Chevron	5 tcf of gas
Carabobo 1	2012+	200		Pdvsa	9 billion bbl of heavy oil
Corocoro	2009	70		Pdvsa	West Paria Gulf
San Cristobal	2008+		400	Pdvsa	Block 2, Manatee area, 6 tcf LNG project
Deltana	2010+			Pdvsa	38 tcf off Venezuela and 21 tcf off Trinidad and Tobago
Mariscal Sucre	2008		600	Pdvsa	Offshore gas
Mariscal Sucre expansion	2011		600	Pdvsa	Offshore gas
Vietnam					
Vietnam gas project	2012		500	Chevron	$3.5 billion, Blocks B, 48/95, 52/97, production start in 2011
Su Tu Vang	2008			ConocoPhillips	65,000 boe/d
Ca Ngu Vang	2008			Soco	Block 9-2
Song Doc	2008	30		Talisman	FPSO, 55-m water




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Transocean's GSF C.R. Luigs drillship was in Green Canyon deep water, drilling Shenzi oil and gas field for BHP Billiton last month (photo by Marc L. Bik, INTEC Engineering).

Industry invests record sums in rigs, drilling campaigns

Nina M. Rach
Drilling Editor

The market for offshore oil and gas drilling services continues to expand and newbuilds swell the fleets. As of May 9, more than 90% of the world's mobile offshore drilling units were under contract, according to ODS-Petrodata.

In addition to exploration wells, operators have committed large amounts of capital to drill and develop major projects around the world (see article, p. 55).

Drilling expenditures are reaching record highs, but high oil prices still make it profitable to explore and to redevelop old fields, generating heavy activity for light workover rigs and coiled tubing systems.

DRILLING MARKET FOCUS

Oil price driver

Demand drives prices, and prices drive drilling activity.

The benchmark futures price of US light, sweet crudes rose above $126/bbl for the first time in intraday trading May 9 (for June contracts) on the New York Mercantile Exchange (OGJ, May 12, 2008, p. 6). North Sea Brent crude was not far behind, with the June IPE contract closing at $125.40/bbl.

In mid-May, Goldman Sachs said that oil prices could rise to $150 or $200/bbl within 2 years.

Drilling expenditures

Last month, the American Petroleum Institute released its 2006 joint association survey on drilling costs. The survey estimates total spent to drill and equip wells in the US.

The industry spent $109.8 billion in 2006, up 44% from $76.2 billion in 2005, according to API.[1] This included:

- $14.7 billion on exploration wells, up 19% from 2005.
- $93.8 billion on development wells, up 47% from 2005.
- $33.6 billion on development oil

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E1077 Current E1077C Historical, 1980 to current

Enhanced Oil Recovery Survey — Covers active, planned and terminated projects worldwide. Updated biennially in March.
E1048 Current E1148C Historical, 1986 to current

Worldwide Gas Processing Survey — Gas processing plants worldwide with details.
E1209 Current E1219C Historical, 1985 to current

International Ethylene Survey — Information on country, company, location, capacity, etc.
E1309 Current E1309C Historical, 1994 to current

LNG Worldwide — Facilities, Construction Projects, Statistics
LNGINFO

Worldwide Construction Projects — List of planned construction products updated in May and November each year.

	Current	Historical 1996–Current
Refinery	E1340	E1340C
Pipeline	E1342	E1342C
Petrochemical	E1341	E1341C
Gas Processing	E1344	E1344C

U.S. Pipeline Study — There are 14 categories of operating and financial data on the liquids pipeline worksheet and 13 on the natural gas pipeline worksheet.
E1040

Worldwide Survey of Line Pipe Mills — Detailed data on line pipe mills throughout the world, process, capacity, dimensions, etc.
PIPEMILL

OGJ 200/100 International Company Survey — Lists valuable financial and operating data for the largest 200 publicly traded oil and gas companies.
E1345 Current E1145C Historical 1989 to current

Oil Sands Projects — Planned Canadian projects in four Excel worksheets. Includes mining, upgrading, in situ projects, and historical table with wells drilled back to 1985.
OILSANDPRJ

Production Projects Worldwide — List of planned production mega-projects.
PRODPROJ

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wells, up 58%.

• $53.7 billion on development gas wells, up 72%.

For the 19th consecutive year, companies spent more drilling for natural gas (54%) than for oil (34%), with 12% of the total drilling spend resulting in dry holes.

The number of wells and total footage drilled increased from 2005, pushing the average cost per well and per foot to the highest levels ever.

North American drilling

Based on Baker Hughes Inc. rig counts, total US rig activity has increased by about 130 rigs during the past year. Most of the increase (80 rigs) is due to an increase in oil drilling in response to higher oil prices, which have risen steadily since January 2007.

BHI's US rig count showed 1,754 land rigs, 23 inland water rigs, and 69 offshore rigs operating as of May 9.

In the 5 quarters beginning January 2007, rig activity increased notably in Texas, Oklahoma, and Colorado, which added 120, 40, and 30 rigs, respectively. But rig counts dropped in Louisiana (40 rigs) and Wyoming (20 rigs) over the same period.

Rig activity in the Gulf of Mexico has declined since 2001, dropping to about 60 rigs in first-quarter 2008 from a high of 176 rigs in 2001. ODS-Petrodata's weekly rig count showed 124 MODUs in the Gulf of Mexico fleet in mid-May, down from 135 rigs a year earlier.

The number of US rigs drilling horizontal wells began increasing about 5 years ago, from about 50 in second-quarter 2003, to about 500 rigs in first-quarter 2008.

The number of US rigs drilling vertical wells has decreased to about 1,300 from about 1,450 in early 2006.

Directional drilling has remained essentially flat in the US over the last 2 years.

Overall drilling activity in Canada has declined over the past 3 years, driven predominantly by a 30%/year reduction in Alberta gas drilling in the 2007-08 winter season. The drop has been attributed to adverse changes in currency exchange rates, lower natural gas prices, and changes in Alberta's royalty regime.[2]

Offshore forecast

In mid-April, Douglas Westwood Ltd. announced its forecast of shallow and deepwater drilling budgets. The report notes that offshore drilling accounted for 45% of all offshore capital expenses in 2007, when nearly 4,000 wells were drilled offshore. Operators spent nearly $50 billion on shallow water drilling in 2007, and about $18 billion on deepwater drilling, according to Douglas Westwood estimates.[3]

The company says that drilling will continue to increase over the next 5 years, with deepwater drilling increasing to 31% of total offshore spending, compared with 26% in 2007.

By 2012, the industry will spend about $26 billion on deepwater drilling and $57 billion on shallow water drilling, worldwide.

MOBILE OFFSHORE DRILLING UNITS

Table 1

	Existing units	Fleet, % of total	Under construction	Increase, %	Future total	Fleet, % of total
Drillships	39	5	31	79	70	8
Semisubmersibles	171	24	44	26	215	25
Jack ups	424	59	75	18	499	57
Tender-assists	28	4	4	19	32	<4
Drilling barges	48	7	0	0	48	6
Submersibles	7	1	0	0	7	<1
Total	**717**	**100**	**154**	**22**	**871**	**100**

Source: drilling contractor, operator, and shipyard reports, as of May 27, 2008

Newbuilds

With 154 mobile offshore drilling units under construction, the MODU fleet is set to increase 22%, to 871 units from 717 units (Table 1).

Drillships show the largest increase, 79%, with 39 ships in the current fleet and 31 more under construction. They now comprise 5% of the MODU fleet but will increase to 8% of the total. Houston-based Transocean Inc. is building 8 of the 31 ships; all but 1 already have contracts.

The semisubmersible fleet is poised to increase 26%, with 44 floaters under construction, adding to the 17 already working. Semisubs will increase to 25% of the future MODU fleet, up from 24% of the current fleet.

The tender-assist fleet will grow 19%, with 4 new units soon to be added to the 28 working. They now represent about 4% of the fleet, and that will decrease slightly.

Jack ups represent 59% of the current MODU fleet; after adding 75 units now under construction, that portion of the fleet will decrease slightly, to 57%.

Drilling barges and submersibles represent 7% and 1% of the current MODU fleet, respectively. With no new units under construction at this time, those units will represent 6% and less than 1% of the future MODU fleet.

The push into deep water will require additional vessels capable of drilling in water depths exceeding 10,000 ft. These rigs will also be in demand for interventions unless a new fleet of deepwater intervention vessels is built (OGJ, May 26, 2008, p. 37).

We expect shipyards to continue to book orders for new drilling units, particularly drillships and semisubs. Operators will also continue to book long-term contracts for newbuilds, particularly those capable of working in deep and ultradeep water.

In mid-April, two Indian industrial conglomerates announced plans to begin manufacturing deepwater drilling rigs (OGJ Online, Apr. 14, 2008)—Reliance Industries Ltd. and Larsen & Toubro Ltd. Reliance had to put drilling on hold for 3 years due to its inability

to secure rigs to explore nine deepwater blocks.

L&T plans to double revenues from its offshore business by getting into rig construction. In 2007, it built a port at Sohar, Oman, to serve a shipyard where it plans to build rigs and other offshore equipment. L&T also plans to construct two new ports at Dhamra in Orissa and Kakinada in Andhra Pradesh.

Tom Kellock, a Houston-based analyst at ODS-Petrodata Consulting & Research, told OGJ that the market will absorb still more floaters, but the supply of jack ups is probably adequate at this time.

Billion-dollar drillship

Last month, Stena Drilling, a wholly owned subsidiary of Stena AB, announced it's building a new Arctic-class drillship at Samsung Heavy Industries shipyard in South Korea. The estimated total delivery price for the dynamically positioned Stena DrillMAX IV is $1.15 billion. It will be delivered in December 2011.[4]

The ship is designed with a thickened hull for drilling in harsh, high-latitude environments, and will be capable of drilling in ultradeep water. It will have six propellers and a total displacement of 97,000 tons.

Stena's existing drilling fleet includes four semisubmersibles, active off Norway, Great Britain, Angola, and Australia, and three drillships. The Stena DrillMAX I operates off Brazil under a 4-year contract with options for Repsol-YPF; two other drillships, Stena DrillMAX III and Stena Carron, are under construction at Samsung in Korea.

The two unfinished drillships have contractual commitments when delivered. The Stena Carron, named for a Scottish river, will be completed mid-2008 and begin a 3-year contract with Chevron, drilling off northern Europe. The Stena DrillMAX III will be delivered in mid-2009 and begin a 5-year contract with Hess Corp.

Realignments

In late May, Pride International announced that it sold its fleet of platform rigs to Blake International LLC for $66 million. Pride intends to focus its offshore drilling operations in deep water.

In April-May, private Norwegian investor Dry Ships Inc. acquired a majority of shares of independent offshore drilling contractor Ocean Rig ASA. On May 27, Ocean Rig announced that Dry Ships held an aggregate of 75.15% and intended to delist Ocean Rig from the Oslo Stock Exchange. Founded in 1996, Ocean Rig owns and operates two of the world's largest harsh environment semisubmersibles, the Leiv Eriksson and the Eirik Raude currently operating in the North Sea and the US Gulf of Mexico.

Dry Ships also announced in late April that it was exercising options to build two new drillships at Samsung Heavy Industries Co. Ltd. The ships will each cost about $800 million and will be delivered third-quarter 2011.

Calgary's Saxon Energy Services Inc. announced discussions in late April about a potential sale of the company to Schlumberger Ltd. and First Reserve Corp. On May 5, Saxon announced an arrangement agreement with Sword Canada Aquisition Corp., a company indirectly owned by Schlumberger; a special shareholders will be held mid-July.

Saxon estimated that about 16% of its 2008 revenue will derive from its drilling joint ventures in Mexico and Colombia with Schlumberger. ✦

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Innovative method solves catalyst pinning problem

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Yanbu, Saudi Arabia

Installation of a restriction orifice in a regeneration gas blower solved catalyst plugging and blowouts in a continuous catalyst regeneration (CCR) tower in Saudi Aramco's Yanbu refinery. This solution allowed the unit to avoid shutdowns that would have cost the refiner about $600,000/day.

The CCR section of the Yanbu platformer unit was experiencing successive catalyst blowouts, which led to shutdowns of the regeneration section. This caused the platformer section to operate at reduced feed rates, 30,000 b/d vs. 40,000 b/d, and severities, 95 RON vs. 100 RON.

Saudi Aramco's Yanbu refinery and process department and the control system department worked jointly to troubleshoot and resolve the successive plugging of the CCR tower. They concluded that the problem's root cause was that the regeneration gas blower had 10% too much capacity.

Available options to reduce pinning—the tendency of catalyst to stick to the screen due to radial thrust exerted by the vapors surrounding it—was to lower the regeneration gas flow. Installation of a restriction orifice on the regeneration-gas blower suction eliminated pinning and normal CCR platformer operations resumed.

Yanbu platformer

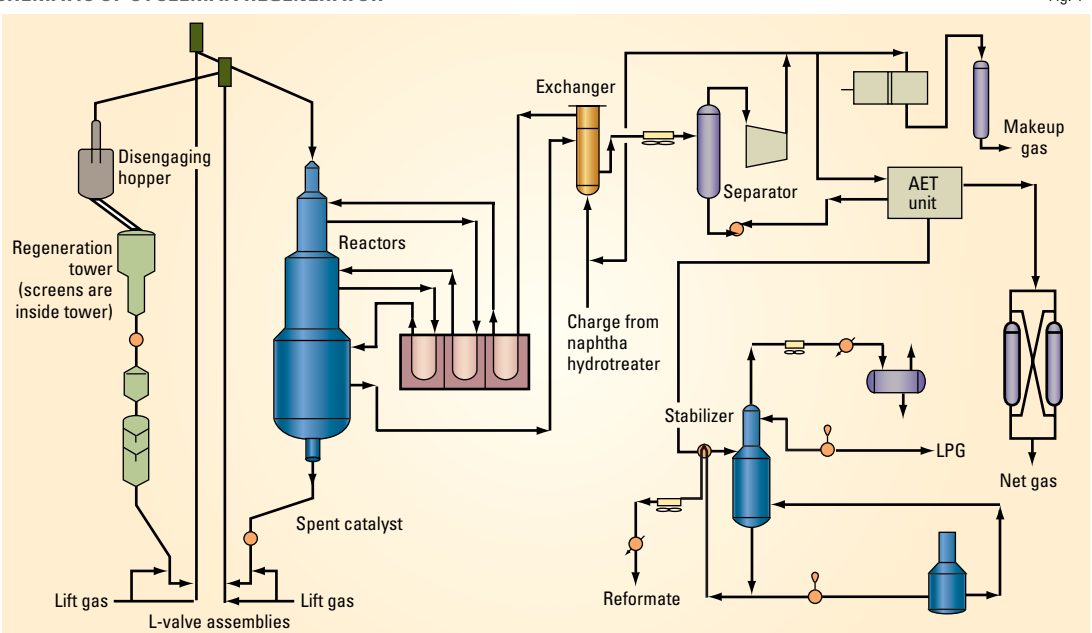
The Yanbu platformer unit was revamped in June 2006 from a fixed-bed unit to a CCR unit (OGJ, Dec. 10, 2007, p. 52). Coked spent catalyst from platforming reactors continuously flows to the regeneration tower where coke is burned off and spent catalyst is regenerated in four steps:

1. Coke burning.
2. Oxychlorination, which disperses catalyst metals and adjusts catalyst chloride.
3. Catalyst drying.
4. Reduction, which changes catalyst metals to a reduced state. Finally, regenerated catalyst circulates back to the first platforming reactor.

Because the catalyst is in continuous movement, catalyst fines will plug the regenerator screen over time. The CCR must be shut down and the screen removed for cleaning every 12 months. Fig. 1 shows a schematic of the CCR unit.

SCHEMATIC OF CYCLEMAX REGENERATOR

Fig. 1



Incident background

Since the first start-up in June 2006, the regeneration tower has operated with a partially plugged screen due to catalyst fines. These were generated from a containment loss in the platformer reactors due to a weld failure in the center pipe of the first

reactor. This failure reduced regeneration gas flow without affecting the CCR operability.

The licensor recommended cleaning the screen as soon as possible. Saudi Aramco shut down the CCR unit for 5 days in January 2007 to clean the regeneration tower screen.

The unit was restarted in blackburn mode. In this operating mode, air for regeneration is introduced in the regenerator tower's upper half to prevent exposure of highly coked catalyst to high oxygen concentrations, which could damage tower internals.

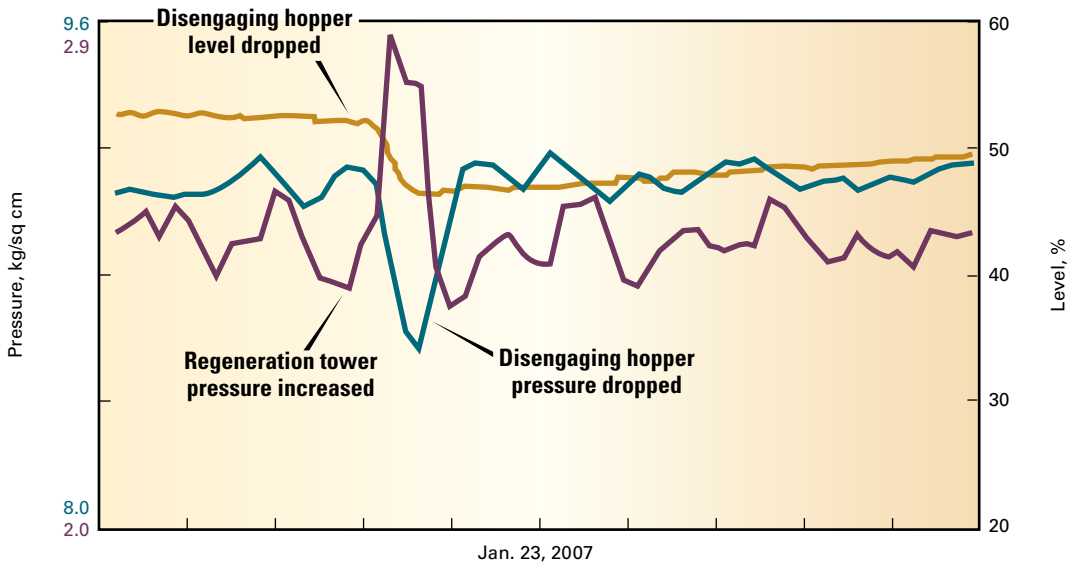
The start-up was normal and the regeneration tower's temperature profile peaked at the second top temperature indicator (TI) in the burn zone. Regenerator operations for the subsequent 36 hr were normal with regenerated catalyst carbon at 0.095 wt % and spent catalyst carbon at 4.3 wt %.

A blowout occurred between the disengaging hopper and regeneration tower, causing the disengaging hopper level to drop to 47% from 52%. The disengaging hopper pressure dropped and the regeneration tower's pressure increased briefly.

Fig. 2 shows the pressure fluctuation and level drop when the blowout occurred.

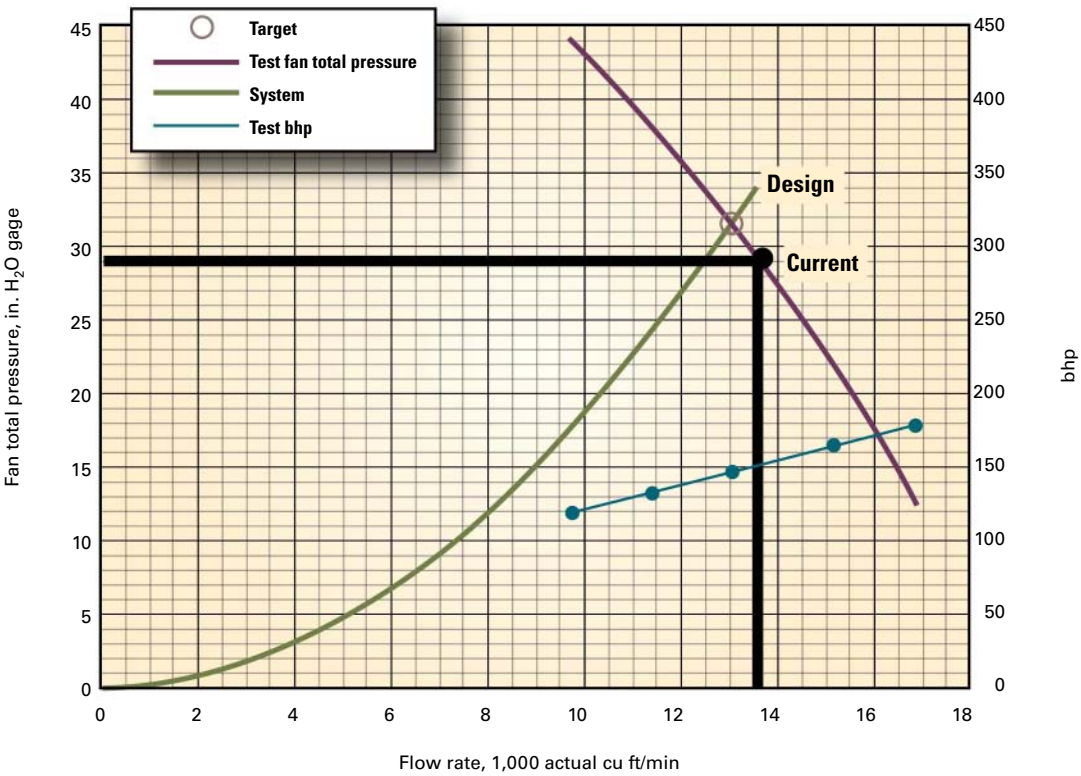
Pressure, level profiles

Fig. 2



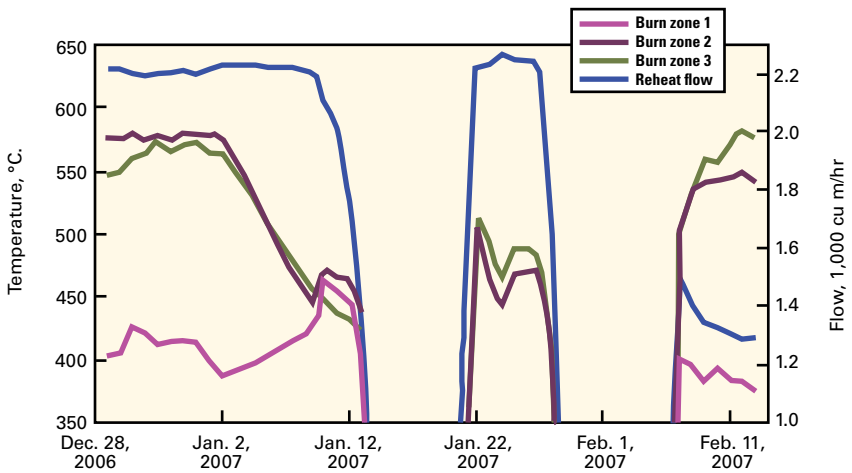
Blower performance

Fig. 3



Regenerator temperature profiles

Fig. 4



Temperature profiles

Table 1

Temperature indicator	Temperature, °C. Licensor-specified range	Normal profile	Shifted profile
1	479-510	380	250
2	493-593	563	465
3	493-593	557	475
4	493-560	503	511
5	491-504	492	543
6	491-504	487	479
7	491-504	485	472
8	479-499	485	

The blowout generated many fines and chips that plugged the regenerator screen. A shift in the burn zone's temperature profile occurred and the peak temperatures shifted to fifth TI, which is at the bottom of the burn zone (Table 1).

Maintaining a proper burn profile in this section is critical for safe unit operations. If the burn profile shifts downward, unregenerated catalyst will enter the chlorination zone, potentially causing catalyst to agglomerate and damage regenerator internals.

In many discussions, refinery engineers and licensor experts on this subject concluded that it is difficult to pinpoint the blowout's root cause. The team attempted, at the licensor's suggestion, to stop the regeneration blower and conduct cold circulation of the catalyst to clear the screen. The regeneration tower cooled at 50° C./hr;

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when the blower switched to low speed at 350° C., a blowout again occurred.

We observed a similar phenomenon when we switched the blower to high speed (3,565 rpm) from low speed (1,785 rpm) during the reheat. But unit performance did not improve.

The refiner, therefore, again shut down the regeneration section due to a repetitive blowout between the disengaging hopper and regeneration tower. We reduced the CCR platformer throughput to 30,000 b/d from the 40,000-b/d design rate and the operating severity to 95 RON from 100 RON to control coke lay down.

Analysis, findings

It is unusual for a blowout to occur in a CCR because it is normally full of catalyst. During normal operations, the catalyst flows down due to gravity.

The disengaging hopper operates at about 9 kg/sq cm gage (128 psig) and the regeneration tower operates at about 2.5 kg/sq cm gauge (35.55 psig). Pipes between the disengaging hopper and regenerator are full of catalyst, which balances the large pressure drop across the two vessels.

If a void is created in the regeneration tower, the huge differential pressure will force the catalyst downward, which will cause a pressure fluctuation and generate fines and dust. The fines will block the regenerator screen, causing the temperature profile to slip.

The problem analysis included these facts:

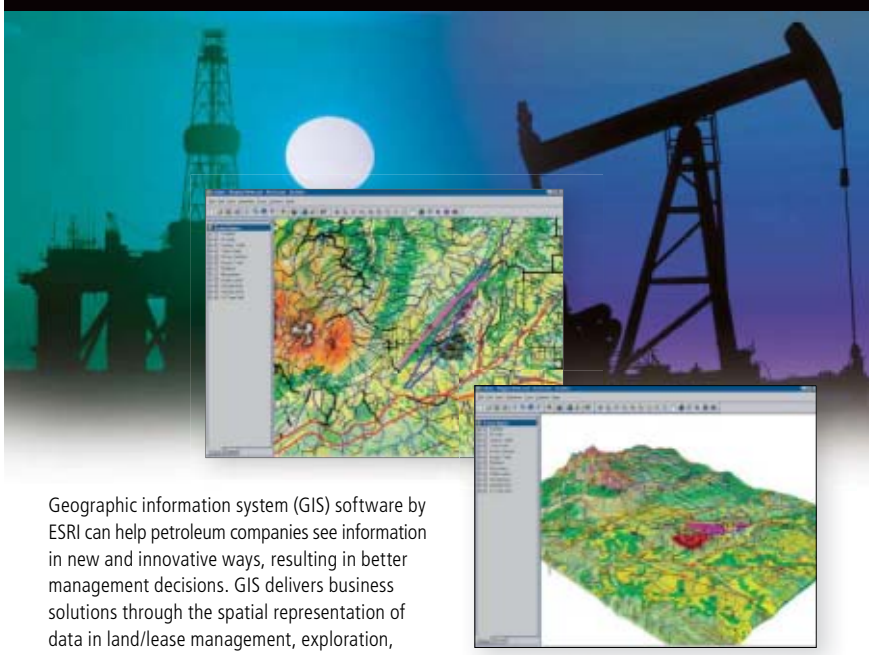
- One probable cause could be something blocking the catalyst transfer pipe. But this would be a one-time occurrence that would automatically clear after the blowout. Because the blowout recurred, it was obvious that the blowout was not due to plugging of transfer pipes.
- The only difference between the two start-ups was the screen's condition. Since initial start-up, the unit operated with a plugged screen. The recent start-up was the first one with a clean screen.
- The blowout was clearly related to the blower operation because it had happened on two occasions when the blower speed was switched.

The inspection team conducted a detailed analysis of the blower data. During unit start-up, we conducted a test run to evaluate blower performance. The head delivered was equivalent to 29.53 in. H_2O vs. a design head of 30.94 in. H_2O. Based on the blower's performance curve, this motor was delivering 13,300 actual cfm vs. a design of 12,986 actual cfm (Fig. 3).

The team concluded that the blower flow was 2.4% above design, even with a partially plugged screen, indicating that the actual degree of overdesign was even higher.

Once the screen was cleaned, the flow increased, causing catalyst to pin

How Can Petroleum Companies Make Better Decisions?



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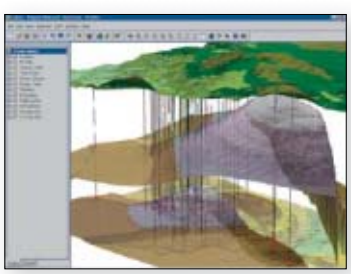

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(stick to the screen instead of freely flowing downward) in the regeneration tower. The lock hopper's removing catalyst created a void at some location in the regeneration tower.

When the differential pressure between the disengaging hopper and regeneration tower was high enough, it forced catalyst to fill the void, creating a blowout. This would also explain the blowout occurring when the blower speed changed.

The first time, when the blower switched from high to low speed, the catalyst unpinned, which caused an immediate blowout. The second time the blower switched from low to high speed, this caused the catalyst to pin.

The blowout did not occur immediately, however. During subsequent heat-up, the catalyst slumped, created a void below the pinned area, and caused a blowout.

The licensor, convinced that the blower was a likely cause for the blowout, agreed to:

- Size a restriction orifice to reduce the regeneration gas flow by 15-20% to avoid pinning. Yanbu refinery engineers kept it ready until the unit was immediately shut down for a screen cleaning. This was installed in the regeneration tower gas outlet line.
- Conduct an inspection of the disengaging hopper and regeneration tower screen.
- Install the restriction orifice in the regeneration-gas outlet line and observe unit performance during restart if the inspection revealed no obvious reason for the blowouts.

Field inspection

Inspectors opened the regeneration tower and disengaging hopper inspection immediately after the blowout. During catalyst unloading, the team found that the last few drums from the disengaging hopper contained fresh catalyst. Aramco had added 12 drums of fresh catalyst to the disengaging hopper during a recent reload.

Because catalyst had circulated for 500 cycles, there should have been no fresh catalyst in the disengaging hopper. This clearly indicated that the catalyst was not moving due to localized catalyst pinning on the regeneration tower screen.

There were no clumps or debris between the disengaging hopper and regeneration tower. The regeneration screen was heavily plugged, and there was no sign of integrity loss or severe damage to the screen.

The team concluded that the root cause for this problem was oversizing of the regeneration-gas blower.

Recommendations

The main available option to reduce pinning was to lower regeneration-gas flow. The least costly option was to install a restriction orifice in the regeneration-gas blower's suction line to reduce regeneration-gas flow, which would increase the pinning margin.

After discussions with Saudi Aramco engineers, the unit licensor recommended the optimum size for the restriction orifice. It concluded that a 15% reduction in total regeneration-gas flow would improve the pinning margin to 25%.

The licensor designed a restriction orifice with a bore size of 340 mm, which we fabricated and installed in the regeneration-gas outlet line. Higher burn-zone oxygen offset the reduced burn-zone capacity, which fell due to less regeneration gas flow. Oxygen levels increased to 0.95-1.10 mole % from a normal operating value of 0.85-0.95 mole %.

CCR restart

Aramco restarted the regeneration section after installing the restriction orifice. The start-up was smooth without any pressure fluctuations or signs of blowout.

There were no major deficiencies in regeneration blower operations. Temperature profiles across the regeneration tower were normal (Fig. 4).

To test the capacity of the regeneration tower, we conducted a coke-burn test. We slowly increased the circulation to 95% of design and slowly reduced oxygen concentration to 0.8 mole % from 1.0 mole %.

Laboratory results showed that there was less than 0.07 wt % carbon on the catalyst, which indicated complete regeneration. The test results indicated that there was no major reduction in unit capacity. ✦

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INTEGRITY MANAGEMENT—1

Argentine NGL case study applies economic procedure

Fernando Vicente
Eduardo Risso
ABB Full Service
Neuquen, Argentina

A simple economic procedure applied to NGL pipelines can help operators determine whether abnormalities detected during periodic magnetic-flux leakage pigging are large enough to shut the pipeline for repair or if operations can continue.

An Argentine NGL plant in Neuquén separates rich components of gas and pumps them 600 miles through a pipeline to the Bahía Blanca fractionating plant (Fig. 1). Pipeline construction used low-carbon API-5L-X65 steel, electric resistance welding, and an external three-layer extruded polyethylene coating to prevent external damage.

In September 2004, after 4 years of uninterrupted operation, the operator used a magnetic-flux leakage intelligent pig[1] to conduct internal inspection, fulfilling its maintenance plan. The final report showed some internal defects, only one of which was of major interest, having a 44% thickness reduction and a rectangular shape.

Pipeline failure would likely result in a stoppage of production or safety incidents, such as fire, explosion, environmental pollution, injury, or death. Identifying and recognizing defects and failures in hydrocarbon pipelines is important and necessary.

This first of two articles uses a simple economic procedure to help operators, engineers, and general managers make the right decision should a leak be detected, based on its behavior under different scenarios.

The procedure consists of three steps:

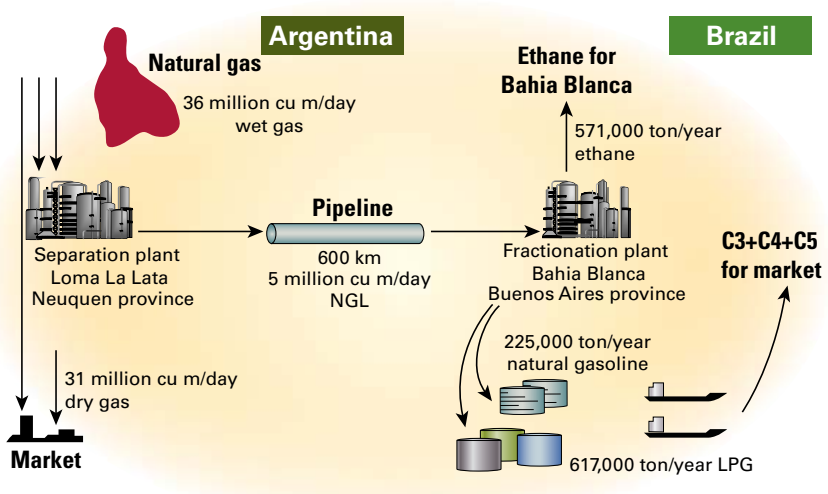
- Identification. A magnetic-flux leakage intelligent pig report and ultrasonic Scan B testing located the defect.
- Quantification. Ultrasonic thickness measurement and Scan B results use gammagraphic inspection to determine the defect's size and location on the wall pipe.
- Assessment. A simple finite element analysis model simulates the real defect and then corroborates results against API Recommended Practice 579 Fitness for Service, January 2000.

The concluding article next week will apply this procedure and finite element analysis directly to a fitness for service assessment.

Based on presentation to the Pipeline Rehabilitation & Maintenance conference, Manama, Bahrain, Dec. 11-13, 2007.

GENERAL BUSINESS FLOW

Fig. 1



Equations

$$V_s = \sqrt{\frac{\frac{K}{\rho}}{1 + \frac{K * d * C}{E * t}}} = \sqrt{\frac{\frac{1.4 \times 10^9}{500}}{1 + \frac{1.4 \times 10^9 * 305 * 0.95}{2.1 \times 10^{11} * 5.2}}} = 1,428 \text{ m/sec} \quad (1)$$

Where:
V_s = speed of sound through NGL, m/sec
K = bulk modulus of NGL, newton/sq m
d = pipeline ID, mm
C = constant of pipe fixity (0.95 for an axially unrestrained line)
t = WT, mm
ρ = NGL density, kg/cu m
E = modulus of elasticity, newton/sq m

$$\Delta P = \frac{\rho * V_s * \Delta V_{(fluid)}}{100,000} = \frac{500 \frac{kg}{cu\ m} * 1,428 \frac{m}{S} * 1.7 \frac{m}{S}}{100,000} = 12 \frac{Kgf}{sq\ cm} \quad (2)$$

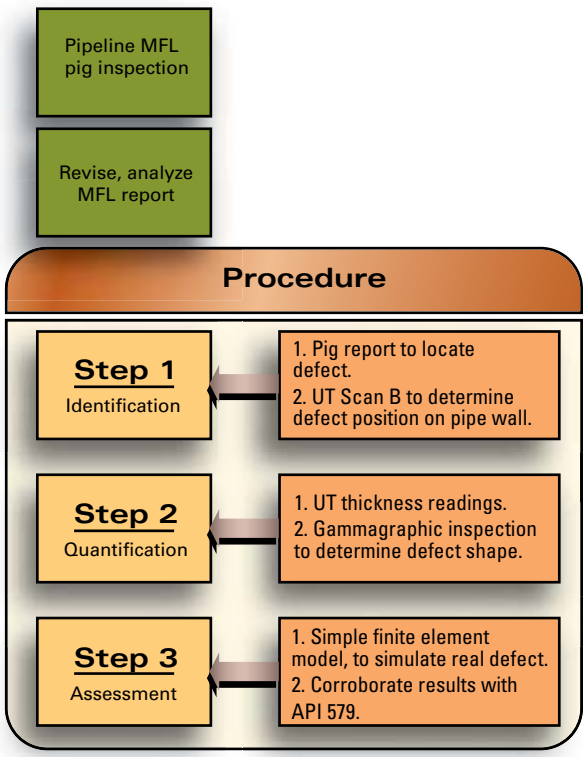
Where:
ΔV = total change in velocity of fluid, m/sec
ΔP = amplitude of wave pressure, bar

$$P_{surge} = Pi + \Delta P \quad (3)$$

Where:
Pi = internal pressure, bar
P_{surge} = total pressure reached at valve closure, bar

Process flow

Fig. 2



Procedure

An MFL intelligent pig inspection conducted after 4 years of uninterrupted pipeline operation fulfilled the pipeline maintenance plan. The MFL pig inspection, though not the focus of this work, is an important step of a pipeline integrity management plan.

The procedure presented here applies to all pipelines after an intelligent pig inspection report has been generated and consists of the three steps listed earlier (Fig. 2). Table 1 shows different scenarios analyzed in the defect zone.

Identification

The pig inspection report showed a rectangular (61 × 90 mm) internal defect with 44% metal loss on the bottom pipe wall, near valve No. 5 (about 83 km from the NGL extraction plant). In this part of the procedure, identification in the field marked where excavation for nondestructive testing should occur (Fig. 3).

Ultrasonic inspection introduces beams of high-frequency (0.1-25 Mhz) sound waves into materials for the detection of surface and subsurface flaws in the material.[2] Sound waves travel through the material and are reflected at interfaces. The reflected beams detect and locate flaws or discontinuities.

Ultrasonic inspection preformed NDT on the NGL pipeline through its protective coating (three-layer polyethylene extruded, PE-3PL) without breaking it. Successful application of ultrasonic techniques requires good adhesion between the protective layer and steel. Extruded polyethylene coatings generally have optimum adherence to the steel and allow high-quality ultrasonic testing (Fig. 4).

The coating helps prevent external damage due to soil interaction. Ensuring pipeline protective coating's integrity during NDT requires ultrasonic equipment capable of performing an examination through the three-layer polyethylene extruded material (2.82 mm).

UT Scan B conducted on the pipeline exposed the defect profile and determined where the gammagraphic film should be located on the pipeline wall. Analysis of the UT Scan B screen images yielded the following results:

- *Axial scan.* The defect resembled a keyhole; rectangular with sharp sides increasing the hoop stress on the pipe wall. Real internal metal loss equaled 1.2 mm, or 23%, instead of the 44% reported by the MFL pig inspection.
- *Circumferential scan.* The screen image in this direction showed the internal metal loss as progressive on both sides.

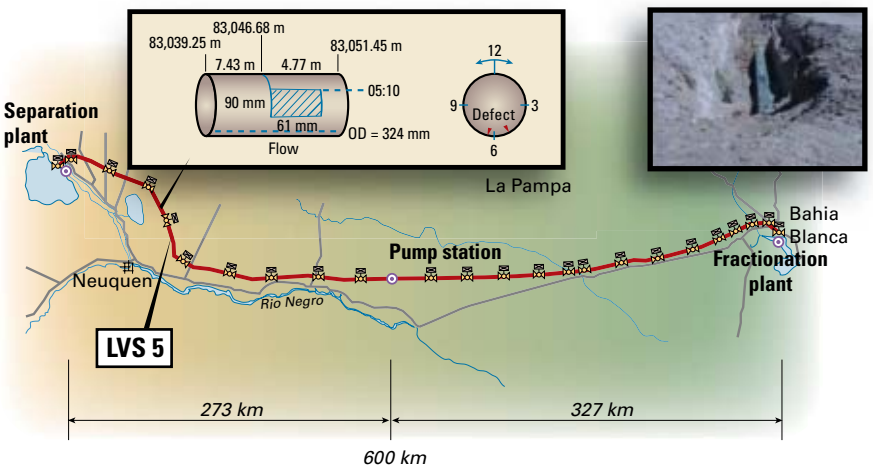
Defect-zone scenarios

Table 1

Description	Pressure, bar
Normal working pressure	73
Maximum expected pressure under normal condition	80
Unexpected pressure increase due to valve shutdown	85-92
Hydrostatic pressure test	131.4

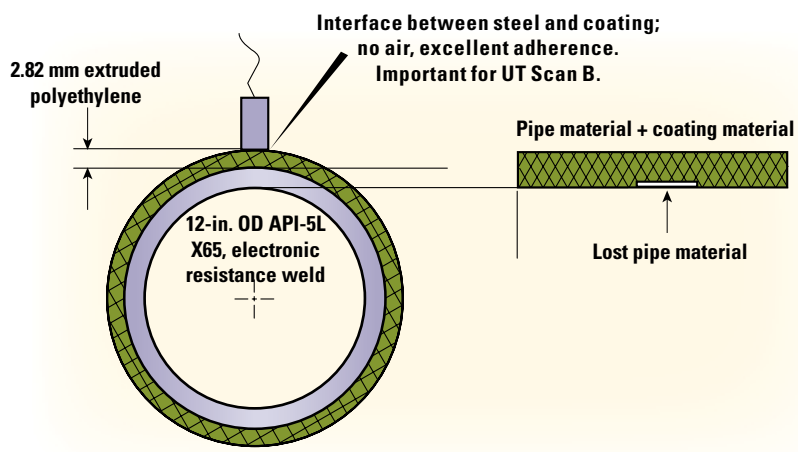
REPORTED DEFECT LOCATION

Fig. 3



UT SCAN B INSPECTION

Fig. 4



Quantification

Following identification and location of the defect with UT Scan B, a gammagraphic inspection identified the defect's real dimension and position on the pipe wall.

Radiography detects features of an assembly exhibiting a difference in thickness or physical density compared to surrounding material. Radiography generally only detects features with an appreciable thickness parallel to the radiation beam. Radiography can be used to inspect most types of solid material; metallic and non metallic. Inspection of this pipeline used gamma-rays.

Successful in-service pipeline radiographic inspection depends on knowledge of NGL's absorption coefficient (the attenuation of electromagnetic radiation) because its density varies between water and gasoline.

Field-development of the radiographic film revealed a 40 × 60-mm defect, circumferentially oriented. The dimensions corroborated the rectangular defect predicted by UT Scan B and the pig inspection report, but revealed a surface area difference of 44.4% between the defect reported by pig inspection and radiographic examination. No cracks were found on the corner defect, which could have been created by the notch effect.

This part of the procedure completely quantified the real defect, combining the UT Scan B and radiographic examination results. Fig. 5 clearly shows the three-dimensional defect image.

Table 2 shows the difference between the defect reported by MFL pig inspection and that reported by ultrasonic and radiographic examination.

MFL, UT-RADIOGRAPHY DETECTION COMPARISON

Table 2

Dimension, mm	MFL	UT, gamma-rays
Length	90	60
Width	60	40
Depth	2.28	1.2

Defect origin

Fitness For Service assessment requires identification of the damage mechanism. Skipping this critical step can lead to failure; creating false conclusions from a stress perspective.

Identifying the damage mechanism requires the appropriate NDT method, an estimate of the future damage rate to find remaining life, and proper monitoring and mitigation methods.

NGL's non-corrosive nature makes it unlikely the defect occurred in service, raising the probability it occurred during manufacturing. Electric-resistance welded line pipe consists of plates, longitudinally butt welded by heat from electric current, without filler metal and rolled until uniform in their OD. It is unlikely either rolling or storage created the defect. Quality inspection at the steel manufacturer likely failed.

This type of damage is not accepted by the international standard API 5L Specification for Line Pipe.[3]

Assessment

This part of the procedure ensures the mechanical integrity of the pipeline under different loading scenarios based on the real defect quantified. The need for more accurate and reliable assessment results forces use of both analytical and numerical methodologies. This

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analysis method allows assessment of whether the pipeline can keep operating at normal working pressure and still handle other potential loads (such as surges or liquid slugs) or if it is necessary to take the pipeline out of service to repair the damage.

A simple finite-element model performed the stress analysis on the damaged zone. It first considered the highest loads (Table 1), then corroborated and validated the numerical result using Recommended Practice API-579, Fitness For Service, Section Five.[4]

Surge pressure

A sudden change in flow velocity and pressure can cause a surge, potentially creating large forces and overpressure. Fig. 6 shows a simple view of this phenomenon.

If a liquid flowing steadily at a velocity v and pressure P from a reservoir or pump station through a valve finds the valve closed, the liquid comes to a stop, with v = 0 and pressure increasing to P + ΔP. Both a pressure wave and a reflected wave subsequently travel through the fluid, up and down the pipe at the velocity of sound in the medium.

Flow stops in the vicinity of the valve, even as material continues to enter the pipeline at the pump station. The resulting surge wave begins at the valve and travels upstream, reflecting back downstream, and oscillating back and forth until its energy is dissipated by pipeline wall friction. The amplitude of the surge wave (dP), or the magnitude of pressure surge (P_{surge}), is a function of change in velocity and the velocity of sound in NGL.

This case assumed the mainline block valve (LVS 5) closed instantaneously, using a simple hand calculation to determine the pressure reachable in the damage zone by a surge event (Equation 1).

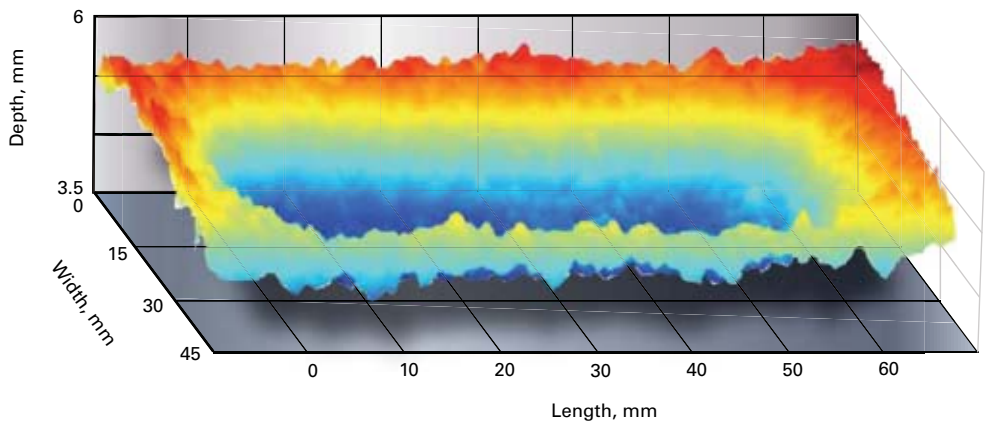
Equation 2 calculates the amplitude of the wave pressure, while Equation 3 calculates surge pressure.

Two cases considered stress analysis due to transient fluid, first when the pipeline was subject to normal working pressure and second at maximum expected pressure during normal operation. If valve LVS 5 suddenly closed, the surge pressure calculated by Equations 2 and 3 would equal 85 bar (73 + 12) in normal conditions and 92 bar (80 + 12) undergoing maximum expected pressure.

This calculation only approximates surge pressure magnitude for limited cases by the stated time closure criteria ($T < 2L/v$, where T is the valve closing time and L is the distance between valve and pump station). Dynamic simulation can yield detailed results if required. Friction attenuates the surge and the surge pressure arriving at the damaged zone is less than the surge pressure at the origin point.

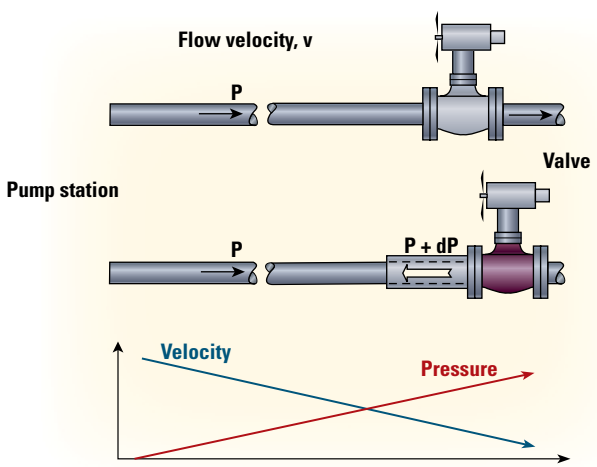
THREE-DIMENSIONAL DEFECT IMAGE

Fig. 5



PRESSURE-WAVE TRAVEL

Fig. 6



Acknowledgments

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Fulbright & Jaworski LLP

has added three lawyers to its global energy practice. Partners Lisa Tonery and Erik Swenson have joined Fulbright from King & Spalding LLP, while Mark Tibberts arrives from Simpson Thacher & Bartlett LLP. Tonery and Tibberts will be based in Fulbright's New York office; Swenson will practice from Washington, DC. All three routinely serve as lead counsel on energy infrastructure development matters. Tonery is a regulatory lawyer who represents independent developers of Federal Energy Regulatory Commission-jurisdictional LNG import terminal projects, interstate natural gas pipelines, and natural gas storage projects. She has also represented independent power producers and power marketers. Tonery has represented clients in the natural gas, oil, and electric power industries in proceedings before FERC, state commissions, and federal courts.


Tonery


Swenson


Tibberts

Swenson has more than 20 years experience practicing energy law. He represents energy project participants, including developers, equity investors, and lenders. He also represents energy traders with respect to regulatory matters and industrial and commercial companies with regard to energy matters. His work includes guiding clients developing LNG import terminals and gas storage projects, assisting major energy companies with acquisitions and dispositions of substantial generating facility portfolios, and representing a power marketer in FERC proceedings involving an allegation of gaming. Tibberts has spent more than 18 years working with energy industry clients, focusing on the finance, development, and sale and acquisition of energy infrastructure projects, such as power plants and gas pipeline and storage facilities.

Fulbright & Jaworski is a leading full-service international law firm, with nearly 1,000 lawyers in 16 locations worldwide.

Fortis Energy Marketing & Trading

(FEMT), Houston, appointed Bruce Sukaly managing director, asset management, and Lloyd P. Jackson managing director, power trading. Previously, Sukaly worked at Constellation Energy Commodities Group, where he served as vice-president, energy investments, and was responsible for the energy merchant assets of natural gas, power, coal, and natural gas liquids. Prior to that, he worked at Foothills Energy Ventures and was chief commercial officer for Cinergy Marketing & Trading. Jackson formerly was head of Midwest power trading at FEMT and acting head of power trading. Prior to joining Fortis, he was managing director, Midwest power trading, for Cinergy; senior power trader and asset manager with Dynegy; and manager, real-time trading, Midcontinent and Southeast regions, at Williams Cos.

FEMT is a division of Fortis Merchant Banking, part of the Fortis global financial services group based in Brussels.

Spectraseis,

Zurich, has named Vassil Bliznakov CFO. Bliznakov brings more than 10 years of financial experience in the oil and gas industry to his new role and will be tasked with further developing Spectraseis' financial and operational controls and managing expansion. Bliznakov comes to Spectraseis from Schlumberger, where he was controller for the company's business in continental Europe. Prior to that, Bliznakov worked as Schlumberger's South Russia regional controller based in Nefteyugansk and corporate internal auditor based in Paris, where he conducted four acquisition audits. Bliznakov is a graduate of the Hautes Etudes Commerciales in Paris.

Established in 2003 in partnership with leading European universities, Spectraseis is the principal technology and service provider in the fast-emerging field of low-frequency, passive-seismic geophysical surveys.

Seismic Micro-Technology

(SMT), Houston, has appointed Bill Stephenson vice-president of sales, Americas. He is responsible for all direct and channel sales across North and South America. He will work closely with his counterparts in Europe and Asia to align goals as SMT continues its rapid expansion globally. Previously, Stephenson was senior director of sales at Symantec. He has also worked in finance and specialty products distribution in various roles of sales and management. Stephenson earned a bachelor's degree in finance from the University of Houston and is a 4-year veteran of the US Army, where he served in South Korea, Germany, and in Southwest Asia during Desert Storm.

SMT is a market leader in PC-based geoscientific interpretation software aimed at oil and gas geoscientists.

The Information Store

(iStore) Houston, named Ezat Zarasvand general manager of the Middle East office the company is establishing in Abu Dhabi. He will oversee business development and services in the Middle East and Africa market. Zarasvand brings more than 30 years of global technology and management experience in the petroleum industry to iStore. Previously, Zarasvand managed sales and delivery of enterprise resource planning systems for Oracle Corp.. During his time at Oracle he worked closely with exploration and production (E&P) companies in the US, Europe, the former Soviet Union, Asia-Pacific, and the Middle East to develop E&P applications and align systems with business processes. He has also held various key positions with companies such as BP Exploration, Foxboro/Invensys, Cap Gemini/Sogeti Corp., and Cerner Arabia.


Zarasvand

The iStore has been assisting oil companies with their information and data access challenges for more than 14 years.

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New protective covers for drilling equipment

New Envelop protective covers are designed specifically for use in drilling operations. They are suited for use in harsh and corrosive environments, helping to protect drilling equipment from the weather.

By virtually eliminating the penetration of moisture and humidity, Envelop covers have proven to reduce equipment corrosion by as much as 90%, the company says.

Protected by three patents, Envelop's four-layered design is waterproof yet breathable, allowing moisture vapor to evaporate from underneath and reducing rust.

Envelop products incorporate special materials to absorb condensation trapped underneath the cover and hold it away from the metal being protected, until it evaporates it into the air. In addition, long-life vapor corrosion inhibitors released into the enclosed atmosphere help prevent oxidation.

Source: **Shield Technologies Corp.,** 3225 Neil Armstrong Blvd., Suite 300, Eagan, MN 55121.

New in-line pipeline inspection service

The new CPCM in-line inspection (ILI) service is a method to assess effectiveness of a pipeline's cathodic protection system from inside the pipe.

Pipeline operators can utilize an ILI tool to identify gaps and flaws in their cathodic protection systems.

ILI utilizes a smart pig traveling through the line, performing high-resolution cathodic protection measurements of the entire pipeline. There are no gaps in the data stream due to rough terrain, lakes or streams, and other inaccessible areas. The system is also suited for assessing offshore pipelines.

Source: **Baker Hughes, Pipeline Management Group,** 12645 West Airport Blvd., Sugar Land, TX 77478.

Imports of crude and products

	Districts 1-4 5-23 2008	Districts 1-4 5-16 2008	District 5 5-23 2008	District 5 5-16 2008	Total US 5-23 2008	Total US 5-16 2008	Total US *5-25 2007
	1,000 b/d						
Total motor gasoline	930	1,134	93	9	1,023	1,143	1,610
Mo. gas. blending comp.	565	637	50	9	615	646	1,014
Distillate	191	196	59	2	250	198	198
Residual	289	282	12	200	301	482	426
Jet fuel-kerosine	96	100	20	61	116	161	294
Propane-propylene	283	164	13	12	296	176	100
Other	309	647	6	54	315	701	368
Total products	**2,663**	**3,160**	**253**	**347**	**2,916**	**3,507**	**4,010**
Total crude	**7,768**	**8,093**	**1,191**	**1,144**	**8,959**	**9,237**	**10,018**
Total imports	**10,431**	**11,253**	**1,444**	**1,491**	**11,875**	**12,744**	**14,028**

*Revised.
Source: US Energy Information Administration
Data available in OGJ Online Research Center.

Purvin & Gertz LNG netbacks—May 30, 2008

Receiving terminal	Liquefaction plant: Algeria	Malaysia	Nigeria	Austr. NW Shelf	Qatar	Trinidad
	$/MMbtu					
Barcelona	8.77	6.82	7.78	6.69	7.04	7.69
Everett	10.58	7.85	10.08	7.88	8.58	10.96
Isle of Grain	10.26	8.29	9.81	8.16	9.04	9.80
Lake Charles	8.67	6.10	8.31	6.32	6.73	9.62
Sodegaura	7.14	9.66	7.38	9.41	8.56	6.28
Zeebrugge	9.17	6.70	8.45	6.56	7.41	8.45

Definitions, see OGJ Apr. 9, 2007, p. 57.
Source: Purvin & Gertz Inc.
Data available in OGJ Online Research Center.

Crude and product stocks

District	Crude oil	Motor gasoline: Total	Motor gasoline: Blending comp.[1]	Jet fuel, kerosine	Fuel oils: Distillate	Fuel oils: Residual	Propane-propylene
	1,000 bbl						
PADD 1	15,523	55,313	29,195	10,870	33,288	15,394	3,078
PADD 2	67,003	48,644	17,626	7,235	28,760	1,267	13,611
PADD 3	156,392	69,216	33,093	12,272	32,222	16,320	17,287
PADD 4	13,316	5,485	1,548	586	2,981	273	[1]781
PADD 5	59,325	27,497	20,854	8,618	12,180	5,931	—
May 23, 2008	**311,559**	**206,155**	**102,316**	**39,581**	**109,431**	**39,185**	**34,757**
May 16, 2008	**320,442**	**209,413**	**105,635**	**40,122**	**107,790**	**40,930**	**34,028**
May 25, 2007[2]	**342,233**	**198,027**	**89,362**	**40,885**	**120,415**	**37,006**	**35,079**

[1]Includes PADD 5. [2]Revised.
Source: US Energy Information Administration
Data available in OGJ Online Research Center.

Refinery report—May 23, 2008

District	Refinery operations: Gross inputs	Refinery operations: Crude oil inputs	Refinery output: Total motor gasoline	Refinery output: Jet fuel, kerosine	Refinery output: Fuel oils: Distillate	Refinery output: Fuel oils: Residual	Refinery output: Propane-propylene
	1,000 b/d		1,000 b/d				
PADD 1	1,461	1,458	1,898	111	443	114	56
PADD 2	3,416	3,382	2,432	216	994	51	202
PADD 3	7,442	7,385	3,102	675	2,171	336	680
PADD 4	545	542	281	24	187	14	[1]135
PADD 5	2,596	2,530	1,385	444	520	145	—
May 23, 2008	**15,460**	**15,297**	**9,098**	**1,470**	**4,315**	**660**	**1,073**
May 16, 2008	**15,464**	**15,083**	**9,028**	**1,560**	**4,344**	**648**	**1,117**
May 25, 2007[2]	**15,911**	**15,615**	**9,258**	**1,450**	**4,294**	**694**	**1,138**
	17,588 operable capacity		**87.9% utilization rate**				

[1]Includes PADD 5. [2]Revised.
Source: US Energy Information Administration
Data available in OGJ Online Research Center.

Additional analysis of market trends is available through **OGJ Online**, *Oil & Gas Journal's* electronic information source, at http://www.ogjonline.com.

OIL&GAS JOURNAL online research center

OGJ crack spread

	*5-30-08	*6-1-07	Change	Change, %
	$/bbl			
SPOT PRICES				
Product value	145.08	86.82	58.26	67.1
Brent crude	129.76	68.40	61.36	89.7
Crack spread	15.32	18.42	–3.11	–16.9
FUTURES MARKET PRICES				
One month				
Product value	148.84	88.83	60.01	67.6
Light sweet crude	128.46	63.93	64.53	100.9
Crack spread	20.37	24.90	–4.52	–18.2
Six month				
Product value	142.95	80.72	62.22	77.1
Light sweet crude	127.97	67.71	60.26	89.0
Crack spread	14.98	13.02	1.96	15.1

*Average for week ending.
Source: Oil & Gas Journal
Data available in OGJ Online Research Center.

OGJ GASOLINE PRICES

	Price ex tax 5-28-08	Pump price* 5-28-08	Pump price 5-30-07
	¢/gal		
(Approx. prices for self-service unleaded gasoline)			
Atlanta	356.6	396.3	308.1
Baltimore	340.7	382.6	306.5
Boston	337.5	379.4	300.6
Buffalo	340.5	400.6	308.8
Miami	356.9	407.2	320.5
Newark	357.2	390.1	290.2
New York	329.3	389.4	313.0
Norfolk	344.3	381.9	297.0
Philadelphia	338.5	389.2	312.1
Pittsburgh	336.7	387.4	299.3
Wash., DC	357.8	396.2	314.2
PAD I avg.	345.1	390.9	306.4
Chicago	368.5	419.4	371.0
Cleveland	330.3	376.7	315.5
Des Moines	332.3	372.7	313.3
Detroit	337.5	386.7	325.0
Indianapolis	339.0	384.0	326.1
Kansas City	333.4	369.4	313.0
Louisville	358.4	395.3	316.8
Memphis	334.5	374.3	299.3
Milwaukee	349.0	400.3	337.9
Minn.-St. Paul	338.9	379.3	319.8
Oklahoma City	335.6	371.0	316.8
Omaha	333.3	379.7	325.3
St. Louis	347.3	383.3	308.9
Tulsa	331.3	366.7	312.7
Wichita	325.9	369.3	317.0
PAD II avg.	339.7	381.9	321.2
Albuquerque	338.6	375.0	345.9
Birmingham	340.0	378.7	301.6
Dallas-Fort Worth	342.3	380.7	305.8
Houston	337.3	375.7	304.0
Little Rock	337.5	377.7	298.4
New Orleans	339.6	378.0	300.7
San Antonio	336.6	375.0	297.5
PAD III avg.	338.9	377.3	307.7
Cheyenne	334.7	367.1	303.5
Denver	355.6	396.0	326.2
Salt Lake City	334.1	377.0	320.7
PAD IV avg.	341.4	380.0	316.8
Los Angeles	357.7	416.2	346.8
Phoenix	339.8	377.2	310.6
Portland	347.8	391.1	329.2
San Diego	366.1	424.6	347.3
San Francisco	371.3	429.8	371.8
Seattle	347.1	399.5	341.8
PAD V avg.	355.0	406.4	341.3
Week's avg.	**343.3**	**386.8**	**317.6**
May. avg.	**329.3**	**372.9**	**307.6**
Apr. avg.	**296.4**	**339.3**	**278.3**
2008 to date	**283.9**	**327.5**	—
2007 to date	**213.0**	**256.6**	—

*Includes state and federal motor fuel taxes and state sales tax. Local governments may impose additional taxes.
Source: Oil & Gas Journal.
Data available in OGJ Online Research Center.

REFINED PRODUCT PRICES

	5-23-08 ¢/gal		5-23-08 ¢/gal
Spot market product prices			
Motor gasoline (Conventional-regular)		Heating oil No. 2	
New York Harbor	327.35	New York Harbor	387.33
Gulf Coast	325.43	Gulf Coast	384.66
Los Angeles	351.60	Gas oil	
Amsterdam-Rotterdam-Antwerp (ARA)	313.31	ARA	401.07
Singapore	327.00	Singapore	408.81
Motor gasoline (Reformulated-regular)		Residual fuel oil	
New York Harbor	342.48	New York Harbor	230.29
Gulf Coast	348.60	Gulf Coast	234.24
Los Angeles	353.43	Los Angeles	224.26
		ARA	241.66
		Singapore	240.75

Source: DOE Weekly Petroleum Status Report.
Data available in OGJ Online Research Center.

BAKER HUGHES RIG COUNT

	5-30-08	6-1-07
Alabama	5	4
Alaska	6	8
Arkansas	48	43
California	43	31
Land	42	30
Offshore	1	1
Colorado	110	106
Florida	0	1
Illinois	1	0
Indiana	2	2
Kansas	9	12
Kentucky	10	8
Louisiana	152	175
N. Land	53	54
S. Inland waters	20	23
S. Land	25	30
Offshore	54	68
Maryland	1	0
Michigan	1	1
Mississippi	14	14
Montana	13	19
Nebraska	0	0
New Mexico	74	83
New York	7	5
North Dakota	68	34
Ohio	11	13
Oklahoma	208	194
Pennsylvania	19	14
South Dakota	2	4
Texas	921	843
Offshore	11	11
Inland waters	2	0
Dist. 1	28	19
Dist. 2	33	26
Dist. 3	70	60
Dist. 4	97	98
Dist. 5	179	180
Dist. 6	120	122
Dist. 7B	28	37
Dist. 7C	72	54
Dist. 8	135	110
Dist. 8A	26	25
Dist. 9	40	37
Dist. 10	80	64
Utah	41	37
West Virginia	26	34
Wyoming	70	79
Others—AZ-1; NV-2; OR-1; TN-5; VA-5; WA-1	15	10
Total US	**1,877**	**1,774**
Total Canada	**176**	**136**
Grand total	**2,053**	**1,910**
Oil rigs	390	288
Gas rigs	1,479	1,484
Total offshore	67	81
Total cum. avg. YTD	**1,802**	**1,741**

Rotary rigs from spudding in to total depth.
Definitions, see OGJ Sept. 18, 2006, p. 46.

Source: Baker Hughes Inc.
Data available in OGJ Online Research Center.

SMITH RIG COUNT

Proposed depth, ft	5-30-08 Rig count	5-30-08 Percent footage*	6-1-07 Rig count	6-1-07 Percent footage*
0-2,500	71	5.6	64	7.8
2,501-5,000	119	56.3	111	52.2
5,001-7,500	219	12.3	239	20.5
7,501-10,000	431	4.4	413	2.9
10,001-12,500	476	2.5	425	2.1
12,501-15,000	293	0.3	282	0.3
15,001-17,500	123	—	109	0.9
17,501-20,000	76	—	79	—
20,001-over	35	—	38	—
Total	**1,843**	**7.0**	**1,760**	**7.6**
INLAND	24		46	
LAND	1,764		1,650	
OFFSHORE	55		64	

*Rigs employed under footage contracts.
Definitions, see OGJ, Sept. 18, 2006, p. 42.

Source: Smith International Inc.
Data available in OGJ Online Research Center.

OGJ PRODUCTION REPORT

	[1]5-30-08 1,000 b/d	[2]6-1-07 1,000 b/d
(Crude oil and lease condensate)		
Alabama	15	19
Alaska	723	755
California	653	670
Colorado	44	38
Florida	5	5
Illinois	25	27
Kansas	93	102
Louisiana	1,359	1,326
Michigan	14	15
Mississippi	51	54
Montana	93	96
New Mexico	164	163
North Dakota	116	115
Oklahoma	174	171
Texas	1,345	1,365
Utah	46	51
Wyoming	145	145
All others	61	76
Total	**5,126**	**5,193**

[1]OGJ estimate. [2]Revised.

Source: Oil & Gas Journal.
Data available in OGJ Online Research Center.

US CRUDE PRICES

	5-30-08 $/bbl*
Alaska-North Slope 32°	96.05
South Louisiana Sweet	129.50
California-Kern River 13°	113.85
Lost Hills 30°	121.70
Southwest Wyoming Sweet	118.85
East Texas Sweet	123.25
West Texas Sour 34°	116.25
West Texas Intermediate	123.75
Oklahoma Sweet	123.75
Texas Upper Gulf Coast	120.25
Michigan Sour	116.75
Kansas Common	122.75
North Dakota Sweet	116.50

*Current major refiner's posted prices except North Slope lags 2 months. 40° gravity crude unless differing gravity is shown.

Source: Oil & Gas Journal.
Data available in OGJ Online Research Center.

WORLD CRUDE PRICES

	5-23-08 $/bbl[1]
United Kingdom-Brent 38°	126.33
Russia-Urals 32°	121.30
Saudi Light 34°	123.89
Dubai Fateh 32°	122.85
Algeria Saharan 44°	127.81
Nigeria-Bonny Light 37°	130.90
Indonesia-Minas 34°	130.44
Venezuela-Tia Juana Light 31°	123.84
Mexico-Isthmus 33°	123.73
OPEC basket	126.21
Total OPEC[2]	123.86
Total non-OPEC[2]	122.73
Total world[2]	123.35
US imports[3]	120.16

[1]Estimated contract prices. [2]Average price (FOB) weighted by estimated export volume. [3]Average price (FOB) weighted by estimated import volume. Source: DOE Weekly Petroleum Status Report.
Data available in OGJ Online Research Center.

US NATURAL GAS STORAGE[1]

	5-23-08	5-16-08 bcf	5-23-07	Change, %
Producing region	622	595	760	–18.2
Consuming region east	845	797	951	–11.1
Consuming region west	234	222	311	–24.8
Total US	**1,701**	**1,614**	**2,022**	**–15.9**
	Mar. 08	**Mar. 07**	**Change, %**	
Total US[2]	**1,247**	**1,603**	**–22.2**	

[1]Working gas. [2]At end of period.
Source: Energy Information Administration.
Data available in OGJ Online Research Center.

WORLDWIDE CRUDE OIL AND GAS PRODUCTION

	Mar. 2008	Feb. 2008	3 month average production 2008	3 month average production 2007	Change vs. previous year Volume	Change vs. previous year %	Mar. 2008	Feb. 2008	Cum. 2008
	Crude, 1,000 b/d						Gas, bcf		
Argentina	640	640	631	631	—	—	150.0	140.0	412.18
Bolivia	40	42	41	44	–3	–6.8	40.0	39.0	121.00
Brazil	1,750	1,772	1,766	1,754	12	0.7	39.0	35.0	108.00
Canada	2,584	2,588	2,567	2,615	–48	–1.8	499.8	478.0	1,500.30
Colombia	562	564	560	519	41	7.9	22.0	20.0	64.00
Ecuador	500	500	500	499	1	0.2	1.0	1.0	3.00
Mexico	2,847	2,929	2,911	3,158	–247	–7.8	207.1	189.7	599.40
Peru	95	114	105	112	–7	–6.2	8.5	7.5	23.00
Trinidad	119	116	117	124	–8	–6.4	111.8	107.6	349.38
United States	5,097	5,113	5,101	5,174	–73	–1.4	1,817.0	1,694.0	5,295.00
Venezuela[1]	2,350	2,410	2,400	2,437	–37	–1.5	75.0	72.0	227.00
Other Latin America	80	80	80	80	—	–0.3	5.5	5.2	16.32
Western Hemisphere	**16,664**	**16,868**	**16,780**	**17,148**	**–368**	**–2.1**	**2,976.7**	**2,789.0**	**8,718.58**
Austria	16	17	16	17	–1	–5.6	5.4	5.1	15.70
Denmark	285	286	290	315	–25	–7.9	29.7	29.4	90.64
France	20	22	21	18	2	11.8	3.1	3.0	9.24
Germany	61	63	63	70	–7	–10.1	50.6	47.4	149.31
Italy	110	114	111	109	1	1.2	26.0	25.0	78.00
Netherlands	37	40	39	43	–4	–8.6	335.0	340.0	1,055.00
Norway	2,209	2,176	2,205	2,426	–221	–9.1	335.5	324.8	986.00
Turkey	38	39	39	40	–1	–2.9	0.0	0.0	0.00
United Kingdom	1,470	1,503	1,484	1,597	–112	–7.0	249.5	231.3	737.15
Other Western Europe	4	4	4	4	—	–2.3	2.9	2.7	9.72
Western Europe	**4,250**	**4,265**	**4,272**	**4,639**	**–368**	**–7.9**	**1,037.7**	**1,008.6**	**3,130.76**
Azerbaijan	945	940	945	817	128	15.7	35.0	30.0	96.00
Croatia	15	15	15	16	–1	–6.1	6.0	5.7	16.73
Hungary	14	15	14	17	–3	–15.4	7.1	6.7	21.43
Kazakhstan	1,360	1,400	1,373	1,083	290	26.8	75.0	70.0	213.00
Romania	95	95	95	98	–3	–2.7	18.0	17.0	53.00
Russia	9,730	9,760	9,763	9,903	–140	–1.4	2,100.0	2,000.0	6,200.00
Other FSU	400	400	400	400	—	—	540.0	500.0	1,590.00
Other Eastern Europe	50	49	49	49	—	0.8	19.6	17.8	56.38
Eastern Europe and FSU	**12,609**	**12,674**	**12,655**	**12,383**	**272**	**2.2**	**2,800.8**	**2,647.2**	**8,246.55**
Algeria[1]	1,390	1,380	1,390	1,330	60	4.5	280.0	260.0	825.00
Angola[1]	1,861	1,919	1,891	1,618	273	16.9	4.9	4.7	14.60
Cameroon	85	86	87	84	3	3.6	—	—	—
Congo (former Zaire)	20	20	20	20	—	—	—	—	—
Congo (Brazzaville)	240	240	240	240	—	—	—	—	—
Egypt	630	630	630	660	–30	–4.5	42.0	40.0	124.00
Equatorial Guinea	320	320	320	320	—	—	0.1	0.1	0.18
Gabon	210	240	227	230	–3	–1.4	0.3	0.3	0.92
Libya[1]	1,760	1,760	1,763	1,693	70	4.1	35.0	32.0	102.00
Nigeria[1]	2,010	2,100	2,057	2,227	–170	–7.6	78.0	75.0	233.00
Sudan	480	480	480	450	30	6.7	—	—	—
Tunisia	80	80	81	92	–11	–11.7	6.5	6.0	19.25
Other Africa	232	232	232	232	—	—	10.2	9.5	29.75
Africa	**9,318**	**9,487**	**9,418**	**9,196**	**222**	**2.4**	**456.9**	**427.5**	**1,348.70**
Bahrain	170	169	170	170	–1	–0.5	23.8	22.3	69.64
Iran[1]	4,020	3,950	4,023	3,903	120	3.1	310.0	290.0	900.00
Iraq[1]	2,410	2,450	2,383	1,893	490	25.9	9.5	9.0	27.50
Kuwait[1,2]	2,600	2,580	2,583	2,435	148	6.1	40.0	37.0	115.00
Oman	760	720	727	723	3	0.5	60.0	55.0	173.00
Qatar[1]	840	850	847	797	50	6.3	170.0	160.0	500.00
Saudi Arabia[1,2]	8,950	9,020	8,993	8,475	518	6.1	220.0	210.0	645.00
Syria	390	390	390	393	–3	–0.8	18.0	17.0	53.00
United Arab Emirates[1]	2,540	2,660	2,623	2,567	57	2.2	130.0	130.0	400.00
Yemen	310	320	317	357	–40	–11.2	—	—	—
Other Middle East	—	—	—	—	—	–54.6	11.0	11.1	33.62
Middle East	**22,990**	**23,109**	**23,056**	**21,714**	**1,342**	**6.2**	**992.3**	**941.4**	**2,916.76**
Australia	413	404	409	440	–31	–7.0	111.0	107.3	317.40
Brunei	190	193	184	188	–4	–2.0	36.0	35.0	107.89
China	3,779	3,757	3,771	3,755	16	0.4	258.0	231.6	719.10
India	702	647	678	695	–16	–2.4	85.3	81.8	250.82
Indonesia[1]	871	872	859	850	9	1.1	200.0	190.0	590.00
Japan	20	21	20	19	2	8.5	13.0	12.4	38.45
Malaysia	780	770	777	753	23	3.1	150.0	140.0	440.00
New Zealand	56	60	60	17	44	262.0	11.0	11.0	33.90
Pakistan	66	68	68	65	3	4.0	127.4	119.5	375.31
Papua New Guinea	10	10	10	17	–7	–40.0	1.0	0.9	2.90
Thailand	214	214	215	208	7	3.5	47.0	44.0	137.00
Vietnam	280	330	303	327	–23	–7.1	13.0	14.0	42.00
Other Asia-Pacific	35	28	31	35	–4	–11.1	96.5	88.7	280.67
Asia-Pacific	**7,417**	**7,374**	**7,386**	**7,367**	**19**	**0.3**	**1,149.1**	**1,076.2**	**3,335.44**
TOTAL WORLD	**73,247**	**73,776**	**73,568**	**72,447**	**1,120**	**1.5**	**9,413.6**	**8,889.9**	**27,696.79**
OPEC	32,102	32,451	32,314	30,225	2,089	6.9	1,553.4	1,470.7	4,582.10
North Sea	3,981	3,982	3,997	4,354	–357	–8.2	715.1	687.2	2,129.42

[1]OPEC member. [2]Kuwait and Saudi Arabia production each include half of Neutral Zone. Totals may not add due to rounding.
Source: Oil & Gas Journal. Data available in OGJ Online Research Center.

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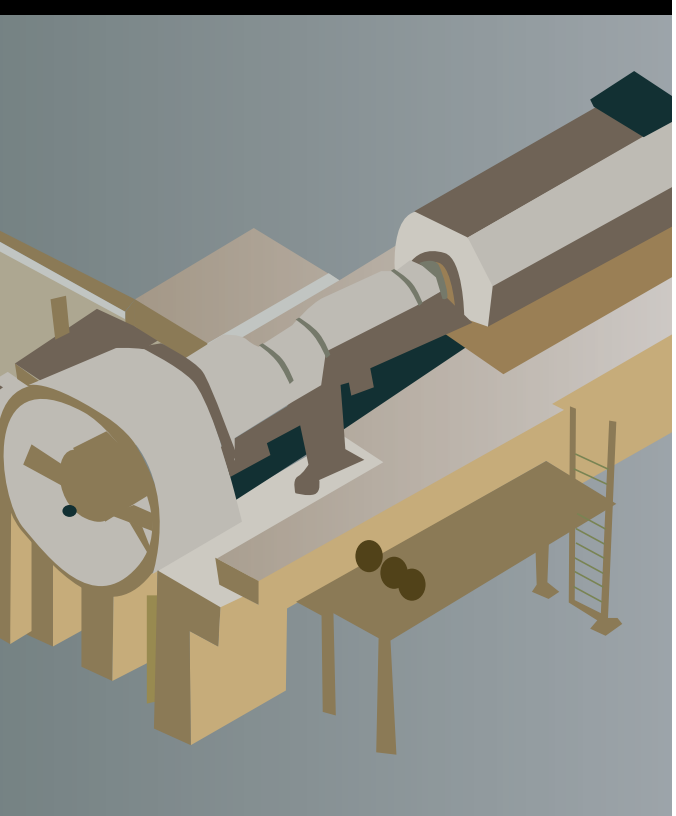

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- Units comes complete with all normally supplied auxiliaries and includes factory warranties covering manufacturing defects and performance guarantees.
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- Steam inlet conditions are 1900 psia (nominal)/ 1050°F/1050°F.
- Air-cooled TEWAC generator rated 165 MVA, 15.75 kV, 3 phase, 50 Hz, 3000 rpm.

THOMASSEN AMCOT INTERNATIONAL LLC

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Contact

FOR INFO OR PRICING
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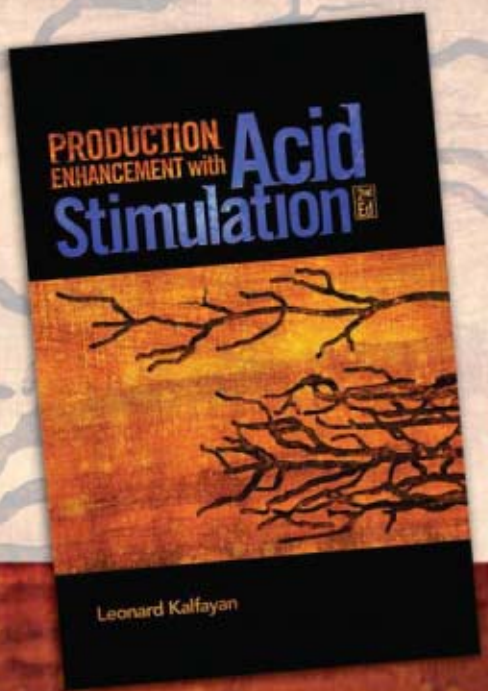
A Concise Guide on ACID TREATMENT AND DESIGN



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Latest oil-price investigation targets traders

Oil and gas companies have reason to welcome but be wary of the latest report of an oil-price investigation.

Most such probes start in Congress, focus on operating companies that sell gasoline, and find nothing. The one lately in the news started at the US Commodity Futures Trading Commission, targets traders, and remains under way. There's a difference between operating companies and traders,

The Editor's Perspective

by Bob Tippee, Editor

although some traders work for operating companies. The oil industry should hope these distinctions stay clear. The CFTC on May 29 unveiled an investigation begun last December into "the purchase, transportation, storage, and trading of crude oil and related derivative products." It called disclosure of a continuing investigation "an extraordinary step," taken "because of today's unprecedented market conditions."

The step also might have something to do with pressure from Congress. On May 27 Jeff Bingaman (D-NM), chairman of the Senate Energy and Natural Resources Committee, asked CFTC to examine commodity trading on foreign exchanges and challenged its assertions discounting speculation as a factor in oil-price elevation (OGJ Online, May 28, 2008). In its statement announcing the investigation, the CFTC reported an agreement with the UK Financial Services Authority and ICE Futures Europe increasing the exchange of information about commodity contracts with US delivery points.

Although the statement didn't say so, that move responds to concern about the so-called Enron loophole, which exempts from CFTC oversight forward contracts traded outside the US covering US commodity deliveries. The statement also reported measures to enhance the transparency of index trading.

Whether misbehavior in any of these areas can account for recent leaps in the price of crude oil is questionable. Yet individual traders of various types have been known to misbehave, sometimes with spectacularly damaging consequences. Oil companies don't benefit from anything that distorts markets, including trading shenanigans. They should applaud government exertions to keep markets honest. But they'll face guilt by association if the CFTC probe uncovers trading irregularities anywhere.

And if problems center on any of their own traders, they'll have to deal with political hostility that will make the currently nasty mood on Capitol Hill feel tame.

(Online May 30, 2008; author's e-mail: bobt@ogjonline.com)

Market Journal

by Sam Fletcher, Senior Writer

Energy is top political issue

From a record intraday high of $135.09/bbl May 22, the contract for benchmark US light sweet crudes closed at $127.35/bbl May 30, down 3.7% during the four trading sessions following the May 26 Memorial Day holiday on the New York Mercantile Exchange. For the whole of May, however, the price of crude was up 12%.

By the end of May, the average retail gasoline price exceeded $4/gal in more than a dozen US states, with the national average just a few cents below the same mark. "Prices have never been this high. California has become the first state where diesel fuel prices average $5/gal" said analysts at Pritchard Capital Partners LLC, New Orleans.

Because of public outcry against high energy costs, said Olivier Jakob at Petromatrix, Zug, Switzerland, "The price of oil has now become the No. 1 issue for politicians." Under pressure from Congress to change the limit rule or at least bring more transparency to the futures market, the Commodity Futures Trading Commission is investigating possible manipulations of energy futures prices. However, Jakob warned, "Any change of regulation on index trading will likely not materialize overnight (although the current political pressure is making for quicker than usual developments), but it exposes the long-term passive investors (pension funds) to a new risk; basically that the rules change by the time they want out, or force them out of positions." Such "system risk" should start to price a higher premium, he said.

Hundreds of British truck drivers tied up traffic in London, and fishermen blockaded ports in France in protests against high fuel prices. French President Nicolas Sarkozy proposed a European Union cap on fuel sales tax. UK Prime Minister Gordon Brown met with oilmen in Aberdeen to discuss how to maximize production from the UK's depleting North Sea fields, including possible tax reductions. Brown increased taxes on North Sea production when he was chancellor. Two years ago, he joined other European leaders in increasing taxes on large vehicles, fuel, plastic bags, and air travel in an effort to reduce carbon emissions 60% by 2050. Now Brown pledges global action on high oil prices will be the top topic at the Group of Eight (G8) July summit in Japan.

With the current public push to reduce energy prices, some observers are saying—perhaps prematurely—that the political power of the Green Party and other environmentalists may be broken. A recent poll sponsored by the National Center for Public Policy Research, a conservative think-tank and policy institute, found 65% of US residents don't want to spend even a penny more for gasoline in order to reduce greenhouse gas emissions.

Demand destruction

"Higher prices are causing demand destruction, but only in regions where consumers see price signals," said Richard Berner, co-head of global economics at Morgan Stanley & Co. Demand for crude within the Organization for Economic Cooperation and Development in 2008 is expected to decline for the third year in a row, although perhaps by less than 1 million b/d. However, Berner said non-OECD demand led by China and the Middle East is likely to remain strong even if oil hits $150/bbl.

Demand destruction "is a much abused term, which refers to demand that is not only lost when prices rise, but that stays lost even if prices fall back to their original levels," said Paul Horsnell, Barclays Capital Inc., London. "It is a concept about an asymmetry in demand response to price movements. The reduction in OECD power and heavy manufacturing sector use of oil in the early 1980s was genuine demand destruction. However, there is no suggestion as yet that demand destruction is currently taking place, and, by definition, what was destroyed in the 1980s cannot be destroyed twice." Instead, he said, "What we are looking at in the numbers is straightforward demand reduction with no necessary implication that lower prices would not price that demand straight back in."

Jakob said, "On the demand side, Taiwan is added to the list of countries going through the process of price revisions with an increase of 16% on diesel and 13% on gasoline. India should be the next country in line to lower internal subsidies. The problem is that these budgetary imbalances have not been created by $130/bbl but by $100/bbl oil and will likely be followed by more revisions."

The South Korean government is considering cutting more oil taxes, including the tax on diesel, to help ease price pressure on households. The government lowered oil taxes by 10% in March.

(Online June 2, 2008; author's e-mail: samf@ogjonline.com)

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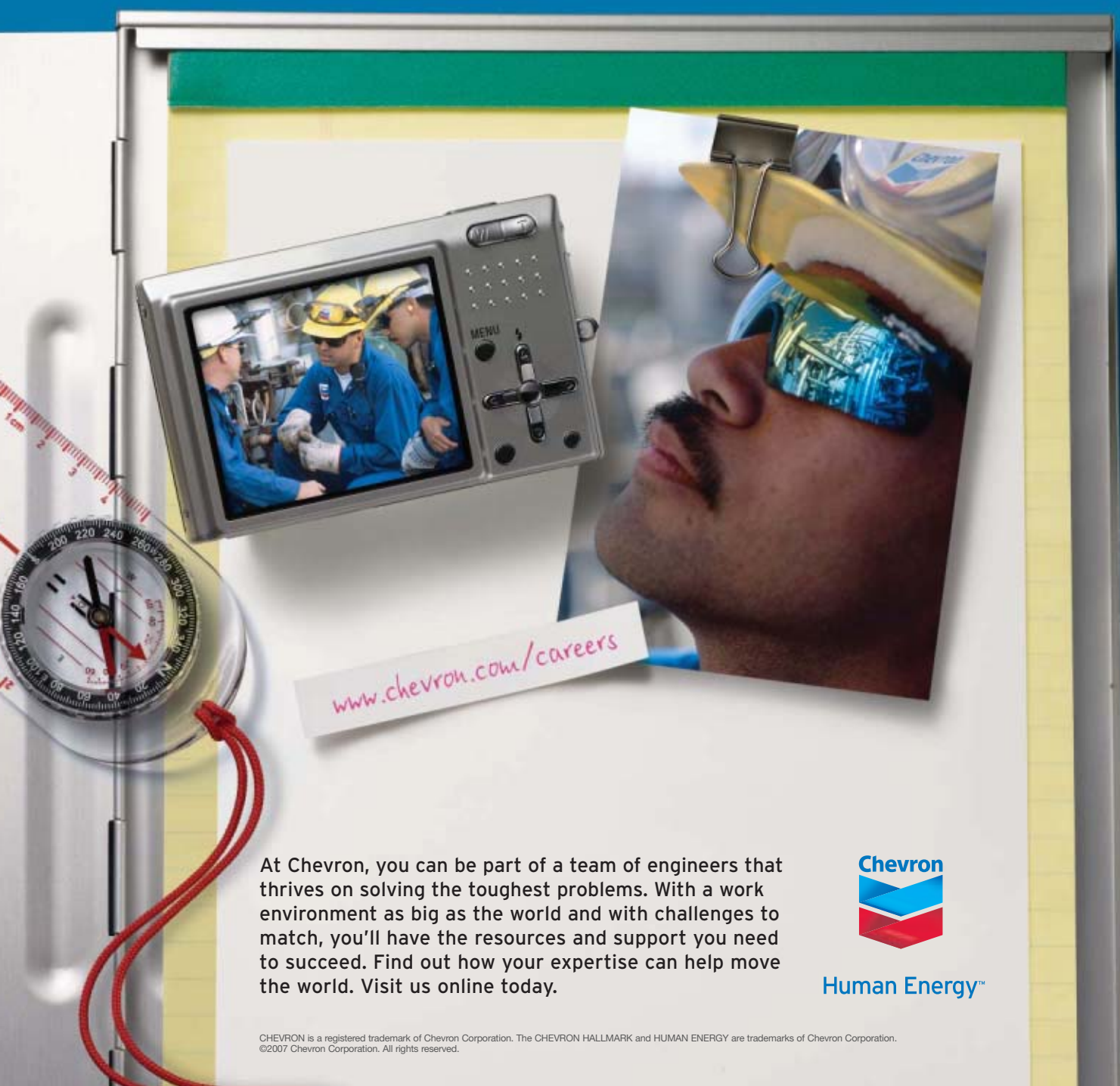

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September 30 – October 2, 2008
Fort Worth, Texas USA
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PRELIMINARY EVENT GUIDE

THE RETHINKING CONTINUES

By rethinking recovery methods, producers have brought to a hungry market gas from reservoirs once considered economically and technically impossible. Tight sands, shales, and coalbeds now represent large and growing sources of an essential form of clean energy. But they're still unconventional. The reservoirs are complex. The costs of drilling into and completing wells in them are high and rising. They present unique environmental problems. Producing gas from unconventional reservoirs profitably, safely, and in amounts demanded by the market requires continuous rethinking – the kind of thinking that shoves back limits on what's possible with gas supply.

Rethinking of recovery methods will continue September 30 – October 2, 2008, at the Unconventional Gas International Conference & Exhibition at the Hilton Fort Worth in Fort Worth, Texas. Planned by editors of *Oil & Gas Journal* and an advisory board of industry experts, the event will highlight innovation from unconventional gas plays around the world. It will be your chance to meet and learn from other professionals in the fastest-growing sector of the gas-producing industry.

Plan to attend the first annual Unconventional Gas International Conference & Exhibition.

THE CONFERENCE SETTING

PennWell's Unconventional Gas International Conference & Exhibition will be a highly focused event developed to benefit exhibitors and attendees. This pivotal event provides a sophisticated new venue where buyers and sellers meet, learn and build business relationships.

A PennWell designed venue ensures a rich learning and marketing environment focused on unconventional gas recovery techniques through:

- Exhibitions unencumbered by space restriction
- High-visibility sponsorships
- Topic-specific technical papers written for this event
- Expert-led, expert-attended technical sessions

PennWell conferences and exhibitions are user-friendly-forums that attract senior-level industry experts. From Advanced Technology conferences and forums to the largest Power and Fire exhibitions in the world, our events are the standard for building industry understanding and exhibitor return on investment.

TECHNICAL FOCUS AREAS

- Regulatory Concerns
- Recovery Methods
- Coal Bed Methane
- Tight Gas Sands
- Shales
- Field Development
- Frontier Areas
- Sustainability Issues
- Completion Technologies
- Reservoir Management
- Well Control
- Drilling Methods
- Field Geology
- Workforce and Demographics
- Market Dynamics
- Field Economics
- Transportation and Logistics
- Risk and Reliability
- Technology Qualification and Implementation
- Well Stimulation
- Project Execution and Management
- Produced Water Handling
- Geological Methods

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For more information, please visit our website at **www.unconventionalgas.net**

WHO SHOULD ATTEND?

The Unconventional Gas International Conference & Exhibition is an event for senior–level industry experts. It will provide a learning and networking environment through topic–specific exhibits and presentations of leading industry technology.

Industry experts who will attend this event are:

- Operational engineers and managers who plan and develop new methods of retrieving gas
- Field supervisors who must understand the complexities and parameters of redeveloping existing fields and the complexities of processing, and transportation
- Operations planning personnel involved in planning and scheduling unconventional gas development projects worldwide
- Engineering staff and management involved in unconventional gas development decision-making processes
- Suppliers who provide equipment or services for unconventional gas development, processing, or transportation
- Consulting companies that advise clients on current industry standards on unconventional gas development trends
- Business development managers pursuing unconventional business opportunities.

EXHIBITS

Exhibitors benefit directly from PennWell's experience in producing technical conferences and exhibits, ensuring a well-managed opportunity to:

- Increase brand awareness and build brand value
- Meet strategic decision-makers face to face
- Build meaningful relationships
- Source new suppliers

Your participation as an exhibitor entitles you to powerful benefits to boost marketing efforts, including:

- Client invitations for free admission to the exhibit floor
- Fast visibility and reference with listings online and in the Conference Program – including company contact information and a 30-word description of your company

Exhibit rates are an economical US $39.00 per square foot (min. 10 ft. x 10 ft. of exhibit space). Space includes one full conference registration and two booth staff personnel passes.

This booking includes: An obligatory presence in the enhanced UGCE 2008 online show catalogue and customer management system which will be charged at the flat rate of US$275 per exhibitor. Included in this basic listing is a powerful interactive online directory. This fully searchable directory will give buyers access to your information around the clock. This package includes descriptions and photos of up to 5 products, a 30 word company description and full contact details.

Platinum and Standard Packages are live for 12 months.

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This allows your company to:

- list up to 10 products, with descriptions
- use 500 words for your company description describing in detail the solutions you have to offer
- use up to 10 links out to your own web pages
- upload 10 pdf's or other material for buyers to view

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- Registration Sponsorship

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MARKETING OPPORTUNITIES

Share your ideas, experiences, technology, and expertise with operators and project managers who are eager to improve their operations. Innovative, responsive, and professionally managed PennWell events maximize your return on investment – whether you are an exhibitor or an attendee.

PennWell's Unconventional Gas International Conference & Exhibition offers an integrated program of marketing opportunities to help you achieve your objectives.

LIVE WEBCAST PRESENTATION

A unique sponsorship opportunity as the live webcast includes a conference summary by members of the advisory board followed by an in-depth question and answer session from conference delegates in attendance as well as oil industry professionals participating remotely via computer.

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Reservations must be guaranteed with a major credit card or one night's room & tax. Cancellation must be made 72 hours to arrival or one night's room and tax will be charged to the credit card or deposit will be retained. Cut-off for discounted rate is August 30, 2008

CONFERENCE PROGRAM DETAIL

TUESDAY, SEPTEMBER 30, 2008

3:00 – 5:00 p.m. **Opening Session - Crystal Ballroom D**
Steve Holditch – *Texas A&M University*
Gioa Falcone – *Texas A&M University*

5:00 – 6:30 p.m. **NETWORKING RECEPTION EXHIBIT HALL** Sponsored by: WG WOOD GROUP Wood Group Pressure Control

WEDNESDAY, OCTOBER 1, 2008

8:00 – 9:15 a.m. **OPENING PLENARY SESSION** – Crystal Ballroom D

8:00 – 8:15 a.m. **WELCOME/INTRODUCTION & OPENING REMARKS**
Bob Tippee, Conference Director – *Oil & Gas Journal*

8:15 – 9:15 a.m. **KEYNOTE PRESENTATION**
The Imperative of Efficient Water Use in the Development Of Unconventional Gas Reserves
L. Peter Galusky, Jr., Ph.D – *Texerra*

Paper Title TBD
Larry Lunardi – *Chesapeake Energy Corporation*

9:15 – 10:00 a.m. **COFFEE BREAK**

10:00 – 11:30 A.M. SESSION 1

TRACK 1 - TECHNOLOGY & OPERATIONS – Texas A & B Rooms

Reservoir Management
Chair: John Wessels – *Quintana Energy Partners, L.P.*
Co-Chair: Guntis Moritis – *Oil & Gas Journal*

10:00 – 10:30 a.m. **A Case Study: Using Wireline Pressure Measurements to Improve Reservoir Characterization in Tight Formation Gas - Wamsutter Field, Wyoming**
Tex Boratko – *Schlumberger*

10:30 – 11:00 a.m. **Unconventional Gas Resources to Reserves - A Predictive Approach**
Scott Reeves – *Advanced Resources International*

11:00 – 11:30 a.m. **Horizontal Wells for Improved Unconventional Gas Production: Getting the Most Out of Modeling Technology**
Dr. Arden McCracken – *Object Reservoir*

TRACK 2 – BUSINESS ASPECTS – TEXAS C & D ROOMS

Business Markets
Chair: Bill Powell – *Schlumberger*
Co-Chair: Tom Muchard – *El Paso Energy*

10:00 – 10:30 a.m. **Building the E&P Factory**
Andy Steinhubl – *Booz Allen & Hamilton*

10:30 – 11:00 a.m. **The New Dynamics of Technology in Unconventional Gas Development**
Don Warlick – *Warlick International*

11:00 – 11:30 a.m. **Paper Title – TBD**
John K. Howie – *Goldman Sachs & Company* (Invited)

11:30 – 1:00 p.m. **LUNCH**

1:00 – 2:30 P.M. SESSION 2

TRACK 1 - TECHNOLOGY & OPERATIONS – Texas A & B Rooms

Field Development Strategies
Chair: Kent Perry – *RPSEA*
Co-Chair: Alan Petzet – *Oil & Gas Journal*

1:00 – 1:30 p.m. **Economics of Mannville CBM Development: Drilling and Production Innovation at Corbett Creek**
John Cockbill – *Trident Exploration Corp.*

1:30 – 2:00 p.m. **Integration of New Technologies to Map Structural Features and Improve Stimulation Treatments in Shale Gas Plays: Coupling Surface Seismic, Microseismic and Wireline in the Fayetteville Shale**
Donald Burch – *Aspect Abundant Shale, L.P.*

2:00 – 2:30 p.m. **Coalbed Methane and Shale Gas Potential in Wind River Basin, Wyoming**
Dr. Thomas Gentzis – *Petron Resources, L.P.*

TRACK 2 – BUSINESS ASPECTS – TEXAS C & D ROOMS

Permitting & Regulations
Chair: Glenda Wylie – *Halliburton*
Co-Chair: Guntis Moritis – *Oil & Gas Journal*

1:00 – 1:30 p.m. **The Right To Drill: At What Point Do City Drill Site Ordinances Become A Government Taking?**
David J. Drez, III – *Haynes and Boone, LLP*

1:30 – 2:00 p.m. **Paper and Speaker – TBD**

2:00 – 2:30 p.m. **Paper and Speaker – TBD**

2:30 – 3:00 p.m. **COFFEE BREAK**

3:00 – 4:30 P.M. SESSION 3

TRACK 1 - TECHNOLOGY & OPERATIONS – Texas A & B Rooms

Drilling and Completions
Chair: John Wessels – *Quintana Energy Partners, L.P.*
Co-Chair: Bill Powell – *Schlumberger*

3:00 – 3:30 p.m. **Re-Thinking Wellhead Systems for Unconventional Applications.**
Stan Hosie – *Wood Group Pressure Control*

3:30 – 4:00 p.m. **Barnett Shale Completion Optimization and the Role of Several Completion Diagnostic Technologies**
Richard Leonard – *ProTechnics*

4:00 – 4:30 p.m. **Horizontal Wells in the Cotton Valley Formation - Filling the Gap at Understanding Good from Poor Producers.**
John Thompson – *Schlumberger*

TRACK 2 – BUSINESS ASPECTS – Texas C & D Rooms

International Opportunities
Chair: Scott Reeves – *Advanced Resources International Inc.*
Co-Chair: Alan Petzet – *Oil & Gas Journal*

3:00 – 3:30 p.m. **Unconventional Gas Beyond North America**
Chris Hopkins – *Schlumberger*

3:30 – 4:00 p.m. **Techno-economic Feasibility of Coal Bed Methane Prospects in India**
Dr. Mandira Agarwal – *University of Petroleum & Energy Studies*

4:00 – 4:30 p.m. **Paper and Speaker – TBD**

4:30 – 6:00 p.m. **Exhibition Hall Networking Reception**

THURSDAY, OCTOBER 2, 2008

8:00 – 9:30 A.M. SESSION 4

TRACK 1 - TECHNOLOGY & OPERATIONS – Crystal Ball Room D

Production & Stimulations 1
Chair: Scott Reeves – *Advanced Resources International Inc.*
Co-Chair: Don Sebastian – *Baker Energy*

8:00 – 8:30 a.m. **Modeling of Gas Production for Liquid Hold Up and Techniques Used to Deliquify Wells**
Jose Macias – *Champion Technologies*

8:30 – 9:00 a.m. **Non-Damaging Stimulation Technique Helps Make Unconventional Reservoirs Economically Feasible**
Derek Krivak – *Stealth Ventures Ltd.*
Garnet Olson – *Canyon Technical Services*

9:00 – 9:30 a.m. **Integration of Log, Downhole Testing and Core Data to Optimize Stimulation Design in Gas Shales**
Richard E. Lewis – *Schlumberger*

9:30 – 10:15 a.m. **COFFEE BREAK**

10:15 – 11:45 A.M. SESSION 5

TRACK 1 - TECHNOLOGY & OPERATIONS – Crystal Ball Room D

Production & Stimulations 2
Chair: Kent Perry – *RPSEA*
Co-Chair: Glenda Wylie – *Halliburton*

10:15 – 10:45 a.m. **Unlocking Tight Oil: Selective Multi-Stage Fracturing in the Bakken Shale**
John Paneitz – *Whiting Petroleum Corp.*

10:45 – 11:15 a.m. **Hydraulic Fracture Complexity: Diagnosis, Remediation, and Exploration**
Craig L. Cipolla – *Pinnacle Technologies*

11:15 – 11:45 a.m. **Reservoir Modeling of Multi-Stage Fracture Stimulated Horizontal Shale Wells**
Bill Grieser – *Halliburton*

11:45 – 1:15 p.m. **LUNCH**

1:15 – 2:45 P.M. SESSION 6

TRACK 1 - TECHNOLOGY & OPERATIONS – Crystal Ball Room D

Produced Water Management
Chair: Don Sebastian – *Baker Energy*
Co-Chair: Tom Muchard – *El Paso Energy*

1:15 – 1:45 p.m. **Subsurface Drip Irrigation for Beneficial Use of Produced Coalbed Water**
John Zupancic – *BeneTerra LLC*

1:45 – 2:15 p.m. **Conformance Technology for Tight Gas Well Stimulation**
Larry Eoff – *Halliburton*

2:15 – 2:45 p.m. **Energy Development and Water Needs in Texas: The Next 20 Years**
David Barnett – *Texas A&M University*

2:45 – 3:30 p.m. **COFFEE BREAK – Exhibit Floor**

3:30 – 5:00 p.m. **WRAP-UP – Crystal Ball Room D**

3:30 – 4:45 p.m. **WEBCAST**

4:45 – 5:00 p.m. **CHAIRMAN'S CLOSING REMARKS**

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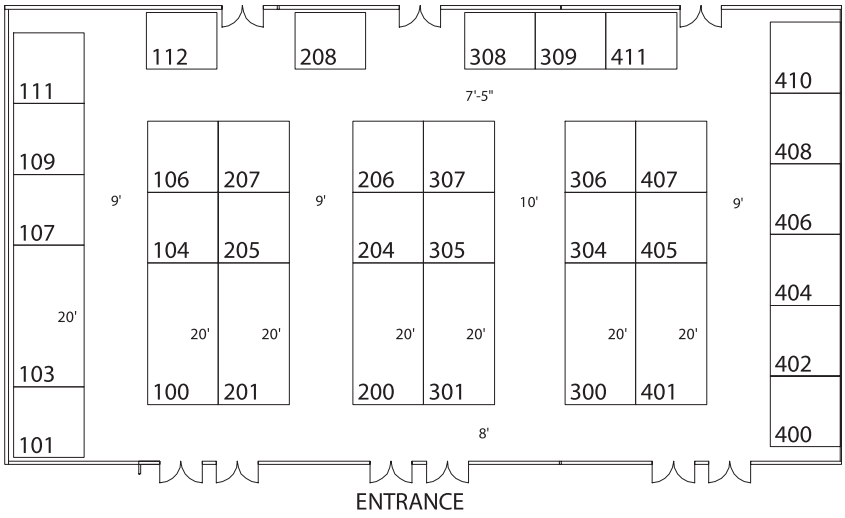
September 30 – October 2, 2008
Hilton Fort Worth
Fort Worth, Texas USA

2008 FLOOR PLAN



REGISTRATION HOURS:

Tuesday, September 30	8:00 a.m. – 7:00 p.m.
Wednesday, October 1	7:30 a.m. – 6:30 p.m.
Thursday, October 2	7:30 a.m. – 2:00 p.m.

EXHIBITION HOURS:

Tuesday, September 30	5:00 p.m. – 7:00 p.m.
Wednesday, October 1	
Morning Hours	9:15 a.m. – 1:15 p.m.
Afternoon Hours	4:00 p.m. – 6:00 p.m.
Thursday, October 2	10:00 a.m. – 1:30 p.m.

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1. Type of Company or Organization:

- ☐ 10 Oil/Gas company
- ☐ 20 Consulting Company
- ☐ 30 Contractor
- ☐ 40 Engineering/Construction
- ☐ 50 Financial
- ☐ 60 Service/Supply
- ☐ 65 Government/Library/Education
- ☐ 70 Other _____

2. Job Function:

- ☐ 02 Management (CEO, Pres.VP)
- ☐ 05 Engineering/Technical/Geoscience
- ☐ 06 Superintendent/Field Professional/Foreman
- ☐ 10 Purchasing/Consulting
- ☐ 12 Other _____

3. Areas of Interest/Involvement:

- ☐ 10 Exploration
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- ☐ 29 Gas Processing
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- ☐ 15 Refining
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- ☐ 46 Other _____

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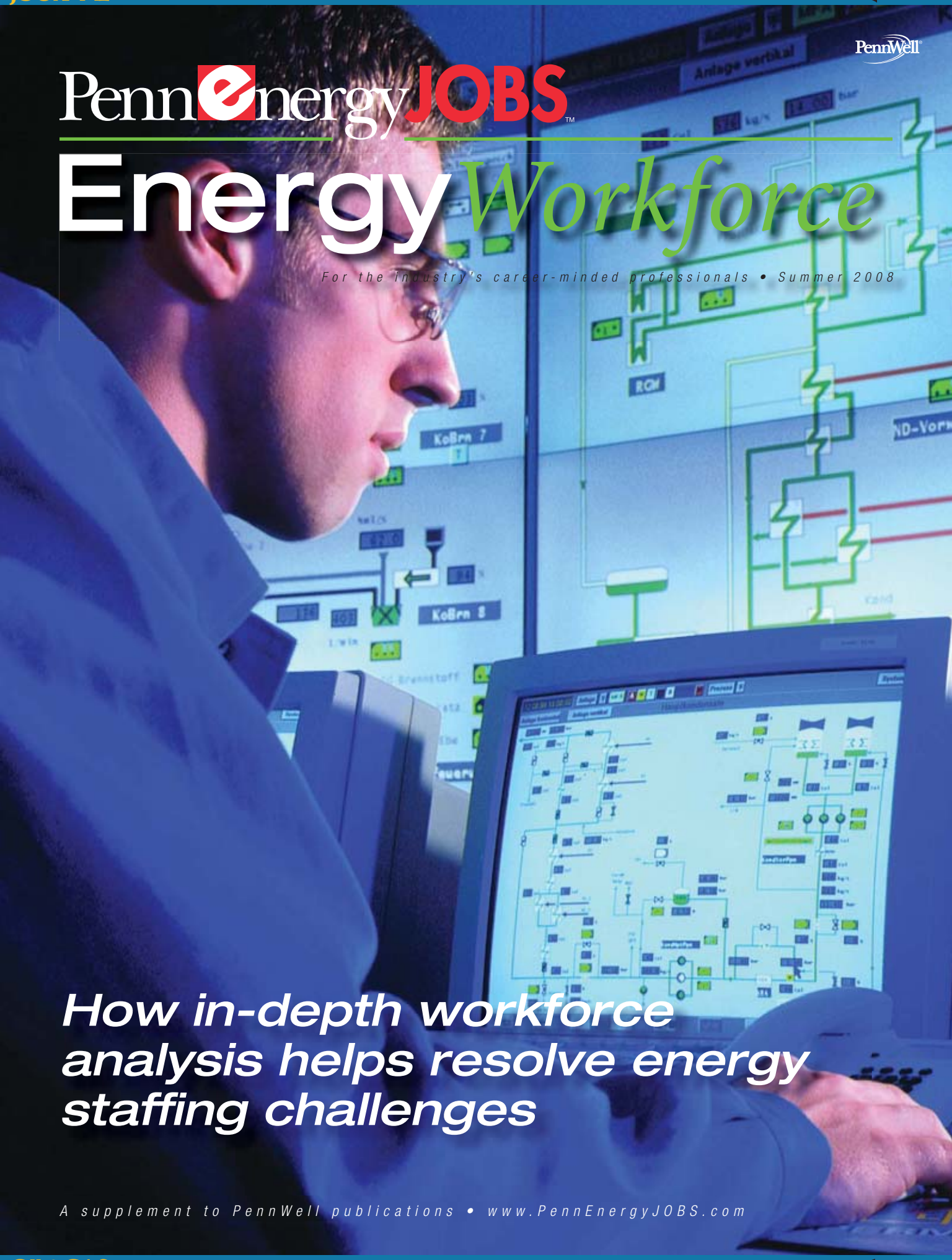

How in-depth workforce analysis helps resolve energy staffing challenges

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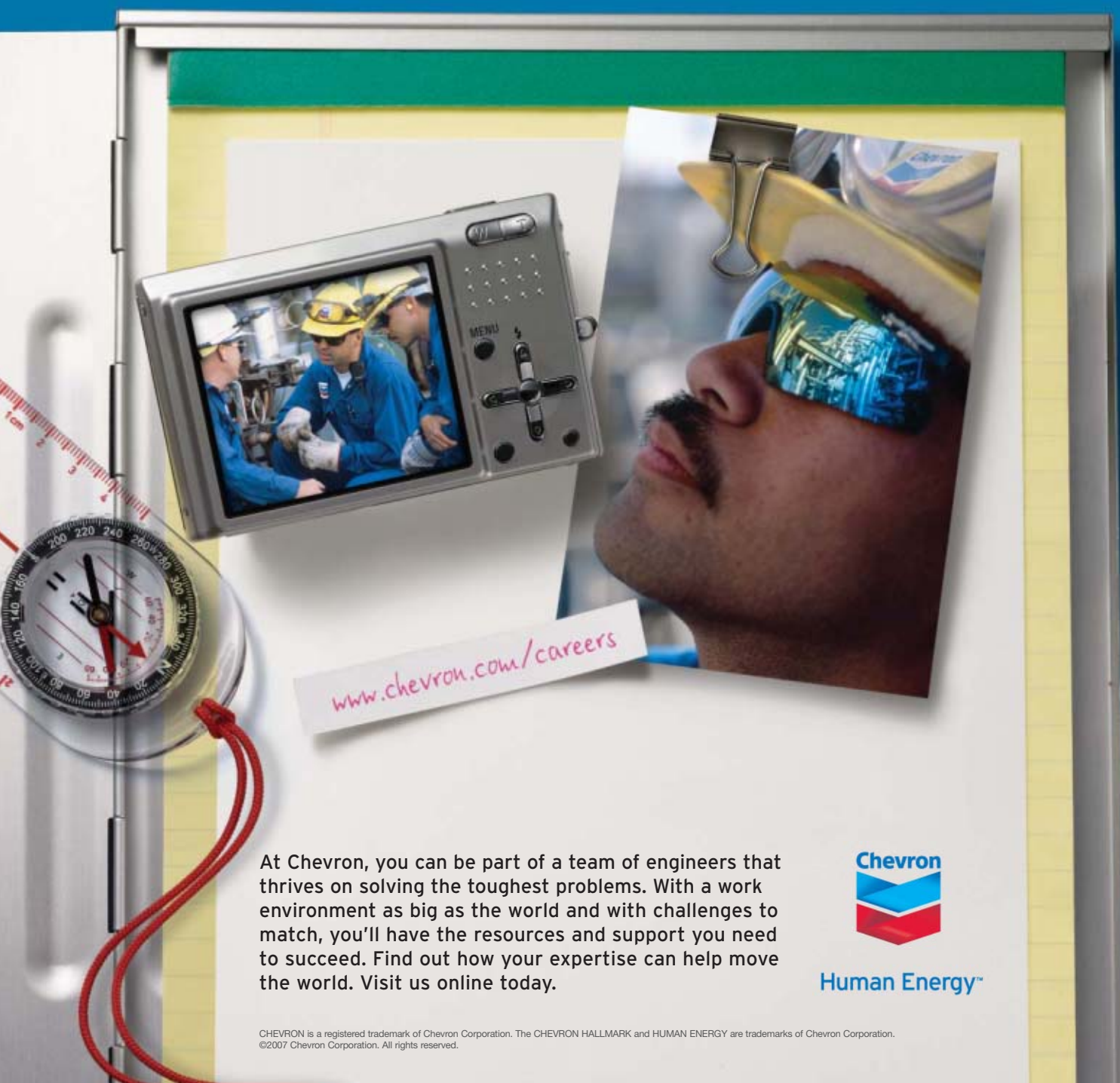

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The power industry is grappling with a hypercompetitive labor market, according to two human resources executives with The Shaw Group Inc.. The Shaw executives sat for a Q&A session for Energy Workforce's new HR Insights feature, introduced in this issue. The cover photo depicts a power plant control room operator checking equipment status during start-up commissioning. Photo courtesy of Siemens Energy.

www.PennEnergyJOBS.com

OTC shows value of conferences to energy professionals

This year's Offshore Technology Conference (OTC) in Houston demonstrated in its typically big way why industry trade conferences are invaluable for an energy professional's career development.

OTC is a powerfully effective amalgam of strong technical content and jaw-dropping exhibits. Attendance this year reached 75,092, a 26-year high, as energy professionals from 110 countries met to learn about the latest technology to find and produce offshore oil and natural gas resources. Some of the exhibits are truly, if you pardon the well-worn term, awesome—costing in the millions of dollars and featuring equipment weighing many tons. About 2,500 companies from more than 30 countries participated in OTC 2008, many of them displaying in an area the size of 13 football fields at Reliant Center.

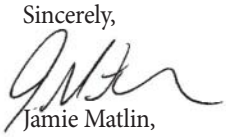
A truism in the energy industry today: Companies that don't make every effort to keep continuing education and training of skilled professionals uppermost in their retention initiatives will fail to grow and succeed.

Beyond the gee-whiz technology and imposing equipment is the transfer of knowledge, as more than 300 technical papers were presented at the Houston conference. Conferences such as OTC excel as opportunities to learn and to network among all oil and gas professionals. But of special note this year was the conference's emphasis on networking among and education of young minds. The Next Wave event was a special OTC session devoted to issues important to industry professionals under the age of 35. In addition, the second OTC Energy Education Institute brought 100 Houston area elementary and secondary teachers to OTC for a workshop on bringing energy topics to their classrooms.

Facing a potentially crippling shortfall of skilled talent due to the impending retirement of more than half of its workforce in the coming decade, the oil and gas industry is pulling out all the stops to recruit and retain talent. Many of the exhibits featured displays and kiosks managed by company recruiters. PennWell's own large booth featured a room-length wall displaying hundreds of PennEnergyJOBS listings, such as those featured at the back of this issue; young professionals often were seen clustered around our wall of career opportunities.

But it wasn't just youth being served by these recruiting initiatives; seasoned professionals could often be seen visiting recruiting stations as well. That underscores part of the message of the article on p. 5 of this issue that, for now, retention is a bigger concern than recruitment for many oil and gas operating and service/supply companies. And judging by the way that PennWell books, magazines, and marketing materials were flying off the shelves, there is an unquenchable thirst for knowledge by young and mature alike, demonstrating that learning is a constant in a successful career. Those two circumstances add up to what must be a truism in the energy industry today: Companies that don't make every effort to keep continuing education and training of skilled professionals uppermost in their retention initiatives will fail to grow and succeed.

Sincerely,



Jamie Matlin,
Publisher & Director of Recruitment Advertising

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Whose 'ox' is getting gouged?

Oil prices are in stratospheric territory these days. Not only are oil prices at record highs, some see even higher prices on the horizon. Goldman Sachs recently concluded that oil prices are in the midst of a "superspike" that could last for years and even reach $200 per barrel. There are a number of drivers for this:

- A weak dollar (oil is priced in US dollars) spurring a speculative frenzy by investors in commodities, especially oil. Some analysts say speculative buying of oil futures contracts accounts for 30% of the runup in oil prices.
- A small sliver of surplus productive capacity, leaving the supply/demand balance on a razor's edge (and an unwillingness by OPEC to expand production, thereby trimming that sliver even thinner).
- Production disruptions caused by domestic strife in major producing countries such as Nigeria.
- Larger threats to oil supply caused by war in the Middle East.
- Oil field megaprojects slowed by soaring costs and staff and equipment constraints, as well by some changing government fiscal regimes.

The list goes on. But for many people, especially in the US, the cause of sky-high prices boils down to one thing: oil company greed.

And so begins anew the chorus of complaints, the cries for legislation to punish the oil industry as companies post record profits. The oil companies are gouging us, the public cries, and pandering politicians feel compelled to confiscate oil company revenues via imposition of a "windfall" profit tax.

But is the industry's financial performance that impressive? Sure, tens of billions of dollars is a lot of profit for ExxonMobil, but that must be measured against company revenues measuring in the hundreds of billions. In recent years, oil companies' return on capital has been in line with most other businesses and industries—and much less than that of others, such as cosmetics and pharmaceuticals. Most profits are pumped back into finding and producing more energy.

Are consumers getting "gouged" at the pump? Gasoline approaching $4 per gallon sounds like a lot to Americans, but that cost is up only 50% from a year ago, and crude oil prices have more than doubled in that timespan. So refiners are making less profit than they did a year ago.

Oil companies don't set prices—Wall Street does, on the futures exchanges. "Big Oil" controls only about 12% of global oil production. And oil companies are also spending more: Finding and development costs are up about 50% in the past 5 years.

There are many drivers for oil prices, but in the end, it all boils down to supply and demand. And the price of oil today reflects the perceived directions of supply and demand.

Compare the cost of gasoline to that of other liquids. A gallon of gasoline is cheaper than a gallon of milk, soda pop, orange juice, vegetable oil, rubbing alcohol, shampoo, etc. Yes, you say, but I don't need to put 30 gallons of soda pop into my Hummer to get to work each week. And the counter-argument would be: Maybe you need to cut back on those Starbucks frappuccino iced coffees that cost five times per gallon what the gasoline cost, if the need is so great.

OK, maybe that was uncalled for, but the underlying question is this: Why should oil be exempt from the law of supply and demand? Higher pump prices are already having an effect—gasoline demand in the US fell significantly in the first quarter. But oil demand worldwide is expected to climb another 1 million b/d or more this year, thanks to the soaring economies of China, India, and other developing nations.

You want to talk price gouging? Ever buy roses for your sweetheart on Valentine's Day? A 300% markup in 24 hours. I recently bought tickets for an October concert that officially list at $118 apiece; but the only decent seats were available through a scalper—pardon me, online ticket broker—for $225 apiece plus a $41.40 "handling" fee (!) apiece. Let's say you were lucky enough to have purchased an Xbox or Cabbage Patch doll or Miley Cyrus concert ticket at face value when those items were the focus of a consumer buying frenzy. Thanks to hysterical preteen girls and their exasperated parents, Miley Cyrus tickets last fall were going for as much as $3,000 apiece on E-bay. What would you have done with that $100 ticket? Now let's talk "greed" vs. "need."

There are many drivers for oil prices, but in the end, it all boils down to supply and demand. And the price of oil today reflects the perceived directions of supply and demand.

Whether or not that's "fair" depends on whose "ox" is getting gored, uh, gouged.

Bob Williams,
Managing Editor

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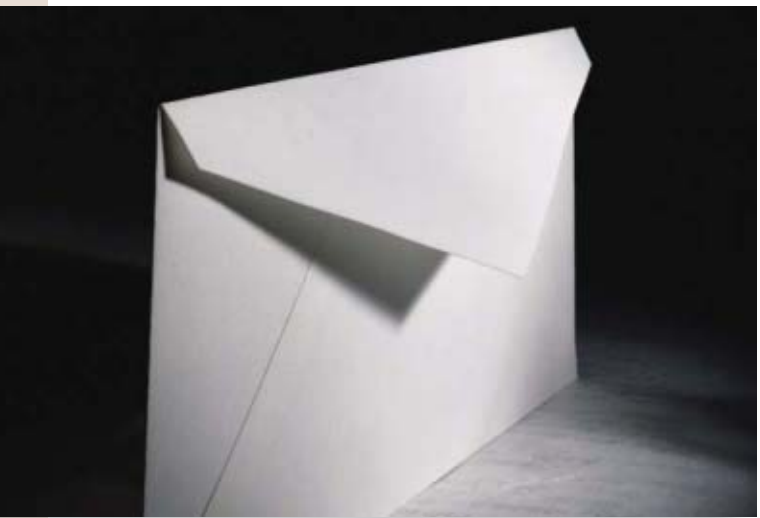
Increase engineering salaries — debate continues



If the letter you received (Letters to the Editor, p. 4, EnergyWorkforce, Winter 2008) is correct, and salary is determined on risk, then engineers should be the highest paid. To say that a engineer does not have the risk factors that a doctor, lawyer, or even CEO does is just unfounded. A doctor makes a mistake, and one patient dies. A structural engineer doing bridge calculations makes a mistake, and hundreds die. (Don't get me wrong: Doctors go through a lot more schooling and deserve a higher salary—just not based on risk.)

A engineer in an auto company makes a mistake, and a recall is required. The company loses millions of dollars, the engineer is fired, and the CEO is given a bonus for addressing a safety issue. Worst case, the CEO is fired with a $10 million severance package. Where is the risk in being a lawyer—trial record? That is purely reputation. If you fail at one or two projects as a engineer, you can't get a job. If you lose a couple of big cases as a lawyer, you can always chase ambulances.

So I will ask the question, Who has more risk? I don't think the writer's risk model holds up for engineering-intensive companies or positions. I think he is mixing risk and responsibility—being responsible for your own actions, being responsible for a working group, or being responsible for the success of a company.

— *Brian Mayall, Lead electrical engineer*
Chief, engineering section, (Company not identified)

Energy futures trader job profile

Just to let you know that I thoroughly enjoyed the article on energy futures trader and risk hedging advisor Steve Mosley (Humility seen as key trait for energy futures trader's success, p. 14, EnergyWorkforce, Winter 2008). I originally picked the article because of the word "humility" in its title, something that you do not normally hear next to the word "trader" in boom times. The article went along the lines of what I was expecting, and more. Although some of the terms are difficult to understand (I am a neophyte on hedges and trading), the overall message from Steve was not that self-glorifying and provided attitudes that could apply in other roles. Being a semi-mature Young Professional, I thank him for his advice.

— *Gerardo Arteaga, Senior petroleum economist*
Aupec Ltd., Aberdeen, UK,

Kudos and request for concision

This is a lovely buildup for the energy workforce. However, more could be done to streamline the disciplines more for concise reading. Wonderful work; keep it up!

— *Subomi, Geoscientist*
Energy & Mineral Resources ltd., Lagos, Nigeria

We encourage your feedback on this or any PennEnergyJOBS EnergyWorkforce article. Please send your comments to feedback@PennEnergyJOBS.com

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In-depth workforce analysis needed to resolve energy staffing challenges

Brad Kamph, Interliance Consulting Inc.

This is the second of three articles analyzing the bottom-line approach to knowledge retention in the energy industry.

What on earth is wrong with the workforce? It would be great if one simple answer prevailed, applicable to all organizations across the energy sector. However, broad generalities not only don't apply, they can be downright dangerous.

Witness the fact that fad after fad has swept across the business world over the past couple of decades. All it takes is one isolated and unusual success, and suddenly everyone is doing it. Large-scale downsizing, Y2K, e-business, and other fads have all come and gone. While there were certainly victories recorded in some companies by virtue of these initiatives, the losses outweighed the gains in many cases. And the reason is obvious: Attempting to shotgun the one solution into all businesses without evaluating the existing situation at your specific business is a sure route to failure. Or if, as a manager, you take the latest fad from a magazine article and assume it applies to your own situation.

The fact is that each organization is uniquely different. What works in one power plant might have no relevance for a sister plant in another state. What brought miracles in a Fortune 50 empire might not translate well into a mid-sized utility environment. What improved profitability at a natural gas processing facility might prove to be destructive when forced into play at a transmission outfit.

What it takes, then, is an accurate estimate of the current environment. Without a firm knowledge of where things

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stand, it is impossible to set correct strategy. This applies in particular to the workforce. The key to correctly solving any organizational problem is to fully and comprehensively understand where your workforce currently stands.

Management fads

Fad after fad has overtaken the nation over the past two decades. Remember "Chainsaw" Al Dunlap? That man may have salvaged Scott Paper by taking drastic measures to eliminate vast overstaffing that had accumulated over time. But how did that one limited success end up becoming "the way to run American companies?" Overnight, literally everyone was laying off people in droves. Certainly other economic factors were at work, but this kneejerk movement contributed to dark economic days in the late 1980s and early 1990s. And what happened to "Chainsaw" Al himself? His subsequent efforts to apply similar methods to Sunbeam resulted in his dismissal.

Yet this craze wreaked havoc across the energy sector. Some would go as far as to say that the industry has yet to fully recover. Power plants, oil refineries, natural gas processing facilities, and energy transmission units no longer have the in-house resources they once possessed. Gone are the internal maintenance crews and massive parts and equipment inventories.

A 1,000-MW power plant, for instance, may have once retained a full-time maintenance crew of anywhere up to 100 people. Many of them were long-term veterans who knew every inch of the facility and just about anything there was to know about the machinery in their charge. While they looked after outages and overhauls, another team of up to 35 people was available for day-to-day maintenance duties. While this number of resources may not now be economically viable in a more deregulated world, it appears that the downsizing fad has thrown the baby out with the bathwater. Surely a middle ground would have been a more optimum solution instead of the current pictures, where plants are largely dependent on outsourced maintenance or expensive consultants—in many cases the very same people that were offered early retirement or were let go as surplus to requirements.

Another fad of note was Y2K. The very fabric of civilization was to be torn apart once a single digit changed on aging computer systems. In response, every business spent a fortune updating its systems. Utilities, for instance, abandoned mainframe computing on a wholesale basis as it contained the dreaded Y2K bug. In a good number of cases, the computing infrastructure did indeed need upgrading. But in just as many instances, perfectly valid systems were tossed aside to be replaced by inferior technologies. And what happened in the end? Y2K turned out to be largely a myth with almost no instances of system failures at midnight on Jan. 1, 2000.

Around that same time, Enron Corp. was being lauded as a "revolutionary paradigm." The kudos continued right up to the day the whole house of cards collapsed. Businesses were encouraged to throw out the dated (i.e., tried and true) ways and adopt this new model. Much of the language was steeped in e-commerce buzz words (another fad), not to mention vague pronouncements about "diversified portfolios," "proactivity" and "divesting old-economy assets."

Speaking of e-commerce, what havoc that whole movement wrought! All of a sudden, every aging manager felt the urge to get with it and transform a stable brick-and-mortar establishment into an e-commerce play. Fortunately, at least, the energy sector didn't buy into this to the same degree as other sectors.

Let's cover one more past fad: core competency. A couple of successes in the information technology sector were trumpeted as business strategy de jour for the new millennium. With chip manufacturers and computer firms no longer actually making any hardware—they outsourced the physical production to firms in Asia—companies were told to reevaluate their core strengths. Were you really a manufacturer or a power producer? Perhaps in reality, your core competency was power marketing or distribution. That led to the big "therefore"—throw out everything else and just focus on this imagined core competency. Sell off your plants, or your coal mines or your refineries and throw all your efforts into selling energy. This gave a new impetus to earlier downsizing trends, and again threadbare organizations resulted.

Aging workforce fad

Of course, there have been a few movements that were more positive. Total Quality Management, ISO 9000/2000, and Six Sigma quality can perhaps be placed in this camp. But even here too many jumped aboard the bandwagon and overinvested in programs when capital could perhaps have been better spent elsewhere. Some companies, for example, poured millions into such programs without seeing a significant return on investment. Perhaps it was the case that those who truly understood these initiatives reaped the most reward. But on the other side of the coin, some got swept along in the latest thing. It is that mentality the energy industry has to avoid.

So how can you guard against the overexuberance of analysts and management gurus? Without a firm knowledge of where things stand, it is impossible to set correct workforce strategy. The key to correctly solving any organizational problem, then, is to only conduct improvement programs that are based upon an accurate estimate of where your workforce currently stands.

A case in point: Survey top management across the industry about the No. 1 workforce issue, and what is the top response? In all likelihood, it will be the aging workforce. Obviously, this is an issue of importance. And it is certainly getting enormous play in the both the trade magazines and in popular culture. It is hardly possible to go through a day without hearing about the baby boomers hitting retirement in droves, or the average age of American engineering talent getting older and older. But is this really our most pressing workforce challenge? The statistics belie that argument. The Department of Labor recently estimated, for instance, that annual retirements in the utilities field amounted to 4.4% of the workforce. That's actually less than a quarter of the total number of people leaving employment overall for the year. Conclusion: a large number of people nearing retirement does pose a direct threat to operations, but other areas of the workforce merit even more serious consideration.

But the aging workforce theme, in effect, has developed into a sort of mini-fad within the energy sector. In some firms it is the situation. But for most firms, it is only one of several factors that add up to a serious problem. Thus if you are investing hard to prevent the loss of the skills of retirees from walking out the door, even more serious workforce situations could be developing unnoticed that could wreck any hope of long-term expansion.

Further, Interliance surveys reveal that only one out of every eight companies currently has a goal of addressing nonretirement attrition. Whatever these nonretirement attrition challenges are, very few organizations are actually facing up to them.

This isn't to say that everyone should immediately reverse course, abandon aging workforce problems, and dive off in some new direction. The pendulum-swing mentality has prevailed for too long. After all, each organization has unique

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needs. No two organizations are alike. So no one program is ever going to be a universal winner.

Zeroing in on the correct target

To succeed with your workforce, it is essential to zero in on the correct target or targets and set strategy as well as priorities accordingly. That can be done only by following an in-depth analysis of the workforce as a whole. Such an analysis opens the door to remedial actions that not only can relieve the immediate workforce pressure but also set the organization on the right path for future prosperity.

In one company, for example, Interliance researchers conducted a workforce analysis to determine those workers most at risk from nonretirement attrition. Within a few days a pattern emerged: Personnel most likely to leave were those who had worked with the company for 2–7 years. Another interesting fact also emerged: Of those leaving, 35% took positions in other companies within the industry. Armed with factual data, management could correctly set strategy to address these priorities.

To be effective, though, a workforce analysis has to be embracive. It can't dwell only upon training or retirees or recruitment, but most span all these zones and more. In our experience, retention, knowledge management, and process design can be just as important. Typically, several factors dovetail together to present a comprehensive solution.

Further, an accurate workforce analysis is an excellent way to marry up workforce requirements with immediate business needs. For example, attrition risk can be correlated to the various skill levels that exist within the organization. When this is done properly, it exposes the skills that pose the highest risk of being lost. This lets management set strategy to immediately recruit two experienced engineers for Turbine X or Boiler Y, as the personnel in those areas are due to retire within a year without replacement. This can be paralleled with mid-term and long-term actions to restore full health to the workforce.

Ideally, a workforce analysis should also identify key areas of organizational knowledge to capture. Once again, this should not be done too broadly or too haphazardly. In the example above about the two people about to retire, it is wise to analyze their areas for efficiency as part of the workforce analysis process. This might reveal that one of those workers is the very model of excellence, while the other is responsible for a unit that has suffered long-term downtime issues and continual problems. By investigating detailed performance metrics as part of the analysis, it is possible to determine which knowledge to capture and which areas where process improvement is the more advisable path to follow.

Achieving ROI from workforce programs

What this is really about is changing the game when it comes to workforce programs. Historically, such programs as training, knowledge management, and process improvement have tended to be so vague that it was hard, if not impossible, to determine any actual return on investment (ROI) from them. Thus they tended to be viewed as costs, as opposed to investments in the future.

An in-depth analysis takes away the mystery and presents workforce issues within a workable framework. This framework can then be translated into tangible ROI. How? By creating an exact business case, i.e., by investing X dollars in very specific training, process improvement, recruitment, and retention efforts, savings can be achieved in the range of millions to tens of millions of dollars for Plant Y.

A workforce analysis, therefore, is both a strategic and tactical tool. It is designed to isolate the exact organizational skills and the depth of knowledge that currently exist, and relate specific skills to the business reasons for each performance requirement of the job position. It categorizes the strengths and weaknesses of the workforce, provides a detailed attrition analysis, and assesses the impact on critical business skills, as well as defining key areas of required training, process improvement, and knowledge capture.

In reality, this represents an opportunity. By finding out the actual workforce situation inside your company, you will be given the tools to rapidly bring about a substantial reduction in the level of turnover. And by instituting precisely tailored changes in recruitment requirements, it is possible to save millions of dollars on workforce development costs alone.

The Author

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INGAA study: Gas pipeline industry not addressing staff shortfall

Bob Williams, Managing Editor

The natural gas transmission industry is falling short when it comes to addressing the tough challenges of maintaining an adequate technical workforce today.

And the challenges will get only tougher in the coming decade, as companies are ill-equipped to cope with the rising attrition of qualified employees in the skilled trades, operations, and professional engineering fields.

Given the comparably daunting challenge of accommodating the public's growing demand for natural gas with an aging infrastructure and increasingly stringent regulatory regime, it's imperative that the natural gas transmission industry put workforce planning strategies and action steps at the forefront of their business planning.

Those are among the chief conclusions of a comprehensive study conducted for the Interstate Natural Gas Association of America (INGAA) by Interliance Consulting Inc., Santa Ana, Calif. The study, conducted specifically for the INGAA Foundation Inc., was concluded in 2007.

Scope and methodology

The INGAA study assessed the risks to industry's workforce and knowledge assets resulting from current internal company activities, along with external factors.

The analysis was based on data gathered from executives, managers, and operations and human resources professionals within the natural gas transmission industry and secondary data sources.

The study also recommended strategies for the INGAA Foundation and member companies to follow, along with short-, medium- and long-term actions necessary to meet the workforce challenges. The complete study, with strategic action plan roadmaps, is available at http://www.ingaa.org/cms/31/43/4913/5332.aspx.

The study focused on "the technical workforce in the transmission segment of the natural gas industry that is responsible for design, construction, operation, and maintenance of pipelines."

This means:

- Pipeline, storage, corrosion, civil, and project management engineers.
- Dispatch and station operators.
- Welders, electricians, pipefitters, mechanics, and instrumentation and control technicians.

Marketing, accounting, sales, and management were not included in the study scope but may be considered in a follow-up study. Midstream and gathering segments were deemed outside of the report's scope and were considered as an external industry that competes for the same workforce resources.

"The overall strategy incorporates external trends and influences with internal company actions and policies, providing an effective strategic roadmap for the INGAA Foundation and its members in terms of short-, medium-, and long-term actions," the report said.

Roadmaps

The INGAA Foundation described its workforce strategy as a customizable roadmap for companies in the natural gas transmission pipeline industry, helping them to manage the impending challenges in workforce and knowledge management.

The roadmap's key components for maintaining a capable workforce in the natural gas industry are:

- **Supply.** Ensure there are enough new, skilled workers willing to take on positions in the transmission industry, now and in the future.
- **Recruit.** Attract the required numbers of new hires in a timely manner by offering competitive compensation packages and well-defined, challenging positions.
- **Develop.** Employ effective skill development and knowledge management that maintains the company's knowledge assets for use in preparing new employees for their positions,

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allowing fully qualified employees to develop new skills, and supporting corporate-wide operating improvements.

- **Maintain.** Retain skilled, committed, and motivated employees while meeting budgetary goals.

The study noted that the workforce supply goal will be a key focus for the INGAA Foundation and its industry roadmaps, along with supporting members' actions for reaching the other three goals.

Degreed engineers gap

The number of engineers graduating with bachelor's degrees has remained steady for the last several years, although their proportion of the total number of bachelor's degrees has fallen (Fig. 1), the INGAA study noted. Demand for engineers has also remained steady over the past 10 years.

"While the percentage of engineering graduates has dropped in recent years, DOL [the US Department of Labor] forecasts engineering positions increasing at the same or slightly lower pace than overall job growth," the report said.

Pointing out that DOL does not track specialties within the natural gas industry, the study acknowledged that the supply of engineers in these specialties is not easily quantifiable: "Supply shortages for expert natural gas engineers are being experienced by the human resources professionals surveyed in the management study. Human resources professionals report engineers as the most difficult job position to recruit—in particular engineers with natural gas experience, such as pipeline engineers, project engineers, storage and reservoir engineers, and engineers with skills in friction stir, nondestructive evaluation, and plastics."

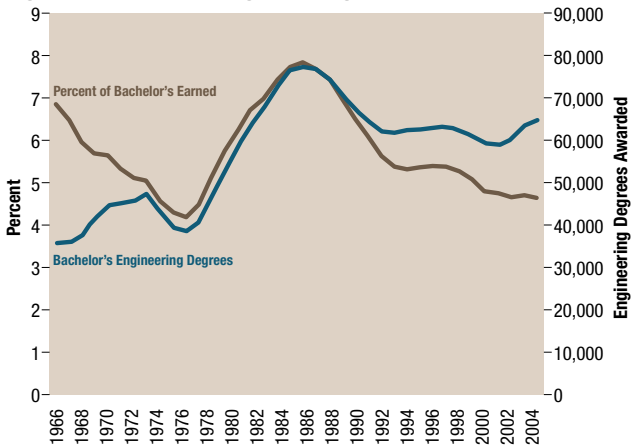
The study also said that attrition is reducing the number of experienced natural gas engineers by 10%/year, as forecasted growth is increasing the requirements by 3–5%/year.

Recruitment

The INGAA report noted that it takes an average of 3 months to hire a technical employee today, and this time span has been increasing over the last several years.

"Companies are adding external recruiting resources to counteract the limited pool of skilled new hires, as most companies prefer to hire fully qualified candidates," it said. "At present, four out of five new hires are experienced, with an average of 7 years in their field of work. The most successful recruiting methods involve extra monetary incentives for candidates, such as hiring bonuses or relocation allowances."

Figure 1. Decline in Degreed Engineers



Source: INGAA Foundation, after US Department of Labor

The study also found that natural gas industry salaries are competitive when compared with other industries and other types of utilities: "At present, utility companies pay their technical employees an average of 2% more for engineering positions and 21% more for other technical positions (e.g., supervisors, electricians, operators, control-valve installers)."

Among utilities, the electric utility industry pays an average of 5% more than the natural gas industry, the report added.

The INGAA study used a baseline of 11,000 pipeline and 39,000 technical services employees and an employment growth rate of 3%/year to calculate the recruitment requirements for replacing employees that retire or leave the industry, additional workers for employment growth, and replacement workers for those that change positions within the industry (Fig. 2).

The resulting recruiting requirement estimates indicate that:

- At least 5,200 new technical workers must be brought into the natural gas transmission industry

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each year to make up for attrition caused by retirements or workers leaving the industry.

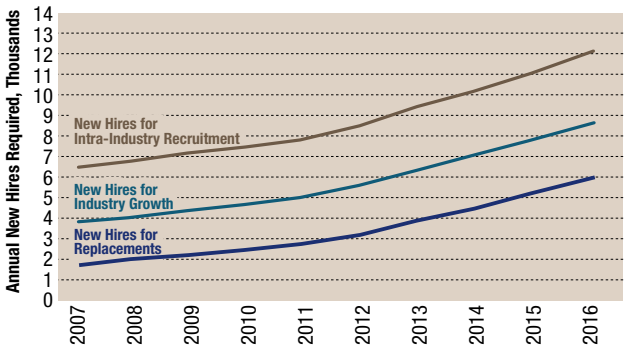
- Natural gas transmission companies' expected growth will increase the number of new hires required by 1,500 annually.
- Intra-industry recruitment will add the need for an another 1,800 hires.
- The present annual total of 8,600 new hires is projected to increase by 1,600 employees in 5 years.

Skill development, knowledge management

The INGAA study also found shortcomings in the natural gas transmission industry's efforts to develop technical employee skills.

"Survey respondents in operations or maintenance functions reported that their companies' employee development and knowledge management processes are only partially sufficient," it said, noting that more than half of survey respondents said there was inadequate training for existing employees.

Figure 2. Recruitment Needs for Natural Gas Transmission Industry



Source: INGAA Foundation

Comparable results were reported for knowledge management programs:

> "Technical survey respondents report about half of their companies have tools in place to capture knowledge, and half of those tools enable process improvements. Few executives reported a thorough understanding of knowledge management."

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According to the INGAA study, a complete skill development and knowledge management program includes:

- Training and competency development requirements at the line level.
- Forecasted future competency development requirements, paying special attention to at-risk skills and expert knowledge requirements.
- Organization needs assessment for scheduling training and curriculum development.
- A formal and cost-effective system for developing best practices for achieving gains in efficiency, productivity, and quality and for minimizing losses.
- Fully tested and documented best practices that have undergone a job safety analysis and have been developed into standard policies and procedures.

Retention

Among the natural gas transmission industry's poorest showings was the area of employee retention.

The study found that retention was mentioned by only one in eight respondents as a method of reducing the risk to workforce and knowledge management, with 87% of companies not having a target for non-retirement attrition.

In addition, two-thirds of companies surveyed do not measure employee satisfaction, "which is the best predictor of future attrition."

DOL statistics show that employees are changing jobs faster today than they were a decade ago, the study pointed out: "Delaying the average employee's attrition by 1 year can save $75 million overall for the industry, or $770,000 a year for a 500-person company. For the 11,000 pipeline technical workers and 39,000 services employees, this is a total attrition cost of $575 million annually, and is expected to increase by $93 million in 5 years."

Of that total attrition cost, $165 million is caused by the 34% of nonretirement attrition attributed to employees changing companies within the natural gas transmission industry.

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The INGAA study observed that reducing nonretirement attrition is mainly a matter of increasing job satisfaction. Job satisfaction is increased by earning compensation commensurate with the position and doing interesting and challenging work; job satisfaction is decreased by physically and psychologically straining work environments, restricted social opportunities because of long or irregular hours, and work inhibitors, such as poor policies, bureaucracy, and inadequate resources.

"After receiving a competitive salary, younger workers tend to be more attracted to positions that have performance-based pay or career advancement opportunities," the report said. "Older workers report more interest in health and retirement benefits. Almost two-thirds of retirement-age employees would like to work part-time before retiring completely."

Training increases capability and commitment, in addition to maintaining a skilled workforce in the presence of changing technologies and attrition, the study added.

Conclusions, action steps

According to the INGAA study, many executives believe their companies are adequately managing their workforce and knowledge assets. In a critical disconnect, however, lower-level managers reported that their companies are not committing sufficient time or resources to that effort.

"While 29% of executives were 'very confident' of their company's ability to maintain their workforce and knowledge assets, less than 3% of managers, operations, and human resources respondents were equally confident," the report said. Only 1 in 20 company managers reported that their company had allocated sufficient time to plan and implement workforce and knowledge initiatives.

The study recommended that INGAA and its member companies should build awareness that understanding and acting on workforce issues are critical to successful business operations. That should be followed up with efforts to increase communication among INGAA Foundation, executive leadership, and company management and to develop a workforce business case to justify additional resources.

Another key finding was that few natural gas transmission companies focus on retaining existing employees. Instead, companies try to cope with an average annual attrition rate by simply training new employees faster.

"Employees are changing jobs faster than in the past," the study noted. "Over one-third of nonretirement attrition is the result of employees moving within the industry, and most human resources professionals expect that figure to stay the same or rise. Only one in eight companies have a goal for nonretirement attrition, and only one in three measures employee satisfaction, the key predictor of future attrition."

The present level of attrition costs an average company more than $10,000/year per employee, the study added.

Survey respondents blamed a lack of time and resources for the limited strategic planning and implementation of workforce initiatives.

"When asked what actions are underway, 49% of respondents reported increased efforts in developing new employees, 30% reported increased recruitment efforts, 13% reported retention efforts, and 9% reported initiatives to increase the supply of skilled technical candidates," the report said.

The natural gas transmission industry should do more to emphasize retention of the existing workforce, the study recommended, and follow that up with a plan to target a specific goal for reducing attrition through phased retirements, longevity benefits, improved employee satisfaction, and compensation benchmarking.

Such steps could help support companies' efforts at building an attractive reputation as an employer to reduce attrition and increasing company attractiveness to prospective new employees.

The study also found that companies' skill development and knowledge management efforts are inadequate. In a survey, more than half of the managers responding reported that present skill development for technical employees is inadequate. Of those managers responding, 78% expect workforce issues to have a significant impact on the company's capabilities within 5 years, with loss of knowledge mentioned most frequently. Some report

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impending retirements of "irreplaceable" employees. Half of the managers responding felt that their company's knowledge management processes were insufficient to capture knowledge from retiring employees.

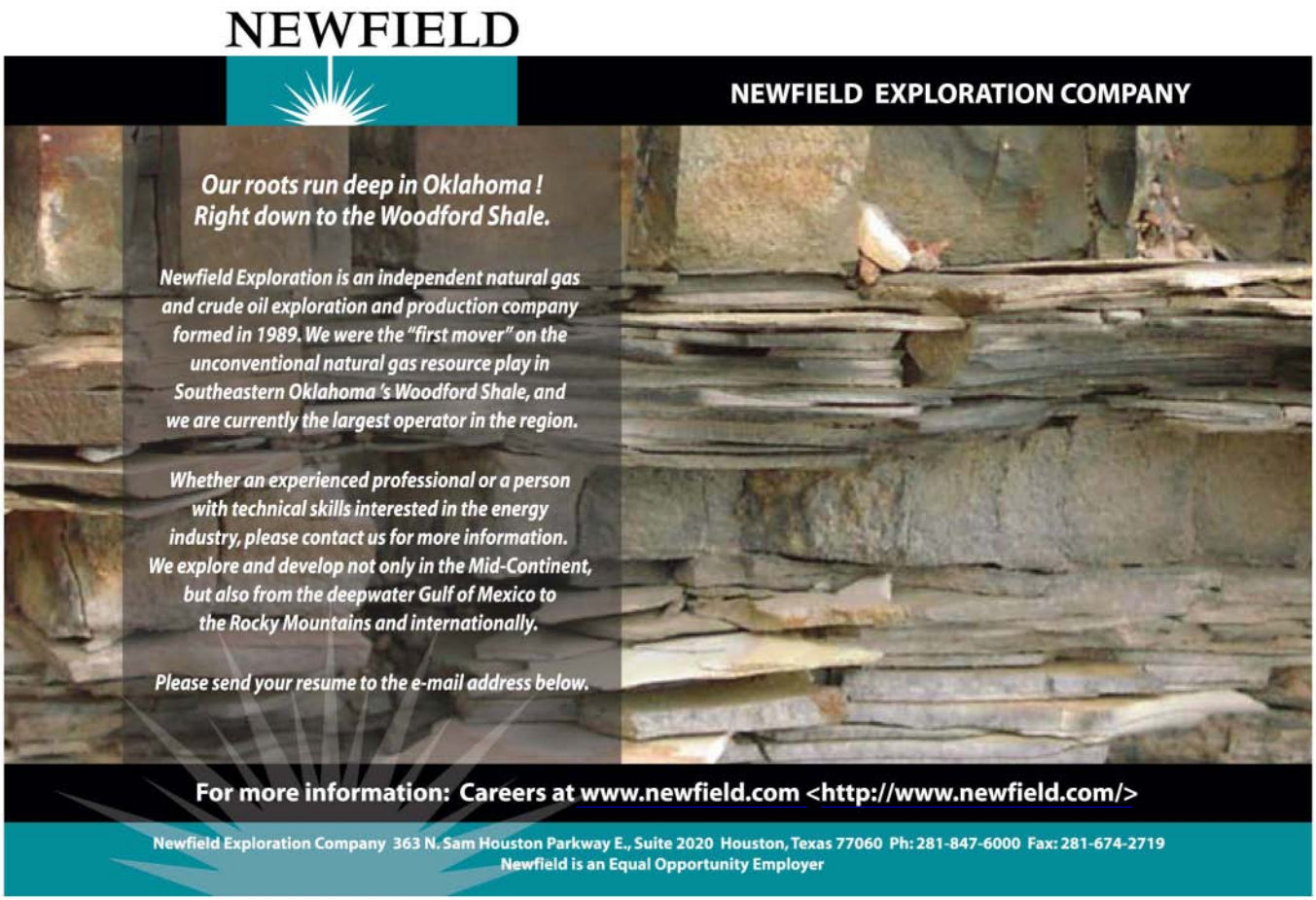
The study recommended that natural gas transmission companies take steps to safeguard existing critical company knowledge and develop the organization's capabilities. Two key steps toward this end are to identify knowledge management risks and mitigate them through knowledge capture, job shadowing, mentoring, and documentation of processes, procedures, and standards and to prioritize skill development plans according to the risk to operating capabilities.

The study concluded that transmission companies will need to add 3–5%/year to their workforces during the next 5 years. This will add even greater burden to a company's recruitment resources.

"Experienced engineers are the most difficult technical employees to recruit," the study said. "Human resources reports that they hire four experienced employees for each new graduate. This level may not be sustainable with the expected growth rate of 3–5% and the 10% attrition out of the industry each year."

Thus it becomes crucial for the industry to build a good industry reputation by marketing the natural gas transmission "brand," according to the study. Steps toward this end include the creation of a marketing plan to make natural gas transmission careers attractive to students and the general public, the development of this natural gas brand in collaboration with other industry organizations, and an outreach effort targeting secondary schools and career centers to make them aware of opportunities in the industry.

The report contended that companies also must increase opportunities for technical training in the natural gas transmission industry by using available government resources, standardized curricula, apprenticeships, and scholarships for training new technical employees—and then utilizing their own resources when required.



The study also called for an effort to improve recruitment effectiveness and ensure attractive job positions and compensation. This could be accomplished by first reviewing and revising recruitment methods and resources and then considering alternative pools of candidates outside the local area or from other industries. Secondly, companies should review their baseline hiring requirements and then look into the possibility of hiring lower-skilled candidates for work/study or apprenticeship programs.

Despite the critical nature of addressing workforce issues is to the continued success of the natural gas pipeline industry, many natural gas companies often fail to consider adequately all of these issues in their planning.

"Since these workforce issues affect every area of the industry and individual companies, from operations to human resources to company leadership and beyond, they must be—and deserve to be—examined from all perspectives and brought to the forefront of business planning," the study concluded.

The report and roadmap comprised the completion of the first phase of the INGAA Foundation's workforce strategy, underscoring a real urgency for industry to take the next necessary steps toward implementing the study recommendations and strategic action plans.

"Key findings show that the workforce issues facing the industry are causing concern among company managers, and these issues are only expected to worsen over the next 5 years," the study said. "Only 3% of managers are 'very confident' of their company's ability to maintain their workforce and knowledge assets.

"The hardest and most important step is to get the industry 'on board' to take action. Tackling these tough workforce issues will require a concerted, united effort on the part of the INGAA Foundation, other industry organizations, and individual companies willing to face the critical issues, commit the necessary resources—and do something about these pressing problems." —EW

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Shaw Group: Power industry grappling with 'hypercompetitive' labor market

Bob Williams, Managing Editor

The power industry today is grappling with a "hypercompetitive" labor market as it seeks to address staffing needs, according to two top human resources executives with The Shaw Group Inc., Charlotte, N.C.

Innovations in recruitment and retention are essential for ensuring viable workforce levels as the industry's employment demographic continues to age. A huge contingent of skilled professionals and technicians will reach retirement age in the next 5 to 10 years. At the same time, there aren't enough potential replacements coming up through the educational and training systems to keep staff shortages at bay.

Shaw HR executives Lacy Kiser and Harry Clark discussed these issues in recent interviews. Kiser is human resources director for the Fossil Power division of Shaw; Clark is human resources director for Shaw's Nuclear Power division.

> *"If you combine the current industry need with the fact that we have gone through an extended period in which we did not bring in large numbers of new hires to develop and grow, we are now faced with a hypercompetitive labor market," he said.*
>
> *— Lacy Kiser*

Hypercompetitive market

The need for experienced professionals in the power industry is growing at a tremendous pace, notes Kiser.

"If you combine the current industry need with the fact that we have gone through an extended period in which we did not bring in large numbers of new hires to develop and grow, we are now faced with a hypercompetitive labor market," he said.

The situation is even more competitive on the nuclear side, contends Clark, where about 25% of the workforce is at or near retirement age, according to the Nuclear Energy Institute.

"This has caused us look at other industries and nontraditional sources for talent, with the understanding that we will need to provide intense training so those new hires have the specific industry knowledge and skills they need to be successful," he said.

Addressing the shortfall

Shaw is experiencing shortages in all of the engineering disciplines, construction management, and project controls, according to Kiser: "The most critical shortages are in civil and structural engineering."

The entire industry is working diligently to identify new talent to bring into the power industry, says Clark: "If you attend any college recruiting event around the country, you will see Shaw and most, if not all, of our competitors in attendance. We also expect to see an increase in student interest as universities adjust their programs to introduce more students to the power industry."

Kiser points out that Shaw is also going into high schools "to educate and inform students about the opportunities that exist in all aspects of our industry—everything from craft jobs and project management at the work site to professional positions such as engineering, safety, accounting, human resources, IT, and other office jobs that support our power projects."

Recruiting initiatives

Shaw is turning to special recruiting initiatives to address its most critical staffing shortages, notes Kiser.

"We are committed to a robust college recruitment program," he said. "We are looking to identify the most qualified talent coming out of today's top universities with programs that align with our needs.

"For experienced workers, we look at industries that are similar to ours for opportunities to recruit people who

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only need some industry-specific training to become valuable assets at Shaw."

The company is also strengthening its partnerships with a select few recruiting agencies. "We want to build strong relationships with these key organizations to ensure that they point top talent in the industry to Shaw," Kiser said.

Clark added that Shaw has implemented a "comprehensive orientation process to provide new hires with all of the information they will need to quickly understand and embrace Shaw's culture.

"This is an important piece of our recruitment process, because it conveys to job candidates that we are committed to employee development."

Retention initiatives

Asked whether Shaw is undertaking special retention initiatives as well, Clark responded, "I wouldn't call these initiatives 'special,' since we continuously work to retain talent at Shaw."

According to Clark, Shaw's retention strategy is three-pronged:

- **Longevity/security.** "We strive to provide employees with job security by having a strong backlog of work. Employees want to know that their company will have significant work in the future, as well as today."

- **Growth opportunities.** "Employees want and need opportunities to grow and develop. Our 'Professional Development Program' provides learning and developmental opportunities for employees at all stages of their careers. We also work to ensure that employees have challenging and rewarding jobs so they feel they are making a contribution to Shaw's success."

- **Rewards/recognition.** "We are committed to providing competitive compensation and benefits packages, and we have programs that provide immediate and long-term rewards for outstanding performance."

Women and minorities

There are plenty of opportunities to improve recruitment of qualified women and minorities, Kiser contends: "At Shaw, we participate in and sponsor a number of job fairs and other events that focus on women and minority recruiting.

"We are also creating a work environment that is family-friendly by offering flexible work schedules, telecommuting, and similar programs.

"We are confident that as word gets out that Shaw is a family-friendly workplace, we will be seen as employer of choice, and we will have greater success in recruiting and retaining top talent—including women and minorities.

Mentoring

The power industry's workforce is dominated by two demographics: people nearing retirement age and employees who were recently in school, notes Clark.

"To help bridge the gap in experience, we are establishing mentoring programs that will allow our industry veterans to share their experience and knowledge with less-experienced employees.

"We are also developing initiatives that will facilitate flexible work hours, reduced work schedules, and job sharing so that we can maximize the contributions of talented employees as they approach retirement age. "

Advice for a veteran employee approaching retirement but wishing to remain engaged: "Ask your employer what types of programs they have or are contemplating to allow for more flexible work solutions to meet your changing lifestyle. Communicate your desires to remain in the workplace but express your concerns and identify the types of conditions that are acceptable. In return, be flexible on the type of work you will accept and be willing to mentor, share job knowledge, and coach others."

— Harry Clark

Career advice

For a young person considering or just starting out a career in the power industry, Kiser advises, "Ask plenty of questions, identify and work with mentors, be willing to take risks, and be a sponge.

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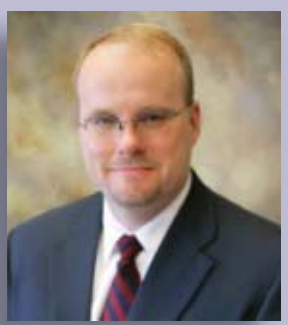
HR Insights: The Executives



As human resources director for The Shaw Group Inc.'s Fossil Power business unit, **Lacy Kiser** is responsible for all human resources-related activities for that unit.

He has an MS in management/human resources management and a BS in organizational management.

Prior to joining Shaw, Kiser spent a year with Centex Homes as a division human resources director. He also spent several years with Bechtel Corp., holding several roles of increasing responsibility in human resources, eventually serving as the human resources director for one of Bechtel's global business units.

Kiser spent 2 years as a Six Sigma Black Belt with Bechtel. He has 9 years of direct engineering, procurement, and construction experience.

Harry A. Clark Jr. joined Shaw in April 2007 as director of human resources for the company's nuclear power business unit. He manages all human resources activities and is overall responsible for employee relations, management and organization developments, staffing, diversity and assisting in general start-up for China and the US.

Prior to Shaw, Clark was vice-president of human resources at Greyhound. Before that, he was a consultant for Fischer Group International—a human resources, executive search, and executive coaching company—and spent more than 20 years with ABB Combustion Engineering, most recently as a vice-president, worldwide nuclear power human resources.

Before entering consulting, Clark had over 25 years experience in the power, chemical, petrochemical, manufacturing, and service businesses. Early in his career, he worked for a multinational oil and gas company, where he assumed overall responsibility for technical training. Shortly thereafter, Clark headed up worldwide training and organizational development for Combustion Engineering.

"There are—and will be—plenty of opportunities for development and growth in our industry; you just have to be patient and willing to learn everything you can about our industry."

Each employee is responsible for managing his or her own career, he adds.

For a veteran employee who is approaching retirement but who wishes to remain somewhat engaged in the industry, Clark suggests, "Ask your employer what types of programs they have or are contemplating to allow for more flexible work solutions to meet your changing lifestyle.

"Communicate your desires to remain in the workplace but express your concerns and identify the types of conditions that are acceptable.

"In return, be flexible on the type of work you will accept and be willing to mentor, share job knowledge, and coach others."

Time conflicts

As most workers in the power industry already know, it can be extremely difficult to deal with time conflicts while they are juggling training, continuing education, and mentoring with an already heavy workload.

"This is an ongoing issue for virtually every organization," Kiser noted. "At Shaw, our leadership views training and development as a benefit rather than a cost. As a result, Shaw's managers are very supportive of the company's training initiatives."

To help employees balance their workload and the time required for training, Shaw is experimenting with several ideas. "For example, we are finding ways to break training programs that are 1 or 2 days into smaller modules that are spread out over several weeks." —EW

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Civil/Structural Coordinator
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Construction Engineer
Shell
West, TX
Job Id: 9131042

Construction Manager
Canadian Natural Resources Limited
Fort Mcmurray, AB, Canada
Job Id: 6011043

Lead Riser Engineer
G.A.S. Unlimited, Inc
Houston, TX
Job Id: 6757424

Lead Structural Engineer
G.A.S. Unlimited, Inc
Houston, TX
Job Id: 6686344

Pipeline Construction Engineer
Shell
Kuala Lumpur, Miri
Job Id: 8441113

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Job Id: 8289091

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Houston, TX
Job Id: 8469305

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Rio Tinto
QL-Brisbane, QL-Central Coast
Job Id: 9043074

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Cheshire, OH
Job Id: 8828456

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Multiple Locations
Job Id: 2949754

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Completions / Drilling Supervisor
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Alberta, Canada
Job Id: 8780767

Drilling / Completions Supervisors (Junior Level)
Shell
Calgary and, AB, Canada
Job Id: 8707012

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Subsurface Consultants & Associates, LLC
Houston, TX
Job Id: 6641759

Drilling Engineer — Job# 07-123
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Multiple Locations
Job Id: 6722979

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Electrical Designer
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Houston, TX
Job Id: 9043117

Electrical Engineer, Transmission & Distribution
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Multiple Locations
Job Id: 2888592

Engineer — Electric Maintenance
New York State Electric & Gas
Binghamton, New York
Job Id: 8996552

Lead Engineer — Electric Maintenance
Central Maine Power
Augusta, Maine
Job Id: 8855121

Reliability Electrical Engineer
BP
Blaine, WA
Job Id: 7734582

Senior Electrical Engineer
Shell
Job Id: 8780781

Sr Electrical Engineer (Variable Frequency Drives Experience)
Siemens
Pittsburgh, Pennsylvania
Job Id: 8387047

Engineering & Design

Chemical Engineer ID LL043008
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Multiple Locations
Job Id: 9034569

Chief Process Engineer
G.A.S. Unlimited, Inc
Houston, TX
Job Id: 8671447

Control Systems Engineers
G.A.S. Unlimited, Inc
Houston, TX
Job Id: 8434695

Cost Engineer
Canadian Natural Resources Limited
Fort Mcmurray, AB, Canada
Job Id: 6011064

Engineer, Sr Staff Production
El Paso Corporation
Houston, Texas
Job Id: 8143497

Engineers
Buckeye Partners
Breinigsville, Pennsylvania
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Shell
Cologne, Other
Job Id: 8828442

Metallurgy/Welding Engineering Authority
BP
Whiting, IN
Job Id: 8584882

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Perforance Engineer
EPCOR VENTURES LLC
Southport, North Carolina
Job Id: 8365837

Petrophysical Engineer
Shell
Houston, TX
Job Id: 9043112

Plant Engineer III
Xcel Energy
Bayport, Minnesota
Job Id: 9108853

Power Engineer
Rio Tinto
Canada
Job Id: 9014910

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Process Engineer
Shell
Rotterdam, Netherlands
Job Id: 8441248

Process Engineer
Canadian Natural Resources Limited
Fort Mcmurray, AB, Canada
Job Id: 6011076

Process Engineers
G.A.S. Unlimited, Inc
Multiple Locations
Job Id: 6757403

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Shell
Rotterdam, Netherlands
Job Id: 8441059

Risk Engineer
Canadian Natural Resources Limited
Fort Mcmurray, AB, Canada
Job Id: 6967867

Senior Piping Engineer
Hitachi America
Basking Ridge, NJ
Job Id: 8815563

Senior Production Engineer
Shell
Houston, TX
Job Id: 9092563

Senior Subsea Engineer
Shell
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Job Id: 8706991

Senior Well Engineer
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Job Id: 8780756

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Job Id: 6011034

Maintenance Engineer

Engineer, Maintenance
Canadian Natural Resources Limited
Fort Mcmurray, AB, Canada
Job Id: 8434693

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Whiting, IN
Job Id: 9044499

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Rio Tinto
Mid West, WA
Job Id: 8880967

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Job Id: 8815572

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Multiple Locations
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Benson, Arizona
Job Id: 9020339

Senior Mechanical Engineer
Shell
Pernis, Other
Job Id: 8440893

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White Plains, New York
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Lead Pipeline Engineers Onshore
G.A.S. Unlimited, Inc
Houston, TX
Job Id: 6757429

Offshore Pipeline Engineer
DNV
Houston, TX
Job Id: 8056948

PDS Piping Designers
G.A.S. Unlimited, Inc
Houston, TX
Job Id: 7661668

Pipeline Engineer
Shell
Miri, Malaysia
Job Id: 8441152

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Cogeneration Project Engineer
Chevron Global Power Technical Services
El Segundo, California
Job Id: 8771311

Deputy Project Manager
Granite Services International, Inc.
Schenectady, New York
Job Id: 8464624

Engineering Services Project Mgr
Southern California Edison
San Clemente, California
Job Id: 8883283

GE Industrial Hydro Generator Specialist/Project Manager
Granite Services International, Inc.
Philadelphia, Pennsylvania
Job Id: 8052296

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Hitachi America
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Shell
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Washington Group International
Houston, Texas
Job Id: 8581264

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Williams
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Job Id: 8304123

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Job Id: 9014965

Senior Reservoir Engineer
Williams
Tulsa, Oklahoma
Job Id: 8005152

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Regional Sales Manager — Oil Field Chemicals
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Job Id: 8630712

Geologist
Shell
Houston, TX
Job Id: 8441384

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Labrador City, NL, Canada
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Petrophysicists
Shell
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Shell
Cairo, GA
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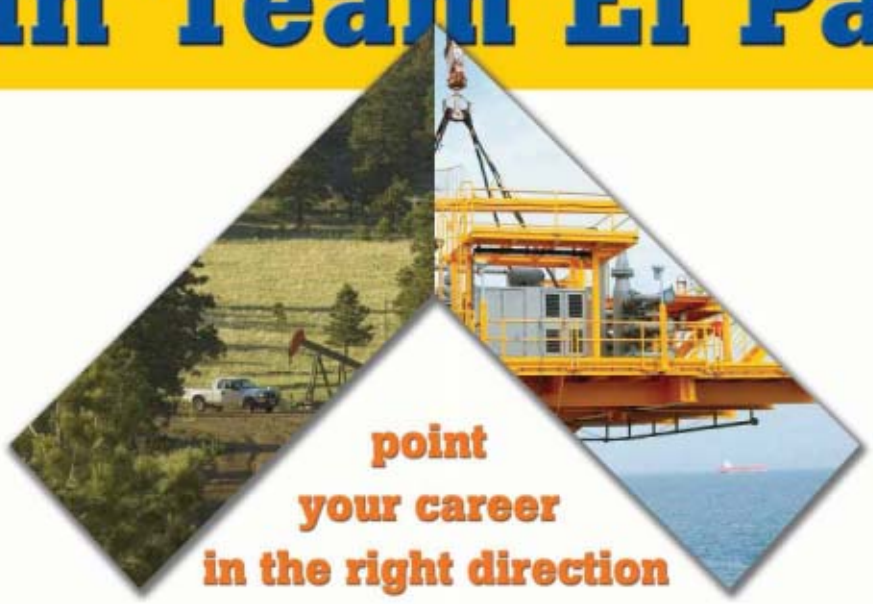

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