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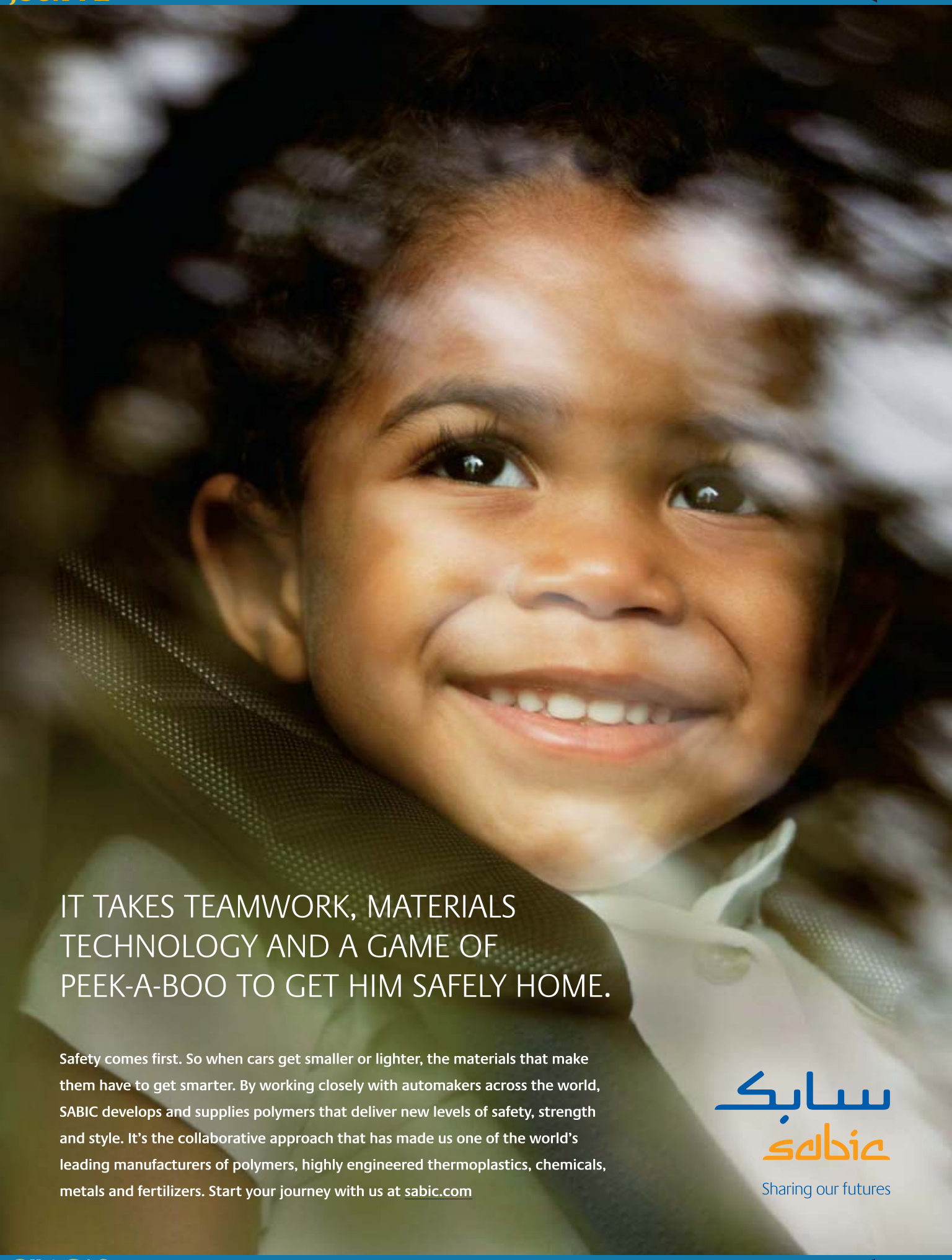
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OIL&GAS JOURNAL®

Sept. 15, 2008
Volume 106.35

OGJ200/100

Regular Features

Cover

The number of companies to qualify for the OGJ200 is on the rise. The ranking of the top US-based, publicly traded oil and gas producers now includes 148 firms. In spite of recording strong production results for 2007, the group as a whole posted a decline in earnings. This exclusive report also includes the OGJ100, which profiles the annual results of 100 major oil and gas producers based outside the US and ranks them by liquids production and reserves.

Is CP worthless?

What kind of question is this? Most in the pipeline industry agree that cathodic protection (CP) is the smart way to provide backup corrosion protection on underground pipelines.

But consider: If you use solid film backed corrosion coatings, you may be wasting money by adding CP to the pipeline.

There is a common sense reason for this statement. CP systems protect pipelines by delivering electrical current to the steel surface. Solid film back corrosion coatings have the property of *resistivity*, which means they *block* electrical current. This blocking effect is called *cathodic shielding.*

The phenomenon of *cathodic shielding,* or blocking of protective CP current, has been the subject of dozens of technical papers since the mid 1980's. You can review a cross section of these papers on Polyguard's website.You can also view a 10 minute explanation of the cathodic shielding process.

Worldwide, we estimate that over half of pipelines are being coated with solid film back coatings, such as shrink sleeves, tapes, and 2 or 3 layer systems. Most of these lines have CP systems. These are the operators who may be wasting their money on CP. Moreover, many install shielding coatings on girth welds, the most vulnerable area for corrosion.

Two corrosion coatings are proven to be non-shielding, and allow passage of protective CP currents. One of these coatings is FBE. The other is Polyguard RD-6.

NACE SP0169-2007 states: *"Materials … that create electrical shielding should not be used on the pipeline"* [1].

49 CFR §192.461 states: *"External protective coating …must …have properties compatible with any supplemental cathodic protection."* [2]

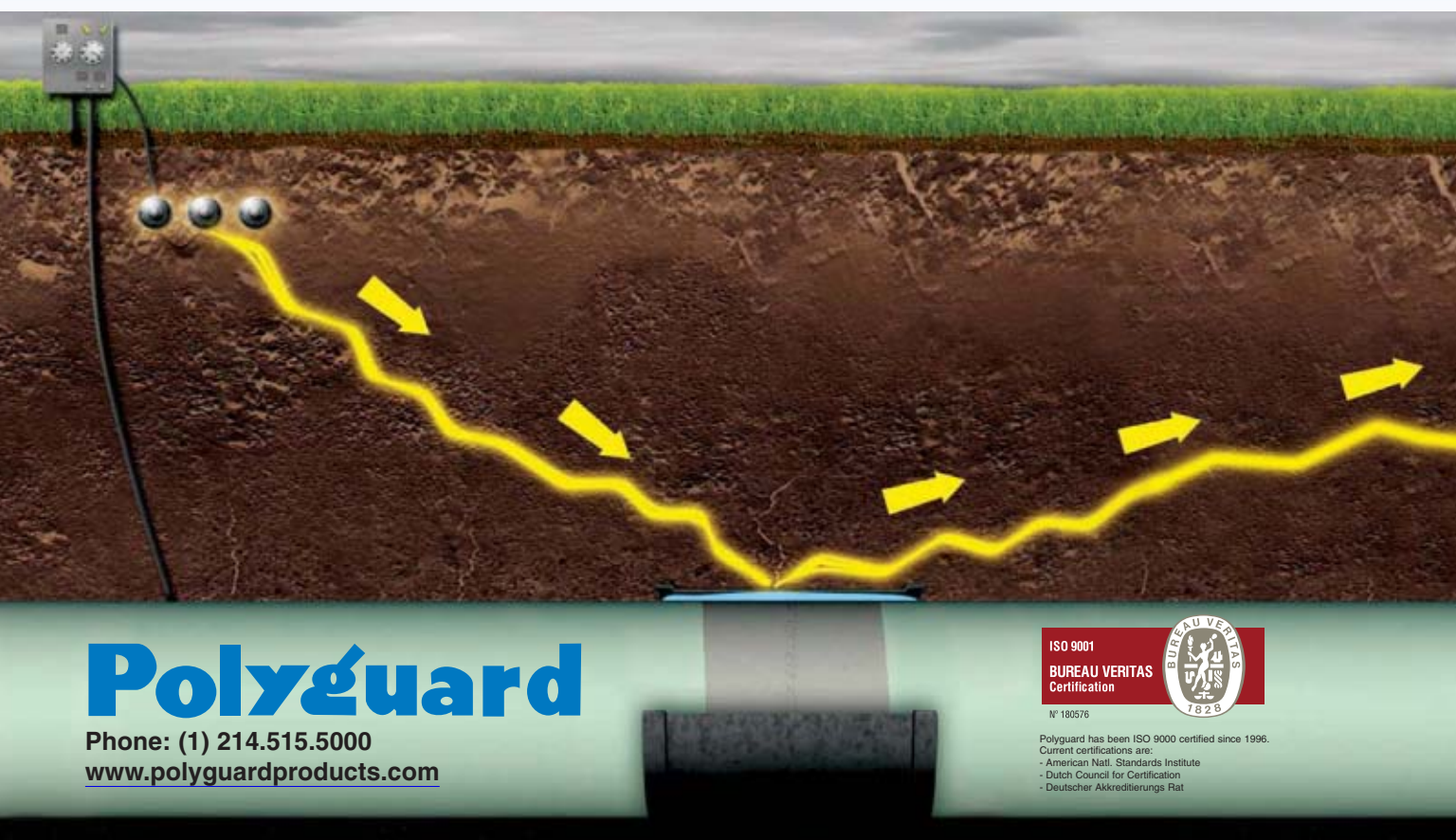
If you are concerned that your organization is behind this curve, we recommend:

1. **Visit polyguardproducts.com/failsafecoating.htm and review the large body of information about shielding problems.**

2. **Talk to operators who have used Polyguard's RD-6 system. *(There are many)* Ask them if they know of any serious corrosion or SCC ever found under RD-6. *(We don't, even after 19 years and thousands of installations).***

3. **Have someone in your organization attend the NACE course *"Coatings in Conjunction with Cathodic Protection"*.**

1. NACE SP0169-2007 *"Control of External Corrosion on Underground or Submergeed Metallic Piping Systems"*.
2. 49 CFR Ch.1 (§192.461 see also §195.559)



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Transportation

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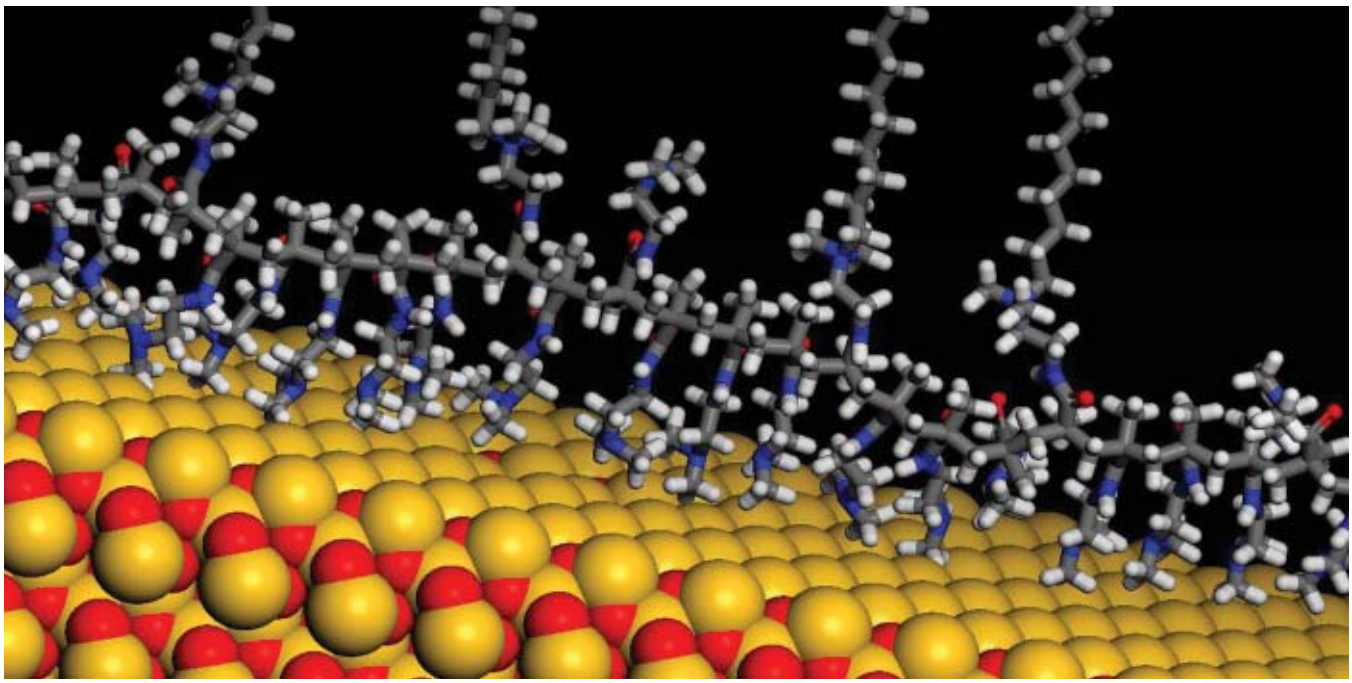
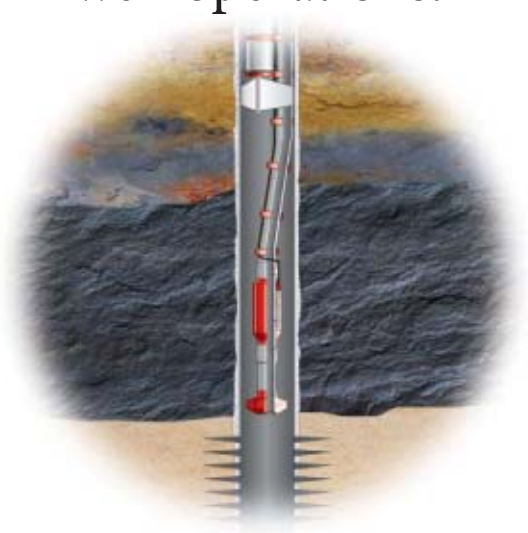


What is reliability worth?

For operators, it's not damaging the formation during well operations.



Industry Challenge

Control fluid loss to the formation during electric submersible pump (ESP) installation, TCP operations, gravel-pack operations or while performing clean outs, tubing changes, etc.

Halliburton Solution

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Operator Benefit

- Avoiding formation damage during completion and workover ops
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Because LO-Gard service's chemical composition impedes water flow not hydrocarbon flow, it can be left in the well.

Operator Results

In a recent West Africa job, fluid loss was cut by 90 percentage while changing out the ESP. Plus, there was no change in hydrocarbon production after the LO-Gard treatment.

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OGJ Newsletter

Sept. 15, 2008

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General Interest — Quick Takes

IEA cuts 2008, 2009 world oil demand forecasts

The International Energy Agency has reduced its outlook for 2008 and 2009 world oil demand, citing weaker-than-expected oil deliveries in member countries of the Organization for Economic Cooperation and Development.

In its latest monthly Oil Market Report IEA says that worldwide oil demand will average 86.8 million b/d this year. This is revised from the agency's previous forecast of 86.9 million b/d.

And IEA now sees 2009 oil demand averaging 87.6 million b/d, down from the estimate of 87.8 million b/d released a month ago.

Oil demand in the OECD will average 48.4 million b/d in 2008, down 800,000 b/d from last year and 47.9 million b/d in 2009. These figures are lower than previous estimates as a result of significant revisions in both North America and the Pacific, IEA said.

The Paris-based agency said data suggest that weaker economic conditions and high prices during this past summer, when oil prices reached an all-time peak, had more of an impact on demand than expected, notably in the US.

Further, the report said that oil demand in the US may be poised for a more permanent downward trend amid sustained high prices and sluggish economic activity.

IEA forecasts that non-OECD oil demand will average 38.3 million b/d in 2008, up 4% from 2007 and 50,000 b/d higher than previously estimated. Next year's demand is pegged at an average 39.8 million b/d, 20,000 b/d higher than in the agency's last report.

These upward revisions are mostly related to a reassessment of China's third-quarter 2008 demand, gas oil use in India, and fuel oil consumption in Iran, IEA said.

EPA approves hurricane-related fuel waivers

Fuel disruptions caused by recent tropical storms and hurricanes prompted the US Environmental Protection Agency to temporarily waive certain federal clean fuel requirements for six counties in Florida until Sept. 15.

Citing Tropical Storms Fay and Hanna, Hurricane Gustav, and the approach of Hurricane Ike, EPA exercised its authority under the Clean Air Act to grant the Florida waiver, which allows greater flexibility for the fuel distribution system.

EPA granted the waiver in coordination with the US Department of Energy following a request from the state of Florida. The waiver affects the following South Florida counties: Broward, Dade, Duval, Hillsborough, Palm Beach, and Pinellas.

Previously, the EPA waived certain federal fuel requirements for parts of Louisiana, Alabama, Georgia, and North Carolina through Sept. 15.

The temporary waivers apply to the Reid vapor pressure gasoline volatility requirements that apply in certain areas. Gasoline volatility standards are imposed during summer months to help control emissions from motor vehicles. Waivers allow the sale of available supplies of conventional gasoline that have higher volatility limits.

Institutes to map European gas shale sites

Three European institutes—Potsdam-based GFZ German Research Center for Geosciences, France's Institut Francais du Petrole (IFP), and Holland's TNO—are establishing a consortium of 15-16 university institutes and energy centers to be launched in late September to carry out a 6-year program to map possible gas shale sites in various European countries.

IFP Francois Laurant, project manager at IFP in charge of basin modeling, told OGJ that in France, deposits could be found in the Aquitaine basin, most likely in source rocks of oil fields; in the Southern Alps area in southeastern France; and the Paris basin.

He said there are black shale fields rich in organic sedimentary matter in England, southern Sweden, Ukraine, Poland, and elsewhere in Europe. There is no specific data, he said, but the research program involves a number of targets.

The €6 million program is being financed by BP, Shell, ExxonMobil, Devon, and others. He said particular exploration methods—which the consortium does not yet have—would be needed. ✦

Exploration & Development — Quick Takes

Total signs exploration agreements with Syria

Total SA has signed three oil and gas agreements with Syria that will strengthen the group's long-term presence in the country, according to Chief Executive Christophe de Margerie.

The three agreements "pave the way for increased cooperation between Total and Syria and bolster our operations in partnership with the national oil companies of this country," De Margerie said, while accompanying French President Nicolas Sarkozy on a trip to Syria (OGJ Online, Sept. 2, 2008).

The first agreement renews the Deir Ezzor oil license, wholly owned by Total and jointly operated by Total and the state-owned Syrian Petroleum Co (SPC) via the Deir Ezzor Petroleum Co. joint venture.

Total said the license for Deir Ezzor was extended for 10 years to 2021, and that the extension will enable the French firm to prolong and optimize production from the Jafra, Qahar, and Atalla fields.

Discussions between the two sides began in early April over the

Industry Scoreboard

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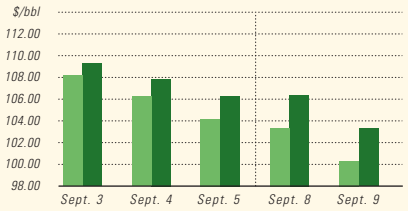
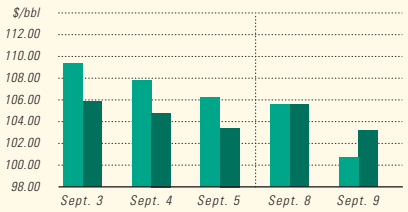
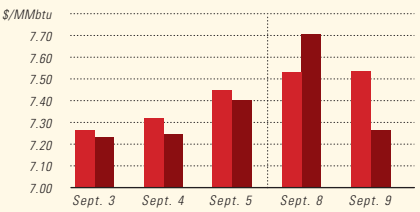


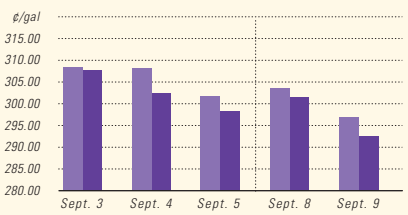
WTI CUSHING / BRENT SPOT



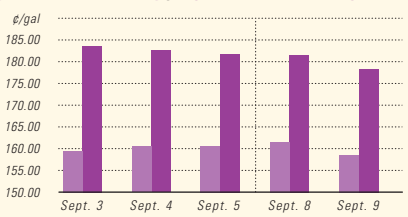
NYMEX NATURAL GAS / SPOT GAS - HENRY HUB



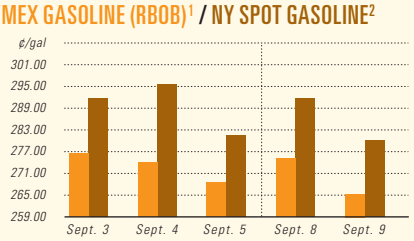
IPE GAS OIL / NYMEX HEATING OIL



PROPANE - MT. BELVIEU / BUTANE - MT. BELVIEU



NYMEX GASOLINE (RBOB)[1] / NY SPOT GASOLINE[2]



[1]Reformulated gasoline blendstock for oxygen blending.
[2]Non-oxygenated regular unleaded.

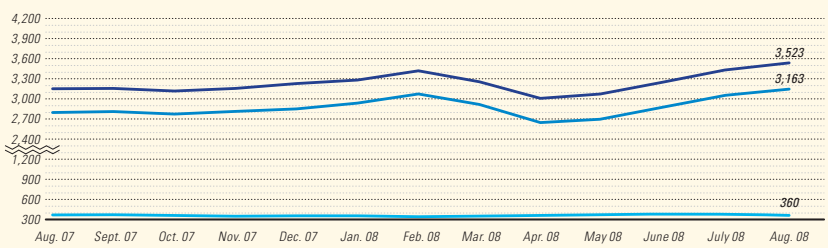
US INDUSTRY SCOREBOARD — 9/15

Latest week 8/29	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	9,426	9,582	–1.6	9,119	9,304	–2.0
Distillate	4,257	4,146	2.7	4,096	4,214	–2.8
Jet fuel	1,545	1,703	–9.3	1,558	1,636	–4.8
Residual	536	761	–29.6	623	743	–16.2
Other products	4,528	4,833	–6.3	4,740	4,822	–1.7
TOTAL DEMAND	20,292	21,025	–3.5	11,266	12,218	–7.8
Supply, 1,000 b/d						
Crude production	5,055	4,914	2.9	5,123	5,098	0.5
NGL production[2]	2,408	2,390	0.8	2,263	2,369	–4.5
Crude imports	10,114	10,316	–2.0	9,869	10,052	–1.8
Product imports	2,868	3,318	–13.6	3,170	3,565	–11.1
Other supply[3]	1,381	995	38.8	1,400	1,054	32.8
TOTAL SUPPLY	21,826	21,933	–0.5	21,825	22,138	–1.4
Refining, 1,000 b/d						
Crude runs to stills	14,918	16,201	–7.9	14,918	15,163	–1.6
Input to crude stills	15,145	15,845	–4.4	15,145	15,449	–2.0
% utilization	86.4	90.8	—	86.4	88.5	—

Latest week 8/29	Latest week	Previous week[1]	Change	Same week year ago[1]	Change	Change, %
Stocks, 1,000 bbl						
Crude oil	303,862	305,760	–1,898	329,660	–25,798	–7.8
Motor gasoline	194,404	195,441	–1,037	191,083	3,321	1.7
Distillate	131,712	132,125	–413	132,170	–458	–0.3
Jet fuel-kerosine	42,081	42,072	9	41,186	895	2.2
Residual	37,424	37,699	–275	36,375	1,049	2.9
Stock cover (days)[4]			Change, %		Change, %	
Crude	20.3	20.5	–1.0	21.0	–3.3	
Motor gasoline	20.6	20.7	–0.5	19.8	4.0	
Distillate	30.9	31.4	–1.6	31.4	–1.6	
Propane	54.4	55.2	–1.4	55.4	–1.8	
Futures prices[5] **9/5**			Change		Change	%
Light sweet crude ($/bbl)	108.30	116.12	–7.82	72.87	35.43	48.6
Natural gas, $/MMbtu	7.32	8.10	–0.77	5.51	1.81	32.9

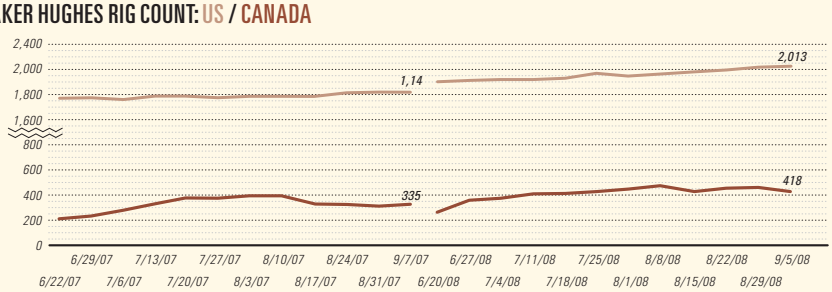
[1]Based on revised figures. [2]Includes adjustments for fuel ethanol and motor gasoline blending components. [3]Includes other hydrocarbons and alcohol, refinery processing gain, and unaccounted for crude oil. [4]Stocks divided by average daily product supplied for the prior 4 weeks. [5]Weekly average 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

earlier agreement, signed in 1988, which allowed Total to produce some 30,000 b/d of oil at Deir Ezzor.

The second agreement covers enhancing output from the Tabiyeh gas and condensate field to increase gas deliveries to the domestic market from the Deir Ezzor plant. This agreement will help Total develop its activities in Syria's gas industry.

The third agreement came in the form of a memorandum of understanding with SPC and the state-owned Syrian Gas Co. to establish a strategic partnership that "will allow the development of common projects between Total and those companies."

GDF Suez acquires stake in Azerbaijan license

GDF Suez has taken a foothold in Azerbaijan by acquiring a 15% stake in the offshore exploration-production license D-222 in the Caspian Sea, owned 65% by Lukoil Overseas and 20% by the national Azeri company SOCAR. It contains the Yalama prospect due to be drilled early 2009.

Lukoil and SOCAR signed the exploration, development, and production-sharing contract for Block D-222 July 3, 1997. The exploration period will extend until late 2011. If successful it will help GDF Suez increase its hydrocarbon reserves by some 35 million boe, which is in line with the group's medium term strategy of increasing its proved and probable reserves to 1,500 million boe from 670 million boe.

GDF Suez also reveals that it will soon take a foothold on the E&P scene in Indonesia as well as in the US to further its asset exchange with ENI within the Distrigaz sale.

Hess makes gas find with Nimblefoot off Australia

Hess Corp. reported that its Nimblefoot-1 exploration well on Australia's Northwest Shelf found 28 m of net natural gas pay.

Nimblefoot-1 is the third of four initial exploration wells being drilled on the WA-390-P permit by Hess this year. Previous wells—Glencoe-1 and Briseis-1—were announced as discoveries on June 10 and July 20, respectively.

Nimblefoot-1 was drilled in 1,115 m of water by Transocean Inc.'s Jack Bates semisubmersible drilling rig. Following the completion of the Nimblefoot-1 well, the rig will move 27 km southeast to drill the Warrior prospect.

Hess holds 100% interest in the 780,000-acre WA-390-P permit.

Chevron to start Makassar Strait gas development

Indonesia has approved a plan by Chevron Indonesia Co. to develop natural gas reserves in five offshore fields in Makassar Strait, including Gendalo, Maha, Gandang, Gehem, and Ranggas.

"The government has approved the POD [plan of development], and the company may now start operations," said Evita H. Legowo, director general for oil and gas at the ministry for energy and mineral resources.

Gendalo, Maha, and Gendang fields form part of the Ganal Block concession operated by Chevron Ganal Ltd., while Ranggas and Gehem fields are on the Rapak Block operated by contractor Chevron Rapak Ltd.

According to a statement released by the ministry, Chevron is required to file a report with the ministry's directorate general of oil and gas on progress once every 6 months.

The ministry also said Chevron is required to file any changes it might undertake in its development scenario, back-up plans, production levels, or investment costs.

"This will be the country's first deep-sea drilling project," said Edy Hermantoro, upstream director at the ministry, who added that parts of the fields lay in concession areas operated separately by Chevron and Eni SPA.

Without elaborating, Edy said the POD in the area will "integrate and involve both companies."

Tullow finds Uganda's shallowest oil to date

Tullow Oil PLC said its Kigogole-1 exploration well, the fifth successive discovery in 5 months in Uganda's Butiaba region along Lake Victoria, found light, sweet, movable oil in reservoirs just below 400 m.

This is the shallowest section in which oil has been encountered in Uganda, the company said.

The well on Block 2 about 1.5 km from the crest of the structure went to TD 616 m and encountered two oil zones with a net pay of 10 m (see map, OGJ, Feb. 11, 2008, p. 36).

Kigogle-1, about 10 km northeast of the Kasamene-1 discovery, is the third test on the Victoria Nile delta play in the Lake Albert Rift basin. Well results have confirmed the presence of good quality reservoir and seals in this area and upgraded several adjacent prospects that will be tested during the 2009 Butiaba drilling campaign, Tullow Oil said.

The company suspended Kigogole-1 as a potential future production well. The rig is to move to drill three exploration wells on Block 1, the first of which is on the Warthog prospect adjacent to Kasamene-1. ✦

Drilling & Production — *Quick Takes*

Aramco begins Khursaniyah field production

Saudi Aramco, which earlier had to delay a planned start-up, has begun production from its Khursaniyah oil field, according to company officials. Production volumes could eventually ramp up to as much as 500,000 b/d.

"The facility is operational and producing crude," a Saudi Aramco official told Saudi Arabia's Arab News. "Its production rates are dependent on our company's monthly production targets for each facility," the source said.

Khursaniyah production, scheduled to begin in December 2007, was delayed due to global material shortages suffered in the construction of its associated gas processing plant.

The new production, which will be welcomed by markets, is part of the Saudi government's larger initiative to boost the country's oil and gas output.

Saudi Arabia, reported to be investing some $90 billion of its oil revenue to further develop production capacity, hopes to increase oil production capacity to 12.5 million b/d and double its refining capacity to 6 million b/d by 2009.

According to analyst Global Insight, "The final confirmation

that Khursaniyah now is on stream, together with the general easing in what was until recently a very tight oil market, is now likely to further soothe fears of temporary shortages."

Norwegian authorities look at CCS in Troll field

The Norwegian Petroleum Directorate (NPD) and Gassnova SF, Norway's state company that handles carbon capture and storage (CCS), have commissioned a seismic survey to see if Troll field in the North Sea can accommodate carbon dioxide from the industrial plants at Mongstad and Karsto.

The 3D seismic survey will focus on whether the Johansen formation at Troll can permanently store large volumes of CO_2 and where the CO_2 injection wells should be drilled. The Johansen formation is 2,500 m below the Troll oil and gas reservoirs and is south of the Troll area.

StatoilHydro will shoot the survey later in September using the Ramform Challenger vessel. Processing and interpretation of the 3D seismic data will probably be completed early in 2009.

Odd Magne Mathiassen, NPD research coordinator, said: "Finding the optimal placement of injection wells is important to ensure that the carbon dioxide can be stored and that it will remain in the reservoir in the future."

This investigation builds upon two other studies carried out for CO_2 where NPD assessed storage sites connected to the Utsira formation in the Sleipner area.

US drilling activity falls from 23-year high

US drilling activity dropped from a 23-year high, down by 18 rotary rigs this week with 2,013 still working, said Baker Hughes Inc. That compares with a rig count of 1,814 during the same period a year ago.

Land operations accounted for the bulk of the decline, down by 19 rigs to 1,919 drilling. Activity in inland waters declined by 1 rig to 22. Offshore drilling increased, however, up 2 to 67 rigs in the Gulf of Mexico and 72 in US waters overall.

Of the rigs working this week, 416 were drilling for oil, the same number as the previous week. However, drilling for natural gas dropped by 20 rigs to 1,586 this week. There were 11 rigs unclassified. Directional drilling increased by 3 rigs to 391. Horizontal drilling was down 2 to 624. ✦

Processing — *Quick Takes*

Pakistan refinery output drops as issues rise

Pakistan refineries reduced gasoline production this month following drastic changes in the pricing formula, the availability of enough stocks, and a slight drop in consumption.

According to Pakistan Oil Companies Advisory Committee (OCAC), National Refinery Ltd. reduced production to 9,000-10,000 tonnes/month from 12,000-13,000 tonnes, and Pakistan Refinery Ltd. (PRL) has cut its monthly production to 7,500 tonnes from 10,000 tonnes. Attock Refinery Ltd. is reported to have slashed production to 21,000-22,000 tonnes from 27,000 tonnes, followed by Bosicor Refinery to 4,000 tonnes from 6,000-7000 tonnes.

OCAC sources, however, ruled out any immediate impact on consumers after falling production because petrol stocks are well above the consumption level. Its impact may be felt in the future, however, they added.

PRL general manager, commercial and corporate affairs, Aftab Husain said the new pricing formula for petrol has some anomalies that need to be rectified.

UOP raises refining, petrochemical catalyst prices

UOP LLC reported it will increase prices for all of its catalysts used in refining and petrochemical production.

Increases of as much as 15% affect its Platforming, Penex, Unicracking, and Merox refining catalysts as well as its Parex, Isomar, Tatoray, Pacol, Oleflex, Q-Max, and EBOne petrochemical catalysts.

UOP said it is raising prices due to "the continued high cost of energy, packaging, and rising raw material prices." Price increases vary by the type of product.

Idemitsu ups product exports as local demand sags

Idemitsu Kosan Co., faced with declining domestic demand in its Asian markets, has signed an initial contract with Petroleos Mexicanos subsidiary PMI Trading Ltd. to supply it with 200,000 kl/year of gas oil.

Because of decreasing domestic demand in Japan and reduced demand from China, Idemitsu said it planned to refine 7.5 million kl of crude during October-December, down 1.2 million kl from the year earlier period.

Most of the reduction will come from planned maintenance on Idemitsu's 120,000 b/d Tokuyama refinery while its other three refineries will operate at lower rates to keep inventories at proper levels. Altogether, the four refineries produce some 640,000 b/d of oil products.

Idemitsu's lower production reflects a recent 10% decline in the company's domestic gasoline sales, in addition to reduced demand for other products, such as diesel for trucks and buses, and kerosine.

While Japan's reduced demand is due largely to environmental factors, sales in China also have fallen because of a downturn in the US economy, which has been a major international consumer of goods produced by Chinese factories.

As a result of Idemitsu's reduced sales into Asian markets, company officials said it plans to increase oil products exports to Latin America generally and Mexico in particular.

"There is certain demand for gas oil from resources-producing countries in Central and South America" such as Mexico and Chile, said Takashi Tsukioka, an Idemitsu supply director.

Besides its gas oil contract with PMI Trading, Idemitsu also plans to export gasoline to Mexico and now is in talks with the Mexican government over specifications. "We are telling them that Japanese specifications are fine (for Mexico)," said Idemitsu sales director Seiji Fukunaga.

For its part, Mexico has increased its imports of oil products as the Pemex refinery system produced 1.5 million b/d of gasoline, diesel, and other fuels in January-July of this year, while imports

of gasoline averaged 342,500 b/d, up 17.6% over January-July 2007.

Pemex said the total volume of petroleum product imports in January-July of this year rose to 555,100 b/d, on average, or 22.2% greater than such purchases during the January-July 2007 period, at a total cost of $14.08 billion (OGJ Newsletter, Sept. 1, 2008). ✦

Transportation — *Quick Takes*

Indonesia, Inpex discuss LNG terminal construction

Indonesia is conducting talks with Inpex Holdings Inc. aimed at having the Japanese firm construct the world's first offshore LNG terminal as part of its development of the Masela offshore gas field in the Timor Sea near the maritime border with Australia.

Indonesian officials, who are making construction of the terminal a condition for the development project, said development could begin as early as November, assuming that a final agreement is reached.

Discussion are said to be complicated by the fact that Indonesia, Japan's main supplier of LNG, is taking a hard line.

Inpex, which holds a 100% stake in the block, had hoped to lay a pipeline from the field to the northern coast of Australia and then use an LNG terminal there to export the gas.

However, Indonesia's Ministry of Energy and Mineral Resources instead proposed construction of the offshore terminal due to what it claims are the difficulties involved in laying pipe through a deep trench.

The proposed offshore LNG terminal would produce some 4-5 million tonnes a year and would begin operations in 2015 or later, according to the ministry. It added that the cost of building the proposed offshore terminal would reach $14 billion—about twice as much as a landside terminal in Australia.

The Japanese firm, which believes construction of an offshore terminal would be both difficult and costly, said negotiations are under way and that that nothing final has been decided.

Shell approved to gather associated gas in Basra

The Iraqi government has approved Royal Dutch Shell's Iraq Gas Master Plan, paving the way for the firm to invest some $3-4 billion to gather 500-600 MMcfd of associated natural gas in the southern part of the country.

"The Council of Ministers, in an exceptional session, decided to approve an agreement of principles with Shell to invest in the natural gas adjoining oil drilling in Basra," the government said.

Shell will establish a joint-venture company with Iraq's state-owned South Oil Co. (SOC) to execute the gathering, treatment, and monetization operation. SOC will hold a 51% majority stake, while Shell will hold 49%.

The agreement enables rapid development of Iraq's associated gas resources, most of which are being burned off. While Iraq's domestic power industry will use most of the gas; other volumes could be exported as LNG via a floating liquefaction facility off Basra.

According to analyst Global Insight, Shell's involvement in the south could place it in a favorable position for similar associated gas production deals in Iraq's Kirkuk area and perhaps Missan province.

The analyst said the agreement holds "vast potential for Shell and Iraq alike," to move away from wasteful flaring of gas—which the country has no infrastructure or know-how to monetize—to a lucrative opportunity to supply domestic markets and earn export revenues.

Origin, ConocoPhillips partner in CSG-LNG project

Sydney-based Origin Energy Ltd. has shunned British suitor BG Group by selecting US major ConocoPhillips as operating partner in its four-train coal seam methane (CSG) and LNG project proposed for Gladstone in Queensland.

The move means that Origin has hooked up with a major LNG player with operational, marketing, and technological expertise but no interest in Origin's domestic gas and electricity business and hence an unlikely candidate for a takeover move against Origin.

The deal, announced Sept. 7, specifies that ConocoPhillips will pay as much as $9.6 billion (Aus.) for a 50% share in the CSG-LNG joint venture. This values Origin's 3P CSM reserves at $1.88/gigajoule.

Origin will act as the upstream coal seam gas supplier to the project while ConocoPhillips will be the downstream LNG operator. The 50:50 joint venture formed by the two companies will market the LNG, probably to Asian markets.

The deal involves an upfront payment by ConocoPhillips of $6 billion plus an additional $1.15 billion to carry Origin's share of the costs to final investment decision for an initial 2-train project—a decision expected by yearend 2010. There also will be four additional payments of $525 million when each of the four LNG trains is approved.

The first two trains each will have a capacity of 3.5 million tonnes/year of LNG and are scheduled to come on stream in 2014.

A full four-train development will need a total of about 24 tcf of gas over a 30-year period. That translates into about 20,500 wells needed to supply the LNG development and Origin's existing supply agreements for the domestic market which will be part of the joint venture.

The project also will involve a major increase in gas gathering, centralized gas processing, and compression station infrastructure in and surrounding Origin's coal seam methane fields in Queensland.

Origin put the new joint venture in place as part of its strategy to ward off the hostile takeover offer of $13.83 billion from UK BG Group.

The transaction is conditional on approval of the Australian Foreign Investment Review Board and any other approvals needed because of the BG offer, which is still on the table. ✦

Letters

Democratic oil finders?

In response to congressional Democrats obstructing new offshore leasing until all existing leases are fully developed, I request that the Democratic National Committee put its money where its mouth is, so as to apply their assumed earth science expertise to locate the undeveloped petroleum precisely. Why not offer $17/ft bottomhole money to lessees to drill no shallower then 17,000 ft total vertical depth at specific surface locations of the Democrats' choice in, say, the Gulf of Mexico's offshore Galveston, Cameron, South Timbalier, Ship Shoal, Grand Isle, West Delta, and Breton Sound areas, in exchange for 17% working interests in such leases? Oil operators seek partners to spread risks.

Rep. Peter A. DeFazio (D-Ore.), among others, seems so certain that he knows where the undeveloped commercial hydrocarbons are that he advised his colleagues (or at least the TV news camera operators), "Hey, c'mon on, guys!.. It's there." All that is needed is more development of existing leases.

Democrats, deliberately remaining ignorant of petroleum, promote the harmful, juvenile fiction that merely because oil, gas and/or mineral leases exist, they must indicate presence of commercial hydrocarbons. As millions of better, wiser, mature US citizens know, initially such leases are basically hunting licenses. Someone believes that commercial petroleum may be present and seeks drilling rights to find out. Were this not so, no one would ever drill dry holes in any sedimentary basin anywhere, in Oregon, Alaska (remember Mukluk?), or elsewhere.

Much of the Gulf of Mexico, which generally tends to be gassier westward, oilier eastward, had been picked over by the early 1970s when I was one of thousands picking it over. For example, I advised my (then) employer against leasing the off-structure West Delta Block 69 North Half, as they were already producing their on-structure Block 69 South Half lease. I also mapped the West Delta-Grand Isle Federal Unit reservoir limits to present to the US Geological

Survey so that my (then) employer could keep its leased acreage while productive within reservoir limits and relinquish the remainder outside these limits.

Harrison T. Brundage
Retired geologist and technical writer
Houston

Calendar

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

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Additional information on upcoming seminars and conferences is available through OGJ Online, Oil & Gas Journal's Internet-based electronic information source at http://www.ogjonline.com.

2008

SEPTEMBER

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. 15-17.

Calendar

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.

Energy Institute Decommissioning Conference, Aberdeen, + 44 (0) 20 7467 7106, + 44 (0) 20 7580 2230 (fax), e-mail: hetheridge@energyinst.org.uk, website: www.energyinst.org.uk/events. 23.

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

DGMK Future Feedstocks for Fuels & Chemicals Conference, Berlin, 040 639004 0. 040 639004 50 (fax), website: www.dgmk.de. 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

GPA North Texas/NGS East Texas Red River Conference, Tyler, Tex., (713) 222-0852, (713) 222-0858 (fax), e-mail: tom.rommel@accessed.com, website: www.gasprocessors.com. 1-2.

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.

Oil Shale Symposium, Golden, Colo., (303) 384-2235, e-mail: jboak@mines.edu, website: www.mines.edu/outreach/cont_ed/oilshale. 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.

GPA Houston Midstream Conference, Houston (713) 222-0852, (713) 222-0858 (fax), e-mail: tom.rommel@accessed.com, website: www.gasprocessors.com. 28-29.

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

Sulphur International Conference and Exhibition, Rome, +44 20 7903 2410, +44 20 7903 2432 (fax), e-mail: conferences@crugroup.com, website: www.sulphurconference.crugroup.com. 2-5.

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, +971 (0) 2 4444 909, +971 (0) 2 4444 383 (fax), e-mail: info@adipec.com, 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.

GITA's GIS Annual Oil & Gas Conference, Calgary, (303) 337-0513, (303) 337-1001 (fax), e-mail: info@gita.org, website: www.gita.org/ogca. 6-7.

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.

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.

Annual Houston Energy Financial Forum, Houston, (918) 831-9160, (918) 831-9161 (fax), e-mail: registration@pennwell.com, website: www.accessanalyst.net. 18-20.

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Canadian Regional Operations
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Calendar

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 Asia/Pacific 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.

USAEE/IAEE North American Conference, New Orleans, (216) 464-2785, (216) 464-2768 (fax), website: www.usaee.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.

SPE 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.

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JANUARY

Petrotech International Oil & Gas Conference & Exhibition, New Delhi, +91 11 2436 4055, +91 11 2436 0872 (fax), e-mail: convenor_petrotech@iocl.co.in, website: www.petrotech2009.org/registration.aspx. 11-15.

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

Pipeline Rehabilitation & Maintenance Conference, Manama, (918) 831-9160, (918) 831-9161 (fax), e-mail: attendingOGMT@pennwell.com, website: www.pipeline-rehab.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.

World Future Energy Summit, Abu Dhabi, +971 2 444 6011, +971 2 444 3987 (fax), e-mail: sales@turretme.com, website: www.worldfutureenergysummit.com. 19-21.

API Exploration & Production Winter Standards Meeting, San Antonio, (202) 682-8000, (202) 682-8222 (fax), website: www.api.org. 19-23.

API/AGA Oil and Gas Pipeline Welding Practices Conference, San Antonio, (202) 682-8000, (202) 682-8222 (fax), website: www.api.org. 21-23.

International Process Analytical Technology Forum (IFPAC), Baltimore, (847) 543-6800, (847) 548-1811 (fax), e-mail: info@ifpacnet.org, website: www.ifpac.com. 25-28.

Global E&P Summit, Madrid, +44 (0)20 7202 7500, +44 (0)20 7202 7600 (fax), e-mail: info@wtgevents.com, website: www.epsummit.com. 26-28.

Offshore West Africa Conference, Abuja, (918) 831-9160, (918) 831-9161 (fax), e-mail: attendOWA@pennwell.com, website: www.offshorewestafrica.com. 27-29.

The European Gas Conference, Vienna, +44 (0) 1242 529 090, +44 (0) 1242 529 060 (fax), e-mail: wra@theenergyexchange.co.uk, website: www.theenergyexchange.co.uk. 27-29.

SIHGAZ International Hydrocarbon & Gas Fair, Hassi Messaoud, + 213 21 21 58 74, + 213 21 21 58 72/76 (fax),e-mail: contact@foirex.com, website: www.sihgaz2009.com. 28-31.

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.

Global Petrochemicals Conference & Annual Meeting, Cologne, +44 (0) 1242 529 090. +44 (0) 1242 529 060 (fax), e-mail: wra@theenergyexchange.co.uk, website: www.wraconferences.com. 3-5.

Russia Offshore Annual Meeting, Moscow, +44 (0) 1242 529 090, +44 (0) 1242 529 060 (fax), e-mail: wra@theenergyexchange.co.uk, website: www.theenergyexchange.co.uk. 4-6.

NAPE Expo, Houston, (817) 847-7700, (817) 847-7704 (fax), e-mail: info@napeexpo.com, website: www.napeonline.com. 5-6.

Pipeline Pigging & Integrity Management Conference, Houston, (713) 521-5929, (713) 521-9255 (fax), e-mail: clarion@clarion.org, website: www.clarion.org. 9-12.

✦SPE Unconventional Fields Conference, Margarita Island, Venezuela, (972) 952-9393, (972) 952-9435 (fax), e-mail: spedal@spe.org, website: www.spe.org. 10-12.

Pipe Line Contractors Association Annual Conference (PLCA), Carlsbad, Calif., (214) 969-2700, e-mail: plca@plca.org, website: www.plca.org. 11-15.

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.

International Petrochemicals Technology Conference & Exhibition, London, +44 (0) 20 7357 8394, +44 (0) 20 7357 8395 (fax), e-mail: enquiries@europetro.com, website: www.europetro.com. 16-17.

IP Week, London, +44 (0)20 8561 6030, +44 (0)20 8561-0131 (fax), e-mail: events@energyinst.org.uk, website: www.energyinst.org.uk. 16-19.

International Downstream Technology & Catalyst Conference & Exhibition, London, +44 (0) 20 7357 8394, +44 (0) 20 7357 8395 (fax), e-mail: enquiries@europetro.com, website: www.europetro.com. 18-19.

Laurance Reid Gas Conditioning Conference, Norman, Okla., (405) 325-2248, (405) 325-7164 (fax), e-mail: bettyk@ou.edu, website: www.engr.outreach.ou.edu. 22-25.

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

International Pump Users Symposium, Houston, (979) 845-7417, (979) 847-9500 (fax), e-mail: inquiry@turbo-lab.tamu.edu, website: http://turbolab.tamu.edu. 23-26.

MARCH

EAGE North African/Mediterranean Petroleum and Geosciences Conference & Exhibition, Tunis, +31 88 995 5055, +31 30 6343524 (fax), e-mail: eage@eage.org, website: www.eage.org. 2-4.

SPE Research & Development Conference, Lisbon, (972) 952-9393, (972) 952-9435 (fax), e-mail:

spedal@spe.org, website: www.spe.org. 3-4.

APPEX Prospect and Property Expo, London, (918) 560-2616, (918) 560-2684 (fax), e-mail: convene@aapg.org, website: www.aapg.org. 3-5.

Subsea Tieback Forum & Exhibition, San Antonio, (918) 831-9160, (918) 831-9161 (fax), e-mail: registration@pennwell.com, website: www.subseatiebackforum.com. 3-5.

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

Doha Natural Gas Conference & Exhibition, Doha, e-mail: gascon@qp.com.qa, website: www.dohagascon.com.qa. 9-12.

European Fuels Conference, Paris, +44 (0) 1242 529 090. +44 (0) 1242 529 060 (fax), e-mail: wra@theenergyexchange.co.uk, website: www.wraconferences.com. 10-12.

Turkish International Oil & Gas Conference & Showcase (TUROGE), Ankara, +44 (0) 207 596 5233, +44 (0) 207 596 5106 (fax), e-mail: oilgas@ite-exhibitions.com, website: www.oilgas-events.com. 10-12.

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.

Annual International LPG Seminar, The Woodlands, Tex., (281) 367-9797, website: www.purvingertz.com. 16-19.

Gas Asia, Kuala Lumpur, +44 (0) 1242 529 090, +44 (0) 1242 529 060 (fax), e-mail: wra@theenergyexchange.co.uk, website: www.theenergyexchange.co.uk. 17-18.

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

Latin American Meeting on Energy Economics, Santiago, 56 2 3541411, 56 2 5521608 (fax), e-mail: info@elaee.org, website: www.elaee.org. 22-24.

NPRA Annual Meeting, San Antonio, (202) 457-0480, (202) 457-0486 (fax), e-mail: info@npra.org, website: www.npra.org. 22-24.

ACS Spring National Meeting & Exposition, Salt Lake City, (202) 872-4600, e-mail: service@acs.org, website: www.acs.org. 22-26.

NACE Corrosion Conference & Expo, Atlanta, (281) 228-6200, (281) 228-6300 (fax), website: www.nace.org/c2009. 22-26.

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.

API Spring Petroleum Measurement Standards Meeting, Dallas, (202) 682-8000, (202) 682-8222 (fax), website: www.api.org. 23-26.

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.

Offshore Mediterranean Conference & Exhibition (OMC), Ravenna, +39 0544 219418, +39 0544 39347 (fax), e-mail: conference@omc.it, website: www.omc2009.it. 25-27

NPRA International Petrochemical Conference, San Antonio, (202) 457-0480, (202) 457-0486 (fax), e-mail: info@npra.org, website: www.npra.org. 29-31.

Petroleum Geology Conference, London, +44 (0)20 7434 9944, +44 (0)20 7494 0579 (fax), e-mail: georgina.worrall@geolsoc.org.uk, website: www.geolsoc.org.uk. Mar. 30-Apr. 2.

SPE/ICoTA Coiled Tubing & Well Intervention Conference & Exhibition, The Woodlands, Tex., (972) 952-9393, (972) 952-9435 (fax), e-mail: spedal@spe.org, website: www.spe.org. Mar. 31-Apr. 1.

Spotlight on new technology

Laura Bell
Statistics Editor

Oil & Gas Journal is a technology-based magazine emphasizing upstream and downstream issues and news for executives, engineers, and other participants in the oil and gas industry. OGJ editors carefully research, write, and edit informative articles showcasing new technology in their fields of expertise.

In addition, throughout the year OGJ publishes special reports or articles that involve other aspects of the industry, such as the financial side.

In this week's publication, the informative and popular OGJ200 special report captures financial data that is critical for investors, analysts, and company executives (see p. 22).

Data are compiled by collecting figures from companies' 10-K reports, which are required by law to be filed with the US Securities and Exchange Commission. EDGAR (Electronic Data Gathering, Analysis, and Retrieval) is the government's current system for allowing public access to companies' financial and operating data disclosures. It enables the public to view time-sensitive corporate information in text or html format. Although this tool is useful, it also has many limits. One is that gathering specific vital data from EDGAR is a time-intensive chore requiring the user to spend countless hours scouring page after page of data. Then the user must pull past years' filings to compare historical trends in order to provide significance to the figures for the specific reports.

An exciting overhaul

There are new and exciting changes on the horizon, however, that should make the data retrieval task more useful and simpler for the industry analyst, investor, and yes, the media. The SEC said it is updating EDGAR to serve a more advanced technical era. More and more people are relying on the internet and e-mail to process information more efficiently. Companies are using electronic systems daily to assimilate reports and other financial indicators. Therefore SEC is replacing the old document-based system with a more advanced medium of relaying government-required interactive data faster and in a more useful and efficient manner.

IDEA (Interactive Data Electronic Applications) will slowly replace the EDGAR system, enabling users to access and assemble data in a format that better fits their specific requirements. The interactive data technology relies on a "tagging" component that works like bar codes. Each "tag" will identify items related to the financial and operating disclosures of each company. This labeling will enable users to gather certain data items off the income statements of a multitude of companies. Once identified, users can download this information into their spreadsheets or use the charts and graphs for a more comparative analysis.

"This new SEC resource powered by interactive data will give investors far faster, more accurate, and more meaningful information about the companies and mutual funds they own," said SEC Chairman Christopher Cox. EDGAR will enhance IDEA by providing an archive of past filings.

Company filers' benefits

This is a win-win situation for the companies required to file with the SEC. Many hours currently are spent compiling, reviewing, and editing information; this interactive data method will allow companies to submit data more quickly and accurately. "Using interactive technology, XBRL (eXtensible Business Reporting Language) could enable public companies to shift resources away from cumbersome manual reporting to an automated approach that saves time and money and produces more standardized, accurate results," SEC reported.

SEC has proposed that companies be required to submit financial disclosures utilizing IDEA as soon as early 2009.

The new technology is very exciting for the financial world. It will offer additional insights to analyzing confusing government legalese and unnecessary information that isn't pertinent to your applications.

Most 10-K reports state that accompanying notes are integral parts of the operations and should be considered along with the financials. This is where OGJ will be able to facilitate you, our readers. Our OGJ200 report will eventually utilize this new technology but will "read between the lines" to get to the heart of the information that our readers need to make informative decisions. We will provide this data by doing all of the research, all of the compiling and editing, all of the work for you in a one-stop special report. This technology will make it easier and faster for us to produce accurate data specific to your needs. In addition, OGJ could eventually provide supplemental data to enhance our current reports. ✦

Editorial

OPEC and hurricanes

The oil market fell subject to more tugs and pushes than usual last week as the Organization of Petroleum Exporting Countries acted to support the price of crude and the second hurricane in 2 weeks threatened production and refining in and near the Gulf of Mexico. It was enough to make the unattentive forget that the fundamentals of supply and demand have taken a sharp turn.

It was with an eye on that turn that OPEC on Sept. 10 agreed to lower group production to the target set a year earlier for members other than Iraq. After adjustments for new members Angola and Ecuador and departing member Indonesia, the target became 28.8 million b/d. That's 570,000 below August production reported by the International Energy Agency for OPEC members other than Indonesia and Iraq. Noncompliance by overproducers such as Iran probably will keep the actual size of the announced cut closer to 530,000 b/d.

No surprise

That OPEC trimmed output should surprise no one. But overreaction is inevitable—and not just by analysts. OPEC's move might revive discussion of a proposal in Congress to subject the exporters' group to federal antitrust enforcement. The threat of a presidential veto has so far kept that nonsense in check. But antagonism toward OPEC will surge, however illogically, if Hurricane Ike, unlike Hurricane Gustav at September's start, damages production and refining systems enough to raise gasoline prices.

The mere possibility of supply interruption, however, no longer sends oil prices into orbit. Prices responded minimally to Russia's invasion of Georgia and Hurricane Gustav's sweep over the Gulf Coast. The market's new insouciance shows that something major has changed (OGJ, Sept. 8, 2008, p. 18). Indeed, as OPEC damped production and Hurricane Ike entered the gulf, evidence of that change strengthened.

IEA on Sept. 10 trimmed its projection for 2008 oil demand again, by 100,000 b/d. The new forecast of 86.8 million b/d is 1 million b/d less than what IEA was projecting in January. Demand at the newly projected level would be up just 0.8% from last year's consumption. And IEA forecasts a demand increase of just 1% next year.

While demand growth sags, potential supply finally is growing. Saudi Arabia is bringing giant Khursaniyah oil field on stream after months of delay related to gas processing facilities. The field is expected to reach capacity output of 500,000 b/d early next year. By the end of 2009, total Saudi production capacity is to be 12.5 million b/d, 1.85 million b/d more than its level before Khursaniyah started up. IEA raised its September capacity estimates for Angola, where new fields have come on stream in the offshore Kizomba C complex, and for Iran, which has been producing as much as 4.1 million b/d. With new fields ramping up production, IEA expects OPEC capacity to climb by a further 500,000 b/d by yearend.

The combination of diminished OPEC production and increased OPEC capacity will thicken one of the oil market's two important buffers against demand surges and supply shocks. Effective spare production capacity has been near or below 2 million b/d since 2002. That's barely enough to cover the loss of supply from politically shaky exporters like Venezuela and Nigeria. The market becomes very reactive to hints of supply problems when idle production capacity is this low and when its other cushion, oil in storage, is thin.

Inventories growing

Now, however, inventories are growing along with spare production capacity. IEA said total oil inventories held in members of the Organization for Economic Cooperation and Development, representing industrial countries, exceeded the recent 5-year average in July for the first time since April. OECD inventories represented 54.5 days of projected demand, almost 1 day more than the 5-year average.

While demand growth eases, supply expands, and market cushions rebuild, two extra forces thought to have added to price strength earlier this year have subsided: dollar weakness and unusually strong flows of investment capital into commodities. So the forces pushing down oil prices are, for now, very strong. They're probably even stronger than a hurricane. ✦

OGJ200 earnings mixed as US production, reserves climb

Marilyn Radler
Senior Editor-Economics

Laura Bell
Statistics Editor

The OGJ200 group of companies recorded a decline in earnings last year as greater expenses ate into returns. The collective 2.5% dip in net income accompanied a 7% swell in revenues.

High costs for labor, equipment, and supplies underpinned the group's capital and exploration spending, and the number of wells drilled climbed.

The group's natural gas production and reserves moved higher from a year earlier, but liquids production and reserves totals were mixed.

There are 147 companies that qualified for this edition of the OGJ200. Last year, the number rose to 144 from an all-time low of 138.

OGJ began publishing this compilation in 1983 as the OGJ400, featuring the top 400 US-based, publicly traded oil and gas producing firms.

The total assets of the firms at the end of 2007 were $1.06 trillion, and their combined stockholders' equity was $487.8 billion. Capital and exploratory expenditures totaled $126 billion, up 11% from the group's 2006 outlays. US net wells drilled climbed 5%.

Changes to the group

Some of the companies in the group are new to the list, and some have changed their names since the previous edition of the OGJ200. Some no longer appear after being acquired or because of other reasons.

Based in South Lake, Tex., Harken Energy Corp. changed its name and now appears in the compilation as HKN Inc. Meanwhile, San Antonio-based Exploration Co. changed its name to TXCO Resources Inc. Panhandle Oil & Gas Inc., meanwhile, previously was listed as Panhandle Royalty Co.

Two of the firms that appeared last year were acquired by other companies and are no longer listed separately. These are Houston Exploration Co., which Forest Oil Corp. acquired, and Pogo Producing Co., which was acquired by Plains

SOME KEY CHANGES FROM 2007 OGJ200

Table 1

How company appeared on last year's list	Why change?	How company appears on this year's list
Dominion Exploration & Production	Reorganized by parent company	Dominion Energy Inc.
Exploration Co.	Changed name to	TXCO Resources Inc.
Harken Energy Corp.	Changed name to	HKN Inc.
Houston Exploration Co.	Acquired by	Forest Oil Corp.
Panhandle Royalty Co.	Changed name to	Panhandle Oil and Gas Inc.
Pogo Producing Co.	Acquired by	Plains Exploration & Production Co.

The following companies sold their US producing properties, liquidated, or became private since the last survey:
Challenger Minerals Inc.
Hallador Petroleum Co.
Toreador Resouces Corp.
Peoples Energy Production
United Heritage Corp.

TOP 20 IN TOTAL REVENUE

Table 2

Rank	Company	Total revenue, $1,000
1	ExxonMobil Corp.	404,552,000
2	Chevron Corp.	220,904,000
3	ConocoPhillips	194,495,000
4	Marathon Oil Corp.	65,207,000
5	Hess Corp.	31,924,000
6	Occidental Petroleum Corp.	20,013,000
7	Murphy Oil Corp.	18,439,098
8	Anadarko Petroleum Corp.	15,892,000
9	Devon Energy Corp.	11,362,000
10	Apache Corp.	9,977,858
11	Chesapeake Energy Corp.	7,815,000
12	XTO Energy Inc.	5,513,000
13	El Paso Corp.	4,648,000
14	EOG Resources Inc.	4,190,791
15	Dominion Energy Inc.	3,527,000
16	Noble Energy Inc.	3,272,030
17	Questar Corp.	2,740,900
18	Williams Cos. Inc.	2,093,000
19	Pioneer Natural Resources Co.	1,833,349
20	Newfield Exploration Co.	1,783,000
	Total	**1,030,182,026**

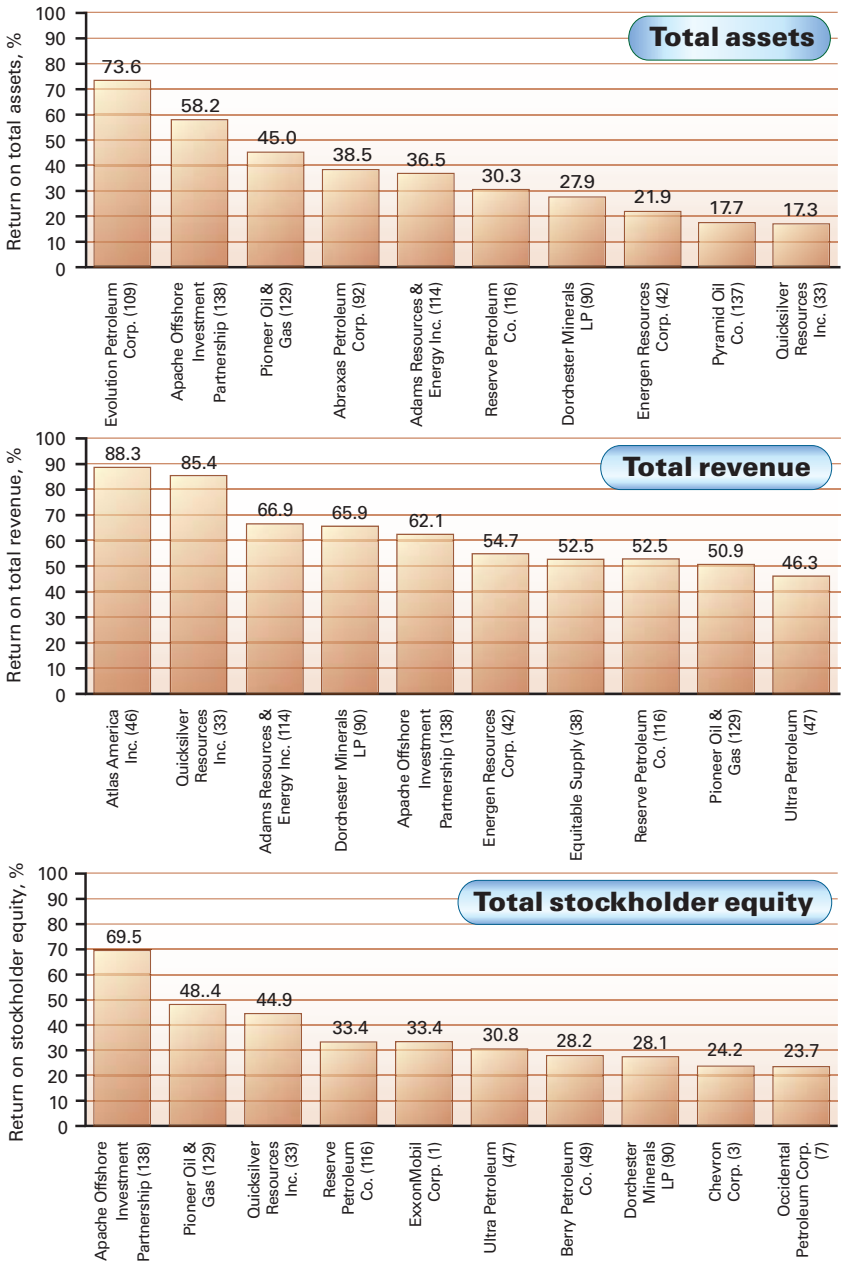
TOP 20 IN ASSETS—MARKET CAPITALIZATION[1]

Table 3

Rank	Company	Market capitalization, $1,000
1	ExxonMobil Corp.	504,239,580
2	ConocoPhillips	142,502,220
3	Chevron Corp.	195,100,202
4	Anadarko Petroleum Corp.	30,742,920
5	Marathon Oil Corp.	43,210,600
6	Devon Energy Corp.	39,494,089
7	Occidental Petroleum Corp.	63,573,409
8	Chesapeake Energy Corp.	20,036,978
9	Apache Corp.	35,802,985
10	Hess Corp.	32,335,674
11	El Paso Corp.	12,077,249
12	XTO Energy Inc.	24,924,688
13	EOG Resources Inc.	22,002,328
14	Noble Energy Inc.	13,696,003
15	Murphy Oil Corp.	16,095,348
16	Plains Exploration & Production Co.	6,091,144
17	Dominion Energy Inc.[2]	27,378,650
18	Williams Cos. Inc.[2]	20,967,080
19	Pioneer Natural Resources Co.	5,749,802
20	Newfield Exploration Co.	6,921,403
	Total	**1,262,942,353**

[1]As of Dec. 31, 2007 [2]Based on parent company data.

TOP COMPANIES IN RETURN ON...*



*Includes subsidiary companies, whose accounting methods vary and who may be helped by contributions from parent companies. Excludes companies whose results were inflated by identifiable extraordinary gains. Excludes royalty trusts. Excludes companies that get only a small portion of their revenue from oil and gas. Numbers in parentheses indicate rank by total assets.

Exploration & Production Co.

Dominion Exploration & Production was reorganized by its parent company and is now listed as Dominion Energy Inc.

Five companies that were previously included in the OGJ200 no longer appear because they sold their producing properties in the US, liquidated their assets, or were bought by entities based outside the US. These include Challenger Minerals Inc., Hallador Petroleum Co., Peoples Energy Production, Toreador Resources Corp., and United Heritage Corp.

The 2007 results of two of the companies that qualify for the compilation were not available at presstime, so those companies' results are excluded from group totals. These companies are Ness Energy International Inc. and PRB Energy Inc.

Thirteen companies appear in the OGJ200 for the first time. The highest-ranking of these, Exco Resources Inc., sits at No. 21 by yearend-2007 assets. Exco, with headquarters in Dallas, became publicly traded with an initial public offering in 2006.

There are five royalty trusts in the compilation, down from six in the pre-

20 FASTEST-GROWING COMPANIES[1]

Table 4

Rank by total assets	Company	Stockholders' equity 2007 $1,000	Stockholders' equity 2006 $1,000	Change, %	Net income 2007 $1,000	Net income 2006 $1,000	Change, %	Long-term debt 2007 $1,000	Long-term debt 2006 $1,000
132	Lucas Energy Inc.	7,444	549	1,255.9	322	62	419.4	0	0
37	ATP Oil & Gas Corp.	309,866	35,918	762.7	48,620	6,877	607.0	1,391,846	1,062,454
75	Gulfport Energy Corp.	304,122	123,809	145.6	37,775	27,808	35.8	65,725,000	36,856,000
80	Arena Resources Inc.	257,811	120,044	114.8	34,442	23,268	48.0	0	0
64	Layne Christensen Co.[2]	423,372	205,034	106.5	37,256	26,252	41.9	0	0
129	Pioneer Oil & Gas	10,936	5,654	93.4	5,290	1,470	259.9	0	0
33	Quicksilver Resources Inc.	1,068,355	575,666	85.6	479,378	93,719	411.5	813,817	919,117
23	Forest Oil Corp.	2,411,811	1,434,006	68.2	169,306	168,502	0.5	1,503,035	1,204,709
66	PetroQuest Energy Inc.	302,317	189,711	59.4	40,619	23,986	69.3	0	0
77	GMX Resources Inc.	208,926	131,481	58.9	16,885	8,975	88.1	121,413	41,569
116	Reserve Petroleum Co.	22,552	16,129	39.8	7,528	4,275	76.1	0	0
27	Range Resources Corp.	1,728,022	1,256,161	37.6	230,569	158,702	45.3	0	0
47	Ultra Petroleum	853,579	629,005	35.7	263,036	231,195	13.8	290,000	165,000
137	Pyramid Oil Co.	6,604	5,109	29.3	1,495	949	57.5	44,542	11,334
34	Denbury Resources Inc.	1,404,378	1,106,059	27.0	253,147	202,457	25.0	674,665	507,786
6	Devon Energy Corp.	22,006,000	17,442,000	26.2	3,606,000	2,846,000	26.7	6,283,000	4,841,000
11	El Paso Corp.	5,280,000	4,186,000	26.1	1,110,000	475,000	133.7	0	0
124	Spindletop Oil & Gas Co.	9,515	7,675	24.0	1,808	920	96.5	0	0
15	Murphy Oil Corp.	5,066,174	4,121,273	22.9	766,529	644,669	18.9	0	0
73	Warren Resources Inc.	349,529	284,976	22.7	11,405	6,435	77.2	0	0

[1]Companies were selected on the basis of growth in stockholder's equity. Only companies with positive net income for both 2006 and 2007 were considered. Companies were not considered if they had a decline in net income for 2007, were subsidiaries of another company, or became public within the last year. [2]Jan. 31, 2008.

TOP 20 IN NET INCOME AND STOCKHOLDERS' EQUITY

Table 5

Rank	Company	Net income, $1,000
1	ExxonMobil Corp.	40,610,000
2	Chevron Corp.	18,688,000
3	ConocoPhillips	11,891,000
4	Occidental Petroleum Corp.	5,400,000
5	Marathon Oil Corp.	3,956,000
6	Anadarko Petroleum Corp.	3,781,000
7	Devon Energy Corp.	3,606,000
8	Apache Corp.	2,812,358
9	Hess Corp.	1,832,000
10	XTO Energy Inc.	1,691,000
11	Chesapeake Energy Corp.	1,451,000
12	El Paso Corp.	1,110,000
13	EOG Resources Inc.	1,089,918
14	Noble Energy Inc.	943,870
15	Murphy Oil Corp.	766,529
16	Williams Cos. Inc.	731,000
17	Questar Corp.	507,400
18	Quicksilver Resources Inc.	479,378
19	Newfield Exploration Co.	450,000
20	Dominion Energy Inc.	387,000
	Total	**102,183,453**

Rank	Company	Stockholders' equity, $1,000
1	ExxonMobil Corp.	121,762,000
2	ConocoPhillips	88,983,000
3	Chevron Corp.	77,088,000
4	Occidental Petroleum Corp.	22,823,000
5	Devon Energy Corp.	22,006,000
6	Marathon Oil Corp.	19,223,000
7	Anadarko Petroleum Corp.	16,364,000
8	Apache Corp.	15,377,979
9	Chesapeake Energy Corp.	12,130,000
10	Hess Corp.	9,774,000
11	XTO Energy Inc.	7,941,000
12	EOG Resources Inc.	6,990,094
13	El Paso Corp.	5,280,000
14	Murphy Oil Corp.	5,066,174
15	Noble Energy Inc.	4,808,807
16	Newfield Exploration Co.	3,581,000
17	Plains Exploration & Production Co.	3,338,247
18	Cimarex Energy Co.	3,259,287
19	Pioneer Natural Resources Co.	3,042,722
20	Questar Corp.	2,577,900
	Total	**451,416,210**

vious OGJ200. There are also five subsidiaries, including Dominion Energy Inc., Seneca Resources Corp., Fidelity Exploration & Production Co., Equitable Supply, and DTE Gas & Oil Co.

Annual results

As the capital spending and drilling efforts of the OGJ200 companies increased last year, their production and reserves totals mostly moved upward.

The combined capital and exploration expenditures of the group increased 11% to $126 billion. Up 5% from 2006, the number of US net wells drilled by the group totaled 23,065.

The number of active rigs in the US climbed 7% last year, according to Baker Hughes Inc. At the same time, the rig count in Canada increased 12%, and the worldwide number of active rigs grew 4%, according to American Petroleum Institute.

Capital outlays varied widely among the companies in the survey. Such spending during 2007 by top-ranked ExxonMobil Corp. was up 5% from a year earlier, but No. 2 ConocoPhillips posted a 24% decline in capital spending. Meanwhile, No. 3 Chevron Corp. reported that its capital spending program last year increased 21%.

As reported a year ago, the previous OGJ200 group's total spending surged 40% from 2005, and their net wells drilled in the US increased 27%.

The OGJ200 shows each company's worldwide liquids and natural gas production and reserves and breaks out the results for the US. The group's US liquids and gas reserves and their worldwide gas reserves totals were up from a year earlier, but their combined worldwide liquids reserves slumped 4%.

The group's combined worldwide liquids production declined last year almost 1%, but their collective worldwide natural gas production climbed 3%. Meanwhile, the group's liquids production in the US increased 3.5%,

Top 20 in spending and US net wells drilled

Table 6

Rank	Company	Capital, exploratory spending, $1,000
1	ExxonMobil Corp.	20,853,000
2	Chevron Corp.	16,678,000
3	ConocoPhillips	11,791,000
4	Devon Energy Corp.	6,158,000
5	Chesapeake Energy Corp.	5,305,000
6	Apache Corp.	4,802,343
7	Marathon Oil Corp.	4,466,000
8	Anadarko Petroleum Corp.	4,246,000
9	Hess Corp.	3,578,000
10	Occidental Petroleum Corp.	3,497,000
11	EOG Resources Inc.	3,401,986
12	Exco Resources Inc.	2,847,000
13	XTO Energy Inc.	2,668,000
14	El Paso Corp.	2,495,000
15	Pioneer Natural Resources Co.	2,067,648
16	Murphy Oil Corp.	1,949,219
17	Newfield Exploration Co.	1,930,000
18	Southwestern Energy Co.	1,519,433
19	Noble Energy Inc.	1,414,515
20	Questar Corp.	1,398,300
	Total	**103,065,444**

Rank	Company	US net wells drilled
1	Chesapeake Energy Corp.	1,919.0
2	XTO Energy Inc.	1,073.3
3	Devon Energy Corp.	1,015.1
4	EOG Resources Inc.	938.3
5	Anadarko Petroleum Corp.	926.5
6	Williams Cos. Inc.	904.0
7	Chevron Corp.	892.0
8	ConocoPhillips	823.0
9	Dominion Energy Inc.	814.0
10	Noble Energy Inc.	803.9
11	Range Resources Corp.	698.2
12	Pioneer Natural Resources Co.	619.0
13	Quest Resource Inc.	571.0
14	ExxonMobil Corp.	486.0
15	Occidental Petroleum Corp.	476.2
16	Atlas America Inc.	473.8
17	El Paso Corp.	465.0
18	Equitable Supply	456.3
19	Quicksilver Resources Inc.	432.8
20	Exco Resources Inc.	405.2
	Total	**15,192.6**

Top 20 in liquids reserves

Table 7

Rank	Company	US liquids reserves, million bbl
1	ConocoPhillips	2,242.0
2	ExxonMobil Corp.	1,851.0
3	Occidental Petroleum Corp.	1,707.0
4	Chevron Corp.	1,624.0
5	Anadarko Petroleum Corp.	662.0
6	Apache Corp.	551.6
7	Devon Energy Corp.	452.0
8	Pioneer Natural Resources Co.	451.1
9	Plains Exploration & Production Co.	436.5
10	Cano Petroleum Inc.	423.3
11	XTO Energy Inc.	308.0
12	Noble Energy Inc.	207.4
13	Hess Corp.	204.0
14	Whiting Petroleum Corp.	196.3
15	Encore Acquisition Co.	188.6
16	Marathon Oil Corp.	166.0
17	EOG Resources Inc.	160.0
18	Denbury Resources Inc.	135.0
19	Kinder Morgan CO_2 Co. LP	132.5
20	Chesapeake Energy Corp.	123.6
	Total	**12,221.9**

Rank	Company	Worldwide liquids reserves, million bbl
1	ExxonMobil Corp.	7,744.0
2	Chevron Corp.	7,087.0
3	ConocoPhillips	6,320.0
4	Occidental Petroleum Corp.	2,228.0
5	Apache Corp.	1,133.7
6	Anadarko Petroleum Corp.	1,014.0
7	Devon Energy Corp.	998.0
8	Hess Corp.	885.0
9	Marathon Oil Corp.	650.0
10	Pioneer Natural Resources Co.	469.7
11	Plains Exploration & Production Co.	436.5
12	Noble Energy Inc.	329.0
13	XTO Energy Inc.	308.0
14	Whiting Petroleum Corp.	196.3
15	Encore Acquisition Co.	188.6
16	EOG Resources Inc.	179.3
17	Murphy Oil Corp.	178.2
18	Denbury Resources Inc.	135.0
19	Kinder Morgan CO_2 Co. LP	132.5
20	Chesapeake Energy Corp.	123.6
	Total	**30,736.4**

and US gas production grew almost 10% from a year earlier.

Financial performance

The OGJ200 group recorded improved combined financial results in each category except earnings. The companies' yearend 2007 assets and stockholders' equity both increased 14% from a year earlier.

The combined revenues of the OGJ200 companies climbed 7% from 2006, but their net income declined 2.5%, partly dragged lower by the high cost of labor, supplies, services, and equipment.

Fifty of the companies in the OGJ200 group recorded positive but reduced earnings for 2007 compared to 2006. Meanwhile, 46 of the firms posted a net loss for 2007.

Strong oil price realizations pushed the group's 2007 revenues to $1.06 trillion, but gas prices on average were unchanged from a year earlier.

Last year, the average US wellhead price of crude was $66.52/bbl, up from the 2006 average price of $59.69/bbl. Last year's average US wellhead price of gas, meanwhile, was $6.39/Mcf, vs. $6.40/Mcf a year earlier.

Refining margins were relatively strong last year but were mixed in comparison to their 2006 averages. The relative strength of these cash refining margins helped increase earnings for the integrated companies in the OGJ200 during both 2006 and 2007. These gains, however, were tempered by a higher average refiners' acquisition cost of crude.

The US Midwest cash refining margin last year climbed 23% to average $18.75/bbl, according to Muse, Stancil & Co. Over the same period, the margin on the West Coast declined almost 13% to average $20.96/bbl last year.

The composite US refiners' acquisition cost of crude during 2007 averaged $67.93/bbl, up from $60.24/bbl a year earlier.

ConocoPhillips reported a decline in 2007 net income to $11.9 billion, including a second-quarter, after-tax

TOP 20 IN LIQUIDS PRODUCTION

Table 8

Rank	Company	US liquids production, million bbl
1	Chevron Corp.	168.0
2	ConocoPhillips	166.0
3	ExxonMobil Corp.	111.0
4	Occidental Petroleum Corp.	95.0
5	Anadarko Petroleum Corp.	64.0
6	Devon Energy Corp.	41.0
7	Apache Corp.	35.9
8	Marathon Oil Corp.	23.0
9	XTO Energy Inc.	22.1
10	Plains Exploration & Production Co.	18.1
11	Noble Energy Inc.	15.5
12	Hess Corp.	15.0
13	Kinder Morgan CO_2 Co. LP	15.0
14	Pioneer Natural Resources Co.	13.6
15	EOG Resources Inc.	13.0
16	Dominion Energy Inc.	11.6
17	Denbury Resources Inc.	10.2
18	Chesapeake Energy Corp.	9.9
19	Whiting Petroleum Corp.	9.6
20	Encore Acquisition Co.	9.5
	Total	**867.1**

Rank	Company	Worldwide liquids production, million bbl
1	ExxonMobil Corp.	801.0
2	Chevron Corp.	641.0
3	ConocoPhillips	506.0
4	Occidental Petroleum Corp.	166.0
5	Hess Corp.	100.0
6	Anadarko Petroleum Corp.	96.0
7	Apache Corp.	95.6
8	Devon Energy Corp.	81.0
9	Marathon Oil Corp.	72.0
10	Noble Energy Inc.	30.8
11	Murphy Oil Corp.	28.7
12	XTO Energy Inc.	22.1
13	Plains Exploration & Production Co.	18.1
14	Pioneer Natural Resources Co.	16.2
15	EOG Resources Inc.	15.8
16	Kinder Morgan CO_2 Co. LP	15.0
17	Dominion Energy Inc.	12.2
18	Newfield Exploration Co.	10.4
19	Denbury Resources Inc.	10.2
20	Chesapeake Energy Corp.	9.9
	Total	**2,747.9**

TOP 20 IN GAS PRODUCTION

Table 9

Rank	Company	US gas production, bcf
1	ConocoPhillips	948.0
2	Anadarko Petroleum Corp.	698.0
3	Chesapeake Energy Corp.	655.0
4	ExxonMobil Corp.	641.0
5	Devon Energy Corp.	635.0
6	Chevron Corp.	620.0
7	XTO Energy Inc.	532.1
8	EOG Resources Inc.	438.9
9	Williams Cos. Inc.	334.0
10	Apache Corp.	280.9
11	El Paso Corp.	238.0
12	Occidental Petroleum Corp.	216.0
13	Dominion Energy Inc.	206.0
14	Newfield Exploration Co.	185.2
15	Marathon Oil Corp.	174.0
16	Noble Energy Inc.	150.5
17	Pioneer Natural Resources Co.	132.8
18	Questar Corp.	121.9
19	Cimarex Energy Co.	119.9
20	Southwestern Energy Co.	109.9
	Total	**7,437.1**

Rank	Company	Worldwide gas production, bcf
1	ExxonMobil Corp.	2,683.0
2	ConocoPhillips	2,110.0
3	Chevron Corp.	1,832.0
4	Devon Energy Corp.	863.0
5	Anadarko Petroleum Corp.	698.0
6	Chesapeake Energy Corp.	655.0
7	EOG Resources Inc.	637.7
8	XTO Energy Inc.	532.1
9	Williams Cos. Inc.	334.0
10	Marathon Oil Corp.	319.0
11	Occidental Petroleum Corp.	261.0
12	Noble Energy Inc.	250.9
13	El Paso Corp.	242.0
14	Hess Corp.	241.0
15	Dominion Energy Inc.	214.0
16	Apache Corp.	204.9
17	Newfield Exploration Co.	185.2
18	Pioneer Natural Resources Co.	151.1
19	Questar Corp.	121.9
20	Cimarex Energy Co.	119.9
	Total	**12,655.7**

impairment of $4.5 billion related to the expropriation of the company's Venezuelan oil projects. For 2006, net income was $15.55 billion.

ConocoPhillips' revenues were up from 2006, and its refining and marketing earnings for 2007 were $5.9 billion, up from $4.5 billion a year earlier.

No. 11 El Paso Corp. posted a 134% jump in earnings for 2007 to $1.11 billion. In February 2007, the company closed the sale of its ANR Pipeline Co. and other assets. The company's operating revenue was up 9% year-on-year.

Fast growers

Lucas Energy Inc. is the fastest growing company in this edition of the OGJ200. With headquarters in Houston, Lucas Energy is ranked by assets at No. 132 and reported stockholders' equity of $7.4 million last year. Earnings climbed to $322,000 from $62,000 in 2006.

The list of fastest-growing companies ranks firms based on growth in stockholders' equity. For a company to appear on this list, it must have posted positive net income in both 2007 and 2006, and it must have had an increase in net income last year. Excluded from this list are limited partnerships, newly public companies, and subsidiaries. The list is limited to the top 20 fast growers.

ATP Oil & Gas Corp. is the second-fastest growing company in the list, posting a 763% boost in stockholders' equity last year. Gulfport Energy Corp., Arena Resources Inc., and Layne Christensen Co. complete the top 5 fastest growing firms.

The highest-ranking company by assets on the list of fast growers is Devon Energy Corp. Devon Energy is the sixteenth-fastest growing company in the OGJ200 and ranks No. 6 in terms of assets.

Six of the current fast growers were also on the list in the previous edition of the OGJ200, which was based on 2006 results (OGJ, Sept. 17, 2007, p. 20). These are Gulfport Energy, Arena Resources, Quicksilver Resources Inc., GMX Resources Inc., Range Resources Corp., and Denbury Resources Inc.

Top 20 companies

The 20 highest-ranking companies in terms of yearend-2007 assets posted results rather similar to the entire

Top 20 in gas reserves

Table 10

Rank	Company	US gas reserves, bcf
1	ExxonMobil Corp.	13,172.0
2	ConocoPhillips	12,634.0
3	Chesapeake Energy Corp.	10,137.3
4	XTO Energy Inc.	9,441.1
5	Anadarko Petroleum Corp.	8,504.0
6	Devon Energy Corp.	7,143.0
7	EOG Resources Inc.	5,180.2
8	Williams Cos. Inc.	4,143.0
9	Chevron Corp.	3,677.0
10	Pioneer Natural Resources Co.	2,903.1
11	Ultra Petroleum	2,842.7
12	Apache Corp.	2,699.0
13	Occidental Petroleum Corp.	2,672.0
14	Equitable Supply	2,669.9
15	El Paso Corp.	2,248.0
16	Noble Energy Inc.	1,840.4
17	Range Resources Corp.	1,832.8
18	Newfield Exploration Co.	1,810.0
19	Questar Corp.	1,668.5
20	Cabot Oil & Gas Corp.	1,560.0
	Total	**98,777.8**

Rank	Company	Worldwide gas reserves, bcf
1	ExxonMobil Corp.	32,610.0
2	ConocoPhillips	25,438.0
3	Chevron Corp.	22,140.0
4	Chesapeake Energy Corp.	10,137.3
5	XTO Energy Inc.	9,441.1
6	Devon Energy Corp.	8,994.0
7	Anadarko Petroleum Corp.	8,504.0
8	EOG Resources Inc.	7,745.1
9	Williams Cos. Inc.	4,143.0
10	Occidental Petroleum Corp.	3,843.0
11	Marathon Oil Corp.	3,450.0
12	Noble Energy Inc.	3,307.5
13	Pioneer Natural Resources Co.	2,964.4
14	Ultra Petroleum	2,842.7
15	Equitable Supply	2,669.9
16	Hess Corp.	2,668.0
17	Apache Corp.	2,445.8
18	El Paso Corp.	2,299.0
19	Range Resources Corp.	1,832.8
20	Newfield Exploration Co.	1,810.0
	Total	**159,285.5**

group. This subset of firms steers the list, having recorded 97% of the entire group's revenues for the year.

The top 20 companies also accounted for 89% of the entire group's assets and 93% of the OGJ200 group's worldwide liquids reserves. The 2007 net income of the top 20 firms declined 1.7% to a combined $101.7 billion on revenues of $1.03 trillion.

Pogo Producing is the only company that previously ranked among the top 20 companies—at No. 19—but no longer is there, having been acquired during 2007.

The one company that was able to join the top 20 in this edition of the OGJ200 is Plains E&P, which moved to No. 16 from No. 30 a year ago.

The market capitalization of this group of 20 firms as of Dec. 31, 2007, was $1.26 trillion. This is 25% higher than the market cap of the top 20 in the previous OGJ200.

Earnings leaders

The OGJ200 also ranks the companies by factors other than total assets, with top 20 rankings by earnings, revenues, capital spending, production, and other gauges.

With record 2007 net income of $40.6 billion, ExxonMobil by far led the OGJ200 group in earnings, followed by Chevron with $18.7 billion in net income. Occidental Petroleum Corp. reported $5.4 billion in net income for the year.

Some of the companies in the top 20 by net income list are not ranked in the top 20 by assets. These include Questar Corp., with earnings of $507 million. Based on its assets Questar is ranked at No. 22 overall, but reported the seventeenth-highest earnings.

No. 33 by assets, Quicksilver Resources Inc. is the eighteenth company among the earnings leaders, with record net income of $479.4 million for the year. The company reported higher production volumes, higher sales prices for oil and gas, and higher production costs from 2006.

Capex, drilling leaders

Leading the OGJ200 companies in 2007 capital and exploratory expenditures are ExxonMobil, Chevron, ConocoPhillips, Devon Energy, and Chesapeake Energy Corp.

Chesapeake Energy reported such spending of $5.3 billion and leads the group in the number of net wells drilled in the US for 2007. The Oklahoma City-based producer last year drilled 1,919 net wells in the US, focusing on onshore gas east of the Rocky Mountains.

The second-leading OGJ200 company in terms of 2007 drilling is XTO Energy Inc, with 1,073 net wells drilled in the US, followed by Devon Energy with 1,015 US net wells drilled.

Top 20 in reserves, production

The top three companies by assets—ExxonMobil, ConocoPhillips, and Chevron—also appear at the top of the rankings by US liquids production, worldwide liquids production, worldwide gas production, worldwide liquids reserves, and worldwide gas reserves, but not necessarily in the same order.

With 168 million bbl of output, Chevron leads the OGJ200 companies in terms of US liquids production. ExxonMobil tops the list of 2007 worldwide liquids production leaders with a total of 801 million bbl.

Kinder Morgan CO_2 Co. LP ranks at No. 43 in the OGJ200 by assets, but is thirteenth on the list of top 20 companies in terms of US liquids production and sixteenth in terms of worldwide liquids production. During 2007, Kinder Morgan CO_2 produced 15 million bbl of liquids, all in the US.

Regarding US gas, ConocoPhillips led producers with 948 bcf of US output last year. Meanwhile, ExxonMobil posted the most worldwide gas production among the OGJ200 companies with 2.683 tcf of output for the year.

ConocoPhillips also holds the most liquids reserves in the US. But ExxonMobil holds the most worldwide liquids reserves as well as the most gas reserves in the US and worldwide. ✦

OGJ200

Rank by total assets 2007	Rank by total assets 2006	Company	Total assets $1,000	Total revenue Rank	Total revenue $1,000	Net income Rank	Net income $1,000	Stockholders' equity Rank	Stockholders' equity $1,000	Capital & expl. spending Rank	Capital & expl. spending $1,000
1	1	ExxonMobil Corp.	242,082,000	1	404,552,000	1	40,610,000	1	121,762,000	1	20,853,000
2	2	ConocoPhillips	177,757,000	3	194,495,000	3	11,891,000	2	88,983,000	3	11,791,000
3	3	Chevron Corp.	148,786,000	2	220,904,000	2	18,688,000	3	77,088,000	2	16,678,000
4	4	Anadarko Petroleum Corp.	48,481,000	8	15,892,000	6	3,781,000	7	16,364,000	8	4,246,000
5	7	Marathon Oil Corp.	42,746,000	4	65,207,000	5	3,956,000	6	19,223,000	7	4,466,000
6	5	Devon Energy Corp.	41,456,000	9	11,362,000	7	3,606,000	5	22,006,000	4	6,158,000
7	6	Occidental Petroleum Corp.	36,519,000	6	20,013,000	4	5,400,000	4	22,823,000	10	3,497,000
8	9	Chesapeake Energy Corp.	30,734,000	11	7,815,000	11	1,451,000	9	12,130,000	5	5,305,000
9	10	Apache Corp.	28,634,651	10	9,977,858	8	2,812,358	8	15,377,979	6	4,802,343
10	11	Hess Corp.	26,131,000	5	31,924,000	9	1,832,000	10	9,774,000	9	3,578,000
11	8	El Paso Corp.	24,579,000	13	[1] 4,648,000	12	1,110,000	13	5,280,000	14	2,495,000
12	13	XTO Energy Inc.	18,922,000	12	5,513,000	10	1,691,000	11	7,941,000	13	2,668,000
13	15	EOG Resources Inc.	12,088,907	14	[2] 4,190,791	13	1,089,918	12	6,990,094	11	3,401,986
14	14	Noble Energy Inc.	10,830,896	16	3,272,030	14	943,870	15	4,808,807	19	1,414,515
15	17	Murphy Oil Corp.	10,535,849	7	18,439,098	15	766,529	14	5,066,174	16	1,949,219
16	30	Plains Exploration & Production Co.	9,693,351	23	1,279,162	37	158,751	17	3,338,247	28	770,409
17	12	Dominion Energy Inc.[3]	9,400,000	15	3,527,000	20	387,000	—	NA	24	937,000
18	16	Williams Cos. Inc.[4]	8,692,000	18	2,093,000	16	[1] 731,000	—	—	—	NA
19	18	Pioneer Natural Resources Co.	8,616,981	19	1,833,349	21	372,728	19	3,042,722	15	2,067,648
20	20	Newfield Exploration Co.	6,986,000	20	1,783,000	19	450,000	16	3,581,000	17	1,930,000
21	—	Exco Resources Inc.	5,955,771	30	906,510	52	49,656	30	1,115,742	12	2,847,000
22	21	Questar Corp.	5,944,200	17	2,740,900	17	507,400	20	2,577,900	20	1,398,300
23	25	Forest Oil Corp.	5,695,548	27	1,083,892	35	169,306	21	2,411,811	26	787,735
24	23	Helix Energy Solutions Group Inc.	5,452,353	21	[2] 1,767,445	23	320,478	23	1,846,566	23	943,596
25	22	Cimarex Energy Co.	5,362,794	22	1,431,166	22	346,469	18	3,259,287	21	1,021,456
26	24	Petrohawk Energy Corp.[2]	4,672,439	31	[1] 883,405	50	52,897	22	2,008,897	29	764,311
27	26	Range Resources Corp.	4,016,508	33	862,091	30	230,569	24	1,728,022	27	782,398
28	31	Southwestern Energy Co.	3,622,716	24	[1] 1,255,131	31	221,174	25	1,646,500	18	1,519,433
29	28	Cheniere Energy Inc.	2,962,299	79	83,282	143	(181,777)	134	(302,114)	—	—
30	29	Whiting Petroleum Corp.	2,952,011	37	818,718	41	130,600	26	1,490,826	36	497,988
31	27	W&T Offshore Inc.	2,822,334	26	1,113,749	38	144,300	29	1,151,340	44	359,376
32	34	Encore Acquisition Co.	2,784,561	39	754,945	66	17,155	34	948,155	46	335,897
33	36	Quicksilver Resources Inc.	2,775,846	47	561,258	18	479,378	32	1,068,355	22	1,020,684
34	32	Denbury Resources Inc.	2,771,077	29	971,950	28	253,147	28	1,404,378	34	613,659
35	35	St. Mary Land & Exploration Co.	2,571,680	28	990,840	32	189,712	37	863,345	33	637,748
36	37	Comstock Resources Inc.	2,354,387	41	688,462	45	68,901	42	771,644	30	743,041
37	46	ATP Oil & Gas Corp.	2,307,133	43	615,538	53	48,620	53	309,866	25	849,491
38	42	Equitable Supply	2,262,851	49	501,675	26	[1] 263,545	—	—	31	715,722
39	44	Penn Virginia Corp.	2,253,461	34	856,601	51	50,754	40	810,098	39	421,509
40	40	Cabot Oil & Gas Corp.	2,208,594	40	[1] 732,170	36	167,423	31	1,070,257	35	596,983
41	38	Unit Corp.	2,199,819	25	1,158,754	25	266,258	27	1,434,817	37	478,950
42	41	Energen Resources Corp.[8]	2,065,229	35	[1] 825,592	24	[1] 273,200	—	—	43	379,479
43	39	Kinder Morgan CO_2 Co. LP	2,004,500	36	824,100	29	252,800	—	—	42	382,500
44	45	Swift Energy Co.	1,969,051	42	654,121	64	21,287	39	836,054	41	398,295
45	33	Stone Energy Corp.	1,889,603	38	765,387	34	181,436	35	885,802	56	227,651
46	71	Atlas America Inc.[4]	1,821,631	59	206,382	33	182,198	—	NA	60	187,483
47	47	Ultra Petroleum	1,776,200	46	567,725	27	263,036	38	853,579	32	697,800
48	69	McMoran Exploration Co.	1,715,288	50	481,167	139	(59,734)	49	372,229	64	153,210
49	50	Berry Petroleum Co.	1,452,106	44	583,457	42	129,928	45	459,974	52	281,702
50	53	CNX Gas Corp.	1,380,703	51	477,308	40	135,678	33	1,023,237	45	357,199
51	—	Continental Resources Inc.	1,365,173	45	582,215	60	28,580	43	623,132	38	477,663
52	48	Rosetta Resources Inc.	1,357,214	55	365,163	47	57,205	36	872,955	50	284,541
53	51	Bill Barrett Corp.	1,329,687	54	392,661	61	26,754	41	773,511	40	414,925
54	49	Seneca Resources Corp.[9, 10]	1,326,073	56	333,942	44	74,889	—	—	67	146,687
55	52	Fidelity Exploration & Production Co.[11]	1,299,406	48	[1] 514,854	39	142,485	—	—	51	283,589
56	55	Delta Petroleum Corp.	1,105,195	61	164,190	142	(149,347)	44	508,405	47	332,450
57	56	Petroleum Development Corp.	1,050,479	57	307,897	59	33,209	48	395,526	54	238,988
58	57	Clayton Williams Energy Inc.	861,096	53	393,895	79	5,990	66	160,806	57	223,453
59	54	Energy Partners Ltd.	814,856	52	456,239	140	(79,955)	71	101,970	48	323,846
60	59	Callon Petroleum Co.	792,482	60	[1] 170,768	69	15,194	56	287,075	70	127,409
61	73	Edge Petroleum Corp.	774,505	62	161,279	76	6,572	46	434,776	68	142,393
62	58	Belden & Blake Corp.	774,225	66	125,656	136	(35,322)	70	102,223	91	23,306
63	64	Carrizo Oil & Gas Inc.	709,670	65	126,480	68	15,469	52	310,721	53	247,003
64	—	Layne Christensen Co.[12]	696,955	32	868,274	57	37,256	47	423,372	79	68,043
65	67	Quest Resource Inc.[13]	681,610	67	123,295	134	(30,414)	74	91,853	76	103,076
66	63	PetroQuest Energy Inc.	644,347	58	263,674	55	40,619	55	302,317	55	233,436
67	97	Dune Energy Inc.	616,632	78	84,334	133	(28,401)	133	(30,162)	65	152,604
68	65	Goodrich Petroleum Corp.	590,118	72	111,305	137	(45,033)	57	283,615	49	291,486
69	68	Parallel Petroleum Corp.	563,093	69	116,228	117	(4,661)	61	235,262	66	149,298
70	62	Brigham Exploration Co.	548,428	68	119,635	71	10,210	58	279,027	69	132,932

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Worldwide 2007 liquids — production — Rank	Mill bbl	Worldwide 2007 natural gas — production — Rank	Bcf	Worldwide 2007 liquids — reserves — Rank	Mill bbl	Worldwide 2007 natural gas — reserves — Rank	Bcf	US 2007 liquids — production — Rank	Mill bbl	US 2007 natural gas — production — Rank	Bcf	US 2007 liquids — reserves — Rank	Mill bbl	US 2007 natural gas — reserves — Rank	Bcf	US 2007 net wells — drilled — Rank	Wells
1	801.0	1	2,683.0	1	7,744.0	1	32,610.0	3	111.0	4	641.0	2	1,851.0	1	13,172.0	14	486.0
3	506.0	2	2,110.0	3	6,320.0	2	25,438.0	2	166.0	1	948.0	1	2,242.0	2	12,634.0	8	823.0
2	641.0	3	1,832.0	2	7,087.0	3	22,140.0	1	168.0	6	620.0	4	1,624.0	9	3,677.0	7	892.0
6	96.00	5	698.0	6	1,014.0	7	8,504.0	5	64.00	2	698.0	5	662.0	5	8,504.0	5	926.5
9	72.00	10	319.0	9	650.0	11	3,450.0	8	23.00	15	174.0	16	166.0	27	1,007.0	33	215.0
8	81.00	4	863.0	7	998.0	6	8,994.0	6	41.00	5	635.0	7	452.0	6	7,143.0	3	1,015.1
4	166.0	11	261.0	4	2,228.0	10	3,843.0	4	95.00	12	216.0	3	1,707.0	13	2,672.0	15	476.2
20	9.882	6	655.0	20	123.6	4	10,137.3	18	9.882	3	655.0	20	123.6	3	10,137.3	1	1,919.0
7	95.57	16	204.9	5	1,133.7	17	2,445.8	7	35.94	10	280.9	6	551.6	12	2,699.0	28	287.5
5	100.0	14	241.0	8	885.0	16	2,668.0	12	15.00	39	38.00	13	204.0	49	270.0	59	56.00
27	7.821	13	242.0	27	92.50	18	2,299.0	25	7.664	11	238.0	30	59.79	15	2,248.0	17	465.0
12	22.10	8	532.1	13	308.0	5	9,441.1	9	22.10	7	532.1	11	308.0	4	9,441.1	2	1,073.3
15	15.84	7	637.7	16	179.3	8	7,745.1	15	13.04	8	438.9	17	160.0	7	5,180.2	4	938.3
10	30.76	12	250.9	12	329.0	12	3,307.5	11	15.45	16	150.5	12	207.4	16	1,840.4	10	803.9
11	28.70	48	24.30	17	178.2	35	590.8	32	4.800	55	17.10	41	31.20	70	113.3	97	5.200
13	18.13	45	29.55	11	436.5	24	1,520.0	10	18.13	44	29.55	9	436.5	21	1,520.0	34	214.1
17	12.19	15	214.0	58	12.61	28	1,019.0	16	11.63	13	206.0	58	12.61	26	1,019.0	9	814.0
—	—	9	[5]334.0	—	—	9	[5]4,143.0	—	—	9	[5]334.0	—	—	8	[5]4,143.0	6	904.0
14	16.19	18	151.1	10	469.7	13	2,964.4	14	13.58	17	132.8	8	451.1	10	2,903.1	12	619.0
18	10.40	17	185.2	22	114.4	20	1,810.0	24	7.800	14	185.2	24	95.20	18	1,810.0	23	342.9
134	0.002	124	0.111	132	0.021	121	1.740	133	0.002	124	0.111	131	0.021	120	1.740	20	405.2
39	3.000	19	121.9	40	33.20	21	1,668.5	39	3.000	18	121.9	39	33.20	19	1,668.5	37	202.8
26	7.945	23	108.0	25	94.48	23	1,552.4	29	6.885	24	82.96	26	87.16	23	1,287.9	29	286.0
35	3.723	37	[6]42.46	38	39.68	40	[6]439.0	35	3.723	35	[6]42.16	37	39.63	38	[6]424.7	75	19.30
28	7.446	20	119.9	32	58.25	26	1,122.7	26	7.446	19	119.9	31	58.25	24	1,122.7	30	281.3
40	2.816	24	99.51	51	17.74	29	955.2	40	2.816	22	99.51	51	17.74	28	955.2	36	206.5
33	4.505	25	90.62	30	66.66	19	1,832.8	33	4.505	23	90.62	29	66.66	17	1,832.8	11	698.2
63	0.614	21	109.9	63	8.912	25	1,396.9	63	0.614	20	109.9	63	8.912	22	1,396.9	26	306.8
122	0.009	104	0.610	135	0.009	125	1.260	121	0.009	104	0.610	134	0.009	124	1.260	104	[7]3.000
21	9.579	44	30.76	14	196.3	49	326.7	19	9.579	43	30.76	14	196.3	46	326.7	41	138.6
24	8.301	28	76.73	34	51.00	48	332.8	22	8.301	27	76.73	33	51.00	45	332.8	93	6.000
22	9.545	49	23.96	15	188.6	52	256.4	20	9.545	47	23.96	15	188.6	50	256.4	49	89.00
38	3.055	33	59.62	26	93.14	30	900.8	38	3.050	38	38.89	25	93.13	31	662.4	19	432.8
19	10.19	42	35.46	18	135.0	45	358.6	17	10.19	41	35.46	18	135.0	42	358.6	45	106.4
30	6.907	30	66.06	29	78.85	33	613.5	28	6.907	29	66.06	27	78.85	32	613.5	27	304.2
42	2.679	29	71.42	39	35.14	32	837.9	42	2.679	28	71.42	38	35.14	30	837.9	42	138.2
34	4.498	41	37.01	31	59.89	46	356.2	34	4.475	46	24.93	36	42.34	59	187.6	90	8.000
85	0.119	26	82.40	86	2.091	15	2,669.9	85	0.119	25	82.40	86	2.091	14	2,669.9	18	456.3
68	0.461	40	37.80	55	15.22	36	588.3	68	0.461	40	37.80	55	15.22	34	588.3	35	213.0
58	0.830	27	80.48	62	9.328	22	1,560.0	58	0.830	26	80.48	62	9.328	20	1,560.0	21	385.7
46	1.876	36	43.46	53	15.83	41	419.6	45	1.876	34	43.46	53	15.83	39	419.6	47	96.64
32	5.718	31	64.23	23	106.3	27	1,115.9	31	5.718	30	64.23	22	106.3	25	1,115.9	40	158.5
16	14.99	112	0.290	19	132.5	129	1.078	13	14.99	112	0.290	19	132.5	128	1.078	69	31.00
25	8.221	50	22.70	28	84.46	44	394.0	23	7.820	56	16.78	28	76.48	44	343.8	56	67.60
31	6.088	35	45.09	41	31.59	57	213.1	30	6.088	33	45.09	40	31.59	55	213.1	78	15.04
82	0.153	52	20.96	87	1.983	31	884.8	82	0.153	49	20.96	87	1.983	29	884.8	16	473.8
45	2.023	22	109.2	49	22.83	14	2,842.7	56	0.870	21	109.2	49	22.83	11	2,842.7	53	76.11
41	2.745	39	38.99	50	19.72	54	245.6	41	2.745	37	38.99	50	19.72	52	245.6	101	4.314
29	7.210	59	15.66	21	116.6	50	315.5	27	7.210	59	15.66	21	116.6	47	315.5	25	322.0
—	—	131	[5]0.058	—	—	123	[5]1.340	—	—	131	[5]0.058	—	—	122	[5]1.340	22	374.0
23	8.699	65	11.53	24	104.1	61	182.8	21	8.699	65	11.53	23	104.1	60	182.8	44	112.1
66	0.561	38	42.00	81	3.021	43	400.0	66	0.561	36	42.00	81	3.021	41	400.0	39	169.3
64	0.586	34	57.68	78	3.222	37	538.3	64	0.586	32	57.68	78	3.222	35	538.3	38	173.5
36	3.450	46	26.27	35	47.59	59	205.4	36	3.244	52	19.84	34	47.59	57	205.4	32	257.5
44	2.365	32	62.80	42	30.61	38	523.7	44	2.365	31	62.80	42	30.61	36	523.7	24	342.0
51	1.085	66	11.25	59	11.03	51	309.5	50	1.085	66	11.25	59	11.03	48	309.5	51	81.16
56	0.910	51	22.51	54	15.34	34	593.6	55	0.910	48	22.51	54	15.34	33	593.6	31	276.3
43	2.531	53	20.68	45	27.95	67	123.2	43	2.531	50	20.68	45	27.95	66	123.2	63	41.90
37	3.201	43	33.64	44	28.12	73	103.1	37	3.201	42	33.64	44	28.12	73	103.1	76	16.90
53	1.063	63	12.34	47	24.53	70	116.5	52	1.063	63	12.34	47	24.53	69	116.5	112	1.470
50	1.097	55	17.54	65	7.819	69	116.6	49	1.097	53	17.54	65	7.819	68	116.6	71	27.32
73	0.348	60	13.36	73	5.149	55	227.2	73	0.348	60	13.36	73	5.149	53	227.2	48	92.00
76	0.241	57	16.04	52	16.53	53	248.4	76	0.241	57	16.04	52	16.53	51	248.4	73	25.00
139	—	78	4.732	—	—	84	50.27	—	—	78	4.732	—	—	84	50.266	46	104.0
123	0.007	56	17.15	126	0.037	58	210.9	122	0.007	54	17.15	125	0.037	56	210.9	13	571.0
52	1.080	47	[6]24.97	84	2.342	66	[6]142.5	51	1.080	45	[6]24.97	84	2.342	65	[6]142.5	67	37.02
65	0.580	74	5.539	61	9.631	68	117.6	65	0.580	74	5.539	61	9.631	67	117.6	68	32.10
77	0.207	58	15.81	88	1.810	47	346.9	77	0.207	58	15.81	88	1.810	43	346.9	54	76.10
54	1.051	72	7.422	43	28.43	81	57.23	53	1.051	72	7.422	43	28.43	81	57.234	62	47.60
71	0.392	62	12.63	72	5.593	71	106.6	71	0.392	62	12.63	72	5.593	71	106.6	85	10.90

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Rank by total assets 2007	Rank by total assets 2006	Company	Total assets $1,000	Total revenue Rank	Total revenue $1,000	Net income Rank	Net income $1,000	Stockholders' equity Rank	Stockholders' equity $1,000	Capital & expl. spending Rank	Capital & expl. spending $1,000
71	66	Meridian Resource Corp.	483,775	63	152,178	75	7,137	51	325,430	72	116,696
72	76	Legacy Reserves LP	481,578	71	112,557	138	(55,662)	60	255,730	59	196,031
73	72	Warren Resources Inc.	440,506	84	61,648	70	11,405	50	349,529	75	103,189
74	70	Black Hills Corp.[4]	432,839	75	[1] 101,522	63	25,437	—	—	78	72,153
75	80	Gulfport Energy Corp.	419,137	74	106,361	56	37,775	54	304,122	58	220,501
76	90	Crimson Exploration Inc.	398,736	73	109,543	145	(430,517)	77	69,653	81	59,049
77	78	GMX Resources Inc.	395,340	82	68,109	67	16,885	62	208,926	61	174,509
78	60	DTE Gas & Oil Co.[14]	355,000	145	[1] (228,000)	144	(217,000)	—	—	63	161,000
79	86	TXCO Resources Inc.	354,607	77	94,235	91	1,340	64	174,716	71	117,311
80	82	Arena Resources Inc.	349,322	76	100,975	58	34,442	59	257,811	62	168,583
81	75	PrimeEnergy Corp.	296,082	64	147,152	73	7,590	82	50,285	74	106,601
82	—	Rex Energy Corp.	268,264	86	57,794	128	(16,211)	65	164,437	87	32,678
83	77	Aurora Oil & Gas Corp.	254,672	93	28,456	116	(4,422)	69	132,143	82	51,956
84	—	Approach Resources Inc.	248,726	90	39,114	85	2,709	63	199,819	83	51,845
85	119	GeoResources Inc.	240,358	88	40,115	84	3,069	79	68,031	73	110,148
86	81	NGAS Resources Inc.	204,801	80	70,526	102	(817)	72	99,909	—	—
87	85	Cano Petroleum Inc.[15]	201,469	92	28,606	101	(790)	78	68,861	85	39,639
88	—	Platinum Energy Resources Inc.	198,389	122	4,308	100	(373)	68	140,967	117	1,714
89	83	Dorchester Minerals LP	154,251	83	[1] 65,365	54	43,048	67	[16] 153,447	134	12
90	89	Contango Oil & Gas Co.[15]	153,936	97	19,574	111	(2,695)	75	90,804	77	77,547
91	88	Abraxas Petroleum Corp.	147,119	87	48,717	49	56,702	80	55,847	89	26,908
92	84	Gasco Energy Inc.	122,512	96	22,198	141	(104,373)	91	25,248	80	63,509
93	87	HKN Inc.	110,465	94	24,298	83	3,229	73	99,766	96	10,867
94	92	American Oil & Gas Inc.	88,091	129	1,969	112	(2,743)	76	84,877	93	15,841
95	94	Double Eagle Petroleum Co.[17]	84,597	99	17,197	125	(11,603)	89	28,624	84	42,307
96	—	Foothills Resources Inc.	78,624	102	15,427	132	(26,028)	104	10,694	101	7,908
97	91	Panhandle Oil and Gas Inc.[10]	78,540	89	39,129	77	6,343	81	53,681	88	27,785
98	102	Teton Energy Corp.	78,299	95	24,119	87	2,377	83	49,028	86	35,635
99	125	Petro Resources Corp.	66,363	114	7,192	120	(5,539)	86	39,724	94	14,266
100	101	Credo Petroleum Corp.[18]	55,349	100	16,993	78	6,091	85	41,140	97	9,144
101	93	New Century Energy Corp.	54,058	105	13,684	129	(19,187)	132	(22,862)	115	2,059
102	105	Westside Energy Corp.	52,684	116	6,799	127	(15,778)	105	10,452	90	24,776
103	—	PetroSearch Energy Corp.	49,037	128	2,059	123	(6,535)	95	20,194	98	9,082
104	103	FX Energy Inc.	46,369	98	18,429	126	(11,691)	87	37,542	102	7,517
105	—	GeoPetro Resources Co.	44,117	115	7,065	106	(1,617)	84	41,701	105	5,214
106	100	Galaxy Energy Corp.[19]	43,797	141	507	130	(20,020)	130	(10,581)	113	2,129
107	96	Infinity Energy Resouces Inc.	42,300	108	9,426	135	(30,842)	113	7,725	92	17,109
108	99	Evolution Petroleum Corp.[15]	34,906	123	3,788	62	25,698	88	32,783	123	418
109	109	Tengasco Inc.[20]	34,282	109	9,369	82	3,510	90	28,103	125	172
110	106	Royale Energy Inc.	32,571	101	16,557	113	(2,779)	99	12,385	99	8,835
111	110	San Juan Basin Royalty Trust	28,923	70	115,205	43	113,221	96	19,881	—	NA
112	107	New Frontier Energy Inc.[21]	26,210	137	1,120	122	(6,402)	93	21,164	104	5,494
113	111	Adams Resources & Energy Inc.[4]	25,267	104	[1] 13,783	72	[1] 9,225	—	NA	95	13,490
114	108	Tri-Valley Corp.	25,255	106	11,016	124	(8,607)	100	12,112	103	5,854
115	118	Reserve Petroleum Co.	24,883	103	[1] 14,333	74	7,528	92	22,552	109	3,878
116	115	Aspen Exploration Corp.[15]	21,139	120	4,555	93	925	102	11,006	112	2,420
117	113	Houston American Energy Corp.	20,715	117	5,627	96	493	94	20,243	—	—
118	112	Cross Timbers Royalty Trust	20,148	91	33,722	65	[22] 19,806	97	[23] 18,388	—	NA
119	114	EnDevCo Inc.	18,988	131	1,872	119	(5,523)	129	(6,753)	119	1,408
120	121	Cubic Energy Inc.[15]	18,108	140	583	121	(5,801)	107	8,795	108	4,017
121	—	Pegasi Energy Resources Corp.	17,993	127	2,601	109	(2,182)	111	7,916	120	1,077
122	116	Daleco Resources Corp.[10]	16,700	136	1,140	118	(4,941)	109	8,594	130	63
123	122	Spindletop Oil & Gas Co.	15,631	110	8,707	88	1,808	106	9,515	110	2,940
124	124	Basic Earth Science Systems Inc.[20]	15,452	113	7,217	86	2,500	101	11,080	116	1,741
125	127	John D. Oil and Gas Co.	15,403	124	3,321	103	(898)	123	2,016	100	7,971
126	—	Index Oil and Gas Inc.[20]	15,180	139	802	110	(2,226)	98	14,324	107	4,099
127	126	FieldPoint Petroleum Corp.	14,260	121	4,422	95	558	108	8,617	124	418
128	132	Pioneer Oil & Gas[10]	11,746	107	10,387	80	5,290	103	10,936	—	—
129	104	Petrol Oil & Gas Inc.	11,502	118	5,566	131	(22,935)	131	(16,334)	122	468
130	123	Blue Dolphin Energy Co.	10,944	125	3,260	107	(1,626)	110	8,230	128	112
131	141	Lucas Energy Inc.	10,425	133	1,347	97	322	115	7,444	106	4,859
132	128	Mexco Energy Corp.[20]	9,959	126	2,976	94	608	112	7,776	118	1,545
133	134	Permian Basin Royalty Trust	9,467	81	68,508	46	[22] 67,619	125	[23] 1,294	—	—
134	—	Daybreak Oil & Gas Inc.	9,211	142	410	115	(4,266)	118	6,667	—	—
135	131	Texas Vanguard Oil Co.	8,499	112	7,404	90	1,354	116	7,210	121	811
136	133	Pyramid Oil Co.	8,460	119	5,030	89	1,495	119	6,604	114	2,085
137	129	Apache Offshore Investment Partnership	8,308	111	7,783	81	4,834	117	[16] 6,960	126	154
138	130	Oakridge Energy Inc.[21]	8,203	132	1,782	99	72	114	7,483	133	59
139	135	Sabine Royalty Trust	6,624	85	59,258	48	[22] 57,060	120	[23] 5,823	—	—
140	—	Knight Energy Corp.	4,783	135	1,153	114	(3,549)	121	2,971	111	2,485

Worldwide 2007 liquids — production — Rank	Mill bbl	Worldwide 2007 natural gas — production — Rank	Bcf	Worldwide 2007 liquids — reserves — Rank	Mill bbl	Worldwide 2007 natural gas — reserves — Rank	Bcf	US 2007 liquids — production — Rank	Mill bbl	US 2007 natural gas — production — Rank	Bcf	US 2007 liquids — reserves — Rank	Mill bbl	US 2007 natural gas — reserves — Rank	Bcf	US 2007 net wells — drilled — Rank	Wells
57	0.838	61	13.24	74	4.856	79	61.33	57	0.838	61	13.24	74	4.856	79	61.329	86	10.80
49	1.305	81	3.052	48	23.61	83	50.86	48	1.305	81	3.052	48	23.61	83	50.860	81	13.00
59	0.825	93	1.255	33	53.11	86	37.77	59	0.825	93	1.255	32	53.11	86	37.768	57	62.90
70	0.409	64	11.70	70	5.807	62	173.0	70	0.409	64	11.70	70	5.807	61	173.0	66	37.85
47	1.501	100	0.816	46	25.12	93	24.26	46	1.501	100	0.816	46	25.12	93	24.259	65	38.00
62	0.695	68	9.068	68	6.463	75	91.24	62	0.695	68	9.068	68	6.463	75	91.239	102	3.440
84	0.127	70	7.974	75	4.693	42	406.3	84	0.127	70	7.974	75	4.693	40	406.3	77	16.00
—	—	71	[5]7.700	—	—	56	[5]219.0	—	—	71	[5]7.700	—	—	54	[5]219.0	61	50.00
55	0.974	86	2.125	64	8.242	85	42.30	54	0.974	86	2.125	64	8.242	85	42.300	70	30.82
48	1.316	91	1.504	36	47.41	39	487.1	47	1.316	91	1.504	35	47.41	37	487.1	43	[7]134.0
67	0.490	67	10.63	71	5.600	82	53.07	67	0.490	67	10.63	71	5.600	82	53.069	80	14.26
60	0.814	95	1.160	57	12.78	98	18.55	60	0.814	95	1.160	57	12.78	97	18.549	55	68.30
107	0.028	82	3.034	118	0.188	63	165.5	106	0.028	82	3.034	117	0.188	62	165.5	58	59.13
90	0.084	77	4.801	79	3.208	64	161.2	90	0.084	77	4.801	79	3.208	63	161.2	60	50.70
72	0.391	90	1.648	60	10.74	90	29.81	72	0.391	90	1.648	60	10.74	90	29.810	92	6.240
97	0.058	83	2.951	107	0.500	74	102.2	96	0.058	83	2.951	105	0.500	74	102.2	50	82.20
75	0.283	92	1.441	37	42.33	65	146.3	75	0.283	92	1.441	10	423.3	64	146.3	52	80.00
104	0.039	121	0.126	67	6.526	95	21.81	103	0.039	121	0.126	67	6.526	95	21.812	—	NA
74	0.316	69	8.264	77	3.566	80	61.26	74	0.316	69	8.264	77	3.566	80	61.255	—	NA
103	0.039	85	2.452	94	1.164	77	77.89	102	0.039	85	2.452	93	1.164	77	77.892	83	12.50
78	0.197	73	5.568	80	3.131	76	88.00	78	0.197	73	5.568	80	3.131	76	88.003	98	5.200
102	0.041	79	4.012	96	1.071	72	104.3	101	0.041	79	4.012	95	1.071	72	104.3	87	10.10
81	0.172	97	0.986	83	2.369	108	5.020	81	0.172	97	0.986	83	2.369	107	5.020	116	0.740
114	0.017	115	0.140	120	0.150	124	1.307	114	0.017	115	0.140	119	0.150	123	1.307	95	5.510
119	0.013	84	2.928	109	0.413	78	71.25	118	0.013	84	2.928	107	0.413	78	71.254	64	39.34
79	0.185	118	0.135	76	4.174	96	21.80	79	0.185	118	0.135	76	4.174	96	21.803	103	3.000
87	0.107	75	5.116	99	0.823	87	37.01	87	0.107	75	5.116	98	0.823	87	37.006	91	7.900
113	0.017	96	1.128	122	0.129	103	13.31	112	0.017	96	1.128	121	0.129	102	13.308	72	25.09
89	0.099	114	0.152	82	2.370	120	2.082	89	0.099	114	0.152	82	2.370	119	2.082	99	5.000
100	0.051	88	1.926	105	0.591	100	16.97	99	0.051	88	1.926	103	0.591	99	16.973	89	8.591
83	0.146	107	0.453	91	1.613	114	3.041	83	0.146	107	0.453	91	1.613	113	3.041	82	13.00
108	0.024	101	0.795	117	0.213	99	17.39	107	0.024	101	0.795	116	0.213	98	17.388	94	5.900
117	0.014	119	0.135	90	1.712	118	2.683	117	0.014	119	0.135	90	1.712	117	2.683	79	15.00
91	0.079	—	—	102	0.617	97	19.79	91	0.079	—	—	108	0.408	—	—	114	1.000
141	—	89	1.755	—	—	94	23.14	—	—	89	1.755	—	—	94	23.139	113	1.000
142	—	122	0.114	138	(s)	133	0.755	—	—	123	0.114	138	(s)	132	0.755	111	1.640
98	0.056	98	0.941	104	0.594	110	4.233	97	0.056	98	0.941	102	0.594	109	4.233	84	11.00
106	0.029	—	NA	95	1.084	111	3.838	105	0.029	—	—	94	1.084	110	3.838	—	—
80	0.185	120	0.127	85	2.276	127	1.134	80	0.185	120	0.127	85	2.276	126	1.134	88	9.250
118	0.014	102	0.791	129	0.024	112	3.772	116	0.014	102	0.791	128	0.024	111	3.772	106	2.900
105	0.035	54	20.12	110	0.388	60	194.9	104	0.035	51	20.12	109	0.388	58	194.9	—	NA
140	—	116	0.140	—	—	101	15.56	—	—	116	0.140	—	—	100	15.561	96	5.330
93	0.069	94	1.182	113	0.297	106	7.068	92	0.069	94	1.182	112	0.297	105	7.068	110	1.970
124	0.007	135	0.046	111	0.372	132	0.791	123	0.007	135	0.046	110	0.372	131	0.791	100	[7]5.000
95	0.062	110	0.345	115	0.291	122	1.664	94	0.062	110	0.345	114	0.291	121	1.664	108	2.150
132	0.004	105	0.598	121	0.130	117	2.701	130	0.004	105	0.598	120	0.130	116	2.701	105	2.930
92	0.071	136	0.044	93	1.285	142	0.136	134	0.002	136	0.044	136	0.004	141	0.136	—	—
86	0.111	87	2.073	89	1.737	91	27.66	86	0.111	87	2.073	89	1.737	91	27.659	—	—
112	0.021	132	0.056	56	13.06	88	35.85	110	0.021	132	0.056	56	13.06	88	35.851	—	—
135	0.001	130	0.070	133	0.013	109	4.242	135	0.001	130	0.070	132	0.013	108	4.242	—	—
128	0.005	126	0.093	108	0.455	104	11.59	127	0.005	127	0.093	106	0.455	103	11.594	—	—
129	0.005	128	0.079	123	0.085	135	0.669	129	0.005	128	0.079	122	0.085	134	0.669	—	—
109	0.024	99	0.881	112	0.345	102	14.37	108	0.024	99	0.881	111	0.345	101	14.367	—	NA
88	0.104	113	0.156	97	0.995	126	1.138	88	0.104	113	0.156	96	0.995	125	1.138	—	—
131	0.004	109	0.350	127	0.037	119	2.646	131	0.004	109	0.350	126	0.037	118	2.646	74	[7]23.00
126	0.006	138	0.008	130	0.024	136	0.541	126	0.006	138	0.008	129	0.024	135	0.541	115	0.841
101	0.048	117	0.139	98	0.885	116	2.743	100	0.048	117	0.139	97	0.885	115	2.743	—	—
127	0.006	123	0.114	128	0.033	130	0.917	125	0.006	122	0.114	127	0.033	129	0.917	—	NA
121	0.011	103	0.741	124	0.065	105	9.777	119	0.011	103	0.741	123	0.065	104	9.777	—	NA
136	(s)	129	0.073	137	0.001	141	0.178	137	(s)	129	0.073	137	0.001	140	0.178	—	—
111	0.021	142	0.002	92	1.583	145	0.042	111	0.021	142	0.002	92	1.583	144	0.042	—	—
115	0.017	111	0.339	116	0.220	107	6.905	113	0.017	111	0.339	115	0.220	106	6.905	117	0.220
61	0.740	80	3.478	66	7.256	92	26.30	61	0.740	80	3.478	66	7.256	92	26.302	—	—
125	0.007	134	0.050	134	0.013	144	0.066	124	0.007	134	0.050	133	0.013	143	0.066	—	NA
96	0.061	108	0.360	103	0.596	113	3.386	95	0.061	108	0.360	101	0.596	112	3.386	107	2.840
94	0.067	139	0.005	100	0.806	137	0.331	93	0.067	139	0.005	99	0.806	136	0.331	109	2.000
99	0.054	106	0.555	106	0.571	115	3.004	98	0.054	106	0.555	104	0.571	114	3.004	—	—
116	0.017	137	0.021	101	0.676	139	0.234	115	0.017	137	0.021	100	0.676	138	0.234	—	—
69	0.424	76	4.900	69	6.425	89	35.82	69	0.424	76	4.900	69	6.425	89	35.815	—	NA
120	0.011	127	0.093	119	0.165	131	0.815	120	0.011	126	0.093	118	0.165	130	0.815	—	NA

OGJ200

Rank by total assets 2007	Rank by total assets 2006	Company	Total assets $1,000	Total revenue Rank	Total revenue $1,000	Net income Rank	Net income $1,000	Stockholders' equity Rank	Stockholders' equity $1,000	Capital & expl. spending Rank	Capital & expl. spending $1,000
141	136	**Miller Petroleum Inc.**[24]	4,564	134	1,346	105	(1,544)	127	(906)	131	62
142	137	**GSV Inc.**	2,981	138	838	98	156	124	1,918	129	111
143	138	**LL & E Royalty Trust**	2,037	130	1,965	92	[22] 1,150	122	[23] 2,037	—	—
144	139	**Bayou City Exploration Inc.**	537	144	50	104	(1,464)	128	(911)	132	60
145	—	**EnerJex Resources Inc.**[20]	493	143	95	108	(2,003)	126	(44)	127	140
—	140	**Ness Energy International Inc.**[25]	—	—	NA	—	NA	—	—	—	NA
—	98	**PRB Energy Inc.**[25]	—	—	NA	—	NA	—	—	—	NA
		Total	**1,059,740,438**		**1,062,560,237**		**106,554,869**		**487,797,273**		**126,066,308**

NA = not available. (s) indicates less than 500 bbl or 500 Mcf. [1]Operating. [2]Net. [3]Subsidiary of Dominion Resources Inc. [4]Oil and gas operations only. [5]Includes some liquids. [6]Includes NGL. [7]Gross. [8]Subsidiary of Energen Co. [9]Subsidiary of National Fuel Gas Co. [10]Fiscal yearend Sept. 30. [11]Subsidiary of MDU Resources Group. [12]Fiscal yearend Jan. 31, 2008. [13]Fiscal yearend May 31. [14]Subsidiary of DTE Energy Inc.

Worldwide 2007 liquids — production — Rank	Mill bbl	Worldwide 2007 natural gas — production — Rank	Bcf	Worldwide 2007 liquids — reserves — Rank	Mill bbl	Worldwide 2007 natural gas — reserves — Rank	Bcf	US 2007 liquids — production — Rank	Mill bbl	US 2007 natural gas — production — Rank	Bcf	US 2007 liquids — reserves — Rank	Mill bbl	US 2007 natural gas — reserves — Rank	Bcf	US 2007 net wells — drilled — Rank	Wells
130	0.005	133	0.055	125	0.061	134	0.702	128	0.005	133	0.055	124	0.061	133	0.702	—	NA
133	0.003	125	0.094	136	0.004	143	0.127	132	0.003	125	0.094	135	0.004	142	0.127	—	—
110	0.023	141	0.003	114	0.294	138	0.319	109	0.023	141	0.003	113	0.294	137	0.319	—	—
137	(s)	140	0.005	131	0.024	128	1.089	136	(s)	140	0.005	130	0.024	127	1.089	—	—
143	—	143	(s)	—	—	140	0.230	—	—	143	(s)	—	—	139	0.230	—	NA
—	NA	—	NA	—	NA	—	NA	—	NA	—	NA	—	NA	—	NA	—	NA
—	NA	—	NA	—	NA	—	NA	—	NA	—	NA	—	NA	—	NA	—	NA
	2,909		**14,718**		**32,720**		**187,281**		**1,019**		**9,350**		**14,108**		**137,629**		**23,065.1**

[15]Fiscal yearend June 30. [16]Partners equity. [17]Fiscal yearend Aug. 31. [18]Fiscal yearend Oct. 31. [19]Fiscal yearend Nov. 30. [20]Fiscal yearend Mar. 31. [21]Fiscal yearend Feb. 29, 2008. [22]Distributable income. [23]Trust corpus. [24]Fiscal yearend Apr. 30. [25]Not filed at presstime.

OGJ100 group posts improved 2007 results

Marilyn Radler
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National oil companies continue to head the lists of the world's oil production and reserves leaders, according to Oil & Gas Journal's survey of the top 100 oil and gas producers based outside the US, but more nongovernment corporations are breaking into the leading-producer rankings.

The OGJ100 survey allows comparison of the performance of oil and gas companies around the world, with all available financial results reported in US dollars. But OGJ doesn't attempt to rank these entities by assets or earnings because many of the largest ones do not report financial results.

The companies are grouped by region according to the location of their corporate headquarters.

Production, reserves leaders

Worldwide production of crude oil, condensate, and NGL in 2007 averaged 85.6 million b/d, according to the International Energy Agency, up just 100,000 b/d from the 2006 average.

Topping the OGJ100 list of production leaders is Saudi Aramco, with total production of 3.1 billion bbl last year. This compares to its total output in 2006 of 3.25 billion bbl.

The second-highest producer in the OGJ100 group is National Iranian Oil Co. (NIOC), with 2007 oil production of 1.43 billion bbl. Petroleos Mexicanos was the third producer on the list, and Petroleos de Venezuela SA is No. 4.

BP PLC ranks as the No. 5 producer, with total 2007 production of 881 million bbl. Two corporations are new to the list of production leaders: Russia's Surgutneftegas and Norway's Statoil-Hydro.

Combined, the top 20 producers in the survey reported 17.6 billion bbl of oil output last year.

Aramco and NIOC also head the OGJ100 list of the top 20 oil reserves holders. The combined oil reserves of these top 20 firms are 1 trillion bbl, up 2% from the total for the group in last year's survey (OGJ, Sept. 17, 2007, p. 36).

The combined oil production of the 25 Canadian companies in the survey declined 7% to 694 million bbl last year.

Annual results

Most of the companies in the OGJ100 that report their annual earnings posted increases in revenues, net income, and capital and exploration spending during 2007 vs. 2006. The yearend-2007 assets of most of the firms also moved higher.

The largest Canadian company with $47 billion in assets at the end of last year, EnCana Corp. reported a 30% earnings decline for 2007, primarily due to the impact of financial hedges.

In Europe, Royal Dutch Shell PLC and BP lead in terms of size and earnings, but each reported a slight reduction in oil production for 2007 from a year earlier.

Ranked by assets, PetroChina is the largest of the Asia-Pacific companies in the OGJ100, followed by Malaysia's Petronas and Australia's BHP Billiton Petroleum.

In Latin America, state-owned PDVSA holds the most oil and gas reserves, but Petroleo Brasileiro SA (Petrobras) and Pemex rank higher in terms of total assets. While PDVSA and Petrobras reported earnings increases for 2007, Pemex posted a nearly $2 billion net loss for the year due to an increase in taxes and an increase in costs. ✦

OGJ100: OIL PRODUCTION AND RESERVE LEADERS

Rank	Company	Production, million bbl
1	Saudi Arabian Oil Co.	3,102.5
2	National Iranian Oil Co.	1,429.7
3	Petroleos Mexicanos	1,124.9
4	Petroleos de Venezuela SA	1,060.0
5	BP PLC	881.1
6	Abu Dhabi National Oil Co.	846.8
7	PetroChina Co. Ltd.	838.8
8	Nigerian National Petroleum Corp.	791.0
9	Kuwait Petroleum Corp.	788.4
10	Iraq National Oil Co.	759.2
11	OAO Rosneft	740.0
12	OAO Lukoil	713.0
13	Petroleo Brasileiro SA	700.2
14	Royal Dutch Shell	663.6
15	National Oil Corp. (Libya)	620.5
16	Sonangol	618.7
17	Total SA	550.8
18	Sonatrach	494.6
19	OJSC Surgutneftegas	474.3
20	StatoilHydro	391.0
Total		**17,589.1**

Rank	Company	Reserves, million bbl
1	Saudi Arabian Oil Co.	259,900.0
2	National Iranian Oil Co.	138,400.0
3	Iraq National Oil Co.	115,000.0
4	Kuwait Petroleum Corp.	101,500.0
5	Petroleos de Venezuela SA	99,377.0
6	Abu Dhabi National Oil Co.	92,200.0
7	National Oil Corp. (Libya)	41,464.0
8	Nigerian National Petroleum Corp.	36,220.0
9	OAO Rosneft	17,513.0
10	OAO Lukoil	15,715.0
11	Qatar Petroleum Corp.	15,207.0
12	Sonatrach	12,200.0
13	PetroChina Co. Ltd.	11,706.0
14	Petroleos Mexicanos	11,047.6
15	Petroleo Brasileiro SA	9,613.0
16	Sonangol	9,035.0
17	Total SA	5,778.0
18	Petroleum Development Oman LLC	5,500.0
19	BP PLC	5,492.0
20	Petronas	5,360.0
Total		**1,008,227.6**

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OGJ100

LEADING OIL AND GAS COMPANIES OUTSIDE THE US

Country	Company	Total assets		Total revenues		Total net income		Capital and exploratory expenditures	
		Million $							
		2007	2006	2007	2006	2007	2006	2007	2006
CANADA									
Canada	Advantage Energy Income Fund	2,451.4	1,700.6	518.9	370.0	(7)	43.9	173.1	133.1
Canada	ARC Energy Trust	3,575.4	2,985.7	1,165.1	1,084.7	461.1	405.6	369.1	319.7
Canada	Baytex Energy Ltd.	1,424.1	926.5	448.3	415.5	123.7	129.7	138.4	116.7
Canada	Bonavista Energy Trust	2,269.0	1,774.7	848.3	802.3	203.1	265.6	341.1	278.9
Canada	Canadian Natural Resources Ltd.	36,547.4	28,457.9	10,381.4	9,165.8	2,427.8	2,224.9	5,914.9	10,533.9
Canada	Canadian Oil Sands Trust	7,358.3	5,605.8	3,025.4	2,143.8	691.7	735.2	170.4	264.5
Canada	Canadian Superior Energy Inc.	257.8	193.5	45.1	43.5	(9.2)	(9.6)	23.3	48.8
Canada	Compton Petroleum Corp.	2,281.7	1,841.3	466.4	476.7	120.4	112.3	358.9	433.3
Canada	EnCana Corp.	46,974.0	35,106.0	21,466.0	16,399.0	3,959.0	5,652.0	8,737.0	6,600.0
Canada	Enerplus Resources Fund	4,359.8	3,607.7	1,132.2	1,144.2	316.2	480.2	577.3	482.6
Canada	Harvest Energy Trust	5,517.1	4,930.9	3,787.8	1,217.2	(23.8)	119.9	279.9	332.2
Canada	Husky Energy Inc.	21,957.4	15,390.1	14,445.7	11,163.3	2,991.9	2,403.0	2,768.5	2,821.7
Canada	Imperial Oil Ltd.	16,482.4	13,852.2	23,336.7	21,601.2	2,967.7	2,683.3	910.4	1,065.7
Canada	Nexen Inc.	18,291.9	14,723.3	6,070.4	4,755.7	1,011.0	529.8	2,915.6	2,819.0
Canada	Paramount Resources Ltd.	1,315.4	1,217.8	263.8	275.6	387.4	(15.7)	313.4	466.1
Canada	Pengrowth Energy Trust	5,297.1	4,025.0	1,622.2	1,086.8	334.8	231.2	288.3	267.4
Canada	Penn West Energy Trust	8,534.2	6,925.7	1,702.6	1,547.9	163.8	587.1	1,024.0	509.5
Canada	Petrobank Energy and Resources Ltd.	1,158.1	384.0	206.6	78.8	75.8	20.4	475.0	202.5
Canada	Petro-Canada	24,138.2	19,434.8	19,781.6	16,456.7	2,544.1	1,533.8	3,712.4	3,027.1
Canada	Peyto Energy Trust	1,206.5	975.5	376.1	387.0	194.5	172.1	113.2	1,002.0
Canada	Provident Energy Trust	5,827.9	2,892.9	2,017.5	1,928.1	28.3	124.2	230.0	167.8
Canada	Sherritt International Corp.	5,530.1	2,191.4	1,247.8	982.3	344.8	216.5	930.3	213.2
Canada	Suncor Energy Inc.	24,457.0	16,099.0	16,693.8	13,953.3	2,636.3	2,618.9	5,040.8	3,184.9
Canada	Talisman Energy Inc.	21,700.3	18,435.0	7,371.8	6,739.9	1,934.4	1,767.4	3,099.9	3,479.3
Canada	Vermilion Energy Trust	1,688.1	1,255.4	567.7	463.6	152.9	129.5	276.4	253.9
LATIN AMERICA									
Argentina	Techint Tecpetrol SA[6]	NA	770.8	NA	470.6	NA	120.1	NA	92.1
Barbados	Barbados National Oil Co. Ltd.[6]	138.5	183.9	208.6	208.5	0.7	(3.8)	3.8	12.3
Brazil	Petroleo Brasileiro SA	129,715.0	98,680.0	87,735.0	72,347.0	13,138.0	12,826.0	20,978.0	14,643.0
Colombia	Ecopetrol	23,880.0	20,915.0	11,084.0	9,128.0	2,571.0	1,683.0	1,507.0	925.0
Cuba	Cubapetroleo	NA	NA	NA	NA	NA	NA	NA	NA
Ecuador	Petroleos del Ecuador	NA	NA	NA	NA	NA	NA	NA	NA
Mexico	Petroleos Mexicanos	122,400.0	110,719.0	113,376.3	97,647.0	(1,827.0)	4,159.0	NA	13,736.0
Suriname	State Oil Co. Suriname Ltd.	489.4	354.2	338.3	264.3	146.7	98.5	114.5	113.6
Trinidad and Tobago	Petroleum Co. of Trinidad and Tobago Ltd. (Petrotrin)[2]	4,045.0	2,952.0	4,204.0	4,117.0	195.0	214.0	551.0	280.0
Venezuela	Petroleos de Venezuela SA	107,672.0	80,529.0	96,242.0	99,252.0	6,273.0	5,452.0	7,955.0	4,166.0
EUROPE									
Austria	OMV AG	31,031.4	23,495.9	27,475.6	23,826.3	2,526.6	2,082.4	6,099.1	3,413.8
Denmark	Dong Energy AS	17,574.2	17,578.1	7,650.7	6,150.1	599.0	50,390.2	2,173.1	1,313.5
Denmark	Maersk Oil & Gas	9,864.0	8,864.0	9,465.0	6,915.0	1,628.0	1,702.0	NA	NA
Finland	Neste Oil[10]	7,113.1	5,727.5	16,592.0	15,993.9	795.1	798.8	457.9	672.0
France	Total SA	165,803.9	138,862.8	187,572.0	166,657.4	18,555.1	15,241.6	16,069.7	14,886.1
Germany	RWE Dea AG	5,140.5	4,197.8	2,322.3	2,224.4	389.3	618.0	692.3	604.1
Germany	Wintershall AG	10,305.3	7,171.2	16,047.8	14,756.7	1,081.6	NA	3,125.7	684.5
Greece	Hellenic Petroleum SA	5,624.5	4,404.9	10,830.0	9,482.7	386.5	265.0	160.5	94.6
Hungary	MOL Group PLC	14,026.1	11,300.1	14,518.9	14,214.5	1,402.2	1,565.2	1,976.8	889.4
Ireland	Dragon Oil PLC	1,318.2	910.8	596.6	325.1	303.9	186.9	228.0	175.0
Ireland	Tullow Oil PLC	3,877.5	3,331.6	1,112.2	923.1	91.5	251.0	369.2	626.9
Italy	ENI	148,162.0	116,545.3	120,753.0	109,131.3	13,724.1	11,576.6	14,521.9	9,838.2
Netherlands	Royal Dutch Shell	269,470.0	235,276.0	355,782.0	318,845.0	31,331.0	25,442.0	25,220.0	24,045.0
Norway	StatoilHydro	80,675.9	73,641.1	89,048.2	80,905.9	7,620.2	8,082.9	43,950.5	38,061.4
Poland	Polish Oil & Gas Company	11,548.3	10,565.2	6,021.4	4,896.8	331.2	427.9	NA	NA
Romania	Romanian National Oil Co. (Petrom)	8,581.9	7,556.2	[8]5,031.5	[8]4,657.1	728.3	813.7	1,564.7	1,045.9
Russia	OAO Gazprom	212,511.7	172,559.3	69,401.7	60,081.6	14,093.6	12,647.4	7,895.2	10,189.4
Russia	OAO Lukoil	59,632.0	48,237.0	82,238.0	68,109.0	9,511.0	7,484.0	10,938.0	8,574.0
Russia	OAO Rosneft	74,805.0	46,790.0	49,216.0	33,099.0	12,862.0	3,533.0	6,240.0	3,462
Russia	OJSC Surgutneftegas	37,049.9	37,533.3	23,299.0	18,418.8	3,261.5	2,837.5	NA	NA
Spain	Compania Espanol de Petroleos SA	13,786.7	11,513.1	29,104.2	26,008.0	1,025.4	1,037.0	870.5	729.7
Spain	Repsol YPF SA	68,873.6	59,651.8	76,664.8	69,180.5	4,599.4	4,205.1	NA	7,205.7
Sweden	Lundin Petroleum AB	3,261.2	2,587.4	726.0	574.0	141.0	107.7	581.4	377.3
Turkey	Turkish Petroleum Corp.	4,357.3	2,381.6	2,210.7	936.0	665.8	293.4	NA	NA

Worldwide oil production (Million bbl) 2007	Worldwide oil production (Million bbl) 2006	Worldwide natural gas production (Bcf) 2007	Worldwide natural gas production (Bcf) 2006	Worldwide oil reserves (Million bbl) 2007	Worldwide oil reserves (Million bbl) 2006	Worldwide natural gas reserves (Bcf) 2007	Worldwide natural gas reserves (Bcf) 2006
3.8	2.9	42.7	34.3	61.1	47.5	546.4	442.7
[1]11.9	[1]12.1	65.7	65.4	[1]124.3	[1]129.7	589.8	593.7
[1]10.1	[1]9.1	18.9	19.7	[1]143.3	[1]120.4	[3]148.9	[3]148.1
[1]8.8	[1]8.4	62.4	64.6	[1]63.7	[1]63.6	427.1	428.2
[1]120.8	[1]121.2	608.8	544.6	[1]1,358.0	[1]1,316.0	3,666.0	3,798.0
NA	33.5	NA	NA	NA	[1]1,000.0	NA	NA
0.2	0.2	4.9	4.9	[1]1.0	[1]1.0	25.3	24.9
[1]2.6	[1]3.5	52.9	51.8	[1 3]31.6	[1 3]40.0	[3]1,120.0	[3]984.0
[1 5]49.0	[1 5]61.8	[5]1,302.0	[5]1,229.0	[1 5]927.2	[1 5]1,133.4	[5]13,300.0	[5]12,418.0
[1]14.9	[1]14.8	95.7	98.9	[1 3]176.4	[1 3]175.9	[3]1,202.3	[3]1,264.1
[1]16.1	[1]15.9	35.7	35.3	[1 3]145.8	[1 3]140.5	278.7	296.5
[1]99.5	[1]90.4	227.5	245.4	[1]649.0	[1]587.0	2,191.0	2,143.0
[1]83.2	[1]82.9	147.5	181.0	[1]725.0	[1]681.0	622.0	673.0
57.0	38.0	72.0	74.0	281.0	286.0	423.0	460.0
[1]1.3	[1]1.3	28.8	29.8	[1 3]9.1	[1 3]10.1	[3]192.8	[3]277.0
[1]12.2	[1]9.8	97.4	64.1	[3]146.0	[3]130.7	[3]869.7	[3]827.0
[1]26.4	[1]22.0	120.2	114.1	[1 3]332.0	[1 3]323.0	[1]901.0	[3]961.0
[1]1.3	[1]0.3	4.2	4.7	[1 3]36.7	[1 3]34.9	62.4	41.8
[1]70.0	[1]96.0	266.0	270.0	672.0	605.0	1,759.0	1,945.0
1.3	1.5	37.4	41.2	NA	NA	NA	NA
7.6	5.9	39.1	31.0	98.6	69.1	696.2	199.5
NA	[7]11.0	NA	NA	NA	NA	NA	NA
[1]1.1	[1]1.1	71.5	69.7	[1 3]6.0	[1 3]7.0	426.0	428.0
[1]87.8	[1]94.2	455.1	483.0	[1]749.3	[1]766.5	5,464.2	5,402.9
[1]6.9	[1]5.6	27.4	26.2	[1 3]81.6	[1 3]74.6	[3]248.3	[3]262.7
NA	12.2	NA	71.7	NA	131.4	NA	865.2
0.3	0.3	0.8	0.8	2.2	2.9	4.6	5.9
700.2	[1]700.8	656.0	607.0	9,613.0	9,484.0	12,547.0	11,843.1
119.5	115.7	147.5	124.5	1,450.0	1,551.0	2,439.0	2,407.0
52.0	27.7	14.0	14.0	NA	NA	NA	NA
[7]186.9	[7]182.5	[7]0.3	[7]0.3	[7]4,517.0	[7]4,517.0	NA	NA
[1]1,124.9	[1]1,332.0	2,211.2	1,955.0	11,047.6	12,849.1	12,578.1	13,856.0
5.4	4.8	NA	0.2	[3]96.2	[3]142.0	NA	NA
[1]19.5	[1]21.7	53.7	52.0	[1]308.2	[1]424.3	611.2	659.3
1,060.0	1,061.1	89.7	91.2	99,377.0	87,324.0	170,920.0	166,249.0
[1]59.8	[1]61.6	321.6	317.6	[1]698.3	[1]738.4	2,878.0	3,071.1
9.1	12.1	2.2	1.7	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA	NA	NA
[1]550.8	[1]549.7	1,766.2	1,706.0	5,778.0	6,471.0	25,730.0	25,539.0
[1]17.3	[1]23.9	113.5	105.1	[3]183.7	[3]196.2	[3]1.9	[3]2.3
64.0	63.0	291.0	278.0	264.0	442.0	5,210.0	2,230.0
NA	NA	NA	NA	NA	NA	NA	NA
18.1	19.4	87.9	106.9	146.5	118.6	624.7	817.0
11.7	7.5	NA	NA	[3]651.0	[3]651.0	NA	NA
14.5	12.2	70.5	64.0	[3]294.0	[3]203.7	[3]384.7	[3]302.6
372.3	393.8	1,501.6	1,447.6	3,925.0	3,481.0	11,204.0	16,965.0
[1]663.6	[1]711.0	2,250.4	2,292.6	[1 5]3,776.0	[1 5]4,197.0	[5]40,895.0	[5]44,142.0
[1]391.0	[1]385.0	1,352.0	1,335.0	[1]2,389.0	[1]2,423.0	20,319.0	20,696.0
133.5	136.4	151.9	151.9	[7]154.8	[7]156.2	[7]3,460.8	[7]3,619.7
[1]28.6	[1]30.1	203.1	209.1	863.0	940.0	NA	NA
248.2	248.2	19,373.3	19,634.6	NA	NA	[7]171,176.0	[7]171,176.0
713.0	703.1	340.9	[7]346.8	15,715.0	15,927.0	27.9	26.6
740.0	582.7	554.4	480.3	17,513.0	15,963.0	25,108.3	24,758.2
474.3	482.4	497.9	515.6	NA	NA	NA	NA
42.3	41.6	NA	NA	88.0	104.0	NA	NA
176.2	191.7	1,140.6	1,236.1	952.0	1,057.4	8,136.8	8,718.3
12.7	10.8	NA	NA	[3]169.8	[3]173.5	162.5	115.3
10.3	2.4	14.9	14.5	NA	NA	NA	NA

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LEADING OIL AND GAS COMPANIES OUTSIDE THE US

Country	Company	Total assets		Total revenues		Total net income		Capital and exploratory expenditures	
		Million $							
		2007	2006	2007	2006	2007	2006	2007	2006
United Kingdom	BG Group PLC	30,543.0	24,850.7	16,596.1	13,150.9	3,603.1	3,361.4	608.5	729.8
United Kingdom	BP PLC	236,076.0	217,601.0	284,365.0	265,906.0	21,169.0	22,286.0	17,830.0	15,125.0
United Kingdom	Cairn Energy PLC	2,381.0	1,913.0	[8]288.0	[8]286.0	1,528.0	(97)	400	273.0
United Kingdom	Premier Oil PLC	1,514.1	937.8	578.2	402.2	39.0	67.6	261.2	156.5
AFRICA									
Algeria	Sonatrach	NA	NA	NA	NA	NA	NA	NA	NA
Angola	Sonangol	NA	NA	NA	NA	NA	NA	NA	NA
Egypt	Egyptian General Petroleum Corp.	NA	NA	NA	NA	NA	NA	NA	NA
South Africa	Sasol Limited[4]	16,913.0	14,387.0	[8]8,333.0	[8]7,574.0	2,438.0	1,651.0	NA	NA
Libya	National Oil Corp.	NA	NA	NA	NA	NA	NA	NA	NA
Morocco	Office National des Hydrocarbons et des Mines (ONHYM)	NA	NA	NA	NA	NA	NA	NA	NA
Nigeria	Nigerian National Petroleum Corp.	NA	NA	NA	NA	NA	NA	NA	NA
MIDDLE EAST									
Abu Dhabi	Abu Dhabi National Oil Co.	NA	NA	NA	NA	NA	NA	NA	NA
Bahrain	Bahrain National Oil Co.	NA	NA	NA	NA	NA	NA	NA	NA
Dubai	Dubai Petroleum Co.	NA	NA	NA	NA	NA	NA	NA	NA
Iran	National Iranian Oil Co.	NA	NA	NA	NA	NA	NA	NA	NA
Iraq	Iraq National Oil Co.	NA	NA	NA	NA	NA	NA	NA	NA
Israel	Ministry of Energy & Infrastructure	NA	NA	NA	NA	NA	NA	NA	NA
Kuwait	Kuwait Petroleum Corp.[6]	NA	NA	NA	NA	NA	NA	NA	NA
Oman	Petroleum Development Oman LLC	NA	NA	NA	NA	NA	NA	2,382.0	1,505.0
Qatar	Qatar Petroleum Corp.	NA	NA	NA	NA	NA	NA	NA	NA
Saudi Arabia	Saudi Arabian Oil Co.	NA	NA	NA	NA	NA	NA	NA	NA
ASIA-PACIFIC									
Australia	Australia Worldwide Exploration Ltd.[4]	627.2	576.0	120.9	18.9	58.5	9.3	19.2	3.0
Australia	BHP Billiton Petroleum[4]	58,168.0	48,516.0	39,498.0	32,153.0	13,496.0	10,534.0	793.0	766.0
Australia	Samson Oil & Gas[4]	40.0	43.4	152.3	224.7	(5.1)	(17.5)	1.8	15.1
Australia	Santos Ltd.	6,424.0	5,442.3	[5]2,087.5	[5]2,073.2	369.9	484.6	1,212.8	1,091.2
Australia	Woodside Petroleum Ltd.	8,539.0	7,070.9	3,221.8	2,619.1	864.0	1,075.4	2,625.6	1,789.1
China	China National Offshore Oil Corp. Ltd.	25,790.8	19,716.4	21,308.3	16,636.2	3,627.3	3,006.2	3,964.7	5,902.6
China	PetroChina Co. Ltd.	117,822.4	91,141.7	[8]112,813.5	[8]86,397.8	20,412.6	18,734.4	23,878.2	18,652.7
China, Taiwan	Chinese Petroleum Corp.	18,383.7	17,518.0	27,166.4	23,928.5	4,455.1	(577.3)	NA	70.4
India	Gujarat State Petroleum Corp. Ltd.	NA	NA	NA	NA	NA	NA	NA	NA
India	Oil & Natural Gas Corp. Ltd.[6]	20,304.0	18,104.6	13,763.9	15,620.4	3,801.2	3,402.9	NA	NA
India	Oil India Ltd.[6]	21,507.4	15,628.3	14,598.9	13,340.8	3,985.2	3,734.7	NA	NA
Indonesia	MedcoEnergi	2,147.5	1,841.6	981.9	792.4	6.5	38.2	384.8	388.9
Indonesia	Pertamina	NA	NA	NA	NA	NA	NA	NA	NA
Japan	Japan Petroleum Exploration Co. Ltd.[6]	5,588.5	4,855.7	1,867.4	1,527.7	170.8	180.4	486.7	272.3
Malaysia	Petronas[6]	85,201.0	74,103.0	50,984.0	44,425.0	14,446.0	12,719.0	5,992.0	4,952.0
Myanmar	Myanmar Oil & Gas Enterprise	NA	NA	NA	NA	NA	NA	NA	NA
New Zealand	New Zealand Oil and Gas Ltd.[4]	115.6	59.8	13.4	5.0	9.6	3.0	NA	NA
Pakistan	Pakistan Oilfields Ltd.[4]	405.3	383.5	235.0	[8]254.8	104.2	101.7	55.5	55.8
Pakistan	Pakistan Petroleum Ltd.	816.0	677.6	633.3	527.1	276.7	222.5	66.5	55.2
Thailand	PTT Exploration and Production Public Co. Ltd.	6,442.3	4,371.4	3,000.0	2,421.5	882.1	740.4	109.8	95.9

NA = not available. All financial data are given in millions of US dollars. End of period exchange rates are used for assets. Annual averages are used for other financial data. Fiscal yearend is Dec. 31 unless otherwise noted. [1]Includes NGL. [2]Fiscal yearend is Sept. 30. [3]Proved and probable. [4]Fiscal yearend is June 30. [5]After royalty. [6]Fiscal yearend is Mar. 31. [7]Estimate. [8]Turnover. [9]Fiscal yearend is Mar. 20. [10]Separated from Fortum Oil. [11]Oil sands. [12]Miller & Lent's audit according to US SEC specifications. [13]Excludes Petrom.

Worldwide oil production (Million bbl)		Worldwide natural gas production (Bcf)		Worldwide oil reserves (Million bbl)		Worldwide natural gas reserves (Bcf)	
2007	2006	2007	2006	2007	2006	2007	2006
[1]63.8	[1]51.7	938.0	1,000.0	[1]392.9	[1]432.1	5,572.0	5,928.0
[5]881.1	[5]903.4	[5]2,972.2	[5]2,855.0	[1]5,492.0	[1]5,893.0	41,130.0	45,931.0
3.0	2.0	27.0	39.0	[3]164.0	[3]180.0	[3]35.0	[3]98.0
[1]13.0	[1]12.0	49.3	46.4	[1 3]38.1	[1 3]26.6	998.0	722.0
[7]494.6	[7]491.8	[7]3,310.0	[7]3,287.0	[7]12,200.0	[7]12,270.0	[7]159,000.0	[7]161,740.0
[7]618.7	[7]514.7	[7]40.9	[7]27.9	[7]9,035.0	[7]8,000.0	[7]9,530.0	[7]2,000.0
[7]232.5	[7]243.6	[7]492.6	[7]484.0	[7]3,700.0	[7]3,700.0	[7]58,500.0	[7]58,500.0
2.1	1.8	58.2	55.1	[3]14.1	[3]15.9	[3]1,276.6	[3]1,306.1
[7]620.5	[7]623.5	[7]265.9	[7]258.5	[7]41,464.0	[7]41,464.0	[7]50,100.0	[7]52,650.0
NA	[7]0.2	NA	NA	[7]0.8	[3]1.0	[7]55.0	[7]58.0
[7]791.0	[7]810.0	[7]860.0	[7]849.0	[7]36,220.0	[7]36,220.0	[7]183,990.0	[7]181,900.0
[7]846.8	[7]894.3	NA	NA	[7]92,200.0	[7]92,200.0	[7]198,500.0	[7]198,500.0
[7]62.8	[7]62.8	[7]317.7	[7]314.3	[7]124.6	[7]124.6	[7]3,250.0	[7]3,250.0
[7]34.7	[7]32.9	NA	NA	[7]4,000.0	[7]4,000.0	[7]4,000.0	[7]4,000.0
[7]1,429.7	[1]1,405.3	2,970.0	3,213.0	[7]138,400.0	[7]136,270.0	[7]948,200.0	[7]974,000.0
[7]759.2	[7]699.0	[7]58.5	[7]61.9	[7]115,000.0	[7]115,000.0	[7]111,940.0	[7]112,000.0
NA	0.4	NA	NA	[7]1.9	[7]1.9	1,075.0	[7]1,275.0
788.4	803.0	371.0	366.5	[7]101,500.0	[7]99,000.0	[7]55,515.0	[7]54,500.0
204.8	215.0	813.5	768.5	[7]5,500.0	[7]5,500.0	[7]30,000.0	[7]30,000.0
[7]292.0	[7]299.3	1,825.0	1,377.0	[7]15,207.0	[7]15,207.0	[7]905,300.0	[7]910,500.0
3,102.5	3,248.5	2,920.0	3,000.3	259,900.0	259,900.0	253,800.0	248,500.0
0.9	0.1	15.1	4.8	17.5	16.2	[3]180.8	[3]202.8
[1]56.7	[1]57.2	355.7	360.4	[1]565.1	[1]551.0	4,727.2	4,867.3
NA	NA	NA	NA	0.5	0.5	18.6	20.3
[1]17.7	[1]20.5	233.0	226.2	134.0	141.0	4,110.4	3,796.8
22.8	30.5	204.0	212.0	170.2	221.1	7,785.0	6,921.0
NA	[1]132.7	350.3	310.4	NA	[1 3]1,489.8	NA	[3]6,231.6
838.8	830.7	1,627.0	1,371.9	11,706.0	11,618.0	57,111.0	53,469.0
5.7	5.8	14.7	15.1	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA	NA	NA
22.6	23.4	80.0	80.1	NA	NA	NA	NA
18.4	19.9	46.4	53.2	104.7	99.1	253.2	285.7
NA	NA	NA	NA	NA	NA	NA	NA
7.4	7.8	45.5	44.0	NA	NA	NA	NA
241.3	255.2	1,942.6	1,956.1	5,360.0	5,250.0	82,992.0	82,096.0
[7]4.7	[7]4.7	NA	NA	[7]50.0	[7]50.0	[7]10,000.0	[7]10,000.0
NA	NA	NA	NA	NA	NA	NA	NA
[1]5.9	[1]4.8	46.7	20.5	NA	[3]45.2	NA	[3]210.1
[1]0.9	[1]0.6	365.5	371.7	[1]20.5	[1]21.2	3,958.7	4,392.0
NA	[1]14.0	NA	239.5	NA	NA	NA	NA

THE OGJ200 COMPANY INDEX

Rank by total assets	Company	Headquarters city
91	Abraxas Petroleum Corp.	San Antonio
113	Adams Resources & Energy Inc.	Houston
94	American Oil & Gas Inc.	Denver
4	Anadarko Petroleum Corp.	The Woodlands, Tex.
9	Apache Corp.	Houston
137	Apache Offshore Investment Partnership	Houston
84	Approach Resources Inc.	Fort Worth
80	Arena Resources Inc.	Tulsa
116	Aspen Exploration Corp.	Denver
46	Atlas America Inc.	Moon Township, Pa.
37	ATP Oil & Gas Corp.	Houston
83	Aurora Oil & Gas Corp.	Traverse City, Mich.
124	Basic Earth Science Systems Inc.	Denver
144	Bayou City Exploration Inc.	Houston
62	Belden & Blake Corp.	North Canton, Ohio
49	Berry Petroleum Co.	Bakersfield, Calif.
53	Bill Barrett Corp.	Denver
74	Black Hills Corp.	Rapid City, SD
130	Blue Dolphin Energy Co.	Houston
70	Brigham Exploration Co.	Austin
40	Cabot Oil & Gas Corp.	Houston
60	Callon Petroleum Co.	Natchez, Miss.
87	Cano Petroleum Inc.	Fort Worth
63	Carrizo Oil & Gas Inc.	Houston
29	Cheniere Energy Inc.	Houston
8	Chesapeake Energy Corp.	Oklahoma City
3	Chevron Corp.	San Ramon, Calif.
25	Cimarex Energy Co.	Denver
58	Clayton Williams Energy Inc.	Midland, Tex.
50	CNX Gas Corp.	Pittsburgh
36	Comstock Resources Inc.	Frisco, Tex.
2	ConocoPhillips	Houston
90	Contango Oil & Gas Co.	Houston
51	Continental Resources Inc.	Enid, Okla.
100	Credo Petroleum Corp.	Denver
76	Crimson Exploration Inc.	Houston
118	Cross Timbers Royalty Trust	Dallas
120	Cubic Energy Inc.	Dallas
122	Daleco Resources Corp.	West Chester, Pa.
134	Daybreak Oil & Gas Inc.	Spokane, Wash.
56	Delta Petroleum Corp.	Denver
34	Denbury Resources Inc.	Plano, Tex.
6	Devon Energy Corp.	Oklahoma City
17	Dominion Energy Inc.	Richmond, Va.
89	Dorchester Minerals LP	Dallas
95	Double Eagle Petroleum Co.	Casper, Wyo.
78	DTE Gas & Oil Co.	Detroit, Mich.
67	Dune Energy Inc.	Houston
61	Edge Petroleum Corp.	Houston
11	El Paso Corp.	Houston
32	Encore Acquisition Co.	Fort Worth
119	EnDevCo Inc.	Houston
42	Energen Resources Corp.	Birmingham, Ala.
59	Energy Partners Ltd.	New Orleans
145	EnerJex Resources Inc.	Overland Park, Kan.
13	EOG Resources Inc.	Houston
38	Equitable Supply	Pittsburgh
108	Evolution Petroleum Corp.	Houston
21	Exco Resources Inc.	Dallas
1	ExxonMobil Corp.	Irving, Tex.
55	Fidelity Exploration & Production Co.	Bismarck, ND
127	FieldPoint Petroleum Corp.	Cedar Park, Tex.
96	Foothills Resources Inc.	Bakersfield, Calif.
23	Forest Oil Corp.	Denver
104	FX Energy Inc.	Salt Lake City
106	Galaxy Energy Corp.	Denver
92	Gasco Energy Inc.	Englewood, Colo.
105	GeoPetro Resources Co.	San Francisco
85	GeoResources Inc.	Williston, ND
77	GMX Resources Inc.	Oklahoma City
68	Goodrich Petroleum Corp.	Houston
142	GSV Inc.	Westport, Conn.
75	Gulfport Energy Corp.	Oklahoma City
93	HKN Inc.	South Lake, Tex.
24	Helix Energy Solutions Group Inc.	Houston
10	Hess Corp.	New York
117	Houston American Energy Corp.	Houston
126	Index Oil and Gas Inc.	Houston
107	Infinity Energy Resouces Inc.	Denver
125	John D. Oil and Gas Co.	Mentor, Ohio
43	Kinder Morgan CO_2 Co. LP.	Lakewood, Colo.
140	Knight Energy Corp.	Irving, Tex.
64	Layne Christensen Co.	Mission Woods, Kan.
72	Legacy Reserves LP	Midland, Tex.
143	LL & E Royalty Trust	Houston
131	Lucas Energy Inc.	Houston
5	Marathon Oil Corp.	Houston
48	McMoran Exploration Co.	New Orleans
71	Meridian Resource Corp.	Houston
132	Mexco Energy Corp.	Midland, Tex.
141	Miller Petroleum Inc.	Huntsville, Tenn.
15	Murphy Oil Corp.	El Dorado, Ark.
--	Ness Energy International Inc.	Willow Park, Tex.
101	New Century Energy Corp.	Houston
112	New Frontier Energy Inc.	Littleton, Colo.
20	Newfield Exploration Co.	Houston
86	NGAS Resources Inc.	Lexington, Ky
14	Noble Energy Inc.	Houston
138	Oakridge Energy Inc.	Wichita Falls, Tex.
7	Occidental Petroleum Corp.	Los Angeles
97	Panhandle Oil and Gas Inc.	Oklahoma City
69	Parallel Petroleum Corp.	Midland, Tex.
121	Pegasi Energy Resources Corp.	Tyler, Tex.
39	Penn Virginia Corp.	Radnor, Pa.
133	Permian Basin Royalty Trust	Fort Worth
99	Petro Resources Corp.	Houston
26	Petrohawk Energy Corp.	Houston
129	Petrol Oil & Gas Inc.	Overland Park, Kan.
57	Petroleum Development Corp.	Bridgeport, W. Va.
66	PetroQuest Energy Inc.	Lafayette, La.
103	PetroSearch Energy Corp.	Houston
19	Pioneer Natural Resources Co.	Irving, Tex.
128	Pioneer Oil & Gas	South Jordan, Utah
16	Plains Exploration & Production Co.	Houston
88	Platinum Energy Resources Inc.	Houston
--	PRB Energy Inc.	Denver
81	PrimeEnergy Corp.	Stamford, Conn.
136	Pyramid Oil Co.	Bakersfield, Calif.
65	Quest Resource Inc.	Oklahoma City
22	Questar Corp.	Salt Lake City
33	Quicksilver Resources Inc.	Fort Worth
27	Range Resources Corp.	Fort Worth
115	Reserve Petroleum Co.	Dallas
82	Rex Energy Corp.	State College, Pa.
52	Rosetta Resources Inc.	Houston
110	Royale Energy Inc.	San Diego
139	Sabine Royalty Trust	Dallas
111	San Juan Basin Royalty Trust	Fort Worth
54	Seneca Resources Corp.	Williamsville, NY
28	Southwestern Energy Co.	Houston
123	Spindletop Oil & Gas Co.	Dallas
35	St. Mary Land & Exploration Co.	Denver
45	Stone Energy Corp.	Lafayette, La.
44	Swift Energy Co.	Houston
109	Tengasco Inc.	Knoxville, Tenn.
98	Teton Energy Corp.	Denver
135	Texas Vanguard Oil Co.	Austin
114	Tri-Valley Corp.	Bakersfield, Calif.
79	TXCO Resources Inc.	San Antonio
47	Ultra Petroleum	Houston
41	Unit Corp.	Tulsa
31	W&T Offshore Inc.	Houston
73	Warren Resources Inc.	New York
102	Westside Energy Corp.	Houston
30	Whiting Petroleum Corp.	Denver
18	Williams Cos. Inc.	Tulsa
12	XTO Energy Inc.	Fort Worth

Global E&P investments for 2007 remain flat, study finds

Paula Dittrick
Senior Staff Writer

Oil and gas companies' 2007 global investment for exploration and development projects totaled $402 billion—unchanged from 2006, said the latest annual upstream performance review by IHS Herold Inc. and Harrison Lovegrove & Co. Ltd.

Capital spending varied greatly by region. Lower levels of investment in Canada and the US last year were offset by gains in regional spending elsewhere.

Rising royalty rates in Alberta and new royalty trust legislation contributed to lower overall upstream investments in Canada by more than 25%, analysts said. Conventional oil and gas spending in Canada plunged by nearly $30 billion from 2006.

In the US, substantially lower acquisition activity contributed to a 9% decline in 2007 upstream spending compared with 2006. Worldwide acquisition spending was $90 billion, down 30% from 2006 record levels.

Asia-Pacific investments rose upon China's increasing natural gas demand and the rest of Asia's increasing LNG demand. Upstream spending in Russia and the Caspian region soared 58% upon higher acquisition activity and development spending.

The review is based on information that 232 oil and gas companies filed with the US Securities Exchange Commission and similar agencies worldwide.

Revenues, costs climb

"Higher prices drove a 10% increase in revenue to $931 billion," said Robert Gillon, IHS Herold senior vice-president. "But cost pressures have been unrelenting with lifting costs rising by 17% and government take up 5% to $253 billion, or 51% of pre-tax profit. "

Consequently, net income edged up 2% to $246 billion. The upstream net income per boe held flat at $12.98/boe after nearly doubling since 2003. World upstream profit margins were lower for the third consecutive year.

Cash flow worldwide from oil and gas producing operations totaled $430 billion in 2007, up 10% from 2006. Cash flow per boe increased 8% to $21.99/boe

Industry's cash flow total exceeded investment 2007 when cash flow was 7% larger than upstream spending, the review showed.

"Our universe generated surplus cash flow of approximately $28 billion in 2007," analysts said. "The US region, and to a much lesser extent Canada, invested in excess of cash generated. A significant cash surplus was generated in Europe, with smaller amounts of cash flow surpluses registered in the other regions."

Reserve revisions cut F&D costs

Positive reserve revisions cut finding and development costs in half in the US and Europe.

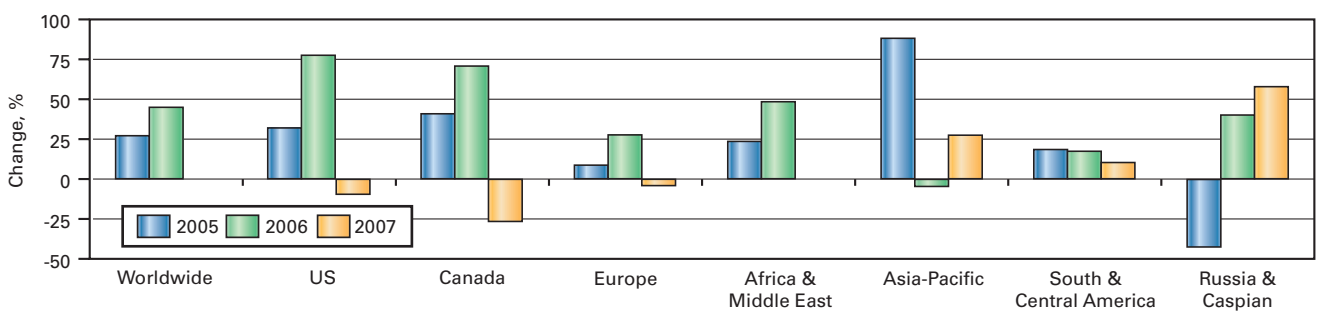
The US finding and development cost was $16.56/boe, down from $31.49/boe in 2006. But excluding estimated reserves revisions, US F&D was virtually flat at $22.50/boe after having risen in previous years. Worldwide, positive reserves revisions cut F&D costs by about $4/boe.

Oil and gas production growth worldwide slowed, reaching 19.6 boe in 2007, which was 1.3% higher than 2006.

Strong gas-related production gains were reported last year in the US and Asia-Pacific. Increased oil output came from Russia and the Caspian region to offset what analysts called "dismal performance in Canada, Europe, and South and Central America." Consequently, oil production held flat.

Natural gas reserves and production continued at the 3% growth rate of the last 5 years, analysts said. ✦

REGIONAL UPSTREAM SPENDING, 2005-07*



The 2008 Global Upstream Performance Review shows the 2007 investment of 232 oil and gas companies was unchanged at $402 billion in 2007 as compared with 2006.
Source: IHS Herold Inc. and Harrison Lovegrove & Co. Ltd.

US Congress presses for energy votes by October

Nick Snow
Washington Editor

Acknowledging that they have less than 3 weeks before the next recess, congressional leaders on both sides of the Capitol said they will bring energy bills up for votes soon.

The atmosphere was stormier in the House, where Speaker Nancy Pelosi (D-Calif.) and Minority Leader John Boehner (R-Ohio) still seemed far apart on their ideas for a comprehensive bill, than in the Senate, where Majority Leader Harry M. Reid (D-Nev.) mentioned three bills he plans to bring to the floor next week and Minority Leader Mitch McConnell (R-Ky.) called for extensions of renewable energy tax credits and for expansions of Outer Continental Shelf leasing.

"So far, Congress has been unable to come together on a comprehensive solution to our nation's energy crisis. But the book hasn't closed yet on the 110th Congress," McConnell maintained on Sept. 8. "There is still time to act on this issue, and we should. We must work to provide relief for Americans across the country who are struggling with the high price of [gasoline] at the pump. Congress can still show that we're responsible to the needs of the American people by doing something about this crisis now."

In remarks on the Senate floor as he opened the September work period the same day, Reid said he would continue efforts to pass comprehensive energy legislation. "I am encouraged by the work of what started as the Gang of 10, and has now expanded to the Gang of 16 and perhaps of a gang of many more by the time this process has concluded. Next week, following Friday's energy summit, we expect to vote on several comprehensive energy bills," he said.

Three proposals

Reid specifically mentioned three proposals. The first, from Energy and Natural Resources Committee Chairman Jeff Bingaman (D-NM) and Finance Committee Chairman Max Baucus (D-Mont.) would open new OCS areas for leasing, including the eastern Gulf of Mexico, and accelerate leasing off Alaska's coast. It also would require diligent development of areas that are already leased; extend renewable energy, energy efficiency, and advanced alternative fuel vehicle tax incentives (which would be paid for with higher oil company taxes); repeal deepwater royalty relief; and enact strong national energy efficiency building codes.

The bill from what has become the Gang of 16 also would open the eastern Gulf of Mexico for leasing as well as other areas off southeastern coastal states (except Florida) at the states' request; extend the same alternative energy tax incentives by raising oil companies' taxes, provide additional subsidies for building coal-to-liquids plants, and increase nuclear power plant subsidies, Reid said.

"And we are open to a vote on the Republican amendment that Sen. McConnell filed to the speculation bill. This amendment opens up all coastal areas to drilling at the states' requests, except for the eastern Gulf of Mexico which stays closed until 2022," Reid continued. The proposals also would close what has come to be called the London loophole by requiring commodity traders using overseas exchanges to trade US energy futures, options, and swaps to meet the same reporting and disclosure requirements as they use in domestic exchanges.

"It should be clear to all that we are offering Republicans multiple opportunities to vote for increased drilling, which they have chosen to make their marquee legislative priority and campaign issue. We offered votes on drilling before the August recess and Republicans rejected our offers. This time, I hope Republicans will put their votes where their mouths are to pass comprehensive legislation that includes drilling," Reid said.

Nothing to fear in this

"Americans want us to act to increase offshore exploration. There is nothing to fear in this. We can and should increase domestic energy exploration even as we encourage the use of alternative energy sources and new conservation measures. There is no good reason we can't get behind a balanced approach that would allow us to find more and use less at the same time," McConnell said.

Even with such sentiments, however, it's apparent that proposals presented as compromises in the Senate could contain punitive provisions aimed at energy producers and processors. The American Petroleum Institute and National Petrochemical and Refiners Association each have said that the proposal introduced Aug. 1 by what was then the Gang of 10 goes too far on new taxes and not far enough in opening more of the OCS.

The gap looked even wider in the House despite at least three proposals to expand OCS leasing and extend renewable energy tax credits which came out before the August recess began. Democratic and Republican leaders there staked out positions similar to those they took before the August recess despite a statement by Pelosi's office that the majority at a press conference on Sept. 9 would discuss comprehensive energy legislation they were preparing.

When they arrived from a midday caucus which ran 45 min overtime, however, the Democratic leadership said that discussions had been exceptionally productive but added that more work would need to be done before the bill was in its final form. "Comprehensive energy legislation will be the result of reasonable compromises," Pelosi said. Then she added that it will need to increase domestic supplies, end subsi-

dies for oil and gas producers, and promote conservation, efficiency and research and development of alternative and renewable technologies.

Pelosi also disputed Republican charges that she had opposed bringing a bill calling for more leasing of the OCS to a floor before the August recess. "I was opposed to their idea that if the House voted in isolation for new drilling, we would bring the price at the pump down immediately. That was a hoax which was perpetrated on the American people," she said.

'Pin prices on the donkey'

Majority Leader Steny H. Hoyer (D-Md.) said that the Democrats' new energy bill would not come to the floor under a rules suspension as others have earlier this year, but he indicated that it will arrive under a rule which has not been determined yet. It also will be different from the bill promoted by Republican leaders and members, many of whom stayed behind to protest taking a recess in August without a vote on opening more of the OCS.

"It's not surprising they're trying to play pin the record gasoline prices on the donkey," Hoyer said, adding that at least one more caucus will be necessary before the Democrats' final bill emerges.

Others said that while Republicans made speeches each day in a darkened House chamber during August, Democrats conferred with their constituents in person and with each other by teleconference about energy issues. "I heard from my constituents all summer that they want an energy bill which will lead to economic growth and more jobs. The Republicans have produced neither in the last 8 years. When they say they want all of the above, they mean more of the same," said Democratic Caucus Chairman Rahm Emanuel (D-Ill.).

House Republican leaders said that voters will accept nothing less than HR 6566, the bill they call the American Energy Act which not only would expand leasing on the OCS but also authorize leasing on the Arctic National Wildlife Refuge's coastal plain, allow development of US oil shale resources and remove obstacles to constructing new refineries and expanding those which already exist. It also contains provisions designed to improve energy conservation and efficiency, and to promote renewable and alternative energy technologies.

"The American people don't want a little bit of the above. They don't want some of the above. They want all of the above," Minority Leader John Boehner (R-Ohio) told reporters at a briefing.

'No new energy'

Minority Whip Roy Blunt (R-Mo.) said that 134 House Republicans participated in the 4-week protest as they addressed tourists on Capitol tours instead of other members. "We'll look carefully at what the other side brings to

WATCHING GOVERNMENT

Nick Snow, Washington Editor

Blog at www.ogjonline.com

API on polar bears

The American Petroleum Institute said on Sept. 5 that it wasn't questioning the US Department of the Interior's decision to list the polar bear as a threatened species when it filed a motion on Aug. 27 to intervene in a lawsuit challenging the findings.

In fact API agrees with DOI's May 15 "determination that the Endangered Species Act is not the right tool to set US climate policy...."

It said, "The oil and natural gas industry is committed to the conservation of the polar bear and other marine mammals. Companies active in Arctic region energy exploration implement polar bear mitigation and avoidance programs, and they provide funding and logistical support for important polar bear studies" in the US and Canada.

The US Chamber of Commerce, National Association of Manufacturers, National Mining Association and American Iron and Steel Institute joined API in the motion which was filed in US District Court for the District of Columbia. The case is Center for Biological Diversity et al vs. Dirk Kempthorne et al.

'Discriminatory carve-out'

The motion states that the five business groups are not challenging the listing itself. Their concern centers on "a discrete provision of only one paragraph of the rule, the discriminatory carve-out of operations in Alaska from an exemption provided to operations in all other states." They call this "the Alaska gap."

Robin Conrad, executive vice-president of the National Chamber Litigation Center, said on Aug. 28: "Environmental activists are trying to use the Endangered Species Act as a back door to set national climate policy, and they're starting with Alaska. Climate change is a global issue and requires a global solution. Singling out Alaska to impose burdensome and onerous regulation is bad policy and violates the law."

While US Interior Secretary Dirk A. Kempthorne said the ESA was not an appropriate vehicle for limiting greenhouse gas emissions, he also used authority under Section 4(d) of the law to issue a special rule which made all states except Alaska exempt from complying with a permitting process for activities that produce carbon dioxide, Conrad said.

'Arbitrary and capricious'

"It is arbitrary and capricious for the secretary to single out Alaska for regulation, given [his] own scientific judgment that no causal link can be established between a particular emissions source and any harm to Arctic ice," Conrad said.

The groups' concern is minor compared to the uproar that greeted Kempthorne's decision to propose changes in the ESA itself. "The existing regulations create unnecessary conflicts and delays. The proposed regulations will continue to protect species while focusing the consultation process on those federal actions where potential impacts can be linked to the action and the risks are reasonably certain to occur," he said on Aug. 11.

Environmental groups said that the proposals would gut the law. US Senate Environment and Public Works Committee Chairwoman Barbara Boxer (D-Calif.) asked Kempthorne to extend the comment period and scheduled a hearing on the matter for Sept. 24. ✦

the House floor. We'll look at what the Democrats roll out later today. My guess is their new energy legislation will produce no new energy," he said.

Republican Conference Vice-Chairwoman Kay Granger (Tex.) said that she found it refreshing to speak directly with voters on the House floor instead of to a microphone or C-SPAN television camera. "Many had their children with them and were going to get them ready to go back to school when they got home from vacation. Some told me that record-high gasoline prices could limit their after-school activities. That's not right," she said.

The protest was "the kind of no-nonsense approach that [2008 Republican vice presidential nominee] Sarah Palin used when she came into office as Alaska's governor," Granger said, adding "She announced that a natural gas pipeline would be built under a competitive bidding system and that's exactly what's happening."

Neither side's leadership appeared ready to consider compromise energy proposals which emerged in the House before the August recess. That didn't surprise Patrick Creighton, press secretary for Rep. John E. Peterson (R-Pa.), one of the original sponsors of one compromise bill which now has 131 cosponsors. "We could break 200 by the end of the week. If Speaker Pelosi and Minority Leader Boehner are serious about getting a new bill passed before Sept. 26, they'll have to take a bipartisan approach and look at one of the compromise proposals," Creighton told OGJ.

Voters still want Congress to act, McConnell insisted. "One senator on the other side said that he thinks frustration over the high price of [gasoline] has peaked. But I've seen no evidence of this at all. In fact, I'm confident, after spending the past month away from Washington, that if we did little else these next few weeks but pass a serious response to high gas prices, fund the government and protect taxpayers, the American people would view these next few weeks as extremely productive," he said. ✦

Alaska gas projects advance; consolidation urged

Judy Clark
Senior Associate Editor

Eric Watkins
Oil Diplomacy Editor

The Federal Energy Regulatory Commission, in its latest report to Congress Aug. 29, said that of the two major projects competing to deliver natural gas from Alaska's North Slope, only one likely will be built, and it is urging that the sponsors work together to build that single line.

"It should be abundantly clear that all stakeholders involved must work together with the shared objective of getting a project built," FERC reported. "We believe it to be in the public interest to avoid the consequences of a prolonged, duplicative regulatory review in a competitive situation, especially during the application phase."

Some members of Congress apparently agree. A bill (HR 6515) was introduced in the House July 16 that would charge the US president with persuading the various stakeholders to join together in a single effort, FERC said.

Projects progress

Meanwhile one of the two competing proposals has advanced to the early, but detailed, planning and project development stage, and the other has received preferred status by the state of Alaska. Another related project, still under consideration, would move some of Alaska's gas to an LNG export terminal in southwest Alaska for export, and an intrastate system also is under consideration.

"We have seen substantial progress on development of the Alaska pipeline over the past 6 months, more progress than in any other reporting period," said FERC Chairman Joseph T. Kelliher.

"This competition for the project is a positive indication of serious interest by major industry players," Kelliher said, adding: "This should all be resolved, ultimately, in the energy and financial marketplaces, and FERC stands ready to act once that takes place."

FERC outlined the major developments that have occurred since its February report:

- *Alaska Gas Pipeline LLC (Denali).* The Office of Energy Projects on June 25 approved Denali's request to begin the prefiling process, and the company has begun field work. The 4 bcfd system, which it says would deliver 6-8% of US daily consumption, is sponsored by BP PLC and ConocoPhillips.

Denali plans to build and operate 750 miles of 48-52-in. pipeline from Alaska's North Slope, generally following the Trans-Alaska oil pipeline to Fairbanks, where it would branch off following the Alaska Highway to the Alaska-Yukon border. Compressor stations of 40,000 hp each would be built every 100-200 miles, the company says. The pipeline would operate at 2,500 psi.

Another 1,000 miles of transmission line, to be built by Canadian affiliates, would extend from the Alaska border to Alberta.

Denali says if additional capacity is needed to transport these volumes to the Lower 48, the affiliates would build an extension through Alberta to the US border, and Denali would construct a mainline across parts of North Dakota, Minnesota, Iowa, and Illinois to the Chicago area. These sections would add another 1,500 miles to the system.

Denali also would build a gas treatment plant on the North Slope, at least five off-take points in Alaska for in-state distribution, and gathering lines from production areas to connections with other portions of its system.

Initial pipeline routing surveys and environmental resource studies began this summer, and the company plans to spend $600 million over the next 3 years before applying for a FERC certificate in fall 2011. Denali proposes to hold its open season before year-end 2010 on the open access pipeline, and its construction schedule calls for bringing gas to market by mid-2018.

- *TransCanada Corp. affiliates TransCanada Alaska Co. LLC and Foothills Pipe Lines Ltd. (TC Alaska).* Alaska Gov. Sarah Palin on Aug. 27 signed a bill passed earlier in August by Alaska state legislators designating TC Alaska the state's preferred applicant under its Alaska Gasline Inducement Act (AGIA) and granting it an exclusive AGIA license.

The award authorizes the state to contribute as much as $500 million toward TC Alaska expenditures for planning and preparation leading to federal and other permit applications. It also represents an agreement to settle various project issues between the state and the applicant.

Denali Pres. Bud Fackrell said the AGIA license award to TC Alaska would not impede the Denali project.

"The granting of the AGIA license will not affect the Denali work program and as long as the state ensures a level playing field should not affect Denali's steady march toward its first major milestone, an open season by the end of 2010," said Fackrell. "Denali is continuing to move forward."

The route of TC Alaska's proposed 5 bcfd gas delivery system is similar to Denali's with 750 miles of 48-in. pipe extending from the existing central gas treatment plant on the North Slope, following the same route in Alaska, and 1,000 miles of pipeline from the Alaska-Yukon border to Alberta's existing gas distribution hub. TC Alaska said it has no plans to build a gas treatment plant on the North Slope, but it is prepared to do so if necessary.

TC Alaska has not yet begun the prefiling process, but FERC says the company could request that many of the prefiling activities for TC Alaska be combined with existing prefiling activities for Denali and that both could

benefit by coordinating some prefiling activities that would be similar or the same.

Under the AGIA, TC Alaska would hold an additional open season every 2 years, and it has designed its project to be expandable to 5.9 bcfd by adding 16 more compressor stations to the original 16 in Alaska-Canada.

Having anticipated that it would receive the AGIA license last April, TC Alaska may see its schedule slip somewhat, FERC said. Originally it planned to conduct open season in 2009, to begin the FERC prefiling process in June 2010, and apply by December 2011 for a FERC certificate.

• *The Alaska Gasline Port Authority (AGPA).* This project contemplates delivering Prudhoe Bay gas by pipeline 800 miles to Valdez where it could be liquefied and shipped on carriers to the Asian market, Hawaii, and the west coasts of the US and Mexico. AGPA has added new partners—Mitsubishi Corp. and Sempra LNG—and Alaska state is assisting AGPA with project development.

Palen issued an administrative order Aug. 20 directing state agencies to continue assisting the LNG project sponsors in the feasibility and permitting process for an LNG project "consistent with TC Alaska's mainline under AGIA." FERC would also regulate this gas export project.

Other gas projects

In addition to the interstate projects, on July 7, Palin announced the formation of a public-private partnership of the Alaska Natural Gas Development Authority, Enstar Natural Gas Co., and the state of Alaska to consider building the first phase of an intrastate pipeline to serve Alaskans within the next 5 years.

This system would not fall under FERC's jurisdiction; nor would the 750-mile, 30-in. Mackenzie Gas Pipeline in Canada that would transport 1.2 bcfd of Arctic gas to market. Planned to be in operation by 2016, it would cost $16 billion and would be regulated by Canada's National Energy Board. ✦

Reactions mixed as BLM issues EIS for oil shale

Nick Snow
Washington Editor

The US Bureau of Land Management issued a final programmatic environmental impact statement Sept. 4 to guide the use of public land containing oil shale and tar sands in three western states. Reactions ranged from applause to expressions of concern.

The document, which BLM developed under Section 369[d] of the 2005 Energy Policy Act, amends 12 land-use plans in Colorado, Utah, and Wyoming to set aside 1.9 million acres of public land for potential commercial oil shale development, the US Department of the Interior agency indicated.

One of the next steps would be to complete rules to govern procedures for issuing leases, but Congress placed a moratorium in the fiscal 2008 DOI appropriation directing BLM not to finalize such a regulation, it continued.

US President George W. Bush has urged Congress to lift the moratorium so the agency can prepare final regulations for a program that would improve the nation's energy security, BLM Director James L. Caswell said. "The goal is to promote economically viable and environmentally sound production of oil shale on western lands where we estimate deposits hold the equivalent of 800 billion bbl of oil, enough to meet [current] US demand for imported oil at current levels for 110 years," he declared.

Most US oil shale deposits are in the Green River Formation of Colorado, Utah, and Wyoming, according to BLM. The programmatic EIS identifies the most geologically promising areas on federal land in the three states, which would be open to applications for commercial leasing, it said.

BLM indicated that it would wait at least 60 days after publication of the final programmatic EIS in the Sept. 5 Federal Register before signing and issuing a record of decision approving the land-use plan amendments.

Cheers, criticism

Utah's two Republican US senators each greeted BLM's step with cheers as Colorado's Democratic governor and a major national environmental organization condemned it. A member of the state's congressional delegation said the programmatic EIS provides important information about potential resources and developmental impacts, which also shows why any further steps toward leasing should be gradual.

"A lot of folks have been armchair quarterbacking on the environmental aspects of oil shale development in this country. Now, we have the official word from the actual experts on how the environment can be protected during oil shale development," said Orrin G. Hatch, Utah's senior US senator.

Robert B. Bennett, the state's junior senator, noted that the programmatic EIS's preferred alternative would exclude 305,000 acres of BLM-managed federal land in the potential development area. Leasing would not be allowed in wilderness areas, wilderness study areas, areas of critical environmental concern closed to mineral leasing, and similarly designated areas, he said.

"The only obstacle standing in the way of producing more American oil through this abundant resource is Congress. As a senator from an oil shale state, I will continue to fight this legislative battle to repeal the moratorium on oil shale," Bennett said.

Colorado's governor took a different view. "With the Department of [the] Interior's action today, the federal government has once again failed to act

as a responsible partner for Colorado. The Bush administration is engaging in last minute maneuvering in its waning days rather than developing a comprehensive, meaningful, and responsible long-term energy policy for America's future," said Bill Ritter Jr.

Short-sighted, premature

"Finalizing an environmental impact statement without any clear understanding of the environmental, community, economic and energy impacts of commercial-scale oil shale development is irresponsible, short-sighted, and premature. This does nothing to address [gasoline] prices at the pump today and has the potential to do much more harm than good," he continued.

Chase Huntley, energy policy advisor for the Wilderness Society, agreed. "The administration and its boosters in Congress are pushing the promise of oil shale in the hope of scoring political points by leading Americans to believe it will lower today's high energy prices. It will not. Putting politics ahead of responsible governance could cause more harm that good," he said.

"In fact, this reckless hurtle toward oil shale development puts thousands of residents of Colorado, Utah, and Wyoming at risk of an economic catastrophe not seen since the Black Sunday collapse of the Colony oil shale project in 1982. This move also promises significant and potentially devastating environmental consequences for nearly 2 million acres of western public lands," Huntley warned. ✦

Producers forecast decline in oil, natural gas production from Indonesia operations

Eric Watkins
Oil Diplomacy Editor

PT Chevron Pacific Indonesia (CPI), already under government scrutiny for alleged violations of its cost recovery claims, has forecast that production from its concessions will decline due to aging fields and seasonal floods.

CPI President Suwitom Anggoro, during a hearing with the House of Representatives' budget committee, said the firm's Duri and Minas concessions in Sumatra might produce just 405,000 b/d this year, down from the 408,000 b/d target set by the government and the 425,000 b/d produced in 2007.

"The rainy season and potential flooding will probably exacerbate the decline," said Anggoro, who predicted production eventually could drop to 382,000 b/d from the current 411,000 b/d due to natural decline. He gave no timetable for the projected decline.

CPI, which produces 40% of Indonesia's total crude output, is one of several international oil companies summoned by the budget committee, which expressed determination to discover the reasons behind the country's falling production of crude oil.

More oil revenues sought

Amid soaring prices on the international markets the Indonesian government wants to increase oil revenues and has estimated production will reach 977,000 b/d this year. In its proposed 2009 state budget, however, the government estimates that production will drop to 950,000 b/d.

The government is concerned at the potential loss of revenue due to the declining production of crude.

Anggito Abimanyu, head of fiscal policy for the finance ministry, said for every 10,000 b/d below target, the government will lose some $322.48 million in revenue based on the Indonesian crude price (ICP) of $100/bbl as established in the proposed state budget for 2009.

To determine reasons for the decline in production, the House also summoned PT ConocoPhillips Indonesia, state-owned PT Pertamina EP, PT Medco E&P Indonesia, and PT ExxonMobil Oil Indonesia.

Of the four companies, only Pertamina EP estimated it would produce more oil next year. Pertamina EP president director Tri Siwandono said, "In 2009, we are projecting to produce 125,000 b/d, about a 6% rise from 118,221 b/d this year."

ConocoPhillips president director Jim Taylor said the company in 2009 might produce only 45,000 b/d, down from this year's 80,000 b/d, while Medco director of production assets Budi Basuki said its oil output would drop slightly to 30,000 b/d in 2009 from 2008's 33,400 b/d.

WATCHING THE WORLD

Eric Watkins, Oil Diplomacy Editor

Blog at www.ogjonline.com

Does OPEC cut by the numbers?

If anything can be counted on in the oil and gas industry these days, it is that the governments of Venezuela and the US are not going to see eye-to-eye on very much at all.

Just look at how they reacted to the announcement of production cuts of about 520,000 b/d by the Organizations of Petroleum Exporting Countries, cuts made as part of a broader move by the group to reduce what it terms "excess oil" on global markets.

Almost immediately, the White House issued an announcement saying that it "certainly disagreed" with the OPEC decision to lower output and renew its call for Congress to act on legislation that boosts domestic energy production.

At the same time, Venezuela said it "trusts" that OPEC members will respect the production and quota cut agreement. Said Oil Minister Rafael Ramirez, "When OPEC reaches a consensus, we expect that it's (to be) respected."

Grinding political axes

The White House wants to characterize the OPEC cuts within its preferred framework, as part of the instability of overseas suppliers and on that basis wants to urge more exploration and production at home.

Venezuela, like one or two other OPEC members, has its own axe to grind, recognizing that reduced production will raise prices, dent the US economy and—indirectly at least—further dent its nemesis at 1600 Pennsylvania Avenue.

OPEC itself preferred to skirt any political over or undertones to its decision. As always, it wants to characterize such decisions as resting solely on the basis of supply and demand. In this case, apparent oversupply dictates reduced production.

OPEC's decision will not affect consumers "in any way," according to the group's president, Chakib Khelil, who explained that, "there is oversupply...(oil) stocks are very high. We will have overhang by the end of this year and it will be even worse early next year."

Is demand slowing?

Is Khelil just blowing smoke? That's up for grabs, maybe, but there are signs around the world that demand is slowing and that current production rates could lead to an oversupply.

Consider the Far East, where three Japanese refiners, which control about 35% of the country's total oil processing capacity, plan to cut output.

Confirming concerns that a reversal in the weakening local and global demand for fuels isn't likely very soon, Showa Shell Sekiyu KK, Cosmo Oil Co., and Idemitsu Kosan Co. all have decided to curtail output.

Why? Because they are said to be facing excess capacity and slowing demand from major consumers such as China, where consumption is declining possibly on account of a slowdown in the US, the world's biggest economy, and a major user of Chinese goods.

Forget the squabble between Washington, DC, and Caracas. Consider it a bit of wrangling over the backyard fence. OPEC may or may not be right, but there are numbers out there to back it up. ✦

ExxonMobil representative Maman told the House that the firm would next year start producing some 20,000 b/d from its Cepu field.

Rama Pratama of the Prosperous Justice Party (PKS) questioned the effort undertaken by international oil companies in comparison with the Pertamina's optimistic outlook. "What is the difference between Pertamina EP and the foreign companies?" asked Rama. He said, "I think the potential is still great." Earlier this week, the House of Representatives inquiry committee on oil and gas management heard claims that a project run by CPI has allegedly cost the state up to $210 million in losses.

"If the project continues, losses to the state could reach up to $1.2 billion," Supreme Audit Agency (BPK) official Udju Djuhaeri told the committee.

Since 2000, the CPI field in Rokan, Riau, has received extra power from a cogeneration installation operated by partner company PT Mandau Cipta Tenaga Nusantara (MCTN). The installation converts gas and feedwater into electricity and steam power. Under the country's cost recovery mechanism, CPI can claim expenses from the government for electricity and steam for the cogeneration installation. But the BPK has alleged that irregularities in the project have resulted in state losses in the form of cost recovery payments.

Udju said the figure of $1.2 billion in state losses was based on the project's long-term operations, which will run until CPI completes its contract to operate in Rokan in 2021.

Santi Manuhutu, CPI corporate communications manager, denied any wrongdoing, saying the electricity and steam processing fee paid by CPI to MCTN was "reasonable and competitive compared to similar projects in Indonesia and in the ASEAN region."

Meanwhile, other firms have also been accused of financial irregularities.

ExxonMobil Oil Indonesia was said to be some $32.53 million in arrears for taxes, dividends and royalties, while the BPK also claimed that that in 2005 ConocoPhillips double-counted a $1.94 million investment credit that had been counted in the previous year. ✦

Canadian firm gets Mediterranean acreage block off Libya, Tunisia

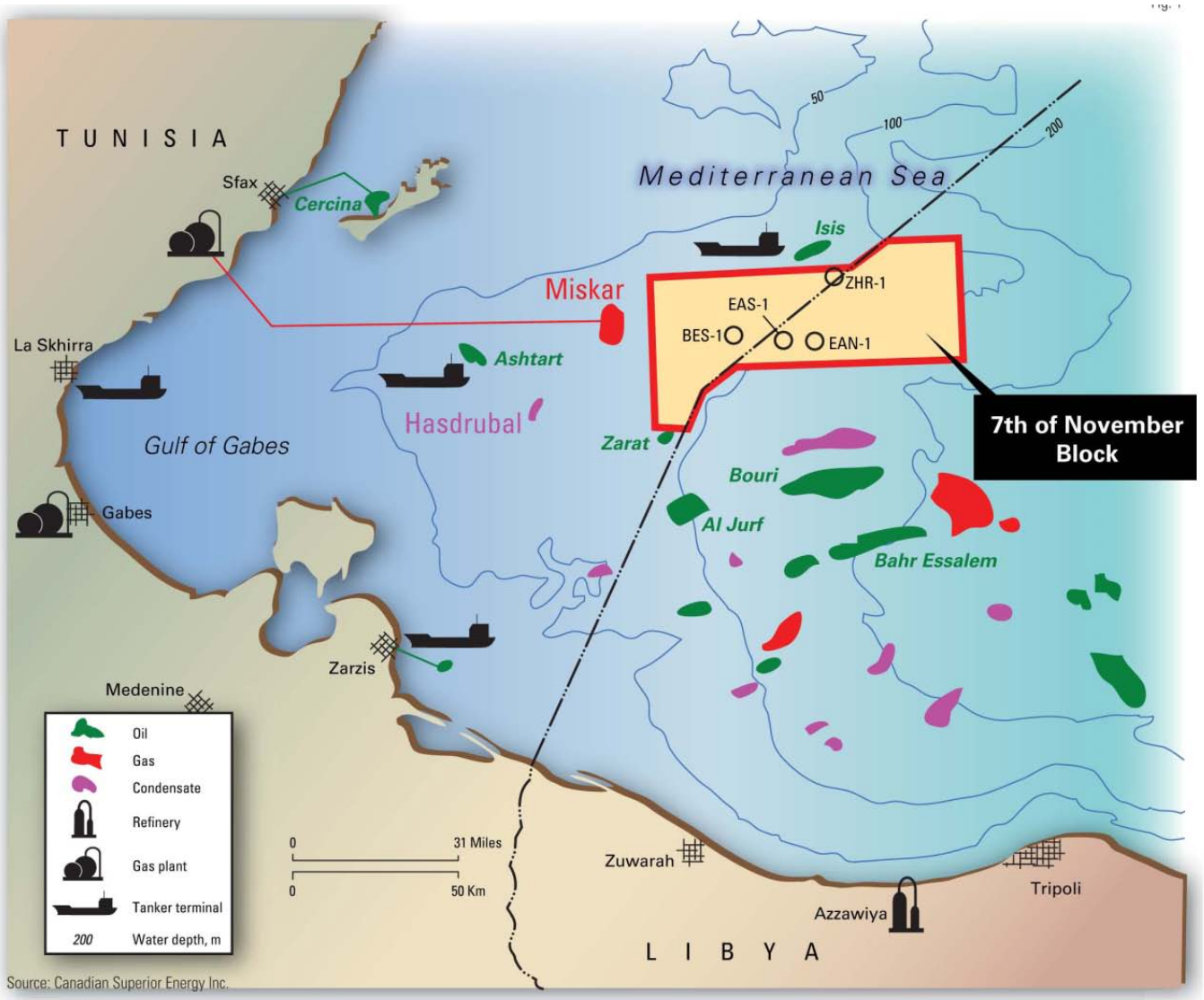
Joint Oil of Libya and Tunisia has awarded the 7th of November block in the southern Mediterranean to Canadian Superior Energy Inc., Calgary.

The work commitment in the first 4 years of the 7-year exploration period calls for drilling three exploration wells and one appraisal well and shooting 300 sq miles of 3D seismic on the 750,000-acre block.

Accompanying the exploration and production-sharing agreement is a swap agreement that awards Joint Oil an overriding royalty interest and optional participating interest in Canadian Superior's Mariner Block in the Atlantic off Nova Scotia, Joint Oil's first participation outside North Africa.

Joint Oil is owned equally by the Tunisian government through Entreprise Tunisienne d'Activites Petrolieres (ETAP) and the Libyan government via Libya Oil Holdings.

Canadian Superior will operate the block, 75 miles offshore in 250-375 ft of water. Nearly equal parts of the block fall in the territories of the two coun-



tries, although Libya's side is slightly larger. Parts of the block lie along the productive trends of giant Bouri oil field off Libya and giant Ashtart field off Tunisia, where cumulative production is 750 million bbl and 250 million bbl of oil, respectively.

Joint Oil and Canadian Superior have identified a number of highly promising prospects on the block using the large existing seismic database that represent a variety of geological plays and proved hydrocarbon systems.

The required appraisal well is to be the first well in a fast-track drilling program. It will offset two large oil and gas discoveries drilled in the 1990s on a feature known as Zarat on an adjacent contract area near the 7th of November block's southwestern corner.

Based on 3D seismic shot subsequent to the discoveries, a large portion of the undeveloped Zarat discovery area is interpreted to extend north into the 7th of November block. The primary oil, condensate, and gas reservoirs are expected at about 9,000 ft.

Canadian Superior said planning and rig contract discussions are under way targeting a two-well, back-to-back drilling program likely starting in within 6 months.

The first exploration well is to be drilled on a geologically related seismic prospect named Fisal about 6 miles northeast of the Zarat appraisal wellsite.

The companies said that eight of the undisclosed number of companies that expressed interest in the block were chosen to negotiate with Joint Oil before it awarded the block to Canadian Superior.

Joint Oil was set up in 1989. Libya's Col. Muammar Qaddhafi named the block for the day in 1987 when Tunisian Pres. Zine al-Abedine Ben Ali took power. Ben Ali is in his fourth 5-year term. ✦

Delaware basin shales strain for economics

The Mississippian Barnett shale has the potential to be a prolific gas producer in the Delaware basin, but it will take time, write geoscientists in the AAPG Bulletin.

One well is reported to have an estimated ultimate recovery of 9 bcf, said Travis J. Kinley of Texas Christian University and fellow authors. Drilling and stimulation costs to as deep as 18,000 ft began at more than $18 million and have been reduced to about $8 million.

Interval A at the top of the Lower Barnett typically has resistivities of 50-100 ohm-m and "is believed to be a significant zone of gas saturation within the Barnett," they reported.

For the most part, however, shale gas plays in the basin have resisted efforts for viable economic development.

Both the Barnett and Devonian Woodford shales should be evaluated, but silica content is less than in the Fort Worth basin. Shale is brittle and will not fracture as well, and proppant embedment may be a problem, the authors wrote. Shales can slough in horizontal wells, and the high pressures challenge frac pumping equipment.

Even so, a few wells have made initial flow rates of up to 3 MMcfd, and IP at the best well was 5 MMcfd, but decline rates are steep. Chesapeake Energy Corp. and Hallwood Energy Corp. have commercial gas sales.

Using logs from 150 wells in a study area of 500 sq miles in the northern part of the basin in West Texas and Southeast New Mexico, Kinley el al. said that areas for future exploration focus can be delineated by mapping a net resistivity greater than 50 ohm-m. No core was available, but the group studied mud logs and cuttings from five wells.

They noted that the first Delaware basin shale gas wells were drilled in southwestern Reeves County in 2002, and shale gas activity in West Texas has waxed and waned over the last 5 years.

They also noted that it took years to discover the correct combination of drilling and completion techniques to tap gas in the Barnett shale in the Fort Worth basin. ✦

Chevron's 3 tcf Piceance basin project gears up

Chevron Corp. has started gas production in a $7.3 billion project to develop an estimated 3 tcf of gas over several decades in the Piceance basin in northwestern Colorado.

Production, begun Aug. 25, is 5 MMcfd from the Cretaceous Williams Fork formation through a 30-in. sales line. Chevron has drilled 82 wells on four pads and is launching work on the fifth and sixth pads. Two rigs are running.

The staged operation will involve drilling, fracturing, and completing 2,000 to 3,000 gas-condensate wells from multiwell pads on 33,000 acres in Garfield County and installing gas gathering and compression equipment. Chevron has 100% working interest.

Current production capacity of the facilities is 50 MMcfd, and capacity is intended to build to 400-450 MMcfd in several years. Development drilling began in 2007 with the two purpose-built rigs, and four more rigs are to join them over time.

As many as 22 extended-reach wells are to be completed from a single pad.

Chevron signed a long-term agreement in late 2007 with Enterprise Gas Processing LLC to gather and treat the gas in Rio Blanco County at Enterprise's 750 MMcfd Meeker processing plant (OGJ, Nov. 26, 2007, Newsletter). Extracted liquids are to be transported from the plant through Enterprise's Mid-America Pipeline.

Condensate from the project is trucked to Rangely, Colo., where it is transported via the Chevron pipeline to the company's 45,000 b/d Salt Lake City refinery. ✦

EXPLORATION & DEVELOPMENT

Colombia

Emerald Energy PLC plans to drill another development well in Vigia field on the Campo Rico Association Contract in Colombia.

Vigia-4ST will use 1,500 ft of the cased well bore of the unsuccessful Vigia-4 well drilled in 2007 and will be drilled directionally to the Une and Gacheta reservoirs south of the Vigia-5 well.

Meanwhile, the Vigia-6 development well found oil in both reservoirs and had good development of clean sandstones in Gacheta, where it was completed at an initial stable flow test rate of 850 b/d of oil with a trace of water.

India

Canoro Resources Ltd., Calgary, plans to obtain a 30% participating interest from Essar Oil Ltd. and Essar Energy Holdings Ltd. in two exploration production-sharing contracts in Upper Assam, India, subject to government approval.

The AA-ONN-2004/3 and AA-ONN-2004/5 blocks total 1,285 sq km.

AA-ONN-2004/3 is north of the Brahmaputra River and has potential for interesting structures in the Himalayan foothills. The first 4-year exploration period requires 50 sq km of 3D seismic and 400 line-km of 2D seismic acquisition plus one exploration well.

AA-ONN-2004/5 is south of the river and has potential for stratigraphic plays. The first 4-year exploration period has a work commitment of 50 sq km of 3D seismic and 180 line-km of 2D seismic acquisition plus one exploration well.

Papua New Guinea

Sasol Petroleum International, Johannesburg, obtained a 51% working interest in four oil and gas licenses totaling 37,000 sq km near established fields in the Papua New Guinea foreland.

Seismic surveys are to start in October on PPL 285, 286, 287, and 288.

Partners include Papua Petroleum Ltd., a Papua New Guinea exploration company.

British Columbia

Result Energy Inc., Calgary, plans to spend $7 million in the first quarter of 2009, subject to board approval, to participate in four wells and 3D seismic surveying in the Horn River basin in Northeast British Columbia.

The company holds 29,000 net acres prospective for gas in the Devonian Muskwa and Evie shales and the underlying Devonian Keg River platform.

Louisiana

Operators reported developments in the emerging Jurassic Haynesville shale gas play.

Cubic Energy Inc., Dallas, cased to TD of 11,950 ft its fifth Haynesville shale well in the play, its second well on Bethany-Longstreet field acreage.

Red Oak Timber 5-1 logged Cotton Valley and Hosston zones and two shale zones comparable in thickness and quality to those cut at the company's Estes 7-1 well. The shale is also comparable to that being produced by operators in Johnson Branch and Caspiana fields, the company said.

Gas sales began Aug. 26 at 886 Mcfd from the company's Bonomo 35-1 well and Sept. 1 at 885 Mcfd from Wilbanks 36-1, both producing from Cotton Valley after a new refrac design.

Chesapeake Energy Corp., meanwhile, completed the $263 million purchase of 13,000 net acres of mineral rights in the Northwest Louisiana Haynesville from International Paper Co., Memphis.

New Mexico

Carbon dioxide injection began on Aug. 25 at Milnesand (San Andres) Unit in Roosevelt County, NM, and unit oil production could grow to 5,000 b/d when fully flooded from the present 70 b/d, said Enhanced Oil Resources Inc., Houston.

The pilot injection rate stabilized at 400 Mcfd for 7 days in the 5,000-acre unit. Cumulative production is 13% of the estimated 95 million bbl of OOIP. Target is 18 million bbl.

Full field development is contingent on construction of a pipeline to deliver CO_2 from western New Mexico and eastern Arizona.

North Dakota

Newfield Exploration Co., Houston, has accumulated 170,000 net acres in the Williston basin Bakken shale oil play the past 3 years and plans to operate at least two rigs there throughout 2009.

The acreage position includes nearly 100,000 acres west of the Nesson anticline, 16,000 acres along the anticline, and 54,000 acres in Elm Coulee field, Richland County, Mont. Newfield has an average 57% working interest in 13,600 gross acres in the Lost Bear Prospect along the anticline in McKenzie and Dunn counties, ND, has identified more than 10 drilling locations, and expects to drill 4-6 wells there in 2008.

It holds 18,000 gross acres 50-50 with Concho Resources in the Westberg Prospect along the anticline in Williams County, ND, where Newfield has more than 20 locations and expects to drill 5-7 wells in 2008.

Continental Resources Inc., Enid, Okla., built its position in the Bakken shale play to 577,000 net acres in Montana and North Dakota, including 32,000 net acres in Mercer County, ND.

It is operating 10 rigs in North Dakota, six of which target the Three Forks/Sanish formation in hopes of proving the company's theory that that zone is separate from the overlying Middle Bakken over the majority of its acreage (OGJ, Apr. 28, 2008, p. 38). It is running four rigs in Richland County, Mont., where it plans to spud its first Three Forks/Sanish well this month.

Corrosion problems solved in CT nitrogen operations off Brazil

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Laboratory and field research with various completion fluids helps refine procedures to reduce corrosion in coiled tubing during use of nitrogen contaminated with oxygen.

For several years, coiled-tubing operations off Brazil have used nitrogen generation units. Petrobras has increased the use of nitrogen generation units because of the remote locations, lack of liquid nitrogen suppliers, and other logistical issues.

Using a nitrogen generation unit in remote locations, where most of the platforms have very limited space, solved the longstanding problem of supplying nitrogen. However, when we used a nitrogen generation unit with coiled-tubing operations, another concern arose.

In situ nitrogen generation does not produce pure (99.9%) nitrogen gas. In situ nitrogen generation can yield nitrogen gas compositions with oxygen content as high as 5%.

Under downhole conditions, using nitrogen with the oxygen content as high as 5% can result in severe corrosion in the coiled-tubing (CT) string. Furthermore, completion brines and acids are sometimes pumped, increasing the corrosivity downhole.

Occasionally operations were stopped because the coiled-tubing bottomhole assembly (BHA) was either completely plugged by oxidized metal flakes or the coiled-tubing string became so corroded that it required inspection before further use. Based on these corrosion and safety issues the use of in-situ nitrogen generation loses its benefits.

To find a solution to this corrosion problem, we undertook a laboratory research study with the most commonly used CT string material, then pumped treatment fluids under surface and downhole conditions with the maximum percentage of oxygen concentration expected in operations. We tested several corrosion inhibitors and mixtures for their ability to control corrosion.

After laboratory testing established which inhibitor systems would control the corrosion rate of the CT, yard tests confirmed that the inhibitor would work in the field. Following successful field trials, we changed the recommended practices to avoid corrosion problems when nitrogen generation units are used offshore.

This article presents the development of this project, beginning with CT corrosion observed in laboratory research studies, yard trials, recommended field applications, and applying the results in live operations on the Merluza platform in the Santos basin.

Nitrogen workovers

Cleaning out depleted vertical wells by removing sand and other debris, and pumping acid stimulation treatments into specific zones is a common application for coiled tubing. Treating depleted wells generally requires nitrogen be added to the workover fluid. This ensures that the hydrostatic pressure

Equations

$$K = A * \exp(-Ez/R^{*}T) \quad (1)$$

$$Fe \rightarrow Fe^{++} + 2e^{-} \quad (2)$$

$$FeCl_2 + 2H_2O \rightarrow Fe(OH)_2 + 2H^{+} + 2Cl^{-} \quad (3)$$

$$Fe_2 + 2H_2O \rightarrow Fe(OH)_2 + 2H^{-} \quad (4)$$

$$Fe + 2HCL \rightarrow FeCl_2 + H_2 \quad (5)$$

$$Fe + 2H^{+} \rightarrow Fe^{++} + H_2 \quad (6)$$

$$H_2O + \tfrac{1}{2}O_2 + 2e^{-} \rightarrow 2H^{-} \quad (7)$$

$$2H^{+} + 2e^{-} \rightarrow H_2 \quad (8)$$

Nomenclature

k = Rate coefficient
A = Constant
Ea = Activation energy
R = Universal gas constant; 8.314 J x mol^{-1}K^{-1}
T = Temperature, K.

Based on a presentation to the SPE/ICoTA Coiled Tubing and Well Intervention Conference, Apr. 1-2, 2008, in the Woodlands, Tex.

Shown here, from left to right: pipe before treatment, after treatment, and rust removed from plugged BHA (Fig. 1).

The coupons for tests 11 and 12 appear clean after removal from incubation cells and before sand blasting (Fig. 2).

Corrosion appeared on test coupons: corrosion inhibitor (CI)-4 dipped coupon (Test 9, wet surface), CI-6 dipped (Test 14, wet surface), and CI-6 incubated in fluid (Test 15, in fluid); all in 3% KCl brine (Fig. 3).

stays below the reservoir pressure.

One of the disadvantages of using a nitrogen generation unit is that it can generate as much as 5% oxygen along with the nitrogen. According to corrosion literature and experience, an oxygen level of 5% is sufficient to create corrosion in the presence of chloride completion brine systems and acidic fluid systems.

In one example, CT operations were stopped because the BHA of the coiled tubing was completely plugged. Later observation of the coiled tubing found severe corrosion that could have resulted in pipe failure.

Corrosion

Corrosion processes are heterogeneous electrochemical reactions that generally occur on metal surfaces in corrosive environments.

These oxidation-reduction reactions involve transferring electrons. Corrosion processes can be considered metal oxidation reactions, which means that metals act as reductors, donating electrons that are received by an oxidant. Corrosion is a method by which the metal material is degraded, due to electrons being lost at the surface.

Corrosion occurs through different mechanisms. For each mechanism, the process is complex, incorporates many factors, and varies according to the metal and the specific operating conditions. Corrosion types are classified by:

- Morphology.
- Mechanism.
- Mechanical factors.
- Environment.
- Attack localization.

Characterization according to morphology helps to clarify the mechanism and adequate application of protection. Based on morphology, the main classification, the general types of corrosion are:

- Generalized or uniform.
- Plaques.
- Pitting.
- Intergranular.
- Transgranular.
- Filiform.
- Exfoliation.

Uniform corrosion

Uniform corrosion normally occurs on metallic surfaces where the homogeneous composition and microstructure are in uniform contact with the corrosion environment.

At elevated temperatures, the attack is generally accelerated. The relationship between corrosion rate and temperature follows Arrhenius´ equation (Equation 1), which affirms that an increase of 50° F. redoubles exponentially the increase in the rate of the chemical reactions.

At higher temperatures, the higher collision rate of molecules, due to the higher kinetic energy, affects the activation energy of the reaction. The activation energy is the amount of energy required to initiate a reaction. In aqueous solutions, the temperature increase can reduce the oxygen proportion and, therefore, the corrosion.

This is the only form of corrosion for which metal loss, or weight loss, data from corrosion coupons or ultrasonic testing can be used

STEEL SAMPLE*

Table 1

C	Mn	P	S	Si	Cr	Cu	Ni	Mo
0.10-0.16	0.70-0.90	0.025 max.	0.006 max.	0.30-0.50	0.50-0.70	0.25 max.	0.20 max.	0.21 max.

Physical properties:

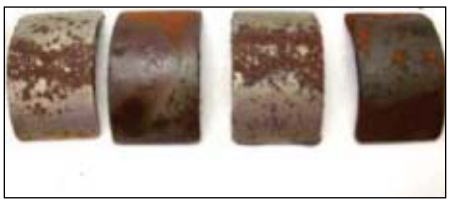
Minimum yield strength	80,000 psi (552 N/sq. mm)
Minimum tensile strength	90,000 psi (621 N/sq. mm)
Minimum elongation	26%
Maximum hardness	Rockwell C22

*Chemistry of elements in weight %. This material is a modification of ASTM A-606 Type 4 high-strength, low-alloy (HSLA) steel designed to corrode uniformly under atmospheric conditions and self-passivate.

to accurately and reliably estimate corrosion rates and pipe's life expectancy.

Observed corrosion

Generalized corrosion inside the CT string was the type observed in this field study. This type of corrosion is well distributed across the entire metal surface, with little or no localized penetration. It is the least damaging of all corrosion types. However, during operations in which fluids were pumped through the coiled tubing after rust had formed, the BHA became completely plugged. Therefore, the coiled-tubing operations were stopped with economic repercussions. Fig. 1 shows a picture of the CT string before use in the field and after the pipe had been used in a field operation with generated nitrogen containing a maximum of 5% oxygen.



Corrosion appeared on coupons after tests in 3% KCl. From left to right: Test 16, CI-7 dipped coupon, wet surface; Test 17, CI-7 coupon immersed in fluid; Test 19, CI-8 dipped coupon, wet surface; Test 20, CI-8 coupon immersed in fluid (Fig. 4).

Corrosion appeared on coupons after wet surface tests with 3% KCl, water containing 2 gal/thousand CI-9, and 1% by volume of different corrosion inhibitors. From left to right: Test 21, water-dipped coupon; Test 22 with CI-9; Test 23 with CI-4; Test 24 with CI-6; Test 25 with CI-8; and Test 26 with CI-7 (Fig. 5).

In this case, we observed uniform corrosion, as well as pitting, primarily because brines and acid blends were commonly used in this CT operation. Although pitting affects only small portions of the metal surface, pitting can cause a quicker loss of wall thickness and result in crevices, perforations, and stress concentration points. These pits reduce the material's mechanical resistance and can result in a fracture of the pipe or a coiled-tubing failure.

The presence of chlorides in a corrosive environment accelerates pitting corrosion. Pitting corrosion is initially slow. However, once pits are formed, this autocatalytic reaction can be self-sustaining in CT as the chromium tends to provide a strong potential for the corrosion cell to continue to grow.

In the anodic area, steel oxidation produces pitting, forming Fe^{+2}, Cr^{+2}, and Ni^{+2} ions. Equation 2 illustrates this, using iron as an example.

This generates an excess positive charge and causes the migration of chloride ions (which have a higher mobility than OH^- ions) inside the pitting to compensate for the charge. Consequently, this causes an increase in salt concentration, $FeCl_2$. This salt undergoes hydrolysis, creating

LABORATORY TEST RESULTS

Table 2

Corrosion rate severity classification*	Range, mpy	Corrosion inhibitors and blends
Very high	>150	CI-2, CI-3, CI-4
High	80-150	CI-1, CI-6, CI-7, CI-8
Medium	50-80	CI-9
Low	20-50	CI-9/CI-4 , CI-9/CI-8, CI-10, CI-9/CI-10
Very low	< 20	CI-5, CI-5/CI-4, CI-8/CI-9

*Regarding the pitting rate, anything >1 was not considered acceptable

3% KCl CORROSION STUDIES*

Table 3

Test no.	Metal	Inhibitor	Concentration, volume %	Conditions	Corrosion rate, mils/yr	Corrosion rate, lb/sq ft/time	Pitting rating
First set of tests							
1	1	CI-1	1	Wet surface	89	0.0075	2
2	1	CI-1	1	Immersed in fluid	32	0.0027	—
3	1	CI-2	1	Wet surface	173	0.0145	2-3
4	1	CI-2	1	Immersed in fluid	44	0.0037	—
Second set of tests							
5	1	None	—	Wet surface	181	0.0152	3-4
6	1	None	—	Immersed in fluid	31	0.0026	—
7	1	CI-3	2	Wet surface	153	0.0129	2-3
8	1	CI-3	2	Immersed in fluid	36	0.0030	—
9	1	CI-4	1	Wet surface	185	0.0156	3
10	1	CI-4	1	Immersed in fluid	30	0.0025	—
Third set of tests							
11	1	CI-5	—	Wet surface	9	0.0008	—
12	1	CI-5 + CI-4	1	Wet surface	21	0.0018	—
13	1	CI-4	1	Wet surface	155	0.0130	3
14	1	CI-6	1	Wet surface	113	0.0095	3
15	1	CI-6	1	Immersed in fluid	61	0.0051	1
16	1	CI-7	1	Wet surface	128	0.0108	2
17	1	CI-7	1	Immersed in fluid	48	0.0040	1
18	1	CI-8	1	Wet surface	137	0.0115	3
19	1	CI-8	1	Immersed in fluid	74	0.0062	2
Fourth set of tests							
20	1	None	None	Wet surface	64	0.0054	2
21	1	CI-9	2 gal/thousand	Wet surface	69	0.0058	3
22	1	CI-9 and CI-4	2 gal/thousand and 1%	Wet surface	26	0.0022	1
23	1	CI-9 and CI-6	2 gal/thousand and 1%	Wet surface	51	0.0043	0-1
24	1	CI-9 and CI-8	2 gal/thousand and 1%	Wet surface	14	0.0012	—
25	1	CI-9 and CI-7	2 gal/thousand and 1%	Wet surface	42	0.0035	—
Fifth set of tests							
*26	1	None	—	Wet surface	35	0.0029	—
27	1	CI-10	25	Wet surface	79	0.0066	2
28	1	CI-9 and CI-10	2 gal/thousand and 12%	Wet surface	28	0.0023	1-2
29	1	CI-9 and CI-10	2 gal/thousand and 25%	Wet surface	39	0.0033	1

*Using QT800 metal, tested for 18 hr, at 230° F., 400 psi of 95% nitrogen and 5% oxygen environment; in a static corrosion cell.

hydrochloric acid, HCl ($H^+ + Cl^-$), as shown in Equations 3 and 4.

The increase in ions (H^+), means the pH drops, which accelerates the corrosion process because the formed HCl begins to attack the metal, as shown in Equations 5 and 6.

With the consequent formation of $FeCl_2^+$, which will again undergo hydrolysis according to Equation 3, the continuity of the corrosion process is assured. Because oxygen practically has no solubility in salt-concentrated aqueous solutions, there is no oxygen reduction inside the pitting according to the reaction shown in Equations 7 and 8.

Laboratory testing

BJ Services conducted laboratory corrosion studies to determine the effectiveness of different corrosion inhibitors in adequately protecting coiled-tubing steel from the uniform and pitting corrosion previously described. Membrane gas generated in-situ creates the corrosive environment, a common situation for CT operations offshore Brazil.

Table 1 shows the specifications of the coiled-tubing steel, which is modified from ASTM A-606 Type 4 high-strength, low-alloy (HSLA) steel. It is designed to corrode uniformly under atmospheric conditions and self-passivate. It is the most common CT material in the Campos basin.

Fluids. The fluids used in the tests were the most commonly pumped fluid systems in CT jobs in the referenced area: 3% KCl brine and 5% acetic acid + 7% formic acid

Gas mixture. Due to the corrosion problems observed during use of the generated nitrogen with 5% oxygen (O_2) content in the field, this gas mixture was used in all corrosion studies. Under standard conditions, the units available at the field produce 750 scf/min at 95% nitrogen (N_2) purity (<5% O_2).

Corrosion inhibitors. Ten different corrosion inhibitors (CI) were tested, as were blends among them. Experiments were run with and without corrosion inhibitors.

The following lists and describes the corrosion inhibitor codes:

- CI-1 = Imidazoline-ethoxylated alkyl ether phosphate organic corrosion inhibitor.
- CI-2 = Corrosion inhibitor blend of naphthalene and ethyl benzene (organic blend).
- CI-3 = Cationic organic acid corrosion in inhibitor.
- CI-4 = Corrosion inhibitor blend of imidazolines, surfactants, and organic acids.
- CI-5 = Oil-based solvent.
- CI-6 = Oxygen high-shear, high-temperature organic corrosion inhibitor.
- CI-7 = Acid corrosion inhibitor blend of alcohols and solvents.
- CI-8 = Acid corrosion inhibitor blend of alcohols and quaternary derivatives.
- CI-9 = Quaternary amine polymers.
- CI-10 = Phosphonate iron chelating agent.

Simulation of downhole conditions. Static corrosion studies were conducted in a 95% nitrogen-5% oxygen environment at the temperature of 230° F., and a pressure of 400 psi, under two different exposure conditions:

1. A wet surface area of the corrosion coupon only from dipping in the test fluid.
2. The metal coupon totally immersed in the test fluid for the entire corrosion study period.

This environment was created with an Ofite HPHT filter press.

Measuring results. We measured test results both quantitatively and qualitatively. Corrosion rates were measured in mils/year (mpy) and lbm/sqft/time; the pitting rating was reported according to the scale in the accompanying box.

PITTING SCALE

Pitting rate	Remarks
0	Zero (no staining or any surface irregularities).
0-1	Slight staining of surface, but no surface irregularities.
1	A trace amount of pitting on surface.
2	A small amount of pitting on the surface.
3	A medium amount of pitting on the surface.
4	A large amount of pitting on the surface.
5	Large holes or very deep pits anywhere on the test coupon.
Trace (Tr)	Slight staining of surface, but no surface irregularities.
Erosion	Large amount of pitting.

Yard test: While pumping generated nitrogen through the CT string, we dosed with corrosion inhibitor to create an internal film that would protect the pipe from corrosion (Fig. 6).

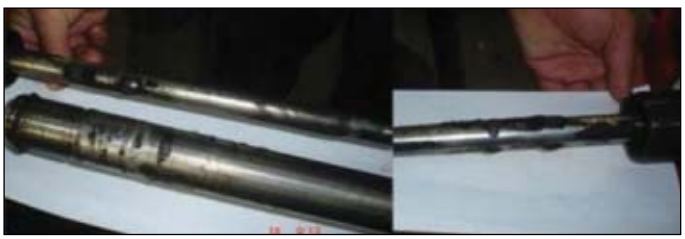
As shown in Fig. 6, the BHA includes a filter and phase separator. The filter has two components: a slotted pipe screen, shown above at left, and smaller diameter magnet, shown above at right. After testing for 3 days at a low N_2 rate, the filter showed a small amount of rust (Fig. 7).

5% ACETIC, 7% FORMIC ACID CORROSION STUDIES*

Table 4

Test	Metal	Inhibitor	Concentration, by volume	Conditions	Corrosion rate, mils/year	Corrosion rate, lb/sq ft/time	Pitting rating
30	1	CI-3	2%	Wet surface	27	0.0023	2
31	1	CI-3	2%	Immersed in fluid	35	0.0030	0
32	1	None	—	Immersed in fluid	4,089	0.3435	3

*Testing QT800 tubing for 6 hr, at 230° F., at 400 psi in 95% nitrogen and 5% oxygen environment; using static corrosion cell.



After testing for 3 days at a high N2 rate, the screen—magnet filter showed a small amount of rust (Fig. 8).

YARD TEST RESULTS

Table 5

Parameters	Nitrogen generation rate — Low	High
Nitrogen rate range, scfm	300-350	600-650
Injection pressure, psi	1,300	2,200
N_2 purity, %	97-98	95-96
Corrosion inhibitor injection rate, l./hr	27	27

Experiment description

We conducted corrosion studies with the 3% KCl brine and the metal coupons using several different corrosion inhibitors. With each corrosion inhibitor and inhibitor blends, one coiled-tubing coupon was dipped twice into 3% KCl brine containing the inhibitor and placed into the Teflon cup inside the corrosion bomb with no fluid sample present.

In the second test with each corrosion inhibitor, we added the 3% KCl with inhibitor fluid to the Teflon cup and placed the steel test coupon into the fluid for the entire corrosion incubation period. We allowed the corrosion tests with the 3% KCl brine and the steel test coupon to run for an 18-hr incubation period at 230° F.

We also conducted corrosion studies with the 5% acetic-7% formic acid system over a 6-hr exposure period. As in the KCl corrosion studies, we dipped one coupon twice in the inhibited acid and placed it in the Teflon cup with no fluid for the entire corrosion study period.

In the second set of corrosion tests with the inhibited acid, we placed the coupon in the inhibited acid fluid volume for the entire 6-hr incubation period.

After each steel coupon was placed in its respective corrosion cell, the cell was closed and evacuated with nitrogen gas three times to insure that all the atmospheric air had been purged. After the third nitrogen evacuation, we pressurized each corrosion cell to 400 psi with a 95% nitrogen and 5% oxygen gas mixture to simulate the nitrogen atmosphere in the field. Each corrosion cell was placed in a 230° F. oven for the test incubation period.

After the incubation period, the cells were cooled and the pressure released. We removed each test coupon from the cell, neutralized it with soda ash, and washed with water. The test coupons were photographed to record their surface condition before being sandblasted, cleaned, dried, weighed, and their surfaces evaluated for pitting. We compared the final weights to the initial weights of the coupons to determine the corrosion rates for each fluid environment.

Laboratory corrosion studies

We conducted tests on ten different corrosion inhibitors and blends, recording corrosion and pitting rates.

Table 2 shows the classified results according to the severity of corrosion observed. This table was used to select the corrosion inhibitors that would be tested in the field.

Tables 3 and 4 provide more detail of the inhibitors' concentrations, blends, and results. Figs. 1-5 show the coupon samples with varying amounts of corrosion.

Table 3 details test results for the 3% KCl brine, at 230° F. in 95% nitrogen and 5% oxygen environment, at 400 psi, in a static corrosion cell for a period of 18 hr.

Table 4 gives the results for 5% acetic acid-7% formic acid, tested at 230° F. in 95% nitrogen and 5% oxygen environment, at 400 psi, in a static corrosion cell for a period of 6 hr.

Based on the laboratory corrosion results, the next step was to select the best-performing corrosion inhibitors and to test its application in the field.

Yard tests were recommended to define injection rates that would fulfill operational limitations, such as offshore product storage, while providing the desired pipe protection.

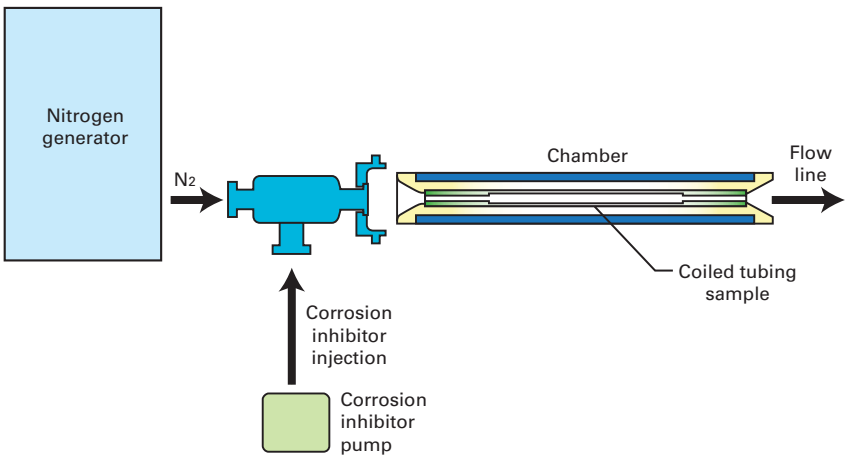
Yard, field trials

We developed new operating procedures for injecting corrosion inhibitors (CI) into the system while pumping generated nitrogen.

First, it is important to understand the final purpose of the in-situ generated nitrogen use in CT operations. In some cases, only nitrogen is pumped through the CT string to reduce the hydrostatic pressure applied downhole by the fluid inside the well and, thereby, bring the well back on production. In the other cases, fluid is commingled

FIELD EQUIPMENT SCHEMATIC

Fig. 9



with nitrogen, to clean the well, perform a stimulation treatment, or activate tools such as rotational jetting tools or downhole motors. For these situations, the most commonly selected fluids are brines, gels, diesel, or acids. These were the scenarios tested in the laboratory, yard, and field.

Fig. 6 shows the yard test equipment rig up, with details of the components. While generated nitrogen was pumped through the string, corrosion inhibitor was dosed to create an internal film that would protect the pipe from corrosion.

Several CI injection rates were tested until the appropriate protection was established for both high- and low-N_2 generation situations. The corrosion inhibitor that performed the best was CI-5. Because this was not a blended product, it was the best choice from an operational point of view being: easy to handle, non-toxic, readily available locally, and economically feasible.

Table 5 shows the observed parameters.

In order to give time for rust to form, the test was performed continuously for 3 days in both cases, the string was pickled with 5 bbl of 5% HCl with the BHA still in place. We removed the BHA afterwards for inspection.

As seen in Figs. 7 and 8, only a small amount of rust and corrosion products were present, or retained in the BHA, at both low and high nitrogen injection rates. The minimal amounts of rust and corrosion oxidation solids did not plug the BHA.

After the yard test, the final step was a field trial that included an additional component in the surface rig up. This component was a chamber in the treating line, containing a sample of the CT string placed after the N_2 and corrosion inhibitor injection points. A drawing of that component is shown in Fig. 9.

The purpose of this chamber was to enable us to check the string condition at intervals, with the CT and BHA still in the hole, while the treatment was performed. This chamber allows CT operations personnel to inspect the sample of coiled tubing without pulling the BHA out of the hole. Although the coiled-tubing sample in the chamber was at surface temperature, corrosion was still observed when corrosion inhibitor was not used, or when improperly dosed.

Merluza platform test

We performed the first field trial in five wells from the Merluza platform. This coiled-tubing operation involved pumping pure nitrogen and commingled nitrogen and a blend of 5% acetic and 7% formic acid.

The results of this field trial showed results similar to those obtained in the laboratory and yard trials. We saw very little corrosion on the CT string in the chamber, with no plugging of the BHA. Also, very low corrosion rates were observed on the CT string after the five-well campaign was completed.

Learnings

Based on the laboratory tests, yard, and field trials, we found that corrosive environments involving nitrogen generator units can be controlled within an acceptable level by using appropriate corrosion inhibitors and procedures. Experiments also demonstrated that selecting the right inhibitor and concentration is fundamental to achieving positive results. Based on this study, we conclude that membrane gas remains an effective and economically feasible solution for CT operations off Brazil.

When liquid nitrogen is used, it requires an average of three tanks (2,000 gal each)/ well in a 24-hr period. No more than three tanks could be stored on the platform and, with no support ships near the location, a standby time of about 30 hr is was incurred to obtain additional liquid nitrogen supplies.

Even after a support ship arrived, another 15 hr was necessary to transfer liquid nitrogen to tanks on location. In total, at least 11.8 days was the average time required to finish one well and obtain enough nitrogen for the next.

When the membrane unit replaced the liquid nitrogen tanks, we saved a total of 6.8 days of standby and transfer time. Additionally, using nitrogen membrane units results in less equipment on location, saving additional space. It also required less time/job, and saved all costs related to nitrogen transportation, resulting in wells being brought back into production faster.

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Production

Considerable potential remains after Daqing polymer flood

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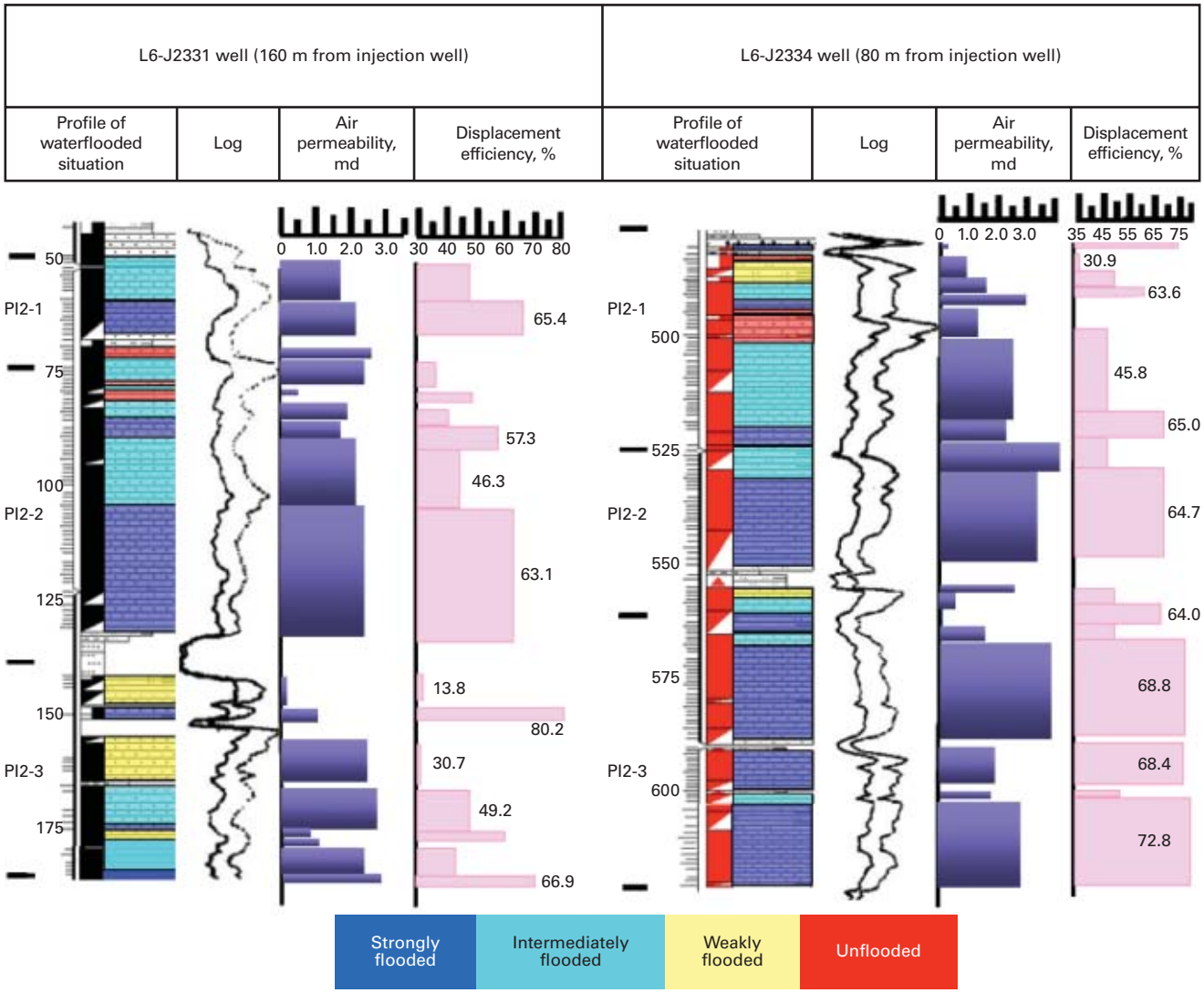
At present, one potential for additional oil recovery from Daqing oil field in northern China is the remaining oil

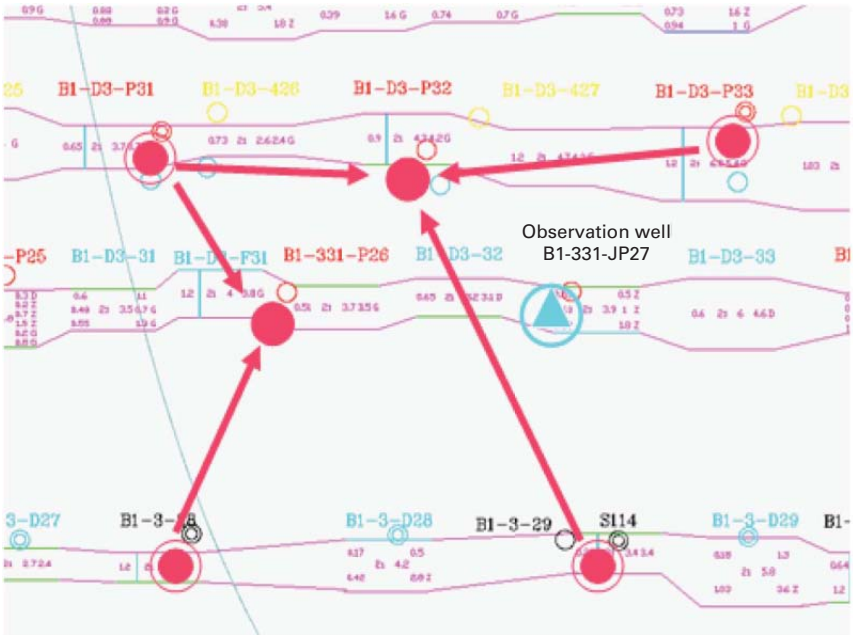
PI2 UNIT AFTER WATERFLOODING

Fig. 1



PI2 LAYER SEDIMENTARY FACIES

Fig. 2



contained in reservoirs that have undergone polymer flooding.

The first field-scale polymer flooding at Daqing started in 1996, and polymer flooding has shown good technical and economic results.

By November 2007, Daqing already had 14 areas in which polymer injection had finished. These 14 areas have more than 2,000 production and injection wells.

Oil recovery after polymer flooding from these areas is 52.8%, meaning that the areas still contain large amounts of crude oil.

Determining the distribution of the remaining oil is the key for tapping this potential source of oil.

Remaining oil

One factor affecting oil recover at Daqing is the cyclic sedimentation of the reservoirs.

Small quantities of oil remain in the upper parts of the sections of the first class, connected, river-channel sand. The polymer flooding was effective in these sands, and a high proportion of the thickness was flooded. There remains, however, some untapped oil. The oil mainly is in the upper part of the section that has poor physical properties.

The remaining oil also has a scattered distribution.

The field has 29 sedimentary units with remaining oil. These units have a total effective thickness of 147.6 m with a weakly flooded and unflooded thickness of 21.4 m or 14%.

Fig. 1 shows that the unflooded thickness of the PI2 unit in the observation well L6-J2331 is 2.05 m, including four isolated intervals that interlace with intermediate-flooded intervals. The unflooded thickness in the PI 2 unit from observation well L6-J2334 is 1.30 m. This includes three isolated intervals that have different distributions in other parts of the waterflood.

The remaining oil has a fragmented distribution.

Most unflooded intervals are in areas with poor physical properties. The intervals have less than a 0.6 md air permeability. The average is 0.19 md, meaning that the intervals require suitable stimulation to displace the remaining oil.

Another factor affecting oil recovery is the poor connectivity between the channel sands.

Where nonriver-channel sand exists between injection and producing well, the area will have relatively low oil recovery.

Twelve sedimentary units contain this kind of remaining oil. The units have a total effective thickness of 24.6 m and a 10.05 m (40.8%) weakly flooded and unflooded thickness. As an example in the PI2 unit of observation well B1-331-JP27, the injection

COMPARISON OF WATERFLOODING IN NORTH SAERTU AREA

Table 1

Well	Layer unit	— Strongly flooded — Thickness, m	Ratio, %	— Intermediately flooded — Thickness, m	Ratio, %	— Weakly flooded — Thickness, m	Ratio, %	— Unflooded — Thickness, m	Ratio, %
B2-322-JP43 (Main streamline)	PI1	—	—	0.20	40	0.30	60.0	—	—
	PI2	3.01	44.7	3.72	55.3	—	—	—	—
	PI3	5.08	78.5	1.19	18.4	0.20	3.1	—	—
	PI4	0.78	26.9	1.42	49.0	0.29	10.0	0.41	14.1
	PI1-4	8.87	53.4	6.53	39.3	0.79	4.8	0.41	2.5
B2-323-JP42 (Branch streamline)	PI1	—	—	—	—	0.32	23.5	1.04	76.5
	PI2	2.50	39.7	3.8	60.3	—	—	—	—
	PI3	2.56	42.0	3.54	58.0	—	—	—	—
	PI4	0.89	33.0	1.49	55.2	0.32	11.8	—	—
	PI1-4	5.95	36.1	8.83	53.6	0.64	3.9	1.04	6.3
Difference	PI1-4		17.3		–14.3		0.9		3.8

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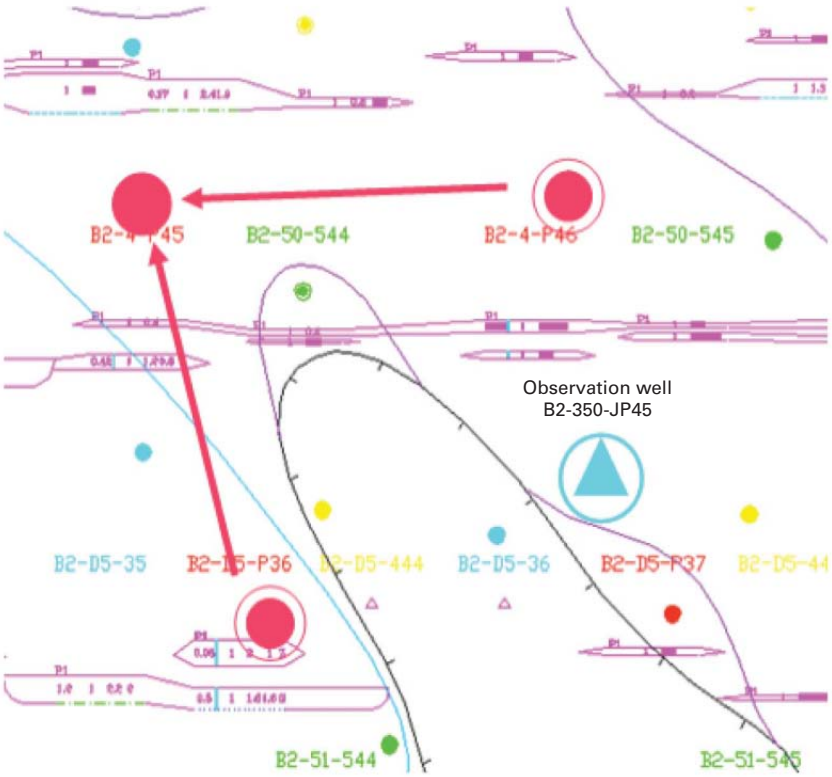
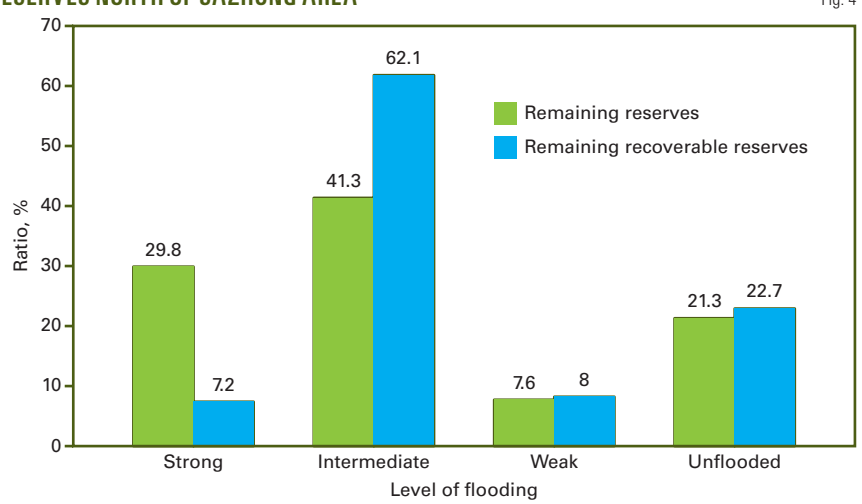
PI1 LAYER SEDIMENTARY FACIES

Fig. 3



RESERVES NORTH OF SAZHONG AREA

Fig. 4



well is in main body, thin sand while the producing well is in a river-channel sand. The distance between the wells is large. The layer has a 3.72 m effective thickness with a 1.88 m (55.5%) weakly flooded and unflooded thickness (Fig. 2).

A third factor affecting oil recovery is incomplete injection-production patterns.

Some intervals in the injection-production well pattern are incomplete and have much remaining oil. Four layer units have this kind of remaining oil. The units have a 14.95 m effective thickness of which 10.63 m (71.1%) is weakly flooded and unflooded. An example is the PI1 unit of observation well B2-350-J45. The well is at the peripheral part of interriver sand and all of its 0.93 m effective thickness is unflooded (Fig. 3).

A fourth factor affecting recovery is that some oil remains in areas that have branch streamlines in the original well pattern for polymer flooding

In 2007, two observation wells were drilled in the same well group in the B-2 area of the north Saertu oil area. The wells are B2-322-JP43 (main streamline) and B2-323-JP42 (branch streamline). Table 1 compares the streamlines.

Most of the reservoir on the main streamline area was strongly waterflooded. This area has a thickness ratio that is 17.3% larger than the area with the branch streamlines. On the other hand, most of reservoir on the branch streamlines was waterflooded intermediately. This area has a thickness ratio that is 14.3% larger than that main streamline area.

The ratio of unflooded thickness in the branch streamline area is 3.8% less than in the main streamline area.

The comparison of log interpretations shows that for the PI layer unit after polymer flooding, the remaining oil in the branch streamline area is much higher than in the main streamline area (Table 2). The water saturation in the area with branch streamlines is 5.77% lower than in the main streamline area after polymer flooding for the PI1-4 units.

Remaining oil also exists near the production well of the original polymer-flood well pattern.

The analysis of data in October 2005 from two cored wells at different points along the injection-production main streamline in the west block of the northern Lamadian oil area show this. Observation well L6-J2331, about 160 m away from the injection well, indicated an oil recovery factor of only 43%,

but another observation well L6-J2334, 80 m away from injection well, indicated an oil recovery factor of 54.3%, 12% higher than in the L6-2331 well (Table 3).

Although river-channel sands are in all PI21, PI22, and PI23 layers, their distances to the injection well are different; and therefore the three layers exhibit different oil recoveries in the observation wells.

Potential after polymer flooding

According to data from 11 observation wells, after polymer flooding, the remaining potential is mainly in the intermediately and strongly flooded intervals that account for 71.1% of the total remaining reserves (Fig. 4).

If the displacement efficiency of strongly flushed intervals remains unchanged while the displacement efficiency of other intervals increases to the average value of the higher flooded levels, the resulting remaining oil in the strongly, intermediately, weakly, and unflooded intervals is 7.2%, 62.1%, 8.0%, and 22.7%, respectively.

After polymer flooding, the focus will be on improving the recovery efficiency of the intermediately flooded intervals in thick pay zones. The major pay zones with remaining reserves are in the PI2 and PI3 sedimentary units in which the river-sands are well developed.

The oil layers of the PI2 unit in the Lamadian area are braided river sediments.

The distribution of remaining reserves is 50.5% in PI21, 32.3% in PI22 unit, and only 17% in PI23 due to the thinness (Fig. 5).

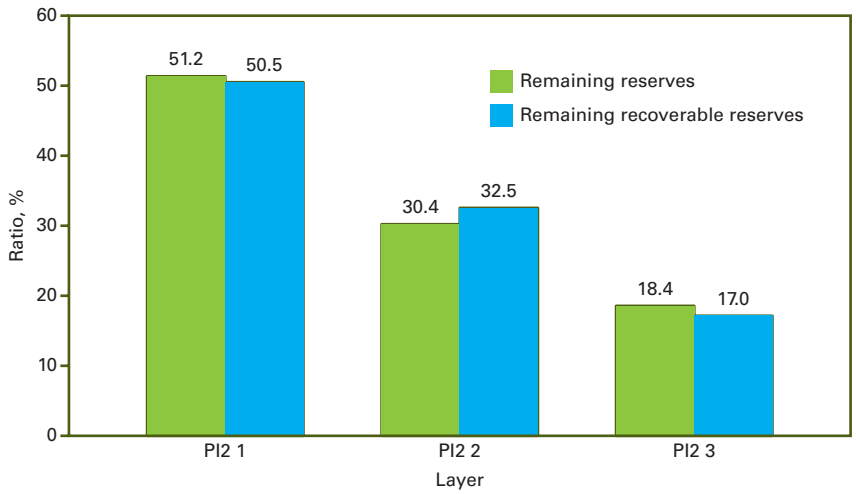
Sazhong and Saibei areas also show the same potential remaining oil distribution.

Some of the possible measures to enhance oil recovery after polymer flooding include surfactant flooding, surfactant-polymer binary flooding, alkaline-surfactant-polymer ternary flooding, high concentration polymer flooding, microbial oil recovery, fracturing, profile control, water shutoff, adjustment of well pattern, thermal recovery technique, horizontal well technique, and combination of these measures.

Daqing oil field has seen good

RESERVES IN LAMADIAN AREA

Fig. 5



WATER SATURATION AFTER POLYMER FLOODING IN WEST AREA OF EASTERN B-1 BLOCK

Table 2

Location	PI1 h_e, m	PI1 S_W, %	PI2 h_e, m	PI2 S_W, %	PI3 h_e, m	PI3 S_W, %	PI4 h_e, m	PI4 S_W, %	PI1-4 h_e, m	PI1-4 S_W, %
Main streamline (20 wells)	1.0	50.61	5.3	57.97	3.4	55.95	2.2	57.86	11.6	56.85
Branch streamline (20 wells)	1.3	44.44	6.0	53.33	2.4	50.38	1.9	49.29	11.6	51.08
Difference in water saturation	—	6.17	—	4.64	—	5.57	—	8.57	—	5.77

Note: h_e = effective thickness; S_W = water saturation.

CORED WELL IN MAIN STREAMLINE AFTER POLYMER FLOODING

Table 3

Well	Layer	h_e, m	k_g, md	Ratio of flooded thickness: Strongly flooded	Intermediately flooded	Weakly flooded	Total	Displacing efficiency, %	Recovery, %
L6-J 2331	PI2 1	11.3	2.120	42.9	41.6	—	84.5	54.0	45.7
	PI2 2	1.1	0.491	12.7	—	87.3	100.0	22.3	22.3
	PI2 3	5.6	2.133	8.2	52.9	38.9	100.0	41.6	41.6
	Total	18.0	2.025	30.3	42.6	17.4	90.3	47.6	43.0
L6-J 2334	PI2 1	10.21	2.431	39.7	42.2	5.4	87.3	54.0	47.1
	PI2 2	5.14	2.802	68.7	21.4	9.9	100.0	59.3	59.3
	PI2 3	4.05	2.405	91.6	8.4	—	100.0	69.5	69.5
	Total	19.4	2.837	58.2	29.6	5.5	93.3	58.4	55.0

Note: h_e = effective thickness; k_g = air permeability.

results for oil recovery after polymer flooding.

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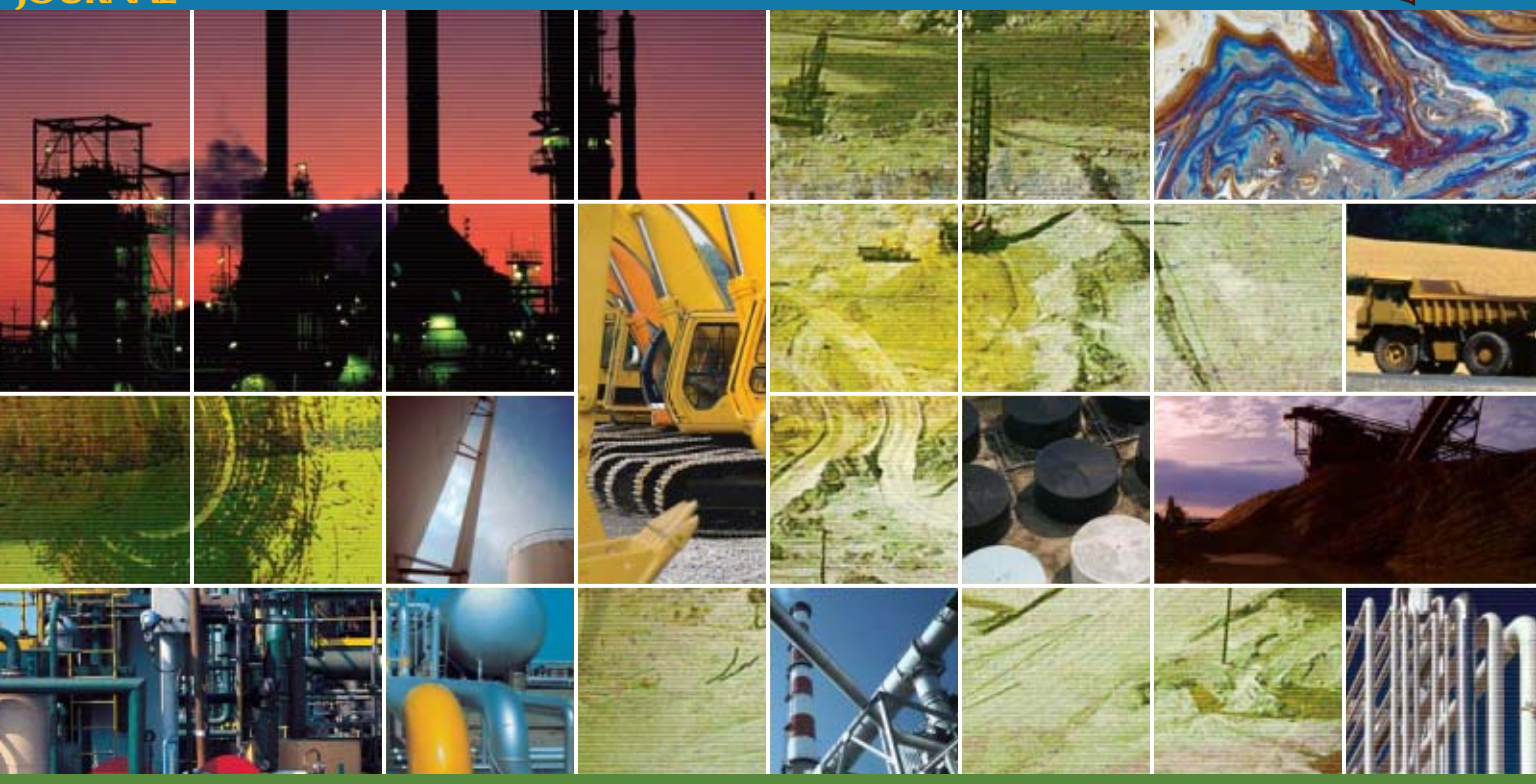

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Contaminants key to refinery offgas treatment unit design

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This article details methods for removing individual contaminants in refinery offgas (ROG). Various configurations of the ROG treatment unit and associated units are compared, depending on the type of product and feedstock. This article also discusses optimization strategies required for design of ROG treatment units.

ROG is produced in refinery units such as hydrotreaters, alkylation units, FCCs, and catalytic reformers, that manufacture conversion products. Refiners can recover valuable products including hydrogen, olefins, NGLs, and higher-btu fuel gas from the offgas if an ROG unit is installed. Incremental economics of product recovery as opposed to using the entire offgas for fuel provides incentives for installation of ROG units.

Specifications of recovered products and catalyst requirements will dictate the allowable limits of these contaminants in the feed stream.

Refinery offgas

Investment incentives for installation of ROG processing units are the incremental economics for production of hydrogen, olefins, NGLs, and higher-btu fuel gas as opposed to using the entire offgas stream for fuel. Added value from the liquids recovered in the offgas processing unit will normally be the largest profit source.

If a refiner can produce a hydrogen stream that is of sufficient purity and at the appropriate battery-limit conditions, then production of this hydrogen will normally have reasonable economic benefits compared to production of hydrogen from standalone plants. If the refinery is near an ethylene plant, recovery of products such as ethylene and propylene for petrochemicals can boost profitability while corecovering hydrogen through refinery and petrochemical integration.

Table 1 shows the composition of a typical ROG stream. The stream's hydrogen content varies appreciably depending on the source. The heavier liquid components (C_2+) also vary considerably, between 20% and 40%.

An ROG stream can contain many trace components such as oxygen, ammonia, nitriles, acetylenes, heavy sulfur compounds, butadiene, chlorides, arsenic, mercury, and water, in addition to the acid gases H_2S, CO_2, and COS. Removal of certain contaminants in feed pretreatment is essential.

Several contaminants that may be present in the ROG can cause significant problems in the cryogenic section. These include diolefins, NOx, mercury, CO_2, water, and some sulfur compounds. The presence of these compounds will require front-end treating for ROG processes with cryogenic units to meet product specifications.

ROG unit products

Products from an ROG unit typically include a hydrogen-rich gas, a methane-rich gas, and an NGL stream. Installation of an ROG unit is beneficial for refiners because the main polluting components from the offgas are separated and value-added products, like hydrogen-rich gas and NGL, are produced. Burning of methane-rich gas without polluting and soot-forming components is also beneficial environmentally.

The cryogenic section produces a hydrogen gas that meets the required purity; or a higher purity if it is further purified in a PSA unit. Recovered NGLs are normally fractionated to produce a mixed C_2 and C_3+ stream.

The C_2 stream can be further fractionated to produce a polymer-grade ethylene and ethane product. The C_3+ stream may be split into a propylene product and a propane product depending on the economics.

TYPICAL REFINERY OFFGAS

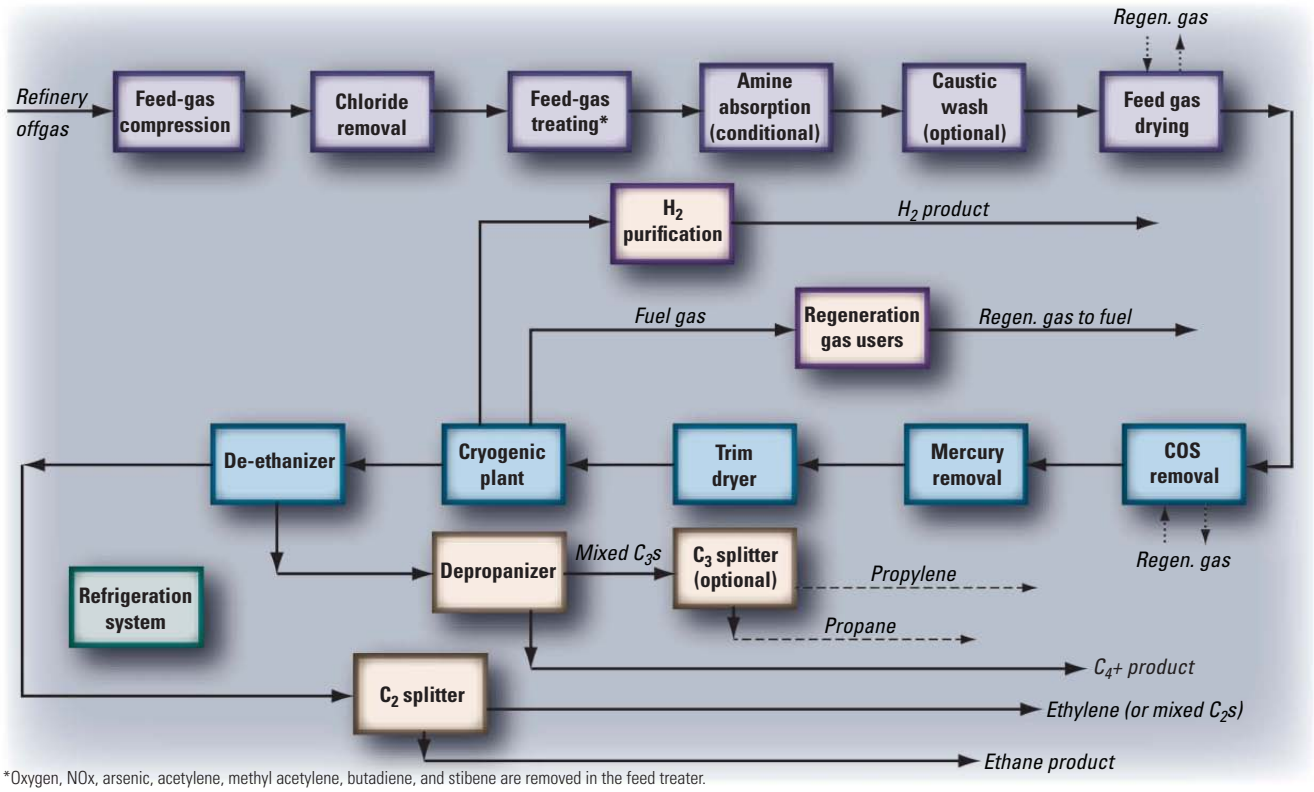
Table 1

Component	Composition, mole %
Hydrogen	5-35
CO	0.1-0.5
Nitrogen	3-10
CO_2	0.1-0.5
Methane	30-50
Acetylene	10-15 ppm (vol)
Ethylene	5-20
Ethane	15-25
Methyl acetylene & propadiene	60-80 ppm (vol)
Propylene	1-5
Propane	1-5
Butadiene	0-0.1
Butylene	0.1-0.3
Butanes	0.5-1.0
C_5+	0.2-1.5

Based on a presentation to the 2008 National Petrochemical & Refiners Association Annual Meeting, Mar. 9-11, 2008, San Diego.

TYPICAL ROG TREATMENT, RECOVERY

Fig. 1



*Oxygen, NOx, arsenic, acetylene, methyl acetylene, butadiene, and stibene are removed in the feed treater.

The propylene can be either polymer grade (99.5 mole % propylene) or chemical grade (93-95 mole % propylene). Generally speaking, it is uneconomical to produce polymer-grade propylene based on the mixed C_3 compositions in typical ROG streams. Production of polymer-grade propylene may be an option contingent on the local market.

ROG units typically feed 25-120 MMscfd of gas. Generally, the compression and cryogenic recovery sections are the most costly and energy intensive depending on the feed treatment requirements.

Designers of ROG plants attempt to maximize NGL recovery and impurity tolerance to reduce the capital cost of front-end treatment. If saturated gas from the refinery, for example, has sulfur compounds and CO_2 as its main impurities, the ROG unit can be designed to remove most of the sulfur and C_4+ compounds in the first stage of chilling and the NGL-recovery unit can be a CO_2-tolerant design. The C_4+ can return to the refinery with the sulfur compounds because they may go to a Merox unit or refinery hydrotreater.

ROG unit configuration

A refinery offgas plant generally consists of the following sections:

- Feed compression and front-end gas treatment.
- Cryogenic separation of H_2, methane, and C_2+.
- Hydrogen purification.
- Fractionation of the C_2+ components.

A refiner selects the process scheme for front-end, feed gas treatment based on the types and levels of contaminants, as well as the allowable levels of contaminants in the final products.[1,2] The process scheme for the cryogenic section is based on many factors including feed-gas pressure, hydrogen product purity, unit cost of electricity, and desired recovery level of the C_2+ fraction.

Available options for hydrogen purification include cryogenic separation, membrane separation, and pressure swing adsorption (PSA).[3,4]

The process scheme for fractionation of the C_2+ fraction depends on the desired product slate and product specifications.

The ROG unit's design should give due consideration to the feed-gas composition from the refinery based on future expansion and modification plans. Upset conditions and off-design cases can also influence drastically ROG unit operations. These conditions can include increased concentration of sulfur compounds and a greater or lesser concentration of hydrogen in the feed gas.

If the hydrogen concentration in the feed gas drops over the time, for example, a membrane type unit may not be the most economical choice. A lower feed hydrogen concentration means that hydrogen removal can be accomplished more economically in a cryogenic unit followed by a PSA unit.

A feed profiling study is therefore important for the most optimal design.

The figure shows a schematic block flow diagram of a typical ROG recovery plant with deep recovery of hydrogen and C_2s.

Process design

Important factors in the design of an ROG unit include inlet gas compression, front-end feed treatment, cryogenics, fractionation, and refrigeration.

Inlet gas compression

ROG is usually delivered to the battery limits at a low pressure (50-250 psig). The gas is then compressed to the required pressure, normally with two compression stages. Reciprocating compressors accommodate sudden changes in feed flow rate and molecular weight. Feed gas should be compressed to a higher pressure consistent with that required for the targeted cryogenic liquid recovery.

The compression section is normally one of the most cost and energy-intensive sections, and the design difficulty lies in optimizing this section. The type and number of compressors, in addition to the efficiency of their drivers, are important design considerations. If a recycle compressor is required, for example, the design should consider centrifugal machines for this service.

The designers should conduct a reliability and maintainability study to evaluate plant availability and determine any sparing requirements.

Front-end feed treatment

Due to the different process sources of ROG, impurities encountered in the stream may include water, H_2S, CO_2, COS, methyl mercaptan, acetylene, methyl acetylene, mercury, HCl, organic chlorides, oxygen, CO, NOx, ammonia, and stibine.

Impurities are normally present in various concentrations. Removal of these compounds is required for:

- Safety.
- Corrosion control.
- Product specifications.
- Prevention of freezing in the plant's cold section.
- Prevention of catalyst poisoning in downstream facilities.
- Compliance with environmental requirements.

Selection of the treating processes will depend on the types and quantities of feed impurities. Various catalysts and chemicals are required for the treating processes. Catalyst loading and chemical consumption are important for ROG recovery. Performance data from vendors are needed to determine the catalysts required and size of equipment.

Generally, front-end treatment is preferred particularly when the contaminants such as mercury and chlorides, water and CO_2, or NOx and oxygen, can corrode equipment and materials of construction, cause operational problems like freezing in the cryogenic section, or reduce safety of the unit, respectively.[1]

Treating the entire ROG feed at the unit's front end or treating the fractionated products individually to meet the finished product specifications at the back end are options to remove contaminants such as acetylenes or sulfur compounds.

For acetylenes, feed concentration is key to the relative location of the acetylene converter in the process scheme. With low acetylene concentrations, front-end hydrogenation of acetylene is preferred. With high acetylene concentrations, back-end hydrogenation with a selective palladium catalyst is preferred.[5]

This article assumes front-end treatment of the offgas and removal of all contaminants.

Chloride removal

Gas from the compressor discharge feeds a chloride guard bed, which removes chlorides. Chlorides can take the form of hydrogen chloride and various organic chloride compounds. Chlorides are present because they are used to condition catalytic reforming catalysts.

Chlorides can act as a poison to the nickel-based catalyst that is required for conversion of acetylene and oxygen. They must therefore be removed beforehand.

Other types of problems due to chloride include chloride-induced corrosion, formation and deposition of ammonium chloride, and off-spec products.[6] The type of chloride in the feed will determine the method for chloride removal.

Activated alumina or promoted alumina can remove HCl but not organic chlorides. Catalyst manufacturers are currently developing adsorbents that can remove organic chlorides. Selective hydrogenation of chlorides in the presence of olefinic components in the ROG is generally not an option.

Selective hydrogenation

The figure shows that feed gas flows from the chloride bed to the feed-gas treater, which is a selective hydrogenation unit. A nickel-based sulfided catalyst, such as Sud-Chemie's C-36, can be used for front-end feed gas treating.

This catalyst was developed to treat FCC offgas. It is a multi-functional catalyst that removes or converts many kinds of poisons and impurities to low levels, including oxygen, NOx, acetylene, methyl acetylene, butadiene, arsine, phosphine, stibine, and mercury.

The nickel-based sulfided catalyst can treat:

- *Oxygen.* This promotes polymeric formation of light olefins and can react with amines to form carboxylic acids, which crystallize at low temperatures. It can also react with H_2S to form sulfur at high temperatures. Furthermore, it may be a major factor in the formation of NOx. It is therefore important to remove oxygen completely from the feed before it enters the cold box to avoid cold box plugging.
- *Acetylene.* This is a catalyst poison for olefin polymerization. It can also promote coking. The typical product specification for polymer-grade ethylene requires concentrations of oxygen and acetylene of less than 1 ppm (vol).
- *NOx.* This forms in FCC units during spent-catalyst regeneration. When reacting with oxygen, NO will form

NO_2 at low temperatures. NO_2 accumulates as a solid in cold sections of the plant. Further reaction of NO_2 with oxygen will lead to formation of N_2O_3 or "blue ice." The N_2O_3 freezing point is –152° F.

NO_2 or N_2O_3 may react with diolefins to form an unstable gum, which can explode when exposed to a sudden warm-up of the plant. N_2O_3 can also react with ammonia to form ammonium nitrate that can explode at warm temperature. NOx is converted to ammonia by the sulfided nickel catalyst that is used in the front end acetylene converter.

• *Nitriles.* Catalyst companies claim that nearly all nitriles are converted to amines using the sulfided nickel catalyst. This claim, however, is unproven and a conservative design for the process assumes no conversion. Molecular sieve adsorption of the offgas feed is the recommended method for removal of these nitrogen compounds if they are present.

Acid-gas removal

After leaving the selective hydrogenation reactor, gas flows through an acid-gas removal system. This system can be an amine unit followed by caustic treating or a stand-alone caustic treating system.

Caustic

Product specification of polymer-grade ethylene recovered from the ROG gas requires a total sulfur level of less than 1 ppm (wt). A caustic wash is required to remove sulfur compounds to required levels.

Feed gas from either the selective hydrogenation bed or amine treater feeds the caustic tower. For ethylene plants, a two- or three-stage caustic tower is normally used. Typical caustic concentrations are 11 wt % for the upper stage and 3 wt % for the lower stage.

Caustic systems require less capital than amine systems, but the operating costs are higher due to caustic use.[7 8] Amine units do not remove mercaptans to a significant extent. A caustic wash system is required if mercaptans are present. The design must also consider disposal of acid gas from the amine unit.

CONTAMINANT REMOVAL Table 2

Contaminant	Removal method
Water	Molecular sieve
CO_2	Amine, caustic
H_2S	Amine, caustic
COS	Alumina
RSH mercaptans	Caustic
Acetylene	Selective hydrogenation
Methyl acetylene & propadiene	Selective hydrogenation
Arsine	Selective hydrogenation
NOx	Selective hydrogenation
Oxygen	Selective hydrogenation
Butadiene	Selective hydrogenation
Ammonia	Adsorbent
Mercury	Impregnated activated carbon
Chlorides	Adsorbent
Stibine (antimony)	Adsorbent
Phosphine	Selective hydrogenation
CO	CO shift

Inlet gas dehydration

After acid-gas removal, the gas must be dehydrated so that hydrates will not form in the downstream cryogenic unit. Temperatures in the cryogenic unit can be as low as –256° F. Because olefins are present, 3A molecular sieve is normally used. This type of molecular sieve was developed specifically for cracked gas drying and will adsorb only water.

Because refrigeration is available, the design should consider chilling the feed gas from the caustic tower overhead to feed the dehydrators. This will reduce the size of the dehydrators and lower regeneration gas requirements. The gas can be chilled to 5-10° F. above the anticipated hydrate point.

COS removal

Amines or caustic do not remove COS effectively. The recommended method is a bed of alumina adsorbent, which is normally upstream of the mercury-removal bed and downstream of the dehydrators.

Alternatively, the COS-removal unit can be upstream of the amine-caustic system and designed as a COS hydrolysis unit. The fixed-bed catalytic reactor converts COS to H_2S and CO_2, which can then be removed in a downstream amine unit.

Mercury removal

The designer should assume that mercury is present unless tests ascertain otherwise. A mercury guard bed captures mercury and protects downstream brazed-aluminum exchangers. A sulfur-impregnated activated carbon can be used for this service. Zinc and copper-based chemical adsorbents can also be used.

Table 2 shows a summary of ROG feed contaminants and the pertinent removal method.

Cryogenic section

Cryogenic separation is the core of the ROG liquids-recovery process. A typical process involves a series of progressive cooling in plate-fin heat exchangers and vapor-liquid separation steps, followed by demethanization.

Mechanical refrigeration is required in the cryogenic unit to reach the temperatures required for desired NGL recovery and to meet required hydrogen purity. Turboexpanders can be used in combination with external refrigeration to increase thermodynamic efficiency of the process. Expander-based liquids recovery is commonly used.

A cryogenics unit produces three product streams from the ROG unit:

• C_2+ liquids to feed the downstream fractionation unit.

• Methane-rich offgas for fuel.

• Hydrogen-rich offgas for further purification.

The cold box includes several stages of cooling in plate-fin heat exchangers. A cryogenic unit can produce a moderately pure hydrogen stream of around 95 mole %. The hydrogen-rich stream from the cold box can be purified to 99.9% in a PSA unit, which also produces a low-btu offgas stream.

If CO is present in the high-purity hydrogen from the PSA unit, the stream can be treated in a methanator for conversion of CO, followed by dehydration in hydrogen dryer.

The cryogenic unit's demethanizer fractionates methane gas from NGL product according to battery-limits product specifications. Depending on

the cryogenic processing scheme used, the demethanizer overhead can feed a PSA unit for hydrogen purification or to the fuel gas system. The demethanizer will normally have several feeds and side reboilers for heat integration.

Fractionation

The fractionation train configuration and complexity depends on the types of products required. The fractionation train normally includes a de-ethanizer, a depropanizer, a C_2 splitter, and an optional C_3 splitter.

Product specifications determine the columns' design parameters:

- The depropanizer can produce refinery-grade propylene.
- The C_2 splitter can produce polymer-grade ethylene.
- The C_3 splitter separates a mixed C_3 stream into chemical-grade propylene and commercial-grade propane.

Propane refrigeration is used for the de-ethanizer and C_2 splitter condensers.

The demethanizer bottoms stream enters the de-ethanizer at the midsection. The de-ethanizer normally operates at about 390 psia at the overhead.

Low-pressure steam provides heat in a thermosyphon reboiler. Refrigerant from a propylene refrigeration system condenses overhead vapors.

The de-ethanizer bottoms, consisting of propylene, propane, and heavier components, feed the depropanizer. De-ethanizer overhead is a mixture of ethylene and ethane. It feeds the C_2 splitter.

Ethane product from the C_2 splitter bottoms goes to the product surge drum. Both ethylene and propylene products are pumped from the product drums, heated, and delivered to pipelines.

The depropanizer operates at 285 psia, which allows cooling water to condense overhead vapors. Low-pressure steam provides reboil heat to the column.

C_4+ product from depropanizer bottom feeds the product pipeline. The overhead product, refinery-grade propylene, is withdrawn from the reflux drum and pumped to a pipeline. Alternately, if required, refinery-grade propylene (mixed C_3s) can be further fractionated to propane and chemical-grade propylene in a C_3 splitter.

Overhead chemical-grade propylene is withdrawn from the C_3 splitter reflux accumulator and pumped to the propylene storage tank for pipeline delivery. The bottoms propane product from the C_3 splitter feeds the propane product surge drum where it is pumped to pipeline pressure for delivery.

Refrigeration

Two refrigeration systems are needed for a typical ROG plant. One system is propylene (or propane) for feed pre-chilling and overhead condensers in the fractionators. The other system, which provides a colder level of refrigeration for the cold box, can be cascaded ethylene refrigeration or a mixed-refrigerant system.

Acknowledgment

This paper is dedicated to the memory of Thomas J. Kenney, who contributed to this paper at Technip USA prior to his passing in late 2005. ✦

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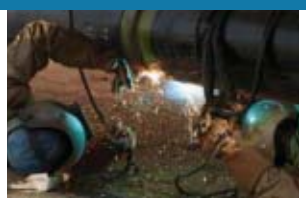

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TERMINAL SITING—Conclusion

Project viability hinges on waterway, land assessments

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LNG terminal development requires careful assessment of both the waterway leading to the potential terminal site and the geographic conditions of the site itself. Establishing critical parameters for these areas helps ensure the economic viability of the terminal.

The first article of this series (OGJ, Sept. 8, 2008, p. 50) assessed the factors leading to onshore or offshore terminal location and the influence of LNG vessels on potential marine terminal siting. This concluding article will consider land requirements for onshore locations, including soil and seismic conditions and site elevations, as well as waterway and jetty requirements.

Land requirements

LNG released to the atmosphere as a result of accidental spillage will immediately start to vaporize and form a gas cloud. This cloud will spread as influenced by the wind and, depending on the size of the spill and weather conditions, could extend beyond the boundaries (plot area) of the terminal. A source of ignition in the flammable area of the cloud could have devastating consequences.

Safety requires addressing worst-case scenarios to ensure their risk of occurrence and consequences remain within acceptable limits.[1] A risk-assessment study addresses the probability of a catastrophic failure of an LNG tank.

Table 1 provides guidance regarding typical areas across which a cloud could extend.

The risk of ignition and the consequences thereafter depend on the type and density of population within the spread of the cloud, making it important to know the population densities and activities within 2 miles of the terminal.

As LNG ship sizes increase, ship-arrival frequency decreases, but correspondingly, required storage volume for loading and unloading increases. Vessel delays due to unfavorable weather or ship problems directly affect LNG stock levels at both terminals and liquefaction plants. The volume and design of ship tankage therefore, largely determines the area required for onshore facilities.

Operating full-size LNGCs will require at least one 265-295 ft diameter tank. Operational considerations, however, suggest the need for more than one tank. Tank-containment philosophy, however, likely most affects the area required for the terminal (and also its location relative to its neighbors).[2,3]

Single-containment tanks require large bounded areas and are only practical where space is readily available and little or no population nearby. Full-containment tanks provide the smallest likelihood of an accidental release and can be used almost anywhere but are expensive. Double-containment tanks cost slightly less than full-containment but still need a large terminal area.

A low throughput terminal (up to about 3 million tonnes/year) handling large LNG carriers (125,000 cu m or larger) will need two tanks. Industrial or residential areas require full-containment tanks, but in greenfield or unpopulated areas double or single-containment designs may be acceptable.

A terminal in an industrial area, with two full-containment tanks, would need about 40-50 acres.

Table 2 provides rough terminal areas for initial site-selection studies based on different containment configurations.

Shoreline lengths

A terminal might also require water intakes and outfalls and firewater or water for use in the vaporizers. Intakes are often large structures accommodated by settling ponds, pumps, and screens and are usually on shore. Water for the intake comes from a pipe placed close to

the bottom of an adjacent waterway but away from the shoreline to avoid bringing too much sediment into the system. Outfalls are simpler structures located away from the intake to avoid recycling water between the two structures.

If insufficient shoreline exists to provide enough distance between water intake and outfall to prevent mixing cooling water, the choice of vaporizer may be limited to either a submerged combustion vaporizer or shell-and-tube exchanger vaporizer.

Soil, ground

Poor soil and ground conditions at a site can raise material and construction costs, typically requiring pile foundations and soil enhancements.

LNG tanks should be founded on rock, but firm sand would also avoid use of piled foundations. Soft materials such as silts and soft clays, often found in estuarine locations, will almost certainly require piling under the larger structures, such as tanks and vaporizers.

Risks associated with flooding, environmental concerns, and the cost associated with ground preparation can make areas such as marshes and swamps unsuitable.

Seismic conditions

Earthquakes can damage storages tanks and pipelines.

Japan, one of the world's largest users of LNG, has many LNG storage tanks and LNG pipelines. Even during its most severe earthquakes, however, no LNG tanks were damaged, even though LNG pipelines were.

Site elevation

Low site elevation may contribute to the risk of site flooding. Events that may result in flooding include:

1. Poor drainage.
2. High river elevations created by upstream conditions.
3. High sea levels created by low atmospheric pressure and high winds.
4. Tsunamis.
5. Hurricanes.

All of these events can damage facilities, lead to partial or complete shutdown, or disrupt terminal operations. The US Federal Energy Regulatory Commission requires a storm-surge study on any prospective site. This study determines site elevation relative to 100-year flood levels and its susceptibility to flooding.

An area that normally floods, however, does not preclude its selection. A number of measures can mitigate risks associated with siting a terminal in such an area. These include using pile foundations, raising site elevation, or building a berm around the facility. Each of these options adds to the facility's cost.

Environmental limitations

Large LNG carriers can normally berth in winds up to about 20 knots. Some current terminals quote a limit of 30 knots, but this may apply principally to membrane carriers since they have a lower sail area than spherical carriers. It is also possible that a terminal will rely on additional tugs should this condition occur. LNGCs will usually remain at berth in winds up to about 40 knots, although the berth itself will usually be designed for 60 knot winds or higher.

Ship breakout from the berth can have serious consequences. Orienting the berth so that the LNG carrier will tend to be pushed toward it can help reduce this risk but may not always be feasible, as other conditions might take precedence. This possibility has prompted LNG discharge arms to be equipped with powered emergency release couplings to reduce any spillage stemming from exceeding the loading or unloading arm's operating limits.

Waves and currents can also place large loads on a ship's hull. Current loads on a ship's hull are high if imposed beam on, with implications for berth design and operation. The speed of a current is less important than its directional uniformity, although current speeds greater than 2 knots will usually result in operational difficulties. Currents should be considered during vessel maneuvering as well as while the LNGC is at berth.

Jetty location

Marine terminals should afford protection from waves and currents and be away from vessel traffic. Berthing a vessel in a strong current (>2 knots) can be problematic and may make a location undesirable from a shipping viewpoint. Water depths should allow passage during all states of tide.[4 5]

APPROXIMATE LNG SPILLAGE EXTENTS*

Table 1

Spillage		Extent of spillage by terrain type, ft			
Source	Rate, cu m/hr	City	Suburb	Rough ground	Water
Tank failure	20,000	3,940	5,250	6,560	8,530
Discharge line	12,000	1,800	2,130	3,940	4,265
Loading arm	4,000	1,310	1,486	2,780	3,445
Small hole	50	390	390	390	390

*For site selection guidance only.

The seabed's nature and underlying strata determine an acceptable draft at the jetty for vessel operations.[5 6] Underkeel clearance typically measures 10-20% of the vessel draft, depending on wind, wave, and current conditions as well as the nature of the seabed and operator requirements. Vessels subject to large wave action will require a greater underkeel clearance than those in calm waters.

Berthing and unberthing operations should occur in a maneuvering area with a minimum diameter of twice the ship's length unless it can be demonstrated the berthing maneuver requires less. The berth should be away from the navigation channel to afford protection to the docked LNG vessel. Aside from the heightened threat of collision with other ships a site near a channel would introduce, wakes can disrupt unload-

ing operations if they cause excessive vessel motion. FERC requires analysis of passing ship wakes' effect on moored gas carriers.

Local port infrastructure such as tugs, pilots, support craft, and operations such as refineries or chemical plants can increase the attractiveness of one location over another.

Marine terminals, however, should remain sufficiently separated from other operations with safety distances determined through risk analysis. Items addressed by risk analysis should include LNG spillage and collision risks from adjacent channel shipping. Analysis should also include vapor cloud dispersion models which take into account LNG spillage and calculating vapor dispersion resulting from site-specific wind speeds and directions as well as other environmental conditions.

Results of these models form part of the required permitting exercise in the US and much of the world and can affect placement of the berth relative to other berthing operations in the area and also relative to the channel. Once a site has been selected, design addresses any risks to operation by carefully choosing equipment and procedures.

Access to the terminal from the sea should be as direct and as short as possible, reducing both transit time through confined waters and the risk of interface with other shipping. Such access also permits quick departure to open water should an emergency arise. Vessels should not have to pass under any bridges or other structures spanning the channel if this situation can be avoided.

LNG vessels require unobstructed approaches from the open sea. Typically the LNG carrier will pick up the pilot(s) at the outer limit of the channel or the sea buoy where an anchorage should be and then be escorted into port.

Wave heights from 2-3 m may impose operating restraints on pilot pick-up or require the use of helicopters. Entrance channels should run straight with as few bends or sharp turns as possible. Buoys should mark the limits of the channel. Leading marks or lights should orient a ship for safe transit into the more sheltered inner port area.

APPROXIMATE TERMINAL AREA REQUIREMENTS*

Table 2

Tank containment design	Terminal area, acres — 1 tank	2 tanks	3 tanks
Full	25-35	40-50	50-65
Double	50-65	90-100	115-125
Single	75-90	115-125	150-165

*For site selection guidance only.

Exposed outer channels may require an underkeel clearance of 20% of the ship's draft to accommodate wave action in its approach to the port, squat (the increase in draft as a result of relatively high speed in shallow water), survey error, rolling, etc.[6] Inner channels may only require an underkeel clearance of 10%.[6] Both the outer and inner channel should be of sufficient depth to accommodate the largest LNG carrier envisioned at the terminal during all states of tide.

A Qmax vessel with a loaded draft of 12 m may require an outer channel depth of 14 m (46 ft) below chart datum and an inner channel depth of about 13.2 m below chart datum. Chart datum is the lowest predicted water level.

Lesser channel depths may be acceptable if the ship can enter and leave the port after low tide, or if the bottom is soft, but this is unlikely given the potential consequences of an incident, particularly in a heavily congested port area.

It may be possible to dredge a deeper channel, but this can be expensive, particularly if the seabed is rocky. Environmental issues associated with dredging and dredged material disposal also require attention. Ongoing dredging costs may become an issue if the selected waterway is subject to accumulation of sediment deposits. If none of these is an option, it may be necessary to limit the size of ship visiting the terminal.

Inner and outer channels also need sufficient width. In most LNG ports the port authority would ensure LNG carriers have a safety zone around them to reduce the risk of collision with other port users. The channel can then be treated as a one-way channel, with no other ships passing. Failure to provide a safety zone greatly increases the risk of ship collision, requiring a much wider channel and potentially straining the economics of the project.

Permanent International Association of Navigation Congresses provides guidance on acceptable channel width, accounting for various conditions which the vessel may encounter in its transit to and from the terminal. These conditions include whether the channel is an outer channel exposed to open water or a protected inner channel. Vessel speed, wind speed and direction, the presence of waves, current intensity and direction, aids to navigation, bottom surface and depth of the waterway, cargo hazards, and bank clearance also require consideration.

All channels require a basic maneuvering lane 1.3-1.8 times the beam width, with the previously listed factors adding to this basic width. Safety also requires bank clearance on either side of the basic maneuvering lane to help prevent damage to the ship's hull from grounding. A damaged hull may result in cargo delay, channel blockage, or worse, breach of containment.

The nominal width of a maneuvering lane for a single LNG carrier transiting through an outer channel measures 6-8 times the beam. The nominal width required for an inner channel is around 5 to 6 times the beam. A 266,000 cu m Qmax requires bottom width of about 900-1,080 ft. Comparing calculated width for an inner channel with an actual channel often shows many are inadequate for larger LNG vessels.

Air draft

A vessel's air draft measures the height of the highest point of a ship (usually the mast) from its waterline. It must therefore measure less than the distance between water level and the underside of any structure spanning the channel. Navigation charts provide river crossing information and can be used for initial site-selection exercises, but elevations on waterway crossings should be verified before completing final site selection.

LNG carriers should ideally avoid passing under any bridges or structures spanning the channel. The superstructure of LNG carriers usually measures 130-160 ft and modifications may need to be made in order for them to pass under lower structures. A waterway's air draft (distance between the highest water level and the underside of the structural span) should therefore measure at least 135 ft for initial site selection. ✦

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1. GAO-08-141, "Maritime Security: Federal Efforts Needed to Address Challenges in Preventing and Responding to Terrorist Attacks on Energy Commodity Tankers," Washington, December 2007.

2. Code of Federal Regulations, "49 CFR 193—Liquefied Natural Gas Facilities," Rev. 2003.

3. National Fire Protection Association, "Production, Storage, and Handling of Liquefied Natural Gas," NFPA 59A, 2001 edition.

4. Joint Permanent International Association of Navigation Congresses (PIANC)-IAPH Report, "Approach Channels-Preliminary Guidelines," MarCom Working Group 30, 1995.

5. Joint PIANC-IAPH Report, "Approach Channels—A Guide for Design," Vol. 2, MarCom Working Group 30, 1997.

6. PIANC, Report of a working group of Permanent Technical Committee II, "Underkeel Clearance for Large Ships in Maritime Fairways with Hard Bottom," 1985.

Equipment/Software/Literature

New fluid cleaning system for drilling rigs

The new Enviro-Pur fluid cleaning system helps increase equipment uptime and lower overall maintenance costs by maintaining the quality of lubricating fluids used by all types of drilling rig equipment, and by reducing the overall consumption of those fluids.

The system was developed in a collaborative project with Felderhoff Bros. Drilling, Gainesville, Tex.

Gear lube is cleaned while the rig is running, helping maximize uptime and reduce equipment breakdown. To ensure that oil is running clean, the firm works with an independent third party lab to provide written analysis of lubrication sample results on all rigs equipped with the system.

Source: **Oil Purification Systems Inc.,** 4 Research Drive, Suite 403, Shelton, CT 06484.

New gauge available for sour gas service

This new National Association of Corrosion Engineers-compliant gauge promises instrumentation safety and reliable performance in sour gas uses.

Meeting NACE International Standards MR0175-2002, gauges come standard with a pressure release disk, so that in case of failure, release of pressure may be discharged out the back of the gauge. It features a standard laminated safety glass lens for added protection.

The gauge meets the industry's minimum hardness requirements and is warrantied for 5 years.

Source: **Winters Instruments,** 121 Railside Rd., Toronto, Ont M3A 1B2.

New cementing service designed to increase well life

The new WellLife III cementing service is designed to increase the economic life of wells.

The solution incorporates diagnostics tools, engineered cement systems, and zonal isolation assurance tool.

The service is an interventionless react-and-respond solution designed to help address the industry-wide challenge of the loss of zonal isolation due to changes in the wellbore that can stress the cement sheath and lead to destabilization at any point during the life of the well.

WellLife III enables zonal isolation over time, even when the well is subjected to various stresses. The cementing service is designed to stop the flow of unwanted fluid and gas in the annulus at any time during the life of the well, preserving production while reducing or even eliminating remediation.

Source: **Halliburton,** 5 Houston Center, Houston, TX 77010.

Aker Solutions,

Oslo, has been awarded a $35 million contract for delivery of a deepwater drilling riser system to Daewoo Shipbuilding & Marine Engineering (DSME). The contract is for the delivery of a complete deepwater marine drilling riser system with buoyancy package and associated equipment. The 7,500-ft system will be used for a semisubmersible drilling rig that DSME is building. This is the fourth deepwater drilling riser contract DSME has awarded Aker Solutions this year. The marine drilling riser system will be manufactured and delivered out of Aker Solutions' manufacturing center in Malaysia. Buoyancy modules will be manufactured at the same center's recently opened buoyancy production unit by Aker Solutions subsidiary Phoenix Polymers International Ltd. Delivery of the drilling riser systems is scheduled for 2011.

Meanwhile, an Aker-designed offshore loading system has been used in the first offloading of crude oil from terminal to shuttle tanker in the Barents Sea. The system was installed on the FOIROT (fixed offshore ice-resistant offloading terminal) in Varandey oil field, allowing for the offshore transfer of crude oil onto highly sophisticated ice-class shuttle tankers designed for transporting oil in the sensitive arctic environment. Both the shuttle tanker Vasily Dinkov and the FOIROT terminal are equipped with the latest Aker Solutions bow and offloading systems designed for arctic conditions. The system also includes additional safety features for the protection of the extremely sensitive arctic environment. Aker Solutions has thus far received orders for bow loading systems for 12 arctic shuttle tankers. The FOIROT is owned by Russian oil company Lukoil, operator of Varandey field, and the Vasily Dinkov is owned by Sovcomflot.

Aker Solutions' offshore crude loading system at work in the Barents Sea off Russia. Photo courtesy of Aker Solutions.

Aker Solutions is a unit of Aker Solutions ASA, a leading global provider of engineering and construction services, technology products, and integrated solutions to the oil and gas, refining and chemicals, mining and metals, and power generation industries.

Expro,

Aberdeen, has secured a major mechanical wireline contract from Total E&P Indonesia and completed a second topsides package for an international customer in Indonesia. The Total contract involves supplying five wireline units and performing specialized mechanical wireline services on Total's wells off Kalimantan. Expro also completed work to engineer, supply, install, and commission a 44,000 b/d, single-life process module for a production topsides system to be installed on the undisclosed customer's floating production, storage, and offloading vessel.

Meanwhile, Expro also has won a 5-year, £25 million contract with Total E&P UK Ltd. covering exclusive provision of slickline and well test services and ad hoc provision of other services, including drill stem testing, tubing-conveyed perforating, and cased hole logging on Total's platforms and mobile drilling units in the UK North Sea.

Expro is a market leader in providing services and products that measure, improve, control, and process flow from high-value oil and gas wells.

CGGVeritas,

Paris, has been awarded a $140 million contract by Qatar Petroleum to undertake a large, ultrahigh-density, high-resolution onshore seismic survey. Work will begin near yearend and is expected to last about 30 months. The survey will cover the Dukhan field in Qatar that extends under desert plains, coastal salt flats, transition zones, and shallow-water areas. CGGVeritas will provide the full range of acquisition and processing services, deploying a 40,000-channel seismic crew, 3-D vertical seismic profile, and imaging services.

Meanwhile, CGGVeritas has opened its UK Center of Excellence, which combines its London and Crawley, UK, offices. Based in Crawley, near Gatwick airport, the new center is staffed by over 200 processing geophysicists. New and upgraded facilities include a state-of-the-art visualization center, visual meeting rooms, and the latest in IT infrastructure. The center hosts R&D teams working closely with process-

Expro's topsides process module being lifted onto the customer's FPSO. Photo courtesy of Expro.

ing groups to ensure the fast and efficient deployment of new technologies. The new center is also the EAME (Europe, Africa, and Middle East) headquarters for other key CGGVeritas business lines, including marine acquisition, data library, data services, and reservoir services.

CGGVeritas is a leading international pure-play geophysical company delivering a wide range of technologies, services, and equipment to its broad base of customers mainly throughout the global oil and gas industry.

Roxar ASA,

Stavanger, has won a 19.5 million kroner (Nor.) contract from Petrobras America to supply integrated reservoir sensors and multiphase measurement systems for installation in the US Gulf of Mexico's Cascade and Chinook ultradeepwater oil fields. Petrobras America will install the Roxar subsea multiphase meter, which provides accurate and continuous online monitoring of flow rates of oil, water, and gas in subsea well streams. Roxar will also install a number of SenCorr SEPT combined sand erosion and pressure and temperature sensor systems to provide valuable real-time information on the subsea reservoir. Due to reservoir uncertainties, a phased development is underway with Phase 1 (two subsea wells in Cascade and one subsea well in Chinook) analyzing reservoir performance to ensure increased production and flow assurance in future stages.

Roxar provides innovative products and services that help achieve maximum performance from oil and gas reservoirs.

MacGregor Group,

Helsinki, has received an order from Finstaship to deliver two electrohydraulic subsea knuckle-jib cranes, each with a 150-tonne SWL active heave-compensated winch system The cranes will be fitted on the multiservice vessel Botnica and the icebreaker/tug/supply vessel Nordica. The new cranes will have a hook travel length of 3,000 m and a compensation speed of 120 m/min. In addition to the main winch, a second auxiliary high-speed winch will be installed. This winch also will have subsea capacity and active heave compensation. The cranes are scheduled for delivery in the second half of 2010 from MacGregor's facilities in Kristiansand, Norway.

Finstaship provides and develops a versatile range of efficient offshore, icebreaking, fairway, ferry traffic, and ship management services for its customers. The primary market area is focused on the Baltic Sea and arctic regions.

MacGregor is a global market leader in engineering and service solutions for the maritime transportation and offshore industries.

Knight Oil Tools,

Lafayette, La., has promoted Jerome Lane to operations manager. Previously, he was a quality assurance/quality control pressure control specialist with Knight. He has worked in the oil industry for the past 30 years, specializing in blowout prevention and related pressure-control equipment. Lane studied marketing at the University of Louisiana at Lafayette.

Lane

Knight is the largest privately held rental and fishing tools business in the oil and gas industry.

Subsea 7 Inc.,

Cayman Islands, has announced that its Seven Seas flex/J-lay vessel has completed its first major installation project, conducted in StatoilHydro's Yttergryta field in the Norwegian North Sea. The Seven Seas installed a 130 tonne pipeline end manifold, 25 tonne flowbase, and 6 km of dual-lay umbilical and 3-in. monoethylene glycol line along with three spools. The Seven Seas will complete mobilization at Dusavik, Norway, for its next project at the BC-10 oil field development in the Campos basin off Brazil. The vessel has been designed to perform highly specialized subsea pipeline laying, construction, and engineering work for the deepwater global offshore oil and gas industry and is capable of operating in water depths as great as 3,000 m. It is the fourth in a series of eight new vessels joining the Subsea 7 fleet during 2007-10.

Meanwhile, Subsea 7 has won the first contract for its new fabrication and spoolbase facility at Port Isabel, Tex. The subsea pipelay fabrication and installation contract was awarded by Marathon Oil Corp. and is valued at more than $45 million. The contract covers fabrication and installation of two 8-in. flowlines totaling 58 km in Marathon's Droshky field development on Green Canyon Block 244 in Gulf of Mexico water depths ranging from 1,350 ft to 3,000 ft. Subsea 7's full scope of work on the project includes project management, engineering, fabrication, and installation services associated with the subsea infrastructure, including the flowlines, pipeline end terminations, and risers. The pipeline will be fabricated at the company's new fabrication and spoolbase facility at Port Isabel. Engineering work will be carried out from Subsea 7's office in Houston. The offshore phase of the campaign will be carried out in the third quarter of 2009 and will be delivered by Subsea 7's flagship rigid reeled pipelay vessel, the Seven Oceans.

Subsea 7 is one of the world's leading subsea engineering and construction companies offering all the expertise and assets that make subsea, umbilical, riser, and flowline field development and operation possible.

Subsea 7's Seven Seas flex/J-lay vessel. Photo courtesy of Subsea 7.

Imports of crude and products

	Districts 1-4 8-29 2008	Districts 1-4 8-22 2008	District 5 8-29 2008	District 5 8-22 2008	Total US 8-29 2008	Total US 8-22 2008	Total US *8-31 2007
	1,000 b/d						
Total motor gasoline	883	1,317	0	51	883	1,368	993
Mo. gas. blending comp.	640	1,090	0	12	640	1,102	525
Distillate	93	123	0	0	93	123	320
Residual	199	166	157	218	356	384	753
Jet fuel-kerosine	46	45	4	22	50	67	203
Propane-propylene	251	138	7	10	258	148	172
Other	464	(167)	60	113	524	(54)	833
Total products	**2,576**	**2,712**	**228**	**426**	**2,804**	**3,138**	**3,799**
Total crude	**8,630**	**8,643**	**1,200**	**1,336**	**9,830**	**9,979**	**9,822**
Total imports	**11,206**	**11,355**	**1,428**	**1,762**	**12,634**	**13,117**	**13,621**

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

Purvin & Gertz LNG netbacks—Sept. 5, 2008

Receiving terminal	Liquefaction plant: Algeria	Malaysia	Nigeria	Austr. NW Shelf	Qatar	Trinidad
	$/MMbtu					
Barcelona	9.75	7.64	8.75	7.51	8.37	8.66
Everett	6.52	4.10	6.09	4.16	4.77	6.85
Isle of Grain	12.42	9.80	11.68	9.67	10.56	11.71
Lake Charles	4.72	2.57	4.46	2.73	3.03	5.41
Sodegaura	9.42	11.39	9.67	11.01	10.89	8.53
Zeebrugge	11.17	8.70	10.54	8.55	9.43	10.54

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	14,896	51,880	29,707	11,128	49,683	14,160	4,209
PADD 2	63,129	48,587	17,523	7,995	30,132	1,519	21,737
PADD 3	157,835	61,510	29,656	12,707	36,535	15,979	24,148
PADD 4	14,430	5,953	1,646	678	2,760	277	[1]2,424
PADD 5	53,572	26,474	20,104	9,573	12,602	5,489	—
Aug. 29, 2008	**303,862**	**194,404**	**98,636**	**42,081**	**131,712**	**37,424**	**52,518**
Aug. 22, 2008	**305,760**	**195,441**	**100,580**	**42,072**	**132,125**	**37,699**	**52,041**
Aug. 31, 2007[2]	**333,632**	**192,564**	**85,869**	**42,153**	**129,914**	**38,599**	**54,300**

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

Refinery report—Aug. 29, 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						
PADD 1	1,447	1,452	2,193	106	517	98	63
PADD 2	3,357	3,317	2,547	220	979	43	198
PADD 3	7,471	7,255	2,980	679	2,193	250	639
PADD 4	549	545	260	26	181	8	[1]114
PADD 5	2,793	2,689	1,466	474	648	103	—
Aug. 29, 2008	**15,617**	**15,258**	**9,446**	**1,505**	**4,518**	**502**	**1,014**
Aug. 22, 2008	**15,366**	**15,111**	**9,151**	**1,556**	**4,395**	**591**	**1,100**
Aug. 31, 2007[2]	**15,749**	**15,469**	**9,086**	**1,408**	**4,158**	**642**	**1,083**
	17,610 Operable capacity		**88.7 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.

OGJ crack spread

	*9-5-08	*9-7-07	Change $/bbl	Change, %
SPOT PRICES				
Product value	123.45	87.04	36.40	41.8
Brent crude	104.67	74.96	29.71	39.6
Crack spread	18.78	12.09	6.69	55.3
FUTURES MARKET PRICES				
One month				
Product value	119.91	85.59	34.32	40.1
Light sweet crude	108.30	75.95	32.35	42.6
Crack spread	11.61	9.63	1.98	20.5
Six month				
Product value	121.83	85.32	36.51	42.8
Light sweet crude	110.84	72.10	38.74	53.7
Crack spread	10.99	13.23	–2.24	–16.9

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

OGJ GASOLINE PRICES

	Price ex tax 9-3-08	Pump price* 9-3-08	Pump price 9-5-07
	¢/gal		
(Approx. prices for self-service unleaded gasoline)			
Atlanta	323.8	368.2	277.4
Baltimore	329.5	371.4	268.1
Boston	327.2	369.1	265.1
Buffalo	304.6	364.2	281.1
Miami	313.6	365.2	291.1
Newark	325.2	358.1	264.7
New York	308.4	368.0	280.8
Norfolk	325.0	363.0	262.3
Philadelphia	320.3	371.0	279.1
Pittsburgh	316.3	367.0	277.1
Wash., DC	327.8	366.2	280.1
PAD I avg	320.2	366.5	275.2
Chicago	338.6	396.5	314.6
Cleveland	315.1	361.5	284.3
Des Moines	315.4	355.5	277.6
Detroit	318.0	372.4	301.3
Indianapolis	311.4	361.5	292.2
Kansas City	319.5	355.5	281.8
Louisville	328.6	365.5	295.9
Memphis	314.7	354.5	271.5
Milwaukee	319.2	370.5	298.0
Minn.-St. Paul	322.1	362.5	287.1
Oklahoma City	315.1	350.5	279.4
Omaha	323.2	365.5	284.8
St. Louis	320.5	356.5	273.0
Tulsa	314.0	349.4	277.9
Wichita	308.1	351.5	279.9
PAD II avg	318.9	362.0	286.6
Albuquerque	322.6	359.0	276.5
Birmingham	320.7	359.3	267.4
Dallas-Fort Worth	308.3	346.7	266.1
Houston	305.3	343.7	272.7
Little Rock	318.1	358.3	268.7
New Orleans	322.8	361.2	272.5
San Antonio	318.9	357.3	266.1
PAD III avg	316.7	355.1	270.0
Cheyenne	331.3	363.7	278.9
Denver	353.1	393.5	288.1
Salt Lake City	346.9	389.8	290.1
PAD IV avg	343.8	382.4	285.7
Los Angeles	339.8	403.7	278.0
Phoenix	334.2	371.6	284.0
Portland	334.4	377.8	282.4
San Diego	337.8	401.7	288.8
San Francisco	349.7	413.6	285.6
Seattle	335.1	389.5	278.8
PAD V avg	338.5	393.0	282.9
Week's avg.	**323.4**	**367.9**	**280.3**
Aug. avg.	**330.8**	**375.3**	**280.8**
July avg.	**361.3**	**405.7**	**295.2**
2008 to date	**309.4**	**353.3**	—
2007 to date	**228.9**	**272.5**	—

*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

	8-29-08 ¢/gal		8-29-08 ¢/gal
Spot market product prices			
Motor gasoline (Conventional-regular)		Heating oil No. 2	
New York Harbor	290.00	New York Harbor	315.03
Gulf Coast	304.99	Gulf Coast	315.85
Los Angeles	302.17	Gas oil	
Amsterdam-Rotterdam-Antwerp (ARA)	283.14	ARA	326.42
Singapore	278.60	Singapore	305.83
Motor gasoline (Reformulated-regular)		Residual fuel oil	
New York Harbor	297.00	New York Harbor	229.69
Gulf Coast	283.55	Gulf Coast	239.21
Los Angeles	312.17	Los Angeles	273.26
		ARA	254.03
		Singapore	256.01

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

BAKER HUGHES RIG COUNT

	9-5-08	9-7-07
Alabama	6	6
Alaska	10	6
Arkansas	59	49
California	50	36
Land	48	34
Offshore	2	2
Colorado	119	110
Florida	3	1
Illinois	0	1
Indiana	2	2
Kansas	10	13
Kentucky	12	12
Louisiana	182	178
N. Land	81	68
S. Inland waters	21	22
S. Land	25	24
Offshore	55	64
Maryland	0	1
Michigan	2	3
Mississippi	14	11
Montana	10	14
Nebraska	1	0
New Mexico	92	79
New York	7	6
North Dakota	75	42
Ohio	10	14
Oklahoma	219	193
Pennsylvania	27	17
South Dakota	1	1
Texas	938	855
Offshore	9	6
Inland waters	1	1
Dist. 1	27	25
Dist. 2	35	35
Dist. 3	65	56
Dist. 4	92	88
Dist. 5	188	190
Dist. 6	123	128
Dist. 7B	31	40
Dist. 7C	72	60
Dist. 8	135	108
Dist. 8A	26	19
Dist. 9	37	37
Dist. 10	97	62
Utah	47	41
West Virginia	28	33
Wyoming	77	78
Others—NV-2; OR-1; TN-2; VA-6; WA-1	12	12
Total US	**2,013**	**1,814**
Total Canada	**418**	**335**
Grand total	**2,431**	**2,149**
Oil rigs	416	294
Gas rigs	1,586	1,514
Total offshore	72	74
Total cum. avg. YTD	**1,859**	**1,759**

Rotary rigs from spudding in to total depth.
Definitions, see OGJ Sept. 18, 2006, p. 42.

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

SMITH RIG COUNT

Proposed depth, ft	Rig count	9-5-08 Percent footage*	Rig count	9-7-07 Percent footage*
0-2,500	84	3.5	59	8.4
2,501-5,000	135	50.3	104	56.7
5,001-7,500	254	15.7	234	22.2
7,501-10,000	489	2.6	425	3.7
10,001-12,500	465	1.7	441	0.9
12,501-15,000	372	—	284	0.7
15,001-17,500	140	—	119	—
17,501-20,000	86	—	67	—
20,001-over	17	—	34	—
Total	**2,042**	**6.4**	**1,767**	**7.8**
INLAND	31		40	
LAND	1,972		1,663	
OFFSHORE	39		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]9-5-08	[2]9-7-07
	1,000 b/d	
(Crude oil and lease condensate)		
Alabama	20	21
Alaska	680	618
California	645	655
Colorado	62	64
Florida	4	5
Illinois	26	27
Kansas	104	106
Louisiana	380	1,188
Michigan	15	15
Mississippi	53	57
Montana	93	94
New Mexico	163	160
North Dakota	124	125
Oklahoma	172	170
Texas	1,095	1,324
Utah	50	55
Wyoming	148	149
All others	61	74
Total	**3,895**	**4,907**

[1]OGJ estimate. [2]Revised.
Source: Oil & Gas Journal.
Data available in OGJ Online Research Center.

US CRUDE PRICES

	9-5-08 $/bbl*
Alaska-North Slope 27°	127.45
South Louisiana Sweet	108.75
California-Kern River 13°	93.40
Lost Hills 30°	101.80
Wyoming Sweet	92.23
East Texas Sweet	102.25
West Texas Sour 34°	95.25
West Texas Intermediate	102.75
Oklahoma Sweet	102.75
Texas Upper Gulf Coast	99.25
Michigan Sour	95.75
Kansas Common	101.75
North Dakota Sweet	93.25

*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

$/bbl[1]	8-29-08
United Kingdom-Brent 38°	115.11
Russia-Urals 32°	111.19
Saudi Light 34°	110.32
Dubai Fateh 32°	112.06
Algeria Saharan 44°	115.05
Nigeria-Bonny Light 37°	116.69
Indonesia-Minas 34°	119.21
Venezuela-Tia Juana Light 31°	111.85
Mexico-Isthmus 33°	111.74
OPEC basket	113.85
Total OPEC[2]	111.75
Total non-OPEC[2]	111.92
Total world[2]	111.83
US imports[3]	110.04

[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]

	8-29-08	8-22-08	8-29-07	Change, %
	bcf			
Producing region	793	777	903	–12.2
Consuming region east	1,676	1,609	1,685	–0.5
Consuming region west	378	371	407	–7.1
Total US	**2,847**	**2,757**	**2,995**	**–4.9**
	June 08	**June 07**	**Change, %**	
Total US[2]	**2,171**	**2,580**	**–15.9**	

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

International rig count

Region	Aug. 2008 Land	Aug. 2008 Off.	Aug. 2008 Total	Aug. 07 Total
WESTERN HEMISPHERE				
Argentina	82	—	82	73
Bolivia	4	—	4	3
Brazil	26	29	55	40
Canada	448	1	449	343
Chile	1	—	1	2
Colombia	41	—	41	41
Ecuador	12	—	12	11
Mexico	77	27	104	87
Peru	6	2	8	7
Trinidad	1	3	4	4
United States	1,920	67	1,987	1,804
Venezuela	56	14	70	78
Other	1	—	1	2
Subtotal	**2,675**	**143**	**2,818**	**2,495**
ASIA-PACIFIC				
Australia	14	15	29	26
Brunei	1	3	4	5
China-offshore	—	24	24	19
India	52	28	80	80
Indonesia	48	15	63	60
Japan	3	—	3	2
Malaysia	—	11	11	17
Myanmar	4	1	5	7
New Zealand	6	—	6	5
Papua New Guinea	4	—	4	3
Philippines	2	—	2	—
Taiwan	—	—	—	—
Thailand	2	11	13	6
Vietnam	—	9	9	8
Other	—	4	4	3
Subtotal	**136**	**121**	**257**	**241**
AFRICA				
Algeria	23	—	23	29
Angola	1	4	5	4
Congo	1	2	3	2
Gabon	1	—	1	3
Kenya	—	—	—	—
Libya	15	—	15	13
Nigeria	—	4	4	9
South Africa	—	—	—	1
Tunisia	3	2	5	3
Other	2	4	6	4
Subtotal	**46**	**16**	**62**	**68**
MIDDLE EAST				
Abu Dhabi	8	3	11	14
Dubai	2	—	2	1
Egypt	49	11	60	47
Iran	—	—	—	—
Iraq	—	—	—	—
Jordan	2	—	2	1
Kuwait	13	—	13	13
Oman	54	1	55	49
Pakistan	25	—	25	19
Qatar	3	7	10	12
Saudi Arabia	65	10	75	78
Sudan	—	—	—	—
Syria	20	—	20	20
Yemen	15	—	15	15
Other	1	—	1	1
Subtotal	**257**	**32**	**289**	**270**
EUROPE				
Croatia	—	—	—	—
Denmark	—	2	2	3
France	1	—	1	1
Germany	10	—	10	5
Hungary	5	—	5	2
Italy	3	1	4	4
Netherlands	—	3	3	4
Norway	—	17	17	20
Poland	1	—	1	2
Romania	15	3	18	3
Turkey	6	—	6	5
UK	2	22	24	29
Other	6	—	6	4
Subtotal	**49**	**48**	**97**	**82**
Total	**3,163**	**360**	**3,523**	**3,156**

Definitions, see OGJ Sept. 18, 2006, p. 42.
Source: Baker Hughes Inc.
Data available in OGJ Online Research Center.

Oil import freight costs*

Source	Discharge	Cargo	Cargo size, 1,000 bbl	Freight (Spot rate) worldscale	$/bbl
Caribbean	New York	Dist.	200	310	2.63
Caribbean	Houston	Resid.	380	247	2.35
Caribbean	Houston	Resid.	500	211	2.01
N. Europe	New York	Dist.	200	290	3.97
N. Europe	Houston	Crude	400	252	5.09
W. Africa	Houston	Crude	910	155	3.44
Persian Gulf	Houston	Crude	1,900	88	3.62
W. Africa	N. Europe	Crude	910	172	2.82
Persian Gulf	N. Europe	Crude	1,900	75	2.26
Persian Gulf	Japan	Crude	1,750	93	2.26

*Aug. 2008 average.
Source: Drewry Shipping Consultants Ltd. Data available in OGJ Online Research Center.

Waterborne Energy Inc. US LNG imports

Country	Sept. 2008	Aug. 2008	Sept. 2007	Change from a year ago, %
	MMcf			
Algeria	—	—	2,820	—
Egypt	2,980	3,000	11,800	–74.7
Equatorial Guinea	—	—	—	—
Nigeria	—	2,880	3,030	—
Norway	—	5,910	—	—
Qatar	—	—	—	—
Trinidad and Tobago	23,970	24,890	23,880	0.4
Total	**26,950**	**36,680**	**41,530**	**–35.1**

Source: Waterborne Energy Inc.
Data available in OGJ Online Research Center.

Propane prices

	July 2008	Aug. 2008	July 2007	Aug. 2007
	¢/gal			
Mont Belvieu	186.15	165.09	119.00	118.61
Conway	176.36	158.42	118.18	118.64
Northwest Europe	186.84	162.61	117.28	119.28

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

Muse, Stancil & Co. refining margins

	US Gulf Coast	US East Coast	US Mid-west	US West Coast	North-west Europe	South-east Asia
	$/bbl					
Aug. 2008						
Product revenues	137.23	124.78	135.97	129.99	127.91	122.68
Feedstock costs	–125.73	–117.06	–116.27	–111.66	–115.32	–119.50
Gross margin	11.50	7.72	19.70	18.33	12.59	3.18
Fixed costs	–2.10	–2.43	–2.36	–2.75	–2.36	–1.84
Variable costs	–2.32	–1.56	–2.05	–3.83	–4.71	–1.30
Cash operating margin	**7.08**	**3.73**	**15.29**	**11.75**	**5.52**	**0.04**
July 2008	4.48	–1.71	7.43	7.87	5.24	4.20
YTD avg.	8.59	2.24	10.37	14.17	6.16	3.13
2007 avg.	12.53	6.65	18.67	20.89	5.75	2.26
2006 avg.	12.54	6.38	14.97	23.69	5.88	1.06
2005 avg.	12.53	6.98	12.31	20.55	5.51	1.52

Source: Muse, Stancil & Co. See OGJ, Jan. 15, 2001, p. 46
Data available in OGJ Online Research Center.

Muse, Stancil & Co. gasoline marketing margins

July 2008	Chicago*	Houston	Los Angeles	New York
	¢/gal			
Retail price	423.44	398.32	448.91	425.94
Taxes	65.23	38.40	70.42	56.97
Wholesale price	339.10	334.26	356.48	338.80
Spot price	323.87	318.16	323.39	318.38
Retail margin	19.20	25.66	22.01	30.17
Wholesale margin	15.23	16.10	33.09	20.42
Gross marketing margin	**34.43**	**41.76**	**55.10**	**50.59**
June 2008	31.53	22.87	17.10	29.37
YTD avg.	24.08	22.45	18.02	31.21
2007 avg.	26.96	23.12	19.05	31.10
2006 avg.	19.74	20.34	18.03	27.90
2005 avg.	19.77	16.26	20.39	27.13

*The wholesale price shown for Chicago is the RFG price utilized for the wholesale margin. The Chicago retail margin includes a weighted average of RFG and conventional wholesale purchases.
Source: Muse, Stancil & Co. See OGJ, Oct. 15, 2001, p. 46.
Data available in OGJ Online Research Center.
Note: Margins include ethanol blending in all markets.

Muse, Stancil & Co. ethylene margins

	Ethane	Propane	Naphtha
	¢/lb ethylene		
Aug. 2008			
Product revenues	87.77	147.31	180.80
Feedstock costs	–44.09	–94.02	–158.38
Gross margin	43.68	53.29	22.42
Fixed costs	–5.38	–6.36	–7.19
Variable costs	–6.61	–7.84	–10.64
Cash operating margin	**31.69**	**39.09**	**4.59**
July 2008	8.29	22.83	–14.46
YTD avg.	18.51	21.12	–13.92
2007 avg.	14.41	14.14	–7.42
2006 avg.	19.53	22.44	1.34
2005 avg.	14.43	20.68	1.28

Source: Muse, Stancil & Co. See OGJ, Sept. 16, 2002, p. 46.
Data available in OGJ Online Research Center.

Muse, Stancil & Co. US gas processing margins

Aug. 2008	Gulf Coast	Mid-continent
	$/Mcf	
Gross revenue		
Gas	7.96	6.31
Liquids	1.75	4.47
Gas purchase cost	8.87	8.47
Operating costs	0.07	0.15
Cash operating margin	**0.77**	**2.16**
July 2008	0.76	2.24
YTD avg.	0.60	1.88
2007 avg.	0.44	1.47
2006 avg.	0.26	0.97
2005 avg.	–0.06	0.25
Breakeven producer payment % of liquids	54%	51%

Source: Muse, Stancil & Co. See OGJ, May 21, 2001, p. 54.
Data available in OGJ Online Research Center.

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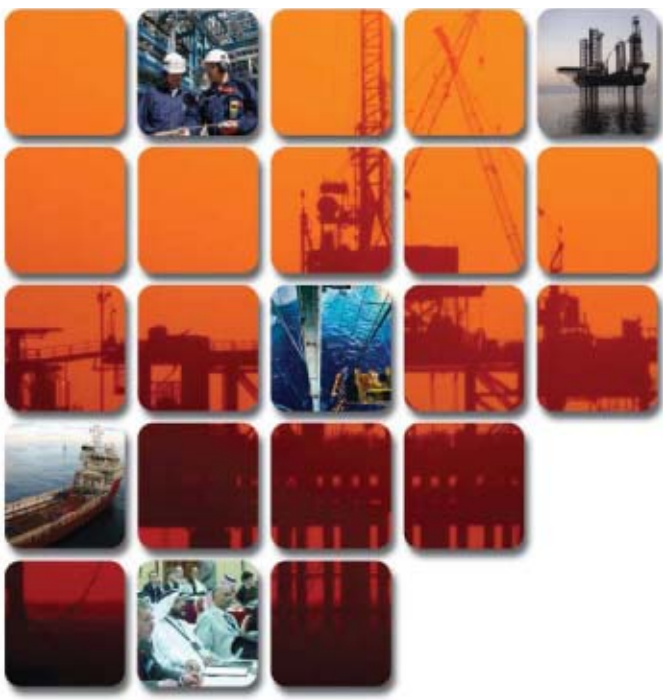

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Oil prices change faster than market perceptions turn

The Editor's Perspective

by Bob Tippee, Editor

Market perceptions, whatever they are and whatever their influence over oil prices, take a long time to change.

Analysts blame perceptions when prices contradict their forecasts. And since all analysts have been wrong at least once about oil prices, many of them worry about the extent to which perceptions influence markets.

Yet it's no great mystery. Perceptions are all that buyers and sellers of oil have to work with. Some perceptions are just better than others. And some are acted upon with better timing.

Market perceptions embedded in public consciousness turn slower than a laden tanker.

Politicians in the US, for example, keep promising to rescue Americans from $4/gal gasoline. Yet the prices of nonpremium grades haven't been that high on a national average basis for several weeks.

Prices of all oil products are falling because the price of crude oil is plummeting. It has dropped by $25/bbl since mid-July and only fluttered when Russia invaded Georgia and when Hurricane Gustav blew across the Gulf of Mexico and Louisiana coast.

Yet the perception remains that prices are headed the other way. And fees based on that perception keep showing up.

While jet-fuel prices were rising, American Airlines famously started charging for the first piece of checked baggage. Several other airlines quickly followed suit.

Now jet fuel prices are falling. They peaked about the first week in July and have been as much as 96¢/gal below that level since then in a clearly declining trend.

Yet on Sept. 5, Continental Airlines announced that, to help offset high fuel costs, passengers on some flights must pay $15 for each parcel submitted to the tender mercies of its suitcase tossers.

Desperate times call for desperate measures. But Continental's timing seems poor. Will there be a backlash?

This writer knows of a lawn service that hiked its fee by $5/visit, blaming rising gasoline prices at a time when, in fact, prices were falling.

Guess who now mows his own yard. And guess who's watching fares of Southwest Airlines, which also flies out of Houston and still charges nothing for first checked bags.

(Online Sept. 5, 2008; author's e-mail: bobt@ogjonline.com)

Market Journal

by Sam Fletcher, Senior Writer

Storms, OPEC guide oil prices

Front-month crude prices fluctuated at $111-122/bbl through most of August on the New York Mercantile Exchange but fell sharply Aug. 28-Sept. 5 primarily as Hurricane Gustav proved less of a threat to offshore production and Gulf Coast refining than some anticipated.

October benchmark US light, sweet crudes dropped $2.56 to $115.59/bbl Aug. 28, pulled down initially by falling prices in the natural gas market. The contract closed at $106.23/bbl Sept. 5, having lost $9.20/bbl over the first five trading sessions in September as the euro dropped to its lowest level against the dollar this year and as gulf oil and gas operations shut in by Gustav began coming back on stream. As Gustav was downgraded prior to landfall in Louisiana Sept. 2, traders brushed aside the price support provided by that storm, and prices fell to a 5-month intraday low of $105.46/bbl; it slipped to a fresh intraday low of $105.13/bbl Sept. 5 amid concerns of a weak global economy and declining demand.

But oil prices were up in early trading Sept. 8 as Hurricane Ike ripped through Cuba. The storm was expected to enter the southeastern Gulf of Mexico on Sept. 9, headed for the US Gulf Coast. Shell Oil Co. said Sept. 6 that 615 of its 1,400 workers evacuated ahead of Gustav had returned to work offshore. However, the company said it would not redeploy the rest "because of the possibility that Hurricane Ike might enter the Gulf of Mexico and require another evacuation," officials said.

OPEC outlook

"Further impending hurricanes may postpone a quick test of $100/bbl crude and limit pressure on the Organization of Petroleum Exporting Countries to reduce output at its Sept. 9 meeting," said analysts at KBC Market Services, a division of KBC Process Technology Ltd. in the UK. "We do not expect Saudi Arabia to take preemptive steps to keep prices above this threshold. But OPEC knows that it must reduce supplies at some point in the coming months, and any return to double digit crude prices may be of short duration."

An OPEC decision to maintain quota levels "could amount to a de facto cut, which might not be a problem for the Saudis because the 500,000 b/d Arab Extra Light Khursaniyah field could give Saudi Arabia higher per-barrel revenues if it rolls off heavier production in equal measure," said analysts at Friedman, Billings, Ramsey & Co. Inc. (FBR), Arlington, Va., prior to the cartel's meeting. "The counterbalance, of course, is that other OPEC producers—especially Iran and Venezuela—require higher per-barrel prices than Saudi Arabia to fund domestic spending."

Analysts at the Centre for Global Energy Studies (CGES), London, noted that today's oil market "looks very different" since the meeting of OPEC ministers in March. Then, they said, "The outlook for demand growth still appeared relatively robust and economic weakness was largely confined to the US—at least in the view of OPEC. Now, oil demand is falling fast in the US and the rest of the Organization for Economic Cooperation and Development, the economic outlook for the developed economies appears to worsen by the day, and there are even fears that the slowdown will begin to have an effect on the economic health of the Asian economies that supply many of the manufactured goods bought in the West. In March, oil prices were marching upwards, propelled, according to OPEC, by the weakness of the US dollar, rising inflation, and speculation. Oil prices have been falling ahead of the September meeting."

CGES analysts said, "The change in market sentiment from bullish to bearish is amply illustrated by the lack of any real price response to the loss of 1 million b/d of light, sweet Caspian crude in early August after an explosion on the [Baku-Tbilisi-Ceyhan] oil pipeline and the closure of the export routes across Georgia, or the loss of 1.3 million b/d of production as Hurricane Gustav swept through the Gulf of Mexico."

They observed, "With oil prices still above $100/bbl there have been few calls for a cut in the organization's output quotas, although the usual suspects, led by Venezuela and Iran, have been calling for a reduction in output by those member-countries, particularly Saudi Arabia, who are exceeding their output quotas." CGES said, "Should oil prices continue to fall, Saudi Arabia will come under pressure from other OPEC members to unwind some of its recent production increases, but there is every indication that the kingdom shares the desire of other member-countries to prevent oil prices from falling much below $100/bbl."

(Online Sept. 8, 2008; author's e-mail: samf@ogjonline.com)

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VetcoGray Offers Innovative Solutions for Offshore Drilling

"VetcoGray's HMF risers waiting to be prepared for buoyancy for an operation in the Gulf of Mexico."

VetcoGray, a GE Oil & Gas business, is proud of our long standing relationship with Transocean and contribution and participation in the Enhanced Enterprise-Class drillships.

VetcoGray has been building its reputation as a highly skilled and experienced supplier of drilling equipment to the oil and gas industry since 1906. Today, we are one of the world's leading suppliers of marine drilling riser systems. Our legacy of technology development and innovative solutions puts us at the forefront of offshore drilling, especially for deepwater exploration. We strive to support our customers in extreme drilling environments with our thorough product range including marine drilling risers, diverter systems, and subsea connectors.

Risers

Transocean pushed boundaries and broke the world record for deepwater drilling with the use of VetcoGray's HMF G class riser. This 10,011 foot water-depth well in the Gulf of Mexico utilized one of the most reliable and advanced marine riser systems in today's market. The HMF G class riser is also being used on Transocean's Enhanced Enterprise-Class drillships. Our HMF marine drilling riser was developed through extensive design analysis and test programs of bending, tension, internal pressure and function evaluations. The HMF design has been proven and tested in the most extreme conditions in the field since the mid 1970s. VetcoGray's HMF coupling is highly pre-loaded which is ideal for deepwater and high current applications where high load operating conditions exist.

"The Super Heavy Duty connector being tested to 7 million pounds bending capacity at VetcoGray's Houston facility."

Diverters

VetcoGray is also a leading supplier of diverter systems in the offshore drilling market. We are a single source supplier for complete systems including diverter assembly, controls and valves. VetcoGray developed a new 72" Complete Shut-Off (CSO) diverter with increased through bore space to accommodate deepwater drilling applications. The CSO is able to close over open hole as well as around drill pipe. Our 72" diverter, one of the largest in the market, was developed specifically for Transocean's Enhanced Enterprise-Class drillships.

Connectors

We have supplied subsea connectors to every major producing region in the world and every offshore environment since the H-4 family of subsea connectors was introduced in 1964. The VetcoGray family of H-4 connectors are field proven, hydraulically operated, metal-to-metal sealing connectors that are ideal for deepwater use. The H-4 line of connectors has reliable, simple operating characteristics; excellent bending and tensile load capacities; and a long, economical service life. The Super Heavy Duty (SHD) H-4 connector, the latest subsea connector offering by VetcoGray, has exceptional bending load capacities and fatigue life characteristics and is ideal for deepwater, critical service where high bending loads are anticipated. Transocean utilizes the SHD H-4 connector with its 7 million ft-lbs bending capacity.

Aftermarket

VetcoGray is fully committed to helping our customers achieve greater levels of performance and productivity through all phases of Oil & Gas drilling and production. We have over 100 years experience serving the industry with our field proven technology. We provide inspection, maintenance, repair, spare parts and upgrade services for our current and legacy equipment in every region of the world. As part of GE Oil & Gas, VetcoGray has more than 70 locations around the world with Global Services teams providing support for our customers wherever they are. Our crews perform extensive onsite support, plus ongoing design and engineering solutions that help prolong equipment life, reduce costs, and improve performance. VetcoGray has riser stings that have been operational for over 35 years. Through our extensive Global Services facilities and personnel, we partner with our customers to ensure our equipment has a long, safe, economical life cycle.

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Discoverer Clear Leader

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Enhanced Enterprise-Class Drillships: The Next Frontier in Ultra-Deepwater Drilling

Transocean ushered in a new era of offshore drilling technology, performance and efficiency with the development and introduction of its three ultra-deepwater Enterprise-Class drillships in the late 1990s and 2001. Now, Transocean has enhanced the Enterprise-Class units, and construction of the first of five newbuild Enhanced Enterprise-Class drillships, the *Discoverer Clear Leader*, is being completed in 2008 for Chevron. Designed to safely and efficiently construct wells 40,000 feet deep and in 12,000 feet of water, the *Discoverer Clear Leader* features the most advanced capabilities in the offshore drilling industry.

The prior generation of ultra-deepwater drillships, the Enterprise-Class rigs, have set a high standard which the Enhanced Enterprise-Class drillships are designed to exceed. Since 1999, the *Discoverer Enterprise*, *Discoverer Spirit* and *Discoverer Deep Seas* have drilled wells in significantly shorter time than conventional rigs, set world water-depth records and experienced dramatic up time, all resulting in more savings and drilling opportunities for our customers.

Both the Enhanced and Enterprise-Class rigs feature Transocean's proprietary dual-activity derrick designed to reduce by approximately 15 percent the time required to drill exploration wells and up to 40 percent

for production wells. The dual-activity derrick's capability allows drilling tasks to be performed in parallel rather than sequentially as with conventional offshore rigs. The result is time and cost savings for clients. Also, the rigs' water depth capability allows drilling in water depths previously unreachable before the development of these latest generation drillships.

The *Discoverer Spirit*, as one example, set several world water depth records. In May 2001, the vessel drilled in 9,687 feet of water in the U.S. Gulf of Mexico. The rig surpassed that record later that year, drilling in 9,727 feet of water in the U.S. Gulf of Mexico. In 2003, the *Discoverer Deep Seas*, working for Chevron, became the first rig in history to drill a petroleum well in more than 10,000 feet of water. The well was spud in 10,011 feet of water in the U.S. Gulf of Mexico while drilling the operator's Toledo well in Alaminos Canyon Block 951. The *Discoverer Enterprise* also has set its share of records and is known as the world's first dual-activity deepwater drilling rig and the first DP drillship to offload produced well fluids to a shuttle barge.

These three rigs continue to drill deepwater and ultra-deepwater wells, making such drilling seem almost routine due to their technology and efficiency. Their capabilities and performance led Transocean to develop an Enhanced Enterprise-Class vessel for drilling deeper wells in deeper waters to meet anticipated future drilling requirements. As a result of the positive drilling experience with the *Discoverer Deep Seas*, Chevron became the first operator to contract the Enhanced Enterprise-Class design vessels, the new *Discoverer Clear Leader* and the *Discoverer Inspiration*.

With the offshore drilling industry in the midst of an uprecedented up cycle, the Enhanced Enterprise-Class drillships offer operators yet another cutting-edge tool to access and develop petroleum reserves faster, more efficiently and safely in this time of record commodity prices.

And while these rigs are new, Transocean is building them backed by more than 50 years of experience in introducing the world's most technologically advanced and highest-performing offshore drilling rigs.

The *Enhanced Enterprise-Class* ultra-deepwater drillships: the latest chapter in ultra-deepwater drilling.

Discoverer Clear Leader Transocean

Creating the Next-Generation Ultra-Deepwater Drillship

By applying lessons learned from building and operating its three Enterprise-Class drillships and combining them with equipment and power upgrades and systems enhancements, Transocean has developed the industry's state-of-the-art Sixth-Generation drillships designed for drilling 40,000-foot wells in up to 12,000 feet of water.

Now, the *Discoverer Clear Leader* and four other Enhanced Enterprise-Class drillships are poised to deliver more efficient drilling operations and capabilities from bow to stern. Greater flexibility and capacity for materials and tubular handling, blow out preventers (BOPs) and subsea trees are just a few of the many new enhancements. The rig's mud system can save the operator days when switching from circulating mud to circulating completion fluid and back again. The latest in Cyberbase® technology by National Oilwell Varco allows the driller and assistant driller to more efficiently handle Transocean's patented dual-activity drilling technology with some drilling operations performed with fewer rig crew on the drill floor, increasing crew safety.

The top drive drilling system, designed by Transocean and Aker Kvaerner Maritime Hydraulics, is the most robust and powerful system today. Dubbed the modular derrick drilling machine (MDDM™), the unit is a 1,250-ton system for four Enhanced Enterprise-Class drillships (*Discoverer Luanda* will be equiped with a 1,000-ton unit). It is designed to operate for 10 years between major overhauls. Should the MDDM require repairs, the system's modules can be changed out quickly offshore, saving the operator days of waiting and repair time for a traditional top drive.

Birth of the Sixth-Generation drillship

The birth of the *Discoverer Clear Leader*, the first of five of Transocean's Enhanced Enterprise-Class rigs to be delivered, began when the world's largest drilling contractor saw a developing market for new high performance ultra-deepwater drillships. Transocean began conversations with several operators about their future requirements and learned that the type of wells they anticipated drilling would require a rig that could go beyond

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GE imagination at work

DSME, the best shipyard for the best rigs

Daewoo Shipbuilding & Marine Engineering Co., Ltd. (DSME) carried out Transocean Discoverer Clear Leader's engineering, procurement, construction, test & commissioning, and project management as the main contractor.

Overview

Based in Okpo on Geoje-Island, South Korea, and conducting business with major shipping and oil companies all over the world, DSME has prospered into the world's premium specialized shipbuilding and offshore contractor boasting more than three decades of an excellent track record. DSME prides itself on being able to complete sophisticated products with a level of technical superiority second-to-none, with on-time delivery and an unparalleled dedication to customer satisfaction.

DSME can supply 60 to 70 commercial ships and 8 to 10 offshore projects per year. DSME employs about 2,000 design engineers and more than 26,000 highly-skilled workers that can construct various vessels, such as LNGCs and LPGCs, containerships and tankers, as well as offshore platforms, drilling rigs, floating oil production units, and submarines and destroyers - all to the highest standards of quality. Furthermore, DSME operates five research centers, staffed by more than 350 highly-skilled engineers who are devoted to developing new products.

Offshore Business

With over 30 years experience in offshore projects, DSME is leading the market as an EPCI (Engineering, Procurement, Construction and Installation) turnkey contractor of offshore projects. For example, DSME has built and almost completed installation of Agbami FPSO (Floating, Production, Storage, and Offloading Facility) successfully off the coast of Nigeria. Following Agbami, DSME is currently executing another gigantic Pazflor FPSO project to be installed in off Angola.

DSME has been very active in building offshore drilling rigs. To date, a total of 14 offshore drilling rigs have been successfully delivered. Currently, DSME is running six semi-submersible drilling rig projects, and is working on five consecutive Enhanced Enterprise-Class Drillships for Transocean under construction. In addition, DSME has received six new drillship orders from several other clients for different designs.

HSE First

DSME is sparing no effort in establishing a zero accident workplace through an extensive range of safety management programs and policies, all of which place the highest priority on employees' health and safety. Daily safety training and safety walk-throughs are conducted on a routine basis for site managers and supervisors, as well as on-site safety personnel.

The Agbami FPSO project's 8 million man-hours were entirely incident and injury free, and so far, the Discoverer Clear Leader project has achieved 1.1 million man-hours incident and injury free.

Best Quality

More than 450 professionals are responsible for quality management. They have the highest credentials in inspecting hulls, outfitting, and painting, and in material quality management. International quality management certificates, including ISO 9001-2000, are held in both the shipbuilding and offshore construction sectors.

Transocean Drillship Projects

DSME developed the world's finest drillship by enhancing the pre-existing Enterprise Class Design jointly with Transocean's expert experience and knowledge in drilling operation. With its extensive technological knowledge of ship and offshore design & construction, DSME carried out not only the hull design, but also applied cutting-edge techniques to the topside design in areas such as drilling and power. At every stage of the design, maintenance, operation, construction, and safety were taken into account.

During the construction stage, DSME used many innovative construction methods in derrick transfer technology, thruster installation, and the supply of onshore electricity to drillships via a separate high voltage transformer. At each stage of development from planning to actual execution of innovative techniques, DSME shared all the information with Transocean maintaining an excellent working relationship. The building process runs smoothly and efficiently based on triangle of cooperation between DSME, the owners and vendors who are treated as vital members.

With its core-values "TRUST and PASSION" DSME can confidently build Transocean drillships that will be front runners in the drilling market.

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Discoverer Clear Leader

even the world water-depth record of 10,011 feet of water set by Transocean's drillship *Discoverer Deep Seas*.

"We took the Enterprise-Class drillship design and incorporated all of the lessons learned from about 15 rig years of operation," said Mike Hall, Transocean's Vice President, Newbuilds. "We incorporated things that we knew we could do better and things that needed to be of higher capacity in order to handle the types of wells that are anticipated, primarily in the U.S. Gulf of Mexico – very deep, long reach and deviated wells."

"We saw equipment that could be enhanced to perform better, with more robust designs, more capability, and more user-friendly designs," Mr. Hall added.

The result is five new Enhanced Enterprise-Class drillships under construction or on order that are similar in size to the Enterprise-Class Fifth-Generation drillships with greatly extended capabilities for the types of wells operators anticipate drilling in the future.

"The Enhanced Enterprise-Class drillship began with a hull similar in size to the Enterprise-Class rigs and we optimized it, changing the hull form to enhance motion characteristics, deck load capacity and mobilization speed, while keeping a double-hull design," Mr. Hall explained.

The first and third Enhanced Enterprise-Class rigs to be delivered, *Discoverer Clear Leader* and *Discoverer Inspiration*, are contracted by Chevron for work in the U.S. Gulf of Mexico. The second rig, *Discoverer Americas*, will work for StatoilHydro in the Gulf, while the fourth unit, *Discoverer Luanda*, is contracted to BP for work offshore Angola. The fifth, as yet unnamed drillship, is contracted for operations offshore India for Reliance Industries.

High capacity derrick houses new MDDM™

The high capacity derrick has a 2.5-million-pound hookload capacity and is designed around the 1,250-ton MDDM. This compares with a 2.0-million-pound capacity on the Enterprise-Class units that utilize 750-ton top drive systems. The Enhanced Enterprise-Class handling system incorporates a crown and traveling block with an active heave compensator drawworks compared with a crown-mounted compensator on the Enterprise-Class rigs.

With the active heave compensator, the driller has the ability to more finely tune weight on bit (WOB) during many of the drilling and coring operations. "Because of the more finely tuned weight on each type of bit to optimize drilling performance, we have better recovery of cores and we get better drilling performance and operation," Mr. Hall said. "Transocean has a lot of confidence in the active heave drawworks and has been operating them on a number of our deepwater rigs."

The MDDM, jointly developed by Transocean and Aker Kvaerner MH, overcomes some issues that were common among the top drive drilling systems in the fleet. "We wanted a unit that was more robust that could confidently go 10 years between major overhauls," Mr. Hall explained, "and that could be repaired much more quickly in the field if and when repairs became necessary."

Transocean and Aker Kvaerner MH designed the MDDM's duty cycles and load capacities so they can be used at or near their rated capacity for most of the expected 10 years. Also, the long–reach, deep wells that are anticipated to be drilled in the Gulf require a stronger top drive than currently exists, Mr. Hall pointed out.

"The previous top drives perform the way they were designed to perform," Mr. Hall said. "However, the higher usage and the more challenging type of drilling that is conducted on the deep wells requires a more robust unit to mitigate potential operating problems."

In addition to a longer life, the MDDM was designed for safer, faster and more efficient maintenance. The MDDM includes a redundant lubrication system featuring online oil monitoring, automated greasing system, work platforms that eliminate manriding operations, dual, redundant drives and troubleshooting, and offline load path inspection.

Should repairs become necessary, they can be performed quickly in the field due to the unit's modularity rather than having to ship the unit onshore for repairs, a process that could take days. Today, even if a rig has a complete spare top drive, it can still take days to remove and replace it. With the MDDM, Transocean expects replacing a module will require no more than about eight hours.

Additionally, the MDDM was designed to rest on the rig floor during repairs, eliminating any repair and maintenance operations that previously would have been done in the derrick.

A prototype MDDM was completed and tested and the first few production models have been sent to the shipyard. The prototype unit that was built with modular components will become a fleet spare for Gulf of Mexico operations. A slightly smaller version of the MDDM, capable of handling 1,000 tons, is being designed for the *Discoverer Luanda*, which is not expected to drill wells as long or as deep as those anticipated in the U.S. Gulf of Mexico.

Efficient and safer systems

"User friendly" is not an overworked phrase when it comes to the latest drilling and pipe-handling upgrades and enhancements on the Enhanced Enterprise-Class vessels. Many of the drilling and pipe handling systems have been designed with better ergonomics and friendlier interfacing between people and machines, much of which resulted from lessons learned from the earlier Enterprise-Class rigs.

"The Enterprise-Class rigs continue to perform very well," Mr. Hall said, "but again we saw where some improvements could be made. We improved what the machines can do to further minimize the amount of manual interface with the equipment."

One result is a reduction in the number of workers on the drill floor during most of the operations. This was accomplished by taking some of the operations that previously were performed manually and incorporated them into the rig's mechanization. For example, the Enhanced Enterprise-Class units are equipped with iron roughnecks, casing roughnecks and other enhanced mechanizations that can perform more tasks with fewer crew on the rig floor. The mechanized equipment is not designed to reduce the number of crew overall but to keep them out of potentially hazardous areas.

On the Enterprise-Class rigs, there may be one or more floorhands on the drill floor most of the time. On the new drillships, the rigs are designed to operate more often with fewer workers there, eliminating or reducing exposure to moving equipment and the risk of dropped objects.

Most pipe handling is done by machines, not by workers, enhancing safety. When handling drill pipe and cas-

On board from the start

When Schlumberger was invited to participate in the design and build process for Transocean's two new ultra-deepwater drill ships, the Discoverer Clear Leader and the Discoverer Inspiration, the company faced three technical challenges:

First, to build the largest cementing units in the world. Second, to design a robust wireline system that would allow the vessel's twin derricks to both be used at the same time, and third, to install interchangeable well-testing equipment that could be replaced quickly at sea.

Such challenges are nothing new, but the way Schlumberger addressed them was.

People, process and technology

The Discoverer Clear Leader core team has been in place since January, 2007. From a people, process and technology prospective, it has been one team with Transocean, the client and the different service partners. That decision has been key to the success of the project so far. When the ship is completed in 2009, the commissioning process should be nearly seamless, because things that typically go wrong will have already been worked out.

"The exceptional thing is that we were invited to be a part of the Clear Leader project from early on," says Lees Rodionov, Chevron account manager for Schlumberger.

"By having input at such an early stage, we could be sure that the components we deliver are technically right and fit-for-purpose. It is a unique and very collaborative way to work."

Employee performs a test at the Schlumberger Cementing Client Support Lab.

Heavy-duty cement

Both the Discoverer Clear Leader and its sister ship, the Discoverer Inspiration, will have nearly identical cementing units, and they will be the largest ever built. The 3,450-horsepower pumps were specifically designed for these rigs, and are the first of their kind in the world.

One of the client's requirements was that the cementing package needed to have enough power to serve as a substitute for the rig's mud pumps. The cement pumps also have special instrumentation to displace fluids with much greater accuracy than mud pumps typically achieve.

A cementing package serves two purposes: to first mix and then to put into place the cement slurry. That's not particularly difficult and it could be done with a smaller unit, but one reason for the extra pumping capacity is to be able to complete the cement job faster.

While most cementing units mix five to eight barrels of cement per minute, the dual system Schlumberger designed can mix at twice that rate, so the larger pumps are needed to move the greater volume of cement. The ability to use dual mixers to mix faster should save about half a million dollars of rig time on each new well.

The second reason for having so much power is to control the formation if the well fluids have to be displaced, or if well control becomes an issue. While a typical mud pump can generate a few thousand pounds of pressure, that's not enough to overcome the downhole pressures in ultra-deepwater wells. With high pressure manifolds, the new Schlumberger pumps can generate up to 18,000 psi.

The objective is to be able to circulate under controlled conditions in such a way that preserves the integrity of the wellbore. To handle extreme downhole conditions, the pump must be able to generate higher pressures.

Another key part of the cementing package is the computerized high-rate liquid additive system, which has much more capability than standard equipment. It was designed from scratch, and Schlumberger believes that it is the first process-controlled liquid additive system to be used offshore.

When blended into the cement, additives control such variables as viscosity, compressive strength and thickening time. The exact composition is determined in advance by laboratory tests. At the well site, the bulk cement is then mixed with water and chemical additives to create a fluid of the correct density and characteristics needed for the job.

"The first of the two ultra-deepwater cementing packages, the one for the Discovery Clear Leader, was designed, manufactured and tested, then delivered to Korea by air in just eight months," says Red Bryant, lead designer of the system.

"With our industry's history of long lead times, that was an almost impossible achievement. Confidence in our technical ability to meet the goal was one reason that Schlumberger was awarded the contract."

A hidden wireline

The wireline package for the Discoverer Clear Leader is a robust version of similar units on other drill ships, with one notable exception. The cable runs through a special tray that is hidden below the rig floor. With the dual-derrick system, that feature allows a crew to run the wireline from one derrick without having to shut down the second rig.

The most noticeable feature is a specially designed wireline unit and capstan that was developed for this application. Utilizing a 330HP engine, the wireline unit/capstan combination will be capable of pulling 24,000 lbs of line tension at speeds of 25,000 fph and reaching depths exceeding 40,000 ft. While that is beyond the limits of current cable technology, the system is designed for the future.

In addition, heavy-duty sheave wheels were developed to handle the additional cable tensions. Sheave wheels under the floor and in the derrick are what guide the cable from the spool into the well. If needed, the cable can also be threaded through the rig,s top drive, using a special top-entry access system.

"This wireline package is very robust," says Bob Kern, wireline engineer, Schlumberger. "If our client does eventually want to drill a well to 40,000 feet, this is the first wireline system that can handle it."

A flexible design for well tests

One of the most interesting features of the Discoverer Clear Leader and its sister ship is that well test fluids are designed to flow directly into the hull of the ship itself, rather than a barge tendered nearby. The ships will each have a capacity of more than 100,000 barrels, and they will be able to test wells at flow rates up to 20,000 barrels a day.

The ability to flow onto the ship greatly improves the efficiency of a testing program, since scheduling tests no longer depends on the availability of barges.

Schlumberger has had experience outfitting Transocean's Enterprise-class ships before, when it designed and installed the well testing equipment on the Discoverer Enterprise itself.

One difference between the Discoverer Enterprise and the Discoverer Clear Leader is that the well testing equipment on the first Enterprise-class vessel was built as part of the ship. For the newer vessels, the client wanted the test equipment to be interchangeable between the two vessels, and to have the ability to replace it quickly if the fluid-handling requirements change.

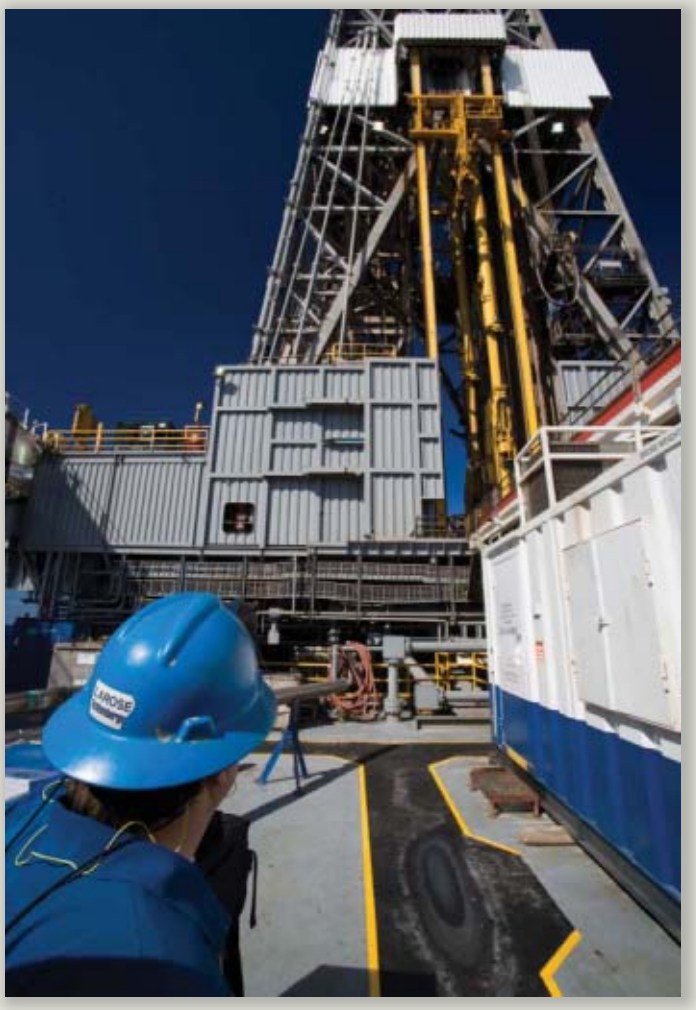
The system Schlumberger delivered was a combination of standard and non-standard well testing equipment; part of the challenge was bringing the two together.

To meet the client's objectives, design engineers used mobile equipment that can be ordered, transported and installed at sea within weeks. Specific components were then piped into the standard package to increase the system's capabilities.

Looking ahead

The well test package, like most other aspects of the Transocean's Enhanced Enterprise-Class ships, is ready when it is time to push beyond the limits of current technology.

"Quite often, companies design and deliver something that meets a challenge today," says Dennis Foret, North American marketing manager for Well Testing Services, "but by the time they deliver it two years later, the client is already up against the wall with new challenges. Transocean's Enhanced Enterprise-Class ships are designed to drill in water depths as deep as 12,000 feet. While our clients may not be ready to do that yet, they are certainly looking ahead. That's a very good thing, and we are excited to be part of the team."



Schlumberger personnel preparing for a wireline operation on the Discoverer Enterprise.

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Discoverer Clear Leader

ing, single stands are moved from the pipe deck via a knuckle boom deck crane to a catwalk machine and then to the drill floor. Pick up/lay down machines secure the pipe, pick it up and present it to the pipe racking machine inside the derrick. Practically the only pipe handling performed by floorhands is handling the pipe from the pipe deck to the catwalk area where the catwalk machines can do their job.

Drillers performing the drilling operation and assistant drillers operating the pipe-handling equipment are housed in a state-of-the-art cabin that features Cyberbase® chairs and consoles in a climate-controlled enclosure. Each chair has joysticks and touch screen controls to reduce fatigue. There is a driller and assistant driller for each of the two drilling stations, fostering communications as the teams work together, simultaneously operating the dual drilling centers.

The cabin sits in the center of the derrick between the two drilling stations so each team not only has a good view of the drilling station for which it is responsible but also the other drilling station with a good look up into the derrick. When this set up was installed on the Enterprise-Class rigs, there was a question about whether the drillers and assistant drillers would be distracted by the different operations. That has proven not to be the case, and the arrangement works very well as planned.

Subsea tree production prep area

The Enhanced Enterprise-Class vessels feature a dedicated subsea tree production preparation area on the port side of the moonpool that is protected from waves and wind. Three full–size, fully assembled trees can be lifted, stored, prepared and tested before running them to the seafloor. The BOP-handling system is used to move the trees to either the drilling center or the tree–preparation area, reducing handling time.

"We are commonly seeing 80 to 100-ton trees in ultra-deepwater development plans," Mr. Hall said. "On the Enterprise-Class rigs, which could handled one 75-ton tree at a time, sometimes we had to place the tree in two pieces and handle them separately because of their weight."

Mud pumps, volume capacity, efficiency increased

Drilling and completion fluid capacity and pumping capability have been enhanced on the new drillships. Five, 7,500 psi National Oilwell Varco (NOV) Hex mud pumps will be installed on the *Discoverer Clear Leader* and *Discoverer Inspiration* compared with four 7,500 psi Triplex pumps on the Enterprise-Class drillships. The *Discoverer Americas* will have four Hex mud pumps.

The new rigs also will feature 10 Brandt LCM-3D shale shakers compared with eight Brandt LCM-2D shakers on the earlier Enterprise-Class vessels. The extra shaker capacity offers redundancy and flexibility to the operations should a problem occur with one of the shakers, which can be bypassed without having to shut down the entire mud system.

The Hex pump is a novel concept designed to improve performance, versatility and efficiency in a smaller design pump.

Trelleborg CRP, Inc is the Worldwide Leader in Drill Riser Buoyancy Solutions

Trelleborg CRP Inc. leads the world in the supply of drill riser buoyancy modules in the ever changing deepwater arena. During the last 40 years of offshore exploration, Trelleborg CRP has become the client's supplier of choice. Worldwide, we have engineered, produced and delivered nearly 80% of all drilling and production riser buoyancy modules in service today. During our long history we have gathered numerous industry "firsts," and today our Ultra M.I.S. drill riser buoyancy technology gives our customers unsurpassed durability and safety. We are proud to have been chosen by Transocean to supply our Ultra M.I.S. drill riser buoyancy for their Enhanced Enterprise-Class drillships.

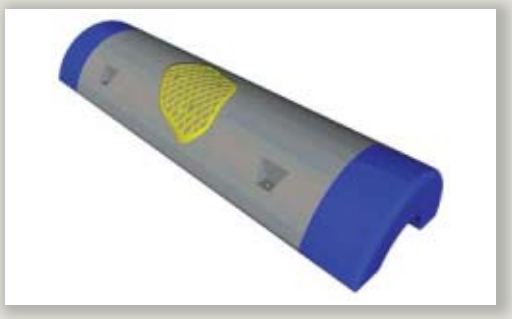
Ultra M.I.S. Buoyancy being loaded for operation

Industry Leader

The increasing global demand for oil and gas has resulted in man's continuing pursuit to explore for resources in ever deeper and more challenging waters. This has led to a need for lighter, stronger, safer and more cost effective engineered solutions in the buoyancy market. Throughout its offshore division, Trelleborg CRP Inc. has been at the forefront of technological advances. We are proud to have been the first to pioneer the development of the hollow glass microsphere in the 1940s and continuing through holding the record for the deepest operating drill riser buoyancy modules at 10,000 ft. Today, Trelleborg is pleased to have been awarded the first production orders for 11,000 and 12,000 ft drill riser buoyancy to be delivered in 2009. In the very near future, we will have completed ongoing qualifications that will allow our drill riser buoyancy to be used to depths of 15,000 ft, even though the company routinely provides ROV buoyancy rated for depths greater than 15,000 ft.

Expanding to meet the requirements of our customers

To allow Trelleborg CRP to remain at the forefront, we are finishing an aggressive upgrade of our present facility in Houston, investing $20 million to expand the capability of our existing plant. This expansion not only will allow Trelleborg to quadruple the capacity of a facility that already was the largest in the world, but add state of the art equipment and processes. When completed, Trelleborg's upgraded facility will be able to produce more buoyancy in one location than all other buoyancy manufacturers combined. In addition, our state-of-the-art buoyancy testing center, located at our plant in Houston is home to the largest privately-owned test tank in the world. This hydrostatic test chamber allows us to instrument test up to three buoyancy elements simultaneously. There are two smaller test tanks that supplement the larger tank. To meet the growing industry demand, a fourth pressure vessel has just been added, giving Trelleborg even more testing capability.



"Ultra M.I.S." buoyancy

Ultra M.I.S. buoyancy provides safety and durability

Our "Ultra M.I.S." drill riser buoyancy is the safest and most durable syntactic foam on the market today. It was designed through a coordinated effort between Transocean and Trelleborg CRP engineering. Ultra M.I.S. buoyancy was engineered to improve the safety on rigs by minimizing the risk associated with broken pieces of buoyancy falling during the running and pulling of riser. In addition, the new Ultra M.I.S. elements have convincingly demonstrated a dramatic advance in structural properties. The Ultra M.I.S. system provides virtually a two-fold increase in mechanical strength as well as buoyancy elements that have the ability to accommodate nearly twice the deflection before sustaining damage when compared with a non-M.I.S. buoyancy element. This has clear implications for health and safety, and would ease and minimize the cost of any repair of the elements.

Experience

For over 60 years, our experience and technological innovations have enabled Trelleborg CRP to become the worldwide leader in syntactic foam engineered systems. These highly engineered systems have been included in some of the world's most notable projects with great success. Today our worldwide network of sales and service coupled with our newly expanded capacity and technological innovations assures the industry of superior quality and unsurpassed service before and after the sale. Trelleborg CRP: the world-wide provider of comprehensive syntactic foam solutions.

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Discoverer Clear Leader

"We have investigated the Hex pump and conducted design reviews and we have a lot of confidence in them," Mr. Hall said. "We have Hex pumps operating in some of our rigs now."

Installing five mud pumps on the first and third drillships for Chevron anticipates a drilling program where a fifth pump contributes additional efficiency to the drilling program. The fifth mud pump also provides redundancy in the event one pump is down.

The fluid system volume capacity is about 20,000 barrels of drilling mud and completion fluids compared with a mud capacity of 15,400 barrels on the earlier Enterprise-Class rigs. The fluid handling system on the Enhanced Enterprise-Class rigs have separate and independent pits for mud and completion fluids. The dedicated piping, pumps and pits for drilling mud and completion fluids removes the requirement to wash out all of the piping, the pumps and the pits before converting from drilling mud to completion fluids and back, which typically can take several days.

Revolutionary power system

In order to power all of the Enhanced Enterprise-Class rig's systems, Transocean selected MAN Diesel engines, which are very robust with plenty of additional power capacity. Each rig will have six engines divided into two engine rooms. The new rigs feature DP2 dual redundant dynamic positioning systems for station keeping. Transocean worked with Siemens to implement an electrical distribution system designed by Transocean to significantly reduce the possibility of electrical power interruptions during operations. The system begins by not automatically shutting down an engine when it behaves erratically.

Instead, the system's special diagnostic software analyzes situations in conjunction with a number of modeling techniques that aid in predicting what could happen. The engine will shut down automatically if the system's prediction is for failure.

"This sequence is an operating philosophy change and we now monitor engine events and the power plant longer before deciding to take part of the plant off line," Mr. Hall said.

The system also includes an advanced generator–protection scheme that works to counter electrical problems. This particular system, developed by Transocean, is used on several Transocean rigs, including the *Sedco 702* semisubmersible when it was upgraded recently to deepwater capability with a DP system. All the system-related software has been fully tested.

Greater safety measures

While many enhancements made from lessons learned are designed for significantly improved operating performance and efficiency, safety remains the number one priority in the vessels' operation. All equipment has been examined to minimize manual intervention, thus mini-

Comparing the Latest-Generation Drillships		
	Discoverer Enterprise	**Discoverer Clear Leader**
Operating Water Depth, Designed	10,000 ft (3,048 m)	12,000 ft (3,660 m)
Drilling Depth Capacity, Designed	35,000 ft (10,667m)	40,000 ft (12,190 m)
Storage Capacities: Riser storage	10,000 ft (3,048 m)	12,000 ft (3,660 m)
Cranes	4 ea x 75 mt	4 ea x 100 mt
Major Drilling Equipment		
Dual-Activity Derrick	2 x 1,000 tons	2 x 1,250 tons
Top Drive	2 x 750 tons	2 x 1,250 tons
Rotary	2 x 60.5 inch/1,000 ton	1 x 75.5 inch/1,250 ton (fwd) 1 x 60.5 inch/1,250 ton (aft)
Drawworks	2 x 1,000 tons CE-EH-V	2 x 1,050 tons NOV AHD
Motion Compensation	2 x Crown mounted	2 x Active heave drawworks
Drilling mud/completion fluids system		
Liquid mud/completion fluids	15,400 bbls	20,000 bbls
Active mud	6,000 bbls	8,000 bbls
Reserve mud	9,000 bbls	11,600 bbls
Slugging tanks	400 bbls	400 bbls
Mud pumps	4 x 7,500 psi triplex	5 x 7,500 psi NOV Hex
Shale shaker	8 x Brandt LCM-2D	10 x Brandt LCM-3D
Subsea and well control		
Marine riser (21 in x 75 ft joints)	Class F (2.5mm lb) couplings	Class G (3mm lb) couplings
Blowout preventer	1 x 15k psi x 18-3/4 inch	2 x 15k psi x 18-3/4 inch
Diverter	1 x 60 inch bore	1 x 72 inch bore
Well test provisions		
Wellbore fluid storage	125,000 bbls	125,000 bbs
Tree handling	1 x 75 ton	Simultaneous 3 x 100 mt

mizing potential risk. Everything in the derrick, including the operating machinery and lighting fixtures, is examined with safety improvement in mind.

"We are trying to eliminate the risk of anything coming loose and dropping from the derrick onto the rig floor," Mr. Hall said. "That is also true below the rig floor and on the deck as well. Everything is examined to make sure that anything that could fall is secured. If something could possibly fall, it has a secondary retention method that would not let it drop to the deck."

Other safety enhancements include foam deluge systems for fire protection in the test areas below the substructure, on the drill floor as well as in many machinery spaces. Additionally, Transocean worked to eliminate any kind of operations that require manriding. "We don't pick up people in a riding belt unless it is absolutely necessary," explained Mr. Hall. "Most of the systems are designed where all routine maintenance and repair work occurs at a location where we can access the equipment safely without manriding."

MAN Diesel Powers Latest State-of-the-art Drillships

With 250 years experience as a business, 110 of these in the diesel industry, MAN Diesel is a well-reputed company with a thoroughly tested product. Last year, the U.S. drilling contractor Transocean chose MAN Diesel to provide the power to five new Enhanced Enterprise-Class drillships, thereby ensuring a reliable and efficient result.

MAN Diesel

It is a complex and technical challenge to provide a complete power supply system to a modern drillship. For this task, you need a reliable and experienced provider. Transocean chose MAN Diesel as the provider of the power supply system for five new Enhanced Enterprise-Class drillships on order and under construction at Daewoo Shipbuilding and Marine Co. Ltd. (DSME) in Korea. The six generating sets ordered for each drillship use the MAN 14V32/40 engine which will be manufactured by STX Engine Co., a MAN Diesel licensee in Korea. Even though the engine is manufactured by a licensee, it is built according to the drawings and specifications provided by MAN Diesel, and all tests are performed as specified by the customer.

MAN 32/40 Engine – the experienced workhorse

MAN Diesel's engines are powering the newest and most advanced drillships in the world today, but the company has a rich 250 year history of developing technologies in several industries. In 1887, the German Rudolf Diesel designed and built the world's first diesel engine, thereby founding and naming what today is the worldwide company MAN Diesel. Thus, MAN Diesel boasts more than 110 years of experience in the design, manufacturing and operation of diesel engines.

In 1957, MAN Diesel ventured into the offshore business when it powered the first floating drilling rig in Europe. Since then, MAN Diesel has gone on to power virtually every type of marine equipment and vessels supporting offshore exploration and production. The product range includes applications for drillships, jackups, semisubmersibles and floating production, storage and offloading (FPSO) units. MAN Diesel also powers platform supply vessels and anchor handling tug supply (AHTS) vessels used in support of offshore drilling and production operations, as well as pipe laying and cable laying vessels and construction vessels.

The MAN 32/40 engine is one of the most popular products in MAN Diesel's product line. It is referred to as the "workhorse" because of its durability and reliability. Today, there are nearly 2,000 MAN Diesel 32/40 engines in daily service in propulsion, genset and stationary applications. In the past year, the 32/40 engine has gained a strong foothold in the specialized newbuild drillship market, due to the fact that MAN Diesel had an order book of over 100 generating sets, totaling 776MW for 17 drillships.

The 32/40 engine is just one of MAN Diesel's products that have benefited from the 110 years of experience with developing and producing reliable, economical engines.

Trained Personnel Minimize Down-time

MAN Diesel offers a range of training options from short-term in-factory training to long-term on-board or on-site training. It is MAN Diesel's experience that monitoring engines and performing maintenance by MAN Diesel-trained drilling contractor crews results in increased engine life and reliability, minimal down-time, improved fuel efficiency and reduced cost of operation. Thus, Transocean's drilling rig crew will be trained to correctly operate and maintain the new engines.

Training for Transocean's mechanics will be conducted at MAN Diesel's Houston facility, whereas superintendents and mechanical superintendents will receive more extensive training at MAN Diesel's PrimeServ Academy in Germany.

24/7 Service Capability

Once the engines are commissioned, onshore or offshore, MAN Diesel provides a service organization of 150 agencies, service centers and authorized repair shops around the globe. MAN Diesel operates its own service centers, MAN Diesel PrimeServ, in North America, Europe and Asia, totaling over 50 service centers around the world.

When Transocean's Enhanced Enterprise-Class drillships arrive in the Gulf of Mexico, MAN Diesel will service their engines from its PrimeServ locations in Houston, Texas, and Ft. Lauderdale, Florida. The range of services provided by MAN Diesel's service facilities include spare parts for engine and turbocharger maintenance, parts reconditioning and replacement and troubleshooting services. Service facility locations offer high parts availability and quick delivery of spare parts to minimize any downtime.

Environmental responsibility today…

When it comes to protecting the environment, MAN Diesel is ahead of the curve. In June 2008, MAN Diesel relaunched its portfolio, making all its engines compatible with the limits established by International Maritime Organization (IMO) in its Tier II regulations.

…and for the future

MAN Diesel's newest technology further reduces emissions and not only meets current emission rules and regulations but future anticipated emission rules as well. The company's 32/44CR (Common Rail) engine is designed to meet future emission regulations with the use of electronic injection controls, variable timing, and is equipped with the latest generation of the proven MAN Diesel engine management system.

For the first time, the Safety and Control System on the 32/44CR combines all of the functions of modern engine management into one complete system. It provides integrated self diagnosis functions, maximum reliability and availability, quick exchange of modules and trouble-free and time-saving commissioning.

MAN Diesel is here for you today and in the future

With our experience and knowledge, MAN Diesel can provide the equipment and the expertise to solve the problems you might encounter when you are looking for that critical solution to your power needs. We are ready to support your equipment wherever it might work in the world. Contact one of our worldwide representatives to see how we can provide for all your offshore requirements.

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Transocean's shipyard-based inspection team assures the highest quality

Perhaps the most experienced rig construction team in the offshore drilling sector, Transocean's engineers and quality control/quality assurance personnel ensure the highest quality construction on its Enhanced Enterprise-Class drillships being built at Daewoo Shipbuilding and Marine Engineering (DSME) in South Korea. The inspectors pore over equipment during factory acceptance tests (FATs) before the machinery goes to the shipyard for installation on the vessels. The Transocean team at the shipyard also works closely with DSME's quality control/quality assurance department during construction, equipment installation, testing and commissioning.

Transocean has had a presence at DSME since mid-2006 when an engineering team went to work on designs of the Enhanced Enterprise-Class drillships. Detailed design continued with construction of the *Discoverer Clear Leader*, commencing in February 2007. Today, Transocean maintains a staff of more than 50 engineers and inspectors at DSME managed by Ken Adcock, Senior Project Manager for the Enhanced Enterprise-Class drillships project.

A shipbuilding factory

"DSME is a first-class shipyard. It is a shipbuilding factory," Mr. Adcock said. "They are ISO-certified for safety, quality control and quality assurance."

Mr. Adcock noted that the *Discoverer Clear Leader* marks the first drillship constructed at the DSME shipyard, which has tremendous experience at building commercial ocean-going vessels and some experience building semisubmersible drilling vessels. While building a commercial ship is quite different than constructing an offshore drilling rig, he noted that the

INNOVATION

Downhole

Drilling

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Tubular and Corrosion Control

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INTEGRATION

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Discoverer Clear Leader

shipyard has "learned a lot of good lessons from past vessels that they've carried over to our subsequent drillships."

"Working with the shipyard is really a partnership. We work together and try to help each other where we can, and so far it has worked out very well," Mr. Adcock concluded.

Ongoing quality assurance

Transocean's engineering team includes 10 people who are responsible for reviews and approvals during the ongoing engineering process. Inspections during construction ensure that the shipyard is following the correct procedures that will result in the delivery of the highest quality product.

The inspection and quality control staff includes construction managers, supervisors and inspectors who are responsible for ensuring inspections during construction, equipment FATs and various installations on the rigs. The shipyard is basically responsible for the engineering, construction, commissioning and delivery of the drillships.

"The shipyard uses a system called In Process," Mr. Adcock said. "The job is never stopped or held up for the inspections; they are done in process jointly by Transocean inspectors and the DSME QA/QC department."

Inspection schedules

Juggling the schedules of the inspection team among the multiple drillships under construction is not an easy task. However, because inspections are organized around the current construction phase, scheduling is made less complex. For example, the *Discoverer Clear Leader* was in the commissioning phase in mid-2008 with a commissioning team aboard the vessel. Most of the heavy construction on the *Discoverer Americas*, the second rig, had been completed at that time and equipment was being installed. An inspection team assigned to that rig monitored equipment installation and commissioning.

Heavy construction was ongoing for the third rig, *Discoverer Inspiration*, which entails assembling the various "blocks" that will be welded together to make up the vessel. In this case, most of the inspection relates to this construction phase, such as ensuring good welds.

Almost all of Transocean's inspection team members at DSME are Koreans who speak English with the inspection team's managers. As a result, the Transocean inspection team communicates effectively not only with the engineers on DSME's staff but also with the shipyard workers, including welders, pipe fitters and electricians.

Factory acceptance testing

All the equipment is subject to a FAT before it is shipped to DSME. The test is conducted for all critical equipment; that is, engines, generators, drilling equipment, electrical switchboards and switchgear, among other items. Transocean's shipyard inspectors go wherever the equipment is being tested. There is also a team in Houston which will attend the testing when the shipyard team is unavailable due to other priorities in the shipyard. Should any issues arise during the testing, the equipment manufacturer corrects the situation before the equipment is shipped to DSME. Only a few instances have prevented equipment from being shipped as originally scheduled, due to remedial work,

but that is the reason for the testing.

The Enhanced Enterprise-Class drillships under construction and on order at DSME are almost identical. Although certain equipment may be similar or even identical, each undergoes the testing process. For example, in mid-2008, the engines for the second vessel had been installed after testing while the factory acceptance testing for the third rig's engines was in progress. This process will continue until all five of the drillships' engines have been tested and accepted.

Validating the system software

With these state-of-the-art drillships, it is important that the software for running the vessels' systems is correct. Mr. Adcock's quality control/quality assurance team also gets involved here. The team ensures that the software is accurately monitoring and operating the various systems during the FATs. In some cases final software configuration takes place on board the rig during the testing and commissioning phase.

"When we finalize the software for the first vessel," Mr. Adcock said, "we should be able to download the software for the subsequent vessels with few modifications."

"That should reduce our future commissioning time on the subsequent vessels significantly," Mr. Adcock emphasized.

"Also, at Transocean, we have specific ways we want to operate our dynamic positioning control system and our power management system," Mr. Adcock said. "As a result, we work with the vendors to adapt their software to meet our operating philosophies."

Once again, it's a team effort, and everyone involved looks forward to a successful startup of the *Discoverer Clear Leader* and her sister units.

Company Profile

Electro-Flow Controls Provides Choke Control Systems

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Transocean's new generation of drillships is equipped with Electro-Flow Controls (EFC) choke control systems. Working closely through Worldwide Oilfield Machine Inc. (WOM of Houston), supplier of the drilling manifolds, EFC designed and built the controls in its Aberdeen headquarters.

WOM chose EFC to supply complete systems, including sensors for manifold pressures and choke position, control console with touchscreen displays, and direct hydraulic control of both remote chokes.

The Choke Control systems comes with an interface to the drilling controls and instrumentation system, allowing choke control signals and manifold data to be exchanged across a Profibus communications link. The system has been designed with flexibility in mind and can be expanded as operations dictate, with the addition of other well control products from EFC.

These products have been developed over the past 15 years in response to direct requests from rig owners, and come with a proven track record of success. They are found on rigs worldwide, providing invaluable well control support under the most demanding operational conditions of high pressures, high temperatures, gas well drilling.

Products supplied to Transocean include:

Finescale Gauges (FSG) – high resolution, analogue, manifold pressure displays
Liquid Seal Monitor (LSM) – displays and alarms against loss of liquid seal integrity
Temperature Monitoring (TEMP) – of BOP & manifold temperatures
Overboard Valve Controls (OBC) – interlocked, sequenced control of overboard valves, to provide emergency flow dumping
Glycol Injection Units (GIU) – 23,000 psi dual pumping units, with 1,000 litre tanks
Manual Valve Status (MVS) – console indication of manual valve open/close status
Pump Stroke Counter (PSC) – SPM & total strokes of quad and more mud pumps

Electro-Flow Controls designs, manufactures, installs and commissions a range of control, monitoring and instrumentation systems for safe and hazardous areas. The company was established in Aberdeen, UK, over 20 years ago and has been supplying tailored systems solutions to the global oil and gas industry ever since.

Operational readiness key to success

The single most important key to Transocean's success of more than 50 years of pioneering new generations of offshore drilling rigs has been its people, and the ultra-deepwater drillship *Discoverer Clear Leader* is no exception. Led by Dan Haslam, Rig Manager – Performance, the rig in August 2008 was in full swing of becoming operationally ready and crewed with the best possible personnel – from floorhands to toolpushers, motormen and chief electricians. Going from the shipyard to drilling in the U.S. Gulf of Mexico requires thousands of hours of work by people from Transocean, Chevron, the shipyard and third-party companies. But it's Mr. Haslam who takes the lead with every key entity, as well as with Transocean's functional departments, including Human Resources, Engineering, Technical Support, Operations, QHSE, Maintenance and Procurement.

The consummate drilling rig

For Chevron, which is contracting the *Discoverer Clear Leader* and *Discoverer Inspiration* to operate in the U.S. Gulf of Mexico, Mr. Haslam ensures that everything the client requires will be ready. All newbuilds are complex, but the *Discoverer Clear Leader* goes beyond standard features. Besides Transocean's patented dual-activity drilling systems, the rig has a new and enhanced top-drive system, an expanded high-pressure mud-pump system, and expanded completions facilities.

Working with Chevron on the *Discoverer Clear Leader* and *Discoverer Inspiration* has led to this ultimate drilling machine.

"Chevron has a lot of experience operating the *Discoverer Deep Seas*, one of our Enterprise-Class drillships," Mr. Haslam said. "They have been a phenomenal partner in helping make the Enhanced Enterprise-Class rigs the exceptional drilling rigs that they are going to be. Transocean knows how to operate a rig but Chevron has been able to tell us, from an operator's standpoint, everything they need to drill a deepwater well."

Assembling the rig crew

While the rig was being constructed, Mr. Haslam continued the challenging task of assem-

Transocean Awards High Pressure/High Performance Valving to WOM

Transocean awards high pressure/high performance valving for choke, cement, standpipe, mud room manifolds and subsea BOP fail-safe stack valves to WOM for the Enhanced Enterprise-Class drillships.

Worldwide Oilfield Machine, known as WOM is a multinational manufacturer of pressure control equipment with world headquarters in Houston, Texas and manufacturing, sales and service facilities strategically located throughout the world. Satisfying the customer's needs is top priority at WOM. Whether it's an engineering concern, a special design requirement or field service, WOM delivers...whenever and wherever in the world they are needed. WOM can help keep pressure under control anywhere in the world 24 hours a day with one of the largest inventories of replacement parts available for flow control products produced by all major manufacturers.

WOM Subsea Fail-Safe BOP Stack Gate Valve

Service facilities worldwide

WOM has fully equipped service facilities in the major oil and gas production regions of the world, with even greater expansions in the planning stage. Select WOM facilities offer value added services that measurably extend competitors gate valve life through a comprehensive reconditioning and upgrading with Magnum "Dual-Seal" technology.

Invention of the Magnum Gate Valve "Dual-Seal" Concept

Through invention, innovation and engineering creativity, WOM began improving existing valve designs to increase reliability and reduce maintenance since 1981. In 1985, WOM introduced a breakthrough sealing concept for gate valves used in the petroleum industry. After thorough testing and retesting at WOM and third party test facilities, WOM's Magnum gate valve design proved it's superiority.

Expanding to meet worldwide needs

For almost thirty years, through aggressive new product development and a willingness to experience growth and expand its customer support, WOM has greatly expanded their product offering, manufacturing capabilities and service to provide customers a single source to control a wide range of demanding flow applications found in all facets of the oil and gas industry.

WOM Choke Manifold

Maintaining standards that exceeds customer requirements

The business mission of Worldwide Oilfield Machine, Inc. (WOM) is the design, manufacture, and testing of Drill Through Well Control Equipment in accordance with API 6A, API 16A, 17D, 6D, and API 7. In addition, WOM will repair or refurbish in accordance with customer requirements and/or the existing WOM repair and testing procedures. The Quality Policy and objective of WOM is to meet or exceed the Quality Standards expected by our customer. The mission and quality policy is understood, implemented, and maintained at all levels of the WOM organization. The Quality Assurance Manual sets forth the requirements for establishing and maintaining programs for the WOM Quality System. Another objective of WOM is to provide our customers with the highest quality products, innovative yet proven designs, unsurpassed service and uncompromising reliability.

Providing custom design for flow control equipment that is trouble free

WOM provides custom designed systems for onshore, offshore and subsea applications. The engineering staff at WOM has successfully developed numerous pressure control systems that have been installed to meet a wide range of operating conditions and flow control requirements.

The Magnum Gate Valve is reliable, adaptable and versatile

The basic building block of these systems is the Magnum gate valve. The versatility, adaptability and reliability of this valve design enables it to be incorporated with other components to provide greater safety, longer service life and less maintenance. Providing unique solutions based on advanced technology for unusual requirements is one of the reasons WOM is quickly becoming the leader in global drilling, completion and production pressure control.

The "Dual-Seal" technology provides longevity

At the core of every flow control system is the valve. After almost three decades, and hundreds of successful installations worldwide, the Magnum Gate Valve has proven superior in the field. In drilling, testing, production, surface and subsea, the superior Magnum "Dual-Seal" metal-to-metal sealing system has been put to the test time and time again. In critical services and in standard installations customers have taken notice of the long service life, reliable sealing, and low maintenance advantages of the Magnum Gate Valve.

Deepwater testing

If you want to put a valve and actuator to the test, lower it 11,000 feet beneath the sea. The Magnum Subsea Gate Valve and Actuator are a prime example of WOM's engineering, design, and manufacturing abilities. Thoroughly tested and approved, Magnum Subsea Gate Valves and Actuators surpassed the stringent API 17D Specification for Subsea Wellhead and Christmas Tree Equipment. A 3-1/16" 15,000 psi Magnum Subsea Gate Valve easily passed the required number of cycles at 4038 meters (13,250 ft.) of water depth. An additional non-required test was conducted by WOM where the actuator was cycled 4,500 times at full working pressure, proving reliability and safety in tough subsea operations. The results were verified by DNV.

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bling a well-experienced rig crew. Fortunately, Transocean across its fleet has experienced crews available who have been working with highly technical operating systems and equipment for years. The majority of the senior and mid-level crew are being chosen from among Transocean's three Enterprise-Class drillships and the rest of the company's Fifth-Generation fleet, which have technology similar to that on the Enhanced Enterprise-Class vessels.

Crewmembers already on the rig

About 55 people for the *Discoverer Clear Leader* crew were in Korea while the rig was being built, supporting the project team by providing operational input and assisting with commissioning. This process aided in a smooth commissioning phase, and ensured the crew became intimately knowledgeable about the rig's equipment and systems. The crew members performing these tasks primarily filled supervisory rig positions.

Additional crew will be assigned to transit the rig to the U.S. Gulf of Mexico. The remaining crew members will join the drillship when it arrives in the Gulf prior to starting operations for Chevron.

"We are in a much better position to crew our state-of-the-art rigs than we were seven or eight years ago with the last round of newbuilds," Mr. Haslam said, "At that time we didn't have any Fifth-Generation drillships or semisubmersibles from which to draw our crews.

"As such, all the crews at that time came from conventional, single-activity rigs that had nowhere near the level of mechanization we see on the latest-generation units."

Transocean has been continuously training crews to operate the Enhanced Enterprise-Class vessels. "We have been taking advantage of any extra beds available on our existing rigs to expose personnel to similar systems, making them ready to support the Enhanced Enterprise-Class rigs as they are delivered," Mr. Haslam said. "Again, we are leaps and bounds ahead of where we were with the last round of newbuilds."

In order to man the Enhanced Enterprise-Class vessels and maintain a high level of competency within the existing Transocean fleet, the company has implemented various programs to accelerate recruiting and training.

"For recruiting, we have launched an internal, Web-based system so that people can be found from within our own workforce using the theme: 'We're Building More Than Just Rigs. We're Building Careers,'" Mr. Haslam said.

Overall, Transocean's recruitment plan for newbuild rigs includes approximately 2,000 new hires during the next few years as the new rigs are delivered and crews are transferred from other rigs to operate them.

"We have people right now within the Transocean fleet that are ready for promotions. These individuals have been identified through our succession planning and employee appraisal process, and we know what additional training they need to become outstanding operators on the new vessels," Mr. Haslam said. "The existing rigs that provided the newbuild drillship crews will promote internally and the new hires will fill in their positions," he added. "Across our fleet, we have effective programs to recruit high-potential people from areas such as maritime academies for our marine departments, and from the military who have received training in electrical areas. So our focus remains on hiring the best people, training them with the best on-the-job training program, and mentoring them so we can provide the safest, most reliable and efficient services for our clients.

In short, success is all about the people.

Innovative system to radically raise reliability and availability of power generation, propulsion and drilling systems

The power generation and propulsion system on Transocean's newbuild fleet is designed to fully meet the most demanding conditions during the missions of these modern drilling vessels. Developing such resilience in a Marine Power and Propulsion System required a step change in overall system predictability. Transocean achieved this step change during the deployment of the "Sixth-Generation Power and Propulsion System." The Sixth-Generation system's efficiencies also will help reduce emissions on the *Discoverer Clear Leader* and on the four other Enhanced Enterprise-Class drillships. Eventually, the system will be installed on other rigs in the Transocean fleet. In addition, the technology already is attracting the interest of wind farms and hybrid ship power systems which are seeking the same benefits.

"The whole point of the Sixth-Generation power plant is to improve predictability," said Ed Bourgeau, Engineering Discipline Manager, Electrical and Power Systems. "If you can predict the behavior of the machinery, you can take action to accommodate it."

The new system takes the guesswork out of addressing "hidden" faults that are not obvious in conventional or older systems. Key elements of the Sixth-Generation Power System have already been installed on the recently upgraded DP (dynamically positioned) semisubmersible rig *Sedco 702* and the operational results have surpassed design expectations. Transocean's *Discoverer Clear Leader* and its four other future Enhanced Enterprise-Class vessels will be fitted with this system not only on the power generation and propulsion systems, but also on the drilling power system. In addition, Transocean plans to install the power system or certain components of it on other existing vessels in its rig fleet.

Three initiatives to improve predictability

Transocean focused on three areas to improve predictability in the power system to avoid and eliminate faults and the possibility of a power interruptions on a rig. These initiatives include the Advanced Generator Protection (AGP) for power generation equipment, Advanced Thruster Control and Protection (ATCAP) for power consump-

Discoverer Clear Leader

tion equipment and Intelligent Power Distribution (IPD) for power distribution equipment.

AGP initiative

The AGP initiative eliminates the complex real power (KW) and reactive power (KVAR) load-sharing schemes found on typical power generation systems. In a surprising return to the forefront of technology, the simple and robust "droop" regulation technique handles the real and reactive load sharing. "Droop" regulation is where the main bus frequency and voltage droops slightly when loaded. This allows for independent generator operation. This key element of autonomy results in highly predictable behavior of speed and voltage regulators, so that any faults can be detected and isolated before they escalate. In short, a conventional PLC runs a simple real-time diesel/generator model, compares the model results to the actual situation and takes action accordingly.

The autonomy of the AGP power system also greatly reduces the possibility of faults. Unlike conventional systems, there are no real or reactive load-sharing communication lines. This simplified control and autonomy makes fault identification much easier. In addition, AGP speed and voltage droop control enables intelligent loads to independently initiate power-management functions.

ATCAP Thruster Control improves load response

"The ATCAP initiative allows intelligent loads like thrusters and drilling drives to take full advantage of the droop plant regulation to confirm the main power plant health and independently modify their power consumption based upon actual power plant conditions," Mr. Bourgeau explained.

It eliminates many of the complex requirements and removes the possible fault conditions on these loads.

ATCAP also eliminates large in-rush currents when connecting large loads such as a propulsion transformer. The in-rush current (from the initial magnetizing current into the transformer) creates significant stresses on a transformer, pulls the bus voltage down and creates high

currents in the generators. Often, the currents are so high that multiple generators are needed on the bus to allow a transformer to be brought on line.

"As part of the ATCAP initiative, Transocean looked at the loads and asked what can be done to reduce or eliminate this shock loading," Mr. Bourgeau said. "By using the drive to magnetize the transformer, we are able to eliminate the shock load entirely and verify with certainty that the load is healthy before it is connected to the vessel's medium voltage bus. The elimination of the risk of connecting a faulty transformer or drive is a major step forward on a DP2-class drilling vessel."

"Because we have removed the sudden impact of a load connecting to a bus, for the first time we can connect multiple loads simultaneously," Mr. Bourgeau continued. "As a result, each different load can intelligently decide if it is in good order, and they can connect themselves to the bus."

This process is performed without regard to other loads, eliminating the requirement for a central control system to predict and regulate that function. Consequently, response is much faster, less faulty and statistically less likely to fail.

The ATCAP initiative increases thruster autonomy by simplifying the interface to other equipment. This removes the requirement for any control interface other than thruster on/off, and the azimuth direction and thrust commands.

With ATCAP, thrusters have their own independent auxiliary power and control all of the thruster auxiliaries, such as lube-oil pumps and azimuth drives.

"ATCAP eliminates any kind of system failure that could be caused by a faulty load getting connected to the bus, distributes and limits the consequences of component failure and speeds up the time to make thrusters available to the DP system from the previous 45 seconds or longer to less than three seconds, an order of magnitude improvement," Mr. Bourgeau concluded.

Intelligent Power Distribution (IPD)

The IPD initiative focuses on distribution transformers, tie breakers and feeder breaker coordination. Much like ATCAP features, the step load of connecting distribution power transformers is eliminated. IPD also removes the possibility of connecting a faulty transformer to the main bus. This initiative includes several innovations designed to improve "Tie Breaker" performance by dynamically changing the tie breaker's trip levels based on the number of generators connected and allowing normally opening of bus ties only after the power transfer is reduced to zero.

System development

One of the major issues involved with a modern power distribution system is controlling and verifying software packages on the many digital controllers.

"To write the software and use it on the vessel and make sure it was tested properly was a challenge," Mr. Bourgeau explained. "It took a lot of record keeping. The equipment we used is much more sophisticated than that used before."

Transocean, with the assistance of AKA, an independent engineering firm, developed a process tool called "DeviceTrak"™ to aid in the control and verification that the right software is deployed in the right controller now and for many years of service to come.

"The dynamics of active front-end power-conversion technology was challenging due to the numerous innovations on the Enhanced Enterprise-Class vessels that are not present on other rigs," Mr. Bourgeau continued. "For example, Transocean runs DC voltage directly on the AC power cables in the emergency feeders. This has never been done before, and certainly attracted the attention of the shipyard engineers."

The Enhanced Enterprise-Class vessels also will be the first floating drilling rigs with a 100-meter DC bus, operating at 1kV and 3,000 amps. This innovative distribution of power addresses the dynamics seen in some 20 megawatts of drilling process loads, including two active heave compensated drawworks.

Upgrading existing rigs

Existing Transocean rigs are built to industry standards; however, plans call for applying the advantages of these power innovations fleetwide wherever possible.

"Sometimes it is just not possible to modify an entire rig," Mr. Bourgeau said. "But there are many elements of these three initiatives that can be applied with relatively low impact to cost and service time on an existing vessel that will improve power reliability and availability."

"We have a rig fleet that is extremely reliable but as technical leaders, we are committed to continuously improving our performance to meet our clients' increasing needs," Mr. Bourgeau concluded.

Through the companies that worked with Transocean and Siemens, the key technologies developed for the Sixth-Generation power plant are being directly exported to the so-called green power industry. IDS of Zurich and AKA of Canada are moving innovations such as multiple voltage regulators on a common DC bus, direct use of DC power on AC power lines and energy-based predictive models directly to wind farms and hybrid ship power systems.

The Sixth-Generation Power System is a major step toward the goal of infallible, single diesel, DP operations with a greatly reduced carbon footprint.

Environmental performance; reaching the fullest potential

Transocean's Enhanced Enterprise-Class drillships feature state-of-the-art drilling equipment and power management systems for drilling clients' wells in the most efficient and cost-saving way. What's not always visible but is just as important are the rig's environmental systems to assure nothing goes overboard that could harm the environment. These preventions include everything from a detailed drainage system for all fluids, containment systems across all deck spaces, fluid separation systems, biodegradable hydraulic fluids, a moonpool skimming system, an improved mud system and an innovative power-management system that allows for the computerized control of the rig's power for more efficient use and minimized emissions.

Crew training and the establishment of a rig-based "Green Team" ensure that all environmental systems are operated and managed to their fullest potential. The goal: continuous environmental improvement.

Environmentally friendly shipyard

The environmental culture begins at the shipyard in South Korea.

"One of the things that impressed me was the degree of environmental management at Daewoo Shipyard and Marine Engineering," said Ian Hudson, Ph.D., Transocean's Corporate Environmental Manager. "They have one of the most comprehensive shipyard environmental management systems I have ever seen."

"DSME implemented a diligent waste segregation system across the entire shipyard. When the yard sets up a project it brings in a full waste management system and everybody is 100 percent in support of the recycling process. There is not one item out of place in the entire shipyard," Mr. Hudson said.

"That is something that impressed me as part of the building process itself. That is good because it shows environmental responsibility from the yard during the building process, and because the moment you walk onto the new vessel you are presented with a very clean space."

"Anyone who takes that amount of pride in their workplace also takes pride in their

Discoverer Clear Leader

workmanship," Mr. Hudson continued. "It suggests that you are in a place where the culture is right and that reflects on their performance."

That results in a premium rig for Transocean, which also takes extreme pride in its workplace as part of its drive for optimum drilling performance.

Environmental lessons learned

As Transocean applied drilling improvements learned from the Enterprise-Class vessels to the Enhanced Enterprise-Class, numerous environmental lessons were applied to the *Discoverer Clear Leader* to upgrade the environmental aspects of it and Transocean's other new Sixth-Generation drillships. Beginning from the bottom of the vessel and working up, an important enhancement is the drainage and containment system on the rigs.

"The Enterprise-Class vessels feature an excellent fluid containment system but the new system takes it to a different level," Mr. Hudson said. "We are able to take specific fluid streams from specific areas of the rig, which have their own drainage system, through a triple barrier or 'weir' system."

The idea is that most of the solids are removed before the fluid goes into a complex array of settling tanks in the vessel's hold. When a specific area of the rig is cleaned, the drainage could contain unusable mud or other drilling fluids. Due to the difficulty of moving that fluid through the containment system, it's best to avoid mixing fluids if possible. To mitigate that situation, the Enhanced Enterprise-Class design goes to great lengths to keep the different areas of the vessel drained to separate tanks.

"This Transocean-designed drainage and containment system is a real advantage because it means we can treat different fluids specific to their attributes," Mr. Hudson explained. "For example, drainage from the drill floor has different components than drainage from the deck areas. It means we can treat the specific fluids rather than treating them holistically."

The different, large-volume tanks below deck are used to remove the solids, skim the oil off the top and run it through a filtration system.

Additionally, the rig floor is built with a containment pan so that everything that falls on the rig floor will go into the pan. It is piped separately to the weir system and then to a tank system. Also, any fluids from the deck areas will drain to a separate tank via a unique set of piping, in effect creating a double containment system for fluids.

Another scenario involves retaining fluids that cannot be diverted overboard. During heavy rainstorms, the deluge needs to be moved off the rig quickly, which is accomplished with double plugs to release the clean-deck space seawater and rainwater. If it is suspected that the rainwater contains anything that could affect the environment, the drainage system has the capability to re-route the water to below deck for treatment.

"If the decks are clean and the rig is clean, it's just rainwater falling on the deck and there is no problem diverting that overboard," Mr. Hudson said. "If we have any doubts, we do a visual check and inspection, and keep the drainage plate sealed so the water will go into the rig's drainage system and through an oil and water content monitoring and separating system. It is then discharged at a specific level

based upon compliance to clean water regulations."

In this case, if the water meets a certain discharge standard (15 parts per million), the system automatically allows the separated water to discharge overboard. If the water doesn't meet the standard, it is automatically routed back to the separator for separating and cleaning.

Additional containment areas

Transocean also has provided additional containment for the spaces below and above the deck where materials designated as hazardous are accumulated. For example, fluids move through pipework in one of the machinery areas below deck, which includes a containment system for handling potential leaks. If there is a leak, it is contained in a pan that is routed to the specific tank for cleaning. This approach prevents any potential leakage from entering a lower deck.

"I call it bunding, some people call it combing," Mr. Hudson noted, "and basically every conceivable space or area below something that can drip or lose containment is bunded."

"We paid a lot of attention to details such as this so that all spaces from top to bottom are contained when it comes to potential fluid leaks. Every conceivable internal and external space that can be bunded is bunded," he explained.

Should small spills occur, kits are located around the rig with cleanup and containment supplies specific to the different areas of the rig, such as places where chemicals or hydraulic fluid are used.

Biodegradable hydraulic fluid

Transocean has worked to mitigate or minimize other potential environmental situations. As an Enhanced Enterprise-Class drillship is highly mechanized, much of its operations are performed using hydraulics. "We employ the best hydraulic fluid available in the industry for our hydraulic systems," Mr. Hudson said, "and we are filling all of our hydraulic systems with what is termed readily biodegradable hydraulic fluid."

The non-toxic hydraulic fluid is biodegradable to over 95 percent in seawater. In addition to being used on all of the Enhanced Enterprise-Class rigs, the fluid is being rolled out to other rigs in Transocean's fleet to replace standard hydraulic fluid. Uses include fluid for operating cranes and the central hydraulic systems. The point behind the biodegradable fluid is that in the unlikely event of a hydraulic fluid spill, its potential environmental impact is vastly reduced.

The blowout prevention system (BOP) and riser tensioner system also use biodegradable hydraulic fluid, re-

Discoverer Clear Leader

ducing the potential impact due to fluid losses.

Assuring a clean moonpool

Should debris fall into the rig's moonpool, which is the open area to the sea just below the drill floor, the rig is prepared to recover it immediately with its skimming system, essentially a rotating boom deployed to "sweep" up moonpool debris.

"We keep the moonpool as clean as possible," Mr. Hudson said, "but if wind blows something in it we can deploy the system and skim off the product."

The skimming system also means that crewmembers don't have to visit the moonpool to keep it clean, further increasing safety. Besides cleaning debris that has fallen or been blown into the moonpool, the system also can help retain any fluids that may have dripped there by accident.

Power management system

Another key area that Transocean focused on is the rig's power management system and the engines used to provide power to the rig's systems.

"We wanted to optimize our engines and the way they perform to provide a maximum reduction of emissions," Mr. Hudson said. "We have the engines configured for that and we have a system that will allow us to get the maximum from the engines with the least emissions."

"The comprehensive power management system on these rigs will allow us to automatically control and vary the way we set up the power," he continued. "There is a diligent methodology behind matching the power requirements with the engine requirements resulting in more fuel-efficient and lower-emission engines."

The low-emission and fuel-efficient engines, supplied by MAN Diesel, are designed and built to meet current and anticipated emission standards.

Other improvements

Numerous other improvements, while not as high a profile as engines, are just as important. For example, in the mud pit rooms, specific locking systems and blanking plates have been installed to eliminate an incorrect valve being inadvertently opened that could result in a discharge. A color-coded system lets the crew member know which valves are not to be opened.

Another feature is the use of fluid transfer hoses with quick-release, dry-break connections, which are used on the rig's loading hoses for fuel and other fluids. Should a hose inadvertently come loose from a connection, the dry-break feature shuts off the hose entirely. Transocean also implemented a rigorous hose replacement program so hoses are not in use over extended periods, potentially resulting in breaks and leaks.

Also, much of the rig's electrical wiring and piping are in an enclosed tunnel running the entire length of the rig and removed from the elements to provide an extra level of protection. That also means that if repairs are necessary, the electrical engineers can work in a protected area, resulting in a safer and healthier workplace.

Training assures ongoing environmental standards

All of Transocean's rig crews are trained in the use of the company's Environmental Management System. It is the same on the company's rigs worldwide so a crewmember changing rigs knows the system regardless of where he or she works.

"Another thing the crew does is to create a Green Team," said Mr. Hudson. "These team members are the environmental champions on the rig."

Each team helps run the management system, which includes a comprehensive waste-management program to minimize waste. Data is collected on areas such as emissions and waste generation as a way to reduce them. Waste-segregation stations are color coded and located in several areas on the rig. State-of-the-art waste compacters compact the waste into different recyclable components such as cans, cardboard, paper and rubber. For three of the Enhanced Enterprise-Class rigs operating in the U.S. Gulf of Mexico, these items will be sent to a waste-recycling program onshore.

"We will set up every rig with a waste management plan, display that plan everywhere on the rig so the crew knows where the waste stations and segregation stations are, and we can then track the type and volume of waste," Mr. Hudson explained. "We will examine the waste volumes and the types of waste and learn how we can reduce the volumes."

Constantly learning: a major key to Transocean's continuous environmental improvement.

Tong-Il Boiler & Industries is a Leading Provider of Specialized Pressure Vessels

Tong-Il Boiler & Industries (TBI) has provided pressure vessels, module packages, mud tanks, BOP rails and top structures for Transocean's five newbuild Enhanced Enterprise-Class drillships. Based upon its 25 years of experience in power and industrial plan, TBI has expanded its business to the offshore industry and successfully performed more than 60 offshore projects. With its extensive experience and expertise, TBI is continuously developing innovative technologies in the rapidly changing offshore industry

Mud Active Tank for Transocean Project (16t X O.D. 4,600 X H 7,000 : 16ton/set)

Extensive experience and expertise in offshore pressure vessels

TBI was established in 1980 as a manufacturer of power and industrial plants such as heat exchangers and condensers. Based upon this experience, the company boosted its excellent welding technology and abundant impact data influence, which is one of its core competencies in pressure vessel fabrication. In addition, outstanding piping technology and integrated system fabrication skills are TBI's other strengths. Since 1998, the company has successfully performed more than 60 offshore projects for Chevron, ExxonMobil, National Oilwell Varco, Daewoo Shipbuilding & Marine Engineering (DSME), Hyundai Heavy Industries (HHI), Samsung, Aker Solutions, POSCO and Rolls Royce, among others.

Pressure Vessel for LPG Ship (42t X O.D. 4,000 X L 32,800 : 130ton/set)

Manufacturing with no size or weight limitations

Recently, TBI completed its second factory. With its first and second factory, the company now has manufacturing capacity of 50,000 tons annually. The company's second factory, affiliated company Y&S Co., Ltd., has a load out quay allowing TBI to fabricate all kinds of offshore products without limitation to size and weight.

Geographical advantage provides lead-time reduction, prompt handling

As major Korean offshore builders such as DSME, Samsung and HHI take a substantial proportion of the worldwide offshore markets, TBI's geographical location in Korea can be a great advantage for clients and owners. The company is located within 1 ½ hours from the manufacturing facilities of the three major companies noted above. This geographical proximity can significantly reduce the costs and lead time to deliver products to their sites. Additionally, various unexpected situations during fabrication such as modifications or maintenance can be handled immediately.

As one of the main subcontractors of DSME, Samsung and HHI, Tong-Il Boiler has performed numerous projects for each. Ultimately, TBI's close cooperative relationships with the companies provide many benefits and advantages to clients and owners.

Based upon its Customer First motto, TBI will be the best partner to meet every detailed requirement for its clients.

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