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OFFSHORE

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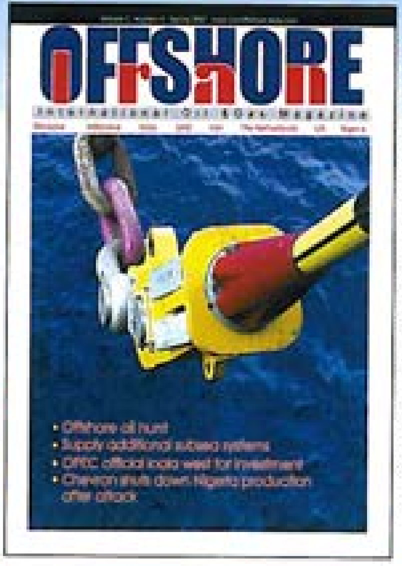

Cover story:
The future of the offshore oil and gas industry is in deepwater exploration and production.It has been argued, based on energy forecasts and estimated production life of operating fields, that production cannot be sustained unless the industry moves to deeper waters.
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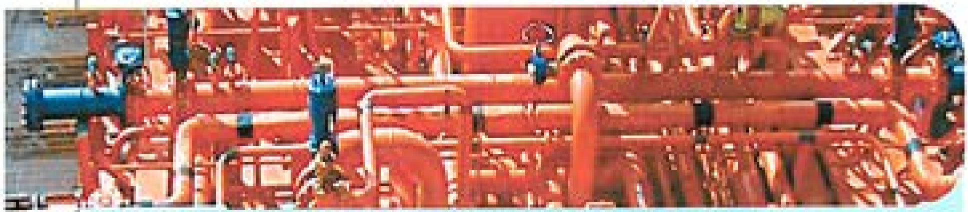
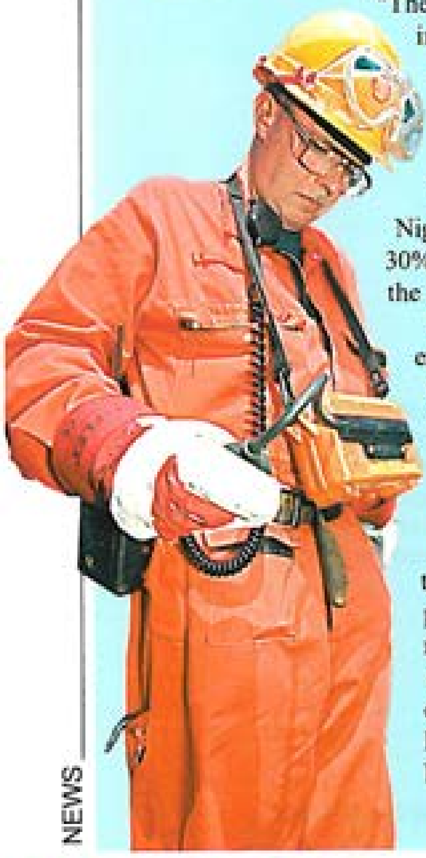


Shell begins Nigeria ops cost-cutting program to offset costs

Royal Dutch Shell(RDSB.LN)said it has started implementing a number of cost cuts to its operations in Nigeria, which are likely to include job cuts,to combat rising costs and falling oil revenues caused by production outages.

A Shell spokesman in the Netherlands said the changes were underway and follow an internal announcement May 30 in which the company told its roughly 4,500 Nigerian employees that it would implement a"series of measures"to cut cost and boost productivity.

The changes amount"an austerity program for three years, "the company said in the announcement, which wasn't made public but was made available to Dow Jones Newswires.



"The measures will demand significant step change in performance at personal and organizational levels as well as focus on how to reduce costs, "the company said at the time. The announcement didn't indicate what cost savings Shell hoped to strip out of its Nigerian operations.

Shell is the biggest western oil company in Nigeria, Africa's largest oil producer, through its 30% stake in a government-run venture known as the Shell Petroleum Development Co.

The spokesman declined to comment on what exact measures the cost-cutting program entailed, but a Nigerian news report said several hundred job cuts were planned. The spokesman declined to confirm or deny the contents of that report."We don't comment on the details of these plans, "the spokesman said.

Shell has borne the brunt of attacks by militants on oil installations in Nigeria during the past 18 months which have cost it and the Nigerian government hundreds of millions of dollars in oil revenues. Around 475,000 barrels a day of oil operated by Shell, through the Shell Petroleum Development Co. has been shut in Nigeria since February 2006.

Supply good despite Nigeria output problems

Global crude supply is "good" despite ongoing production problems in Nigeria that have cut output by a third because of ongoing violence, Algerian oil minister Chakib Khelil said.

Asked if the Nigeria production problems would affect OPEC's decision to maintain production cuts ahead of the U.S. driving season, Khelil said,Nigerian production "has been down for a while now, and it hasn't affected supply."

"So we still have good supply and are meeting demand, "the minister said, speaking on the sidelines of an Algerian-U.S. conference here.

Unrest over the past few weeks has shuttered about 220,000 barrels a day of Nigerian oil output. About a third of Nigeria's pumping capacity of about 2.5 million barrels a day has been shut down by violence.

The International Energy Agency predicted in its monthly report a tightening product market in June and questioned the ability of refiners and the willingness of the Organization of Petroleum Exporting Countries to meet a 1.6 million barrels a day jump in oil product demand in June.

Although OPEC officials, the IEA and U.S. Department of Energy officials say much of the product tightness is caused by low refinery utilization rates on planned and unplanned maintenance, the IEA has also warned OPEC's cuts are contributing to falling global crude stocks.

Iraqi exports hit 2007 high

Iraq's crude oil exports rose in May to their highest rate since September 2006 due to increased shipments from Basra,its main terminal,shipping sources said.

Seaborne exports in May climbed to 1.63 million barrels per day from 1.49 million bpd in April, according to shipping data compiled by Reuters. That was the most since 1.64 million bpd last September.

Iraq relies on its southern export route because shipments through a pipeline from its northern fields to the port of Ceyhan are often hit by sabotage.

There were no sales of crude from the north in May,although Iraq did pump some oil along the pipeline into storage in Turkey during the month, according to industry sources.

An American official, meanwhile, said the US was holding talks with Iraq and Turkey to drum up investment to restart Iraqi gas production and exports to Europe."It could be linked up to the(Azeri-Turkish)Baku-Erzerum pipeline, "US State Department Deputy Assistant Secretary Matthew Bryza told a conference in Baku.

"The US is hurrying to create the conditions in Iraq for investors to want to put money into restarting gas production there,"he said.

Turkey, Iraq and the US planned to continue talks on developing Iraq's energy sector, having held an earlier round of talks in March,he said.

"There are not yet any assessments of the investment needed for Iraq's gas infrastructure. But it will be necessary to invest in improving the existing gas infrastructure," he said.

Azeri president Ilham Aliyev told the same conference his country will increase gas output to 16 billion cubic metres in 2008 from 12 bcm this year and start large-scale exports to Europe via the Baku-Erserum pipeline.

The pipeline will get most of its volumes from the giant Azeri Shakh-Deniz field on the Caspian Sea.

Indian cos have to bid for Iraq oil, gas reserves

Indian companies wanting to secure much sought-after rights for oil and gas exploration and production blocks in Iraq will have to compete with rival bidders from other countries, Iraq's oil minister said.

This rule would also apply to India's Reliance Industries Ltd. and ONGC Videsh Ltd. who had previously negotiated for the Tuba oil field, Hussein al - Shahristani told a press conference. Shahristani is on a three-day official visit to India.

Iraq has the third-largest proven oil reserves after Saudi Arabia and Iran but only 10% of the country has been explored,according to the U.S. Energy Information Administration.

However, U.S.-led forces invaded Iraq before an agreement could be reached with the regime of former President Saddam Hussein.

Iraq is currently engaged in drawing up a draft bill that would provide a framework for foreign investment in the oil and gas exploration sector.

Under the law, all foreign companies would be required to bid for oil and gas assets.

Iraq plans to announce a licensing round for oil and gas blocks in the second half of 2007, the minister said without elaborating on the number of blocks that could be offered.

A senior Iraqi official said the country is planning to offer 15 blocks under the proposed round.

For the new round to be announced, Iraq has to approve the law, something which Shahristani hopes will be done

However, the proposed legislation wouldn't apply to exploration Block 8 that ONGC Videsh secured in 2001, he said.

OTC: Sri Lanka prepares to launch licensing round

Sri Lanka is preparing to launch a licensing round and expects to have bid documents available in August as it kicks off a road show in Houston, said Neil DeSilva, director general, Petroleum Resources Development Secretariat.

Speaking May 1 at the Offshore Technology Conference in Houston, DeSilva, just one of several Sri Lankan officials present, said in the upcoming bid round, Sri Lanka will offer three parcels in the Mannar basin. The basin has been divided into eight blocks.

India and China's state oil companies have been promised one block each. DeSilva said Sri Lanka's oil and gas potential is supported by its shared geology with countries that have commercial oil and gas production.

The Mannar basin has thick sedimentary rocks with large structures that are compared geologically to Brazil, he said.It also contains regions of shallow gas. The source rocks are of Cretaceous and Jurassic age.

Petroleum Minister A.H.M. Fowzie said Sri Lanka is soliciting cooperation from the US as it begins to develop its oil and gas industry. He said the country needs technical resources to exploit its oil and gas.

During 2001 and 2005,over 6,000 km of 2D seismic data have been acquired. These data, along with interpretation reports and well data, will be included in the bid packages that will be available by midyear, De Silva said.

He explained that earlier exploration efforts in Sri Lanka were unsuccessful as they were in the shallowest parts of the basin.

16 offshore cranes to 9 semisubs under construction

The last two months Dreggen has received order for 16 units rail travelling offshore cranes to semisubmersible platforms under construction at yards in Singapore, Korea and Norway.

The orders has a total value of approx 73 million NOK and will be delivered during 2006-2008.

The crane package includes BOP handling cranes and X-mas handling cranes and will to be used in the drilling area of the semisubs together with Aker Kvaerners drilling equipment.

There will be delivered cranes of three different capacities;2x50 ton SWL,2x75 ton SWL and 2x100 ton SWL.The cranes will be used in EExe Zone IIB/T3 area and will be designed according to all relevant regulations.

The cranes will be installed on West E. Drill semisub to be built at Samsung,on Sedrill 8,Seadrill 9,Petromena and Petrorig 2 at Jurong,on Sedrill 10 and Seadrill 11 at Daewoo and last but not least on Aker H6 Alpha and Beta at Aker Stord.

General info:Dreggen Crane of Bergen-has operated in the petrochemical industry as a supplier of explosion proof lifting equipment since 1978 when the first cranes were delivered to Elf Aquitaine's Frigg field,developed offshore Norway.

Dreggen's reference list show that they have been engaged as a supplier to almost all of the fields developed offshore Norway, with the main activity being cranes for operation in hazardous and explosive areas.

In recent years Dreggen has expanded its geographical target area to the rest of the world and has established manufacturing companies in Lithuania ,Russia ,South Korea and China.

Dreggen's specialty from the start has been rail going BOP and X-mas tree handling cranes,but for the last few years a considerable quantity of the cranes being delivered are offshore slewing deck cranes.

The company is situated in Bergen with 3000 m2 offices and production facilities.

Norway lends Madagascar a helping hand

Norway has agreed to provide a grant of NKR 36 million (6 million U.S. dollars)for management of the oil and gas sector in Madagascar.

An agreement of cooperation was signed in Antananarivo, Madagascar by Norwegian Ambassador Hans Frederik Lehne and Malagasy Minister of Economy, Finance and Budget Andriamparany Radavidson Benjamin. The grant was aimed at implementing the program"Management of Oil and Gas in Madagascar"in two years.

This project comprised the development of oil policies and strategies, the revision and development of legal and fiscal cadre,the mastery of resource evaluation, the intensive training of personnel as well as the elaboration and organization of programs on oil promotion.

The Madagascan government is eager to produce oil from its promising offshore oilfields and the first production of oil was expected by the end of this year.

Ten companies have been working on Madagascan oil sector for years.

Madagascar, known to have oil and gas reserves but with no major production, opened up for licenses last year to explore possible oil or gas reserves in its offshore Morondava Basin.

The Office des Mines Nationales et des Industries Strategiques in Madagascar (OMNIS)issued licenses to the Norwegian geophysical company TGS-Nopec in June last year to explore oil in the Morondava Basin, offshore western Madagascar.

The province is estimated to be among the most underexplored and promising hydrocarbon areas worldwide.

The existence of smaller oil and gas reserves in the island country has already been confirmed, but systematic mapping still is necessary before large-scale production can start.

The Antananarivo government and OMNIS have been keen to attract foreign oil companies to explore the island.

Madagascan President Marc Ravalomanana signed a request letter for technical and financial assistance in upstream petroleum sector two years ago.

4 more offshore exploration areas for Australia

The federal government has released 34 new offshore petroleum exploration areas to help assure Australia's long-term energy security.

Industry Minister Ian Macfarlane said the areas were located across six basins off the Northern Territory, West Australian and Victorian coastlines.

"Increasingly, global petroleum explorers are viewing Australia as a big gas opportunity with low sovereign risk, and Australia has attracted a number of new global explorers over the past two years, "Mr Macfarlane said.

The minister said the take-up rate for new exploration areas has continued to rise, from about 50% in 2002 to 90% in 2005.

Bids for 17 of the new areas will close on 18 October this year, with the remaining 17 closing on 17 April 2008.

Indonesia well confirms 1974 Kutei gas find

Aabar Petroleum Investments Co. PJSC, Abu Dhabi, gauged gas at the Makassar Straits-4 well on the 5,920 sq km Sebuku production-sharing contract, confirming for the second time a 1974 Ashland Petroleum discovery off East Kalimantan.

MS-4,TD 5,367 ft, cut 279 ft of net gas pay in a single reservoir and a total of 318 ft of gross gas pay.MS-4 and the earlier MS-1 well 1.2 km east proved a combined 618 ft gas column.

MS-4 flowed 16 MMcfd and 23 MMcfd, respectively, on two drillstem tests. The company said the strong flow rates confirm excellent reservoir properties in the Lower Miocene Upper Berai carbonate zone.

OPEC to dig In, won't pump more oil pre-Summer

The Organization of Petroleum Exporting Countries will stand firm on its view that global oil markets are amply supplied and don't need an increased supply before the summer, a top official from the group said.

"There's no need for us to do more, "Abdalla Salem El-Badri, OPEC's Secretary-general, told Dow Jones Newswires in an interview.

His remarks are the latest sign that OPEC wants to see crude oil stocks being drawn down more as a way to shore up prices.

El-Badri said U.S. gasoline stock levels are "acceptable" despite the industry's concern that inventories have fallen too low to meet the usual surge in summer demand.

The U.S. driving season unofficially begins with the weekend ahead of Memorial Day, May 28.

With the U.S. oil refining sector struggling with a string of technical troubles, gasoline stocks there have fallen well below the 210 million-barrel mark that analysts say will be needed to see the market through the summer.

The U.S. Department of Energy said stockpiles of the motor fuel rose 1.7 million barrels on-week to 195.2 million barrels, on higher domestic refinery output and imports.

But demand stood at a robust 9.4 million barrels a day,the data showed.

El-Badri is in the Indonesia resort island of Bali for two days of talks with consumer nations led by the International Energy Agency, the Paris-based energy watchdog of the Organization for Economic Cooperation and Development.

The discussions will be about the oil demand outlook in Asia rather than OPEC policy, he said-a reference to repeated calls by the IEA for OPEC to take the lead in supplying more crude. The 12-member group currently pumps just over 30 million barrels a day, about 40% of global needs,according to Dow Jones Newswires estimates.

El-Badri also said it's too early to talk about the agenda for OPEC's next meeting,as members aren't scheduled to convene until Sept. 11 in Vienna.

"A significant rise in OPEC output appears unlikely to us at current prices, "analysts at investment bank Barclays Capital, led by Paul Horsnell, warned in an overnight research report.

"Without that increase, we expect the market to overheat in the second half of the year."

Oil giants rush to purchase Iran blocks documents

Fourteen oil giants have so far purchased the tender documents of 17 Iranian oil blocks," said a National Iranian Oil Company (NIOC)official.

Hossein Roshandel, NIOC deputy director for exploration affairs, added 62 information packages have been purchased.

The Anglo-Dutch Shell, France's Total, Brazil's Petrobras, Malaysia's Petronas, Spain's Repsol, and Austria's OMV were among the bidders, said the official, however refusing to name the purchasers.

Roshandel said at least €450 million is needed for exploratory operations.

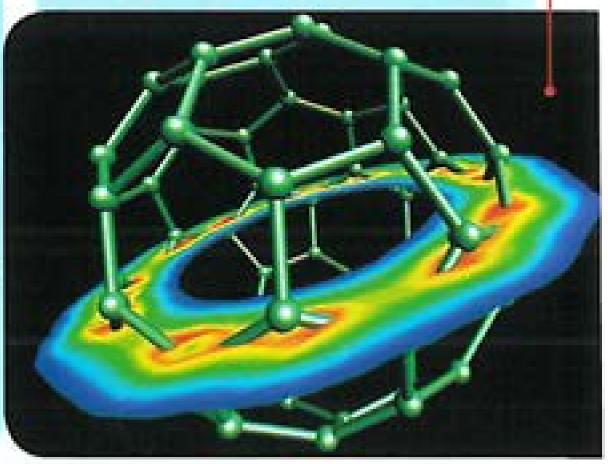
Of the blocks, five are offshore and 12 onshore, spreading across nine provinces in a 129,000km area.

Quchan, Naft-Shahr, Ilam, Danan, Fassa, Bandar Abbas, Razi, Maraveh, Tappeh, Moghan 1 and 2, Kavir, Alvand, Ferdowsi, Laleh, Taban, and Deir constitute the 17 blocks.

Companies may purchase tender documents at varying prices, but the maximu m price is €38 thousand.

Iran expects to attract €46 million for the blocks, Roshandel said.

Iran introduced 17 oil blocks for exploration and development during a February meeting in the Austrian capital Vienna.



Environmental review of Porcupine basin area

Ireland's Minister for Communications, Marine & Natural Resources, Noel Dempsey, announced the commencement of a Strategic Environmental Assessment (SEA) of the Porcupine Basin area. The comprehensive environmental assessment is being held prior to an exploration licensing round later this year in which applications will be invited for licenses to explore the potential of the Porcupine area.

The SEA will primarily involve the gathering and analysis of a wide range of data on the Porcupine area. It will assess the projected level of activity arising from any potential exploration in the area and consider measures to ensure that any effects of exploration on the marine environment are minimal.

External environmental experts ERT (Scotland) and AquaFact (Ireland) have been appointed to conduct the assessment, which will be managed by a technical Steering Group. The Steering Group has membership drawn from Governmental and non-governmental agencies, environmental agencies, industry and the research and university sectors.

The Steering Group will publish a draft environmental report.A six-week public consultation process will then take place, after which a final report will be published, taking account of the issues raised during the public consultation phase.

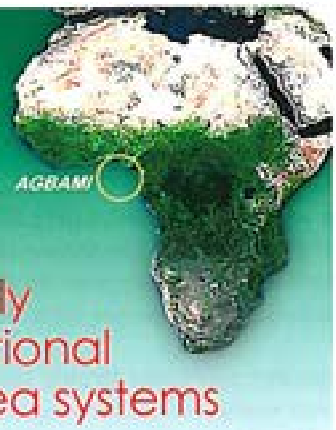
World record breaking deepwater handling enabled by Bridon international

Ever wondered how loads are accurately and safely lifted to the sea bed in water depths of over 10,000ft? The answer is with specialist low rotation, high strength wire ropes supplied by Bridon and the expertise of deepwater construction companies such as Heerema Marine Contractors.

In support of Heerema's deepwater operations Bridon International has succeeded in breaking its own world record following the successful manufacture of the World's largest piece weight of steel wire rope manufactured at Bridons manufacture plant in Germany. The single piece was a 4000m(13,120ft)length of 5½" diameter Bridon Big Hydra product with a nett weight of rope in excess of 340 metric tonnes-breaking Bridon's previous record.

The specialist low rotation deepwater handling rope is being supplied by Bridon and its local representative United Offshore Services to Heerema Marine Contractors for use on its deepwater construction vessel Balder. A further 4000 metre length will be supplied later this year along with several specialist crane ropes for the DCV Balder and Thialf.

The single, Bridon Big Hydra rope comprises of over 4.4 million metres of wire spun together to a unique low rotation construction to enable controlled handling while operating in deepwaters.18 of Bridon's most experienced employees worked for a period of over 5 weeks to complete the manufacturing. The finished package weighed in at in excess of 370 metric tonnes and measured over 7½metres (24ft) in length. A specialist logistics service was necessary to complete the overnight movement from the factory to the local port in Gelsenkirchen, Germany. The full transport train, comprising of a self propelled modular transporter with 28 axles at each side (each axle with 8 wheels), which measured over 250ft in length brought the town to a stand-still many people coming to watch the overnight entertainment!Using specialist cranes of 1000 tonne capacity.



Supply additional subsea systems

FMC technologies, Inc. announced that it has received approval to supply an additional 11 subsea trees and associated structures and control systems for the Agbami project, offshore Nigeria.The contract with Star Deep Water Petroleum Limited,an affiliate of Chevron corporation, has a value of approximately $54m in revenue to FMC technologies.

The manufacture of these trees and systems is under an existing contract to supply subsea equipment awarded to FMC in 2005.Deliveries will be completed over a multi-year period and are scheduled to commence in the third quarter of 2008.

"We are pleased to receive the approval to supply these additional trees, "said John Gremp, executive vice president, FMC technologies. "Our experience with the Agbami project combined with our growing local presence in Nigeria should contribute to the successful execution of this contract."

The Agbami field covers approximately 45,000 acres across OMLs 127 and 128, in water depths of approximately 4,800ft(1,500m).The field is approximately 70 miles (113km)offshore Nigeria,in the central Niger delta area. The Agbami field is operated by Star Deep Water Petroleum Limited on behalf of its partners, NNPC,Famfa Oil Limited, Statoil Nigeria Limited, Petroleo Brasileiro Nigeria Limited and Texaco Nigeria Outer Shelf Inc.(a Chevron affiliate).

Nova Scotia tries to be more attractive to offshore oil & gas exploration

The Canada-Nova Scotia Offshore Petroleum Board said that it intends to make the province's coast more attractive for oil and gas exploration by introducing more flexible terms and conditions for new exploration licenses.

"We want the offshore of Nova Scotia to be regarded as a part of the global industry, not apart from it, "Diana Dalton, chair of the Canada-Nova Scotia Offshore Petroleum Board,said in a speech to the Offshore Onshore Technology Association of Nova Scotia .

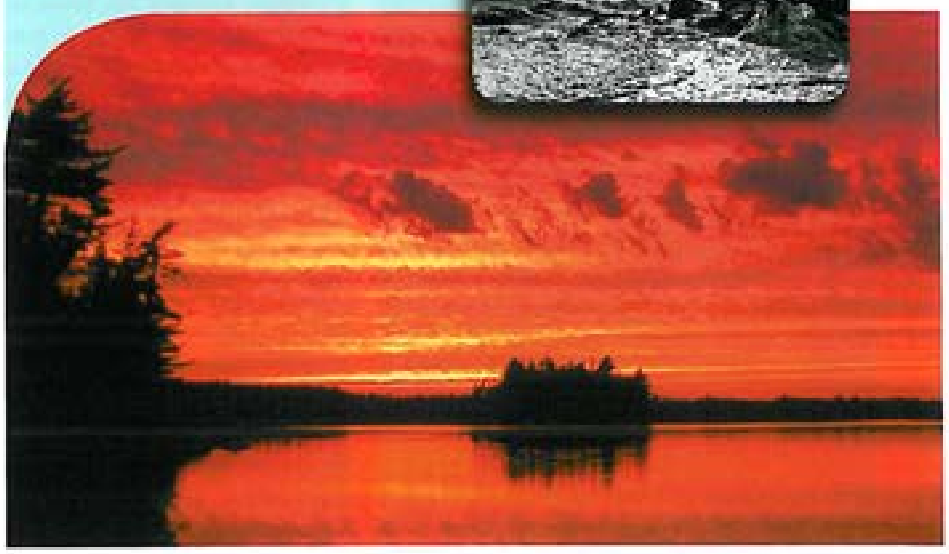
Dalton said that in the future there will be a second type of exploration license with a term of two or three years and with a lower cost of entry. This type of license will appeal to a broader range of oil and gas companies, allowing them to do preliminary work without up-front, long-term commitments, she said.

The board plans to appraise and evaluate data in areas thought to have potential for oil and gas.The board then will package the information and announce that the area is open for exploration through a competitive call for bids at regular intervals.

According to Dalton,the board also plans to begin using a new data management system,which is expected to be fully operational in October.

"We believe the changes we've announced today will get explorers exploring at minimal cost and provide valuable geosciences information on the offshore, "she said.

The Canada-Nova Scotia Offshore Petroleum Board is a joint agency of the governments of Canada and Nova Scotia.The board regulates petroleum activities offshore Nova Scotia.



Beaufort sea offshore lease sale generates $42m

Oil companies bid more than $42m for offshore leases in the Beaufort Sea along Alaska's northern coast.

The federal Minerals Management Service, which offered the lease sale in Anchorage, said it was pleased with the results.It was the tenth federal offshore lease sale in the Beaufort Sea.

"The oil and gas resources present in the Beaufort Sea are vital to our nation's and Alaska's economy and we hope this will boost future supplies into the trans-Alaska pipeline, "John Goll, regional director for the agency, said in a statement.

Companies submitted bids totaling $42.3m on 92 blocks covering about 502 million acres off Alaska's Arctic Coast.Shell again was the big bidder,accounting for more than $39m in bids.Shell Gulf of Mexico, Inc., bid more than $14m to lease Flaxman Island northwest of the Arctic National Wildlife Refuge.

"Shell is committed to Alaska for the long-term and is pleased to be the apparent high bidder for a number of tracts in today's Beaufort Sea Outer Continental Shelf Lease Sale 202",Shell spokeswoman Terzah Tippin Poe said.

Not everyone was happy with the lease sale.Earlier, Native American and conservation groups appealed a federal government decision to approve Shell Oil's exploration plan for the Beaufort Sea.The groups want to halt Shell exploration activities off the north coast of Alaska that are scheduled to begin in June.These leases were approved in 2005.

The groups say in their lawsuit that the federal agency has failed to consider the potential effects from a crude oil spill during exploration.They fear a spill would be catastrophic, harming polar bears, bowhead whales, walrus and other marine mammals.

Oil & gas UK to represent UK offshore oil and gas players

Oil & Gas UK, a new representative body with membership open to all companies active in the UK offshore oil and gas industry, has been launched.The first board of the new organisation is made up of 16 leaders who have been selected from across the industry.The new association will unite all companies with a stake in the future of the UK offshore oil and gas industry in one forum for the first time.These companies will range from super majors to large contractor businesses and from small independent oil companies to small and medium enterprises working in the supply chain.

The first joint chairmen of the new representative body will be Dave Blackwood, head of BP's North Sea Business and Tom Smith, managing director of Nessco.The chief executive will be Malcolm Webb, who was formerly chief executive of the UK Offshore Operators Association.

Mr. Webb said:"Oil & Gas UK continues a process started several years ago to give the UK oil and gas industry a forward-looking and dynamic representative body with the skills and resources required to address the full range of issues before it.The association will operate from premises in Aberdeen, London and Brussels to develop and deliver pan-industry policies to secure the long-term health of the sector."

Interior plans broader offshore drilling in Virginia

The Interior Department has put the final touches on a five-year plan to expand oil and gas drilling in the Gulf of Mexico and offshore from Alaska and Virginia.

Interior officials said that the plan will include more environmental buffer zones around lease areas and make other minor changes to a previous draft. Interior secretary Dirk Kempthorne is scheduled to announce the major oil and gas development programme soon,a department statement says.

The new leasing plan 'would significantly increase the nation's domestic energy supplies while protecting the coastal and marine environments,and provide a major economic stimulus to the nation and participating coastal states',the statement said.

Details were sketchy,but in January, Bush ended drilling bans in an area of the central Gulf of Mexico and in Alaska's Bristol Bay.That action cleared the way for:

- Making an area in the Gulf of Mexico south of Florida's panhandle available for drilling–The 'Lease Area 181' is a small part of a much larger 8.2 million acres that Congress approved for oil and gas development in December.
- Opening 5.6 million acres to drilling in waters northwest of the Alaska Peninsula,known for endangered whales and the world's largest run of sockeye salmon–Interior plans to sell leases there in 2010 and 2012,pending environmental reviews–an estimated 200 million barrels of oil and five trillion cubic feet of natural gas exist under those federal waters.

Interior's plan would, for the first time,allow drilling off Virginia's eastern shore, in a wedge-shaped area between the Maryland and North Carolina state lines stretching to a point about 200 miles east.

Congress put Alaska's Bristol Bay off limits to drilling in 1990 after the devastating Exxon Valdez tanker oil spill on the other side of the peninsula.The bay is a major fishing area for salmon,cod,red king crab,halibut and herring. Congress lifted that ban in 2003,but the area remained under a presidential drilling ban until Bush lifted it in January.

Kempthorne has said his department is looking at conducting one or two lease sales there over the next five years,but only after thorough environmental reviews.

Environmentalists say the proposed leasing areas overlap the migratory route for all the wild salmon returning to Bristol Bay and the western Alaska river system.

Congress will have until the end of June to review the final drilling plans for all three areas.

Chevron shuts down Nigeria production after attack

Chevron Corp. has shut down 15,000 b/d of oil production in Nigeria after one Nigerian sailor was killed and six foreign oil workers were kidnapped by members of the Militant Movement for the Emancipation of the Niger Delta (MEND), who attacked Chevron's Oloibiri floating production, storage, and offloading vessel off southern Bayelsa State.

A Chevron spokesperson said the firm had shut down the production from Funiwa oil field to avoid any additional security or safety incidents following the attack.The FPSO supports the Funiwa oil field.

MEND spokesman Jomo Gbomo said the hostages would be released, if oil companies and Bayelsa State government officials made no attempt to secure their release or offered ransom money.

Gbomo, who warned that such offers would be viewed as a "slight" and would "worsen the situation of these hostages,"identified the men as Raffele Pascariello, Alfonso Frawza, Ignazio Gugliota, Mario Celetano, John Stapleton and Juricha Ruis.

Gbomo said the attack on Chevron's facilities should also be interpreted as a warning to Royal Dutch Shell PLC, which has recently returned to fields in Bayelsa and Delta states earlier attacked by MEND. MEND is fighting for more local control over the Niger Delta's oil wealth.

The May 1 attack followed a national election Apr. 21 in which Katsina State Gov. Umar Yar'adua and Bayelsa State Gov. Goodluck Jonathan were voted in as Nigeria's new president and vice-president.

But Gbomo said the election meant nothing to MEND unless"it is accompanied by a fulfillment of all conditions we have previously given to the Nigerian government and oil companies for peace to return to the Niger Delta."

MEND's May 1 killing and kidnapping follows a report by the International Maritime Bureau that oil tankers and installations off Nigeria continue to be a main target of pirate attacks, despite a downward trend elsewhere around the globe.

Service Cos focus on relationships with national energy firms

Service companies are strengthening their ties with national energy champions as the balance of control over global reserves tilts away from the integrated majors.

At stake are revenue streams potentially worth billions of dollars. As oil-rich countries move to shrink the roles played by publicly traded multinationals in favor of national oil companies, or NOCs, their continued need for expertise and the latest technological advances could see them relying more on services companies,which have no designs for the crude-oil and natural-gas reserves they discover.

"Service companies must become national,or local,"said Bernard Duroc-Danner,chief executive of Houston-based energy-services company Weatherford International Ltd.

(WFT)."We have to get involved in the fabric of a society."

When integrated energy majors,such as Exxon Mobil Corp. (XOM)and Royal Dutch Shell PLC (RDSB.LN), are granted the status of operator for a project, they take on the responsibility of organizing the work and farming out contracts to companies like Weatherford. As countries increasingly look to their NOCs to take over operating control, service companies see an opportunity to step up their involvement. For example, instead of drilling according to specific instructions, service companies could advise the operators on where and how to drill wells.

Evidence of closer ties to the NOCs can be seen sector-wide, from Halliburton Co. (HAL)setting up a new headquarters in Dubai to Baker Hughes Inc. (BHI) Chief Executive Chad Deaton speaking of successful"Saud iization"on a recent conference call, where the company had increased the proportion of local workers on its Saudi Arabian projects to 60%. One measure of service companies' success in penetrating the fast-growing Siberian market is how many Russians they have hired.

The new "intimacy and breadth" in the relationship, as Duroc-Danner put it on a panel at the Offshore Technology Conference in Houston, is paying off for both sides.

Schlumberger Ltd. (SLB), the largest service company by market capitalization and the most geographically diverse, has notched seven straight quarters of record profits.

NOCs say they benefit as well,gaining technological expertise from service companies that have no claim of ownership on reserves.

Syanga Abilio, vice president of Sonangol, the Angolan oil company, called for an even greater degree of cooperation.

He said service companies should sign onto the national oil companies' commitment to social and economic development.

"Why not have local entrepreneurs partner with the service companies?"he said, speaking on the same panel as Duroc-Danner.

The close partnership between NOCs and service companies is still in its early stages.

Uroc-Danner said Weatherford's business with NOCs is growing faster than international oil companies, but from a smaller base. Like most of the largest services firms, Weatherford still derives more than 40% of its revenue from the U.S. and Canada, where international oil companies dominate.

Not so with the offshore drillers, Noble Corp. (NE) earns 60% of its revenue from NOCs and is angling for more,Chief Executive Mark Jackson said on the sidelines of the Offshore Technology Conference. In one of the more dramatic illustrations of the tilt toward state-financed projects, the driller in 2005 and 2006 moved its shallow-water rigs, known as jackups, out of the U.S. Gulf of Mexico. Many found work in Mexican waters for state-owned Petroleos Mexicanos(PEM.YY), or Pemex.

CNOOC revenues fall 11pc on oil prices

CNOOC Ltd (0883), China's largest offshore oil producer, posted a 10.9 percent drop in first-quarter revenues-despite higher output-because of falling oil prices.

For the three months ended March 31, revenues fell to 14.85 billion yuan (HK$15.04 billion) from 16.66 billion yuan the previous year. Net profit figures were not released.

CNOOC's first-quarter total output of oil and gas was 473, 280 barrels of oil quivalent a day, up 5.1 percent year on year.

The Beijing-based oil producer attributed the growth to the 41 percent increase in natural gas to 550 million cubic feet, mainly driven by production from Australia's North West Shelf project and Southeast Sumatra gas project in Indonesia, chief financial officer Yang Hua said.

Of this amount, the output from offshore China declined by 3 percent to 353, 416 barrels, while the output from overseas jumped 32.4 percent to 25, 318 barrels.

Yang said he is positive on the outlook as more reserves are explored.

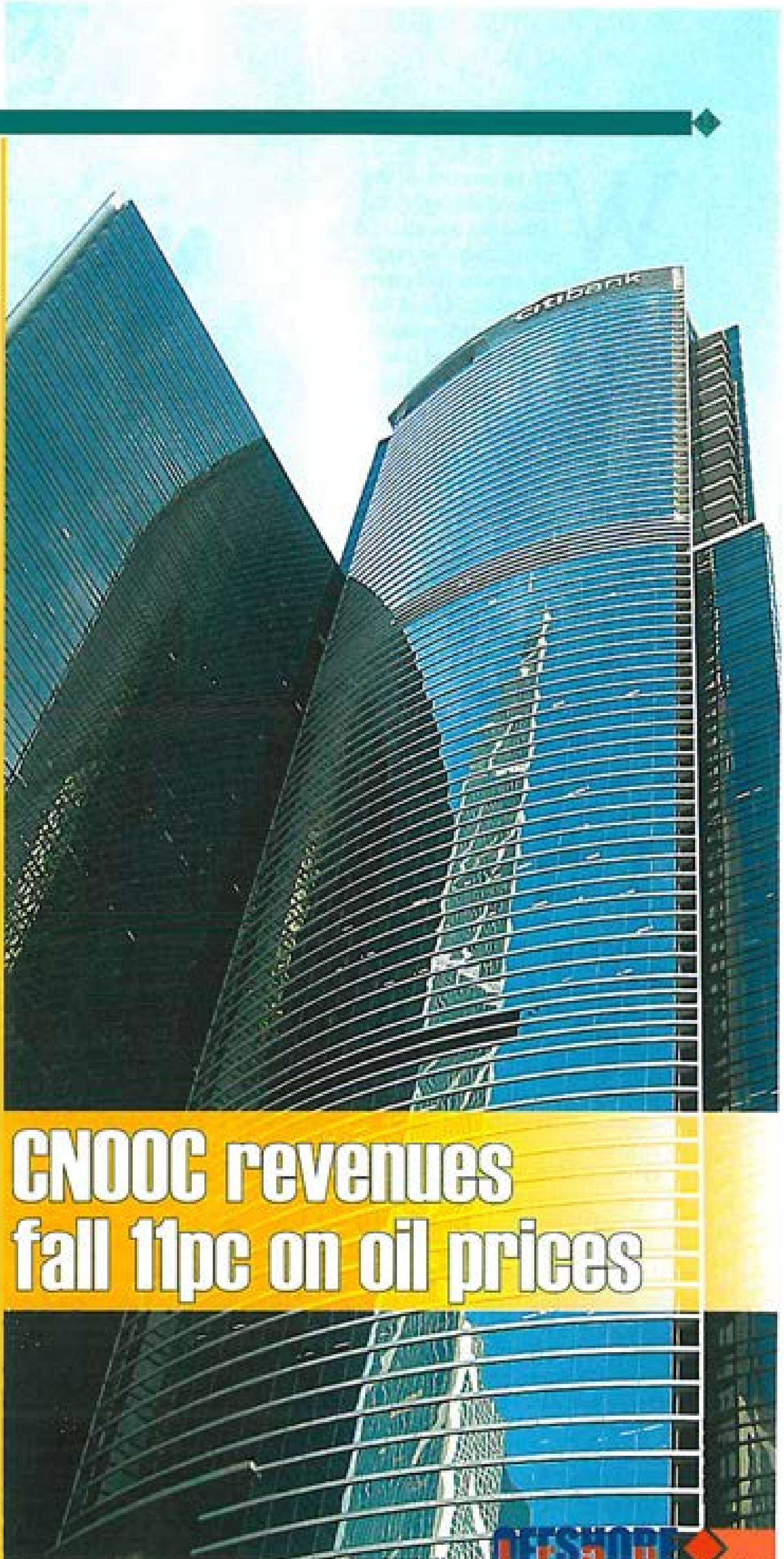
CNOOC, part of a mainland oil conglomerate that also includes PetroChina (0857) and Sinopec (0386), aims to produce 162 million to 170 million BOE in 2007 and 190 million BOE in 2008.

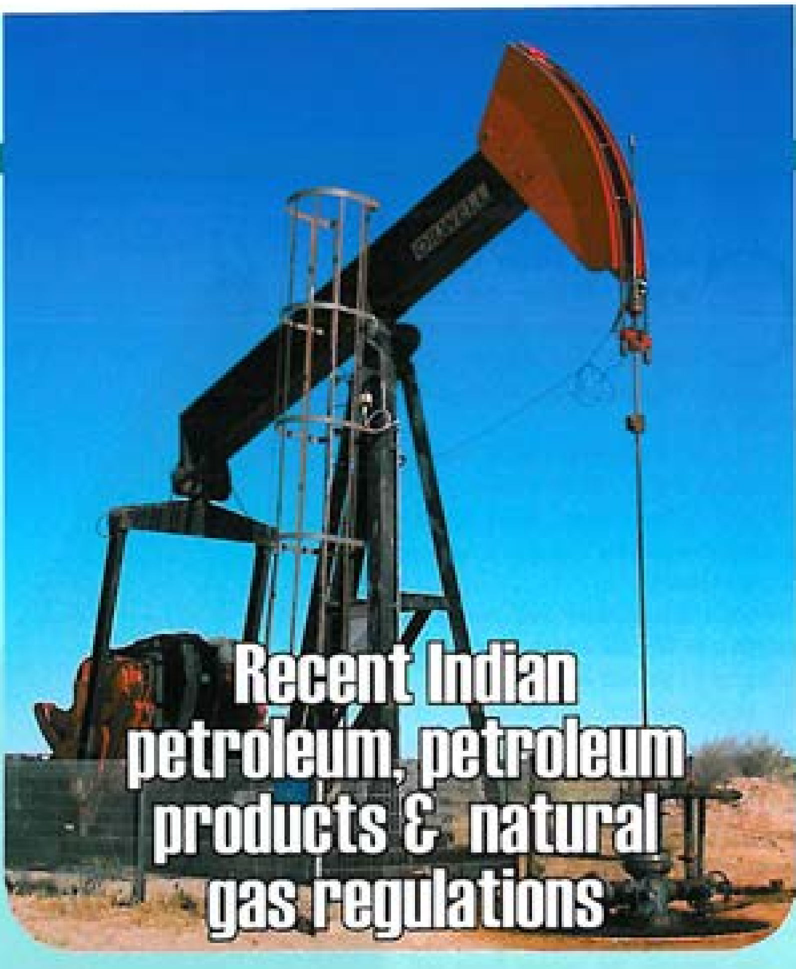
In the first three months, it produced 550 million cubic feet of natural gas per day, up from 390 million cubic feet the previous year.

CNOOC spent 6.33 billion yuan as capital investment in the first quarter, 70.3 percent more than last year, mainly for the exploration of its Akpo field in Nigeria.

Its 45 percent-owned Akpo field is expected to begin production as scheduled by the end of 2008,Yang said, adding that the deep-water field will have an output of 175,000 BOE a day when it reaches its peak.

He said more oil reserves may be found in the Bohai Bay area, but this can only be confirmed after more exploratory work is done.





Recent Indian petroleum, petroleum products & natural gas regulations

With an increase in the demand and supply for petroleum and natural gas products, and with multiple new players entering the market, the Indian government has enacted the Petroleum and Natural Gas Regulatory Board Act, 2006 (the'act'). Its aim is to:

- promote competition among entities;
- avoid infructuous investment;
- maintain or increase supplies;
- secure equitable distribution; and
- ensure adequate availability of petroleum, petroleum products and natural gas nationwide.

The act is to provide for the establishment of the Petroleum and Natural Gas Regulatory Board (the'board')in order to regulate the refining, processing, storage, transportation, distribution, marketing and sale of petroleum, petroleum products and natural gas, excluding production of crude oil and natural gas.

This is to protect the interests of consumers and entities engaged in specified activities relating to petroleum, petroleum products and natural gas, and to ensure uninterrupted and adequate supply of petroleum, petroleum products and natural gas in all parts of the country whilst promoting competitive markets.

Foreign Direct Investment

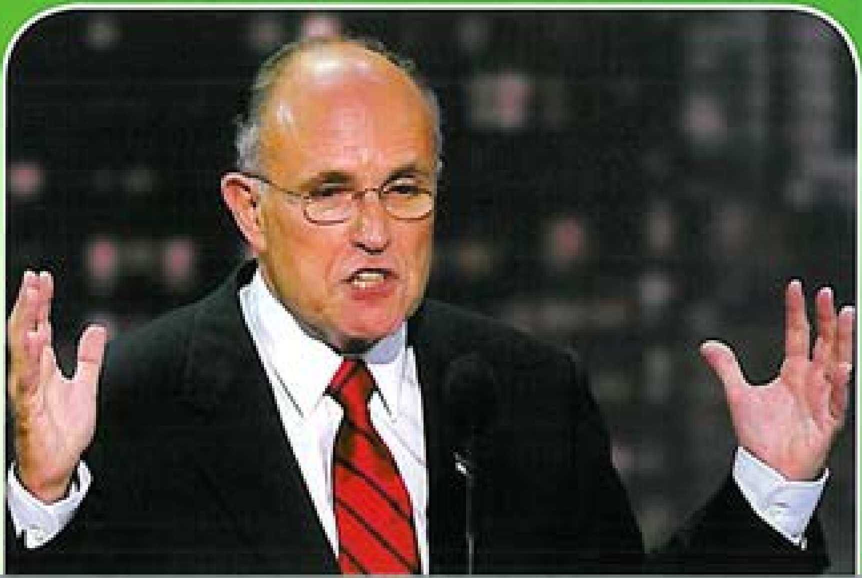
The Ministry of Finance, Government of India, now permits up to 100% foreign direct investment(FDI)into the petroleum and natural gas sector,under the automatic approval route of the Reserve Bank of India.The caps on FDI are as follows:

- FDI up to 100% is permitted on the automatic route on petroleum product marketing.FDI for this sector would be permissible subject to the existing sectoral policy and regulatory framework in the oil marketing sector.
- FDI up to 100% is allowed on the automatic route in oil exploration in both small and medium-sized fields, subject to and under the policy of the government on private participation in:(1)exploration of oil and(2)the discovered fields of national oil companies.
- FDI up to 100% is permitted on the automatic route for petroleum product pipelines subject to and under the government policy and regulations thereof.
- FDI up to 100% is permitted for natural gas/ liquefied natural gas (LNG) pipelines with prior government approval.
- FDI up to 100% is permitted in, other than refining and including market study and formulation; investment/financing, setting up infrastructure for marketing in petroleum and natural gas sector subject to sectoral regulations, issued by the Ministry of Petroleum & Natural Gas, and in the case of actual trading and marketing of petroleum products, divestment of 26% equity in favour of Indian partner/public within five years.
- FDI up to 26% are permitted in the refining sector in case of public sector undertakings (PSUs), with prior approval of the Foreign Investment Promotion Board (FIPB) and up to 100% in case of private companies under the automatic route.

Policies and Procedures

A number of policy initiatives have been taken by the Government of India for facilitating the inflow of foreign capital and for encouraging entrepreneurs to invest in India, such as:

- equity participation in commercial and industrial ventures, which has been freed from all restrictions, FDI is now permitted up to 100% in different activities in the petroleum sector;
- rupee convertibility on the current account;
- deregulation and delicensing of various petroleum products in the country;
- gradual decontrol of pricing and distribution;
- freedom to form joint venture companies (JVCs) for the development of infrastructure and for marketing and refining activities;and
- procedure for obtaining industrial licences has been simplified by making an application to the Secretariat for Industrial Approvals(SIA), Department of Industrial Policy & Promotion, Ministry of Industry.Approvals will normally be available within six to eight weeks under a fast time-bound schedule.



Giuliani: Consider more offshore oil

Republican presidential candidate Rudy Giuliani said everything has to be considered if the US wants to break its reliance on foreign oil,including more drilling off Florida's coast.

Calling the energy supply a major domestic problem,Giuliani said the nation needs to focus on nuclear power production and renewable energy sources.In the meantime it also needs to see what oil can be tapped,he said.

"Energy independence means everything has to be open for discussion,"Giuliani said when asked about offshore drilling."The idea of having more oil under our command, so to speak,or within our orbit probably for some period of time is going to be important. The ultimate goal,however,should be renewable sources of energy."

Florida's congressional delegation has been fighting attempts to open more of the Gulf of Mexico to drilling,saying they are concerned that spills could damage beaches,the environment and tourism.

The former New York mayor cited Brazil's use of ethanol as an example the US should follow.

"Brazil's a wonderful country,wonderful economy,wonderful scientific community-it's not the US.Why should they be ahead of us on ethanol?We should be ahead of them. That should be our goal,"he said.

If the US concentrates on new or improved technologies for energy production,it can then turn around and sell them to countries like India and China who have a growing demand,he said.

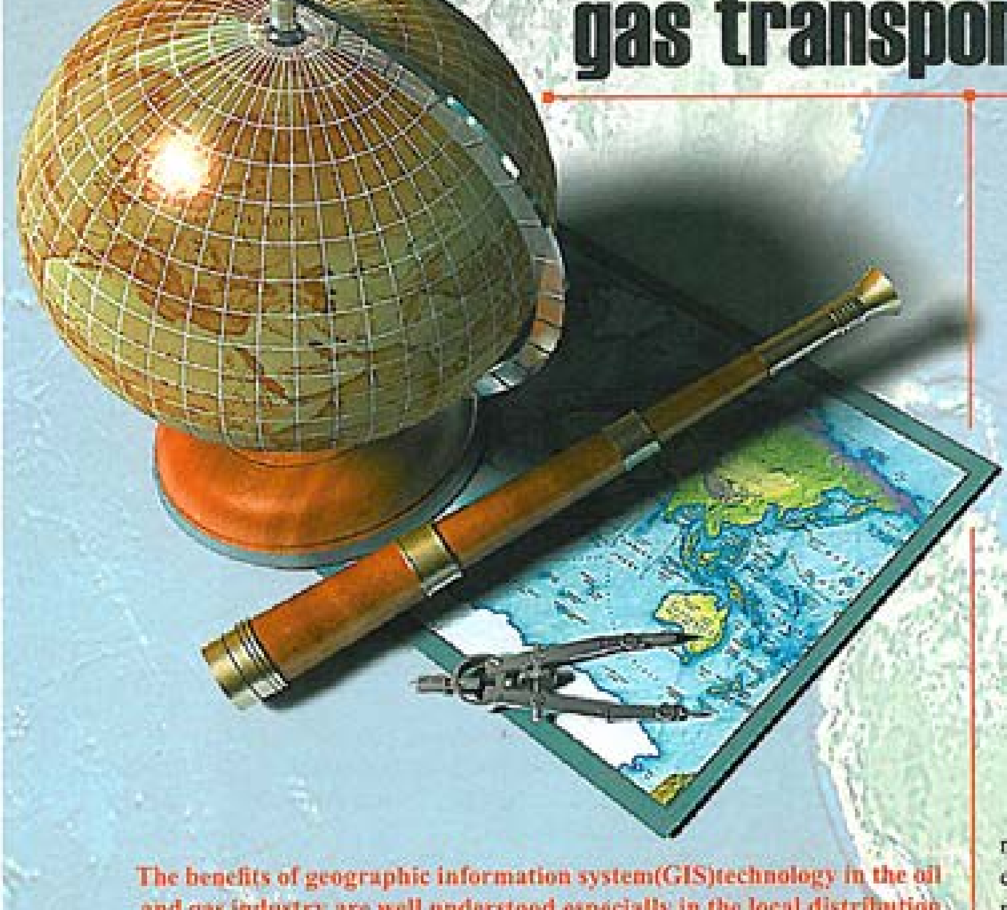
"That's the way America grows in global trade,"Giuliani said."Energy independence is a great industry for us.Let's think about this like business people."

In remarks later at St. Petersburg High School,Giuliani reiterated his support for President Bush's strategy in Iraq and said the US needs to stay on the offensive against terrorists. He has been critical of Democratic efforts in Congress to have troops brought home.

"We can never,ever go back to the way we used to be before September 11,"he said.

"And I believe that if this election in 2008 goes the other way,we will be right back playing defence,because that's what the Democrats are doing."

Geographic Information Systems (GIS) in oil and gas transport



The benefits of geographic information system(GIS)technology in the oil and gas industry are well understood.especially in the local distribution network.GIS technology has served as a valuable tool for the efficient and effective management of assets in the industry for many years.From a cartographic and geospatial data perspective,three major structural differences distinguish the corridor-mapping projects performed for gas and oil pipeline companies from traditional mapping projects performed for local gas distribution companies,municipalities and counties, telephone and utility companies and most other private sector companies.The first difference is the geometry of the network.The second difference is the need to support remote or long-distance design,monitoring and maintenance activities.The third difference is the need to accommodate often extremely variable terrain conditions and accessibility issues during base-map data collection.These differences,which affect the definition and development of appropriate GIS, are the focus of this analysis.

Network Geometry

Traditionally, local service companies have concentrated their efforts on the provision of services within relatively small,contiguous service areas.Even in situations where the corporate entity provided service over a large geographic area, the territory was typically contiguous and subdivided to facilitate local support and logistics.

In contrast, corridor-based transmission networks are essentially concerned with point-to-point linkages over great physical distances. For engineering design purposes,such a network can be thought of as one-dimensional. The basic work unit is a line or link (the pipeline) connecting nodes such as compressor stations.

One significant result of this difference is the area covered by a basic work unit and therefore the method of organising data and contracting for engineering and data conversion services. Another result is reflected in the arrangement and number of maps required for graphic display. A typical local service gas company in the US might serve an area of 15km by 20km in extent,or approximately 300km2. The GIS for this typical service area might use maps that are 500m (north to south) by 1,000m(east to west). Therefore, approximately 600 maps would be required to provide complete coverage.

The basic work unit for a corridor-based transmission company is the backbone project,which defines a link between two major sites (and,perhaps,intermediate stations).A typical work unit might be a line of 1,200km(or more)in length and from 1–3m wide. The as-built records will provide information only for a narrow swath, perhaps 50m wide,of the project's total length.Therefore, the mapping area covered by this work unit would be, in aggregate,only a few dozen square kilometres.

However,because this area might extend more than 1,200km, at least 1,200 digital maps(500m by 1,000m)would be needed for complete coverage.

The phrase'at least'is an important qualifier.If the local service company approach of panelling maps together is used by a corridor-based transmission company,and if the 1,200km route runs straight east to west,1,200 maps would suffice.If the route runs straight north to south,2,400 maps would be needed.

If the route was markedly sinuous, an even larger number of maps might be needed.

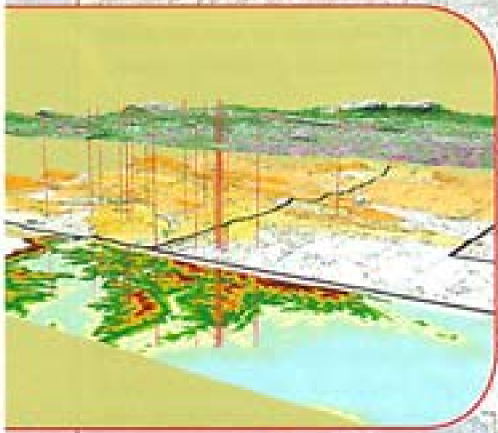
At this point,an objection might be raised that panelling in this manner is not an efficient way to map corridor-based transmission company facilities. Although this is an option in some circumstances, there are two fundamental reasons for retaining the panelling approach. First, corridor-based transmission company systems often exhibit a pattern of irregular growth (at least in terms of ancillary or secondary routes), and the jigsaw puzzle-like network continues to become more complex.Provision must be made in many cases for the addition of new route information in some coherent and rational manner. The same would be true in the case of asset acquisition or the management of multiple routes by a single owner.The integration of geo-referenced third-party databases is accommodated most easily by building the system using a regular geographic co-ordinate system and grid. This is particularly important if secondary uses such as the addition of fibre optic cables to pipeline corridors are anticipated.Regardless of the approach to tiling, the question of tile configuration must be explicitly considered for corridor-mapping.

Given the theoretical length of the project,the GIS designer must also consider the probability that the project will cross one or more central meridians (longitude origins) for a given projection and co-ordinate system,requiring calculation of dual co-ordinates near that line of longitude to accommodate multiple co-ordinate systems or zones.

Network Design and Monitoring

GIS and computer-assisted mapping offer several advantages over manual mapping and record- keeping. Among these advantages is the system's ability to incorporate a coherent,network-wide geographic reference system. GIS technology supports storage and display of multiple layers of information.These layers are independent,permitting production of maps using any combination of information.This organisation of data permits production of custom-purpose maps and reports for a variety of end-users.In other words,the system supports production of hard-copy maps with user-definable content on an as-needed basis.

GIS technology supports the generation of reports in summary form by operating district and for the company as a whole.For example,a GIS can support cost and capital expenditure analyses and generate reports of those analyses. The reports may contain information



Traditionally, local service companies have concentrated their efforts on the provision of services within relatively small,contiguous service areas.Even in situations where the corporate entity provided service over a large geographic area,the territory was typically contiguous and subdivided to facilitate local support and logistics.

on the costs of placement,cost of materials and types of facility.

Such reports typically would be tabulated or cross-referenced by project,year of placement or other variable(s).Although terrain and physical environment are major factors in the total cost of a project,the methods used by a particular contractor or engineer may be more cost-effective than other methods. Such efficiencies may be identified and incorporated in standard procedures.

These and other benefits of GIS are common to both local service and corridor-based service companies.

However,certain other benefits may be identified as specific to one or the other type of network.

Network design and engineering activities performed by local gas service companies tend to focus on upgrading and maintaining the existing infrastructure.Design tends to focus on upgrades,enhancements and comparatively modest growth,while monitoring and maintenance activities tend to occur within a well-defined local area.

Designers at local service companies tend to live in relatively close proximity to their geographic work area and are very familiar with local conditions and the attributes of the networks, often focusing their attention solely on an even smaller sub-area.The local service companies tend to have maintenance and repair staff located in virtually every corner of their service areas.

As a corollary of this proximity, GIS projects' design for local service companies tend to be comparatively detailed. They tend to be built using existing maps,existing engineering drawings and multiple data sets.In addition,the local service companies must consider the proximity of assets belonging to other utilities and government entities.

The costs of building a GIS reflect the multiplicity of data sources and the need to reconcile these sources.

The benefits of GIS for new design and construction may be quite pronounced in the case of corridor-based companies, particularly for relatively new and growing networks. Here, the GIS database is'compiled'while the underlying software is used to design, build and manage the network. This organic approach to GIS development is economically attractive, particularly in comparison with the expense of cleaning, for example, 100 years or more of accumulated errors embedded in the records of traditional local service companies. This approach also permits the close integration of comparatively new supporting technologies such as the global positioning system (GPS) satellite constellation, mobile GPS and inertial navigation systems,laser range finders, portable computers and voice recognition database engines into the design process.

Although these tools are valuable to all system developers, corridor-based companies can justify these necessary expenditures as part of initial network-construction.In this sense, GIS provides competitive advantage in network design and deployment by supporting faster,more accurate and more easily managed designs.

Corridor-based service companies tend to have proportionally smaller staff sizes,and the members of staff are dispersed non-uniformly throughout their networks.Initial network design tends to be performed at national or regional headquarters, while maintenance is performed remotely. In a typical network,one individual may have maintenance responsibility for a section of network some 400km in length.It is not practical for this individual to engage in daily route surveillance,so automating responses to outage reports and preventing outages through automated one-call management become significant benefits of GIS technology.

This application and others highlight one important aspect of corridor-based activities:

he network is removed from daily, personal oversight, and management would benefit from automation of oversight to achieve competitive advantage.The fundamental differences in the applications for which GIS technology is deployed must be considered during system design and data collection.This generally requires support for a broader range of software applications dedicated to maintenance, which, in turn, prompts differences in database contents (including, for example, contact information for remote site restoration contractors and points of access to private rights of way).

Network Geography

The third major structural difference is the need to accommodate often extremely variable terrain conditions and accessibility issues during data collection (and, by extension, during data update and system maintenance).

Relatively few local service companies comprise,at the daily operating level, such geographically extensive or topographically diverse areas as to preclude physical access by engineers in a one-day or one-week period. This means that data collection for local service companies is comparatively simple. Benchmarks tend to be readily recoverable and access is relatively easy, certainly compared with wilderness areas.

Corridor-based networks, on the other hand, are almost, by definition, located primarily away from centres of population, connecting settlements that depend on the corridors for the flow of some commodity (power, telecoms or petroleum, for example). Such corridors transect mountains, hills, swamps, lakes and rivers–indeed, the complete national or regional range of geomorphologic diversity.

This diversity of environments makes initial access difficult and updating problematic. It dictates that data collection be as complete as possible on the first site visit because of the cost of revisiting the corridor.It also recommends use of newer technologies such as digital photography, both still and video, to permit virtual 're-evaluations'of route options subsequent to the actual survey,inventory and mapping visit.

This diversity of environments also recommends the application of several specific GIS technologies for data capture.

The first and, given its ubiquity,most significant technology is aerial photography using inertial measurement units and the full range of GPS tools.While ground control is a critical component of the survey process in either situation, the relative lack of monumentation along rural corridors makes the use of GPS–both on board the aeroplane and in the field–a virtual necessity.The second technology,which incorporates the first,is the use of light detection and ranging (LIDAR) sensors for detailed corridor-mapping. The extraordinarily high resolution of contemporary LIDAR offers an unprecedented ability to capture details such as the actual sag and height above ground level of transmission lines.This,in turn,permits the development of a new generation of applications for the GIS that further assists with cost justification.The costs of using LIDAR as a data collection tool have become substantially lower in recent years, which has further encouraged deployment.

Another technology that is appropriate for corridor-mapping is three-dimensional (3-D) visualisation. Interactive 3-D models and databases may be created from existing digital spatial data (for example digital imagery, elevation models and feature coverages). These interactive 3-D databases may be used, in turn, to provide 3-D visual simulations and to aid decision support applications.

This is a particularly valuable tool in situations where multiple routes are under consideration.

The fourth technology is hyperspectral image analysis. This branch of remote sensing offers support for analysis of such variables as local weather, agriculture, orestry/rangeland, land resource management and environmental management. In the context of corridor-mapping, the specific analyses will be driven by the target applications.In any case,the fundamental analytical capabilities of hyperspectral image analysis have significant implications for corridor-mapping and GIS.

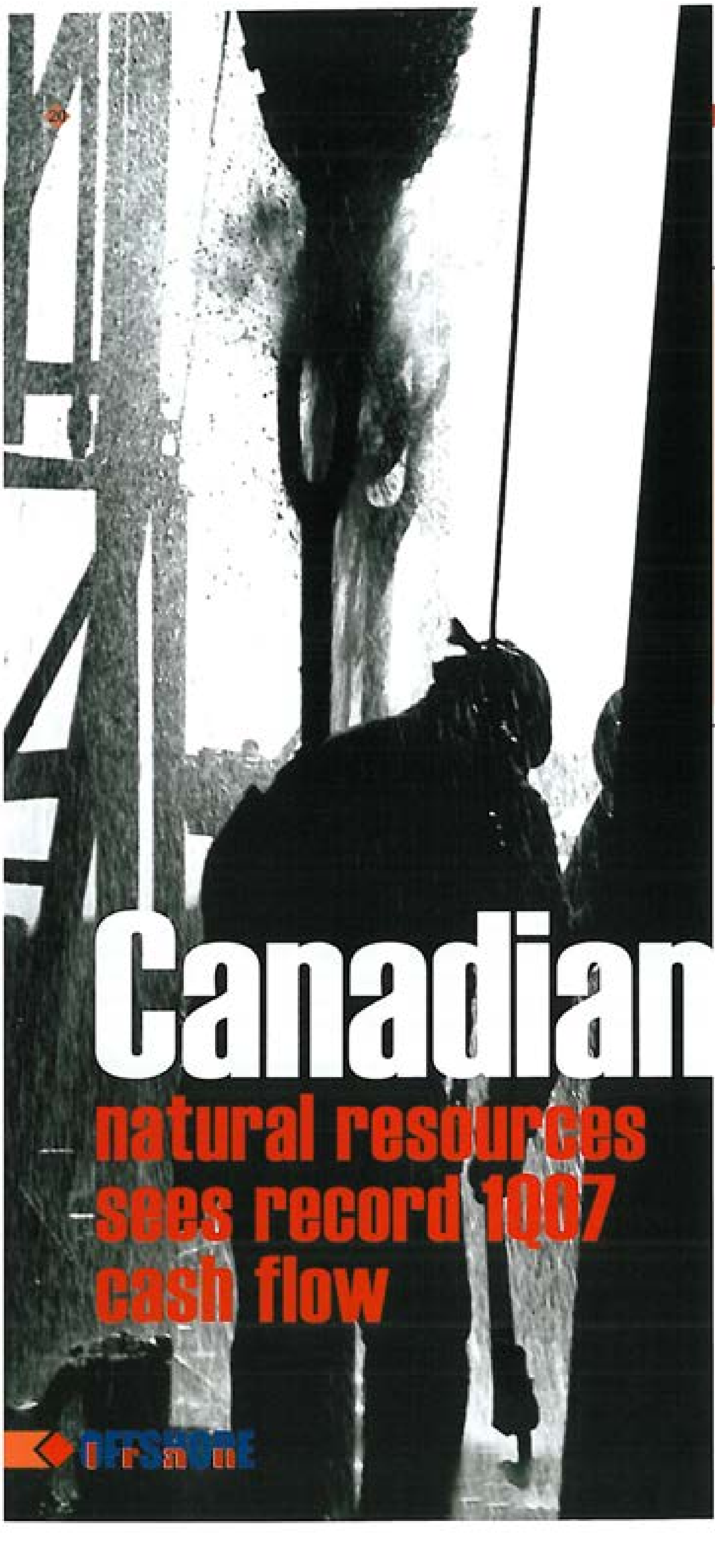
Other Issues

These technical variations dictate the use of appropriate technologies during data acquisition and map production. In addition,there are several other requirements for corridor-mapping that extend beyond the structural differences outlined here.

Corridor-planning and mapping require an awareness of the human and natural environment, as well as an evaluation of engineering considerations.Achieving this awareness requires an interdisciplinary team that includes engineers, planners, geographers, biologists, hydrologists and environmental scientists, sharing the goal to recognise social and environmental concerns as early as possible.

Timely recognition of critical issues permits consideration of social and environmental concerns early in the planning process,rather than demanding impact mitigation after the fact. For each discipline,GIS technology serves as a backdrop for the collecti on,management,storage and retrieval of relevant information.

GIS technology supports storage and display of multiple layers of information.These layers are independent,permitting production of maps using any combination of information



Canadian natural resources sees record 1Q07 cash flow

In commenting on first quarter 2007 results, Canadian Natural's Chairman, Allan Markin stated, "It was a very successful quarter yielding strong crude oil and natural gas production volumes.We completed the integration of the Anadarko Canada assets with their performance overall better than expected.Through focused execution we have been able to maximize the efforts of our winter natural gas drilling program.

A reduced program from first quarter of 2006 levels allowed us to concentrate on operational efficiencies and we were able to maximize the value of every dollar spent.

The result was production at the top end of our first quarter guidance generated with capital expenditures within our original targets.This capital discipline is being maintained throughout our organization and is exemplified through the winter drilling program as well as continued cost controls at the Horizon Oil Sands Project."

Further comment from John Langille, Vice Chairman,included,"The successful drilling program and volumetric growth enabled us to generate record cash flows in Q1/07.

We expect that our conventional business will generate 2007 cash flows of $6.0 to $6.5 billion based upon today's strip pricing. After conventional capital requirements of $3.1 billion,the conventional business is generating free cash flow of approximately $3 billion. In 2007,a large portion of that free cash flow is being directed toward construction costs at the Horizon Project which remains on target for first oil for the third quarter of 2008.We are continuing to deliver on our defined plan,and the cash flow potential of our businesses should be more than sufficient to fund the plan."

Steve Laut,President and Chief Operating Officer of Canadian Natural added, "The execution of our defined plan is a dynamic one, based upon maximizing shareholder value. Reflecting this principal,during the first quarter we made the strategic decision to reduce natural gas drilling in favor of higher return heavy oil projects. Similarly,we made the strategic decision to defer further work on a second heavy oil upgrader to handle our in-situ production growth pending stability in construction costs and clarification on how various government initiatives will be implemented.The acceleration of re-drilling at Baobab,where a portion of our 2008 capital budget will now be directed to accommodate the recent availability of a deepwater drilling rig is another example.In essence,we retain flexibility in our ongoing programs such that capital allocation for projects is continually high-graded."

Natural gas production volumes reached record levels and represented 47% of the Company's total production. Natural gas production for Q1/07 averaged 1,717 mmcf/d compared to 1,436 mmcf/d for Q1/06 and 1,620 mmcf/d for Q4/06.The increase in natural gas production from the comparable periods primarily reflected a full quarter of additional natural gas production from the Anadarko Canada Corporation("ACC") acquisition completed in November 2006 along with a very successful natural gas winter drilling program.

Total crude oil and NGLs production of 327,001 bbl/d was comparable to 323,662 bbl/d for Q1/06,and decreased 5% from 343,705 bbl/d for Q4/06.The decrease from the prior quarter was anticipated due to the timing of steaming cycles related to the Company's thermal crude oil projects in North America and planned maintenance activities at the Espoir Field.

- Quarterly cash flow of $1.6 billion,an increase of 25% from Q4/06 and 56% from Q1/06. The increase from Q1/06 reflects the impact of increased crude oil pricing related to a narrower heavy crude oil differential from WTI, increased natural gas sales volumes, decreased realized risk management losses,and a slightly weaker Canadian dollar relative to the US dollar.
- Quarterly net earnings of $269 million, representing a 14% decrease from Q4/06 and a 372% increase from Q1/06. Net earnings in Q1/07 included unrealized after-tax expenses of $352 million related to the effects of risk management activities, foreign exchange gains, stock-based compensation expense, and statutory tax rate changes on future income tax liabilities.
- Quarterly adjusted net earnings from operations of $621 million, 51% higher than Q4/06 results and a 132% increase from Q1/06, reflecting stronger cash flow.
- Completed a Q1/07 drilling program of 193 net crude oil wells and 201 net natural gas wells, excluding stratigraphic test and service wells, with an 87% success ratio.The success rate is a reflection of Canadian Natural's strong, predictable, low-risk asset base.Crude oil drilling increased 110%,compared to Q1/06.Natural gas drilling decreased by 54% compared to Q1/06, representing Canadian Natural's reallocation of capital towards a higher return crude oil drilling program and reduced natural gas drilling program.
- Maintained a strong undeveloped conventional core land base in Canada of 12.4 million net acres-a key asset in today's highly competitive industry.
- The Horizon Oil Sands Project ("Horizon Project") exited Q1/07 ahead of

The execution of our defined plan is a dynamic one, based upon maximizing shareholder value. Reflecting this principal,during the first quarter we made the strategic decision to reduce natural gas drilling in favor of higher return heavy oil projects

schedule at 66% complete, with approximately $5.3 billion in purchase orders and contracts having been awarded to date.

- Continued production improvements at the Pelican Lake Field from new drilling activity and the expansion of the enhanced crude oil recovery program.Pelican Lake crude oil production averaged approximately 32,000 bbl/d during the quarter,up 10% or approximately 3,000 bbl/d from Q1/06. Production is expected to continue to increase in Q2/07 and throughout the remainder of 2007.
- Secured a deep water drilling rig for the Baobab Field.The equipment will be mobilized in late 2007 or early 2008, enabling shut-in production to come back on-line over the course of 2008.-Completed the issuance of US$1,100 million principal amount of 5.70% unsecured notes due May 2017 and US$1,100 million principal amount of 6.25% unsecured notes due March 2038. Concurrently, the Company entered into cross currency interest rate swaps to fix the Canadian dollar interest and principal repayment amounts on US$1,100 million of unsecured notes due May 2017 at 5.10% and C$1,287 million.The Company also entered into a cross currency interest rate swap to fix the Canadian dollar interest and principal repayment amounts on US$550 million of unsecured notes due March 2038 at 5.76% and C$644 million.
- Declared a quarterly cash dividend on common shares of C$0.085 per common share,payable April 1,2007, a 13% increase over the 2006 quarterly dividend. This is the sixth consecutive annual increase.

OPERATIONS REVIEW AND CAPITAL ALLOCATION

In order to facilitate efficient operations, Canadian Natural focuses its activities in core regions where it can dominate the land base and infrastructure.Undeveloped land is critical to the company's ongoing growth and development within these core regions.Land inventories are maintained to enable continuous exploitation of play types and geological trends, greatly reducing overall exploration risk. By dominating infrastructure, the Company is able to maximize utilization of its production facilities, thereby increasing control over production costs. Further, the Company maintains large project inventories and production diversification among each of the commodities it produces;namely natural gas, light/medium and heavy crude oil and NGLs.A large diversified project portfolio enables the effective allocation of capital to higher return opportunities.

The Company operates in the North Sea and Offshore West Africa where production of lighter quality crude oil is targeted in conjunction with natural gas that may be produced in association with crude oil production.

OPERATIONS REVIEW

- Q1/07 production increased 20% over Q1/06 and increased 6% over Q4/06. These increases reflect full quarter inclusion of ACC production along with a successful winter drilling program.
- Canadian Natural drilled 201 net successful natural gas wells in Q1/07 compared to 440 net natural gas wells in Q1/06,which represents a 54% reduction.High drilling success rates reflect Canadian Natural's low-risk exploitation approach and high quality land base.The Q1/07 natural gas drilling program represented an active program across the Company's core regions. In Northeast British Columbia 49 net wells were drilled,while in Northwest Alberta 78 net wells were drilled. In the Northern Plains,92 net wells were drilled, with 26 net wells drilled in the Southern Plains.
- Planned drilling activity for Q2/07 includes 13 natural gas wells compared to drilling activity for Q2/06 of 48 natural gas wells. This is a reflection of the Company's decision to proactively reduce exposure to over-inflated service and supply costs,along with the seasonality of natural gas drilling.
- Although third party service costs have not decreased significantly, Canadian Natural has experienced productivity gains as a result of the focused drilling program.
- Q1/07 North America crude oil and NGLs production decreased 5% from Q4/06 and increased 7% over Q1/06. Pelican Lake experienced strong performance and continued production improvements that offset the decrease in Q1/07 that was largely a result of the timing of the normal steaming cycle in thermal crude oil production.
- During Q1/07, drilling activity included 144 net wells targeting heavy crude oil, 36 net wells targeting Pelican Lake crude oil,9 net wells targeting thermal crude oil and 18 net wells targeting light crude oil. The majority of the wells were drilled in the Northern Plains core region.
- The Primrose East expansion program continues with a planned expansion of the crude oil processing facility from 80,000 bbl/d to 120,000 bbl/d,as well as the construction of a steam generation plant and new pad drilling targeted to add production gains of 40,000 bbl/d in 2009. Primrose East is the second phase of the 300,000 bbl/d conventional expansion plan identified to unlock the value from Canadian Natural's thermal crude oil resource base. Detailed engineering, procurement and site clearing are underway.
- At Pelican Lake, the development and secondary recovery implementation projects continued as planned with 36 horizontal producing wells drilled in Q1/07 and 96 additional horizontal wells planned for the remainder 2007.In addition, 30 production wells were converted to injection wells (9 for water injection and 21 for polymer injection)in Q1/07. Results from the polymer flood continue to be positive and 2 additional polymer skids were installed in Q1/07. The program continues to be optimized and the results will be monitored.
- Planned drilling activity for Q2/07

includes 86 net crude oil wells,excluding stratigraphic test and service wells.

• In early 2007,Canadian Natural issued its proposed development plan for the 30,000 bbl/d Kirby In-Situ Oil Sands Project located approximately 85 km northeast of Lac La Biche in the Regional Municipality of Wood Buffalo. The Company is targeting to file its formal regulatory application documents for this project in the latter half of 2007 pending the results of potential changes to royalty regimes and environmental regulations, and the associated costs resulting there from.

Anticipated Changes to Legislation

• The Alberta provincial government is currently reviewing its crude oil and natural gas royalty regime.It is too early to predict the outcome of this review.

• The Federal and Provincial governments are in the process of drafting policy and legislation to control greenhouse gas emissions. Operating in the high cost and highly regulated environment of the Western Canadian Sedimentary Basin ("WCSB"), additional cost requirements as a result of greenhouse gas legislation will add to the challenge of executing projects within the WCSB.

International

The Company operates in the North Sea and Offshore West Africa where production of lighter quality crude oil is targeted in conjunction with natural gas that may be produced in association with crude oil production.

North Sea

• Canadian Natural continues to execute its exploitation strategy in the North Sea. The first stage of this exploitation program is based upon optimizing existing facilities and waterfloods.Canadian Natural continues to apply this first stage of exploitation on its holdings in the North Sea.The second stage of exploitation incorporates more near pool development and exploration in order to maximize utilization of the common facilities and ultimately extend all fields' economic lives.Ongoing development at the Columba Terraces and the Lyell Field are examples of this type of work.

• In Q1/07,1.6 net wells were drilled, with an additional 2.8 net wells drilling at the end of the quarter.

• The development of the Lyell Field continued during the first quarter. Tranche 1 of the Lyell Field development comprises two production wells scheduled for completion during 2007,and an additional 2 production wells and 2 well workovers in 2008.

• Construction of the Columba E Raw Water Injection facilities continued during the quarter. Commissioning is scheduled for Q2/07 at which time water injection wells are due to be completed, with production ex-

In order to facilitate efficient operations, Canadian Natural focuses its activities in core regions where it can dominate the land base and infrastructure

pected to reach full capacity by 2008.

Offshore West Africa

• During Q1/07,1.2 net wells were drilled with 0.6 additional net wells drilling at the end of the quarter.

• First oil from West Espoir commenced in 2006 with 3 production wells and 2 injector wells.During Q1/07,1 additional production well was added.The West Espoir area development drilling will continue until 2008 with producers and injectors being brought on-line as they are completed.

• A deepwater drilling rig has been secured for the Baobab Field. The rig will be mobilized in late 2007 or early 2008,which will enable the Company's shut-in production to be brought back on stream.

• At the 90% owned and operated field in offshore Gabon, activity continued with contracts awarded for the construction of the wellhead towers and for a drilling rig. Drilling is scheduled to commence in Q2/07 and first crude oil is targeted for late 2008. Production is forecasted to plateau at approximately 20,000 bbl/d.

Horizon Project

• Phase 1 of the Horizon Project continues on schedule with first production of 110,000 bbl/d of light, sweet SCO targeted to commence in Q3/08.

• The progress on major milestones, a key component in achieving critical path success, is slightly ahead of schedule.

• During Q1/07,the Company awarded a further $131 million of contracts, including several that were previously deferred in order to optimize pricing. This brings the total awarded contracts to $5.3 billion.To date, all major plants have been through hazard/operability engineering review without requiring major scope change, providing even greater cost certainty.The construction is at a point where the critical foundations are complete, steel is being erected, modules are being placed and equipment is being set.

• Canadian Natural continues to effectively execute its well defined strategies. Overall work progress at the end of Q1/07 (engineering, procurement and construction) was at 66% complete.

Field construction itself is over 52% complete.All major vessels have either been erected or are currently on-site as work moves forward into the most labour-intensive portion of the Horizon Project. Work scheduled for the coming months will focus more on mechanical construction efforts, which are scheduled to be completed through a mix of lump sum and reimbursable contracts.

• The Company has now entered into the majority of the construction contracts and as the final 34% of the overall project is undertaken,the aforementioned challenges are causing cost estimates for certain isolated pieces of the project to increase above targeted cost.

Our actual spending to date is near plan (69% actual versus 68% plan)and our overall project forecast cost is currently forecasted in a range that is not materially in excess from that approved by the Board of Directors in February 2005, positioning Canadian Natural favorably given the rise in costs that has occurred during the last two years. Our current project completion cost forecast ranges from approximately 5% to 12% over the original $6.8 billion estimate.

Phase 2/3 Update

• Originally commenced in mid 2006, Canadian Natural continues to proceed forward with Phase 2/3 of the Horizon Project with significant progress made towards the EDS portion of front end engineering. To date, Canadian Natural has spent approximately $124 million on Phase 2/3, with $203 million budgeted for 2007 for these phases.

• In 2006, Canadian Natural ordered certain major vessels required for Phase 2/3 of the Horizon Project, including the coke drums and the hydrotreating vessels. To date, coker foundations have been built, together with the construction of significant piperack and common service infrastructure.The engineering and construction work that has been completed provides Canadian Natural a distinct and strategic advantage over other projects as Canadian Natural builds the Horizon Project.Canadian Natural is currently evaluating several execution options for the balance of Phase 2/3 construction that will provide flexibility and balance the risks associated with building in the current high cost environment.

Operations Readiness

• Canadian Natural has had operations staff involved in the design, procurement and construction of the Horizon Project from project commencement.

Canadian Natural believes this has resulted in a design that will be less difficult to commission and start-up had there been no operations staff involved.

The operations staff is responsible for the commissioning and start-up of the facilities and have already prepared a commissioning and start-up schedule which is directly linked to the construction schedule.This allows the project team to identify challenges early on and ensure that adequate contingency plans are in place.

• Currently there are 142 operations staff employed in the development of start-up procedures,preparation of training programs,recruitment of additional staff, establishment of maintenance programs and operation of several plant systems.

• The operations staff has had the opportunity to test-run many programs through the early operation of plant systems.The team is currently operating some mine equipment and several plant facilities such as water treatment, sewage treatment,communications,natural gas and power distribution. As a result,the team has already developed several early learnings that have been incorporated into later start-up plans.

- Throughout 2007,increasing focus will be placed upon commissioning and start-up as operations staff levels increase and procedures are optimized.
- In Q1/07,the Company experienced a narrowing of the heavy oil differential to under 30%,well below seasonal expectations and favorable compared to Q1/06. Canadian Natural has committed to 25,000 bbl/d of pipeline capacity on the Pegasus Pipeline,which transports Company volumes to the U.S. Gulf Coast,as part of the Company's efforts towards working with various industry groups to find new markets for Western Canadian heavy crude oil.
- During Q1/07, the Company contributed approximately 135,000 bbl/d of its heavy crude oil streams to the Western Canadian Select ("WCS") blend as market conditions resulted in this strategy offering the optimal pricing for bitumen.

FINANCIAL REVIEW

- Canadian Natural has structured its financial position to profitably grow its conventional crude oil and natural gas operations over the next several years and to build the financial capacity to complete the Horizon Project and other major projects.A brief summary of its strengths are:

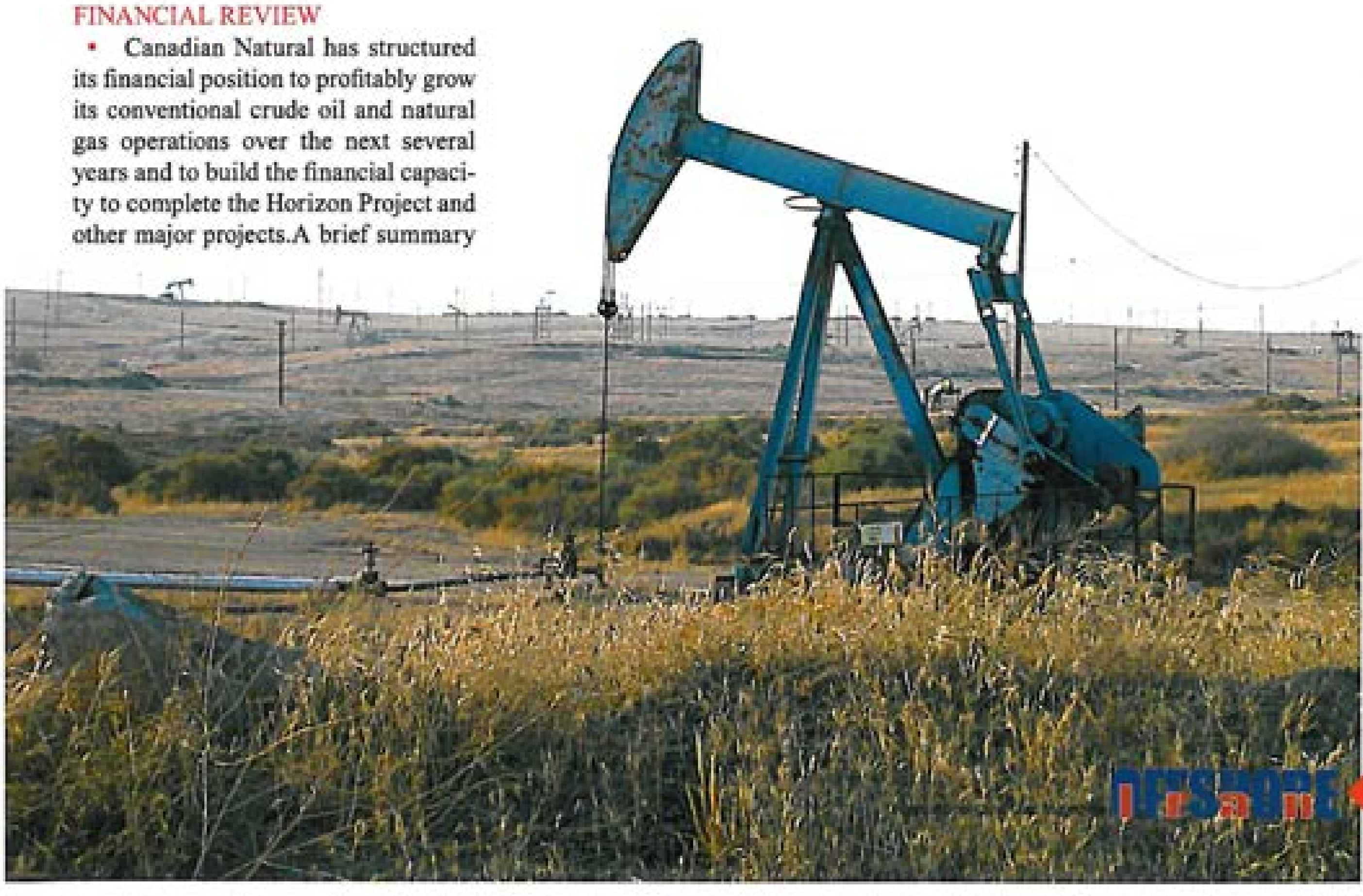
a- A diverse asset base geographically and by product-produced in excess of 613,000 boe/d in Q1/07, comprised of approximately 47% natural gas and 53% crude oil-with 95% of production located in G7 countries with stable and secure economies.

b- Financial stability and liquidity-approximately $6.3 billion of bank credit facilities, with an aggregate $1.6 billion of unused bank lines available at March 31,2007.

- Completed the issuance of US$1, 100 million principal amount of 5.70% unsecured notes due May 2017 and US$1, 100 million principal amount of 6.25% unsecured notes due March 2038, which have been sold to investors in the United States. The 5.70% unsecured notes were sold at a price of 99.725% per note to yield 5.734% to maturity. The 6.25% unsecured notes were sold at a price of 99.323% per note to yield 6.30% to maturity.Net proceeds from the sale were used to repay bank indebtedness.
- Concurrently,the Company entered into cross currency interest rate swaps to fix the Canadian dollar interest and principal repayment amounts on US$1,100 million of unsecured notes due May 2017 at 5.10% and C$1, 287 million.The Company also entered into a cross currency interest rate swap to fix the Canadian dollar interest and principal repayment amounts on US$550 million of unsecured notes due March 2038 at 5.76% and C$644 million.
- Declared a quarterly cash dividend on common shares of C$0.085 per common share,payable April 1,2007,a 13% increase over the 2006 quarterly dividend.This is the sixth consecutive annual increase.

OUTLOOK

The Company forecasts 2007 production levels before royalties to average between 1,594 and 1,664 mmcf/d of natural gas and between 315 and 360 mbbl/d of crude oil and NGLs. Q2/07 production guidance before royalties is forecast to average between 1,677 and 1,698 mmcf/d of natural gas and between 313 and 329 mbbl/d of crude oil and NGLs.



Offshore oil hunt

Singapore's shipyards want a bigger share of the offshore shipbuilding industry, eyeing areas now dominated by South Korea, Japan and Norway.

Singapore-listed yards have secured well over half the 92 oil drilling rigs under construction worldwide,and are now looking to expand capacity in a bid to meet a next wave of demand for vessels and platforms needed to pump oil and gas from the ocean bed to the market.

Industry executives see rising demand for deep-water floating production capacity as oil prices remain high and some 84 new offshore fields are set to come onstream in the next five years.

"Clearly the next step has to be focused on production capabilities, which ultimately determine the amount of throughput that refineries depend on to supply the swelling demand for energy" said JP Morgan analyst Winnifred Heap.

As Keppel Corp and SembCorp Marine venture into new business areas, they will come up against South Korean and Japanese yards that are world market leaders in building gas carriers, floating production units, floating production, storage and offloading (FPSO) vessels and semi-submersible production rigs.

Singapore yards, world leaders in building shallow-water jack-up and deep-water semi-submersible drilling rigs, have only led in recent years in converting tankers into FPSOs and have made a few floating production units such as the P-52 by Keppel for Brazil's Petrobras.

But that's likely to change "gradually but surely", said an executive at one of Singapore's shipyards."Within months, you'll see in our yards more FPSOs and gas carriers,too."

Both the top Singapore yards will also receive drillships-the first in several years-for major refurbishment.

Building these vessels that carry a derrick amidships is another area currently dominated by the South Koreans.

Samsung Heavy Industries is building six drillships and Daewoo Shipbuilding two.

In building gas carriers,which transport liquefied natural or petroleum gas,Samsung and Daewoo are followed by Korea's Hyundai Heavy Industries and Japan's Kawasaki Heavy Industries and Mitsubishi Heavy Industries.

Analysts in Seoul, however, said there was currently enough work for everyone though competition with yards in Singapore or China might emerge in later years.

"South Korean shipbuilders and Singapore yards have different markets,"said Ko Min-je, analyst at Hanhwa Securities in Seoul.

He said Koreans were focused on large floating systems while Singapore specialises in rigs."Shipbuilders from both countries will enjoy earnings growth together," he added.

Choi Young-chul, analyst at TongYang Investment Bank in Seoul, said rising oil prices meant orders from the oil industry may rise even further.

Meanwhile, smaller Singapore yards are marking their presence by making offshore support vessels (OSV) such as anchor handling, towing and supply vessels(AHTS).

These OSVs are the work horses of the offshore industry, helping transport, moor and supply staff and goods to offshore rigs and platforms.

Singapore yards Labroy Marine, Jaya Holdings, Pan United Marine and ASL Marine are building nearly a quarter of the 300 or so OSVs on order worldwide, vying with leading global players such as Norway's Aker, unlisted Kleven Verft and Bollinger Shipyards of the United States.

China's Dayan Shipbuilding, and India's ABG Shipyard and Bharati Shipyard have also recently emerged as OSV builders in Asia.

Keppel Corp's OSV-building subsidiary, Keppel Singamarine, recently won an order to build two icebreakers for Russian oil major LUkoil, becoming the first Asian yard to build such vessels that cut channels through floating ice.

Keppel, building the highest number of offshore rigs, recently announced plans to get new yard space in Singapore. Operating 17 shipyards across the globe,Keppel is also expanding and upgrading yards in China and the Philippines.

SembCorp

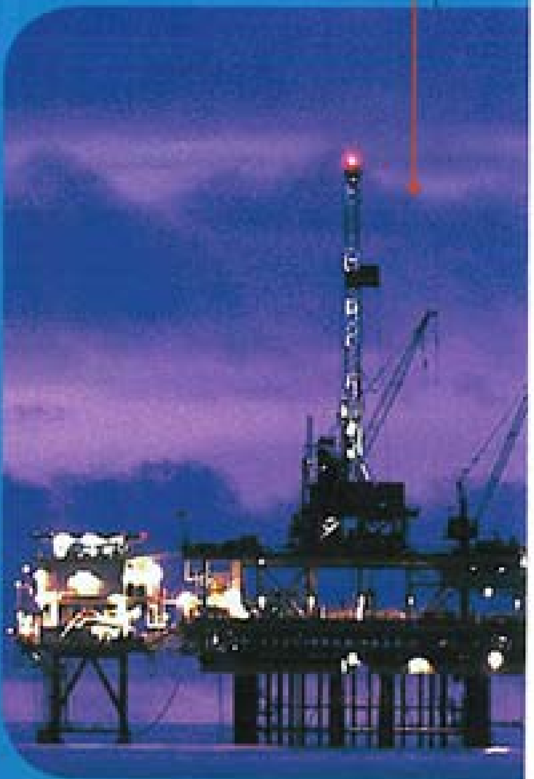
Marine (SembMarine), the world's number-two rig builder, recently acquired an additional seashore area in Singapore and facilities in Indonesia.

SembMarine has 11 yards across the world, including five Chinese yards,and was already in the process of making room at one of its main yards in Singapore for building more rigs.Its 12th yard, in the US Gulf of Mexico, should start this year.

Analysts such as Citigroup's Kevin Chong said the confidence behind the planned expansion of yard capacity stems from signs of rising capital spending by the world's oil majors.

Citigroup's 24th Exploration & Production Spending Survey in June predicted global E&P spending will rise by over 22 per cent in 2006 to $253 billion from 2005. The group's December 2005 survey had forecast 14 per cent growth.

"Clearly the next step has to be focused on production capabilities, which ultimately determine the amount of throughput that refineries depend on to supply the swelling demand for energy"



Orphan basin drilling offshore Newfoundland faces another delay

Offshore Newfoundland has taken another bruising with partners in a deepwater exploration venture stalling the second and third wells in the program for at least one year, possibly two.

With their schedule upset by mechanical problems affecting the drilling rig,completion of the initial exploration well in the Orphan basin has been delayed and it is no longer possible to spud a second well this year. Plans for a third well, originally scheduled for 2008,are also uncertain.

A spokeswoman for rig contractor ExxonMobil told the St. John's Telegram the second well should be drilled in 2008-09, pending regulatory and owner approval.

The semi-submersible rig Eirik Raude, owned by Norwegian-based Ocean Rig, is back on location at the Great Barasway well site after undergoing repairs at the Marystown shipyard in Newfoundland, Chevron Canada spokesman Dave Pommer told.

EIRIK RAUDE BOOKED FOR GULF WORK

He said the partnership 'needs to complete the work', but when is not certain.

Pommer said it was initially anticipated that the wildcat would be finished by about mid-February, six months after spudding, "but you never know when you set out on an exploratory well in deep water how long it will take or what you will encounter."

The Eirik Raude is under a two-year contract with ExxonMobil and is next booked to drill wells for the company in the Gulf of Mexico.

But ExxonMobil and others in the Newfoundland industry are confident exploration of the Orphan basin will proceed, although Pommer said a rig has to be procured if a decision is made to continue the drilling program.

The exploration licenses covering eight parcels were acquired in 2003 for C$628m in work commitments.

Partners in Great Barasway, estimated by outsiders to carry a price tag of at least C$140m, are operator Chevron Canada 50%, Shell Canada 20% and sister companies Imperial Oil and ExxonMobil Canada 15% each.

Continuation of the Orphan program is important for rig hands and support companies in Newfoundland, where activity has taken setbacks from cancellation of the Hebron-Ben Nevis project, delays in opening up a new portion of the Hibernia field and the absence of a natural gas royalty regime.

Some of this is being blamed on spillover from Premier Danny Williams's hard line on improving returns for his province from offshore activity.

DNO reports Yemen progress

DNO is carrying out an extensive drilling program in Yemen in 2007 through planned drilling of 22 wells, consisting of 13 exploration wells and 9 appraisal wells.

The status of ongoing drilling operations is as follows:

Appraisal and Development Wells

Sharyoof-Block 53(24.45%)

Sharyoof # 20, which was drilled in 2006,was originally completed as a Qishn S1C sandstone producer, but was shut down after a short while due to high water production.The well has now been re-completed and the shallower S1A sandstone interval has been brought on stream at an initial gross oil rate of 2,400 bopd.This is another successful operation adding production from the Sharyoof Field following the completion of the two recent infill wells Sharyoof # 23 and # 24, which were brought on stream in November 06 and February 07, respectively.

Drilling of Sharyoof # 26 is expected to commence shortly, and the well is planned as an infill/appraisal well at within the Sharyoof Field area.

Nabrajah-Block 43(56.67%)

Following the interpretation of the new 3-D seismic acquired across the Nabrajah Field during second half of 2006, drilling resumed at the Field earlier this year.

There are currently two drilling rigs operating at the Nabrajah Field.

Nabrajah # 14 commenced drilling on 26 April and is the second Qishn appraisal well that is based on the new 3-D seismic interpretation.

Drilling of Nabrajah # 13 commenced on 29 March and is targeting a new play concept within the Nabrajah area.

There are several additional Qishn prospects identified from the new 3-D seismic which will be drilled later this year.Contingent on the results from Nabrajah # 13,additional deeper targets may also be drilled. Following the completion of Nabrajah # 14, the plan is to fully utilize one rig in Block 43 for the remainder of the year.

Godah-Block 32 (38.95 %)

In Block 32 the joint venture group has secured an additional drilling rig for two slots back-to-back as part of the additional development drilling on the Godah field.

Drilling of Godah #5 commenced on 11 April and will follow on with Godah #6 utilizing this rig. Godah #7 is planned to be drilled with another rig, and is expected to start beginning of June.

Drilling of the Ardah #1 exploration well has been completed by DNO as Operator.

The well penetrated both Qishn Formation as well as deeper targets without encountering hydrocarbons.

DNO has to date completed 4 of the 13 wells planned under the 2007 exploration program in Yemen.According to the current plan the remaining 9 exploration wells are expected to be drilled as follows:

- **Block 32: 3 wells**
- **Block 43: 1 well**
- **Block 44: 2 wells**
- **Block 47: 1 well**
- **Block 53: 2 wells**

China, Vietnam spar over gas

Just when it seemed China and Vietnam had buried their conflicting claims to the Spratly Islands,Beijing is contesting a new Hanoi-tendered, BP-led,US$2 billion natural-gas project near the rocky group of islands and reefs in the South China Sea.

The flare-up marks perhaps the strongest indication yet that Beijing's soft-power overtures toward Southeast Asia are hardening when it comes to energy-security concerns.

The contested Moc Tinh and Hai Thach gas fields,in the Nam Con Son Basin about 370 kilometers off Vietnam's southeast coast, are both run by British energy giant BP through a production-sharing contract with state-owned PetroVietnam and in partnership with US oil firm ConocoPhillips.

The Chinese Foreign Ministry on April 12 claimed that the project encroached on its territory, saying"any unilateral action taken by any other country in these waters constitutes infringement into China's sovereignty, territorial rights and jurisdiction. We are firmly opposed to this. "Hanoi has countered that the multinational-led project lies in its territorial waters and exclusive economic area, consistent with the 1982 United Nations Convention on the Law of the Sea.

Beijing first lodged its complaint during a visit by members of the Vietnamese National Assembly, symbolically led by its chairman, Nguyen Phu Trong. The contested project lies adjacent to the Lan Tay gas field and pipeline, which commenced construction in the late 1990s and came on-stream in 2003. Until now it had not stirred any official complaint from China.

Led by BP and in partnership with PetroVietnam,Lan Tay is Vietnam's first large-scale gas-supply-chain project, piping fuel to the 3,800-megawatt combined-cycle power plant at the Phu My industrial estate outside Ho Chi Minh City that is popular with foreign investors. The pipeline also takes gas from the Korea National Oil Corp's Rong Doi field.

The contested BP-led Moc Tinh and Hai Thach project, which will include a new pipeline designed to deliver gas to a common processing facility onshore, is scheduled to supply gas to new power plants totaling 2,640MW at Nhon Tach., some 60km east of Ho Chi Minh City.Vietnam's offshore oil reserves are dwindling and Hanoi is increasingly looking to natural-gas projects to help fill the gap.

According to projections compiled last year by the Asia Pacific Energy Research Center, Vietnamese energy planners aim to have 23,000MW of power-generation capacity installed by 2010, of which 7,000MW will be fueled by natural gas. By 2020, Hanoi hopes nearly to double that capacity to 44,000MW, with natural gas providing 12,000MW of the total power, according to the same projections.

At the same time, China has launched a global investment spree to meet its surging energy appetite, including recent politically risky forays in Africa.Beijing has expressed its desire to source more of its fuel needs from Asia, because of its security concerns about shipping through the congested Malacca Strait between Indonesia's Sumatra island and peninsular Malaysia. And securing new fuel sources in the nearby Spratly Islands would help to alleviate those concerns.

Old enemies, new friends

Relations between neighboring Vietnam and China have long been tense,including recent armed skirmishes in the late 1970s and '80s. The two sides fought a brief but bloody border war in the wake of Vietnam's invasion of Cambodia, which ousted the Beijing-backed Khmer Rouge regime.In 1988,Vietnam and China fought a brief naval battle over the contested Spratly Islands in the south-central area of the South China Sea.

In line with China's regional economic charm offensive,more recently diplomatic relations have warmed and commercial ties have blossomed. The two sides have in recent years launched "friendship and cooperation "meetings, including regular reciprocal visits from each country's top government leaders.

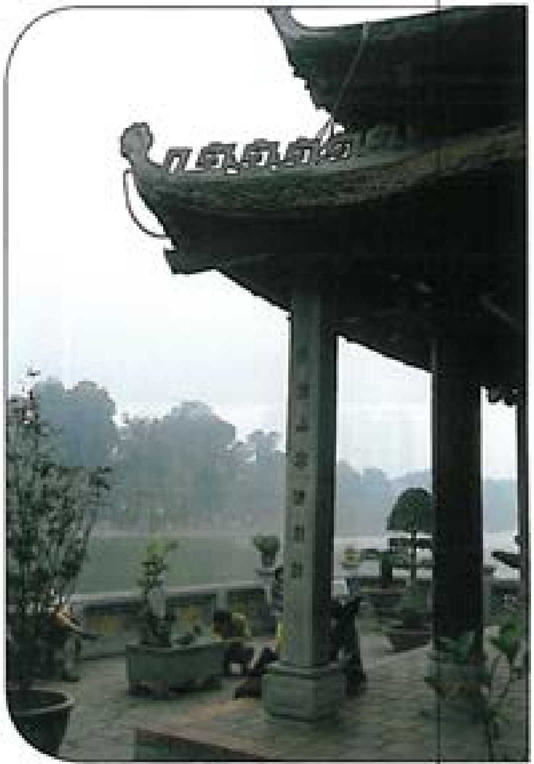
Improved diplomatic ties have paved the way for Vietnam to develop new transport infrastructure in its northern regions, aimed at better connecting its manufacturing base with China's booming southern provinces. Bilateral trade reached $10 billion in 2006, up more than 21% year on year.

Overlapping maritime claims still overshadow those improved relations, as the new dispute over Vietnam's Nam Con Son Basin natural-gas project shows. Notably, progress has been made on long-contested land boundaries. China this year ratified a treaty signed last October defining precisely the point where the national borders of China,Vietnam and Laos meet. But settling maritime boundaries, particularly concerning the Spratly Islands, has proved more difficult precisely because access to potentially abundant oil and gas resources is at stake.

During the 1990s, disputes over the Spratly Islands were commonplace, with different regional actors at times forcefully staking their claims. Recently China, Vietnam and others with overlapping claims there-including Malaysia, Brunei and the Philippines-agreed under the Association of Southeast Asian Nations'(ASEAN's) Declaration on the Conduct of Parties in the South China Sea to resolve any future disputes peacefully.

The Nam Con Son Basin area,the focus of the current disagreement,is a potentially important regional energy source. Most of Vietnam's present oil production is based closer to shore in the Cuu Long Basin, but in Hanoi's drive to secure new energy sources the more distant Nam Con Son Basin has become a focus of Vietnam-tendered, multinational-led exploration.Shell and ExxonMobil are operating in blocks that Vietnam claims but could also be subject to claims by Beijing.

Despite the high stakes, it does not appear that the latest bilateral squabble will escalate into full-blown saber-rattling-as past contested claims have, including China's seizure of the Paracel Islands from Vietnam in 1974. The



Nam Con Son issue was discussed at a regular annual meeting between senior foreign-ministry officials from the 10 ASEAN member states and China in the Chinese city of Anhui.

The matter was examined in the context of the Declaration on the Conduct of Parties in the South China Sea.

Beijing said shortly after making its claim to the territory on April 12 that the two sides had a consensus to resolve their disputed maritime boundaries around "the principle of shelving differences and seeking common exploration". The Chinese Foreign Ministry spokesman said in mid-April,"We should not take any unilateral action that will further complicate the situation."

A few days afterward, a delegation of Vietnamese government officials and army officers visited the Spratlys, sent ostensibly to celebrate the 32nd anniversary of the islands'liberation from the old US-backed government of South Vietnam, but which also entailed an inspection of troops in islands just to the north of the archipelago stationed clearly to defend against potential Chinese expansionism.

OPEC official looks west for investment

In an unusual admission, OPEC's new secretary-general said oil-producing countries may have to attract more foreign investment to meet world oil needs. But his call is at odds with the rising barriers faced by Western oil companies hoping to tap the cartel's vast reserves.

Abdalla el-Badri said in an interview that members of the Organization of Petroleum Exporting Countries, which supplies about 40% of global petroleum output, need to invest as much as $500 billion by 2020 to satisfy rising global demand for crude.He acknowledged some of that must come from foreign sources, like Western oil majors, and not just from state-run national oil producers.

"I'd like to see further cooperation between national oil companies and international oil companies,particularly in exploration and enhanced oil recovery, "said Mr. Badri, a former Libyan oil minister who took over the senior position at OPEC in January.

Such cooperation could run into toughened barriers between many cartel members and the West's oil giants, despite the latter group's keen interest in developing new reserves.

Many barriers are longstanding. Oil-production assets within the borders of many OPEC members, especially big Persian Gulf producers such as Saudi Arabia, have been off-limits to foreign companies for years. OPEC nations that actively encourage foreign investment, such as Angola and Nigeria, are in the minority.

But even those that have traditionally put out the welcome mat for Western oil majors have toughened terms recently as high world prices for crude triggered a rise in resource nationalism.In February, Western companies were forced to hand over operating control of major projects in Venezuela to state oil monopoly Petroleos de Venezuela SA, known as PDVSA. Algeria, meanwhile, imposed a tax on what it considers excess profits and restricted the role of foreign oil companies in production projects. As an example of cooperation, Mr. Badri cited a $900 million natural-gas exploration deal struck last month between the Libyan government of Col. Moammar Gadhafi and British energy giant BP PLC. Libya has seen a sharp uptick in interest from Western oil companies since 2003, when it abandoned its weapons of mass destruction programs, prompting the U.S. and Europe to ease sanctions.

But in some of its licensing rounds, Libya has imposed terms that are so tough that some private companies have wondered how they could ever make a profit.

Mr. Badri heads the OPEC secretariat, an administrative and research body. Supply decisions are made by oil ministers of member nations who periodically meet at the OPEC conference, which coordinates the group's policies.

For decades, oil-rich nations were incapable of fully exploiting their resources without Western help.

But with oil prices so high, state oil companies no longer have to rely on foreign capital and are making massive investments to boost production.

However, not all of them have the technology to find and develop new reserves, and many lack the expertise of Western oil majors in unconventional techniques, such as enhanced oil recovery and deep drilling.

Meanwhile, some national oil companies have been criticized for low levels of exploration and investment.

Iran has seen its production capacity fall in recent years a result, analysts say, of underinvestment in new upstream projects.

Mr. Badri said OPEC would need investment of between $230 billion and $500 billion by 2020 to achieve a target of nine million barrels per day of additional production.OPEC currently produces a little more than 30 million barrels a day, the equivalent of 40% of global output.

He said international oil companies have the "technology, the know-how, [and] the financial back-up to expedite any discovery they find, to bring that discovery to market as fast as possible."

Compact connections will benefit refineries

As refineries are upgraded and extended across the Middle East and Asia, the latest high performance compact connection technology from Vector International is set to see rising demand, thanks to the significant savings, ease of installation and minimised maintenance requirements it offers.

At one refinery these benefits were demonstrated in a furnace upgrade, where some 24 pairs of three inch SPO Compact Flanges are being used in the re-tubing of the furnace convection bank and replacement of the outlet transfer lines to the radiant bank (all being upgraded from carbon steel to stainless steel).

These compact flanges will ensure joint integrity at design pressures of 26 bar and design temperatures to 400°C–well within the capabilities of the flange which can accommodate pressures in excess of 40,000 psi and temperatures to 720°C.

Vector's SPO Compact Flanges were selected for the project following the success and benefits derived by the refinery operator in using these connections on a previous furnace radiant bank re-tube project, involving the reconfiguration and installation of a radiant coil bank and outlet transfer lines to the column.

A number of key features drove the selection of SPO Compact Flanges for both applications:ease of installation, their significantly reduced weight, and their leak-free performance and minimised maintenance requirements.

The use of SPO Compact Flanges as opposed to traditional ANSI flanges for the 24 outlet and inlet nozzles to the furnace minimised installation issues, including avoiding the need for field welding, and by overcoming considerations arising from the use of dissimilar metals.

Minimising the risk of welding defects and subsequent rework during the shutdown was important to avoid costly delays. Use of the compact flanges reduced the number of the field welds on this project by 60 per cent.

The light weight of the SPO Compact Flange is also a significant advantage, given the location of the flanges(15metres high and inaccessible, while those installed during the earlier project are at a height of 25 metres above ground level).

The SPO Compact Flange design makes it considerably smaller and typically 70-80 per cent lighter than a traditional ANSI flange for the equivalent pressure rating.

By overcoming the need for heavy lifting equipment and challenges presented by a congested site with severe space restrictions, the SPO Compact Flange offered valuable time and cost savings.

Particularly significant was the refinery's need for leak-free connections–which the SPO Compact Flange met with its unique no-leak sealing technology.

Cyclic thermal expansion and contraction resulting from planned and unplanned outages heightens the risk of gasket failure over time when using ANSI flanges for joining dissimilar metals.

Given the height and inaccessibility of the flange locations,design and installation of permanent access platforms would have been required for inspection and maintenance if ANSI flanges were used.

However the SPO Compact Flanges offered a cost-effective alternative, negating the requirement for access platforms due its capability to maintain seal integrity in such conditions.

The SPO flange features a triple seal design,and uses a wedging action with radial compression to ensure a rigid,full contact seal between the faces which remains static regardless of load conditions.

When the joint is made up the metal to metal seal created at the inner diameter of the flange faces is a fully qualified seal, while the compressed sealring (a flexible metal ring located in a groove in the flange face) provides a second seal.

In addition,a small wedge around the outer diameter of the flange face creates a third, environmental, seal. The result is a connection that combines the integrity of a welded joint with the versatility of a mechanical one.

"Because the height of the flanges means they are inaccessible during normal operation and would require scaffold erection for maintenance (with time ,cost and risk implications), the refinery operator wanted a reliable high integrity low maintenance flange, rather than standard ANSI weld neck flanges, to safeguard against leaks under operational conditions, "Vector vice-president marketing and sales Ian Robinson stated.

The security threat to oil companies in and out of conflict zones - expro

At the beginning of the 20th century, oil for combustion engines became the most critical source of energy for states that were in the process of industrialisation and by "the end of the twentieth century, oil was still central to security, prosperity, and the very nature of civilisation".Now, at the beginning of the 21st century, the most powerful states in the the world, the G8 states(Canada, France, Germany, Italy, Japan, the UK, the US and Russia), are even more reliant on oil.Furthermore,it is predicted that the demand for energy will grow by 50%(mainly in Asia, Latin America, Africa, the Middle East and India)over the next 25 years.Thus, oil will become even more important for both powerful states and poorer countries--unless an alternative source of energy is found to be more effective than oil.

However, many of the G8 states that consume much of the oil that is produced have the smallest reserves.For instance, while the US consumes one-quarter of all oil, it has only 2% of the world's reserves, and these are expected to run out in approximately a decade.

The remainder of the G8 states are all in similar positions. While Russia has a significant proportion of the world's reserves, the country is expected to be depleted in two decades. Thus, the oil reserves of some of the most powerful states in the world are not large enough to supply their increasing demand for energy in the future.

Conversely, the less developed regions (LDRs) and the Gulf states have the world's largest reserves. For example, Saudi Arabia has the largest reserves; they are expected to last for approximately 70 years. Also, Iraq, Kuwait, Iran and the United Arab Emirates have the next largest reserves in the world that are expected to last for approximately a hundred years or more.

In fact,collectively, the Gulf states have almost 65% of the world's oil reserves. Venezuela is the only non-Gulf state that has a significant proportion of the world's oil reserves; these are expected to last for more than 50 years. Libya, Nigeria and Qatar also have relatively significant reserves that are expected to last for between 40 and 70 years. Hence, in 10 to 20 years, many of the G8 states will become almost completely reliant on oil supplies from the Gulf states, Venezuela, Libya, Kazakhstan, Nigeria and other poor countries with significant reserves,unless significant new reserves are found elsewhere.

Oil Conflict Zones

Some of these poorer countries with proven reserves of a billion barrels of oil or more have conflict zones. Iraq, for instance,is in a state of insurgency. In Colombia,there is a civil war between state security forces and guerrillas in the oil producing provinces of Arauca and Casanare, which negatively impacts the industry there; Hundreds of attacks by the ELN [National Liberation Army] and FARC [Revolutionary Armed Forces of Colombia] have been directed at electrical, natural gas and oil infrastructure"and the conflict often crosses the border into Venezuela.

In the trans-Caucasus region west of the Caspian Sea,residual civil war and insurgency in Nagorno-Karabakh are considered to be a threat to the construction of pipelines from the Caspian Sea westward to Europe by various international oil consortia.The Chechen insurgency against Russia on the border between Georgia and Chechnya in the Caucasus mountain range is also considered to be a threat to oil pipelines in the region. In Nigeria,violent elements of indigenous communities and 'militias'attack the oil industry in the Niger Delta Region; "Shell, Nigeria's biggest oil producer, said it had been forced to evacuate four facilities in the coastal swamps amid fears of attacks by ethnic militants". While the civil war in Algeria between the government and the Islamic Salvation Army formally ended in 2000, "small numbers of armed militants persist in confronting government forces and conducting ambushes and occasional attacks on villages"in the north-east, where some of the country's largest oil reserves are located.

Heavy oil may play bigger role in China's oil output growth

China is showing increasing interest in developing its domestic reserves of heavy-grade crude oil as it struggles to line up energy supplies to feed its booming economy.

Although China has substantial heavy oil reserves, their development has been hindered by high extraction and processing costs and a lack of technical skills.But due to current high oil prices and China's dwindling reserves of lighter grades of oil, the sector is getting a boost.

The latest evidence of growing enthusiasm for heavy oils is an agreement in early May signed by Citic Resources Holdings Ltd.(1205.HK), a subsidiary of Chinese conglomerate Citic Group.

It'll pay $150 million to buy a stake in the heavy-oil Hainan Yuedong block in the Liaohe oil field in northeastern China, the country's largest reserve of heavy oil.

The Liaohe field produces around 161,000 barrels a day of oil,and the Hainan Yuedong block is expected to add a further 30,000 barrels a day.

Sources familiar with the field say the block's development has up to now been hindered by a lack of funds.

Heavy oil, which has lower commercial value than lighter grades, is generally defined as having and American Petroleum Institute gravity of lower than 22 degrees.

Apart from Citic, China's three largest oil producers, PetroChina Co.

(PTR)and China Petroleum & Chemical Corp. (SNP), or Sinopec, and Cnooc Ltd. (CEO), all have a long involvement in heavy oil projects domestically.

And all have new ventures in the pipeline and in some cases, are looking for new investments abroad.

China has five main heavy oil fields-PetroChina's Liaohe field and in Xinjiang in northwestern China, Sinopec's Shengli and Henan fields in eastern China, and Cnooc's Bohai Bay project off the eastern coast.

Their combined output was nearly 482,000 barrels a day in 2005, accounting for about 13% of the country's total crude production, said Jia Chengzao, vice president of PetroChina, speaking at a World Heavy Oil Conference in Beijing six months back.

Horizontal wells can allow drillers to extract higher volumes of oil than conventional vertical ones.

High Costs, Technical Difficulties

China has an overall crude oil production target of 200 million tons,or some 4.02 million barrels a day of crude oil by 2015, according to Zhang Guobao,a vice minister of the National Development and Reform Commission.

While 2006 output of 184 million tons wasn't far short of this, bridging the gap won't be easy without pushing ahead rapidly on heavy oil development.

Although PetroChina recently made a big find of high-quality light oil in Bohai Bay, it is also seeing slowing flows from its older fields, including its flagship wells at Daqing in the north.

High costs and technological difficulties need to be overcome if heavy oil output is to take off.

"It's difficult for China to reach the goal only by developing conventional oil given limited resources. Heavy oil is a good option so long as the oil price remains above at $50 (per barrel)," said an official with French oil company Total SA(TOT), who declined to be identified.

According to PetroChina's Jia, China's onshore heavy oil reserves are around 19.8 billion tons, of which 2.06 billion tons are proven.He said that the proven reserves figure will likely rise to 7.95 billion tons, without giving a timeframe.

The estimated reserves account for about 20% of China's total oil reserves, said Jia. It is unclear how much heavy oil lies in offshore fields.

In the first quarter of 2007, PetroChina's heavy oil output accounted for only 10.3% of its total output, down from 13.2% the year before, according to a report posted recently on CNPC's Web site.

Over 80% of heavy oil resources in China are below 800 meters underground, with some in Xinjiang's Tarim Basin as deep as 5,300 meters.Extraction at such depths in sometimes difficult geological structures requires advanced technology, CNPC said.

China has made some progress on technology. For example, PetroChina has developed steam-assisted gravity drainage in the Liaohe field, which it believes will increase its recovery rate by nearly 30%.

Given that some developers of heavy oil reservoirs could go into the red if oil prices fall below around $45/barrel, predicting future output is fraught with difficulty.

"It's hard to predict how much China's heavy oil output will grow in the next decade, as it largely depends on oil prices, "said an official with CNPC.

China's oil producers have been looking abroad-CNPC has invested in several blocks in Venezuela, including the Orinoco River basin, home to some of the planet's largest deposits of heavy crudes and bitumen.

And Chinese companies have long been sniffing around Canada's huge reserves of oil sands. China Petrochemical Corp., or Sinopec Group, the parent company of Sinopec, now has a 40% interest in the Northern Lights project with Calgary-based Synenco Energy Inc.(SYN.T). Synenco has said its best estimate of the resources in the Northern Lights project lands is 1.67 billion barrels of bitumen,of which 1.3 billion barrels is recoverable.

Jura announces three-well program in Pakistan

Jura Energy Corp. said that the operator of its license interests in Pakistan has entered into a contract with the Oil & Gas Engineering Company of Sichuan Petroleum Administration("SPA")to drill three wells back-to-back commencing in September 2007.Negotiations are also currently taking place with another rig owner to contract a second rig for a one to two well program commencing in August 2007. These rigs will be assigned to Block 22 and the Kandra field development project to drill targets of up to 1500m.

Jura's management together with the operator is also actively pursuing a two well contract on a third rig to drill targets of up to 3500m.This rig would be assigned to drill two of the Company's exploration targets early this fall.

Additional details on specific wells and drilling dates will be issued as they become available.

Status of Seismic Acquisition

Earlier this year,a seismic crew was contracted from SPA.The crew commenced seismic acquisition in the Mirpur Mathelo block on February 8,2007. A total of 253.7 surface km of 2D seismic data was acquired over a period of 44 days, representing an acquisition rate of 5.76 km/day. Brute stack processing carried out in the field indicates that the quality of the seismic data at both the Sui Main Limestone("SML") and Lower Goru Basal Sand("LG")targets is very good.

Seismic acquisition continued in the Salam block on March 12,2007 where a total of 88.425 surface km of 2D seismic data was acquired over a period of 26 days, representing an acquisition rate of 3.4 km/day. Data quality in Salam, as indicated by brute stack processing, is also very good.

The seismic crew subsequently moved south and commenced seismic acquisition in the Kandra field on May 20,2007. 85.5 km of the 300+ km program of full-fold 2D surface seismic data has been acquired to date. This represents an acquisition rate of 5.7 surface km/day. Data quality acquired so far is very good.

The field seismic data for both the Mirpur Mathelo and Salam blocks has now been shipped to the seismic processing contractor, Spectrum-Geoplex, in Cairo for full processing with results expected for the Mirpur Mathelo block in approximately 12 weeks. A second seismic crew has been mobilized to Block 22 and has commenced a seismic acquisition program over the Hamza appraisal area. Consequently, the SPA crew can be mobilized to Badin IV North and Badin IV South immediately following completion of the program in the Kandra field.

The seismic program over each block has been designed to image targets at both the SML (shallow) and LG (deep) levels.

Power Project

The Kandra Power Company Limited ("KPC"), which is owned 50:50 with Jura's partner Petroleum Exploration (Pvt) Limited, was established earlier this year.On May 28,2007, management met with senior officials at the Private Power Infrastructure Board of Pakistan ("PPIB")concerning the status of the Kandra gas-to-power project.

The PPIB is responsible for implementing the Government's polices on private sector investment in power generation projects in Pakistan. The PPIB is anxious to see the Kandra field and Sukkur power facility developed as soon as possible, and is offering its full support going forward. KPC recently engaged a firm of industry consultants to perform the front-end engineering and design study on the field development and the results are anticipated within a period of three months.

Fiinancing

Calgary-based Jura Energy Corp. is an international energy company engaged in the exploration, development and production of petroleum and natural gas properties with activities conducted exclusively in Pakistan.

Fenosa & Eni in major project

Union Fenosa and Eni will take part in a $1-billion-plus project to double production at a LNG plant in Egypt following the awarding of a concession to explore for the fuel off the country's coast.

Both the Spanish utility and the Italian energy group signed an agreement with the Egyptian government to expand the plant in Damietta on the northern coast.

Fenosa officials said the expansion would increase the plant's capacity to about 14 billion cubic metres (bcm), about half what Spain consumes in one year.

At the signing ceremony, Eni chief executive Paolo Scaroni said the plant would process the gas from the new concession won by Eni and other partners before shipping it to Asia, Europe, and the United States.

"The...new concession to explore in the Mediterranean is extremely promising," he told.

Details of the investment plans for the plant will be specified by 2007, with the aim of bringing its new production capacity on line by 2009 at the earliest, Eni officials said.

Fenosa said the new expansion will be onstream from the first half of 2011.

Although Eni had yet to confirm the amount it would contribute to the expansion project, its officials said it could total some $600 million since it owned 40 per cent of the joint venture that ran the plant.

Eni said the expansion will cost less than $1.5 billion,while Fenosa pegged the cost at $1.3 billion.

Union Fenosa is also a member of the joint venture.

Other partners in the project include BP and Egypt's state-owned companies, EGAS and EGPC.

Egypt also permitted Fenosa to increase the amount of gas it transported to Spain by one bcm to five bcm for 20 years.

Half of it supplies Fenosa's combined cycle electricity plants, while the rest goes to the industrial market.

Fenosa has a 10 per cent share of the gas market in Spain and aims to reach 15 per cent by the end of 2007.

Meanwhile, Egypt plans to double the number of its LNG trains by 2010 should potential gas reserves be confirmed, First Undersecretary at the Ministry of Petroleum Shamel Hamdy said.

"We plan to add two more trains in Idku and one train in Damietta provided we confirm additional gas reserves with the extensive drilling programme we have," Hamdy said.

Egypt has two LNG projects, one in Idku where two trains are operating and the other in Damietta comprising one train.

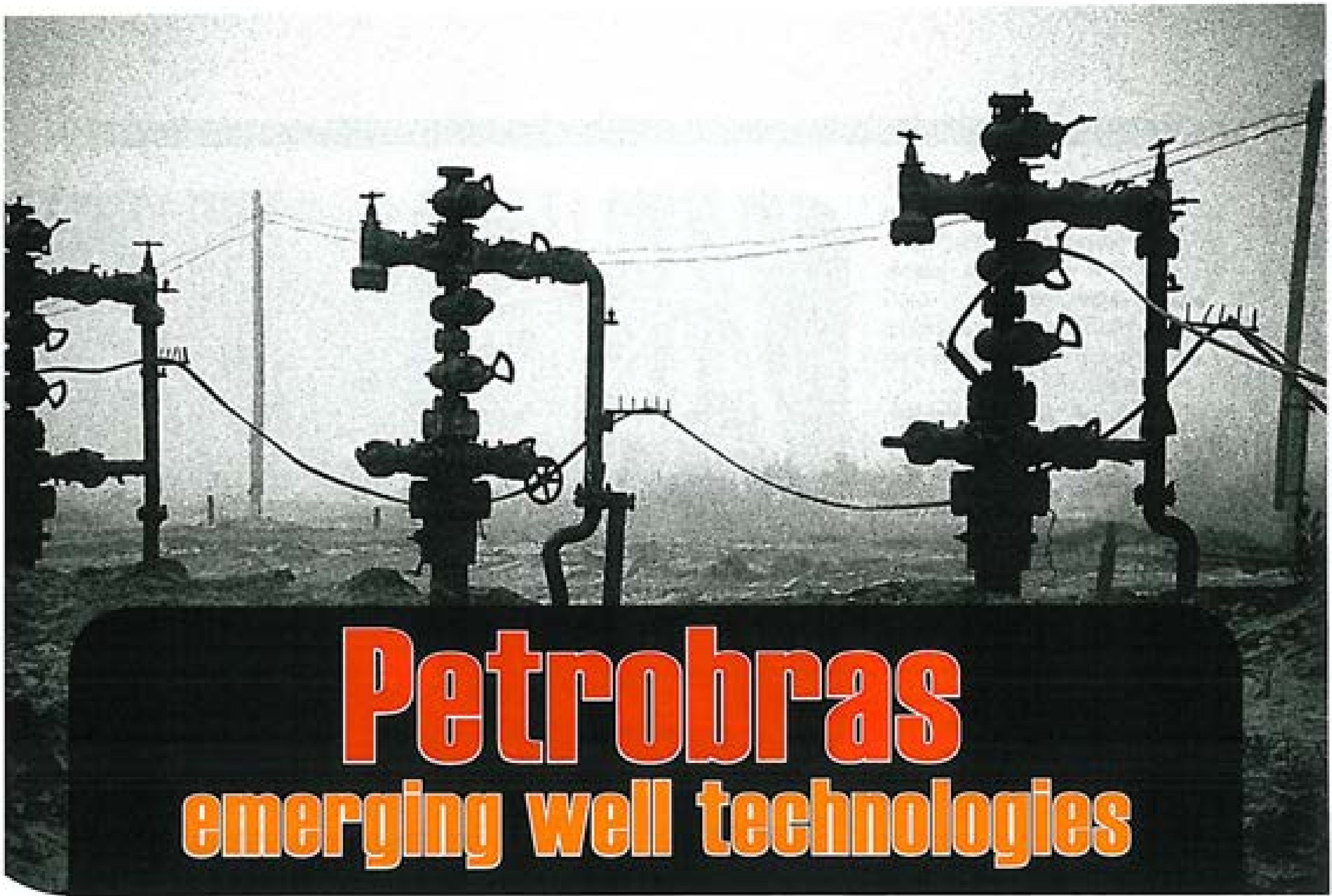
The two plants have a total capacity of 17.5 billion cubic metres per year. Spain's Union Fenosa SA and Italy's Eni SpA(E)are major shareholders in the Damietta plant while BG Group PLC(BRG)has a major stake in the Idku project.

A memorandum of understanding was signed April 2005 for a second 7.5-million-cubic-metre per year train at Damietta by Eni's local subsidiary, International Egyptian Oil Company,BP PLC(BP)and state-owned Egyptian Natural Gas Holding Company, EGAS, but implementation is subject to proving gas reserves.

"We have an extensive drilling programme, we have four or five rigs in the Mediterranean and by the third quarter of this year we should have the results and we will be able to commit to a second train in Damietta," Hamdy said.

BG is also stepping up efforts to find more gas at Idku to start operations on a third train planned there since December, 2004.

"There is a kind of competition between that (Damietta) train and BG's efforts in dku. They are both struggling to find gas and we might end up building them both at the same time,"Hamdy said. LNG exports commenced at the Damietta plant in January, 2005, and so far 60 shipments have been made with a total of 3.5 tonnes exported in a year.



Petrobras emerging well technologies

Petrobras is always looking for new technologies. Since most oil fields are located in deep and ultra-deep water, exploration costs are very high.Therefore, drilling and completion of wells in these conditions must always use the best possible technologies.

In order to make new technologies available, Petrobras first checks whether they are already available on the market. If not, Petrobras normally tries to develop them in partnership with other operators, service companies,independent research centres or universities. Several technologies have been developed using this model.

Here, we are going to describe two technologies that have been developed by Petrobras in partnership with other companies–managed pressure drilling (MPD) and intelligent wells.

Managed Pressure Drilling

According to the International Association of Drilling Contractors (IADC), MPD is an adaptive drilling process that is used to control the annular pressure profile more precisely throughout the wellbore. Its objectives are to ascertain the limits of the downhole pressure environment and to manage the annular hydraulic pressure profile accordingly. The benefits of MPD are as follows:

MPD processes employ a collection of tools and techniques that may mitigate the risks and costs of drilling wells with narrow downhole environmental limits by proactively managing the annular hydraulic pressure profile.

MPD may increase control of backpressure, fluid density, fluid rheology, annular fluid level, circulating friction and hole geometry, or combinations thereof.

MPD may allow faster corrective action when dealing with observed pressure variations. This facilitates drilling of what might otherwise be economically unattainable prospects.

MPD techniques may be used to avoid formation influx, which will be contained safely using an appropriate process.

The main objective is to provide the ability to drill a well with accurate control of the bottomhole pressure(BHP), in order that the operation be conducted with more flexibility and in a proactive way; this is in contrast with the passive mode used in conventional drilling. MPD can be described as the sum of mud weight, equivalent circulation density and casing back pressure. With this in mind, it is easy to see that any one of these components can be modified in order to reach the drilling pressure required for the duration of the drilling process.

Several concepts have already been developed and are now being brought to market. Some of these focus on controlling the equivalent circulating density (ECD), while others focus on the casing back pressure(CBP). The aim is to maintain a constant BHP.However, merely having the ability to control the BHP brings very few benefits if the optimum value to be used is not known. Many of the techniques and alternatives developed in the past were difficult to accept due to their complexity, the number of modifications required to traditional ways of thinking and drilling and the need for substantial investment in equipment and training. In many cases, the application of these technologies was restricted to a defined area and problem, increasing the risks involved in making significant investments.

In order to benefit from the concept of MPD, in early 2006 Petrobras signed a Technical Co-operation Agreement with Impact Group in order to perform a four-well evaluation of secure drilling technology.

Secure Drilling™

Secure drilling™ is a closed-loop MPD system based on the microflux control (MFC) method, a new MPD technology designed to improve drilling in most conditions– from simple wells to highpressure, narrow-margin,offshore and other challenging wells–and to increase safety through automated kick detection and control.

It uses a closed-loop drilling process that allows for the realtime identification of micro-influxes and losses and the control and management of downhole pressures through automated data acquisition and computerised pressure control. The system is capable of detecting influxes and losses very early and controlling an influx automatically, keeping the total volume of the influx in the well to less than five barrels (bbl). In addition, the system can identify many other common drilling problems, including:

- washout;
- mud pump problems;
- wells that are statically under balanced;
- too low mud weight;
- distinguishing a downhole influx from gas (or air) at surface;
- connection gas;and
- trip gas.

Although the primary objective of Petrobras is to use secure drilling in deep and ultra-deepwater operations, the four-well evaluation programme began with a simple land well before progressing to more complex scenarios.The first well selected for the programme was a shallow exploratory well. A kelly-equipped Petrobras rig without any automation was chosen with the aim of confirming the system's capability to be used on virtually any rig. The first well was drilled in August 2006 in the northeast of Brazil using a water-based drilling fluid.A total of 1,824ft (556m) of the 81⁄2-inch section was drilled in five days without the system presenting any problems.The results at this first well confirmed the system's ability to operate in the field under very warm conditions, identify changes in flow on a realtime basis and be installed on most rigs with a minimal number of modifications.

The response from the rig crew was outstanding.They quickly realised the benefits the system would bring to their daily operation,and the simplicity of the system,its small footprint and the fact that all operational procedures are the same as in conventional drilling meant that the rig crew accepted the system extremely well.

A second well was drilled in November 2006,again in the northeast of Brazil but this time from a top drive-equipped rig.A total of 6,621ft (2,018m) of the 121⁄4-inch phase and 1,161ft(354m) of the 81⁄2-inch phase was drilled.The total drilling time was 43 days. During the final phase of drilling the system detected a 1bbl kick while tripping, allowing for a rapid and safe response by increasing mud weight. In addition,a micro-leakage at the wellhead was detected by the system, enabling repair before any major problem ensued.

In the forthcoming months,Petrobras will drill another two wells using the secure drilling method–one in an onshore tight-gas scenario and the other in a high-pressure, high-temperature (HPHT) well from a jack-up rig.

Intelligent Wells

A well is called intelligent only if it adds value to the project during its life-cycle.

Monitoring of production parameter elements and/or flow control devices are used to determine this.

Subsurface monitoring gained popularity in the early 1990s due to an increase in reliability and the improvement of metrological parameters.This has accelerated the development of optical technology, which has been made more robust in order to survive hostile environments such as downhole conditions. Petrobras is investing in the development of optical sensors

as well as downhole flow control for moderated service conditions.These areas have seen significant results, e.g. the Carmopolis intelligent field project (see below). At present, this is the main application of intelligent wells in Petrobras, resulting in a more efficient use of human and material resources.

The definition of 'intelligent completion', according to the White Paper on Digital Oil Fields of the Future (DOFF) by Cambridge Energy Research Associates(CERA), is completion using downhole sensors and remotely actuated flow control devices, allowing access to realtime information and supporting fast decisions.

The use of permanent downhole monitoring systems in oil and gas wells began in the late 1960s, but it was only in the early 1990s–when reliability reached acceptable levels and metrological parameters were improved–that it was widely adopted by operators.The use of quartz sensors and improvements to the robustness of electronic sensors were responsible for this evolution.In the late 1990s,optical fibre sensors began to be used,with a focus on improving reliability and ensuring the simplicity of technological updates.These sensors have played an important role in the high-flow gas wells of HPHT wells.

Among the sensors available on the market, the distributed temperature sensor (DTS) and the pressure and temperature (P&T) sensor are the most common. Sensors play a major role in intelligent wells as they provide the operator with a realtime perception of the production process.

Intelligent completion packers are used to provide hydraulic isolation of each zone, allowing selective control of the intervals; the uppermost completion packer is also responsible for anchoring the tubing and providing the first safety barrier for the annulus–the same basic functions of a regular production packer.Furthermore,there are packers for isolation purposes only;as these include only the isolating material with no anchoring material the force needed to unset them is reduced,allowing a large number of isolation intervals.The intelligent completion packers also include passages for the control and monitoring lines,known as'penetrations';typically,an intelligent completion packer presents four to nine penetrations.During setting procedures,the intelligent completion packer must not allow its components to move to avoid transmitting any tension to the control or monitoring lines.

The flow control valves are responsible for allowing selective control of production or injection.They can be actuated hydraulically or electrically,or by a combination of both(multiplexed). Hydraulic actuation is the most common type;here,a balanced piston is used to shift a sliding sleeve that restricts the passage through the valve.

Usually, one opening control line is used for each valve with a common closing control line for the system to reduce the number of hydraulic lines installed.In electrically actuated valves,an electrical motor is responsible for the shifting of the sleeve.The motors are actuated using a single electrical line for all motors that also supplies the addressing information,which is decoded in the valve.This makes this kind of valve appropriate for wells where there are restrictions on the number of penetrations on the wellhead or on the tubing hanger.

In order to benefit from the concept of MPD, in early 2006 Petrobras signed a Technical Co-operation Agreement with Impact Group in order to perform a four-well evaluation of secure drilling technology

The valves can also be classified according to the flow control they provide–on-off, multi-position and infinitely variable.On-off valves provide selectivity simply by allowing or not allowing the flow.Multi-position valves provide several steps of choking and are designed according to the flow rate expected in the well.They can use an index system to restrict the course and supply choking or an external device that provides a very controlled volume of hydraulic fluid in each shifting.Infinitely variable valves are more complex,as they require sensors to give feedback on their position in order to adjust the choking.There are also several geometries for the valve orifices–the most common are circular and elliptical slots,which are used in on-off/multiposition and infinitely variable valves respectively. The main parameters for specifying intelligent completion valves are flow range, maximum pressure and maximum differential pressure.

When using hydraulically actuated valves, an hydraulical power unit (HPU) is needed.

Basically,an HPU comprises a pump, which can be pneumatic or electrically actuated, and a manifold, which is manipulated according to a logic determined by the maker of the system.This logic can be placed in a programmable logic controller (PLC) that actuates solenoid valves on the manifold,making the entire procedure transparent to the operator,as well as providing the ability to operate the HPU remotely.To confirm shifting, intelligent completion HPUs usually have a small tank that verifies the volume of fluid returned after the pressures supplied to the valves have stabilised.

Some HPUs also measure the flow rate of the returned fluid,but this process is much more complicated and significantly increases the cost without providing many benefits.

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Oil production limits mean opportunities, conservation

In the face of looming oil production shortfalls,all individuals as well as nations as a whole will have to use less oil.And now is the time to begin developing programs accommodating the need for less oil. The coming shortage could provide excellent opportunities for those able to identify them and act strategically.

Civilization is increasingly dependent on oil,now the most important global commodity.The oil and gas industry has surpassed agriculture as the biggest industry in the world. At $70/bbl,the value of the world's crude oil business is about $2 trillion/year. But crude oil is far from uniformly distributed around the world, and only a limited number of countries are significant producers.

Oil production and consumption figures are published annually in the BP Statistical Review of World Energy, and from these figures we can determine which countries are net importers and which are net exporters.

In 2005 the export trade was 48 million b/d, and 29% of global crude oil exports went to the US, up from 27% in 2004.Japan was number two importer with 11%, up from 10% the previous year, and China was number three with 7%, up from 6% in 2004.

Importing nations must find countries that are prepared to export oil to them.

Normally the flow of oil into one country will come from several different sources.

Adding all the exports, we find that Saudi Arabia is the number one exporter with a volume of just over 9 million b/d, up slightly from 2004.Russia is number two with 6.8 million b/d,slightly up from 6.7 million b/d in 2004,and Norway is number three with 2.8 million b/d,down slightly from 3 million b/d in 2004.

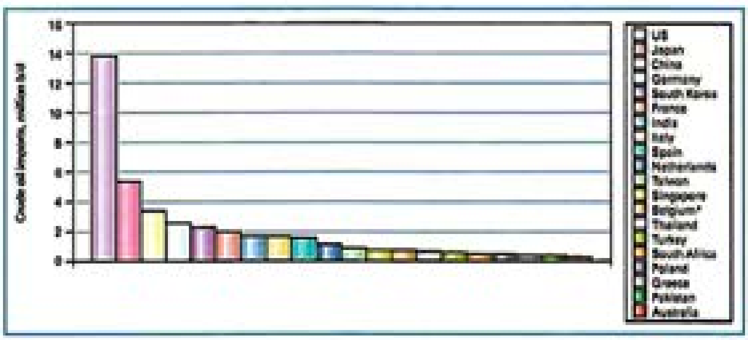
During the last 30 years, the annual increase in average gross domestic product (GDP) globally has been 3%/year compared with an average increase in oil consumption of 1.6%/year. In developing countries, the correlation between GDP and oil consumption is stronger than average. For example, China's increase in GDP on average has been 8.2% during the last 5 years, and the increase in oil consumption, 8.5%.

In its 2004 World Energy Outlook, the International Energy Agency (IEA) forecast that the increase in oil consumption would be 1.6%/year for the next 25 years, requiring oil production of 123 million b/d in 2030. A detailed analysis, however, found that this objective for the oil industry was not possible fulfill. In IEA's 2005 World Energy Outlook, the target had dropped to a 1.4%/year increase in the production of oil, and the number for 2030 was projected at 115 million b/d.

The US Energy Information Administration (EIA) forecasts a production of 117 million b/d for the same year. Compared with today's production of 85 million b/d, an increase of 30 million b/d in global production will be needed if IEA forecasts are correct.

According to EIA, US consumption will increase by 7 million b/d(33%)by 2030.At the same time, consumption in China will increase by the same amount but in percentage terms, by over 100%. In discussions of the global economy,only the increase in China's demand is mentioned as a threat. China has 21% of the global population today and is consuming 8.5% of the world's oil, up from 8% last year. In 2030 China hopes to use 12%, and there is no doubt that it can afford to pay for this increase. The US has just 5% of the global population but intends to maintain its current

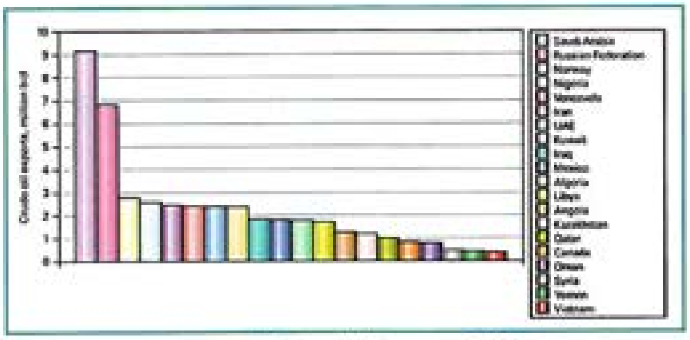
Largest golbal crude oil impoters,2005



REPORT

share of 25% of the global consumption. Compared with China, it appears that the US will have to increase its debt to pay for the crude.

If the decline in existing production and all additional demand forecasts are added, imports by 2030 will have to increase by some 30 million b/d. Would exporting countries be able to meet the demand from the net importers?



Largest global crude oil exporters,2005

Possible production

According to Saudi Aramco,Saudi Arabia has reserves enabling a sustainable production of 10.8 million b/d for more than 50 years, but it plans to boost its production to 12.5 million b/d in 2009. This production is not sustainable, because the country would have to find new oil fields and put them in production before 2030 to maintain the same level of production. When determining possible future exports,the growing Saudi population must be taken into account, as the country will require more of its oil domestically. Exports can be expected to increase by only about 2 million b/d.

Officially, Saudi Arabia claims to have found 720 billion bbl of original oil in place.

So far it has produced 15% of that, and, with a claim of 260 billion bbl as proved reserves-36% of the OOIP-the recovery factor would be 51%.

At a hearing at the Swedish Royal Academy of Sciences in spring 2005, Tor Ragnar Merling from Statoil ASA presented a detailed study of recovery factors of thousands of oil fields in sizes varying from small ones to giants. The average recovery factor was 29%.Merling thought it was possible to increase this number to 38%.

Even though Saudi Arabia produces most of its crude from only a few oil fields,there are hundreds of oil fields there.If the global average recovery factor is applied to the 720 billion bbl of OOIP, the reserves would be 110 billion bbl, and with the Merling future recovery factor, they would be 160 billion bbl. Because Saudi Arabia refuses to be transparent with its oil field data, conservative planners in the future should use these numbers.

In early June, the Russian Ministry of Economics announced that Russia would reach a maximum production of 9.85 million b/d in 2009. By accepting this number as a plateau number for 20 years, taking into account that the GDP will increase 3%/year, and applying a 50% decoupling factor (when the oil consumption is less then the growth in GDP), Russian exports are calculated to be 5 million b/d by 2030-a decline of 1 million b/d.

Norway, the number three exporter today, says that in 2030 its maximum production will be 500,000 b/d, and the minimum, 200,000 b/d.The 2005 export of 2.8 million b/d will decline by more than 2 million b/d by 2030.

Mexico is another export country that will lose a big fraction of its export capacity if new fields are not discovered and massive additional production developed. According to "scout" information from Mexico, Cantarell production will decline by 1 million b/d in coming years.

Over the next 5 years, Angola and Nigeria will increase production by 3 million b/d, but by 2030, production there will have declined back to today's levels.

To avoid any more clouds on the future stark horizon, just assume that other Middle East countries can keep their export volumes constant.

Export shortfall real

In summary, by 2030 it is very likely that there will be an export shortfall of more than 30 million b/d, and it is most irresponsible of IEA and EIA to say "Be happy, don't worry."

The implications are quite clear:Overall, everyone-both nations as a whole and individuals-will have to use less oil in the future. And now is the time to develop conservation tactics.

There are alternatives to oil, but they are most unlikely to be available in sufficient quantities to replace the current enormous demand for cheap oil. However, this will not necessarily put an end to society as some believe. Rather, the situation presents enormous business opportunities for individuals in the future.

The US and some other importing countries have already faced an artificial "Peak Oil" scenario in the 1970s when the taps were intentionally closed in the Middle East. When those who lived through that time think back,they will recall that life was still OK.It might be more difficult now, as we cannot foresee an increase in the production of crude oil, but by then electric cars will have replaced urban transportation.

We do have a future;life will just be quite different than it is today.

Venezuela
takes operational control of Orinoco oil fields

Venezuela President Hugo Chavez's government took over that country's last remaining privately run oil fields on May 1, intensifying a decisive struggle with the oil industry over one of the world's most lucrative deposits.

In 2006 Venezuela took control of 32 privately operated oil fields(OGJ Online,Jan. 9, 2006).

Oil Minister Rafael Ramirez declared that the oil fields had reverted to state control just after midnight. The companies ceding control include BP PLC, ConocoPhillips, ExxonMobil Corp., Chevron Corp., Total SA and Statoil ASA.

These foreign companies have invested more than $17 billion in those projects, now estimated to be worth $30 billion.Venezuela has indicated it may just pay the lesser amount, using oil and tax forgiveness to further reduce the cash payout.

All but Conoco Phillips have agreed in principle to state control and Venezuela has warned that it may expropriate the company's assets if it doesn't follow suit.

Chavez says state-owned Petroleos de Venezuela SA(PDVSA)is assuming at least 60% on each of the Orinoco belt operations, but has invited the companies to stay as minority partners. They have until June 26 to negotiate the terms,including compensation and reduced stakes.

If Chavez persuades the foreign companies to stay, Venezuela will be on track to develop the world's largest known oil reserves and possibly surpass Saudi Arabia as the nation with the most reserves, say energy experts.

But if the multinationals decide to leave, the Orinoco belt region could end up starved of the investment and know-how needed to transform the Orinoco's tar-like crude into marketable oil. Chavez says government firms from China, India, and elsewhere can step in, but industry experts say they doubt they are qualified to face technical challenges.

Petrobras in Venezuela

Some oil companies still need convincing that Venezuela will be a good place to do business. Others believe that Venezuela may still prove enticing because three quarters of the world's proven reserves are already controlled by state monopolies.

Brazil state-owned Petroleo Brasileiro SA (Petrobras) says it is being pressured to sign an exploration contract for the giant Carabobo extra-heavy oil field in the Orinoco belt without knowing how much it will have to pay for the deal.

A company source told OGJ that it had already allocated $1 billion to invest in this field. According to Petrobras, to implement the accord, the Brazilian company must pay a bonus whose value has not been determined after a year of negotiations.

Other sources say the Brazilian company may abandon the project with PDVSA to exploit Carabobo field. Under the accord signed last January, PDVSA will have a 60% stake in the Carabobo project, and Petrobras a 40% stake.

The letter of intent also included the establishment of a joint capital company to develop the Carabobo-1 field.

In exchange, Petrobras would have a 60% stake in a planned 200,000 b/d refinery to be built near Recife, capital of Pernambuco state, in northeastern Brazil. This refinery is slated to, in part, refine oil from Carabobo. PDVSA would have the other 40%. The refinery is slated to be built by 2011.

Carabobo field has reserves of 5 billion bbl of oil, said PDVSA Pres.Rafael Ramirez. The Venezuelan company and foreign oil firms, among them Petrobras, are currently trying to make a more precise estimate of the heavy oil reserves in Carabobo and the Orinoco basin. According to the Venezuelan government the Orinoco belt has estimated reserves of 274 billion bbl.

Last January's agreement also included the development of five oil fields in Venezuela,with 40% percent participation by Petrobras and 60% by Venezuela and the creation of a plant in Venezuela for improving extra-heavy oil from the Orinoco belt.

MacGregor forms offshore division

The MacGregor Group has formed an Offshore division to enhance its already established services to customers in the North Sea and Asia Pacific regions.

The recently acquired companies, Hydramarine in Kristiansand,Norway and Plimsoll in Singapore will be the foundation for a new division within the MacGregor Group, MacGregor Offshore. The Offshore division will comprise more than 660 employees: 160 in Norway and 500 in Asia.

In 2006, Hydramarine and Plimsoll had a combined turnover of approximately €104 million and a order backlog of €175 million.Both Hydramarine and Plimsoll will be financially consolidated into the MacGregor Group as of April 1, 2007.

The new Offshore division will enable a high level of attention and service to the North Sea and Asia Pacific customer base and will form an important platform for the continuous development of existing, as well as new products, to serve the offshore industry.

Hydramarine focuses on the development of hydraulic and electrical load handling equipment for ship and rig owners, yards and operators. Its key products are large Active Heave Compensated (AHC) cranes for the offshore industry. Hydramarine offers a complete range of high-end handling systems such as cranes, davits, winches and subsea load handling solutions. Its products are installed on various kinds of offshore supply vessels and rigs. Hydramarine concentrates on the offshore business in North Sea and the US Gulf region.

Plimsoll focuses on the development of hydraulic deck machinery equipment for ship owners,yards and operators. Plimsoll's key products are a comprehensive range of winches and cranes for offshore and marine applications.Its products are installed on various kinds of offshore support vessels, oil rig vessels, marine tugs and commercial marine vessels.The company also offers a wide range of services and its service business share of net sales is comparable to MacGregor's. Plimsoll is considered as one of the major deck equipment suppliers in the Asia Pacific region.

There are a number of strong synergies in combining Hydramarine and Plimsoll into one new business division. Business-wise, the MacGregor Offshore division will take advantage of the combined strength in the different geographical areas that Hydramarine and Plimsoll represent. There are also strong similarities between the respective product portfolios and technology within Hydramarine and Plimsoll.

MacGregor Offshore division will, together with the existing Service division, also focus on offering the services of the global MacGregor Service Network to the extensive installed base of Hydramarine and Plimsoll equipment. Through strategic acquisitions within the offshore service area, i.e.

Grampian Hydraulics and Vestnorsk Hydraulikk service AS(VNH), MacGregor has strengthened its resources as well as knowledge within this business area.

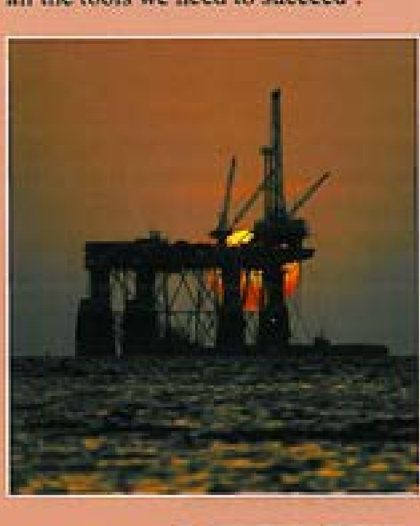
New management team

To take advantage of the strengths and competencies that each acquired company possesses, a full time division management team has been established.The Offshore division management team will be headed by Henrik Vildenfeldt, former senior vice president of corporate development in the MacGregor Group. Its first major task is the integration of the new division. The integration process will be complex as it will have to deal with different time zones, cultures and organizations,and consequently the integration team will include a wide range of abilities.

The following people have been assigned to the MacGregor Offshore division management team:

- Henrik Vildenfeldt, general manager, Offshore division
- Petri Jarvikallio, division controller, Offshore division
- Leif Bystrom,vice president,operations,Offshore division
- Ismo Matinlauri, director, after sales operations, Offshore division
- Kwan Wai Khin, manager,after sales operations,Offshore division
- Henry Yap, managing director, Plimsoll
- Chai Chon Kim, executive director, Plimsoll
- Vidar Robstad, managing director, Hydramarine
- Svein Erik Halvorsen, technical director, Hydramarine

"It is our goal to become a major global player in offshore load-handling equipment, "said Olli Isotalo, president of the MacGregor Group. "With the synergistic effect of being established in both the North Sea as well as in Asia Pacific, we are in a good position to achieve this goal."Having the experience, products and customer base within Hydramarine and Plimsoll, combined with the MacGregor Group's worldwide network, we have all the tools we need to succeed".



Deepwater floating production systems

The future of the offshore oil and gas industry is in deepwater exploration and production. It has been argued, based on energy forecasts and estimated production life of operating fields, that production cannot be sustained unless the industry moves to deeper waters. Fortunately, deeper fields tend to be larger in terms of their production rate, thus making the exercise economically feasible.

Deepwater (defined as water depth exceeding the economic limits of fixed platforms-in and around 400 metres) and ultra-deepwater (1,000 metres) production either needs floating or tethered systems, or subsea production with tie-back to a nearby facility. Facilities that support subsea production are seen mainly as real estate out at sea and, consequently, most developments have focused on the subsea components and riser systems. Floating production storage and offloading (FPSO) vessels and semi-submersibles come under this category.

Innovations in Dry Wellhead Platforms

Perhaps the most expressive innovations in deepwater floating system developments have occurred with dry wellhead platforms. From the advent of the tension leg platform in the early 1980s, design and evolution of dry wellhead concepts have come a long way. New designs are products of a complex mix of factors associated with deep water, such as environmental issues, remoteness of location, capital and operating costs. The current fourth generation of tension leg platforms provides for improved performance at lower cost.

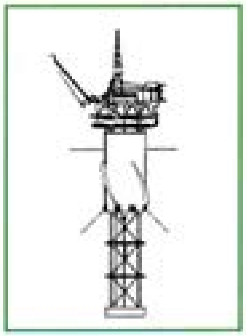


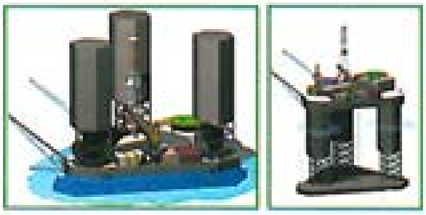
Figure 1: Schematic of a Truss Spar

Classic spars are simple cylindrical structures that support topsides. Since the feasibility of the concept was demonstrated by Deep Oil Technology, Inc. in the 1980s, it took the industry over a decade to accept and build the first prototype. In contrast, newer developments have taken a much shorter time to come to fruition. The truss spar (see Figure 1) is a marked improvement over the classic spar, in terms of minimising steel weight to support equivalent topsides. Research has shown that it is the performance of the heave plates that make the truss spar comparable in performance to the classic system.

Figure 2 :Schematic of a Cell Spar

Lately, with more competition in the market and the desire to drive costs down, the 'cell spar' (see Figure 2) has seen development. The concept proposed less than two years ago has now been selected for deployment in the 5,300-foot Red Hawk field during the later part of 2004. The cell spar is shown to reduce costs by ease of fabrication and consequently transportation. A cell spar with a tube bundle takes in less material than an equivalent-diameter single column spar.

Another evolution in the semi-submersible concept is Technip-Coflexip's extendabledraftplatform(EDP)concept (seeFigure 3). The evolution stems from the need for dockside outfitting, thus saving costs in mobilising crane vessels to outfit the topsides offshore. This must be accomplished simultaneously with obtaining deep draft minimised heave performance. The new types of platform feature retractable legs, which enable a shallow draft during outfitting by onshore cranes. The EDP is an innovative blend of the beneficial features of a jack-up, a semi-submersible and a spar.



Retracted tow-out condition

Figure 3: Schematic of an Extendable Draft Platform

In-place condition

Challenges of Good Facility Design

It is acknowledged that formidable challenges exist in the prediction of well performance and reduction of res-

ervoir uncertainty.The challenges with the production facility aspect of the system are often viewed as inferior.

This is also echoed from the viewpoint of research and development budgets for geological and downhole issues that normally far exceed the proportion spent on facilities.

Underestimating facilities leads to several risks. Since the most visible part of a production system is the facility, a failure in the facility captures attention. The catastrophic failure of the Petrobras P36 semi-submersible and consequent loss of life attracted worldwide negative publicity to both the company and the industry.With increasing awareness of environmental issues and global terrorism, safe facility design may be of paramount importance in comparison with factors that directly affect the profit margin,such as production flow rate. A good facility leads to less downtime during operations, thus indirectly enabling the production target to be achieved.

Flaring gas and oil spillage are common occurrences that need to be controlled.These are challenging issues that combine the expertise of reservoir, process and facility engineers.

Poorly designed floating facilities may suffer from an unacceptable response in cyclonic conditions, or affect safe crude handling operations such as offloading on a day-to-day basis.

There has been publicity recently about possible terrorist attacks on offshore oil and gas facilities. Methods to combat a terrorist attack go back to the basics of fire and explosion.The industry has developed standards based on lessons learnt from well- known disasters such as the Piper Alpha.Most remedial strategies have revolved around common sense by separating key accommodation quarters from possible vulnerable areas of fire,for example.

Considering that a terrorist attack would most probably occur at the sea level,hull subdivision and damage stability considerations of a floating system may need to be revisited,and better escape routes planned. These appear to be feasible within the existing operational and maintenance framework of most operators.

Extrapolation of Recommended Practice to Deep Water

Offshore regulations and recommended practice for deepwater floating facilities were derived largely from accepted criteria for design and operation of ocean-going vessels and those for shallow water fixed facilities.While this is logical,the limitations of extrapolation are often underestimated.For example,bilge keels do not work with FPSO vessels,but they are effective in containing the roll motion of small crafts.It is important to note the difference in forward speed of the two cases and the consequent effect on performance.Wider bilge keels have been suggested as a way of improving performance.Researchers may need to deviate from established practice,adopt a global perspective and get to the roots of the problem in order to find confidence in their answers.

Interesting problems have also arisen with spars. The motion of water in the moon pool results in an extra load on the risers, causing them to vibrate within the guides, thus causing fatigue cracks.

Vortex-induced vibration(VIV)of risers was developed from an understanding of similar vibrations in aerodynamics and industrial applications.

Helical strakes, commonly seen on chimneys, were adapted to risers and found to work, albeit at a considerable cost.However,strakes on spars do not appear to eliminate VIV entirely. The vibrations and consequent movement of the spar have resulted in several operational problems, not to mention personnel fatigue and riser tension.

This situation has led to a rethink of the fundamentals of VIV on spars.

Research on this subject is ongoing.

Chronic hydrocarbon pollution

The pollution of the sea from hydrocarbons (crude oil, fuel, petrol, oily waste, etc.) is a global problem that entails between two and ten million tonnes of these products reaching the sea each year. Although the bulk of public attention is focused on the oil slicks caused by major oil tanker accidents,chronic dumping of these substances –in other words, the residue from ordinary maritime traffic–is three times higher.

Washing out the tanks of oil tankers, dumping bilge water and minor spillages on board or in port are the main sources of hydrocarbon pollution of marine origin.

Illegal dumping

Every year in European waters around 3,000 illegal dumping incidents are detected, but these are just the tip of the iceberg.It is believed that the true number could be up to 30 times higher,but the majority take place unnoticed and are never penalised.

Every year,maritime traffic in Europe generates more than 20 million tonnes of oil residue,oily waters and other pollutants.Despite the fact that there are international laws prohibiting or regulating dumping at sea,and there is a requirement for having treatment systems available in ports,the truth is that only a small percentage of this waste is treated properly and the rest is dumped directly into the oceans.

A large oil tanker can generate some 800 tonnes of crude residue per cargo. And Europe needs almost 6,000 freighters a year to supply its demand for oil,as 90% of its crude oil imports take place by sea.But other merchant ships,fishing vessels and recreational boats also generate waste from used oils,fuel residue,etc.

Extremely harmful compounds

These routing dumping incidents are chronically polluting the sea with a toxic burden.

The levels of hydrocarbons found in sea water, in sediments on the sea beds and in living organisms (ranging from seaweed through to whales, via molluscs,crustaceans and fish) are of great concern, particularly in the case of polycyclic aromatic hydrocarbons (PAHs), a group of compounds present in almost all hydrocarbons which are extremely toxic to living beings,some of which can be carcinogenic,teratogenic and mutagenic.

Almost all the European Union seas are regarded as "special areas"by the United Nations International Convention for the Prevention of Marine Pollution(MARPOL).

Only the area between Finisterre in Brittany and the Strait of Gibraltar falls outside this category.But this has not prevented European waters from being affected every year by illegal dumping.A particularly worrying case is the Mediterranean,which is regarded as the sea that receives the highest levels of hydrocarbon pollution in the world,where more than 50% of the illegal dumping incidents that takes place each year are detected.

The Strait of Gibraltar is crossed by more than 18,000 vessels carrying hazardous cargos each year and lies on one of the main shipping routes for crude oil and its derivatives,from the Persian Gulf across the Mediterranean towards Europe and North America,amongst other destinations.

Effects on marine life

All marine species are affected by hydrocarbon pollution to a greater or lesser degree.Some of them, such as seabirds, sea turtles and cetaceans, appear on the coasts impregnated in oil,tar balls or other residue.

Around 50% of the seabirds that are found dead on European coasts have suffered from hydrocarbon contamination.And in 90% of these cases,when the compounds were analysed it was corroborated that they consisted of heavy fuel mixed with lubricants:the typical waste from ships'bilges.On the other side of the Atlantic,in Canada,it is estimated that every year one oiled seabird is found for each 1.3 kilometres of coastline;a fairly similar figure to Europe.

In the case of sea turtles, some very worrying conclusions have been drawn. Between 20% and 50% of the sea turtles found dead were in some way related to contamination from oil and its derivatives.And in the case of cetaceans, it is not unusual to find animals stained in oil or even with tar balls trapped in their respiratory tracts.

A Very 'Offensive' Fleet

Given its illegal nature,the true scope of dumping from vessels is unknown,as is the total number of infractions committed by the world merchant fleet.

Bearing in mind that in the case of the EU fleet, regarded as amongst the 'cleanest'in the world, it has been proven that 40% of its vessels have either violated or shown deficiencies in complying with the MARPOL convention over the last few years,we can get an idea of the high level of infractions.These figures give us a picture of what the situation could well be in other, less regulated, fleets, which habitually occupy the top places in the"ranking"of offenders.

RFID technology for downhole well applications Karen raley

During the drilling and completion of oil and gas wells, it is necessary to actuate a very wide variety of downhole tools and equipment. Methodology has generally been direct hydraulic pressure (sometimes with ball drops), hydraulic pulses, pipe rotation and/or reciprocation, wireline intervention and very limited attempts to use more advanced systems,such as acoustic telemetry. Marathon Oil Company recognised the significant benefits of adapting key elements of radio frequency identification(RFID) and has been championing its use for downhole applications. RFID has become commonplace in many areas, such as package and asset tracking, identifying cars on toll roads and even keeping track of pets and livestock. In the oil and gas sector, field tests have proven successful and more widespread use is becoming a reality as two service companies, very much focused on this technology, assist Marathon in RFID development. Use of RFID in surface oilfield applications is not new. Companies in the past utilised RFID tags with mixed results for asset tracking as well as work history on drill pipe.

These surface applications of RFID appear to be gaining momentum,with efforts to now track premium tubular inventory, packers, completion hardware and other expensive equipment. Better methods to permanently attach the tags are partially responsible for growth in the industry. What is new,and the subject of this article, is using the technology for the downhole well operations environment.

To actuate wellbore equipment,the downhole tool is configured with a reader,and it actuates when the correct chip or unique identification code is noted. The RFID tags can be pumped past the reader, flowed past the reader or otherwise conveyed past the reader when attached to other tool strings. The RFID tag can be programmed to not only'tell'the downhole tool to fully actuate, but in many instances it may be desirable for downhole tools to only partially actuate. Usually, the operator may desire to partially actuate downhole tools during the drilling phase, while most completion operations usually desire the tools to fully actuate. Some specific applications for completion operations are described below.

Zonal Isolation Tools

Zonal isolation valves generally are used to prevent fluid loss to a gravel packed zone,as a barrier to set packers, and to prevent flow from the well when changing fluid systems over to lighter weight completion brines.These zonal isolation valves are typically cycled

RFID has become commonplace in many areas,such as package and asset tracking,identifying cars on toll roads and even keeping track of pets and livestock

closed when the work string is pulled from below the tool, and a shifting tool actuates the device.Later in the well completion, a series of hydraulic pressure cycles re-opens the valve. RFID allows new approaches to be employed.

The appropriate RFID tag is passed by the valve to either open or close it.This adds tremendous flexibility to the operations and reduces the fear of the valve accidentally being opened with pressure cycles.It is also possible to place the reader at a remote distance from the valve itself, increasing the level of confidence with which the tools can be actuated, even if debris exists on top of the barrier.

Wellbore Clean-up Tools

The key to many well completions is actually having a clean fluid system and all of the drilling mud and other solids removed from the well. One of the first tools developed by the North Sea service companies working with Marathon (Petrowell and Illtec) was a downhole circulating sub, utilised for well clean-up. A downhole circulating sub is run as part of the drill string and activated by passing small pre-programmed RFID tags through the RFID circulation sub. The signal received by the reader in the circulation tool opens or closes the sub depending on the coding of the RFID tag. The RFID tags can be easily programmed on location. From a completion standpoint,being able to not only circulate the liner clean but to also have higher circulation rates above the liner top increases the chances of successfully getting the hole clean.As other operators have become aware of these tools and their capabilities, the desire to perform other operations which could not otherwise be considered are being discussed.The circulating tools can be designed to partially actuate, thereby allowing what would broadly be described as variable flow rates.As one example, the feature of the downhole wellbore clean-up tool or circulating sub may take 100 'strokes' to fully actuate. RFID tags can be pumped past the tool, which contain electronic commands telling the tool to only actuate 50'strokes'. In this manner, flow rate to one or more downhole devices can be adjusted as many times as desired.

Not only can tools be opened, closed or retracted, but it will allow finite control of desired assembly changes.

Marathon is currently contemplating using this tool for a completely different reason. When drilling long horizontal wells onshore US in underbalanced conditions, it is desired to spot heavy weight kill fluid prior to tripping. This well clean-up tool can be used to spot fluids, and then be re-closed. This approach has a lot of merit versus having to first trip out of the horizontal portion of the well to then spot kill weight fluids.

During the August 2005 drilling and completion of CNR's N46z well (approximately 15,000ft)on the Ninian North platform in the UK sector of the North Sea, an RFID circulating sub was run during the clean-up operation prior to running the completion string. This was the first application of such technology in the oil and gas industry and the operation was performed flawlessly.

The RFID tag used in CNR's application looks like a small glass pill about 3mm in diameter and 3cm in length.

Packer Setting

During completion operations, a task as simple as setting a packer can contain its own share of problems and risk. Current technology generally uses hydraulic set packers in many instances.This requires some type of downhole barrier so differential or absolute hydraulic pressure can be applied to actuate the packer setting devices.There have been many instances over the years,all quite expensive, where the barrier device that is used to set the packer is difficult or impossible to retrieve due to debris or

mechanical issues.In this case, RFID actuation allows an economic alternative. The dropped RFID tag is read by the packer setting tool, and well hydrostatic pressure actuates the packer after a port is exposed. This approach is not only more economical, but in many cases, it eliminates the risk of having to run and subsequently retrieve the barrier.

Zonal Isolation and Water Gas Injection

The RFID technology allows a much simpler alternative than smart well technology to regulate flow from or to downhole intervals. Operators are now considering the option of being able to pump down the small RFID tags to actuate downhole readers, which in turn will turn on, turn off or regulate the amount of water or gas being injected into individual reservoir intervals.There is considerable interest in being able to perform such well work without having to install external lines and only having to pump down the small glass tags or chips, which are coded with the appropriate information to actuate the specific completion tool.

Cementing Operations

RFID systems can easily be adapted to open and close cementing stage collars and eliminate the need to subsequently drill out the stage collar, as no plug blocking the interior of the casing need exist. In many aspects,the RFID portion of these tools is similar to the wellbore cleanup tools already developed,which greatly reduces the engineering design time requirements to meet the needs the operators are bringing forward as they become aware of the RFID technology.

Perforating Operations

Four years ago,Marathon fired a downhole external perforating gun using RFID technology in its Excape® Completion Process on an 8,000-foot deviated gas well near Kenai,Alaska. This is believed to be the first overall commercial use of the technology in the oil industry.This RFID application was not progressed to any great extent at the time,due to the conventional hydraulic control line firing methodology working well and being economically more viable. As other RFID applications and development companies make additional resources and technical input available, this perforating application is again being re-visited. It appears that RFID may be a preferred firing system in wells where the use of control lines is not an option the operator wants to consider.

Future RFID Actuated Applications

A great number of opportunities exist and are being progressed to utilise RFID in the wells with downhole readers and the RFID chips subsequently run or pumped past the tool: RFID chips small enough to survive being pumped through a drilling motor are feasible.This will allow tools below the motor to be fully or partially actuated.Both drilling angle and direction can be changed. A key area of interest is in air-and-foam drilling applications, where conventional fluid pulse or pressure activated systems are ineffective. RFID systems will still operate effectively in this environment.

Drilling disconnects, expandable and contracting stabilisers, expanding and contracting under-reamers and similar tools where either full or partial actuation would be desirable are already under development.

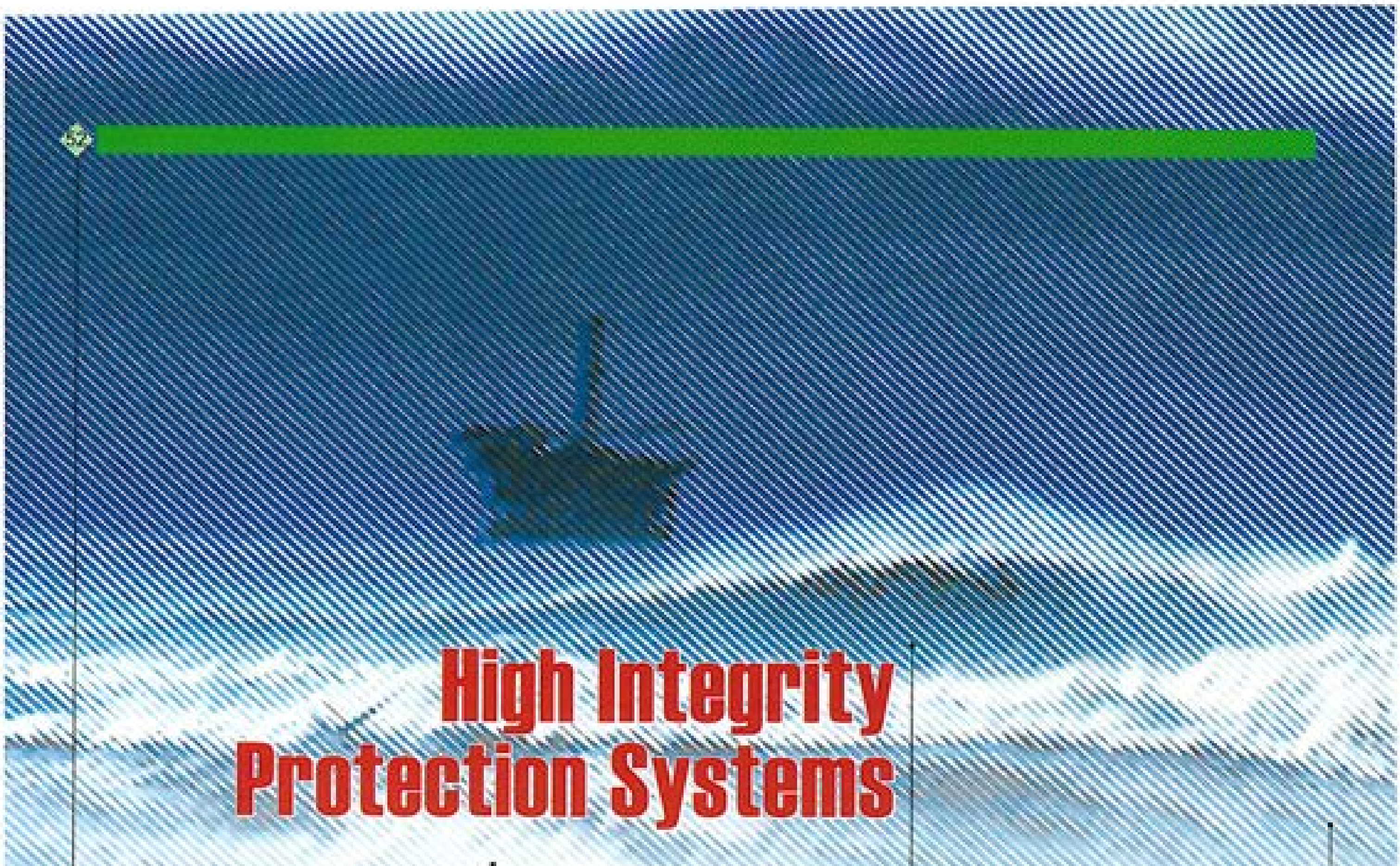
There are many more applications such as coiled tubing tools, indexing fishing tools, changing fishing grapple sizes, retracting casing scrapers near nipple profiles, actuating hydrostatic bailers and a host of other ideas.

Although Marathon holds a significant, worldwide RFID intellectual property portfolio and has licensed aspects of patents and know-how included in this portfolio to others, the company's primary driver is ensuring that this technology is available to industry.

The company chose to become involved because of the potential for this technology to improve well operations by reducing costs and rig time for not only themselves but for other oil and gas operators as a whole. Their Technology Services organisation estimated that a major oil and gas operator could realise at least US$17,000,000 annual savings,as well as improved operational safety benefits, with even limited acceptance and use. Many of the RFID tools can displace existing infrastructure and Marathon did not want to see the technology shelved or to otherwise be slow coming to market.

Marathon joined with prior investors in a company called In Depth Systems Inc. to progress RFID for the downhole well environment.This stirred interest and additional research and development.Two North Sea service companies are now licensed to apply additional engineering expertise for the applications described in this article.

Petrowell, primarily a well completions company, is developing RFID uses in the completion arena. IIITec is a new company with significant funding, and its sole business is developing RFID applications for drilling and coiled tubing operations.



High Integrity Protection Systems

In the oil industry, traditional protection systems as defined in American Petroleum Institute (API)14C are more and more often replaced by high integrity protection systems (HIPS).

In particular, this encompasses the well-known high integrity pressure protection systems (HIPPS) used to protect specifically against overpressure.As safety instrumented systems (SIS)t hey have to be analysed through the formal processes described in the International Electrotechnical Commission (IEC) 61508 and IEC 61511 Standards in order to assess which Safety Integrity Levels (SIL) they are able to claim.

What is really important when dealing with safety systems is that the probability of accident is sufficiently low to be acceptable according to the magnitude of the consequences.This can be done in a lot of different ways: applying rules,know-how or standards that may be deterministic, probabilistic ,qualitative or quantitative, using reliability analysis and reliability methods and tools, collecting statistics, etc.

Among them we find SIL calculations as per IEC 61508 and IEC 61511. Then we have to keep in mind that calculating a SIL is not an end in itself. It is only a tool among many others to help engineers to master safety through the whole life cycle of the safety systems.

This proves to be very efficient from organisational point of view but, unfortunately, some problems arise when probabilistic calculations are performed by analysts thinking that it is a very easy job only consisting to apply some magical formulae (found in IEC 61508-Part 6) or to build a kind of 'Lego'from certified SILed elements bought from the shelf. Beyond the fact that sound mathematical heorems (Bellman or Gödel) demonstrate that doing it that way gives no guarantee of good results, this is the complete negation of the spirit developed in the reliability field over the last 50 years that is based on a sound knowledge of the probabilistic concepts and in-depth analysis of systems under study.

Therefore,a skilled reliability analyst who aims to use the above standards in a clever and compatible way with the traditional analysis has to solve several difficulties:this is simple for the relationship between IEC standards probability concepts and those recognised in the reliability field or for the failure taxonomy and definitions which may need improvements;it is more difficult for handling complex tests and maintenance procedures encountered in oil industry;it is almost impossible for some concepts like the'Safe Failure Fraction'(SFF),which is not really relevant in our field where spurious failures have to be thoroughly considered and avoided.

SIL versus Traditional Concepts

The size of this article being limited, we will only give some indications about our way to manage SIL calculations in an efficient way for oil production installations.

This is actually an average frequency of failure.When the number of failures over [0, T]is small compared with 1, PFH may be assimilated to F1(T)/T. When this is not the case,T/

MTTF shall be used instead. In these formulae F1(T) is the unreliability of this layer over[0,T]and MTTF its classical Mean Time To Fail.

Then,in the general cases, PFH cannot be assimilated to a failure rate. Anyway this gives the demand frequency on the second layer, which runs in low demand mode (if the first layer is efficient). Its Probability of Failure on Demand (PFD) as per the standards is in fact its the average unavailability P2. Then F1(T). P2 is the probability that both protection layers fail during a given period T. If there is no more protection layer this is the probability of accident. If a third protection layer is installed this will be is the demand frequency on this layer. Note that the Risk Reduction Factor (RRF) is infinite when working in continuous mode.

The standard split, the demand mode between low and high according to the demand frequency (lower or greater than 1/year) .From probabilistic calculation point of view we prefer to consider the relationship between test and demand frequencies to

do that: when the test frequency is big compared with the demand frequency, PFD may be used, on the contrary it is better to use the unreliability, which provides a conservative estimation.

From a failure mode point of view the main problem encountered is that the genuine on demand failures are forgotten by the standards.They are likely to occur when the system experiences sudden changes of states.

Therefore, they shall be taken under consideration when calculating the PFD, which comprises both hidden failure (occurring within test intervals) and genuine on-demand failures (due to tests or demands themselves).

Another commonly encountered problem is that a superficial reading of the standard leads one to think that every revealed failure becomes automatically safe.

This, of course,is not true. It remains unsafe as long as something is done to make it safe. This also has to be considered in the calculations.

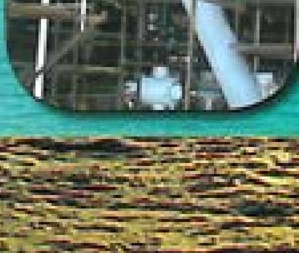
9 & 10 phases, South Pars

Pars Oil & Gas COMPANY is developing the South Pars Gas Field Phases 9 & 10 Project for National Iranian Oil Company (NIOC) in Iran. This Project includes Offshore Facilities (Wells, Platform and Sub sea Pipelines) and Onshore Facilities for the processing of the Reservoir Fluid.

South Pars Gas Field located in the Persian Gulf 100 km off Iranian South coast will be developed to produce 2,000 MMscfd Reservoir Fluid from two development Phases, 1,000 MMscfd each, and to transport the fluids to the mainland for further treatment. These two Contracts referred to as Phases 9 & 10 will be integrated into the overall development plan of South Pars Gas Field which is the largest in the world and Iranian Portion of it is estimated to have 500 TCF (Trillion Cubic Feet) Gas Reserve.

EPC Contract which includes Engineering, Procurement & Supply, Construction, Commissioning, Start-up and Performance Test, has been made on the 15th day of September, 2002 by and between National Iranian Oil Company (NIOC) and Consortium consisting of GS Engineering & Construction Corp., Oil Industries Engineering & Construction (OIEC) and Iranian Offshore Engineering & Construction (IOEC). Company

GS is the Consortium Leader and GS and OIEC are jointly responsible for the Onshore Portion of the Project. IOEC is solely responsible for the Offshore Portion of the Project consisting of Offshore Platforms and Undersea Pipeline.



Part - I: Offshore Platforms

One Unmanned Wellhead Platform for each phase of the Project, equipped with their minimum production facilities. Two (2) Relief Platforms, two (2) Intermediate Support Platforms and four (4) Bridges for both Phases.

Part - II: Sub sea Pipelines

Two (2) 32" Pipelines (each with 4" Piggy-back Line) of 1,000 MMscfd capacity each will be laid to transport the raw Offshore production from each Wellhead Platform to the Onshore Gas Treatment Plant in Assaluyeh.

Part - III: Onshore Facilities

The Facilities shall be developed on the basis of supplying treated Lean gas to the domestic Gas Network and Ethane Gas to the nearby Petrochemical Complex at the required specifications while maximizing liquid recovery as C3 & C4 LPG and stabilized Hydrocarbon Condensate for export.

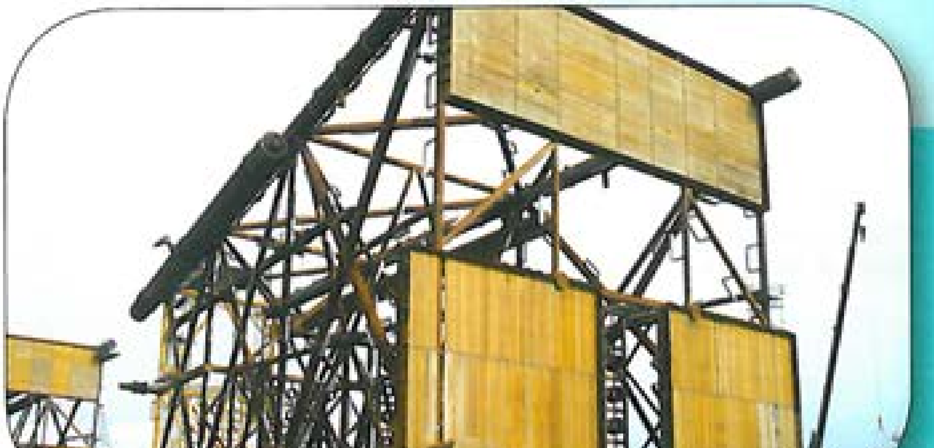
The Lean Gas produced will be discharged to IGAT-4 with a minimum arrival pressure of 73 bars.

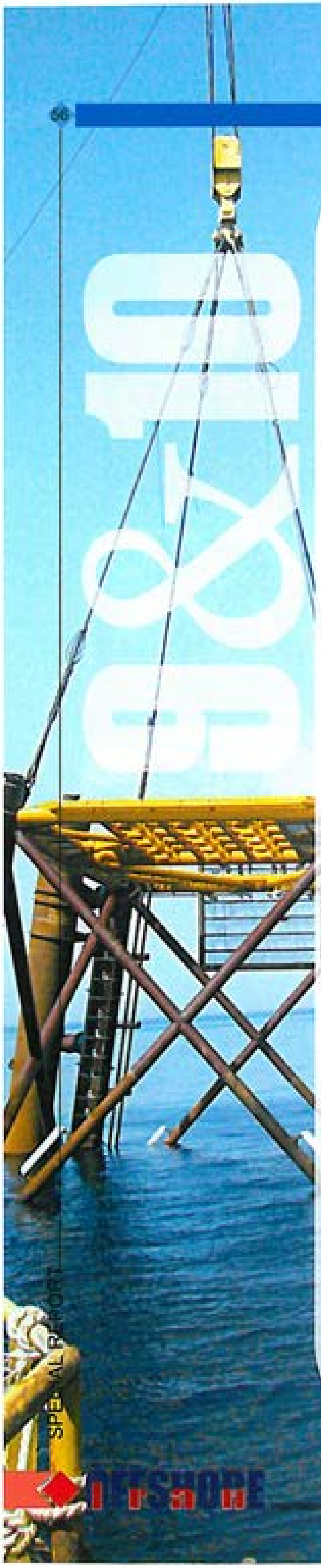
The produced Condensate will be stored in Storage Facilities and periodically pumped to tie-in point located upstream of the Condensate Metering Facilities within Phase - 1 Development and transferred to the SBM through the existing Condensate Export Pipeline.

The Treated C3 & C4 LPG will be stored separately in the Refrigerated Atmospheric Double Wall Storage Tanks and periodically pumped to the LPG Loading Manifold of Phases - 6, 7 & 8.

1.1 GAS TREATMENT CAPACITY

- Overall Plant: 2,000 MMscfd of Wellhead Fluid (Dry Basis)
- Per Phase: 1,000 MMscfd of Wellhead Fluid (Dry Basis)
- Per Gas Train :500 MMscfd of Wellhead Fluid (Dry Basis)





1.2 PRODUCTION CAPACITY

Product	Capacity	Remarks
Sales Gas	1,505 Ton/Hr	
Stabilized Condensate	518 M^3/Hr	
Gaseous Ethane	107 Ton/Hr	
Liquefied Propane	82 Ton/Hr	
Liquefied Butane	52 Ton/Hr	
Sulphur	664 Ton/Day	Plant Capacity

PART I

ENGINEERING

Basic & Details

- Complete of SPD10 & SPD11 (Jackets & Decks) Basic & Detail Engineering.

PROCUREMENT

- Complete of SPD10 & SPD11 (Jackets & Decks) procurement.

FABRICATION

Structure

- Complete of SPD10 & SPD11 Jackets Fabrication.
- Complete of SPD10 & SPD11 Decks Structural Fabrication.
- Complete of FSP10 & FSP11 Tripods Fabrication.
- Complete of BSP10 & BSP11 Decks Fabrication.
- Complete of Bridges & Flares Fabrication.
- Complete of Pile Fabrication.

Equipment

- SPD10 Deck : Fixing & Alignment Equipment
- SPD11 Deck: Alignment of Equipment

Piping

- SPD10 Deck: Continue of NDT & Installation Pipe Spools & Hydro Test
- SPD11 Deck: Continue of NDT & Installation Pipe Spools & Hydro Test

Electrical & Instrument

- SPD10 Deck: Painting & Instrument Supports & Equipments & Installation Tray & Cable Pulling & Glading & Megger Test
- SPD11 Deck: Painting & Instrument Supports & Equipments & Installation Tray & Cable Pulling & Glading & Megger Test

Installation

- Complete of SPD10 & SPD11 Jackets Installation.
- Complete of FSP10 Tripod Installation.
- Complete of BSP10 Deck Installation
- Complete of BSP11 Load out & Transportation
- Complete of Bridge & Flare /10B & Load out & Transportation
- Loading of reaming Ancillaries are in going .

PART II

Engineering

- Complete of Basic & Detailed Engineering Doc.& DWG

Procurement

- Complete of 32" & 4" Pipe & appurtenances procurement.

Pipe Coating

- Complete of 32" Pipe Coating

Site Work

- Complete of beach Pulling phase 9 by AB 1200
- Complete of Shore Pulling phase 10 by AB 1200
- Continue of on shore pipe laying phase 9 & 10 is on going
- Continue of on shore pipe laying phase 6 , 7 & 8 is on going

MAIN SUB-CONTRACTS

- OFFSHORE PART (PART - I & II)

Company Name	Scope of Work	Start Date	Finish Date
Dsir B.V.	Pre-Engineering Survey	01-May-03	01-Jul-03
Intec Engineering B.V.	Basic & Detail Engineering for Sub-sea Pipeline	01-May-03	01-Feb-04
Technip Middle East (Abu Dhabi)	Basic & Detail Engineering	01-Jul-03	01-Aug-05
Bureau Veritas	TPA Services	01-Jan-04	01-Apr-06
Salzgitter International GMBH	EoR Services	01-Jan-04	01-Jun-07
Germaniseher Lloyd	TPA Services for Jacket Fabrication	01-Aug-04	01-May-05

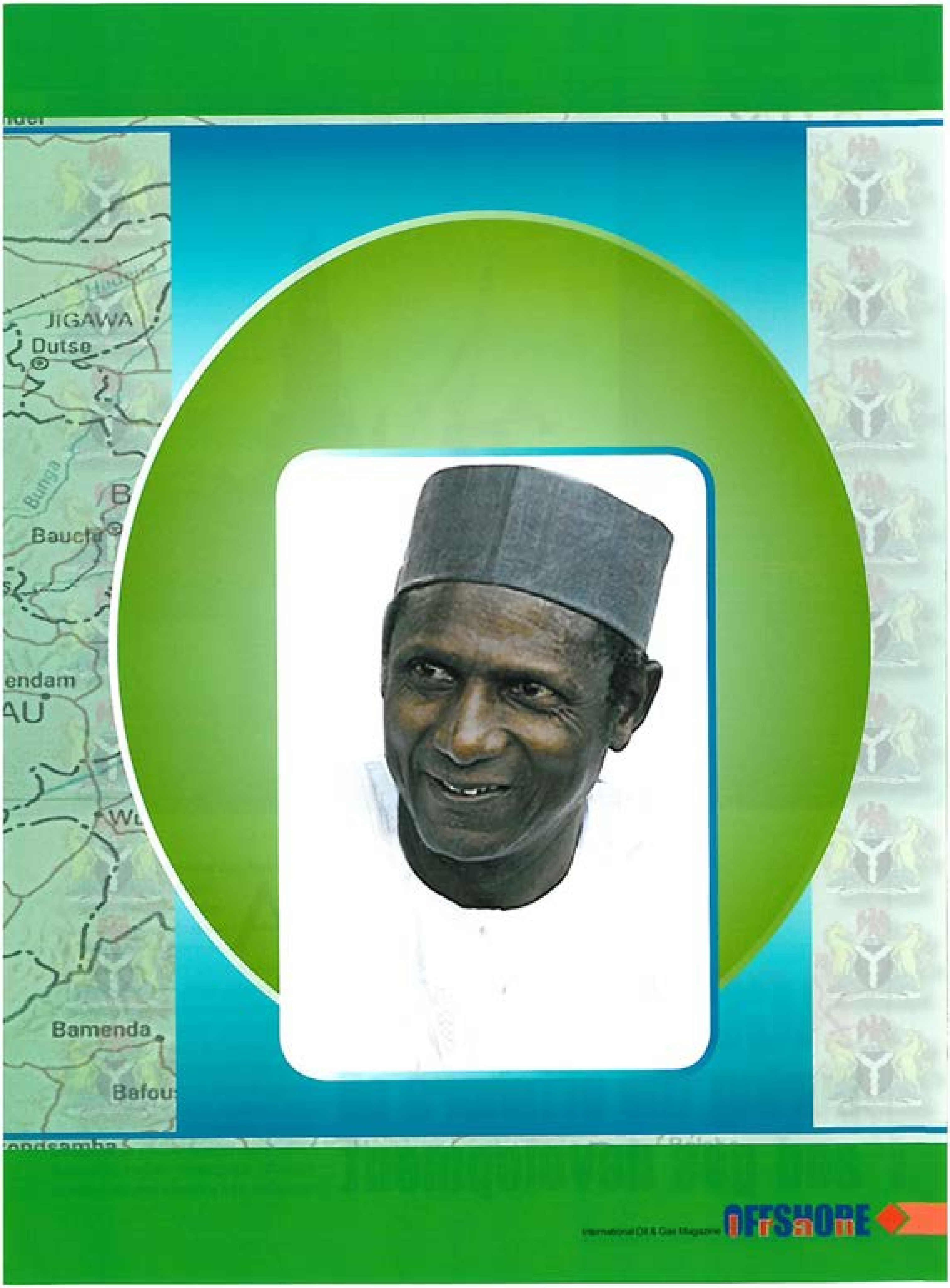
IOEC

Sir. Umaru Yar Adua
Honorable president of Nigeria

I would like to express my congratulations on your decisive victory in the Nigerian general election. Considering the importance of the strategic partnership and long standing relations between Iranian and Nigerian business, IOEC finds itself in the service of our common economical goals, wishing to assist in the achievement of prosperity for both countries.

Wishing you success and goodness

Masoud Soltanpour
Managing Director


JIGAWA
Dutse
Bunga
Bauchi
Bamenda
International Oil & Gas Magazine
OFFSHORE

Accidents during the offshore oil and gas development

Below you will find a short overview of drilling, transportation and storage accidents during the offshore oil and gas activities

Stanislav Patin
translation by Elena Cascio

Oil and gas accidents

Accidents inevitably accompany offshore development. They are the sources of environmental pollution at all stages of oil and gas production.

The causes, scale, and severity of the accidents'consequences are extremely variable.They depend on a concrete combination of many natural, technical and technological factors. To a certain extent, each accidental situation develops in accordance with its unique scenario.

The most typical causes of accidents include equipment failure,personnel mistakes and extreme natural impacts

(seismic activity,ice fields, hurricanes and so on).

Their main hazard is connected with the spills and blowouts of oil,gas and numerous other chemical substances and compounds.

The environmental consequences of accidental episodes are especially severe, sometimes dramatic, when they happen near the shore, in shallow waters, or in areas with slow water circulation.

Drilling accidents

Drilling accidents are usually associated with unexpected blowouts of liquid and gaseous hydrocarbons from the well as a result of encountering zones with abnormally high pressure.

No other situations but tanker oil spills can compete with drilling accidents in frequency and severity.

Broadly speaking,two major categories of drilling accidents should be distinguished. One of them covers catastrophic situations involving intense and prolonged hydrocarbon gushing. These occur when the pressure in the drilling zone is so high that usual technological methods of well muffling do not help. Lean holes have to be drilled to stop the blowout. The abnormally high pressure is most often encountered during exploratory drilling in new fields. The probability of such extreme situations is relatively low. Some oil experts estimate it at 1 incident for 10,000 wells [Sakhalin-1, 1994]. The need to drill lean holes emerges, on average, in 3% of accidental episodes.

The other group of accidental situations includes regular,routine episodes of hydrocarbon spills and blowouts during drilling operations. These accidents can be controlled rather effectively(in several hours or days)by shutting in the well with the help of the blowout preventers and by changing the density of the drilling fluid. Accidents of this kind are not so impressive as rare catastrophic blowouts. Usually, they do not attract any special attention. At the same time, their ecological hazard and associated environmental risk can be rather considerable, primarily due to their regularity leading, ultimately, to chronic impacts on the marine environment.

Transportation and storage accidents

Tanker transportation. Oil extracted on the continental shelf accounts for a considerable part (probably at least 50%)of annual volumes of oil transported by tankers (the latter constitute over 1 billion tons). On some fields, the shuttle tankers are the main way of delivering hydrocarbons to the onshore terminals.

The main causes of tanker accidents that lead to large oil spills include running aground and into shore reefs, collisions with other vessels, and fires and explosions of the cargo. According to official data [IMO,1990], the amount of oil spilled during tanker accidents in 1989 and in 1990 were 114,000 and 45,000 tons, respectively.At the same time,the total volume of oil pollution caused by marine oil transportation was 500,000 tons a year.

Significantly,both large drilling accidents and large tanker catastrophes occur relatively rarely.The frequencies of such incidents as well as the oil volumes released in large spills differ from year to year.

The history of tanker accidents has been thoroughly described by both the scientific literature and the media. Analyzing the statistics and circumstances of such events indicates that they can hardly be avoided.Although the rate of tanker accidents has been declining over the past two decades,we should be prepared to deal with them in the future.

While speaking about the history of tanker transportation,we want to mention a sequence of large supertanker accidents starting with the catastrophic grounding of the tanker Torrey Canyon in the English Channel in 1967.

The spill of 95,000 tons of oil caused heavy pollution of the French and British shores with serious ecological and fisheries consequences.

This accident was followed by a number of other tanker accidents, including Amoco Cadiz (1978, 220, 000 tons of oil spilled), Exxon Valdez (1989,40,000 tons of oil spilled), and Braer (1993, 85, 000 tons of oil spilled).

Each of these episodes developed in accordance with its unique scenario.

In all the situations, though,the levels of oil pollution reached lethal limits for marine fauna, mainly for birds and mammals.The consequences included much more damage than just ecological disturbances in the sea and on the shore.

In some cases, the tanker accidents occurred right in the zone of the oil field development. One of them happened in

1978 in the Shetland Basin. The tanker Esso Bernica was holed during the mooring and 1,100 tons of heavy oil fuel spilled into the coastal zone causing serious damage to nature and the local population.

One of the most dramatic situations developed in 1989 in the shallow waters of Prince William Sound near the Alaskan southern shore.The oil tanker Exxon Valdez ran aground and spilled over 40,000 tons of crude oil.

As the oil spread along the coastline,it covered sea animals, birds plants.It turned hundreds of miles of this area (unique for its cleanness and biological resources) into an area of ecological disaster.

This relatively recent episode in the history of the offshore oil and gas industry causes an alarming association in the mind of a Russian reader.The Exxon Valdez catastrophe happened approximately at the same latitudes where the grand projects of the oil and gas developments on the Russian Arctic shelf have already been started (the shelves of the Barents and Kara Seas in vicinity of the White Sea).The association gets even stronger if we take into account that considerable amounts of hydrocarbons extracted here are going to be transported by the tanker fleet.This will include tanker shuttles(including the ice types), large tankers with dead weight up to 120,000 tons,and supertankers.Each of these vessels is going to make hundreds of trips a year.This regular transportation activity is going to take place with the rest of the traffic in the area of the oil field developments and in addition to the general intense shipping and fishing in this Arctic basin.All of these factors considerably increase the probability of accidental situations occurring in the region.We must remember the high productivity and high vulnerability of the Arctic marine ecosystems.This region contains unique natural resources that are comparable to the rich resources of the Alaskan shelf.

This primary background information and general statistics about large tanker accidents (about 2% a year) allow us to conclude,without any calculations and modeling, that the risk of transportation accidents occurring on the Arctic shelves is going to be high. The consequences of these accidents can be catastrophic. Moreover, the environmental damage of possible accidents can exceed everything that has happened before in such cases, including the accidents on the Alaskan shelf.

Very dangerous situations can emerge in case of a gas tanker accident.Gas carriers are going to be used together with oil tankers in the Barents Sea as well as on the eastern shelf of Sakhalin to transport liquefied natural gas. Gas tanker accidents, although less probable than the accidents with oil tankers, can cause so-called flameless explosions.

It happens due to the rapid evaporation of the liquefied gas on the sea surface and formation of pieces of ice and gas clouds followed by combustion and explosions.

Such explosions can destroy everything alive in areas of up to 400 km2.

At last, the tragic apotheosis of possible outcomes is an accident involving a tanker that is transporting methanol-a rather toxic substance that is completely soluble in water. In case of an accident of such a vessel with a freight-carrying capacity of 35,000 tons,for example in the coastal zone of the Western Murman, the area of lethal impact to marine organisms will be from dozens and hundreds to thousands of square kilometers.In fact,it could cover the whole fisheries regions[Borisov et al.,1994].

Storage. Underwater reservoirs for storing liquid hydrocarbons (oil, oil-water mixtures, and gas condensate)are a necessary element of many oil and gas developments. They are often used when tankers instead of pipelines are the main means of hydrocarbon transportation. Underwater storage tanks with capacities of up to 50,000 m3 either are built near the platform foundations or are anchored in the semisubmerged position in the area of developments and near the onshore terminals.

Sometimes, the anchored tankers

are used for this purpose as well. Of course, a risk exists of damaging the underwater storage tanks and releasing their content, especially during tanker loading operations and under severe weather conditions.However,no summarizing quantitative assessments and statistics of such events are available. After the spill of 1,200 tons of crude oil in 1988 from an underwater storage tank during a storm in the North Sea,some countries introduced restrictions on installing such structures near the shore[Cairns,1992].The most dangerous are the accidents involving underwater storage tanks that contain toxic agents, for example methanol. Such accidents are possible in the area of Shtokmanovskoe field developments in the Barents Sea where over 3,000 tons of methanol products are planned to be stored underwater.

Pipelines. Complex and extensive systems of underwater pipelines have a total length of thousands of kilometers.

They carry oil, gas, condensate and their mixtures. These pipelines are among the main factors of environmental risk during offshore oil developments, along with tanker transportation and drilling operations.The causes of pipeline damage can differ greatly.

They range from material defects and pipe corrosion to ground erosion, tectonic movements on the bottom, and encountering ship anchors and bottom trawls. Statistical data show that the average probability of accidents occurring on the underwater main pipelines of North America and Western Europe are,respectively, 9.3x10-4 and 6.4x10-4.The main causes of these accidents are material and welding defects [Sakhalin-1,1994].

Depending on the cause and nature of the damage (cracks, ruptures and others), a pipeline can become either a source of small and long-term leakage or an abrupt (even explosive) blowout of hydrocarbons near the bottom.The dissolution, dilution, and transferring of the liquid and gaseous products in the marine environment can be accompanied in some cases by ice and gas hydrates formation.The intensity and scale of toxic impacts on the marine biota in the accident zone can be,of course,very different, depending on a combination of many factors.

Modern technology of pipeline construction and exploitation under different natural conditions,including the extreme ones,achieved indisputable successes.However, pipeline oil and gas transportation does not eliminate the possibility of serious accidents and consequences.

It is important to take into consideration that in a number of cases,the accidental oil and gas spills and blowouts on the onland main pipelines can pose danger to the coastal marine ecosystems.This can happen when onland pipeline accidents take place near big rivers or in locations of their crossing. Any pollution of river waters eventually affects the sea zone near the river mouth.Such a situation happened at the end of 1994 in the Usinsk area,Russia. An onland pipeline rupture led to the spill of more than 100,000 tons of oil with the danger of heavy pollution of the basin of Pechora River.The potential hazard of such situations can be even higher during oil and gas development on Sakhalin.The main pipelines are supposed to be laid along the entire eastern coast of the island,right across the main spawning rivers where reproduction of the unique populations of Sakhalin salmon takes place.

ARTICLE

Environmental regulatories for offshore oil and gas industry

Neil Gunningham
Professor of Environmental Law Canberra University

Introduction to Regulatory Profiles

The'Offshore Oil and Gas Environment Forum'is one of a number of activities initiated by the United Nations Environment Programme(UNEP) ,the United Nations Commission on Trade and Development (UNCTAD) and the petroleum industry to help facilitate information exchange. The 'Environmental Regulatory Frameworks for Offshore Oil and Gas Industry'is one component that has worldwide application. The information is presented as a series of national profiles and demonstrates the variety of mechanisms-regulatory,co-regulatory and voluntary, in place between industry and governments.

How the profiles were developed

The profiles were compiled via contacts from UNEP, the Exploration and Production Forum (E&P Forum), World Wide Web, literature searches and a survey questionnaire. The survey was forwarded to government bodies responsible for environment and industry issues and non-government bodies including industry associations and oil companies. The draft profiles were checked by country regulators and industry associations before being uploaded to the Forum website. Several profiles have been completed.

If you can provide further information on other countries or wish to update information on those countries already on the Forum,please contact UNEP with the information.

A number of the countries profiled border the north Atlantic region.It is no coincidence that a region subject to serious environmental pressure has also attempted to find innovative and cost effective forms of operation and regulation.

Overview

As the petroleum industry has expanded exploration and production in all continents, so too has attention on the impact of its activities.There has also been a growing recognition that industry must operate within the scope of social,cultural,economic and physical factors at the local level,while remaining in the global context of Agenda 21.Industry has recognized that future access to petroleum resources depends on finding methods of exploiting resources in an environmentally sustainable manner and in cooperation, rather than in conflict,with regulatory bodies.

The need to minimize environmental impact has been one of the most significant changes occurring in the upstream petroleum industry during the 1980's and environmental regulation of the petroleum industry is therefore a relatively recent phenomenon.

The profiles show that government and industry are attempting to explore innovative strategies that go beyond the traditional adversary approaches to environmental management. The concept of sustainable development also calls for a different approach,to extend the debate about environment and development

from that of simply reducing pollution from operations.

Strategies must provide sustainable multiple use solutions to solve many of the conflicts surrounding conservation and resource use in the marine environment.

Types of Regulatory Approaches

A recent International Expert Meeting (Noordwijk, Netherlands, November 1997) on 'environmental practices in offshore oil and gas activities', noted that there are primarily two approaches to regulating the environmental performance of industry-the 'prescriptive' approach and the'performance based' approach.

The prescriptive or 'command and control'approach is based on specific requirements made by government, to be met by operators. Technical prescriptions make it clear what is required and give the regulations legal certainty.

This makes it relatively easy for government to determine, via an inspection procedure,whether an operator is meeting the requirements. Performance based approaches place a greater emphasis on setting an objective or goal to be reached by industry. An example is a legally binding environment plan or covenant that is subject to reporting and auditing requirements.

oncurrent with the shift in regulatory focus has been a greater acceptance by industry of the principle of voluntary measures. If voluntary action is effective, there is less need for regulations. These measures can include codes of practice, agreed action plans or negotiated targets and limits. Self regulation, an example of a performance based approach,is an agreement made between the operator and government with specified environmental standards.It is the responsibility of operators to define strategies on how they will achieve these standards and provide evidence to assure they are complying with the agreement.

Conclusions of the Joint Chair from Noordwijk

The International Expert Meeting in Noordwijk, made some important recommendations concerning regulatory frameworks. It agreed that these should in part enable industry to assume its responsibility to achieve environmental performance.

Furthermore, environmental best practice guidelines should be developed through information exchange and open discussion between industry, government and other interested stakeholders." Companies should have,and behave according to,an integrated vision on production, safety, health and environment, regardless of where in the world they are active."

What the profiles show

The regulatory frameworks now in place include a variety of traditional and new instruments to influence environmental performance. For the countries profiled, there is still a definite reliance by government on prescriptive legislation as the primary means of regulating the industry. This is demonstrated by the number of Acts and regulations such as permits and discharge standards,required by operators for offshore exploration and production activities.While the'Command and Control'approach is still widely used by governments, this is gradually being complemented by performance based approaches.This is demonstrated by examples of goal setting, negotiated agreements and economic measures,to achieve better results at a lower cost than'command and control'by itself.

Historically industries response to' command and control' was limited to simply achieving compliance.The shift towards performance based measures has provided industry with the opportunity to find other ways of meeting the goals or targets set by government.

This has included the increased use of voluntary measures by industry-the

so called'CO-regulatory'approaches.

The profiles show several proactive relationships with regulators to solve common problems, develop voluntary guidelines and codes to educate members,encourage and fund research programmes to improve daily operations and incorporate performance measures into their reporting approaches.Several industry associations are now attempting to expand beyond their traditional role of lobbying on behalf of their members,by developing their members'capacity to implement environmental protection measures.

The mechanisms established for more effective dialogue between government and industry show a greater emphasis on transparency,problem solving and being inclusive of various stakeholder interests.The following are examples of how information exchange and consultative mechanisms are being used to support the non- regulatory systems.

Consultative forums.

MILJØSOK is the alliance between the Norwegian industry and government to create an open dialogue between the stakeholders on measures to better meet environmental challenges.

An important outcome has been a programme to reduce total produced water discharges. Negotiated Agreement between Environment Department and Industry Association.

A feature in the Australian profile is the strengthening relationship between the national environment agency and the leading industry association.Under an industry-government agreement,there has been a commitment to establish a joint work plan. Reviewed annually this plan will identify opportunities for co-operative programmes.

It will also find solutions to the question of competing resource interests and sustainable multiple use.

The Atlantic Frontier Environmental Network (AFEN)is a coordinated and strategic approach to environmental management by 21 oil operators in the UK Atlantic margin. The companies work with government and regulatory authorities, academic research community and interested parties. The AFEN leads a range of regional activities and studies to understand the environment better.They believe that a joint approach can generate much better data and use resources more efficiently. Industry-initiated Environmental Codes and Guidelines Many profiles demonstrate the use of codes and guidelines to assist operators understand and implement their nvironmental responsibilities. The United Kingdom Offshore Operators Association has produced good practice guidelines on'Environmental Management Systems','Internal Audit and Training','Exploration Operations in Near-shore and Sensitive Areas'and 'Reducing Atmospheric Emissions from Oil and Gas Facilities'.

The Merits of Various Regulatory Approaches

The International Expert Meeting in Noordwijk discussed the effectiveness of various regulatory instruments in protecting the marine environment.

It found that in many countries the offshore industry is developing faster than the government's ability to regulate them.The prescriptive approach requires governments to maintain a strict, regular and costly inspection service. Prescriptive regulations can foster a'compliance mentality'within industry and discourage the development of new technologies and creative practical solutions.In contrast, the focus of co-regulation is on self inspection to check compliance,and subsequently to report to the regulator.This moves the burden of auditing and inspection from government to industry. By allowing the operator flexibility in choosing practical measures to meet environmental objectives,a more cost efficient approach to improving industry environmental performance is achieved.The success of performance-based approaches depends on effective goal setting, with active communication and a sophisticated and multidisciplinary skills profile of both the operators and regulating authorities.The introduction of goal-setting approaches to the regulatory frameworks has not obviated the use of ambient discharge standards which are still necessary to protect environmental quality.

Options for Regulators to Interface with Environmental Management Procedures

- Performance Standards Instead of Prescriptive Rules

The International Expert Meeting in Noordwijk discussed the effectiveness of various regulatory instruments in protecting the marine environment.It found that in many countries the offshore industry is developing faster than the government's ability to regulate them,and that the traditional approach to regulation is inhibiting the industry's capacity for innovation and technological change.This is because regulators impose a prescriptive approach,telling the industry exactly what measures it must take and requiring little interpretation on the industry's part.Prescriptive regulations can foster a 'compliance mentality'within industry and discourage the development of new technologies and creative practical solutions.There is also a limit to the extent to which it is possible to add more and more specific prescriptions without this resulting in counterproductive regulatory overload.Under this approach governments also maintain a strict,regular and costly inspection service, which is resource intensive.

In contrast, performance standards specify the outcomes to be achieved but not how to achieve them.For this reason, they can accommodate to changes in technology and the creation of new hazards. They also allow firms flexibility to select the least costly or least burdensome means of achieving compliance. On the other hand,because they are sometimes imprecise,performance standards are to that extent more difficult to enforce.

The success of performance-based approaches depends on effective goal setting, with active communication and a sophisticated and multidisciplinary skills profile of both the operators and regulating authorities.

However, performance standards offer less guidance to enterprises as to what is required of them,and this can present problems for smaller companies and subsidiary parts of the oil and gas industry such as contractors and suppliers. For these enterprises, effective compliance will be facilitated by the provision of more precise guidance as to how to identify and resolve problems.This could be provided for through technical data sheets and other advisory material, which could be issued not only by regulatory agencies, but also by independent standard setting bodies or by industry itself. It may also be desirable, as under comparable occupational health and safety legislation,to insert a statutory provision making clear that compliance with the advisory material/code of practice will be deemed to be compliance with the performance standard.

- Management system standards

Both prescriptive and performance standards have a substantial limitation:they only require enterprises to achieve minimum standards and provide no incentives or encouragement to go beyond those minima.They do not encourage continuous improvement or industry best practice.Nor do they directly encourage enterprises to develop an environmental culture or to"build in"environmental considerations at every stage of the production process.They are also demanding on regulatory resources.

A number of countries and regulatory regimes are experimenting with an alternative approach which gives industry greater flexibility and autonomy over how it achieves better environmental performance, but within a framework designed to"make industry think" about its environmental challenges and to establish systematic solutions. This is achieved principally by encouraging or requiring industry to adopt certain processes and an environmental management system (EMS).

An EMS is a potentially powerful management tool, which involves the assessment and control of risks and the creation of an in-built system of maintenance and review.It is capable not only of assisting an organisation to achieve its environmental goals but also of building in continuous improvement and embedding cultural change on environmental issues within the organisation. In future, the most popular form of EMS will almost certainly be one that complies with the International Standards Organisation's (ISO) EMS standard, ISO 14000.(Visit also the OEF section on EMS,and the International Standard Organisation (ISO) and on Eco-Management Audit Scheme (EMAS).

Two options are available to policymakers who want to make regulations interface effectively with environmental management systems.

First, they can make the use of such systems mandatory in prescribed circumstances.

This approach could involve an environmental management system being developed by the rig operator and submitted to the regulator for scrutiny and approval. This must not only explain strategies but also demonstrate the adequacy of hazard control and environmental management.The regime should be accepted and technologically challenged by the relevant authority. The other approch is two track regulatory seystem whereby enterprises are offered a choice between a continuation of existing forms of regulation on the one hand (track one), and the adoption of a EMS-based approach on the other (track two).

Track two would put primary responsibility on the operator to find the best means of reducing environmental harm built around an EMS and subject to government and third party oversight.It would provide considerable flexibility and enable enterprises to devise their own least-cost solutions,and give them direct incentives to go "beyond compliance" with minimum legal standards. Experience in the USA suggests that few enterprises will adopt track two unless considerable incentives are provided to do so.

These might include regulatory flexibility (reducing the likelihood of inspections and prosecutions, less prescriptive regulatory requirements; reductions in penalties if prosecutions take place) and logo or other publicity or public relations benefits to participating enterprises.

If an EMS,such as ISO 14001, is used as a regulatory tool,it will still be necessary to maintain a variety of oversight and regulatory fall back mechanisms to ensure that the system actually delivers improved environmental performance to a prescribed level or beyond (because ISO 14001 emphasizes processes but not particular environmental outcomes, and does not require independent verification). Regulatory flexibility initiatives must be based on" ISO Plus"rather than merely on conformity with ISO 14001 itself. Four key components are necessary to the successful implementation of such regulatory flexibility initiatives.These are:

- That those enterprises must commit to outcome-based requirements,the achievement of which can be measured through specific performance indicators;
- That there should be independent verification both of the functioning of their management system and of environmental performance under it (e.g. by a third party environmental auditor or regulator), with the results or a summary of the results available both to the regulator and third parties such as community groups;
- That there should be an ongoing dialogue with local communities (where such communities exist) concerning compliance goals and the means of achieving them, thereby ensuring the credibility and legitimacy of the process and third party input and oversight; and That there should be an underpinning of government intervention; acting as a safety net which only "kicks-in"when triggered by the failure of the other less intrusive mechanisms described above.
- Such an approach is a form of co-regulation whose goal,rather than regulating prescriptively, is to encourage enterprises to establish processes of internal self-regulation to self-inspect,monitor, control and continually improve their environmental performance. Enterprises subsequently report to the regulator on all these issues.

The result is to move the burden of auditing and inspection from government to the industry. The well-documented failures of pure self-regulation (which is often ineffective in bringing laggards up to acceptable standards)are overcome by building in transparency and government and third party oversight mechanisms.

If successful, this approach will be a more cost-efficient and cost-effective way of dealing with environmental problems, it will streamline procedures, provide more reliable and verifiable reporting, and encourage industry to go 'beyond compliance' with fixed standards. It will also substantially reduce the cost of regulatory enforcement. However, not all-regulatory flexibility initiatives using EMS have been successful and careful regulatory design will be essential if such an approach is to achieve better economic and environmental outcomes than traditional regulation. It will also be important to identify best practice models and to learn from them.

As regards smaller enterprises, including some contractors and suppliers, it is less clear that an EMS (even in a simplified form) is the most appropriate regulatory tool, and there may be greater emphasis on providing them with more specific guidance by codes of practice and other mechanisms.There is considerable scope however, for large companies to partner with and mentor their smaller contractors and suppliers,to include an evaluation of their contractors and suppliers in their EMS and in their procurement criteria, and to insist upon environmental performance based incentive programs and greater oversight of their activities.

These extended responsibilities could also be required of large companies under EMS based regulation.

A further challenge relates to regulation in developing countries,where enforcement by regulators is often constrained by economic and political factors, and regulation may lag substantially behind community expectations.In this context, EMS-based regulation may be an attractive option because by requiring or encouraging companies to undertake a goal-setting certified EMS, they can establish a performance-based regulatory program without a major commitment of resources. Even without pressure from regulators, multi-national corporations may decide to adopt an EMS in order to protect maintain corporate reputation and legitimacy, or in response to pressure from public interest and environment groups. Industry associations could also be important in identifying and disseminating best practice models, in developing EMS based codes of practice,and in requiring reports on how far their members are achieving compliance. Here the best practice model is likely to be the chemical industry's Responsible Care initiative.

The overall goal is to find the right mix of regulatory, co-regulatory, incentives and voluntary mechanisms to suit the context of a particular state and the particular types of enterprise being regulated. In this quest, EMSs are destined to play a central role.

The Use of Prescriptive Instruments

A visible feature of the profiles is the continued reliance by countries on permits, usually for each of the exploration, production and abandonment stages. Some permits include a variety of mechanisms like Environmental Management Systems (EMS) and Environmental Impact Assessment(EIA).

The use of an EIA process has formed an integral part of the regulatory process. EIA has become widely accepted as an important tool to identify and address the environmental effects of activities.While there appeared to be no standard procedures for undertaking an EIA,the majority of countries profiled did share key objectives covering planning, operation and decommissioning.

The Use of Economic Instruments

A tax on CO2 emissions came into effect in 1991 in Norway on offshore production to encourage a reduction in air emissions. In a short time,the tax has improved overall energy use in the petroleum sector and greatly reduced the use of certain practices such as gas flaring. Norway is the only country to have introduced this form of economic instrument into its regulatory framework. This approach may be difficult for all countries to apply as it requires a well developed infrastructure for monitoring emissions which is not always present in developing countries for example.

Generally,however,the profiles highlighted the use of permits,fees,fines and liability measures as the traditional economic instruments in place.

The Use Environmental Management Systems

The profiles also demonstrated the increased use of Environmental Management Systems (EMS)by industry.Most of the major oil and gas companies have started to adopt detailed EMS and internal environmental operating guidelines.The development of integrated health, safety and environment management systems was also noted in Norway and USA.Such systems can be used by governments to ease the regulatory burden,essentially by using the reporting systems already developed under the EMS and by placing responsibility for meeting agreed performance on the management system developed by the operator.

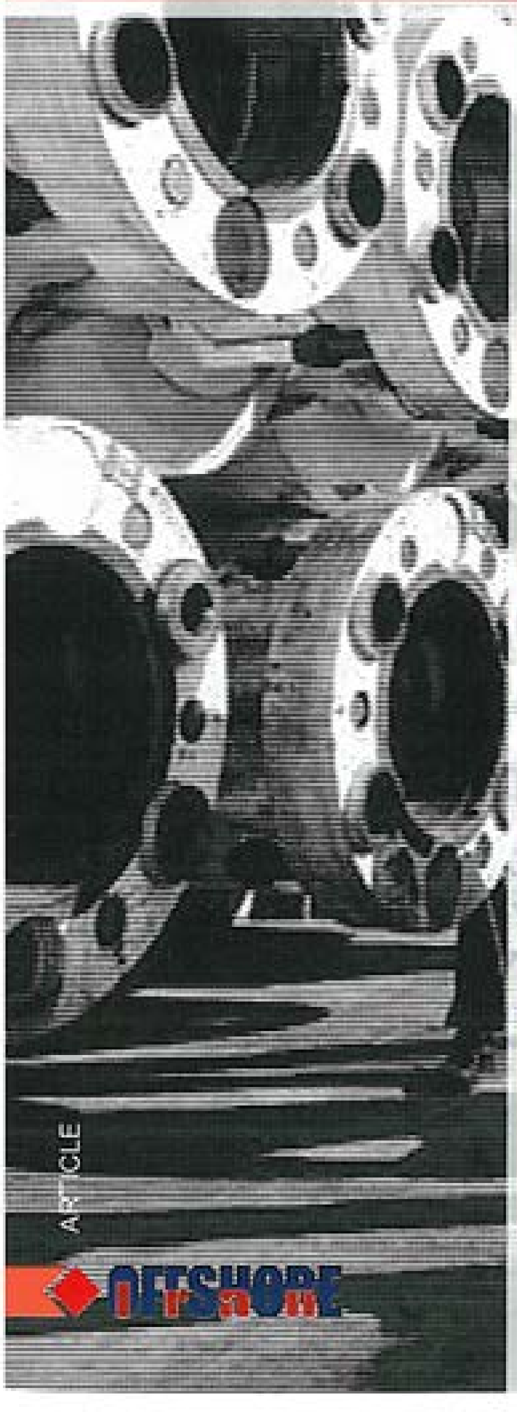
And in developing countries...

In many developing countries the regulatory mechanisms in place are modeled on earlier established approaches in developed countries.Many South East Asian nations,for example,have based their environmental protection frameworks on command and control models from the USA or European countries.Like their OECD counterparts,they are now faced with the practical shortcomings of this approach.This includes the lack of enforcement capability and institutional capacity to effectively administer regulations.The need for well-developed monitoring mechanisms may also be beyond the financial and technical capabilities of an often over stretched environment agency.The concepts behind performance based regulations, voluntary agreements and EMS are not in common use in developing countries.It is therefore difficult for government to rely on these as regulatory approaches at the present time.

Combining Approaches

The profiles demonstrate that in several countries performance based approaches are now being adopted to complement prescriptive regulations. The trend is for industry to take more responsibility for its environmental activities by the use of CO-regulatory and performance based measures. Good communication between government regulators, operators and industry associations is vital to develop a meaningful approach to regulation. It is important also to ensure that research and studies continue to add information to the process.The International Expert Meeting concluded that there is a need for more information on how voluntary instruments work in practice,and on the differences between goal setting prescriptive approaches and self regulation.

THE EVALUATION OF METAL OIL AND GAS EQUIPMENT IN A CURRENT CONDITION BY MEANS OF TRANSFER FUNCTION PARAMETERS



E.Bashirova, N. Svobodina

The equipment used for oil refining, dealing with highly explosive, inflammable and toxic atmospheres at surplus pressure and high temperatures, its operation term considerably exceeds normative one, is potentially dangerous and increases emergency situations, thus it is very important to define technical condition and the possibility of secure operation by scientifically proved methods at the end of normative operation term. The modern definition of technical diagnostics as a field of scientific-technical knowledge, the essence of which is the theory, methods and means of faults detection and search of technical origin, includes the methods and means of undestroyable control.

Nowadays a wide range of undestroyable control methods and items, among which important electromagnetic ones, are used to solve the diagnostic tasks of oil and gas equipment.

A prosperous direction for solving the diagnostics tasks of oil and gas equipment is the usage of electro physical and mechanical properties interconnection

in constructive steels. The mechanical and electro physical properties of metals interconnect with each other on the level of crystal lattice. The deformation of crystal

structure, the fault origin and extension are followed by the alteration of mechanical and electro physical metal properties. This way of interaction is necessary to use for the detection of actual metal condition in the operation process.

If metal is a non-linear system, it is possible to apply well-known methods of condition control such as the analysis of transfer function by incoming effect and system reaction. This way permits not to absorb into consideration but it makes possible to descript a current condition of the system, which is characterized as stable and nonstable.

A stable condition means an operating capacity of the system that is the system is descripted by admissible values of the tested parameters at a certain period of time.

Any system must be operating first of all, that is must function properly and be nonsensitive.

to the external influence of different kind. The system must be stable for any practical task. Stability is the property of the system to return to the initial or close set cycle after outcoming, which is the result of some effect.

The processes in the system are described by means of non-linear system differential equations, which can be solved in certain rare cases. Though the equations of large number systems can be linearized. Then the system processes are described as linear differential equations such:

$$a_n y^{(n)}(t)+a_{n-1}y^{(n-1)}(t+\ldots+a_0 y(t))=b_m x^m(t)+\ldots+b_0 x(t).$$

The solution of a differential equation is connected with calculating difficulties, that is why the system research is carried out by means of indirect methods based on Laplace operational methods and Fourier transformation. The following basic characteristics are used for this purpose: transfer function, transition function and impulse-transition function, complex coefficient transfer and frequency characteristics.

The transfer function is in a more wide use, when it is extracted from the following correlation: give Laplace transformation to the equation, we have:

$$D(p)Y(p)=N(p)X(p)+M_H(p),$$
$$D(p)=a_n p^n+a_{n-1}p^{n-1}+\ldots+a_0,$$
$$N(p)=b_m p^m+b_{m-1}p^{m-1}+\ldots+b_0$$

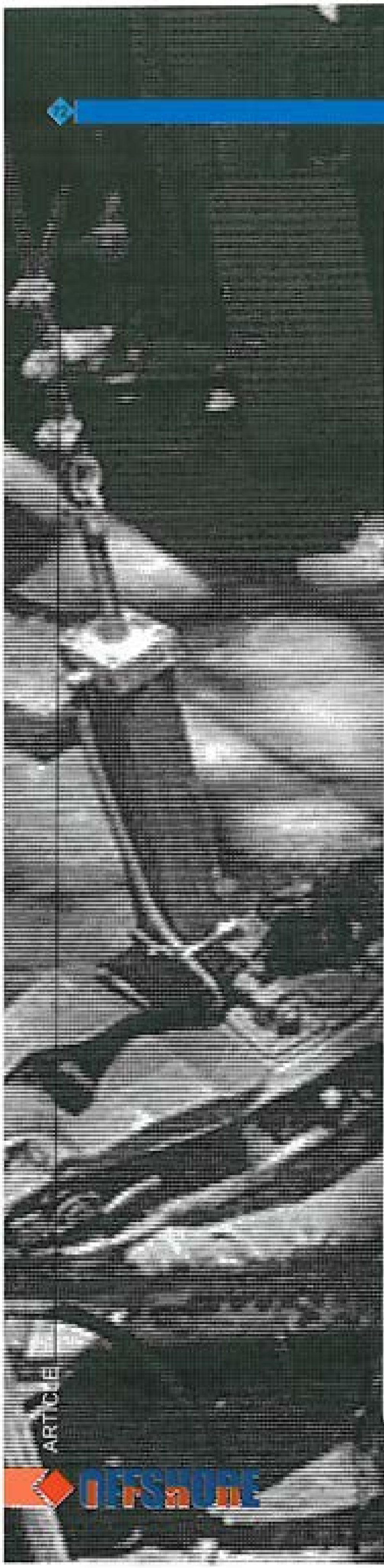
Y(p) - Laplace transformation for outcoming signal of the system; X(p) – Laplace transformation for outcoming signal; Мн(p) - polynominal, showing initial conditions.

Enter the following signs:

$$W(p)=N(p)/D(p);W_H(p)/D(p)$$

Then the expression (2) has the following form:

$$Y(p)=W(p)X(p)+W_H(p)$$



This equation connects outcoming signal image with incoming signal image and with initial condition of the system. The function W(p) characterizes the dynamic properties of the system, it does not depend on the controlling effect and is fully defined by the system factors ai and bi, this function is called a transfer one, and the function Wн(p)- a transfer one relatively initial state of the system.

On zero initial conditions transfer function is equal the correlation of outcoming signal image by Laplace to Laplace transformation of incoming signal. Transfer function is a fractional rational function relatively Laplace operator transformation:

$$W(p)=\frac{b_m p^m + b_{m-1} p^{m-1} + \ldots + b_0}{A_n p^m + a_{n-1} p^{n-1} + \ldots + a_0}$$

For the realization of this method an input effect on the system is to be graduated and impulse. An impulse influence may be presented as a total influence of harmonic components. The frequency methods, which contain mathematical logic of Fourier and Laplace transformations, may be applied for solving tasks at a pulse excitation of
transformer.

An important point in system status analysis is the construction of its mathematical model. The models variety defines different ways to solving and analysis.

If model is rather simple and described by means of a simple linear equation, it isrational to apply time domain. But if the equation is rather difficult, it appears that the transition to frequency domain simplifies calculating actions a lot. It is possible for some models to get frequency characteristic analytically, but impossible to find a solution in time domain.

The convertion of time domain into frequency domain is possible in general for the models, which linear in time domain. Though a satisfactory empiric model can be formed in frequency domain directly.

Empirical transfer functions can be observed on experimental data directly. By the response to impulse incoming signal transfer function, gain coefficient and phase angle (phase lag, phase difference) can be estimated.

The transfer function on some external action does not depend on the law of variation of this action and is only defined by the system properties itself.

The mathematical method of Laplace transformations, it is possible to analyze transfer function as the connection between incoming and outcoming signals of electromagnetic converter at any moment time.

In considered case the subject research is the metal characterized as a nonlinear system. The linear approximation based on the following points is used to simplify such systems analysis:

1. If characteristic equation of linear system has all roots with negative material parts, actual system will be stable. The terms of the second and upper powers, deleted when equation linearization can not change the system stability.

2. If characteristic equation of linear system has just one root with a positive material part actual system will be non-stable. The terms of the second and

upper powers, deleted when equation linearization can not provide stability to the system.

3. If characteristic equation of linear system has just one zero root or a couple of imaginary conjugate roots, the reaction of actual system can not be defined by its linearized equation. In this case the terms of the second and upper powers deleted when equation linearization can radically change the description of actual system process.

The method of phase trajectory can be used for the non-linear system research, the essence of which is the following. If any system is described by the differential equation of n-order, its state is defined at every moment time by the value of regulated quantity x or any other quantity and its (n – 1) derivatives. Multidimensional coordinates space of researched quantity x and all its derivatives is called phase space.

The point M in a phase space with current coordinates values, defining the state system (or phase) is called representation point. At any change of system condition representation point coordinates vary. Its mechanical trajectory in a phase space is called a phase trajectory. The initial system conditions define the initial position of representative point in a phase space. The collection of phase trajectory, found for different initial conditions, with special points and trajectories presents a phase portrait, characterizing all possible conditions of a research system.

The method of phase trajectories is practically used for the systems of the second and third order. For the third order equations a phase space is a three dimensional space, two coordinates make phase plane, one variable makes phase line.

The phase trajectory method has a geometrical evidence and in combination with other methods presents a full representation of possible system changes.

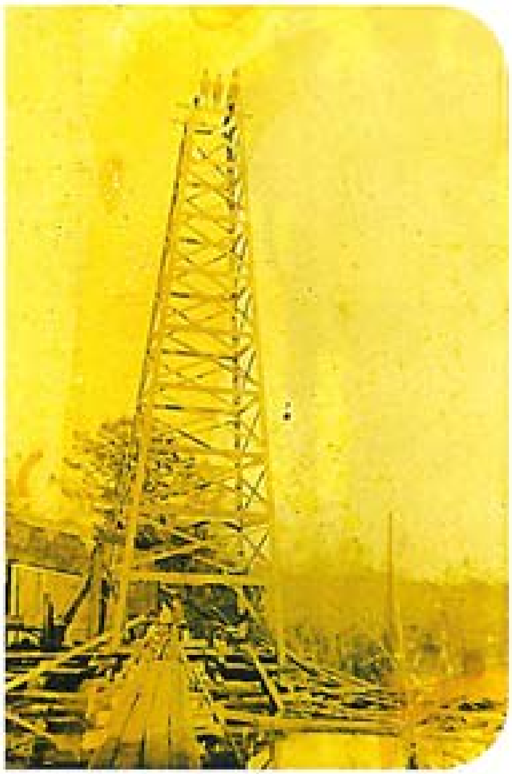
The use of mentioned above methods in research, analysis and the estimation of current condition in metal oil and gas equipment makes it possible to evaluate the actual metal condition developed processes treatment and analysis in it at any moment time.

Prepare for peak oil now

Oil is a finite resource and the decline of world oil production is predicted to occur anytime within the next 30 years.To avoid the worst-case scenario,we must begin today to reduce our dependence on oil

This article, exclusively available to AlterNet, was presented at a Reception with Their Royal Highnesses The Prince of Wales and the Duchess of Cornwall, at the California Leaders Round Table Dialogue on Peak Oil, Climate Change and Business Action; November 7,2005 in San Francisco.

The subject I teach-human ecology--is a discipline that largely concerns population and resources. Over the past few years I have chosen to study oil, because it is the most important energy resource of the modern world.



Only 150 years ago,85 percent of all work being accomplished in the U.S. economy was done by muscle power-most of that by animal muscle, about a quarter of it by human muscle. Today, that percentage is effectively zero; virtually all of the physical work supporting our economy is done by fuel-fed machines. What caused this transformation? Quite simply, it was oil's comparative cheapness and versatility.

Perhaps you have had the experience of running out of gas and having to push your car a few feet to get it off the road.That's hard work.Now imagine pushing your car 20 or 30 miles.That is the service performed for us by a single gallon of gasoline, for which we currently pay \$2.65. That gallon of fuel is the energy equivalent of roughly six weeks of hard human labor.

It was inevitable that we would become addicted to this stuff,once we had developed a few tools for using it and for extracting it. Today petroleum provides 97 percent of our transportation fuel,and is also a feedstock for chemicals and plastics.

It is no exaggeration to say that we live in a world that runs on oil.

However, oil is a finite resource. Therefore the peaking and decline of world oil production are inevitable events-and on that there is scarcely any debate;only the timing is uncertain. Forecast dates for the peak range from this year to 2035.

The peaking phenomenon itself has been observed again and again in individual oil fields and in entire producing nations. One of the first countries to hit its peak was the U.S.During the 1930s and '40s, half the world's production of petroleum came from Texas and Oklahoma. However, U.S.production reached its all-time maximum in 1970 and has been declining ever since.Currently the U.S. imports 60 percent of its oil.

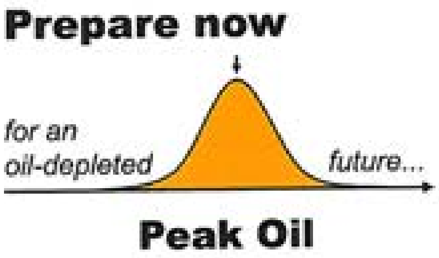
Concern over the likelihood of an impending world peak has increased markedly in recent months as global spare production capacity has dwindled and as prices have achieved what seems to be a new baseline of over \$50 per barrel.

Evidence that we are approaching peak includes the following:

ExxonMobil documents that global oil discoveries peaked in 1964.Declining rates of discovery are therefore a long-established trend.

- Chevron notes in recent advertisements that 33 of 48 nations are in decline. We have thus seen the peaking of production in a majority of individual nations, including some important producers such as Indonesia, Norway, Great Britain, and Venezuela. Mexico will reach its peak within the next two years.
- As noted by the International Energy Agency,there is evidence that a substantial amount of"proven reserves"in OPEC countries are illusory,the result of a scramble for market share within a cartel that allocates export quotas based on stated reserves.

With regard to this last point it



Illustrator: Alireza nourazi

should be noted that reserves figures, even when accurate, have historically given little warning of peaking. The U.S. instance is once again emblematic:in 1970, U.S.oil reserves were higher than ever; so were production rates.But only a year later, American production began its terminal decline.The study of discovery rates and depletion rates gives us a much better idea of when the global peak is likely to occur.

Optimistic estimates of future discovery and production issued by Cambridge Energy Research Associates and the U.S. Geological Survey have been criticized by several analysts.The optimists have generally failed to anticipate peaks, first in the U.S. and repeatedly in the case of other nations around the world.This morning the International Energy Agency(IEA)issued a statement saying that the world will have sufficient energy supplies for the next quarter century. However, the statement noted the necessity of the investment of $17 trillion in the supply train in order to maintain sufficiency for so long. Also, the IEA anticipates Saudi Arabian production expanding to 18 million barrels per day by 2030 a figure considerably higher than the maximum possible rate of production from that country cited not long ago by Sadad al Husseini, the recently retired head of exploration for Saudi Aramco.

Expressions of concern have been voiced by corporations, prominent organizations, and knowledgeable individuals, including ChevronTexaco, the Royal Swedish Academy of Sciences, Volvo, Ford Motor Company Executive Vice President Mark Fields, the Chinese Offshore Oil Corporation's chief economist,and numerous petroleum scientists and oil industry analysts.

The question immediately arises: Will alternative sources be able to make up the difference?

Alternative sources often discussed include oil sands from Canada, shale oil in Colorado, coal-to-liquids, gas-to-liquids, nuclear, and renewables such as solar and wind. Each of these will require immense investment and well over a decade of intense effort in order to produce substantial quantities of energy to offset declines from fossil fuels.And in most cases,rates of production are and will be constrained by non-economic factors.Take the oil sands,for example. Currently Canada produces one million barrels of synthetic crude per day from that source.

here is expectation of two mb/d by 2010,and perhaps as much as four mb/d by 2025. We are unlikely to see higher numbers than that even with extraordinary capital investment, because the production process requires large amounts of natural gas and fresh water,both in short supply in Alberta.

Moreover, according to the IEA, the world needs six mb/d of new production capacity each year (and that number is growing) to meet new demand and to offset depletion from existing fields.

How about increased efficiency-surely that can offset any potential oil supply problems. In principle, yes, but most efficiency strategies will likewise require significant lead times. For example,we have the technology now to enable all of us who own cars to be driving ones that get up to 100 miles per gallon. If we were, that would obviously save an enormous amount of fuel. But how long would it take to implement that strategy? It would certainly take four or five years

for Detroit to begin producing such high-efficiency cars in large numbers.

Then, not everyone buys a new car every year. In fact, it takes about 15 years to change out nearly the entire U.S. car and truck fleet. So, altogether, it would take about 20 years to fully implement this particular efficiency strategy.

Will the market be able to respond quickly enough to forestall serious economic, social, and political impacts? It is often said that the Stone Age did not end for lack of stones, nor will the Oil Age end because we run out of petroleum-but instead because we find a cheaper source of energy. However, as we have just seen, that cheaper source of energy has yet to be identified.

Early this year a report was released, prepared for the U.S. Department of Energy by a team led by Robert L. Hirsch, who has a distinguished background in the oil industry and is a senior energy analyst at SAIC and the Rand Corporation. The Hirsch Report (titled" Peaking of World Oil Production: Impacts, Mitigation and Risk Management") concludes that price signals will arrive at least ten years too late to enable a gentle, market-led transition away from oil to other energy sources. The report describes Peak Oil as an"unp recedented"challenge for modern societies, and describes economic, social, and political risks if preparation is not undertaken soon enough, or on adequate scale.

Let me read you a few sentences from the Hirsch Report:

The problems associated with world oil production peaking will not be temporary, and past "energy crisis "experience will provide relatively little guidance. The challenge of oil peaking deserves immediate, serious attention, if risks are to be fully understood and mitigation begun on a timely basis. Mitigation will require a minimum of a decade of intense, expensive effort, because the scale of liquid fuels mitigation is inherently extremely large. Intervention by governments will be required, because the economic and social implications of oil peaking would otherwise be chaotic.

The report also concludes that the costs of preparing too late for global oil peak would far outweigh those of preparing too early.

The worst-case scenario for the impact of global production peak is very bad indeed. As I mentioned earlier, we are extremely dependent on oil for transportation, agriculture, plastics, and chemicals. In each area, we are already seeing serious impacts resulting from current prices in the $60-per-barrel range.

For example, crrently tens of thousands of farmers are agonizing over whether they can afford to plant next year's crop, given high fuel and fertilizer costs.

- Chemicals and plastics industries are already hard hit: In the chemistry industry alone, more than 100 plants have closed and more than 100,000 jobs have been lost just this year.
- In the airline industry, 40 percent of revenues go to pay for jet fuel;most U.S. air carriers are already in bankruptcy or nearing that situation.
- Home heating costs are projected to be 40-50% higher this winter than last.

As prices go even higher, and with actual scarcities of fuel, people will experience difficulties commuting, and the maintenance of our far-flung food distribution systems may become problematic.

On top of all this,oil is a strategic resource:as supplies become scarce,there is increasing likelihood of international conflict.

To avoid the worst-case scenario we must begin today to reduce our dependence on oil. The effort must have top priority. It must focus primarily on reducing demand,and only secondarily on producing large quantities of alternative transportation fuels.

A global Oil Depletion Protocol would reduce price volatility and competition for remaining supplies, while encouraging nations to move quickly to wean themselves from petroleum.

In essence, the Protocol would be an agreement whereby producing nations would plan to produce less oil with each passing year (and that will not be so difficult, because few are still capable of maintaining their current rates in any case); nd importing nations would agree to import less each year. That may seem a bitter pill to swallow.

However, without a Protocol-essentially a system for global oil rationing-we will see extremely volatile prices that will undermine the economies of all nations,and all industries and businesses. We will also see increasing international competition for oil likely leading to conflict; and if a general oil war were to break out, everyone would lose. Given the alternatives, the Protocol clearly seems preferable.

National governments, local municipalities, corporations, and private individuals will all need to contribute to the effort to wean ourselves from oil, an effort that must quickly expand to include a reduction in dependence on other fossil fuels as well.

All of this will constitute an immense challenge for our species in the coming century. We will meet that challenge successfully only if we begin immediately.

WHO is WHO?

Barry Russell
President, Independent Petroleum Association of America (IPAA)

Barry Russell is President of the Independent Petroleum Association of America (IPAA). Having joined IPAA in 1980, he also serves as Chief Operating Officer of the association and is responsible for its day-to-day operations. Prior to being elected President in March 2000, Mr Russell served as Executive Vice President, General Counsel and Corporate Secretary. In this role, he was the principal deputy to the President, focusing on legislative policy development as well as the legal and financial administration of the association.Previously, he has managed IPAA's environmental issues as one of IPAA's registered lobbyists and served as a founding member of the Environmental Issues Council, an organization of trade associations based in Washington, DC. In addition, he served on the committees that directed the association's strategic planning in 1995 and 1989. He has been IPAA's chief legal and financial officer since 1988 and an officer of IPAA's educational foundation since its inception. Mr Russell began his career in the Environmental Protection Agency's (EPA's) Office of General Counsel and Enforcement, where he represented EPA in civil and criminal actions against some of the nation's largest utilities and industrial concerns. Prior to joining IPAA, Mr Russell worked for several management consulting firms including Booz, Allen and Hamilton. During this period, he specialised in mergers, acquisitions and corporate turnaround assignments, serving as the chief executive officer of companies that were near bankruptcy. He was also active in international business, travelling to over 40 foreign countries during this period. Mr Russell received his law degree with honours from George Washington University Law School and he graduated with distinction and honours from Penn State University with a BS in Psychology and a BA in Economics. He has also completed courses in environmental mediation and negotiation at Harvard University and Massachusetts Institute of Technology (MIT).

Javad Yarjani
Administrator, Directorate-General for Energy and Transport, European Commission

Javad Yarjani has been Head of the Petroleum Market Analysis Department at the Organization of the Petroleum Exporting Countries (OPEC) Secret-ariat in Vienna, Austria, since August 1998. Since joining OPEC, he has taken part in many inter-national forums as a member of OPEC delegations to various high-level meetings such as 2nd OPEC Summit of Heads of State in Caracas, Venezuela, in September 2000, and the International Energy Forum in Riyadh, Saudi Arabia, in November 2000. Mr Yarjani was appointed Managing Director of the International Bureau for Energy Studies in London in 1996. From 1994 to 1996, he was Head of the OPEC Department at the Ministry of Petroleum, while also serving as Advisor to the Minister and National Representative to OPEC. In 1993, he was appointed Deputy Director for International Affairs at the National Iranian Oil Company (NIOC), in charge of crude oil marketing and exports. Mr Yarjani has represented both the NIOC and the Ministry of Petroleum at numerous conferences and seminars and was in charge of the NIOC's offices in Singapore and Tokyo. He was Director for Economic Relations with Europe and America at the Ministry of Foreign Affairs in Tehran until 1986. He has also worked in his country's Foreign Ministry as of 1980, where he has held several positions, including Head of Mission at the Iranian Embassy in Australia from 1980 to 1982. Mr Yarjani obtained his Bachelor's degree in Economics at the National University of Iran and his MA, also in Economics, at the University of Houston, Texas.

HERE'S THE PUZZLE ,

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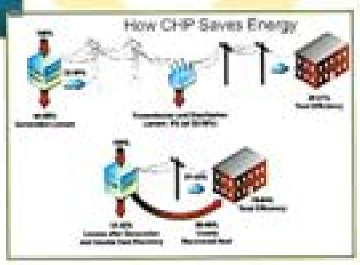

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