

PETROLEUM REVIEW



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OF PETROLEUM

May 1996

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A global review

Qatar

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PETROLEUM REVIEW

MAY 1996 VOLUME 50 NUMBER 592 • £8.00 • SUBSCRIPTIONS (INLAND) £85.00 (OVERSEAS) £100.00

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Published Monthly by
INSTITUTE OF PETROLEUM
A charitable company limited by guarantee

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Printed by The Thanet Press Ltd, Margate

US MAIL: Petroleum Review (ISSN 0020-3076 USPS
006997) is published monthly for US\$165 per year by
the Institute of Petroleum. Second class postage paid
at Middlesex, New Jersey.

Postmaster: send address changes to Petroleum Review
c/o Pronto Malters, PO Box 177, Middlesex, New Jersey
08846, USA.



ISSN 0020-3076
MEMBER OF THE AUDIT BUREAU OF
CIRCULATIONS

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COVER PHOTO

Laying the Etrez to Gland pipeline. Photo by
Jean-Paul Houdry. Courtesy of Gaz de France.

News in Brief

18 March

John Brown E&C, part of the Trafalgar House group, is to conduct a study of Azerbaijan's gas processing facilities on behalf of the State Oil Company of the Azerbaijan Republic (SOCAR). The study, for which the World Bank has provided \$650,000, will focus on what medium- and long-term investment will be required in order to make best use of the region's gas resources.

Premier Oil reports that the coming onstream of the UK Fife, Blenheim and Galahad fields and the Qadipur gas field in Pakistan contributed to a 66 percent increase in average production in 1995. This pushed net profits up by a massive 179 percent to £25.1m.

The Dolphin gas field, a 50:50 British Gas/Texaco joint venture offshore Trinidad, has entered production. It will supply up to 275 mncuft/d to the National Gas Company of Trinidad and Tobago under a 20 year supply contract.

Conoco Taiwan Exploration and Production and Chinese Petroleum Corporation are to jointly explore three offshore areas in the Taiwan Straits.

19 March

Amoco's Ha'py-1 discovery well in the Ras El Barr offshore concession in the Nile Delta has encountered 260 feet of gross gas pay. Tests in three zones yielded rates of 57, 17 and 13 mncuft/d respectively, the first of which is the largest gas flow rate recorded in Egypt to date.

Total reports that two production tests at more than 5,000 metres depth on the Jusepin permit in northeast Venezuela have yielded a cumulative flow rate of 14,200 b/d of light oil.

20 March

Linkman has extended its fuel distribution contract with Safeway Stores and is now responsible for deliveries to 34 of the supermarket's ser-

vice station forecourts throughout the north of England.

21 March

South African state-owned oil company Soekor has signed a deal with Schlumberger and Fred Olsen to develop E-BT, South Africa's first offshore oilfield, reports *Lloyd's List*.

Kvaerner Kenny Ltd has completed the installation and commissioning of a mini-refinery at Dagestan in the Russian Federation. The plant, the first in the republic, will process up to 4,000 b/d of local crude oil to produce gasoline, diesel, naphtha and heavy fuel oil.

Conoco has started develop-ment drilling on its MacCulloch field in the central North Sea. Three horizontal production wells are to be drilled.

The North West Shelf Consortium has discovered new reserves of oil and natural gas approximately 130 km off the northwest coast of Australia. Subsea completions to the FPSO vessel *Cossack Pioneer* on the nearby Wanaea and Cossack oilfields will allow the new discovery to be developed at a relatively low cost.

23 March

Statoil has announced plans to build Norway's first gas liquefaction plant at Tjeldbergodden. The plant will have initial LNG capacity of 7,500 tonnes/yr and is scheduled to start production in autumn 1997.

25 March

Burmah Castrol has sold its Swedish service station network to Norsk Hydro Olje for £24m. Proceeds of the sale will help reduce Burmah's net borrowings.

26 March

LASMO and National Power are to conduct a feasibility study on the prospect of supplying LNG for power generation in Pakistan.

Shell Expro has awarded Colfixip Stena Offshore Limited (CSOL) a contract for the replacement of a water injection pipeline between the Tern and Eider platforms. The 16-inch diameter pipeline will be plastic-lined in order to help to reduce costs.

Arco has signed a co-oper-ation agreement with Lukoil for the joint development of oil and gas projects in Russia and other former Soviet Union Republics.

27 March

Shell and Evikohn have formed a joint venture company, Salyum Petroleum Development, to develop the Salyum oilfields in Western Siberia. The fields have recoverable reserves of 100 million tonnes. Plateau production is expected to reach 120,000 b/d. Total expenditure over the lifetime of the project will exceed \$10bn.

Monument Oil and Gas has announced plans to return £50m of capital to shareholders following the coming onstream of the Liverpool Bay development earlier this year. The payment is equivalent to 7.5 pence per share and amounts to almost a third of the company's published net assets.

28 March

Total's Badamyr-1 appraisal well in the Moattama permit near the Yadana field in Myanmar has produced at a cumulative rate of 32 mncuft/d.

Clyde Petroleum has com-pleted the acquisition of Marathon Petroleum Indonesia and assumed ownership of the Kakap Production Sharing Contract.

The ECS joint venture between European Marine Contractors and Colfixip Stena Offshore Limited has been awarded a £41m contract by BP for pipelay and subsea installation activities on the North Sea ETAP development project.

Ranger Oil reports that its recently completed winter drilling programme at Helmet in northeast British Columbia has added new gas production totalling 20 mncuft/d. Producing over 50 mncuft/d, the Helmet area is Ranger's largest North American production asset.

29 March

The Norwegian parliament has given the go-ahead for the development of Norsk Hydro's Visund oil and gas field. First oil is scheduled for 1998. Gas, initially to be reinjected, is not expected to enter the market until 2006 at the earliest.

Energy Africa has forecast a doubling of production from its existing assets over the next three years. These include interests in the Nkossa development offshore Congo, the E-BT development in the Bredasdorp Basin offshore South Africa and the second phase of the Alba development in the North Sea.

Perenco subsidiary Kelt Cameroon has announced that its KF-2 well in the offshore area of the Douala/Kribi-Campo Basin in the Republic of Cameroon has produced oil at a cumulative rate of 9,800 b/d.

1 April

The UK government has approved plans for the onshore decommissioning and disposal of four redundant installations in the Viking gas fields (see *Petroleum Review*, April 1996) and a redundant flare column in the UK/Norwegian Frigg gas field.

Expro North Sea has secured a contract from Norsk Hydro for an extended well test of an appraisal well in the Hermod field in block 25-11.

SLP Engineering has award-ed an EPIC contract to Colfixip Stena Offshore Limited (CSOL) for the FPSO infield flowlines and riser installation on the MacCulloch field. Fast-track installation of the subsea system is scheduled to take place in August.

News in Brief

IOIS International Inspection

is to carry out the long-term inspection of Amerada Hess' North Sea production facilities. It is the first time that the oil company has awarded the inspection of its UK sector facilities to a single contractor.

2 April

Burmah Castrol reports that the buoyant Far East market helped it post a 15 percent increase in pre-tax profits to £253m on turnover of £3.04bn in 1995. Profits were also boosted by the sale of Burmah's UK petrol retailing network to the Frost Group in mid-1995.

Chevron affiliate Caltex

Petroleum has completed the \$2bn sale of its 50 percent stake in Nippon Petroleum Refining. Chevron received a dividend of \$550m from Caltex and will recognise a \$325m gain related to the sale in second quarter net income.

ABB Lummus Global has

been awarded the engineering services contract for Unocal Thailand's Pailin field in the Gulf of Thailand.

3 April

The Sea Empress has docked at the Harland & Wolff shipyard in Belfast. The vessel is to be cleaned out prior to inspection which will determine whether it should be written off as a total loss.

Amerada Hess Corporation

has sold its Canadian subsidiary to Petro-Canada for \$536.5m plus closing adjustments estimated at \$43.5m. The sale does not include Amerada Hess Canada's heavy oil and tar sands reserves.

4 April

Supermarket majors Tesco and J Sainsbury have increased petrol pump prices by up to 2 pence per litre following the recent surge in crude oil and product prices. Some oil companies have also put up their forecourt prices, while others have made no changes.

9 April

Amoco Orient Petroleum Company, China Offshore Oil Nanhai East Corporation and Kerr-McGee China Petroleum Ltd have announced the start-up of production from the \$620 million Luhua 11-1 oil-field in the Pearl River Mouth Basin of the South China Sea. The field is the largest to be discovered in the South China Sea to date with in-place oil reserves estimated at more than 1 billion barrels.

AOC Australia has secured

a \$30m contract from West Australia Petroleum for all maintenance and modification work on the operator's onshore assets in Barrow Island, Thevenard Island and the Perth Basin in Western Australia.

Kvaerner Energy has been

awarded a NOK435m subsea production equipment supply contract from Norsk Hydro for the Visund field in the North Sea.

Qatar has awarded \$1bn

worth of contracts to two consortia of Japanese, European and US firms, reports *Reuters* in Doha. The contracts cover the construction of platforms and pipelines to bring gas from the North Field, the largest single offshore gas field in the world, to an onshore liquefaction plant.

10 April

ABB Lummus Global has awarded the front end engineering design for Bapetco's (a joint venture operation between Shell Egypt and the Egyptian General Petroleum Corporation) Obayed field development in the western Egyptian desert.

Amoco Trinidad Oil

Company has made a fifth natural gas discovery on its licensed acreage off the east coast of Trinidad.

Amerada Hess Corporation

is selling its Canadian heavy oil and tar sands reserves to Elan Energy for \$23m.

Shell and BP are the only

oil companies to feature in a new MORI 'super league' of the world's most successful corporate identities. Coca-Cola, IBM and McDonald's lead the field with Shell and BP ranking sixth and ninth, respectively.

11 April

Conoco Vietnam Exploration & Production and state-owned PetroVietnam have agreed to jointly evaluate blocks 133 and 134 in the South Con Son Basin area of the South China Sea.

Global Marine Drilling

Company has been awarded the Gold Award for Occupational Safety by the UK Royal Society for the Prevention of Accidents in recognition of its safety record at the company's North Sea offshore drilling rigs this past year.

12 April

Racal Underwater Contractors is to service all Total Oil Marine's remotely operated vehicle (ROV) needs in the North Sea and North Atlantic under a new £3m, four-year contract. It is the first time that the oil company has combined all its ROV requirements within a single long-term agreement.

Amoco Egypt East Tanka's

East Tanka-3 discovery well in the Gulf of Suez has flowed at a rate of 4,884 b/d and 3.7 mncuft/d. It is the company's second oil find in the area within the last three months.

Expro Group Australian has

been awarded a two-year contract by operator BHP Petroleum for well testing services in the Australia-Indonesia Zone of Co-operation in the Timor Sea. The company has also secured a contract for the provision of further well testing services on BHPP's other operations offshore Australia, including the North West Shelf and Otway/Dunroon basins.

13 April

Vietnam Oil & Gas Corp has put up for tender four offshore blocks in the vicinity of the White Tiger and Dragon fields off the southeast coast, reports *Lloyd's List*.

15 April

Greek shipping tycoon Stavros Niarchos (86) has died in Switzerland.

Hardy Oil & Gas has

announced the sale of its US interests for a total cash consideration of \$179m. It is selling its Hardy Oil & Gas USA subsidiary, subject to approval of Hardy shareholders, to a new company (the acquirer) to be financed by Enron Capital & Trade Resources and operated by the existing senior management of Hardy USA. In addition, Hardy USA has agreed to sell certain of its oil and gas assets to a third party prior to its sale to the acquirer.

16 April

IT company Pragma Systems (Scotland) is to provide support for Elf Enterprise Caledonia's North Sea offshore personnel system.

AOC Australia has been

awarded a \$6m hook-up and commissioning contract by the Ampolex Wandoo Alliance in Western Australia.

Phillips Petroleum has

successfully tested its 30/7a P-12 well and proved additional reserves in J-block.

17 April

Amerada Hess has declared the South Arne field commercially viable to the Danish Energy Agency. The field is located in the northern part of the Central Graben area of the Danish Continental Shelf in the North Sea.

18 April

PES (International), Tritech International, Geolink (UK) and Expro North Sea have won Scottish Offshore Achievement Awards for overall performance, small company performance, export and technology, respectively.

Full steam ahead for Schiehallion development

The UK government has given BP and its co-venturers the go-ahead for the development of the Schiehallion oilfield and its satellite Loyal— which lie 100 miles west of Shetland.

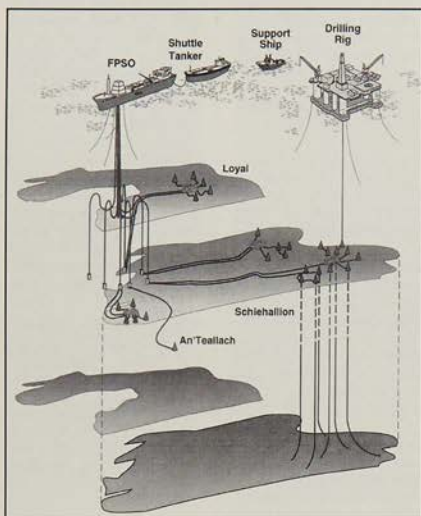
The £900 million project centres on 29 seabed wells, completed in four clusters. First oil is expected early in 1998 and will be handled by a floating production storage and off-loading vessel permanently stationed on the field. A shuttle operation will transfer oil every four to six days.

The Atlantic Frontier Alliance, a consortium comprising Brown and Root, Single Buoy Mooring, Coflexip Stena and Harland & Wolff, has secured the contract for design, engineering and procurement of the new-generation production vessel. Said to be the largest of its kind to be built to date, the vessel will be capable of processing a plateau production of 142,000 barrels of oil per day and has a storage capacity of 900,000 barrels.

Well engineering work will be undertaken by an alliance of BP and PRISM (a joint venture between Schlumberger Oilfield Services and Baker Hughes INTEQ). Trafalgar John Brown has been awarded the contract for subsea design, fabrication and installation.

In order to reduce emissions, gas from Schiehallion will be re-injected, probably into a separate structure named An Teallach.

A displaced gas recycling system will also help minimise



volatile organic compound emissions during transfer operations to the shuttle tankers.

As yet, it has not been decided where the crude will be landed. Sullom Voe in Shetland and Flotta in Orkney are two possibilities, while the prospect of sending the crude direct to European refineries is also being considered.

Schiehallion lies in 375 metres water depth and has recoverable reserves of 340 million barrels of oil. Loyal has reserves of 85 million barrels. The project is the second to be

developed by BP and Shell in Atlantic waters to the west of Shetland – the first is Foinaven which is due to come onstream later this year.

BP Exploration holds a 33.35 percent interest in Schiehallion and acts as operator. Shell UK also holds a 33.35 stake in the field. Other participants are Amerada Hess (15.67 percent), Aran Energy Exploration (5.87 percent), OMV (UK) (5.87 percent) and Murphy Petroleum (5.87 percent). BP (operator) and Shell both hold a 50 percent interest in Loyal.

New offshore design and construction rules

New regulations on the design and construction of offshore installations and wells are scheduled to come into force on 30 June.

Completing the UK Health and Safety Commission's programme of review and reform of offshore safety law announced in August 1992, the new Offshore Installations and Wells (Design and Construction etc) Regulations 1996 will:

- modernise and simplify present legal requirements to introduce a goal-setting legislative framework for the design and construction of offshore installations and wells;
- implement recommendations in Lord Cullen's report on the 1988 Piper Alpha disaster;
- complete the implementation of offshore of a number of detailed provisions deriving from the Extractive Industries (Boreholes) Directive which relate mainly to the workplace environment on an installation; and
- support and complement the objectives of the Offshore Installations (Safety Case) Regulations 1992, an amendment which makes mandatory a scheme of independent verification of safety-critical elements of offshore installations.

Oil industry boosts UK trade figures

The latest figures from the UK Petroleum Industry Association indicate that the oil industry continues to boost UK trade figures significantly. UK refineries contributed over £1 billion to the balance of payments in 1995 for the third year running, while net exports of petroleum products amounted to £1,133 million, up from £1,087 million in 1994.

Petrol sales declined nearly 4 percent last year, reflecting a steady downward trend over the past five years. Diesel sales rose by 4 percent. Total fuel

UK trade figures

use, therefore, remained static over the year in terms of actual tonnes sold.

Meanwhile, retail prices, which have been rising in line with government policy to increase fuel duties by at least 5 percent above the rate of inflation, have recently fallen back to 1994 levels as a result of the current petrol pump price war being waged on UK service station forecourts.

Sales of aviation fuel, which have grown steadily over the past five years, jumped by over 5 percent in 1995.

Israel takes legal advice on setting up competitive natural gas industry

Denton Hall law firm is to advise the Israeli government on the proposed purchase of natural gas from Egypt and the setting up of a natural gas industry in Israel.

The project represents 'a unique piece of legal work', according to Denton Hall's Malcolm Groom. 'Not only is Israel setting up a gas industry virtually from scratch, it will be the first country to introduce competition from

the outset, rather than setting up a state-owned company and then privatising it,' he said.

In addition to advising on gas purchase agreements with Egyptian suppliers, Denton Hall will advise on policy and legislation. The law firm will also be involved in providing advice on the interrelations between the agents, the main transport company and the gas distributor.

First joint venture Egyptian/Israeli oil refinery

Banque Nationale de Paris (BNP) and NatWest Markets (NWM) are to arrange the international debt financing for the construction of a new refinery in Alexandria, Egypt.

The refinery is owned by the Middle East Oil Refinery (MIDOR), a private sector joint venture between Egypt and Israel.

According to NWM, this is the first major private sector project to arise out of the Middle East Peace Process promoting joint industrial development and represents a major step forward in the commercial links

between Egypt and Israel.

The private sponsors – Mr Hussein Salem of Egypt and Mr Yosef Maiman of the Merhav Group of Companies of Israel – both hold 40 percent equity. Egyptian General Petroleum Company holds the remaining 20 percent, a level which under Egyptian legislation leaves the project in the private sector.

The refinery will process 100,000 barrels per day using 'bottom of the barrel' cracking processes. These processes will provide a large proportion of high grade fuels with emissions

controlled to European standards,' states NWM. 'It will be the first refinery to be built in Egypt using this process.'

Technipetrol and Technip, together with a number of subcontractors, have secured the \$1,300 million construction contract.

A mixture of European and possibly Asian export credit agencies will provide project financing. Additional support will come from local financing and the European Investment Bank. BNP and NatWest are to arrange a package of \$600 million of debt.

OPEC threatened

Despite enjoying the current relatively high level of crude prices, the Organisation of Petroleum Exporting Countries (OPEC) faces two threats – from natural gas and from expanding production from non-OPEC countries.

Addressing the recent Centre for Global Energy Studies conference in London, Chairman Sheikh Ahmed Zaki Yamani outlined a pessimistic view of the organisation's future prospects. He said 'The unexpectedly high oil price is a temporary phenomenon, whereas the competition OPEC oil has been facing from natural gas on the demand side and non-OPEC oil on the supply side is not going to go away.'

OPEC member states are at present enjoying a period of unexpected high oil prices, while output has exceeded its quota total by 1.2 million barrels per day (b/d). This occurred because oil production outside OPEC did not reach the expected levels in recent months and at the same time a cold northern hemisphere winter stimulated demand. This caused a run on stocks, especially in the United States, Europe and Japan.

Sheikh Yamani believes that this situation will not continue – stocks will be rebuilt and one day Iraqi oil supplies will return to the market. For these reasons he described the present situation as the 'calm before the storm.'

The time will come, he predicted, when OPEC will have to move from its role as residual supplier; Saudi Arabia and Kuwait cannot carry the burden of keeping up oil prices. Neither now have the financial reserves, thanks to the Gulf War, to be able to cut prices in order to maintain their market share.

According to CGES estimates, demand for OPEC crude might rise by at most 2.4 million b/d by the year 2000. But spare capacity already totals 3.5 million b/d, with Iraq producing at around 600,000 b/d. Such 'huge potential excess oil supplies' will create immense pressures on the market. Hence Sheikh Yamani's pessimism.

New HSE division

The UK Health & Safety Executive (HSE) has established a new division to co-ordinate safety in the chemical explosives and other onshore hazardous industries.

While the HSE has long had responsibility for regulating such activities, it states that bringing them together under one command will provide the opportunity to 'further increase our impact in these areas of high public concern'.

The new Chemicals and Hazardous Installations Division (CHID) will have responsibility for HSE onshore operational functions in the following sectors:

- Chemicals manufacture, processing and storage;
- Explosives manufacture, processing and storage;
- Major hazards associated with non-chemical related activities;
- Major hazard land-use planning;
- Gas transmission and distribution;
- Pipelines;
- On the road transport of dangerous substances; and
- Petroleum licensing and fire certification at major hazard sites.

Dr Paul Davies, Director of CHID, hopes that the new division will help industry to prepare for regulatory changes expected as a result of forthcoming European Directives in the next few years.

Rockall Trough licences on offer

The Irish government offered 615 full and 35 part blocks in frontier exploration acreage in the Rockall Trough lying 100 to 650 kilometres off the west coast of Ireland in its 1997 licensing round announced last month. The round, which covers 150,000 km², follows the UK offer of acreage in the region in November 1995 (see *Petroleum Review*, January 1996).

Mr Emmet Stagg, the Minister of State at the Department of Transport, Energy and Communications stated that all applications must be lodged by 26 March 1997. A technical evaluation comprising all known geological and geophysical data on the Irish Rockall Trough will be published this month. According to Mr Stagg, this is the first comprehensive assessment of the hydrocarbon potential of the area.

Several contractors have pro-

posed further data acquisition programmes in the Rockall Trough region which, if supported by the industry, will provide a good dataset on which acreage offered in the round can be assessed.

The minister also announced that, in recognition of the special nature of the acreage being offered in the round, the normal five-year period for data confidentiality will be extended to seven years for new speculative surveys carried out in the region before the closing date of the round.

The southwest portion of the Rockall Trough, which Mr Stagg closed in May 1995, is not included in the round. Neither is the Porcupine Basin, closed since the date of the Porcupine Round in December 1994. Both areas will be reviewed after the award of the Rockall Trough licences in 1997.

Durward gets development go-ahead

Amerada Hess and its co-venturers have been given the green light by the UK Department of Trade and Industry for the development of the Durward field in blocks 21/16 and 21/11 in the central North Sea.

The field, which has recoverable reserves estimated at 50 million barrels, is to be developed using a

floating production storage and offloading vessel. First oil is scheduled for the first quarter of next year. Peak production is expected to reach 38,000 b/d.

A plan to develop the Dauntless field in parallel with Durward is to be submitted to the DTI shortly. Dauntless would add 17,000 b/d to total production.

Newsdesk

Tales from early UK oil exploration

To celebrate 30 years of PESGB activity, the society has published a compilation of stories, articles and pictures that provide an interesting and entertaining insight into the professional lives of the early UK oil and gas explorers.

The publication, entitled *Tales from Early UK Oil Exploration*, is available from

PESGB at a cost of £7.50 (plus p&p) for PESGB members and £15.00 (plus p&p) for non-PESGB members. Institute of Petroleum members can obtain a copy for £7.50 (plus p&p) if orders are received within the next four weeks.

Postage and packaging costs £5 within the United Kingdom, £6 in Europe and £15 elsewhere in the world.

Emerald field decommissioned

Nowsco UK Limited recently completed the abandonment of Midland Scottish Energy's Emerald field in the North Sea.

The field consisted of four subsea producing wells, two satellite injection wells, five subsea cluster producing wells as well as a number of gas lift umbilicals, two subsea production pipelines and an export production line.

Decommissioning involved flooding of the export line gas lift and umbilical system, cleaning of subsea pipelines, subsea manifolds and production umbilicals, well-killing opera-

tions and nitrogen inerting operations of the topsides production facilities.

Once Emerald field assets were rendered clean and safe, risers were cut and the production rig removed for refurbishment.

According to Nowsco, the use of a single service company for the abandonment project not only reduced the number of offshore personnel and equipment required but also considerably advanced the completion date of the project which finished four days ahead of its 18-day schedule.

Environment Agency gets to work

The Environment Agency for England and Wales, created by the Environment Act 1995, came into existence on 1 April.

Bringing together the National Rivers Authority, Her Majesty's Inspectorate of Pollution and 83 local authority Waste Regulation Authorities as well as a number of small units from the UK Department of Environment which deal with aspects of waste regulation, contaminated land and toxic substances, the Environment Agency employs 9,000 staff and has a 1996/97 budget of approximately £500 million.

The agency claims not only to be one of the biggest environmental protection bodies in the world but also unique in Europe as the only organisation to look at the quality of air, land and water together. According to Dr Jan Pentreath, Chief Scientist and Director of Environmental Strategy for the new agency, such a total overview is essential if different environmental risks are to be compared against each other on even terms to allow

priorities to be identified at national, regional and local levels and to ensure that money for environmental improvements is spent in the most effective way.

As part of its work on protecting and improving the environment, the Environment Agency is setting up a detailed and interactive database on the state of the environment. The information will be placed on the Internet and regularly updated.

A national overview of the data collated so far was published in report form to coincide with the agency's launch. *The Environment of England and Wales - a Snapshot* looks at various 'pressures' on the environment such as energy consumption, transport, heavy industrial processes and releases to the atmosphere, in both text and graphic format.

It also contains some commentary on the nature and extent of the agency's likely future responses to some of the issues which the information raises.

Report on travel trends and fuel consumption in the United Kingdom

People in the United Kingdom are consuming energy and fuel resources at an ever-increasing rate, according to a recent report from the Department of the Environment.

Entitled *Indicators of Sustainable Development for the United Kingdom*, the report shows that the average person today travels far less for each gallon of fuel consumed than in 1970

despite the development of more efficient vehicle engines.

The key to this trend lies in the costs of travel in the United Kingdom. In 1970 the comparatively well off could afford to travel by car, which was more expensive than public transport. However, while disposable incomes have doubled since then, the real cost of motoring has fallen along with

the price of oil and petrol. At the same time, bus and rail fares have risen dramatically. Fuel efficiency has dropped as a result as millions of people travel to work singly in cars rather than sharing a bus or train and using less fuel per mile.

Car travel has nearly doubled since 1970 to an average of 6,500 miles per person per year while travel on buses and coaches has fallen by a quarter to under 600 miles/person/year. Train travel remains fairly static at 400 miles/person/year.

However, the report does indicate that some environmental problems are improving as a result of increasingly stringent regulatory controls on emissions. For example, emissions of sulphur dioxide and nitrogen oxides from power stations have fallen by 30 percent since 1970.

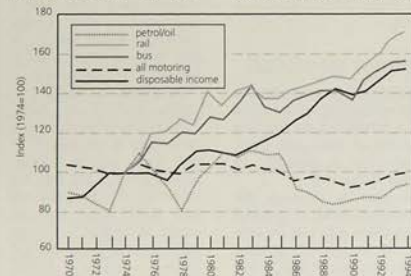
The study also shows that primary energy consump-

tion has remained fairly constant since 1970, despite a 60 percent increase in GDP, indicating that the economy has become more fuel-efficient overall. Most of the improvement has been in the manufacturing sector where energy consumption has fallen by 40 percent.

Meanwhile consumption has increased by 15 percent in the commercial sector since 1970 and by 20 percent in the domestic sector.

Fuel consumption has grown fastest in the road transport sector, rising nearly 90 percent since 1970. It now accounts for a quarter of total final energy consumption.

The report states that there has been no improvement in fuel efficiency over the last 20 years, largely because of the decreased use of public transport, despite improvements in the fuel efficiency of individual vehicles.



Real changes in the cost of transport in the United Kingdom

Diary Dates



Joint meeting:
Exploration & Production Discussion Group and
Information for Energy Group

Performance Contracting: Beyond Alliancing –

**The upstream service industry
in the next millennium**

**Thursday 9 May, tea at 17.00 for
17.30 until 19.00**

By Mr Robin Pinchbeck, Managing
Director, Atlantic Power & Gas

IP contact: Jenny Sandrock



Energy Economics Group

Recent Developments in US Energy Policy

**Wednesday 15 May, tea at 17.00 for
17.30 until 19.00**

By Mr Bruce Rogers, Commercial Attaché,
US Embassy, London

IP contact: Jenny Sandrock



Energy Economics Group in conjunction with World
Petroleum Congresses and British Institute of Energy
Economics

Energy Industries in the 21st Century – The Role of the Pacific Basin

Friday 24 May, 13.00 to 14.00
at the Institute of Petroleum (followed by optional pub
lunch nearby)

By Dr Dennis J O'Brien, Managing
Director, Petroad

IP contact: Jenny Sandrock



Joint meeting: Exploration & Production Discussion
Group and Energy Economics Group

Myanmar (Burma) – Emerging Market Potential

**Thursday 6 June, tea at 17.00 for
17.30 until 19.00**

By Mr Keith Win, Principal, K E Win &
Associates and **Professor Robert Taylor**,
School of Oriental & African Studies

IP contact: Jenny Sandrock



London Branch

Back to Basics – Lubricating Oils

Wednesday 22 May, tea at 17.15 for 18.00

By Messrs F T Stribley, I Robinson, R Meads, Consultants

Lubricating oils are the most sophisticated of all the products obtained from petroleum. How are these complex, high boiling-point materials refined, blended and marketed to match consumers' requirements? The answer to this question will be provided by a team of three speakers, each an expert in his particular field.

Light refreshments will be available afterwards. Enquiries: Mrs E Walker, Hon Secretary, London Branch, Tel: 01926 404768 or Mr J M Wood at the Institute.

All meetings are held at the Institute of Petroleum
Please tell the IP contact if you plan to attend any of these free meetings
Tel: 0171 467 7100 Fax: 0171 255 1472

Newsdesk

From Burmah to the Arctic via Swindon Town

Mr Rikki Hunt, football fanatic and former Managing Director of Burmah Petroleum Fuels Ltd, is not so much heading for pastures, pitches or oil-fields anew, but ice floes.

Mr Hunt, at present Director of Swindon Town Football Club following the sale of Burmah Petroleum Fuels to Save Petroleum, was selected from 500 applicants to take part in a walking expedition to the magnetic North Pole.

The trip, led by David Hempleman-Adams MBE, kicked off last month in

Resolute Bay, on the south side of Cornwallis Island in Canada's North Western Territories, and is expected to last 30-40 days. The team consists of 12 novice and four experienced explorers, who are expected to cover 10 miles per day on the 350 mile journey in extreme temperatures of between -25° and -40° C. To help them cope with the harsh conditions all walkers had to undergo rigorous training which included 27-mile marches and army assault courses. A British and a Norwegian woman are the

first to attempt the trip to the North Pole.

Mr Hunt's aim is to raise money for The Mitchem Trust, a local Wiltshire charity that provides opportunities for children to build self-esteem by experiencing a range of outdoor activities. So far this has raised £25-30,000.

Before he set off, the former Burmah MD told *Petroleum Review*, 'I will feel fantastic when it is done but I'm a bit upset at missing the Liverpool/Manchester FA Cup Final.' Assuming that this expedi-

tion does not dampen his enthusiasm, he has already planned his next trip – to climb Aconcagua in Chile, the seventh highest peak in the Andes.



The drive towards universal communication

Standardisation is one of the keywords in the philosophy of CRINE – Cost Reduction Initiative in the New Era. An excellent example of the movement towards greater standardisation is the Fieldbus communications protocol which addresses the obvious need for a universal system for transferring data.

Launched in March by the Fieldbus Foundation, the Fieldbus communications protocol brings together the best of two existing network management systems – ISP (Interoperable Systems Project) and World FIP. This is a fully digital worldwide standard which will support the HART protocol – Highway Addressable Remote Transducer. This gives field devices the capability of communicating instrument and process data by digital as well as analogue means. It can include calibration, configuration, diagnostic, maintenance and other process data. The protocol provides total system integration via a host device. It can network several devices to a single communication line and is suitable for remote applications.

Speaking at a conference organised by Fisher Rosemount in Angoulême, France in March, Stuart Harris, Manager Asset Management Solutions, Fisher Rosemount, said, 'Today the HART protocol is capable of handling multi-parameters

from a single field device whilst maintaining compatibility with analogue systems. In the near future, Fieldbus will make possible multi-parameter, multi-drop communications with almost unlimited throughput capacity.'

Like the HART protocol, Fieldbus will be an open system available to all users and equipment suppliers. HART was introduced by Fisher Rosemount which then declared it an 'open' system so that anyone could take it up for their applications/products. Some 70 companies then joined together to form the HART User Group and later in 1994 became the HART Foundation. In this way the system was widely adopted and virtually became standard.

For its part Fisher Rosemount is already working on the next generation of field instruments including measurement devices with SMART capability (to measure more than one process variable and to enable two-way communication of real-time information).

Its first technology for the use of the future Fieldbus is already available – a multi-variable and multi-function instrument for flow measurement on distribution networks. It is envisaged that these new instruments will all communicate via open standards.

A considerable advantage to be gained from the new gener-

ation of instruments is that information can be made more widely available on a PC to users throughout a company or organisation for validation, records management, regulatory compliance, predictive maintenance and, hopefully, fewer shutdowns. Information is no longer confined to the control room.

By these means substantial cost savings are predicted. According to Mr Allan Haining, Senior Control Engineer, BP International, his company has carried out trials, for instance, on a flowscanner – in-line control valve diagnostic equipment – which showed that nine of the 15 valves on the Magnus water injection plant were removed for overhaul unnecessarily.

This indicated that a cost saving of 50 percent of the overhaul costs was possible. On a larger overhaul such as a total offshore platform, he believed that the savings could exceed \$100,000. He concluded, 'It is the Fieldbus communications capability which will provide easy and cost-effective access to all the process and diagnostic information.'

In this new world, according to Mr Harris, 'Information from intelligent instrumentation and condition monitoring equipment is communicated under the HART or Fieldbus protocols to serve the needs of the entire business.'

Water pollution in Turkey denied

Environmental activists from Greenpeace have alleged that oil production operations have polluted the water supply of Diyarbakir in southeast Turkey.

They claimed that Shell's subsidiary, NV Turkiye Shell, had pumped produced water contaminated with traces of crude, solvents and other chemicals into the Midyat formation, starting in 1973. This underground formation was subsequently used as a water supply source for Diyarbakir, a city with 2 million inhabitants.

Shell admitted that this practice had taken place, starting before the Midyat was used for water supply, but was now being changed so that the waste water was reinjected into a lower formation – the Mardin – which was not connected to the city's water supply source. A company spokesman said that there was no evidence of contamination in the drinking water at present and that the reinjected water represented a tiny proportion of the water in the aquifer which provided only 10 percent of the city's water supply. These facts were known to the local authorities and testing was continuing although the waste water was now being increasingly reinjected into the oil-bearing reservoir and Shell had sold its Turkish production operations to Perenco on 1 January.

Stability in the Middle East?

Three scenarios

**By Dr Rosemary Hollis,
Head, Middle East
Programme, Royal Institute
of International Affairs**

The root causes of instability in the Middle East run deep. Population growth rates are high, which spells pressure on the governments to increase provision for health care, education and job opportunities. Scarcity of fresh water supplies constitutes an imperative to channel resources to industry rather than agriculture, for the best returns.

Stimulation of the industrial sector requires expansion of the basic infrastructure arrangements, economic liberalisation and tailoring education to the needs of the job market.

This is the mix of challenges facing all the economies of the region. The oil producing states cannot rely on income from energy sales to cushion them, because relative returns on such sales remain essentially static in the face of increased output from non-Middle Eastern producers. The absence of Iraq from the market has enabled other Gulf producers to delay major restructuring. Blessed with excess capacity, Saudi Arabia has actually doubled output since Iraq came under sanctions. Iran has avoided having to accommodate potential investors with equity stakes to keep up production levels. The crunch is coming, however, with the prospect of Iraqi oil resurfacing.

Those countries with few or no oil reserves are under far greater pressure to adapt to the realities of the new global economy. Yet economic liberalisation tends to spell job losses and reduced welfare spending in the short run, which in turn threatens social unrest. Both within and between the economies of the Middle East there is thus the spectre of a widening gap between the 'haves' and the 'have-nots.' This does not make for harmony between states and it portends greater pressure on governments to address criticisms of corruption and privilege in high places.

True, the Middle East peace process promises to ameliorate – if not end one – of the worst causes of division and hostility within the region. It could even open the way to a wholesale reordering of regional economic and political relations. However, that prospect requires governments to rethink their priorities and focus on internal sources of discontent, and it is these which are among the most serious threats to stability. The unrest in Bahrain has pointed the way. The transfer of power from King Fahd to Crown Prince Abdullah in Saudi Arabia, meanwhile, raises immediate questions about continuity at the highest levels. Meanwhile, the consequences of 'dual containment' for Iraq and Iran pose perhaps the greatest uncertainties haunting the region.

Against this background, it would not be wise to predict a single outcome.

Consequently, this paper will look at a spectrum of possibilities for the economies of the region, from turbulence and fragmentation to a brave endeavour to embrace the demands for change.

Domestic problems and challenges

Among the countries of the Middle East there are a lucky few, like the United Arab Emirates (UAE) and Kuwait, where available income is more than sufficient to pro-

vide a comfortable standard of living for the indigenous population. That does not inure these states from external threats to their stability and independence but it does mean that they are relatively free from the kinds of pressures mounting up on the domestic front elsewhere.

In the majority of states of the Middle East, population growth rates are so high that government revenues are insufficient to keep pace with the ever growing demands for health care and education, without cutting back on the level of provision. In fact, in most cases access to higher education has been expanded over the past two decades but this has meant the arrival on the job market of young people with little inclination to undertake menial work, yet insufficiently skilled or qualified for the technical, business, professional and management functions that are needed or available. In Iran, for example, wider access to higher education has brought a reduction in standards. In Saudi Arabia, meanwhile, there is a surfeit of graduates in religious studies and the humanities compared with those with scientific and technical qualifications.

The ability of governments to create jobs in the state sector has reached a plateau. Those with oil revenues are experiencing a drop in real income, because of static prices and increased production elsewhere in the world. Some members of the Gulf Co-operation Council (GCC) have had to borrow to meet their bills from the Gulf War. When Iraq entered that war, it was already heavily in debt from its war with Iran and it will have to borrow anew to rebuild. Iran, meanwhile, over-estimated prospective revenues from oil sales in the early 1990s and is now having to cut back heavily on imports and spending to meet its debt repayment obligations.

Further afield, Egypt and Algeria are bound into economic restructuring agreements with the World Bank and the

IMF. The message from these quarters to all the states of the Middle East and North Africa is that a radical reordering of their economies is unavoidable, if they are to stimulate growth and generate new business activity. The absence of Iraqi oil from the market has bought other oil producers of the Gulf a temporary advantage in revenue levels but the basic trends indicate that they cannot hope to avoid some restructuring of their economies in the longer term. Not surprisingly, though, they are reluctant to embrace the challenge, because the political consequences are not altogether attractive.

In Iran's case, the requirement is probably that it will have to allow foreign companies a real stake in its upstream energy sector and this flies in the face of the government's determination to maintain undiluted national sovereignty. Across the Gulf, in the GCC, the key to attracting more foreign investment is the introduction of regulatory practices and a judicial system that foreigners can both understand and rely on. This means curtailing the patronage system and royal privilege. In Algeria the risks of doing business are of a different order, unless the government can guarantee a greater measure of personal safety from terrorism to its nationals and foreigners alike. In Iraq a rehabilitated regime could re-impose its traditionally tight control of law and order but for now it looks as though social norms have been overtaken by an unprecedented crime wave.

The nature and extent of the problems vary enormously, from state to state, yet across the Middle East and North Africa all governments face some requirement to rethink their role in economic affairs and establish regulatory environments more conducive to business development.

Regional and international setting

At the regional as well as the domestic level in the Middle East resource distribution is a potential cause of conflict. Many of the border disputes that remain unresolved are about ownership of mineral wealth beneath land and sea. Access to water is also a concern, especially given the prospect of ever growing demands for this scarce resource as pop-

ulations increase and cities expand.

The GCC states cannot forge a closer alliance while Qatar and Bahrain are quarrelling about their maritime borders and Saudi Arabia and Qatar are at odds over their land frontier. The dispute between the UAE and Iran over the Gulf islands of Abu Musa and the Turks grumbles on. A new flash point for conflict has surfaced between Yemen and Eritrea in the Red Sea, while a border has yet to be agreed between Yemen and Saudi Arabia. Kuwait can certainly not rest easy in the shadow of Iraq, so long as the latter lacks ready access to the Gulf headwaters and both Iraq and Iran remain uneasy about the ambitions of the other for control over the Shatt al-Arab waterway.

The great river systems of the region present a further source of trouble. If Ethiopia and Sudan institute schemes which threaten the volume of water flowing down the Nile into Egypt, the reaction in Cairo is likely to be bellicose. Syria has yet to be accommodated in the arrangements worked out between Israel, Jordan and the Palestinians for sharing the waters of the Jordan river basin. Last, but not least, Turkey, Syria and Iraq are squabbling over usage of the Euphrates and Tigris.

The potential for conflict in the region is rendered more frightening by the levels of military manning and arms procurement, which are higher than in any other part of the developing world. Partly in reaction to Israel's capability and partly in competition with each other, Iraq and Iran have manifested ambitions to join the nuclear club. Chemical warheads are presumed to exist in a number of states and long-range missiles proliferate.

In the midst of this apparently volatile setting, the United States has attained the predominant role of security guarantor across the board. Its posture is based on access to facilities in North Africa, a military co-operation and assistance programme with Egypt, technical cooperation and military aid to Israel, the NATO alignment with Turkey and bilateral defence pacts, including arms sales and training programmes, with the GCC states. In addition there are US and allied naval and air deployments in the Mediterranean, the Indian Ocean and the Gulf. Current operations in the Gulf

include Operation Southern Watch over southern Iraq, Operation Provide Comfort over Iraqi Kurdistan, air and satellite surveillance of Iran, policing the sanctions on Iraq and, of course, UN monitoring of Iraq's weapons programmes and presence on the Iraq-Kuwait border.

The consequences for regional security are twofold. On the one hand, the US commitment is now intrinsic to the prevailing balance of power and any significant reduction in US involvement could presage an unravelling of the existing order. On the other hand, the US and allied Western presence is viewed with antipathy not only by those regimes that it is designed to contain, but also by dissident groups who see it as underpinning governments to which they are opposed. The bombing of a US military mission in Riyadh last November demonstrates the point. Some US defence guarantee may be the key to maintaining regional stability at one level, but too warm an embrace with the United States could aggravate unrest at the domestic level.

Scenarios for the future

The spectrum of possibilities ranges from peace and prosperity at one extreme to chaos and conflict at the other but it seems unlikely that developments will be uniform across the region. Consequently, there is room for a scenario somewhere between these two extremes, which could be called 'muddling through.'

Taking first the rosy scenario, which may best be termed the 'new dawn' of the Middle East. It could come about if governments in the region opt for policies which will stimulate business and inward investment by opening up their economies to competition within and across borders. The transition can be centrally managed and state control would still be imperative to protect the environment, penalise water wastage, regulate business practices and curtail corruption. Observers believe there is a thirst for accountable and less corrupt government, which does not necessarily translate into a demand for Western-style democracy. On the contrary, many of the Islamic critics of existing regimes direct their attacks at profiteering and immoral

practices by government leaders and officials, while actually advocating media censorship and enforcement of Islamic codes of conduct through the courts.

Nonetheless, to achieve an economic turnaround, Middle Eastern economies would have to open up to the free movement of people, goods and currencies, as well as integrating into global telecommunication systems. To elaborate on how this 'new dawn' scenario could pan out in specific cases – for the oil economies of the Gulf it means radical restructuring, including some political changes. In Saudi Arabia this could involve turning the *Majlis al-Shura* into a more representative and influential body; reducing the role and privileges of the ruling family; ending arbitrary practices and encouraging more private business. In Iran reorganisation of the power structure at the centre would end the propensity of competing factions to block effective decision-making, making way for a visibly competent and uncorrupted leadership committed to economic reform.

In Iraq Saddam Hussein would presumably be replaced by a less brutal and dictatorial regime able to reach accommodation with disaffected Kurds in the north and Shia in the south, even though efficiency might take precedence over 'democracy' *per se*. In Algeria, meanwhile, the army would have to steal the thunder of the most militant Islamists by forming an alliance with some Islamist technocrats, less tainted with corruption than the traditional power-brokers.

In general, the oil-producing states would decide to treat pressures for change as a challenge to be embraced rather than a danger to be suppressed.

At the opposite end of the spectrum of possibilities lies the doom and gloom scenario of 'turbulence and fragmentation.' This could happen if there is retrenchment, inertia, continued corruption and increased repression by the existing regimes. In Iraq's case it could mean that crime and the breakdown of social order accelerates, Kurdistan devolves into civil war, the authority of government diminishes in the south, and the only source of security at the centre derives from protection rackets. In other words, the state of Iraq would come apart, not into three neat sub-states, but into general chaos. By the same token, in

Iran the government – with its factionalism and indecision – could totter on at the centre but its control would continue to fray at the periphery. Component communities of the Sunni, Baluch and other minorities would each have to look to their own. The security of passage for oil pipelines and business personnel could not be assured. Economic recovery would be impossible.

In Saudi Arabia, meanwhile, the 'turbulence and fragmentation' scenario would mean that the royal family resorts to ever more restrictive security measures to curtail criticism and opposition in a costly campaign that deflects resources from productive activity. At some point, perhaps, the United States decides to institute security cordons, manned by the US military, around the oil installations in the Eastern Province. The numbers of pilgrims allowed to make the *Hajj* is cut due to more disturbances, which only serves to undercut the Islamic credentials and perceived legitimacy of the regime in the region. As for Algeria, the prospect would be descent into civil war, with the Kabyles or Berber community a law unto themselves. Some oil and gas installations would fall within the sphere of disorder and, in any case, there would be no single source of authority to hold accountable. Of course, one of the side-effects of interruptions to energy supplies to Europe would be an increase in the price of oil and gas.

It seems improbable that all states will collapse into chaos simultaneously, however. Much more likely is that some economies will 'muddle through,' while others deteriorate and a few perhaps thrive. Up to a point it is a zero-sum game. Iraq's lost revenue is Saudi Arabia's gain at present. In the future, relative fortunes may simply be reordered.

One version of the 'muddling through' scenario would be as follows: At one geographic extreme Algeria would experience an indefinite period of low-level warfare but oil could still be pumped and gas supplies to Europe maintained by the deployment of NATO forces. This NATO involvement would, however, dash hopes of the regime winning over the Islamist opposition. Across the other side of the region, Iran could find itself gradually, but relentlessly debilitated by external

economic pressure and lack of competent leadership. The government would nonetheless linger on at the centre, neither collapsing nor restructuring. The malaise experienced in Iran would worsen as the amount of Iraqi oil on the market increases.

Continuing with this mixed picture, suppose Iraq is one of the relative winners. The country does not fragment and the return of its oil to the market enables the government to enhance its control and re-impose order across the south and over Iraqi Kurdistan. In Saudi Arabia, meanwhile, suppose there is modest restructuring and a greater measure of power-sharing, sufficient to hold the line against serious opposition. For its part, the general mass of the population calculates that the potential alternatives to continuance of Al Saud rule could render them no better off and possibly worse.

Conclusion

It is clear that all the states of the Middle East and North Africa have incentives to restructure not only their economies, but also aspects of their political systems. In some cases the incentives might better be described as imperatives, since the status quo cannot be sustained. However, there are external forces to take into account as well as domestic pressures. For some states those external forces could save them from having to make radical changes at home. Much will obviously depend on the level of world demand for Middle East oil. The role of the United States is also a determining factor.

Suffice to say, sources of instability appear to be increasing at the domestic level in the Middle East. In the unlikely event that all other things remain equal, a number of states are in serious trouble if they do not take remedial action now. Even so, some states stand to benefit from increased problems in others and the combined effect does not constitute stability, but it falls short of a general collapse.

This paper was given at an IP conference, 'Oil and Gas in the Global Economy – The Outlook to the Millennium', held during IP Week in February. The comments were therefore made prior to recent developments in the Middle East.

Qatar – large capital investment planned

By John Roberts

Qatar's energy industry is going through a process of rapid expansion – and change. The first of the emirate's major gas projects will come on stream next year, whilst work continues on the second LNG project and negotiations for a third such project become ever more intense. In oil, the Qatari authorities plan to increase their production capacity by almost half to around 620,000 b/d by the year 2000. Overall, the Qatari authorities forecast that investments in oil, gas and petrochemical industries between 1996 and the end of the year 2000 will total no less than \$25 billion.

In Doha, it is clear that the style, substance and pace of Qatari energy development are all changing. The emirate is basing its long-term financial and industrial future on gas. In June, the first 'Qatargas' LNG plant, being developed as a joint venture between the Qatar General Petroleum Corporation (QGPC) and Total, Mobil, Marubeni and Mitsui, is scheduled to be commissioned. In November, Qatargas (officially, the Qatar Liquefied Gas Company Ltd) will take delivery of the first of a fleet of 10 specially commissioned LNG tankers. And next January, the first LNG shipment to Japan will be made, to be followed almost immediately by the official opening of the actual LNG liquefaction plant and port complex on the Qatari coast at Ras Laffan.

'It's the largest LNG plant in the whole world,' Qatar's Energy Minister Abdullah bin Hamad Al-Attiah told *Petroleum Review*. 'It's a huge plant, a piece of art. We are very proud of Qatargas. We started construction in 1993 and we're finishing on time – and even ahead of schedule. And within budget.' Those last three words are particularly important. The Qatargas project is costed at \$6 billion and required extensive financing, including \$2 billion from Japanese banks to help pay for \$3 billion worth of downstream development work and \$680 million syndicated loan required for \$1.5 billion of upstream work. Most of the additional costs reflect the cost of the tankers and port facilities at Ras Laffan. QGPC says that the port was '99 percent complete' by the end of last year and that full completion and operation of all facilities were expected in September.

Mr Al-Attiah says that the Qatargas project is now 90 percent complete. Firm sale-and-purchase agreements have been concluded to provide 4 mil-

lion tonnes per year (mtpy) to Japan's Chubu Electric Power Company from 1997 onwards and a further 2 mtpy to a group of seven Japanese utilities. The Qatargas scheme is naturally dubbed 'the Japanese project' in Qatar, in view of both its market and participants. Chubu's original contract dates back to May 1992 and was followed a year later by the award of the principal construction and plant contract, for two 2 mtpy gas trains, to Chiyoda. In January 1995, Chubu, acting as buying co-ordinator for seven smaller Japanese utilities, exercised its option to take a further 2 mtpy, entailing construction of a third train which is scheduled to enter service in 1998. In addition, the Japanese-built tanker fleet will be owned by a consortium of Japanese ship-owners who will lease the 135,000-tonne vessels back to Qatargas. Sailing time between Ras Laffan and Chubu's specially built terminal at Kawagoe will be around one month.

Changing partners

The project's ownership structure reflects different roles in the upstream and downstream sectors. Qatar entered into a Development and Production Sharing Agreement with the core foreign partners to provide for the \$1.5 billion upstream development of a 100 sq km section of the giant North Field gas reserve for feedstock. In this section of the project, the basic 65-35 percent project division is maintained but with the local offshoots of the main foreign partners holding their 35 percent stake in different proportions to the downstream shareholders. Upstream, the stakes are as follows: QGPC, the state energy venture, 65 percent; Total Qatar Oil & Gas, 20 percent; Mobil Qatar Inc., 10 percent; Mitsui & Co Ltd, 2.5 percent and Marubeni, 2.5 percent.

Not surprisingly, since the discovery of the North Field is attributed to Shell, there used to be a considerable British interest in Qatar's energy development. But Shell found it difficult to conclude satisfactory terms for development of the resources it had discovered and pulled out of Qatar in 1991. Shortly afterwards, in early 1992, British

Petroleum, one of the original partners when Qatargas was founded in 1984, relinquished its 7.5 percent stake, paving the way for Mobil's entry into the project.

Rasgas scheme

Mobil is believed to have taken its stake in the Qatargas project, in which Total is the upstream operating partner, in order to ensure its dominance in the emirate's second LNG project: Rasgas. The Ras Laffan LNG scheme, universally known as Rasgas, also has firm foundations in East Asia's appetite for Middle Eastern gas. The venture was set up in the Far East, with the Korea Gas Corporation signing a firm Sale and Purchase Agreement last October for 2.4 mtpy. Mr Al-Attiah, speaking in mid-March, noted that Rasgas was now seeking to finalise a further 2.4 mtpy agreement with Taiwan, whilst there are ongoing negotiations for a further 2.4 to 3 mtpy sale to Korea.

Rasgas is costed at \$4.2 billion for an initial two-train, 5 mtpy capacity. Comparable costs are expected for the subsequent 5-7 mtpy extensions being considered by QGPC and Mobil. But such extensions remain dependent on additional sales to Korea and the translation of existing memoranda of understandings covering some 9.5 mtpy of gas with the Petroleum Authority of Thailand, the state-owned Botas energy group in Turkey, five Japanese trading companies, India's Essar group and Germany's Ruhrgas.

In March, Rasgas awarded the principal downstream engineering, procurement and construction contract, covering at least the first train, to a joint venture involving Japan's JGC Corporation, MW Kellogg and the Hyundai group, which was understood to have bid around \$970 million. Despite this decision, Rasgas remains under strong Korean pressure to award further major project work to Korean firms. This appears to be holding up Korean approval of a further sale & purchase accord, despite a high level Qatari visit to Seoul in February intended to resolve the issue. The Rasgas project needs to secure at least one further substantial

sale & purchase contract since a one-train project is not financially viable. One problem is that Korea's Daewoo Corporation, working with Technip and other partners, bid for both the main downstream and upstream works but so far seems to have been frozen out.

Meanwhile, a decision is expected soon on the major upstream platform contract, with the choice seeming to have narrowed to a fierce competition between a joint venture involving Japan's Chiyoda Corporation and the Dubai-based McDermott ETPM group and a rival grouping of ABB Lummus and Abu Dhabi's National Petroleum Construction Company.

Third LNG scheme

Qatar is also considering a third LNG scheme, proposed by the Enron Corporation. This is the most controversial of the projects, not least because it is so politically sensitive. Enron's goal is to sell 2.5 mtpy of gas to India to serve the giant Dabhol plant which it is developing in Maharashtra. But it is proposing that the remaining 2.5 mtpy be sold primarily to Israel, albeit with some going to Jordan and the Palestinian National Authority, and with the deliquescence plant to be sited at the Jordanaian port of Aqaba (see *Petroleum Review*, December 1995). While Enron has secured a series of memoranda of understanding concerning such gas sales, there are as yet no firm sale & purchase agreements, and it is not clear when, or if, they will be signed. The Qatar authorities are taking a slightly reserved approach to the scheme. On the one hand, discussions about such sales to Israel furnish useful proof for the United States, to which the emirate has looked for military assistance in the wake of the Iraqi invasion of Kuwait, that Qatar is playing its part in helping to promote a key US foreign policy goal: the Middle East peace process. Yet it is unlikely that Qatar will approve any final agreement until it is sure that Israel has made peace, or is at least in the process of making peace, not only with the Palestinians but with Syria and Lebanon as well.

Oil prospects

Even though the Qatargas project will start to come on stream next year, it will not reach its initial 4 mtpy capacity until 1999 and, in practice, Qatar will have to wait until the 21st century for income to really start flowing from both the Qatargas and Rasgas projects. In the meantime, it is looking to boost its revenue stream from oil. Until recently, Qatar was producing around 400,000 b/d on a fairly regular basis – a little above its current OPEC quota. But output has been growing steadily in recent months and looks set to exceed 500,000 b/d in the future, with plans in hand that will ensure capacity rises by much more.

In early March, QGPC announced that oil development projects already under way would add an extra 200,000 b/d to previous capacity levels. This appeared to be based on now outdated estimates of a sustainable output capacity of around 420,000 b/d. Current output is already up to 450,000 b/d and Mr al-Attiah told *Petroleum Review* that, while the country's target for actual output for the year 2000 is just 500,000 b/d, 'There are some indications it may reach more than this.'

QGPC itself is currently working to bring capacity at the onshore Dukhan field from 270,000 to 330,000 b/d over the next two years but the real focus for activity concerns the country's foreign joint venture partners on the offshore fields.

The most exciting prospect is Block 5, where the Maersk Qatar Petroleum Company, a partnership with Maersk Oil, is still trying to evaluate just how big a discovery it has. In early March, Maersk Qatar approved a development plan that would take production up in stages from around 50,000 b/d at present to some 65,000 b/d by the end of the year, then to 75,000-80,000 b/d by the end of 1998 and to 100,000 b/d in the year 2000. 'The goal is to reach this plateau by the year 2000 – and maybe more than that,' commented Mr Al-Attiah.

New technology

One factor that could ensure a significantly higher rate of production is if a proposed water injection scheme

proves successful. In the meantime, Maersk Qatar has already secured one notable success – the drilling of what is claimed to be the longest horizontal well in the world. One such well, of 11,000 metres, came close to the former world record, Mr Al-Attayah says. A second well, at 15,000 metres, broke the record. Such technology is vital, for while QGPC asserts that to take production at the al-Shargi North field from around 20,000 b/d in 1994 to at least 70,000 b/d by the year 2000, Elf-Aquitaine is working under a 1989 PSA to develop Block 6, Al-Khaleej, while Arco and Wintershall have a PSA for development of the 'Structure Wintershall' to the immediate west and south of Maersk's North field concession area. Under a 1994 PSA, Pennzoil has been conducting seismic surveys in Block 8, to the west of the Idd al-Shargi fields, with drilling tipped to start midyear. Pennzoil, Maersk, Occidental and Japan's United Petroleum Development Company are also involved in discussions on PSAs covering a further series of blocks: Idd al-Shargi South, Karkara and the 'A' structure next to the Bunduq field. Bunduq, a joint field shared with Abu Dhabi, is currently producing around 30,000 b/d. United Petroleum is the operator, with output owned and shared equally by Qatar and Abu Dhabi.

QGPC is also bringing in foreign companies to boost condensate output by means of an 'alliance' venture, in which both the risks and rewards of a project are shared by working co-operatively with a group of partners. The Dukhan Arab D Gas Recycling Project being undertaken in collaboration with Brown & Root represents the first time that the alliance concept, developed in the North Sea, has been tried out by a

state oil company in the Gulf. QGPC's Technical Director, Abdul Razzaq al-Siddiqi, has said that in the four months that followed the initial alliance accord last September, the joint design team has been able to reduce costs, increase condensate output and shorten project development time considerably. They have also been able to screen 20 alternative options, compared with just seven screened by QGPC alone before the alliance was initiated.

QGPC's own initial plan for the project required two process trains handling 600 trillion cubic feet of gas per day (trillion meaning million million) with a 92 percent recovery rate that would yield 2,000 b/d of condensate once the project started in January 1988. The alliance plan postulates 800 trillion cfd of plant throughput through a single train, with a 95 percent recovery rate yielding 41,000 b/d of condensate from a start date at least six weeks ahead of the original QGPC estimate.

Qatar's experimentation with new technology in association with active participation by foreign oil companies could wind up blurring, if not eliminating, the difference between its vast gas resources and its more limited oil reserves. In recent months, Qatar has been discussing with Exxon the possibility of converting gas to liquids in order to obtain from gas the kind of refined product that usually comes from oil. Exxon is currently preparing a feasibility study and is looking at the possibility of a pilot project.

Unlike LNG, which requires both a long lead time to set up the liquefaction projects and sale & purchase accords lasting 20 or 25 years, 'This is something which can go into the open market and sell universally,' notes Ismail M. Nasralla al-Emadi, QGPC Manager

for Downstream Ventures. 'We're looking for a refined premium type of product, using the North Field as if it were crude; we don't want to put all our eggs in the LNG project,' he told *Petroleum Review*.

Transformation scene

The overall cost of what amounts to the transformation of Qatar's energy industry is considerable. In a presentation in early March, QGPC said the extent of oil sector investment output would total \$7.7 billion by the end of the year 2000, whilst gas investments would total \$14.3 billion and petrochemical industries \$3.3 billion. QGPC says that \$17.8 billion of this \$25.3 billion total will come from foreign investments and the rest from the country's own resources. 'The size of such investment clearly reflects the confidence of foreign companies in the investment climate in Qatar,' Mr Al-Attayah said.

The figures may well be on the high side since they include \$4 billion for the proposed Enron project. Yet even if the Enron project is sidelined or delayed, or if some of the petrochemical projects are deferred for a few years, the energy investments will leave the country financially stretched. One reason is that QGPC is, in effect, having to borrow to finance its own substantial equity stakes in a number of petrochemical projects. But the country's possession of recoverable reserves currently estimated at 380 trillion cubic feet provides the incentive for foreign lenders, especially the Japanese banks, to put up funding for the major gas projects. And what looks to be a steady expansion of actual oil production will help bridge the gap until the gas revenues start to come in next century.

Petroleum Review

Subscription Rates 1996

United Kingdom	£85 (VAT zero rated)
Overseas	£100 (\$160)
Overseas Airmail Direct	£140 (\$225)
Frequency of issue	Monthly

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Natural gas opens up a new era for Oman

By Dr Naji Abi-Aad,
Energy Consultant

Natural gas is opening up a whole new era of development for Oman's hydrocarbon industry. The Sultanate, in an attempt to diversify its economy away from oil, has decided to exploit its huge reserves of natural gas through a regional gasline scheme to the emirate of Ras al-Khaimah and two large export projects. The first (and more advanced) of these schemes entails the production of liquefied natural gas (LNG) for export by sea to markets in the Far East and possibly elsewhere, while the second involves pumping natural gas by pipeline to the Indian sub-continent.

The export projects were prompted by the discovery of the Saih Nihayda, Saih Rawl and Barik gas fields in 1992. Petroleum Development Oman (PDO) estimates that these large structures contain as much as 420 billion cubic metres (cu m) of non-associated gas reserves.

These discoveries have already led to the construction of two gas-fuelled power plants, as well as plans for a petrochemical complex and several schemes for exporting gas. The government is currently concentrating on two projects to export natural gas in the form of pumped gas and as LNG. A gasline from the offshore Bukha field to the emirate of Ras al-Khaimah is under construction.

The recent discoveries form only part of the total proved natural gas reserves

in Oman, which have increased steadily since the early 1980s. At the beginning of last year, proved gas reserves — the bulk of which are contained in Natih/Yibal, Lekhwair, Fahud, Saih Nihayda, Bukha, Marmul, Makarem, Saih Rawl and Barik fields — were revised upwards and officially estimated at 750 billion cu m, of which some 110 billion cu m are associated and about 640 billion cu m are non-associated gas. The proved gas reserves are officially estimated to reach 900-1,000 billion cu m in the next few years, as a result of an ambitious gas exploration programme.

In addition, Oman has a 50 percent stake in the offshore West Bukha (Henjam) gas field that straddles the maritime border with Iran in the Strait of Hormuz. The field, discovered in 1976, is estimated to hold about 30 billion cu m of natural gas reserves. The field could be tied into the gasline running from the Bukha field to Ras al-Khaimah. A preliminary agreement was reached last year between Oman and Iran for the joint development of the field, with production planned for the first half of 1998.

Bukha - Ras al-Khaimah gasline

An agreement was reached in July 1991 between the International Petroleum Corporation (IPC) of Canada, the Omani government and the Ras al-Khaimah Gas Commission (Rakgas), under which the IPC group undertook to develop the offshore Bukha field and transport its gas reserves by pipeline to the emirate of Ras al-Khaimah from 1994. The Bukha field was discovered in 1979 and is estimated to contain around 11 billion cu m of natural reserves and about 17.7 million barrels of condensates.

The \$60 million development programme carried out by IPC included the construction of a 35 km, 16-inch subsea pipeline for carrying the gas and condensate to the Rakgas onshore processing facilities at Khor Khwair, which consist of condensate and LPG units and an export terminal.

Since mid-1994, around 6,000 b/d of condensate and 1,100 b/d of LPG are

being transported to Dubai by road tanker, while around 1.13 million cu m/day of gas is piped to Rakgas free of charge in exchange for the use of its facilities. Discussions are currently under way with the other members of the United Arab Emirates for the export of further volumes of gas. Bukha's output was expected to reach 3 million cu m/day last year and rise to 7 million cu m by the year 2003.

Oman - India gasoline project

Negotiations have been taking place for the sale of Omani gas to India. In September 1994, the governments of the two countries confirmed the terms of an earlier agreement, deciding that, in the first stage, a 24-inch gasoline with an annual capacity of 10 billion cu m should be built by July 1999 and that a second 24-inch line should be laid parallel to the first one and completed two years later. The first phase is expected to cost \$2.8 billion and the second \$2.2 billion.

After considering two possible marine routes for the pipeline, the state-owned Oman Oil Company Ltd (OOC) opted in favour of the more direct one across the Arabian Sea, starting from Ras al-Jiffan on the Omani coast, running southeast for 240 km, swinging up to an easterly path through seas where the water depth is more than 3,000 metres and then moving from the Owen fracture on the extreme southern edge of Pakistan's territorial waters to Rapar Gadhwal in India. This subsea gasoline will be 1,135 km long, with a further 168 km onshore in India from the point of arrival at Blachau.

Pakistan has expressed its interest in importing Omani gas either through the projected gasoline to India or through a separate gasoline direct to Pakistan. Meanwhile, Oman has suggested to both Iran and Qatar, fellow members of the Gulf Co-operation Council, that they should consider linking up with its planned gasoline to India.

However, it seems that the proposal for the pipeline to India has now stalled as a result of financial and technical constraints. Potential equity partners in the project, such as Enron, have withdrawn;

the technical feasibility of constructing such a pipeline and its ability to withstand the high pressures necessary for the deep-water route have been questioned; and the Indian government has not yet committed itself to the long-term purchase agreement. All these negative factors have led the Omani government to indicate that the project has only a limited chance of success. It now appears that priority is to be given instead to the Omani LNG project.

In fact, financing two capital-intensive gas export projects seems problematic, at least both at the same time. Likewise, existing gas reserves would not be sufficient to sustain two gas export projects and leave enough reserves for future domestic consumption, especially at a time when the Omani government is pressing ahead with plans to replace the local consumption of petroleum products with natural gas.

LNG project

The Omani government and Shell International Gas Ltd are jointly undertaking the LNG project. A final decision to go ahead with the project was taken in May 1994 when the government confirmed that 200 billion cu m of natural gas reserves are being reserved for the production of LNG. The liquefaction plant will have an annual capacity of 66.6 million tonnes of LNG and is scheduled to begin production at the beginning of the year 2000. The whole project is expected to cost \$9 billion (1992\$), allowing \$2 billion for the upstream work, around \$3 billion for the downstream facilities and up to \$4 billion for the purchase of LNG tankers.

The upstream work includes the drilling of around 90 production wells on three gas fields (Saih Nihayda, Saih Rawl and Barik), a gathering system, an 8-billion cu m/year central processing unit near Qarn Alam in central Oman, and a 42-inch, 350 km pipeline link to the liquefaction plant. Development drilling is due to start in 1997, with the fields scheduled to come on stream in early 1999.

The government will be the sole owner of the upstream facilities and

PDO the operator. PDO has already awarded the Canadian firm, Delta Catalytic Hudson, a front-end engineering and design (FEED) contract for the facilities at the gas fields. It has also awarded a contract for laying the gasoline from the fields to the plant to R J Brown of Singapore.

The downstream facilities will include the liquefaction plant itself that will comprise two trains each with a capacity of 3-3.3 million tonnes/year, which will make them the largest ever built. The plant is to be located at al-Ghailiah on the northeast coast of the sultanate, about 15 km north of Sur and 200 km southeast of Muscat. The site is protected from ocean currents and tropical storms and the water is deep, enabling tanker-loading operations to take place throughout the year. Seven 130,000 cu m LNG tankers will be bought.

The Omani Liquefied Natural Gas Company (OLNG) was set up in May 1993 to build and operate the liquefaction plant and market its output. This is a joint venture between the Omani government (51 percent), PDO shareholders (42 percent — with Shell holding 34 percent, Total 6 percent and Partex 2 percent) and three Japanese companies — Mitsubishi and Mitsui 3 percent each and Itochu Corp 1 percent.

In November 1994, the OLNG awarded a FEED contract for the liquefaction plant to a consortium composed of M W Kellogg and JGC. The tender for the main engineering, procurement and construction (EPC) contract was put out in 1995. Technical bids by the four prequalified consortia — M W Kellogg/JGC, Fluor Daniel/Mitsui/Mitsubishi, Chiyoda/Foster Wheeler and Bechtel/Technip/ Snamprogetti — are due to be submitted shortly and commercial bids by April. The final investment decision will be taken later this year.

Meanwhile, in February 1995, the OLNG received from Korea Gas Corporation the first letter of intent for the purchase of Omani LNG. Korea Gas has in principle agreed to lift 3 million tonnes/year of LNG over a 25 year period starting in the year 2000. Talks have also been held with China which is considering lifting 1.5 million tonnes/year. 

Visit to Ford Dagenham

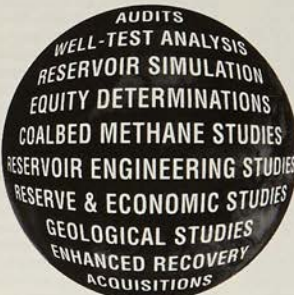
Wednesday 5 June 1996

The annual visit of the London Branch will be to the Ford Motor Company, Dagenham, on Wednesday, 5 June 1996, commencing at 1.15 pm. The tour of the manufacturing plant will last about 2 hours. Numbers will be limited to 50 people and those wishing to attend should register by 20 May 1996.

For further details and registration, please contact Mrs E Walker, Hon Secretary, London Branch, Tel: 01926 404768

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Revolution in the gas industry: a tale of two markets

**By Jean-Marie Dauger,
Executive Vice President,
Gaz de France**

The title of my presentation was, I guess, intended to reflect the alleged cultural differences between the Continent (and more specifically France) and Great Britain. What was Dickens' intention when publishing 'A Tale of Two Cities' and what are the possible links with our present natural gas situation?

At that time the French Revolution was just beginning and a group of people of high moral and human values – some English but even some French – were unwillingly drawn by the flow of the political process, at the risk of their life. Only the United Kingdom could bring them protection and peace.

No doubt the French Revolution is not presented by Dickens as the emergence of the new *philosophie des lumières* as well as of the democracy but rather as an inexorable and violent process nourished by feelings of revenge and cruelty.

The sole excuse for the cruelty and obscurantism of the French *sans-culottes* is the behaviour of the French aristocracy, presented with the same degree of cruelty and shortsightedness.

In a nutshell Dickens tells us:

- that revolution is dangerous and blind vis-à-vis the people
- that violence brings more violence
- there is - of course - a message in favour of humanism

England is quite different from France but, and this might be his message for that time, it might not necessarily escape from the same process if people do not take care.

Two hundred years later, what does all that mean for gas? The answer is not easy because one could wonder at length who in the gas industry equates to Dickens' English and French sides.

However, some basic facts remain:

- The Continent is still isolated from the United Kingdom; no gas link has been installed so far, although it should come soon when the Interconnector is in place
- The gas situations in the United Kingdom and the Continent are very different.

But any further comparison could be rather hazardous. The gas industry is somewhat a tale of two markets since the UK situation is rather different from the Continental one and changes are underway on both sides of the Channel. We should, however, not regard that situation as a struggle between two differing political or economic philosophies but simply as the result of the need to take account of the same fundamental principles governing the gas supply market, while viewing the problem from two objectively different positions when considering access to gas resources.

For this reason, I would first like to outline the principles which underpin all types of organisation throughout the world before examining the development prospects for the two major

models (Anglo-Saxon and continental European). Lastly, I will attempt to define the strategies that are needed to cope with the co-existence of these two models, strategies to be implemented by operators which, for many of them, work in an international framework.

Since the gas economy remains a highly capitalistic activity, it is becoming all the more important to avoid duplication of transmission and distribution networks. The construction of parallel or partially redundant networks runs contrary to economic good sense and would lead to higher costs for consumers in the long run.

Access to resources

For any country, the possession and the dimension of its own gas resources or the fact of having easy access to external supplies is a determining factor when analysing the various organisations of gas markets, as it was for the emergence of the gas industries in the early days.

Countries which possess their own gas resources to cover the needs of their market enjoy greater freedom of movement. Had they not been self-sufficient in gas, would the United States and the United Kingdom have been able to enforce new operating rules aimed at stimulating competition in the gas market?

In continental Europe, dependent upon a small number of producers operating as a monopoly, responsibility for gas supply is generally devoted to companies with sufficient power to negotiate gigantic long-term contracts and able to carry the corresponding commitments and risks. In this context, the idea that 'Nothing is better than free competition' reaches its limits. Being more and more dependent on import for the supply of its market and

the potential sources of gas being more and more distant from the market, continental gas companies need to be able to act on a larger scale and to commit on projects which involve very different types of risk as compared to those of a self-sufficient country already benefiting from a high density of pipelines on its territory.

In response to the specific characteristics and constraints of the supply as well as of the market I have just mentioned, the strategy of integration, both vertical (between gas industry businesses) and horizontal (between sectors), is a mode of organisation that has been adopted, in a variety of forms, throughout the world.

The scale and unit cost of gas supply of energy projects, the inflexibility of supply chains and the price uncertainties of competing sources mean that gas supply is a high-risk business. Vertical integration allows for greater control over the gas supply chain, both upstream and downstream.

Similarly, it is in the interest of consumer countries to have gas supply companies of adequate size, especially when facing a monopoly of producers and a very large commitment. Indeed, downward integration of producers is not the only possible risk management strategy, long-term supply contracts are another, the importer country's gas company having itself integrated the transmission and distribution functions.

In this case, the gas company's integration is an essential component of its relations with producers; any unbundling of businesses or hiving off of integrated companies to form independent operators — a strategy recommended by some — when it already exists may destroy the balanced partnership between gas supply companies and producers.

According to the extent to which a zone is dependent on distant or more risky resources and according to the degree of concentration of these resources, gas buyers everywhere have adapted their organisational structure



to the degree of concentration of sellers. In this sense, we can talk of a common principle shared by all, ie the adaptation of the downstream market structure to that of the upstream market. Today two main types of organisation exist:

The Anglo-Saxon model

The first option aims at recreating competition in spite of the fact that the network creates the condition for a natural monopoly, leaving the market rules to set the adjustment parameters. This system is found in zones with a high density of gas resources or in self-sufficient regions where, for technical and economic reasons, risks are low and producers are numerous and widely dispersed.

This is the 'Anglo-Saxon model', sometimes qualified as a deregulated system, set up in the United States and more recently in the United Kingdom. Organisation is fragmented, creating the basic conditions for a gas market of sorts — there is less need for buyers to join forces to confront powerful producers (or huge projects) than in the continental European system.

Great Britain is practically self-sufficient in gas and will continue to be so for another 10 years at least. The public

authorities have thus been able to organise competition, first in exploration and, over the last four years, in production, by obliging British Gas to reduce its share of gas purchases from new British fields. The spot price, whose current level reflects a relative gas bubble, will perhaps rise if the winter is especially cold. However, there is practically no threat to short- and medium-term supply continuity, given the excess of available production capacity. However, this situation may well change once this excess capacity has been absorbed after several years of low prices, or the possible signature of supply contracts with continental Europe.

This type of organisation requires that a regulatory body prevents any dysfunction in the gas market and, beyond this level, in the energy market as a whole. Moreover, it is a kind of system where long-term developments are more difficult to predict. The balance between supply and demand is therefore achieved on a more short-term basis and prices are often highly volatile, as shown by the American case. Financial risk management instruments have been developed, at a cost, to provide additional insurance and an extra margin, though without necessarily improving long-term visibility. It has become necessary to com-

plicate the system, by the fragmentation of contractual relationships where previously only one was needed to anticipate changes in demand or in prices. As forecasting is difficult, investments might become cyclical, resulting in periods of pressure on prices, followed by periods of depression.

It is worth noting that, as in continental Europe, the technical function of the gas transmission cannot escape from advantages and handicaps of the natural monopoly: the integration of the Transco transmission system is not questioned since it gives access to scale effect and to the mutualised management of risk.

The continental European model

The gas supply of the European continent is more exposed to geopolitical risk, since it obtains a growing share of its gas from a limited number of distant suppliers, more or less constituting some sort of an oligopoly. Consequently, the gas industry is necessarily more integrated, both to match a similar level of integration among producers and to guarantee security of supplies. Any fragmentation of buyers would weaken their capacity to negotiate and commit. It would also threaten supply security, currently achieved through the diversification of supply sources and the use of storage facilities and interruptible supply contracts. The supply and security functions are the responsibility either of a large company or of a grouping based around one or two main operators. Even more so in France, supplying the market can only be achieved through Gaz de France, according to the present legal framework.

Germany also relates to that model. Ruhrgas is the leading gas importation and transmission company, together with Wintershall, a wholly-owned subsidiary of BASF, which recently teamed up with Gazprom with a view to selling Russian gas to western Europe and to Germany in particular. The system is still based upon concession contracts and demarcation agreements which estab-

lish regional and local monopolies for distribution. The German states have the power to influence energy policy by authorising the construction of infrastructures and setting certain tariffs. The federal government plays a co-ordinating role for energy policy as a whole. For public gas distribution, horizontal integration is common practice. Today there are around 600 distribution companies, including 420 municipal utilities (*Stadtwerke*).

As far as gas supply is concerned, only long-term take-or-pay contracts are used for tapping the gas from the production zones.

The French system also follows the 'continental' model. It is founded on long-term relations between the main operator, Gaz de France, and a limited number of foreign suppliers delivering 90 percent of French gas supplies from often distant sources. Regulation is organised at a national level and at a local level through concession specifications which give local authorities a role to play in distribution.

Although Gaz de France operates within the competitive energy market, it also has to sustain some specific missions of public interest. The French market, like others, is thus specifically organised to take account of its specific situation, namely nearly full dependence on imports. However, this does not mean that the operators are any different from their European counterparts. Gaz de France has to behave according to



the rules of the market economy, notably as regards investments, and it receives no state subsidies.

Development prospects for the two models

The world gas industry is undergoing organisational change, both for reasons of political choice and in order to adapt to local market conditions. In all cases, the internationalisation of the gas sector is growing resulting in an increased interpenetration of the various gas supply systems.

Evolution of the British model

We can, perhaps, identify two stages of change: firstly, new players appear on stage, both producers seeking to maintain high revenue over the long term,

LNG carrier Descartes mooring at Fos-sur-Mer. Photo by Philippe Dureuil. Courtesy of Gaz de France.

and traders seeking to improve their margins; we then observe a tendency for operators to integrate their businesses and for previously dispersed companies to re-amalgamate: in an unexpected way, deregulation may give rise to the development of a re-integrated monopoly of companies under the control of a state regulatory body.

It should be noted that the new arrivals are often subsidiaries of upstream companies, though they are less numerous than in the United States. Moreover, horizontal integration between the gas and electricity sectors could also develop.

In the long term, the United Kingdom will have to import most of its gas and will become subject to the same conditions as continental Europe. It will then have to decide whether it is wise to allow its two or three supplier countries to control the entire gas supply chain, from importation to distribution thus ruling out any real competition. But you still have time to think about it....

Evolution of the model based on long-term planning

When the Interconnector comes into service, exchanges will be possible between Great Britain and the Continent. This may give European gas companies an opportunity to find new resources, perhaps outside the framework of long-term contracts with traditional European suppliers. However, the quantities involved (a minor fraction of European consumption over a few years) will doubtless be marginal when compared with potential needs well after the turn of the century (in the beginning the market might prove to be somewhat oversupplied). This may be why no fundamental modification in the organisation of exchanges on the continent should be expected as a result of the quantities sold via the Interconnector, although it is not quite clear today how short-term and long-term deals will be integrated together.

Moreover, even if EU regulations are likely to change, they will have to take into account the specific features of the

continental European market. Without jumping to conclusions, it is reasonable to assume that, for the major share of its gas supplies, each state will maintain its long-term relations with suppliers within the framework of the current model.

In Germany, competition between gas companies is beginning to emerge under the pressure of Wintershall, which recently teamed up with Gazprom. Dependence on Russia, the country's main supplier is thus growing steadily. However, there is no third-party access for gas and little willingness to consider the concept.

France, for its part, believes that no change can be brought in the framework of subsidiarity. Subsidiarity allows the country to decide itself what type of organisation to adopt, so that its specificities can be taken into account, in particular in terms of import dependence and security. Up to now, the French authorities have always pronounced in favour of continued control over supplies and networks by a national operator. There is also consideration within my company about whether operators should be able to enter into new types of alliances, with a view to establishing the industrial partnerships necessary for the development of markets both in France and abroad.

At a time when practically all operators, including Gaz de France, necessarily conduct their business on an international scale, how are they to deal with the dialectical juxtaposition of two such highly contrasting models?

Conclusion

Among all the changes we are observing, one factor seems to remain constant – the need for closer co-operation, despite growing competition. Indeed, the gas industry needs to establish strong synergies between its various business units, following the example of the oil industry, where co-operation and competition co-exist for the development and exploitation of oil and gas fields. Such co-operation remains of paramount importance if we want to be able to structure the main projects we all need in the longer term and it provides a means to share risks and

investment costs.

Future projects will be increasingly complex and will involve multiple, international partnerships (the use of natural gas for electricity production and co-generation is a good illustration of this).

Beyond co-operation on one-off projects, operators now have the opportunity to develop two types of alliance:

Alliances between companies all along the gas supply chain, should provide guaranteed markets for some and security of supply for others. The growth and reinforcement of co-operation between companies along the supply chain, each one mainly concentrating on its core business, is an appropriate solution for the continental European context, both for consumers and companies. It does not exclude more integrated relationships between upstream and downstream.

Horizontal alliances are leading gas companies towards multi-energy and even multi-service activities, in association with local partners. This horizontal integration can involve companies from other sectors, as is observed with the greater integration among electricity suppliers and service companies outside the energy sector (for example, the water supply company).

My conclusion is that there are not two different worlds. There is only one but not all countries are in the same position when it comes to the question of gas supply, and security as well as social rules such as unification of tariffs are still to be decided on a national basis. As a consequence there is no real ground for looking for one single model applicable to all. There is no reason for and there is also no necessity since there is no incompatibility between the 'two markets', as was proven by the development of the European gas industry in the past.

In addition I am convinced that such an approach – through subsidiarity – will not prevent the inevitably growing trend for larger internationalisation of our business as well as new forms of co-operation between the companies.

This paper was presented to Schroders' International oil and gas seminar held last December.

Forthcoming Events

May

2nd-3rd

Manchester:

'Computational Fluid Dynamics'. Details: Ms Irene Bowker, UMIST, Mechanical Engineering Department, PO Box 88, Manchester M60 1QD. Tel: 0161 200 3702 Fax: 0161 200 3733

6th-9th

Houston: '1996 Offshore Technology Conference'. Details: OTC, PO Box 833868, Richardson, Texas 75083-3868 USA. Tel: 1 214 952 9494 Fax: 1 214 952 9435

8th

London: 'New pipeline regulations: the future of pipeline safety'. Details: Pipeline Industries Guild, 14/15 Belgrave Square, London, SW1X 8PS. Tel: 0171 235 7938 Fax: 0171 235 0074

9th-10th

London: 'The North Sea Annual Conference'. Details: The Conference Division, LLP Ltd, 1 Singer Street, London, EC2A 4LQ. Tel: 0171 250 1500 Fax: 0171 253 9907

13th-15th

London: 'International Oil Technology Forum'. Details: International Quality & Productivity Centre Ltd, 3rd Floor, 83-84 George Street, Richmond, Surrey TW9 1HE. Tel: 0500 821057 0181 332 1112 Fax: 0181 332 1191

14th-15th

Istanbul: 'Oil and Gas Pipelines in the Central Asian Republics'. Details: Business Seminars International Ltd, Sussex House, High Street, Battle, East Sussex TN33 0AL. Tel: 0171 490 3774 Fax: 01424 773334

15th

Coventry: '1996 Brookfield, Methodology and Rheology Seminar'. Details: Ms Susan Kings, Brookfield Viscometers Ltd, 1 Whitehall Estate, Flex Meadow, Pinnacle West, Harlow Essex CM19 5TJ. Tel: 01279 451774 Fax: 01279 451775

15th-16th

France: 'The European Gas Grid Systems'. Details: IBC Technical Services, Gilmoora House, 57-61 Mortimer Street, London W1N 8JX. Tel: 0171 637 4383 Fax: 0171 631 3214

15th-16th

London: 'Basic Oil and Gas Accounting'. Details: IBC UK Conferences Ltd, Gilmoora House, 57-61 Mortimer Street, London W1N 8JX. Tel: 0171 453 2708 Fax: 0171 631 3214

17th

London: 'United States Oil and Gas Accounting Standards'. Details: IBC UK Conferences Ltd, Gilmoora House, 57-61 Mortimer Street, London W1N 8JX. Tel: 0171 453 2708 Fax: 0171 631 3214

20th-21st

London: 'Russian Financial Markets'. Details: The Royal Institute of International Affairs, Chatham House, 10 St James's Square, London SW1Y 4LE. Tel: 0171 957 5700 Fax: 0171 321 2045

21st

Aberdeen: 'New pipeline regulations: the future of pipeline safety'. Details: Pipeline Industries Guild, 14/15 Belgrave Square, London, SW1X 8PS. Tel: 0171 235 7938 Fax: 0171 235 0074

21st-22nd

Russia: 'Legal and Tax Regimes for Oil & Gas Projects in Russia'. Details: Euroforum, 45 Beech Street, London EC2Y 8AD. Tel: 0171 878 6888 Fax: 0171 878 6999

22nd-23rd

London: 'Production Sharing Contracts'. Details: IBC UK Conferences Ltd, Gilmoora House, 57-61 Mortimer Street, London W1N 8JX. Tel: 0171 453 2708 Fax: 0171 631 3214

23rd-24th

London: 'Operating in the CIS/FSU'. Details: Customer Services Manager, IIR Ltd, 6th Floor, 29 Bressenden Place, London SW1E 5DR. Tel: 0171 915 5055 Fax: 0171 915 5056

23rd-24th

London: 'Capacity & Margins in European Oil Refining'. Details: SMI Ltd, 1 New Concordia Wharf, Mill Street, London SE1 2BB. Tel: 0171 252 2222 Fax: 0171 252 2272

24th

London: 'The UK & Continental Gas Industries - converging or diverging models'. Details: Caroline Little, The Institute of Petroleum.

29th-30th

Poland: '1996 Central/East European Gas Conference'. Details: EconoMatters Ltd, 82 Rivington Street, London EC2A 3AY. Tel: 0171 613 0087 Fax: 0171 613 0094

31st May - 1st June

California: 'International Deep Ocean Technology Symposium (1996)'. Details: ISOPE, PO Box 1107, Golden, Colorado 80402-1107 USA. Tel: 1 303 420 8114 Fax: 1 303 420 3760

June

3rd-4th

London: 'Automotive, Aviation and Marine Fuels'. Details: Abacus International, 214 Inchbonnie Road, South Woodham Ferrars, Essex CM3 5WU. Tel: 01245 328340 Fax: 01245 323429

3rd-6th

Florence: '29th ISATA'. Details: The ISATA Secretariat, 42 Lloyd Park Avenue, Croydon CR0 5SB. Tel: 0181 681 3069 Fax: 0181 686 1490

4th-5th

NEC Birmingham: 'Profitability through Innovation - The European Petroleum Industry's Response to a Regulated Retail Market Conference'. Details: Fiona Horan Tel: 0181 742 2828 Fax: 0181 747 3856

4th-6th

Birmingham: 'Forecourt '96'. Details: Forecourt '96 Team, Blenheim Exhibitions & Conferences Ltd, Blenheim House, 630 Chiswick High Road, London W4 5BG. Tel: 0181 742 2828 Fax: 0181 994 9735

4th-7th

Azerbaijan: '3rd International Caspian Oil & Gas Exhibition & Conference'. Details: Spearhead Exhibitions Ltd, Ocean House, 50 Kingston Road, New Malden, Surrey KT3 3LZ. Tel: 0181 949 9222 Fax: 0181 949 8186

5th-6th

Gaydon: 'Gear up for Gas'. Details: Natural Gas Vehicle Association, 11 Berkeley Street, Mayfair, London W1X 6BU. Tel: 0171 388 7598 Fax: 0171 355 5099

Forthcoming Events

10th-11th

London: 'The Financing and Economics of Gas and Electricity Projects'. Details: IBC Financial Focus, 57-61 Mortimer Street, London W1N 8JX. Tel: 0171 453 2703 Fax: 0171 323 4298

10th-12th

London: 'Energy Derivatives Made Clear'. Details: Rachel Marks, International Quality & Productivity Centre, 3rd Floor, 83-84 George Street, Richmond Surrey TW9 1HE. Tel: 0181 332 1112 Fax: 0181 332 1191

10th-12th

Bahrain: 'Middle East Petrotech '96'. Details: Overseas Exhibition Services, 11 Manchester Square, London W1M 5AB. Tel: 0171 486 1951 Fax: 0171 486 8773

10th-12th

Johannesburg: 'Sub-Saharan Oil & Minerals Conference'. Details: Europe Energy Environment Ltd, 3 Hayne Street, London EC1A 9HH. Tel: 0171 600 6660 Fax: 0171 600 5810

10th-13th

Birmingham: 'Turbo Expo '96'. Details: The International Gas Turbine Institute, The American Society of Mechanical Engineers, PO Box 422029, Atlanta, GA 30342 USA. Tel: 001 404 847 0072 Fax: 001 404 847 0151

11th-13th

Netherlands: 'Fluid Handling '96'. Details: Koningin Wilhelminahaven NZ6, 3134 KE, Vlaardingen, The Netherlands. Tel: 31 (0)10 234 1082 Fax: 31 (0)10 234 1172

13th-14th

Norway: 'ICMES '96'. Details: The Institute of Marine Engineers, The Memorial Building, 76 Mark Lane, London EC3R 7JN. Tel: 0171 481 8493 Fax: 0171 488 1854

13th-14th

Antwerp: '1996 European Oil Refining Conference & Exhibition'. Details: Edward Bradfield, WEFA Energy, Mappin House, 4 Winsley Street, London W1N 7AR. Tel: 0171 631 0757 Fax: 0171 631 0754

13th-14th

London: 'Gas Trading & Risk Management'. Details: AIC Conferences Ltd, 2nd Floor, 100 Hatton Gardens, London EC1N 8NX. Tel: 0171 242 2324 Fax: 0171 242 2320

16th-20th

Florence: 'OMAE '96'. Details: Ms Daniela Mercati, Snamprogetti SpA, Viale De Gasperi 16, 20097 San Donato Milanese, Italy. Tel: 39 2 5203 8524 Fax: 39 2 5203 2712

18th-19th

Moscow: '5th Moscow International Oil & Gas Projects Conference'. Details: International Trade and Exhibitions J/V Ltd, Byron House, 112a Shirland Road, London W9 2EQ. Tel: 0171 286 9720 Fax: 0171 286 0177

18th-20th

Birmingham: 'Breakthrough Logistics'. Details: Institute of Logistics, Douglas House, Queens Square, Corby, Northants NN17 1PL. Tel: 01536 205500 Fax: 01536 400979

19th-21st

London: 'Introduction to Oil Industry Operations Course'. Details: Caroline Little, The Institute of Petroleum.

24th-26th

London: 'Introduction to Petroleum Economics Course'. Details: Caroline Little, The Institute of Petroleum.

24th-25th

London: 'Regulation & Investment in European Gas Pipeline Projects'. Details: SMI Ltd, 1 New Concordia Wharf, Mill Street, London SE1 2BB. Tel: 0171 252 2222 Fax: 0171 252 2272

24th-26th

London: 'International Exploration & Production Business Opportunities & Investment Strategies in Oil & Gas'. Details: Global Pacific & Partners Pty Ltd (Africa). Tel: 27 11 886 4053/4 Fax: 27 11 789 5057



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Countdown to open competition in the UK gas market

By Kim Jackson

Gas companies have been lining up to take on British Gas as the first phase of the UK government's programme for the deregulation of the domestic gas market got underway in the southwest of England at the end of April. Some 500,000 customers in Cornwall, Devon and Somerset have been bombarded by mailshot, television, radio, newspaper, billboard and on-the-doorstep sales and marketing campaigns. It was reported in the month preceding start-up of the pilot trial that as many as 60,000 customers had indicated an interest in changing from British Gas to an alternative gas supplier.

Deregulation of the UK gas market actually began in 1986 when large industrial consumers using over 25,000 therms of gas per year were given the opportunity to place their gas supply contracts with companies other than the British Gas monopoly. Today there are 40 compa-

nies supplying the UK industrial gas market with British Gas retaining a 30 per cent market share. Since then, consumers of smaller volumes of gas (between 2,500 and 25,000 therms/year) have also been able to take advantage of increased competition and 29 April marked the beginning of the latest stage in the march to a fully competitive industrial and domestic gas market in the United Kingdom.

Although much of the recent media coverage and, indeed, information circulated by The Office of Gas Supply (Ofgas), the UK Department of Trade and Industry (DTI) and the Gas Consumers Council (GCC), refers to this latest step as deregulation of the 'domestic' market, it is important to note that it is, in fact, users of less than 2,500 therms of gas per year that will benefit from this last stage of increased competition. While such customers will indeed be domestic household consumers in the main, some small industrial or commercial concerns are also included in this category.

Steps one, two and three

Deregulation of the domestic gas market is to take place in three phases:

- (1) 29 April 1996 – a pilot trial covering 500,000 gas consumers in Devon, Cornwall and Somerset
- (2) 1997 – a further 1.5 million gas consumers in Avon, Dorset, Kent, East and West Sussex
- (3) 1998 – full competition nationwide, with some 19 million domestic customers – a market worth £5.7 billion.

The southwest of England was chosen to pilot open competition because the region has clearly defined boundaries, a mix of urban and rural areas and a representative cross-section of types of consumer. Furthermore, it was

decided that customers in this region should have the earliest possible opportunity for cost savings because of the relatively higher costs of the transportation of gas from the North Sea to the southwest.

The precise dates for expansion of the pilot trial have yet to be announced although it has been made clear that they will be no later than 31 December 1997 and 1998 for phases (2) and (3) respectively. However, UK Minister for Industry and Energy Tim Eggar recently stated that the dates could well be brought forward if the Director General of Gas Supply Clare Spottiswoode 'so determines ... following consultation and taking into account the readiness of the recording and accounting systems that are necessary to allow consumers to change gas supplier'.

Indeed, recording and accounting systems have already proved a stumbling-block for the pilot programme in the southwest. The start-date for this stage was delayed from 1 to 29 April because computers could not be tested live end-to-end. According to Mr Eggar, the four-week postponement was 'in the interests of consumers' and was necessary to ensure that the administrative and computer systems were fully ready to give customers the service they deserve. 'It is a complex procedure, and we need to get it as right as possible before "going live" with consumers,' he said.

The consumer's choice

The opening-up of the southwest of England gas market has unleashed a price war that will see domestic gas bills fall by as much as 25 per cent as gas suppliers vie for a share of a business worth £150 million per year.

According to Ofgas, in 1994/95 the average UK domestic consumer used 625 therms of gas per year, paid an average price of about 50 pence per

therm and had a total gas bill of around £310 excluding VAT. Thus, the average customer can expect savings in the region of £77 per year just by changing from British Gas to an alternative gas supplier. Further savings can be made by taking advantage of the zero standing charges, lower maintenance and service contract charges compared with British Gas, freezing of gas prices for a limited period and the variety of payment options with reduced unit gas therm prices on offer from the new competitors in the market.

Testing the waters

As *Petroleum Review* went to press, Ofgas had issued 10 companies with a licence enabling them to supply gas to consumers in the southwest of England. The nine companies are:

- Amerada Hess Gas (Domestic) Ltd
- British Fuel (Oils) Ltd (trading as British Fuels - Gas — limited to certain areas)
- British Gas Trading Ltd
- Eastern Natural Gas (Retail) Ltd
- London Total Energy Company Ltd
- Northern Electric plc (trading as Gas UK)
- Norweb Gas Ltd
- Southern and Phillips Gas Ltd
- Texaco and Calor Gas Ltd (trading as CalorTex)
- Western Gas Ltd (trading as SWEB Gas).

A further three companies — Kinetica Limited, Alliance Gas Limited and Southern Gas Limited have also qualified for licence extensions under Condition 35 of the Gas Suppliers Licence. Whilst this condition allows suppliers to enter the domestic market, their Customer base is limited to chains of commercial premises only, requiring less than 2,500 therms of gas per year.

Amerada Hess Gas was one of the earliest to show its hand in the new market, promising at least 15 percent savings for customers, lower standing charges and cheaper units of gas compared with British Gas. It has also pledged 'zero inflation' on bills to the year 2001 for those



customers signing up before the end of this year. Total, too, has cut standing charges and gas unit costs and is offering savings of 16-19 percent. Its package also includes the added incentive of up to £15 worth of Boots and Marks & Spencer gift vouchers when customers sign up for Total's standard supply contract and its 'Gas Plus Service Plan'.

CalorTex was another early entrant in the new domestic gas arena and is one of the few companies to announce that it will backdate its reductions to 1 April to ensure that its customers do not miss out because of the delay in the start of competition. This will save the average consumer about £5. The company, a 50:50 joint venture between Calor Gas and Texaco, is offering savings of up to 25 percent, has pledged to keep prices static for the next two years and is to donate £1 to the NSPCC for every contract signed during this year. It is also offering, via the Energy Saving Trust, free advice on energy conservation and energy efficiency and will charge no

termination fee in the event that a customer decides to change to another gas supplier after signing up with CalorTex. According to Neil Lambert, Joint General Manager of CalorTex, the company's customer package is 'unmatched' by rivals.

Meanwhile, SWEB Gas, the natural gas marketing arm of the regional electricity company for southwest England, is offering savings in the region of 17 to 21 percent with added cost reductions for direct debit payments. More recently, British Fuels - Gas announced a package including savings of about 20 percent, no standing charges and £150 off the price of a holiday for those who sign up within the first four weeks. Eastern Natural Gas, too, is offering 20 percent savings and promises 'no bill till October'.

The competitors are all able to undercut British Gas' tariffs because of lower overheads and because they are free to buy North Sea gas at current market rates of 9 pence/therm. In contrast, British Gas is locked into agreements

Service, as well as price, is a key issue in the various gas supply packages on offer to customers in the southwest

which oblige it to pay an average of 20 pence/therm, well over the market rate.

As the former monopoly, British Gas's hands have effectively been tied by legal constraints which prevent it from making any changes to prices, products or services in a bid to retain customers until competition is fully established in the southwest. Such measures would be deemed 'predatory' and 'anti-competitive', according to Ofgas. Once competition is established, British Gas plans a complete price review and the introduction of new products and services. Price cuts may well be problematic, however, as cuts in the southwest could alienate customers in other regions. Indeed, if British Gas should decide to cut prices across the board, it will have to get approval from Ofgas to do so – a lengthy and time-consuming process.

'Added-value' service packages are a more likely alternative but the company is in a difficult position following recent bad publicity on the increasing numbers of customer complaints, deteriorating service standards – and top executive pay.

Some industry observers expect British Gas to lose, at the very least, some 12 percent of its market share in the southwest.

Price, though a key factor in the gas companies' marketing strategies, is not the sole issue however. Competitors are also offering a range of service options. For example, SWEB is playing on the fact that, as a well-known local concern, it can offer customers many more locations at which to pay bills, while Amerada Hess Gas is offering flexible charging bands and central heating and boiler service contracts backed by the Sun Alliance insurance company. CalorTex is offering a range of service and maintenance options under its 'Safeguard' scheme.

All has not gone smoothly as the various competitors battle it out and the Gas Consumers Council has already had cause to intervene following allegations of 'heavy-handed doorstep selling' by SWEB Gas sales representatives. Most of the complaints centred around customers being misled into signing gas supply contracts which they thought were, in fact, request forms for addition-

al information. As a result, SWEB Gas suspended its doorstep selling campaign and went on to sack a number of its sales representatives. Other companies wishing to enter the market voiced concern that they might be 'tarnished with the same brush'. However, these fears do not appear to have materialised.

Meanwhile, the gas companies themselves have taken umbrage with the GCC which has been advising customers to delay changing gas supplier until all competitors, including British Gas, have announced their price and servicing packages. Some fear that this may well deter customers from changing gas supplier at all. Indeed, they are keen to see the GCC take a more 'educational' role that encourages the consumer to take an interest in the process rather than approaching the issue from a more negative stance by saying 'wait'.

Keeping an eye on the market

Some gas companies, wary of jumping in at the deep end, are waiting on the sidelines to see how the pilot market develops. Kinetica, for example, states that while it is extending its current industrial gas marketing activities to those smaller commercial premises in the southwest that are consuming less than 2,500 therms per year in order to 'further reinforce' its position in its core business market, it wishes to study the development of the pilot phase closely before making any decision on whether to enter the domestic gas sector.

According to Kinetica Chief Executive Norman Ellis, the company wishes, in particular, to observe:

- The performance of TransCo in managing the transfer of domestic sites from British Gas to the independents and the timetables of the closing and opening meter reads associated with these transfers – crucial to providing good service to the domestic market;
- The reaction of British Gas – which at this stage is not yet clear;
- The extent to which prices and, therefore, potential profit margins are driven down by competition;

- The way the independents handle the obligations imposed by their licences; and
- Progress of the domestic market through further market research.

Networking in the pipeline

Gas will continue to be piped across the country by TransCo, British Gas' transport arm.

Those companies wishing to enter the new gas market have had to sign a Framework Agreement with TransCo, agreeing to operate under the terms of the Network Code. The code is an operating and commercial regime by which TransCo conveys and transports gas. It sets out the rules, rights and obligations for the use of the TransCo pipeline system by competing gas suppliers in order to ensure that competition works in a secure, safe and controlled manner.

The code requires that:

- Gas transportation and storage services meet market requirements on a non-discriminatory basis
- System security and safety are not affected
- Market competition in gas supply is facilitated
- Pricing should reflect the 'real' costs of the services concerned
- Robust computer systems be developed and maintained
- Daily energy balancing be operated
- Shippers become responsible for balancing their own supply and demand.

An integrated suite of computer systems known as UK-Link has been set up to support the Network Code. Whilst each shipper is responsible for its own information systems, UK-Link provides the core system that is accessed, via an electronic network, by each company. It comprises five interlocked systems, each dealing with a separate aspect of the code. These can be summarised as follows:

- AT-Link which caters for the needs of energy balancing and supports shipper services such as gas nomi-



nations, allocations, balancing and capacity trading

- Supply Point Administration supports activity concerned with end-users such as transferring a site from one shipper to another and meter reading
- Invoicing 95 produces and administers monthly invoices to shippers for services used
- Sites and Meters Database maintains a record of every meter and supply point connected to the system and supports all the other systems. The database will grow as competition spreads across the United Kingdom
- Information Exchange provides a computer link between Transco and shippers to enable industry-wide use of UK-Link.

UK-Link also interfaces with a number of operational systems which are

used to help manage the pipeline network.

Obviously the requirements of the Network Code may change with time as shippers gain experience and market conditions vary. With this in mind, a 'Modification Panel', comprising representatives from Transco, shippers, Ofgas and delivery facility operators has been established that will meet at least monthly to consider any modification proposals put forward, in writing, by the shippers or Transco.

According to Wood Mackenzie, problems have already arisen with the Network Code, concerning the 'illiquidity and lack of depth' in the flexibility mechanism whereby Transco balances

the gas system on a daily basis. The problem centres on the highly inflated prices offered via the flexibility mechanism.

The analysts cite two cases on 9 and 11 March when available beach supplies on the flexibility bid list were insufficient to meet Transco's anticipated demand. British Gas Trading was the only company with additional supplies – offering stored gas from the Rough field at an inflated price of 73.3p/therm and LNG at a price of 148p/therm, much higher than the spot market price of 10p/therm. These prices were dropped to a maximum of 35p/therm and 49.8p/therm upon the intervention of Transco.

Wood Mackenzie states that 'the risks of operating in such a market are likely to advance the development of risk hedging facilities and instruments.'

Shippers are also concerned about delays in making metering data available. Instead of the agreed two days, this is currently taking 11 days.

Filling in the spaces

Other companies can operate their own pipeline network as public gas transporters (PGTs) too, covering 'infill' areas outside of Transco's pipeline system. Indeed, this has allowed the Agas Group to steal a march on the other UK gas suppliers through its transportation arm Agas Developments Limited which has been transporting gas to new housing developments in the United Kingdom outside of the Transco network since 1994. A wholly owned subsidiary of Elf, Agas was the first company, other than British Gas, to secure such a PGT licence.

It seems likely, however, that this market sector will prove of interest only to a small minority of the gas suppliers as very high capital costs are involved and companies will be unable to guarantee that they will be the primary gas supplier in whatever region the infill gas transport system is placed. As the former monopoly public gas supplier, Transco is expected to remain the largest PGT in the country.

Safety of supply

As intimated earlier, safety of supply is of paramount importance to the UK gas industry. Indeed, a set of new regulations – *The Pipelines Safety Regulations 1996 (PSR)* – was recently introduced to improve safety standards of all pipelines both on and offshore.

In force from 11 April, a date chosen specifically to tie in with the opening-up of the UK gas markets, the new simplified regulations replace a number of separate and prescriptive sets of regulations and introduce a new unified and goal-setting regulatory regime for all UK pipelines.

These new regulations reflect not only our general drive to simplify health and safety legislation but also allow us to take forward further legislative reforms, in respect of offshore pipelines, recommended by Lord Cullen in his report following the Piper Alpha disaster in 1988,' said UK Environment Minister Sir Paul Beresford. 'They also include provision

Transco gas distribution system.
(Courtesy of Transco Public Relations)

Domestic gas demand

According to a recent report *UK Domestic Gas 1996* from MarketLine International, domestic consumers of gas account for the major share of overall gas consumption in the United Kingdom. Indeed, this sector consumed 320.7 TWh of gas in 1995, corresponding to 43.5 percent of total consumption. Not surprisingly, as consumption depends on climatic conditions, the largest average consumers are found in Scotland and the North of England with 19.2 MWh and 18.8 MWh per customer, respectively.

The quantity of gas available in the United Kingdom has steadily increased since 1990, with the volume for 1995 estimated at 764.7 TWh. MarketLine attributes this trend to a 224.4 TWh increase in production from the North Sea as new fields have come onstream. As a result, gas imports have fallen from 72 to 17.3 TWh over the same period.

Future gas consumption by all sectors is expected to grow by an average of 5.3 percent per year over the next 15 years. Domestic consumption, however, is forecast to rise at a much lower rate of 1.1 percent per year to reach 400.6 TWh by the year 2010. On a regional level, Scotland and Wales are expected to show the largest increase in total domestic consumption as customers residing in remote areas are connected to the gas network for the first time, while demand in London and the southeast is predicted to grow slowly because of the greater use of gas heating systems and appliances by consumers in these areas.

Pricing pressures

Analysing the Southwest pilot project, the report states that the discounts being offered by competing gas companies are 'clearly unsustainable outside the short term'. Indeed, it predicts that price cuts in any region will peak in the first year of liberalisation and then prices will steadily rise over the next three to four years, returning to current levels by the start of the next millennium as competition matures and gas companies begin to pass the high costs of investing in customer service infrastructures on to the consumer in order to achieve steady profits in the long term.

Furthermore, prices will inevitably begin to rise once the current surplus of gas – which enables companies to buy gas at much lower prices than British Gas which is constrained by take-or-pay contracts – is siphoned off by the UK-Interconnector due to be ready in 1998. UK gas prices, currently lower than those in Europe, will also be pushed up in the drive to create a uniformity of pricing throughout the European gas market.

to maintain safety standards as the gas market is opened up to competition.'

The introduction of the PSR regulations was also timed to tie in with the implementation of the *Gas Safety (Management) Regulations 1996* on 1 April. Also designed to facilitate the safe management of the flow of gas through the UK pipeline network, the regulations require each gas transporter to put together a safety case which must be approved by the UK Health and Safety Executive (HSE) before operations may commence.

The *Gas Safety (Management) Regulations* also require gas transporters to appoint a Network Emergency Co-ordinator (NEC) who will have the powers to co-ordinate action in emergency circumstances where there may be total or partial failure of supply, so as to ensure continued safe operation of the network. The NEC, too, must prepare a safety case and have it accepted by the HSE.

Looking to the future

It will probably be well into the next millennium before the domestic gas market truly 'settles down' after the introduction of nationwide competition. Once this has happened, however, indus-

try observers expect that perhaps 10 major players will be left in the domestic gas arena and that British Gas will have retained perhaps a 30-35 percent market share – similar to its share in the industrial gas sector. Indeed, if the United Kingdom is to have a truly competitive gas market, British Gas' share must be under 50 percent to avoid an over-dominant position.

Companies such as CalorTex and Eastern Natural Gas state that they intend to be long-term players in the UK domestic gas market and plan to be within the top three or four companies. This would require a market share of between 10 and 12 percent. Both are treating the pilot scheme as a learning exercise and will use the experience to put together the 'best possible' packages for their customers when the scheme expands.

Mr Lambert believes that his company, CalorTex, is particularly well placed to serve a nationwide gas market. Not only has it got a network of gas supply points and 1,000 nationwide sales and marketing outlets through Calor Gas, its Texaco backing provides additional financial and branding muscle power. Furthermore, he believes that by entering the domestic market so early in the deregulation process, CalorTex can prove to customers that its scheme actually works.

Local regional electricity company gas marketing ventures are expected to be the primary competition in their specific regions. 'Such companies have the advantage of well-known branding in their own backyard and on-the-ground networks already in place,' states Mr Lambert.

The last word

Deregulation of the UK domestic gas market can only be good news for the customer with savings available at almost every turn and gas companies bending over backwards to provide value-added service.

It is good news for the gas companies too. After all, as Mr Lambert succinctly points out, 'It's not every day that you get a chance to go for a market of 19 million new customers!'

Auto LPG: global review and criteria for success

By R Groeneveld,
General Manager, BK-Gas BV

The world motor vehicle population for 1994 is estimated at 750 million (cars, vans, trucks, buses and motorcycles). Recent projections of motor vehicle growth indicate that the billion mark will be reached by around the year 2006.

About 80 percent of all the world's cars run in countries of the Organization for Economic Co-operation and Development (OECD). Motor vehicles are by far the biggest energy users and in OECD countries they represent 82 percent of total transport energy use. Motor vehicles are also a major source of air pollution. Tail-pipe emissions

from light duty gasoline-powered vehicles in the OECD contribute 90 percent of CO emissions, 30 percent of CO₂ and 50 percent of NO_x. Gasoline remains relatively cheap and plentiful, and gasoline engines are the cheapest way of providing power for most personal private cars. But with ever-increasing air pollution, many governments are studying, discussing and/or encouraging the use of alternative fuels such as:

- gaseous fuels (LPG and CNG)
- alcohol fuels (ethanol and methanol)
- reformulated fuels (gasoline and low sulphur diesel)
- other sources (electricity, hydrogen and fuel cells).

Alternative fuels

What is the present position of alternative fuels in the global motor fuel market? Let us take a look at the passenger car population in the world in 1992. There were about 440 million passenger cars, of which one-third are in the United States. Only 2.2 percent of these cars ran on alternative fuels.

Alcohol fuels represented 1 percent, auto liquefied petroleum gas (LPG) 0.9 percent and compressed natural gas (CNG) only a modest 0.2 percent. As far as alcohol fuels are concerned, over 90 percent was consumed in Brazil as gasohol (ethanol).

For worldwide use, auto LPG is at the moment the

alternative fuel. LPG as an engine fuel can be propane (United States), butane (South Korea) or – as in most countries – a mixture of propane and butane. In this presentation I will use the expression 'auto LPG' for the various mixtures of LPG as automotive fuel.

Criteria for success of auto LPG

First, and most important, the national government has to support the use of auto LPG in its automotive fuel balance. This boils down to competitive pricing, providing the market with realistic break-even points between gasoline, diesel and auto LPG.

Another important factor is the provision of a good dispensing network for auto LPG. Adequate LPG equipment for installation in the vehicles is another criterion – especially with the trend towards sophisticated engines with three-way catalytic converters and lambda control, adequate equipment is a must.

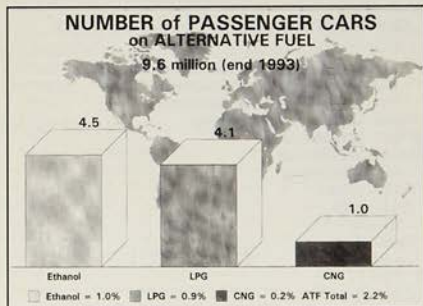
Of course, LPG availability in the market has to be ensured.

Finally, development of an auto LPG market should be supported by oil companies and/or LPG wholesalers willing to invest in a dispensing network.

In all countries which today use auto LPG as part of the automotive fuel market, the criteria I have mentioned have by and large been met. Generally speaking, one can say that the development of an auto LPG market primarily needs political support.

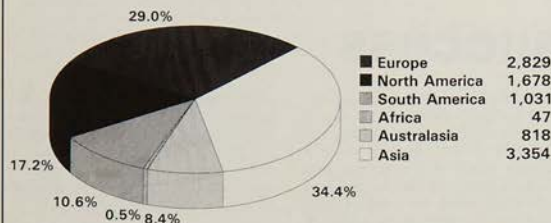
Consumption

Both Europe and Asia represent about one-third of the global auto LPG consumption. Let us take a closer look at some of the countries and check to what extent governmental support has been instrumental.



CONSUMPTION of AUTOMOTIVE LPG 1993

in ,000 tonnes



Canada

Auto LPG sales started in 1980 after the second oil crisis and with increasing concern for air quality. The start was healthy, supported by a \$400 federal grant for propane conversion and tax exemption grants in some Canadian provinces. In 1985 the federal government discontinued the subsidies and most provinces withdrew their grants. Consequently conversion to propane peaked in 1985 and nowadays retirements are higher than new conversions. In 1987-90, the industry launched aggressive marketing/finance campaigns to reboost conversion which proved successful. Because of the fuel efficiency of modern gasoline engines, the break-even point increased from 16,000 kilometres in 1986 to 40,000 in 1993. In 1994 one of Canada's largest LPG distributors, Superior Propane, embarked on a rejuvenation programme to try to stabilise the present market. Auto LPG sales represent about 40 percent of industry LPG sales. Without governmental support in the early 1980s the market would not have been there.

United States

The principal road transport fuel consumed by light duty vehicles in the United States is gasoline – diesel fuel is virtually absent. The federal government has programmes in place to mandate the use of alternative fuels for increasing percentages of new fleet

sales over the years. In addition, many states have their own programmes (eg California and Texas). Auto LPG is at present the leading alternative fuel (ATF) but only for 0.3 percent of the car population. It should be borne in mind that the use of ATF in the United States is mandated and is low and in many cases LPG is taxed above gasoline, whilst CNG is some 30 percent cheaper than gasoline. The Propane Vehicle Council promotes LPG as an automotive fuel and campaigns for a reduction of excise duty. The US Department of Energy states that they foresee propane as the most used ATF by the year 2010. A lot of work still has to be done but auto LPG looks set to have a promising future in the United States.

European Union

Most of the European LPG (excluding LPG as feedstock) is consumed in Spain, France and Italy as a traditional fuel for cooking and heating, because natural gas is not readily available for that purpose in those countries. Looking at auto

LPG penetration, it is obvious that – with the exception of Italy and the Netherlands – auto LPG does not really exist in the European Union.

One may wonder why such a perfectly clean automotive fuel should have a penetration of only 1.4 percent in the EU automotive fuel market. The answer is quite simple: one of the main criteria (ie competitive pricing) has not been met in many countries. There must be a financial incentive to induce car-owners to convert their gasoline-engined cars to run on auto LPG. In opting for auto LPG they have to pay for a conversion kit and sacrifice part of their boot capacity to make room for a gas tank.

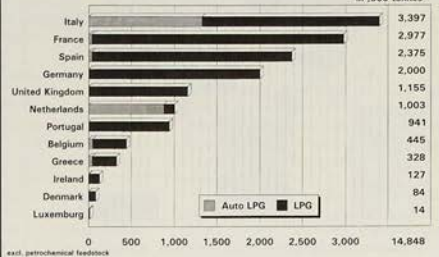
Also, because of the lower calorific value per litre, the average car's fuel consumption on auto LPG is some 25 percent higher than on gasoline. To overcome these disadvantages, auto LPG ex pump must be priced much lower than gasoline and diesel.

Netherlands

The Netherlands is a relatively small country with a huge refining capacity where the Dutch government for over 40 years has accepted auto LPG as a clean motor fuel. Consequently the maturest auto LPG market in the world has developed there and 8 percent of all the country's passenger cars run on LPG. For high mileages, the diesel-powered car is the main competitor. The government maintains a certain bal-

CONSUMPTION of LPG in the EU 1993

in ,000 tonnes



ance between the three motor fuels by imposing a combination of different excise duties and road taxes for the various fuels. The auto LPG industry is well organised and maintains a good working relationship with the government. Recently, new markets like city buses and light vans have been actively encouraged to use LPG as a clean fuel for the inner cities.

Italy

As in the Netherlands, the Italian government has encouraged the use of its surplus LPG as a clean motor fuel. Control instruments are the difference in excise duties and surcharges in the road tax. Some 4 percent of all Italian passenger cars run on LPG. Because of the complexity of modern engines, the price of LPG conversion equipment has had to be increased in recent years. This has led to a marked decrease in the number of conversions. The government's reaction was twofold, firstly by reducing the excise duty on auto LPG and – when this proved not to be fully satisfactory – by eliminating the surcharge in the road tax. Another measure taken was that since early 1992 Italy, with at times a high degree of atmospheric pollution in its big cities, has had a measure in place whereby it can compel car owners to drive on alternative days only (odd or even licence plate numbers), while auto LPG vehicles are permitted to drive every day in periods of heavy pollution.

Since 1994 the number of conversions has been back to normal, demonstrating that active involvement of a government is a must for a mature auto LPG market.

Other European countries

From an environmental point of view, auto LPG is a proven preferred automotive fuel, even for the sophisticated gasoline engine of today. Its environmental advantage is even more pronounced in countries with relatively older car populations and crowded urban areas with a high degree of atmospheric pollution such as Athens, Madrid and Rome. New positive trends

for auto LPG are therefore emerging.

Portugal and Norway have accepted LPG as an automotive fuel and their markets are starting to build.

Greece is actively pursuing conversion to auto LPG for taxis in its polluted cities.

In France – with the highest diesel penetration in the world – the LPG industry has for many years been lobbying for a reduction of excise duty on LPG. The French government – finally convinced of the environmental advantages – reduced the auto LPG excise duty by 70 percent from 375 ECU per ton to 115 ECU per ton effective from 13 January.

In Germany the government decreased the excise duty on auto LPG by 60 percent from 316 ECU per ton to 132 ECU per ton in October last year. This decrease will be effective for five fiscal years and then reviewed.

Finally, in the United Kingdom with effect from 28 November last year, duties on petrol and diesel were increased by 9.5 percent, whilst the duty on auto LPG was decreased by 15 percent from 423 ECU per ton to 359 ECU per ton. This makes the position of auto LPG slightly better but, to really stimulate the market, further reductions will be necessary.

Also, in Europe demand is growing for gaseous fuels for public transportation buses, which are all diesel powered. Some cities have programmes to ban, over time, diesel powered heavy duty vehicles from their inner cities. European engine manufacturers have noticed the trend and are actively working towards adapting their engines for gaseous fuels. Recently DAF introduced an HEAVYDUTY LPG engine. Other HEAVYDUTY engine manufacturers are in the process of following suit.

LPG for buses and fleets do not need an extensive LPG retail network as can be organised through a central



refuelling facility on the premises of the customer. Bus companies switching to LPG demand a filling speed for LPG equal to diesel (max. 3 minutes) and quick-fill dispensers had to be developed for that purpose. Within the Netherlands BK-GAS took the forefront in this respect.

Asia

Asia accounts for another one-third of global auto LPG demand. This is a completely different picture, because the Asian market is an auto LPG market mainly for taxis.

In Japan the government is well known for its endeavours to reduce emissions in crowded urban areas. The Japanese manufacturers all produce monofuel LPG taxis, whilst the government taxes auto LPG at only 18 percent of the tax on gasoline.

New Japanese motor vehicle emission control standards have been introduced. Especially for the six big cities, a further sharp reduction of NO_x was initiated in 1994. The new NO_x law enables local authorities to ban the use of non-NO_x certified cars in designated zones of major cities. With the new NO_x law, the Japanese government aims persuade companies to change their fleets from diesel to gasoline or auto LPG.

Toyota and Mazda already have LPG-powered small trucks and delivery vans available for this new market. New models of diesel cars have to comply with the new regulations – existing

models from 1 September 1995 and imports from 1 April this year. It is estimated that some 2 million diesel cars will be replaced by new cleaner ones. Most certainly, auto LPG will benefit from this development, again stimulated by a government measure.

South Korea is the second largest taxi market for auto LPG (100 percent butane), and it is still growing rapidly. Because of a shortage of LPG, the use of auto LPG in other vehicles is prohibited, however.

Thailand's auto LPG taxi market is mainly concentrated in the city of Bangkok where even many of the three-wheeled tuk-tuks are fuelled by LPG.

Contrary to the European continent, therefore, the Asian auto LPG market is one of public transportation, mainly in the big cities.

Australia

Auto LPG is the main alternative motor fuel in Australia and currently represents 6 percent of passenger and LD commercial vehicle demand. More importantly, from the viewpoint of urban air quality, auto LPG represents nearly 1.0 percent of vehicle fuel demand in the major cities. There are now more than 300,000 vehicles running on auto LPG in Australia. Some 15,000 of them are taxis (over 90 percent of local taxi fleets) and these account for over one-quarter of auto LPG demand. The balance of the market comes mainly from the high-mileage private and commercial categories. So, the Australian market is a mix of Europe and Asia as far as auto LPG users are concerned.

The driving force behind the strong growth in auto LPG demand has been the Australian government policy of exempting auto LPG from excise duty and state taxes. Consequently, auto LPG enjoys a substantial price advantage over gasoline and diesel.

The government policy was last expressed in a statement on the environment by then Prime Minister Paul Keating in December 1992:

'The government has committed

itself to a five-year guarantee of the current excise-free status of alternative transport fuels, with at least one year's notification of any intention to change that status'. This reiterates the first criterion for success for auto LPG that I stated earlier.

Conclusion

The conclusion to be drawn from this global survey is that a country will not have an auto LPG market if the local government is not supportive of its use as an environmentally friendly fuel.

Vehicle manufacturers' involvement in LPG is already more than it used to be. In Japan, Toyota, Nissan and Mazda have for many years been producing their monofuel LPG taxis. In Europe, some manufacturers are actively involved in retrofitting certain of their models for auto LPG. Renault France is quite active in this field and Fiat Italy is considering optimised LPG/CNG systems in a separate production line for the Fiat Tempra 2 litre car.

Chrysler Canada returned to the LPG market by introducing its new propane-powered RAM VAN. More and more city buses are being retrofitted for LPG and DAF of the Netherlands is executing a \$4 million project for a factory-made 8.6 litre gas engine. US car makers are a bit more reluctant, as within the United States they have to choose from five alternative fuels. The co-operation between the LPG industry and vehicle manufacturers should be intensified – some good workshops already exist. Auto LPG technology has to meet vehicle standards and further development therefore is a must. The aim for the next century should be to have LPG-powered cars available straight from the production lines.

In this presentation I have described the main auto LPG mar-

kets in the world. Except for Japan, until now all cars are fitted with LPG conversion systems in the aftermarket. Their users are fleets, taxis and individual car owners, whilst niche markets – eg for public bus transportation – are emerging.

Are there lessons to be learned? As I have demonstrated, the main criterion for success is government support, so the aim should be to place pressure on governments (and environmentalists) to gain acceptance for auto LPG as a preferred alternative motor fuel. Not only national LPG organisations but also the European LPG Association (AEGPL) and World LPG Forum have to play a more active role in this respect. Intensive lobbying should be conducted at all influential levels to promote further use of this clean and efficient motor fuel. The AEGPL recently established an Automotive Committee and in January the World LPG Forum's white paper on auto LPG was distributed to over 1,000 addresses. Finally, the LPG industry will have to take care of further improvements in conversion technology and be willing to invest in a good dispensing infrastructure. ♡

Mr Groeneveld gave an address on this subject to the March meeting of the IP Netherlands Branch. Two weeks later he presented an updated version of the same paper to a conference, 'LPG – a Clean and Efficient Motor Fuel', organised by the LPG Association.



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Alternative road transport fuels

Much attention has focused on the control of road vehicle emissions over the past two decades as concern has grown over their impact on health and the environment in the United Kingdom. The introduction of increasingly stringent standards for the emissions of carbon monoxide, nitrogen dioxides, hydrocarbons and particulate matter has not only encouraged vehicle manufacturers to develop improved emissions control technologies for installation on vehicles such as three-way catalysts, but also led to various studies, many government-sponsored, into the relative merits of alternative road transport fuels which offer the prospect of both reducing emissions and improving energy efficiency.

One such study in which a number of conventional and alternative fuels – petrol, diesel, liquefied petroleum gas (LPG), compressed natural gas (CNG), electricity, biomethanol, bioethanol and biodiesel – were compared on a life-cycle basis taking into consideration energy use and emissions associated with their production, distribution and end-use in vehicles was jointly commissioned by the UK Department of Trade and Industry and the Department of Transport. Conducted by ETSU (Energy Technology Support Unit), the results were published in March in a two-volume report *Alternative Road Transport Fuels – A Preliminary Life-cycle Study for the UK*. The first volume summarises the major findings and implications of the study, while the second provides a detailed analysis of each fuel.

Light goods vehicles, considered to be one of the most likely first applications of alternative road fuels, are the basis of comparison of fuels in the study. Buses, another likely candidate for conversion to alternative fuels, are considered in detail in the second volume of the published results.

The relative merits of some of the alternative fuels studied, on a life-cycle basis when used in a light goods vehicle, are summarised below.

Liquefied petroleum gas

LPG is a mixture of mainly propane, butane and iso-butane, the exact blend varying from country to country. It falls between diesel and petrol in terms of energy use, carbon monoxide (CO) and carbon dioxide (CO₂) emissions on a life-cycle basis and produces similar hydrocarbon (HC) and less nitrogen oxide (NO_x) emissions and particulates than diesel. When used to power a bi-fuel vehicle, LPG was found to have a similar operating cost to conventional fuels.

Production capacity constraints and

the current lack of a public refuelling infrastructure may limit widespread take-up of this alternative fuel.

Compressed natural gas

CNG is intermediate between diesel and LPG in terms of life-cycle energy use. Its lower carbon to hydrogen ratio produces lower overall CO₂ emissions per gigajoule of fuel consumed. A disadvantage is the high pressure (about 200 bar) storage tank required which adds both a weight and performance penalty. NO_x, CO and particulate emissions are low but life-cycle HC emissions are higher than for petrol or diesel.

CNG vans have higher overall operating costs than petrol or diesel vans because of the current level of vehicle technology and CNG fuel duty.

Electricity

Electric powered vehicles produce zero emissions at point-of-use, while their CO₂, NO_x and HC life-cycle emissions are comparable with petrol and diesel. However, ETSU reports a sulfur dioxide



(SO₂) penalty. Uptake of this alternative fuel is limited by the high capital costs and limited performance of current electric vehicle designs. Although such vehicles offer a low energy cost per kilometre, operating costs are high because of the expensive batteries needed.

Biofuels

Three biofuels were analysed in the ETSU study – biomethanol (produced from biomass such as forest and agricultural residues, municipal solid wastes, wood, straw and miscanthus), bioethanol (produced from carbohydrates in biomass) and biodiesel (produced from a range of vegetable oils including rapeseed oil, palm oil, sunflower oil and soybean oil). The CO₂ neutrality of each means that these fuels offer better CO₂ performance than petrol or diesel. However, the report points out that CO₂ levels are not zero on a life-cycle basis because of the relatively energy intensive processes required to produce these fuels, in particular bioethanol.

Biomethanol and bioethanol have similar emissions of HC and NO_x and less CO relative to petrol on a life-cycle basis. However, the processes used to

produce the fuels leads to higher particulate emissions on a life-cycle basis. NO_x and particulate emissions are better on a life-cycle basis for these fuels when compared with diesel.

Biodiesel can be used as a direct replacement for mineral diesel. According to the report, while sources are said to differ with regard to regulated emissions from biodiesel vehicles – especially concerning particulate emissions – regulated vehicle emissions can generally be considered as similar to mineral diesel except for NO_x and particulates, which are significantly higher, and smoke emissions which show consistent reductions with biodiesel.

Market penetration of biofuels is expected to be constrained by the limited volume of such fuels that could be produced by UK agriculture and the substantial investment that would be required in the supply chain. Furthermore, the fuels, except biodiesel, are projected to be expensive leading to higher operating costs than diesel and petrol vans.

The final word

The ETSU study concluded that LPG, natural gas, electric power and alcohol

fuels are the 'most appropriate' alternative fuels for the reduction of urban pollution. However, market penetration of any alternative fuel is expected to be constrained by a number of factors including their economic competitiveness compared with traditional fuels, security of fuel supply, harmonisation of fuel distribution, availability of vehicle technology, vehicle emissions standards and the availability of maintenance services.

Fleet operators are expected to be amongst the earliest to convert to alternative fuels as they may easily establish strategically placed central dispensing depots for their vehicles.

ETSU considers that LPG and natural gas are the most likely fuels for early introduction. Indeed, LPG has been used in the transport sector for over 60 years – primarily in Japan, the United States, the Netherlands and Italy. However, the report concludes that petrol and diesel will 'remain the major fuels for the foreseeable future'.

Copies of *Alternative Road Transport Fuels – A Preliminary Life-cycle Study for the UK* are available from HMSO Books.

Kim Jackson



Natural gas hydrate – an alternative to liquefied natural gas?

**By Professor
J S Gudmundsson,
Norwegian
University of Science
and Technology, and
A Borrehaug, Aker
Engineering**

The use of natural gas hydrates for storing and transporting natural gas poses a serious alternative to LNG technology. Now a new method for the storing and transport of natural gases at atmospheric pressure has been developed at the Norwegian University of Science and Technology. In this method natural gas hydrates are refrigerated to stable conditions, enabling transport of natural gas in an insulated bulk carrier to distant gas markets.

The purpose of this paper is to report a first-order comparison of the capital cost of natural gas hydrate (NGH) technology with that of established LNG technology. The study shows that the capital costs of an NGH chain are much lower than those of a standard LNG chain.

Snohvit case study

Capital cost comparison of LNG and NGH technology was facilitated with a case study of the Snohvit offshore gas field in northern Norway. Statoil and its partners presented plans to develop Snohvit by piping natural gas 130 km to an onshore LNG facility.

Shell recently stated that 'LNG technology is in essence mature and since one cannot beat the principles of thermodynamics, it is unrealistic to expect a dramatic decrease in capital costs from a single process improvement' and concluded that with likely improvements in LNG production and shipping technology, a 5 percent capital cost reduction was possible.⁹

Snohvit's offshore field is officially planned to produce up to 12.6 million standard cubic meters (Sm^3) of natural gas per day, corresponding to a maximum annual rate of 4.5 billion Sm^3 . The present study, however, assumes an annual production rate of 3.5 billion Sm^3 per year, based on the capacity of three 125,000 m^3 LNG ships operating a transport distance of 3,000 nautical miles (about 5,500 km). Recoverable gas is estimated at 103 billion Sm^3 , recoverable condensate 9 million Sm^3 and recoverable oil 46.7 million Sm^3 . The water depth in the Snohvit field is 330 metres and the reservoir depth 2,400 metres (Falch and Haugen 1992).⁴

Natural gas hydrate

Until recently, the use of natural gas hydrate (NGH) for storing and transport purposes was a laboratory curiosity. See Englezos (1993) literature review.²

Gudmundsson (1990) argued that natural gas hydrates need not be refrigerated down to equilibrium temperature to remain stable under large-scale storing and transport. Instead, hydrates could sufficiently keep under near-adiabatic conditions.⁵

Gudmundsson and Parlaktuna (1992)⁶ and Gudmundsson et al (1994)⁷ demonstrated experimentally that the decomposition rate of frozen natural gas hydrates at atmospheric pressure is negligible. In Russia, Ershov and Yakushev (1992)³ and Yakushev and Istomin (1992)¹⁰ reported unexpected stability of natural gas hydrates stored at atmospheric pressure and temperatures in the range -1°C to -18°C .

Capital cost of ships

The volume of hydrates is nearly four times larger than that of LNG, assuming that LNG contains 600 Sm^3 and hydrate 150 Sm^3 of natural gas. Therefore, disregarding the void spaces between hydrate particles in bulk storage, the volume capacity of NGH ships needs to be at least four times larger than that of LNG for the same amount of natural gas shipped.

Typical LNG ships carry approximately 125,000 m^3 of liquefied natural gas and 135,000 m^3 ships are under construction (Nagelvoort and Tijm 1994).⁹ Hydrate ships can be built to at least twice that size – to carry 250,000 m^3 of hydrates. Ships designed to carry frozen hydrates need be no larger than insulated bulk carriers – and need not be refrigerated.

ed - and will thus be substantially less expensive than LNG ships.

The capital cost of LNG ships (18 knots) is reported to be \$280 million for 125,000 m³ ships and \$250 million for 135,000 m³ ships (information available to Aker Engineering in 1994). Four 135,000 m³ LNG ships under construction in Finland cost NOK6.5 billion in total. Using an exchange rate of 6.8 NOK=\$1, the cost per ship approximates \$240 million (cost highly subject to exchange rate fluctuations). Hydrate ships capable of transporting one-half of a 125,000 m³ LNG ship need to measure approximately 250,000 m³, assuming solid hydrate. If the solid hydrates' density is 928.5 kg/m³, its weight will equal 232,125 tons. To avoid bias toward hydrate ships, a 250,000 tons dead weight(tdw) was assumed. The total capital cost of a typical hydrate carrier will be approximately \$80 million (information available to Aker Engineering in 1994).

Assuming 350 days operation, three LNG ships can deliver approximately 3.6 billion Sm³ of natural gas, and seven hydrate ships 3.7 billion Sm³. Note that hydrate ships could be operated at speeds less than 15 knots and still deliver the same volume of natural gas.

The three LNG ships will cost \$750 million and the seven NGH ships \$560 million. The NGH hydrate ships cost 25 percent less than the LNG ships, a saving in Capex of \$190 million. Hydrate ships capable of transporting one-half

that of a 125,000 m³ LNG ship need to measure about 250,000 m³, assuming solid hydrate. With bulk hydrate porosity of 16.7 percent, the total carrying volume needs to be about 300,000 m³.

For a transport distance of 3,000 nautical miles, each of the three LNG ship will complete 18 voyages annually and each of the seven NGH ships 16 voyages. The total transport capacity will be respectively 4.1 and 4.2 billion Sm³ of natural gas annually. A figure of 4 billion Sm³ per year is assumed in the LNG and NGH production plants below.

Capital cost LNG chain

DiNapoli's (1986)¹ generalised procedure was used to estimate the capital cost of two LNG trains for 200 MMscf/d each. Three 80,000 m³ LNG storage tanks were assumed. Capital cost numbers presented were from mid-1985 in terms of natural gas rates in MMscf/d. A natural gas rate of 4 billion Sm³ per year corresponds to 400 MMscf/d.

An import/re-gasification terminal for LNG that handles 400 MMscf/d of natural gas was estimated to cost approximately \$350 million in mid-1985. The Nelson-Farrar cost index (see *Oil and Gas Journal*) can be used to update the 1986 capital cost estimate of DiNapoli. From mid-1985 to mid-1994 the cost index increased by nearly 25 percent. An LNG chain (production, shipping, re-gasification) for

4 billion Sm³ of natural gas per year was therefore estimated to cost \$2,677 million.

The LNG production cost equals \$886 per tonne of annual capacity. The corresponding capital costs for shipping and re-gasification are \$378 and \$221 per tonne of annual capacity. The total capital cost of the LNG chain amounts to \$1,485 per tonne of annual capacity. The density of LNG was assumed 420 kg/m³.

For an exchange rate of 6.8 NOK=\$1, the total capital cost amounts to NOK10.1 billion for the LNG plant, NOK5.1 billion for the LNG ships and NOK3.0 billion for the import terminal, representing 56, 28 and 16 percent, respectively. In total, NOK18.2 billion for the LNG chain. The Snohvit field development is estimated to cost about NOK 9 billion. It follows that the LNG chain represents two-thirds of the total capital costs and the field development one-third.

Capital cost NGH chain

Aker Engineering's cost-base was used to estimate the capital cost of a natural gas hydrate production plant. The total capacity of the plant was assumed to be 400 MMscf/d (4 billion Sm³ per year) of natural gas. In the LNG chain this rate was divided between two trains, each with a capacity of 200 MMscf/d. In the

hydrate plant, however, the total gas rate was divided into four trains, each with a capacity of 100 MMscf/d. The smaller train size in the frozen hydrate plant is attributed to the much larger liquid volumes involved. The general implication is also that the smaller unit size of NGH plants makes it possible to construct and operate them more in line with actual increases in natural gas demand.

A schematic flow diagram of the NGH process is shown in Figure 1. Water from an arriv-

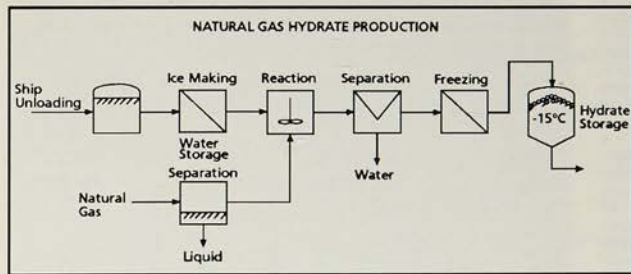
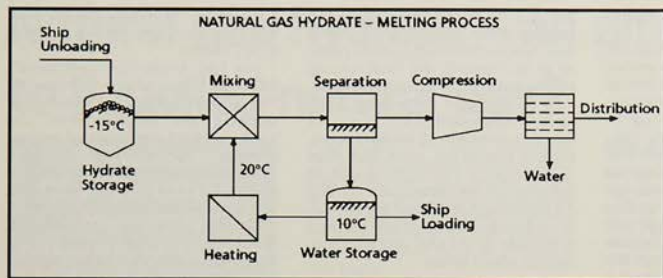


Fig. 1 - Schematic diagram of NGH production process.

Fig. 2 - Schematic diagram of NGH melting process.



ing ship is pumped into a storage tank. There are four trains of the same design and capacity. Water is pumped through an ice-making process where a 50/50 ice/water slurry is produced. Natural gas arrives under pressure from storage (optional) and gas/liquid separation. The natural gas and ice/water slurry are injected into the first stage of the three-stage hydrate reactor system.

A hydrate/liquid mixture leaves the last reactor stage with a hydrate concentration of about 30 wt percent. The mixture enters a vertical separator where hydrate concentrate is obtained. The hydrate depleted liquid returns to the reactor system by pumping.

The hydrate concentrate leaving the vertical separator enters a horizontal decanter system, where wet hydrate is squeezed out at one end and water the other. The separation efficiency of this operation is now known.

The cost of the main equipment is estimated to be NOK1,600 million and cost of bulk materials and plant construction is estimated as 150 percent of the equipment cost, corresponding to recent offshore cost relationships. Marine facilities as well as engineering and management costs are added, resulting in a basic plant cost of NOK5,000 million. Because the process is new, a contingency of 30 percent is added, giving a total erected plant cost of NOK6,500 million. This is the Capex of the 4 billion Sm^3 per year NGH production process and export facilities, comparable to an LNG plant's

grassroots installation.

The re-gasification of frozen hydrates will take place by simple melting. A schematic flow diagram of such a process is shown in Figure 2.

In both the production and melting of natural gas hydrates, natural heat sinks can be used. The NGH process operates at temperatures so near ambient conditions that the heating and cooling systems used will be energy efficient.

The cost of the melting facilities will scale with the capital cost of the production facilities. In the present work, the capital cost of the melting was assumed to be equal to 50 percent of that of the production; that is, NOK3,250 million. The capital cost expressed in Capex of an NGH chain for 400 MMscf/d over a distance of 5,500 km comes to \$1,995 million.

Total capital costs for a 4 billion Sm^3 natural gas production in the Snøhvit field, will approximate NOK22.55 billion; NOK9 billion for field development, NOK6.5 billion for hydrate production process, NOK3.8 billion for 5,500 km ship transport and NOK3.25 billion for hydrate melting.

Cost comparison

Table 1 compares capital cost values for the LNG chain with those of the NGH and illustrates that NGH costs much less than LNG. Hydrate shipping costs 25 percent less than LNG shipping. Moreover an evaluation of capital costs related to its production process (36 percent less) and re-gasification (9 percent more) shows that NGH technology costs 26 percent less than LNG technology.

The cost data have been updated in 1995 in a detailed feasibility study. The overall cost for both NGH and LNG have been reduced but the Capex percentage difference remains about the same.

Conclusions

1. Large-scale and long-distance transport of natural gas at atmospheric pres-

Table 1 - Comparison of capital costs of LNG chain and NGH chain, assuming 4 billion Sm^3 gas rate per year and 5,500 km transport distance.

Item	LNG (%)	NGH (%)	Difference (%)
	Million \$	Million \$	Million \$
Production	1,489 (56%)	955 (48%)	534 (36%)
Shipping	750 (28%)	560 (28%)	190 (25%)
Regasification	438 (16%)	478 (24%)	-40 (-9%)
Total	2,677 (100%)	1,995 (100%)	684 (26%)

sure in hydrate form has been found to be feasible.

2. Experimental studies in Norway and Russia have shown that natural gas hydrates are stable for up to two years when stored at -15° to -5°C at atmospheric pressure.

3. The estimated total capital cost of hydrate production and melting processes was approximately one-quarter less than LNG's equivalent liquefaction and re-gasification processes.

4. For the same natural gas carrying capacity, the capital cost of seven NGH ships was also estimated at approximately one-quarter less than that of three LNG ships.

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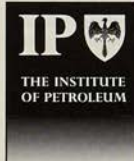
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The UK and Continental Gas Industries - Converging or Diverging Models?

Friday 24 May

To be held at the Cavendish Conference Centre, London

This conference will investigate, not the state of the gas industry next year or the year after, but where it will be 10 years from now. While taking account of the immediate changes, the introduction of competition, the significance of the Interconnector and the break-up of British Gas, it will look at alternative paradigms for the future.

- Developments in the United Kingdom are surely not a model for Europe?
- Will Britain adopt some French or German elements?
- Who, apart from the power generators and petrochemical companies, will be the big buyers and distributors?
- Where will domestic consumers buy their gas? From their local 'utility' company or the local supermarket?

This is an essential event for people with a long-term interest in the industry, general management, strategists, consultants and opinion leaders.

A copy of the programme and registration form is available from the Conference Department, The Institute of Petroleum, 61 New Cavendish Street, London W1M 8AR UK. Telephone: 0171 467 7100 Fax: 0171 255 1472

Oil may lie on troubled waters

Vietnam has signed an offshore exploration contract with Conoco in an area of the South China Sea also claimed by China. The move looks likely to refuel the long-running territorial dispute over the region and could potentially bring the United States and China into confrontation.

By Terry Knott

The joint venture agreement between state oil company PetroVietnam and Conoco was announced in mid-April following formal signing ceremonies in Hanoi. Holding a 70 percent interest in the joint venture, Conoco has been awarded the operating licence to evaluate Vietnam's Blocks 133 and 134 in the South China Sea, located 200 miles southeast of Vietnam's coastline.

The two blocks, covering around 3 million acres, directly overlap a licence awarded by China in 1992 to a small US oil company Crestone. China claims sovereignty over the area, referred to as Wan'an Bei, as part of its wider claim to most of the South China Sea, and rejects Vietnam's assertions that the region - known as Tu Chinh to the Vietnamese - forms part of Vietnam's continental shelf. Tu Chinh lies about 900 miles south of the Chinese mainland.

Crestone has not yet drilled any exploration wells on its licence, which covers over 6 million acres, but at the time of the Conoco announcement revealed it had been granted a two-year extension, indicating that China was ready to press ahead with exploration. Crestone has recently completed an evaluation report for the area in conjunction with the China National Offshore Oil Company, which is believed to show the area has 'outstanding oil potential'. Joint development of the area by China and Vietnam has also been proposed to PetroVietnam, says Crestone.

The Conoco agreement is significant in that it pushes Vietnam's offshore activities out further east in the Nam

Con Son Basin, a geological zone which is already seen as the area most likely to contain Vietnam's most prolific hydrocarbon reserves. Major gas fields have been confirmed and are now in development by BP in the blocks immediately adjacent to the new licence area. Exploration activity remains high, with British Gas, Mobil and Occidental at work in nearby blocks.

Although relations between Vietnam and China have been improving recently, the issues over territorial claims in the South China Sea present a potential flashpoint. Chinese gunboats have reportedly entered Vietnamese areas where foreign oil companies have been carrying out seismic exploration and drilling. Events in the Spratly Islands, a group of coral reefs and low lying islands about 100 miles southeast of the oil exploration area, have also recently led to renewed tensions between China and South East Asian countries (see *Petroleum Review*, June 1995). The islands are claimed in all or part by Vietnam, China, Malaysia, Philippines, Taiwan and Brunei and are rumoured to lie in a potentially rich hydrocarbon area.

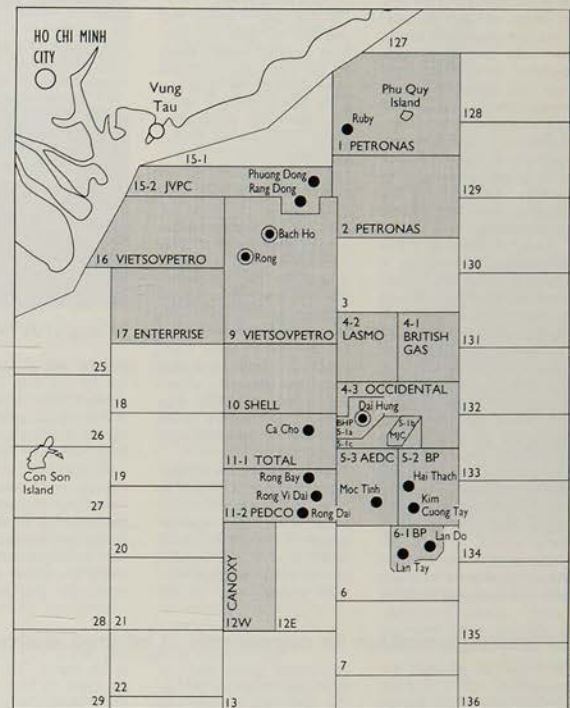
The award of the licence to Conoco follows only months after the company accepted a stake in the consortium determining the feasibility of Vietnam's first refinery at Dung Quat. After Total pulled out of the project on the grounds that its siting in central Vietnam was uneconomic, South Korea's LG Group, Malaysia's state oil company Petronas and Conoco joined the remaining Taiwanese partners to pursue the \$1.3 billion venture. Moves towards a second refinery, which could see the reappearance of Total, are now under way. Conoco is also in the running for the attractive offshore Block 15-1 in shallower coastal waters.

Vietnam continues to rely on three offshore fields for its oil production - Bach Ho, Rong and Dai Hung. Last year production reached 7.7 million tonnes, mainly from Bach Ho which has been on stream since 1986 under the operatorship of the Vietnam-Russian joint venture Vietsovpetro. Dai Hung, the first field to come into production under an international oil company, BHP, has proved disappointing since starting up in 1994, with output now having dwindled to a fraction of that originally predicted due to difficult reservoir conditions. PetroVietnam and BHP have been locked in renegotiations over the contract for several months.

However, oil finds by Petronas Carigali and Mitsubishi's subsidiary JVPC continue to look promising as potential additions to Vietnam's oil production, which has been forecast by PetroVietnam to reach an ambitious 20 million tonnes per year by 2000. The long-awaited redivision of Vietsovpetro's large blocks surrounding Bach Ho and Rong in the Cuu Long Basin has also been completed and four new licences in this area of proven oil productivity are now the focus of competitive tenders.

While additional revenue from oil exports would be greatly welcomed by Vietnam, the country's gas reserves are taking on increasing importance.

Gas is now coming ashore from Bach Ho to fuel the power station at Ba Ria outside Ho Chi Minh City. With BP/Statoil's major gas finds Lan Tay and Lan Do in the Nam Con Son Basin containing 2 trillion cubic feet of gas, detailed studies have been undertaken to determine the most economic ways to transport and use the resources, which would be sufficient to meet the demands of Ho Chi Minh City for sev-



eral years. BP has conducted studies of the Nam Con Son with other oil companies and has proposed that gas deliveries to shore could begin by the end of 1998.

Gas is also being considered in the wider context of developing a national energy infrastructure for Vietnam - a 'value chain'. Nearing completion is the Gas Master Plan, funded by \$2 million of aid granted by the UK Overseas Development Agency, and produced by BP, British Gas and consultants Mott Ewbank Preece, with added assistance from Mobil. Typical large-

scale uses for Vietnam's gas include power generation and fertiliser production, with smaller industries such as cement works and rolling mills also likely to benefit. Liquefied natural gas could also be an option for export to the industrial markets of Asia but, in the absence of a distribution network, domestic consumption will probably be limited to bottled gas for the near future.

Terry Knott is editor and publisher of the business report *Vietnam Oil and Gas Update*

Vietnam: Fields in production and recent discoveries in the southern basins
Source: *Vietnam Oil and Gas Update*, Knott Associates

Technology News

Design of offshore oil and gas installations moves into a new dimension

Virtual reality (VR) technology is revolutionising the way in which offshore installations are designed today. Not only does it provide designers with a powerful new tool to scrutinise and modify designs quickly and cost-effectively, it also allows 'hands-on' engineering, operational, maintenance and safety personnel to become involved in the design process at the earliest stage possible.

A leader in the field of this developing technology is Silicon Graphics which, with input from the CAD Centre in Cambridge, has developed Europe's first VR centre at Theale, near Reading in the United Kingdom.

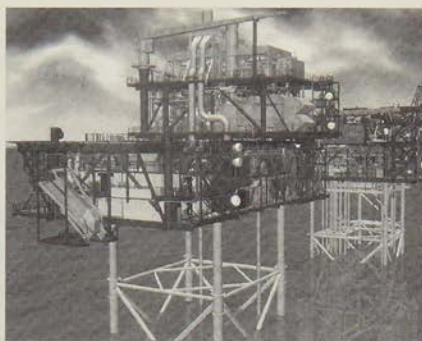
Looking somewhat similar to a small cinema auditorium, the VR room uses three projectors to blend three images into one single, life-like picture on a large wraparound screen with a 150° horizontal field of vision. Depth of perception, textures and lighting are designed to provide as realistic a picture as possible, with representations of the

sky, sea and horizon adding to the overall effect.

A 'fly chair' allows the operator to view the platform from all angles, zoom in on particular sections right down to the 'nuts and bolts' and to literally 'walk-through' the installation along corridors and into individual rooms.

Conoco and its design partner Brown & Root have been quick to take VR onboard and first successfully used the system on pre-installation and hook-up studies for the Ganymede platform, part of the Jupiter development in the North Sea, in 1994. Various potential 'problem' areas were scrutinised from all angles above and below the waterline in order to ensure that hook-up operations could be made as uncomplicated as possible.

More recently, the companies used the VR system to help design the second phase of the Caister Murdoch System (CMS2) which involves the installation of a compression platform bridge-linked to the



VR image of the CMS compression platform

Murdoch platform. The new facility will help boost gas pressure from both Caister and Murdoch and will also handle third-party gas from Shell's Schooner field.

A number of design changes were found to be necessary, including the repositioning of the power generation exhaust to prevent gases gathering underneath the cellar deck. The VR system also helped to

determine the best positioning for two gas turbine driven compressor modules, an accommodation unit and the helideck which is, unusually, to be on the same level as the main deck.

Helicopter operator Bond, the Civil Aviation Authority and UK Health & Safety Executive had the opportunity to 'view' and comment on the design as part of a safety case review.

Extended guarantees for components in infrared analysers

Servomex has increased the guarantee on chopper motors used in its Xendos series of infrared industrial gas analysers to three years following 'major improvements' in the long-term reliability of the motors. According to the manufacturer, this is by far the longest guarantee to be offered on such units anywhere in the world.

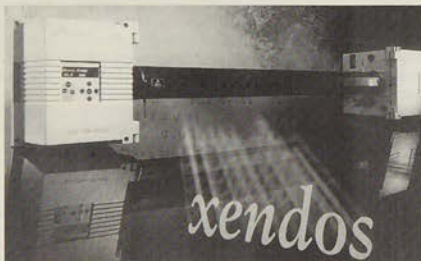
The infrared process analysers are designed to measure continuously the concentrations of a wide range of gases and liquids used in industrial applications, including those found in hazardous environments.

Capable of handling commonly encountered gases such as oxygen, carbon dioxide, carbon monoxide, hydrocarbon gases and pollutants as well as more

aggressive gases such as hydrogen chloride, ammonia, hydrogen cyanide and phosgene, the units measure a single infrared absorbing component in a gas or liquid sample stream.

The company has also extended the guarantee on zirconia oxygen sensors used

in its Series 700 flue-gas analysers to two years in cases where the units are to be used for 'normal applications' in fossil-fuelled plant. The sensors help improve fuel efficiency by providing fast and accurate oxygen readings in a range of combustion applications.



Xendos 2510 infrared process analyser

Gas trading tool

Anticipating increased gas trading amongst banks and end-users alike following the beginning of deregulation of the UK domestic gas market in April (see page 220), Financial Systems Development and gas broker Quantum Energy Derivatives (QED) have launched 'Quantum Gas Trader (QGT)', a complete pricing and analytics tool for anyone trading in gas.

QGT enables traders to track daily spot and forward gas prices in the United Kingdom as well as chart historical gas prices. It is also able to access real-time gas prices from QED via the Internet.

QGT is available to lease for £750 per month. Users can also subscribe to gas news and analysis for a small additional charge.

Technology News

New flow switch

PVL has introduced a new range of piston actuated flow switches to the UK market. Developed by Honsberg of Germany, the 'MR' switches are designed for use with a wide range of liquids and gases and are particularly suited to hydraulic applications.

The range uses a magnetically coupled piston to actuate either a SPDT reed switch or microswitch and can be supplied with an optional visual display if required. A 'damper' is fitted for use with gases to reduce the risk of piston fluctuations.

The switches are available with brass or stainless steel bodies. Mounted either vertically or horizontally, they can handle pressures of up to 500 bar, temperatures of up to 150°C and flow rates of 0.02 to 600 litres/min.



MR flow switch

Far East trading agreement

The Far East is one of the world's fastest growing marketplaces while Hong Kong has long been one of the most active business centres in the world.

In order to better serve the commodity market trading needs of this increasingly important market-place, the New York Mercantile Exchange and the Hong Kong Futures Exchange recently announced a letter of intent that will result in the two companies working together on future trading system and product developments. They plan to:

- place Nymex Access™ workstations in Hong

Kong for use by members of both exchanges;

- analyse interfacing of the two exchanges' electronic trading systems;
- analyse the feasibility of developing systems capable of allowing members of both exchanges to trade and/or clear mutually agreed-upon contracts;
- establish an arrangement to develop contracts for joint marketing to the Hong Kong, Chinese and Asian markets; and
- allow for co-operative arrangements on any other matters that both parties agree is in their mutual best interests.

New look to airline ball valve

As a result of ongoing product review programmes, Fort Vale Engineering has re-vamped its airline ball valve for tank container applications.

The 'new' valve design incorporates a choice of two handle types, a straight type and a cranked version less likely to receive damage if inadvertently left open during stacking operations.

In addition, the base flange has been strengthened and an optional snap-in gauge protection bar is also available which can be retrofitted if required.

'Special attention has been given to simplifying the maintenance procedure but internal parts have not been changed so spare components will not be affected,' states the manufacturer.

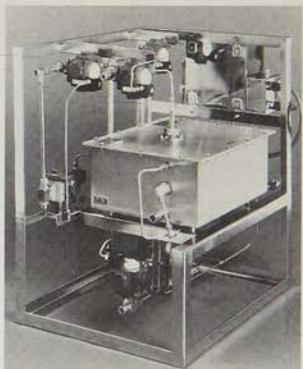
On-line particulate analyser for live process streams

Designed to operate in the most hostile of environments, Acal Auriema's new 'Galai Aladdin' on-line system for the comprehensive analysis of particulates in a live process stream is suitable for a wide range of process and environmental applications, including oil/particulate monitoring of offshore produced water and water injection systems and refinery discharge water systems.

The analyser works on the principle of 'Time of Transition Theory'. A process stream is passed through a measurement cell where particles are scanned by a focused infrared laser beam. The beam is rotated at constant speed within the measuring area by a wedge prism and, as the angular

velocity of the beam is known, the size of each individual particle can be calculated from the duration of signal obscuration caused by the particle.

Each particle produces a signal from the detector. Signal length is related to the size of the particle, while signal shape relates to particle shape, density and optical characteristics. Specialised software allows the system to distinguish between randomly shaped suspended solids and spherical oil droplets.



Galai Aladdin

Advanced drilling facility



A joint venture between Germany's Bentec Drilling & Oilfield Systems and the Consafe Group from Scotland have developed what is claimed to be the world's most advanced offshore drilling facility.

Having recently completed onshore testing and commissioning, the 'New Derrick Equipment Set (NDES)' is scheduled to enter service on Shell/Esso's Brent Charlie platform, 120 miles offshore of Aberdeen, early this summer. It will be operated by Deutag Drilling, Bentec's parent company.

The NDES features an ergonomically designed and air conditioned driver's cabin from which all aspects of drilling operations can be computer controlled. Previously manual tasks can be carried out both automatically and simultaneously, improving the safety of personnel as well as the overall drilling performance.

Technology News

Virtually in the pipeline

Aberdeen-based computer company Morrison McLean Associates (MMA) has secured a £250,000 contract with Norsk Shell to develop a virtual reality system for the Troll gas field in Norway.

The firm is creating a computer generated model of an underwater pipeline tunnel for phase one of the Troll development, the largest offshore gas field in Europe. The model, coupled with the latest remotely operated vehicle (ROV) technology, will allow Shell engineers to monitor and inspect the inaccessible parts of the pipeline network which runs through tunnels under 200 metres of water.

Relevant inspection information such as ROV video footage, photography, written information and recorded speech notes can be packaged together and

stored on the computer. These details can then be accessed at the touch of a button giving an instant report on the current status of any point within the tunnels.

'Real world simulation has the potential of offering cost and safety benefits to the oil and gas industry,' says George Morrison, Managing Director of MMA. 'The system will allow inspections to take place in environments which are hazardous without any risk to personnel. It will cut down on the length of time required for inspections and will allow the results to be stored in an easy, accessible way which again will reduce costs for the client.'

Gramplan Enterprise is helping fund the initial development and trials of the virtual reality system.

New computer systems aid gas trading

With the onset of deregulation of the domestic UK gas market (see page 220), gas companies are requiring more control over their day-to-day buying and selling activities in terms of exposure and position in order to remain competitive.

With this in mind, CMG has developed a Gas Trading System that provides real-time information on individual traders' positions. The system records market bids to enable management to respond to the gas market's volatile price changes and maximise on profitable trading opportunities. Designed to complement the International Petroleum Exchange's soon-to-be launched trading system, it will allow users to manage their portfolio with contracts traded over the IPE network.

The system also prohibits traders from exceeding pre-set limits designed to prevent a company becoming exposed to unauthorised dealing. It can also interface with CMG's Gas Day Management System for

daily gas balancing activities which are required under the terms of the Network Code.

CMG is also involved in field trials of a mobile data system for British Gas Service (BGS) in which portable laptop computers provide an automated link between customer calls, field service engineers, stock inventories and financial systems. 'Such a link will provide a faster and more efficient customer service, using less paperwork, that is far more focused on the task in hand,' says CMG. The system also reduces costs.

Prior to development of the system, the ratio between field service engineers and administrative back-up staff was 1:1. The new system is expected to increase the ratio to 30:1 by the end of this year.



BGS mobile data link in action

A new breath of fresh air

Draeger has augmented its range of PA90 breathing apparatus (BA) with the PA90 Plus Series. This latest model features a new streamlined, air-pressure operated, warning whistle and a luminescent gauge, fully integrated within the



gauge hose, which are positioned lower on the chest than other PA90 BA designs in order to provide maximum protection. It also incorporates a smaller and lighter first stage pressure reducer for both 200 and 300 bar cylinders.

Improved flow characteristics provide in excess of 1,000 l/min at full cylinder pressures with a minimum of 700 l/min even when the whistle sounds, states Draeger. The PA90 Plus unit uses a compact, high performance, first breath positive pressure lung demand valve, as do all the PA90 units, while the balanced piston design provides a stable air supply with low breathing resistance.

Loop powered transmitter indicator

Thermocouple Instruments' new TLP Series of 4-20 mA loop powered three and a half digit (1999) indicators features a stainless steel housing for offshore and other corrosive environments.

The unit's stainless steel connecting head has a clear window to accept both the TLP indicator and a TR55 or other smart temperature transmitter and mounts directly on the thermosensor. The assembly is also

available in die cast aluminium as is a smaller version that accepts a loop indicator on its own.



Contacts

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PVL	01892 664499
Acal Auriema	01628 604353
New York Mercantile Exchange	00 1 212 748 3326
Hong Kong Futures Exchange	00 852 2842 9421
Fort Vale	01282 692525
Consafe	01224 406600
Bentec Drilling & Oilfield Systems	00 49 59 227 2580
Morrison McLean Associates	01224 575011
CMG	0171 233 0288
Draeger	01670 352891
Thermocouple Instruments	01222 734121

People



Mr Ian Burrows has been appointed President of The Institute of Marine Engineers for a one-year term of office. Mr Burrows joined The Institute of Marine Engineers in 1960 and became a Fellow in 1973. In 1990 he was elected a Fellow of Council and was appointed Deputy President in 1993. He has been an active member of the Scottish Branch for many years and Branch Chairman from 1988-90.

Mr Tore Bergerson has taken over from **Mr Ole Jacob Haaland** as Executive Vice President of the Kvaerner Group with responsibility for its overall operations in the oil and gas sector. **Mr Ingebrigt Moum**, head of the Norway region, **Mr Graham Gottsche**, head of the international region and new appointee **Mr Frank Chapman**, who will take charge of the UK region, will report directly to him. He will be based in London with Mr Gottsche and Mr Chapman.

Bond Helicopters Ltd have appointed **Mr Stephen Bond** as Executive Chairman and **Mr Trevor Larman** as the successor to his Managing Director role. Mr Larman was appointed to the Board in 1989 and previously held the position of Director of Operations. Mr Bond will also continue with his responsibilities as Chairman of Australia's Lloyd Helicopters and Rototech and as a Director of Helicopter Service AS of Norway.

Mr David Brooks has been appointed to the post of Managing Director, Quality Customer & Service, British Gas. He was previously Managing Director of British Gas Retail.

Texaco has announced that as of 1 April **Mr Richard F Brenner** will become President of the Human Resources Division and a Corporate Vice President. Mr Brenner's previous position was Vice President, Global Human Resources for AT&T/NCR, a computer subsidiary of AT&T. He succeeds Mr John D Ambler who has taken early retirement after more than 40 years service with Texaco.

Kuwait Petroleum (Thailand) has announced the death of **Mr John Auld**, Managing Director. He was previously Managing Director of Kuwait Petroleum (GB) and Kuwait Petroleum (Aviation).

Mr Maurice Bell has retired as Managing Director of AMEC Process and Energy London after 43 years continuous service. Operations Director **Mr Graham Wilson** will take over responsibilities for AMEC Process and Energy's London operations.



The Expro Group have appointed former Marketing and Development Manager **Mr Graeme Coutts** to its Board of Directors as Director of Marketing and Development. Mr Coutts will be responsible for driving the company's technology development forward.

British-Borneo Petroleum Syndicate plc has announced that **Dr William Roach** is to project manage the development of its Morpeth oil discovery. Mr Roach has worked for Shell for the past 12 years on a number of North Sea projects.



Mr William Rabson has been promoted to General Manager of Western Geophysical's marine and transition-zone operations in the Europe/Africa/Middle East region. Mr Rabson has been with Western Geophysical for 13 years most recently as supervisor and manager of Western hemisphere marine and transition-zone operations.

Mr Tassilo Peyrer-Heimstätt has been appointed by OMV Aktiengesellschaft to the position of Director for Refinery, Sales and Plastics (PCD Polymere Ges.m.b.H) with effect from 1 April. Mr Peyrer-Heimstätt will be taking over areas previously handled by President **Dr Richard Schenz**, in addition to his function as Chairman of the Board of Directors.

Enterprise Oil has announced the appointment of **Mr John Grieves** as a non-executive director with effect from 1 May. Mr Grieves retired from City Law firm Freshfields at the end of April after six years as a Senior Partner and 33 years with the firm.

Mobil Oil Corporation has announced changes to its worldwide Marketing & Refining management team. **Mr William Walsh**, currently Vice-President, Europe/Africa/Middle East, Marketing and Refining Division will retire on 1 June. Mr Walsh will be succeeded by **Mr Hal R Cramer**, currently Vice-President Asia Pacific, Marketing & Refining Division. **Mr Stephen Pryor**, formerly Vice-President, Mobil Chemical Company, will take over from Mr Cramer.

Professor John S Archer, at present Deputy Rector of Imperial College of Science, Technology and Medicine, has been named as the next Principal and Vice-Chancellor of Heriot-Watt University.

Mr Lynton Jones has been appointed Chief Executive, International Petroleum Exchange. He succeeds **Mr Peter Wildblood OBE** who will retire later this year.



Ms Susan Farrell has joined Brown & Root Energy Services (BRES) as Director of Business Planning. Ms Farrell has extensive experience in the oil and gas industry having previously worked for J Ray McDermott both in America and the United Kingdom. She will report to **Mr Larry Farmer**, President of BRES, and her main responsibilities will be for global market analysis and input to long-term strategy.

Publications

Hydraulic Fracture Mechanics

Peter Valko and Michael J. Economides (John Wiley & Sons Limited, Baffins Lane, Chichester, West Sussex PO19 1UD) 298 pages. ISBN 0 471 95664 3. Price: £45.

This book explores the theoretical background of one of the most widespread activities in hydrocarbon wells, that of hydraulic fracturing. The dynamics of the rupture process are discussed from the point of view of the influence of basic phenomena such as elasticity, stress distribution and fluid flow on the created fracture. Currently used design and analysis techniques are derived and improved using a comprehensive and unified approach while numerical examples are elaborated to illustrate important concepts. Chapters are cross-referenced throughout and the connections between various phenomena emphasised.

Prospects for the North Sea Oil and Gas Industry 1996-99

MacKay Consultants (7 View Place, Inverness, Scotland IV2 4SA) 170 pages. Price: £400 (paperback).

This detailed report includes forecasts of offshore oil and gas production, exploration drilling and offshore expenditure in the United Kingdom, Norway, Denmark, Germany, the Netherlands, Ireland, France, the Isle of Man and the Faroe Islands for the period 1996-99. The recent rapid growth in North Sea oil production is predicted to end in 1998, after which output is expected to fall. UK production is forecast to peak in 1997 and decline by 5 percent per year thereafter. In contrast, offshore gas production is forecast to continue to increase with growth of over 20 percent during the period 1996-99, with particularly large increases in production expected offshore the United Kingdom and Norway. Exploration drilling is expected to remain reasonably stable over the forecast period with the United Kingdom continuing to dominate the market. Drilling is expected to begin in Faroe and Isle of Man waters within the next few years. Offshore expenditure, which totalled some £16.4 billion in 1995, is predicted to fall by 11 percent by 1999.

Offshore Engineering – An Introduction

Angus Mather (Wetherby & Company Limited, 32-36 Aylesbury Street, London EC1R 0ET) 229 pages. ISBN 1 85609 078 7. Price: £45.

This publication provides a comprehensive introduction to the offshore engineering industry, taking the readers from exploration, through construction and into production. Of particular use to new recruits in this sector of the offshore business, the book explains the key aspects of the various disciplines and includes a list of references to access more specialised information if required. The publication also provides the more experienced offshore engineer a broader perspective of activities outside of his/her own particular speciality. Whilst frequent references are made to the North Sea oil and gas industry, the bulk of the text is of a more general nature and is thus applicable to offshore engineering on a global basis.

Indonesia – The Political Economy of Energy

Philip Barnes (Oxford University Press, Walton Street, Oxford OX2 6DP) 193 pages. ISBN 0 19 730016 2. Price: £29.50.

Incorporating research work done at the Oxford Institute for Energy Studies, this volume examines the potential for the development of Indonesia's energy resources and the various constraints placed upon this sector. Examining the country's energy resources in the context of Indonesia's political and economic structure, the book studies the development of oil production, the domestic energy scene, natural gas, coal and other alternatives to oil. It also examines the organisation of the country's energy industry and state-owned oil and gas company Pertamina and their relationship with OPEC.

Engine Testing – Theory and Practice

Michael Plint and Anthony Martyr (Butterworth Heinemann, Linacre House, Jordan Hill, Oxford OX2 8DP. Available from Reed Book Services Ltd, PO Box 5, Rushden, Northants NN10 6YX) 312 pages. ISBN 0 7506 1668 7. Price: £35.

Increasing environmental concern regarding exhaust emissions has not only given fresh impetus to the development of the internal combustion engine in recent years but has also led to test procedures becoming increasingly more complex and demanding. This presents a challenge to the test and development engineer who must master these new techniques as well as the traditional skills associated with engine testing. Essentially practical in nature, this publication brings together in one volume the body of information on the theory and practice of engine testing and test plant design to which any engineer responsible for work of this kind needs access.

Oil and the Transformation of Oman 1970-95

Mohamed bin Musa Al-Yousef (Stacey International Publishers, 128 Kensington Church Street, London W8 4BH) 144 pages. ISBN 0 905743 857 (hardback). Price: £18.50; ISBN 0 905743 873 (paperback). Price: £14.95.

The discovery and exploitation of oil has helped transform Oman from a backward country into one with the highest economic growth rates in the world in just 25 years. Written by Oman's Minister of State for Development Affairs, this book traces the links between the growth of oil revenues and economic change and the challenges associated with the country's development. The transformation process began when His Majesty Sultan Qaboos bin Said assumed power on 23 July 1970 and implemented a series of successive five-year plans that helped to maximise oil exports while increasing the level of oil reserves to deal with oil price instability and competition and diversified the sultanate's economy to lessen dependence on oil revenues. The volume concludes with a look to the future and the challenges that face Oman as it moves into the 21st century.

Petroleum Refining (Volume 1): Crude Oil, Petroleum Products, Process Flowsheets

Editor: J.-P. Wauquier (Editions Technip, 27 Rue Ginoux 75737, Paris, Cedex 15, France) 504 pages. ISBN 2 7108 0685 1. Price: FF690.

The first in a series of five volumes covering various aspects in the petroleum refining industry, this book summarises all the information required by engineers and technicians to characterise, analyse and evaluate crude oils from different origins and their corresponding petroleum fractions. The characteristics and specifications of all petroleum products are detailed as well as their simplified production flowcharts. Separation processes, conversion processes, materials and equipment and refinery operations and management will be covered by the remaining four volumes in the series.

The 1996 Natural Gas Yearbook

Editor: R E Willett (John Wiley & Sons Ltd, Baffins Lane, Chichester, West Sussex PO19 1UD) 318 pages. ISBN 0 4711 3560 7. Price: £95.

This yearbook provides an up-to-date and clear explanation of the technical, political, regulatory and economic developments which are shaping the heavily regulated natural gas sector of the energy industry in the 1990s. Topics addressed include developing international markets, recent developments in financial markets, the economic outlook for each industry sector and coverage of recent controversies.

Institute News

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 Mr M A Willett, Banbury
 Mr M P Wright, Inland Revenue Oil Taxation Office
 Mr P Yates, Welwyn Garden City

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 Mr T S Driver, London
 Mr F A Farid, London
 Ms O O Onitiri, Dundee
 Ms C-M Sporkkeree, The Netherlands
 Ms A Tejuoso, Dundee

NEW COLLECTIVES

Aluko & Oyeboide,
 150 Regent Street,
 London W1R 5FA

Nominated Representative: Mr Gbenga Oyeboide
 Aluko & Oyeboide is a Nigerian commercial law firm providing a comprehensive range of legal services mainly to foreign investors in Nigeria's oil and gas industry. It employs 20 lawyers and has offices in Lagos, Port Harcourt and London, with an extensive client base made up of multinational oil exploration and service companies.

Sinclair Roche & Temperley,
 Broadwalk House,
 5 Appold Street,
 London EC2A 2NN

Nominated Representative: Mr Stuart Beadnall
 Sinclair Roche & Temperley is a leading commercial law firm with offices in London, Hong Kong, Singapore, Shanghai, Vietnam, Bucharest and a presence in Brussels. It has considerable expertise in all aspects of international trade, transportation, energy and finance. The Vietnam and Romania offices are closely involved in petroleum industry activities in those areas.

Petline Petroleum Trade Company,
 Bayar Cad Gulbahar Sk No 17,
 96 Perdem Sac Plaza,
 Kozyatagi Kadikoy,
 Istanbul 81090,
 Turkey

Nominated Representative: Ms Tulin Secen
 Petline Petroleum Trade Company was established in 1992. Its seaport has capacity for 15,000dwt and storage capacity of 15,000m³ for chemicals and oil products at Kabakoz near Tupras' Izmit refinery. Land has been bought for the construction of additional storage facilities in other areas of Turkey (total capacity of 47,000m³). With the slogan 'The New Life on the Road' at its 100 service stations, Petline provides products and services throughout Turkey.

AROUND THE BRANCHES

ABERDEEN

14th May: 1994 Technology Award Winner
 Speaker: J Dawson, Expro, North Sea

HUMBER

9th May: *Advances in Medical Techniques*

LONDON

22nd May: *Back to Basics - Lubricating Oils*

NETHERLANDS

23rd May: *Loss control: the future of the inspection companies*

EAST ANGLIA

16th May: *Underwater Intervention and the Changing Commercial Environment*
 Speaker: Malcolm Smith, Project Manager,
 Oceaneering International

SOUTH WALES

22nd-23rd May: Weekend visit to Telford

Financial Risk Management in the Oil and Gas Industry

Seminars for treasury specialists or anyone with profit responsibility in the petroleum industry

Please note this revision:

Seminars 'Management information systems in the treasury environment'

'Trading and the misuse of derivatives'

are now combined into one session, to be held on Monday 3 June from 16.30-19.00

Price and details, from Jenny Sandrock at the IP
Direct line 0171 467 7104

PETROLEUM REVIEW INDEX 1995

Free copies of the 1995 Index for Petroleum Review are now available on request from:

The Library,
The Institute of Petroleum
61 New Cavendish Street
London
W1M 8AR
Tel: 0171 467 7100

UK Deliveries into Consumption (tonnes)

Products	†Feb 1995	*Feb 1996	†Jan-Feb 1995	*Jan-Feb 1996	% Change
Naphtha/LDF	343,311	229,021	619,090	496,014	-20
ATF - Kerosene	491,526	560,405	1,019,073	1,152,312	13
Petrol	1,646,560	1,678,332	3,274,663	3,351,116	2
of which unleaded	1,013,001	1,096,946	2,007,327	2,190,488	9
of which Super unleaded	75,701	61,446	148,762	123,159	-17
Premium unleaded	937,300	1,035,500	1,858,565	2,067,329	11
Burning Oil	305,907	404,840	617,616	776,352	26
Dev Fuel	1,041,845	1,125,972	1,998,555	2,227,736	11
Gas/Diesel Oil	644,275	798,204	1,336,971	1,529,653	14
Fuel Oil	875,627	875,627	1,672,740	1,475,268	-12
Lubricating Oil	69,627	70,104	137,706	141,030	2
Other Products	673,468	492,555	1,358,398	1,184,864	-13
Total above	6,092,146	6,235,060	12,034,812	12,334,345	2
Refinery Consumption	479,463	512,780	1,051,106	1,086,050	3
Total all products	6,571,609	6,747,840	13,085,918	13,420,395	3

† Revised with adjustments *preliminary

The European Auto-Oil Conference: the interrelationship between fuel standards, engine design and air quality

Friday 12 July

To be held at the Cavendish Conference Centre, London

Following the completion of the European Programme on Emissions, Fuels and Engine Technologies (EPEFE) and the expected publication of the Draft Directives on Fuels and Vehicle Emissions by the Commission of the European Union, a period of hectic consultation and lively debate begins with this conference.

Representatives of the oil and motor industries, together with environmentalists, will respond to proposals from the Commission about the objectives and content of the Directives and the process for implementation before their execution through EU institutions, national governments and the European Parliament.

Despite two postponements of this event, following delays in finalising the legislation, it still provides a timely opportunity to hear the arguments and enter into the dialogue and will be crucial for general management, strategists and planners, as well as those charged with technical implementation of the forthcoming regulations.

A copy of the programme and registration form will be available shortly from Conference Department, The Institute of Petroleum, 61 New Cavendish Street, London W1M 8AR UK. Telephone: 0171 467 7100 Fax: 0171 255 1472

Energy issues in Central Europe: refining, marketing and distribution

Wednesday 3 July

To be held at the Institute of Petroleum

The first of two IP conferences in association with the Department of Trade and Industry on the new developing energy markets of Central Europe, focusing especially on the 'new economic tigers', the Czech Republic, Slovakia, Poland and Hungary.

This event will concentrate on the opening of new investment and development opportunities in refining, marketing, transport and distribution, including analysis of environmental and financing considerations.

This is an important event for people and companies seeking to understand these new markets, especially contractors, equipment suppliers, consultants and service companies for which openings may arise as existing facilities are upgraded by indigenous organisations or with the involvement of major international investors.

A copy of the programme and registration form will be available shortly from Conference Department, The Institute of Petroleum, 61 New Cavendish Street, London W1M 8AR UK. Telephone: 0171 467 7100 Fax: 0171 255 1472

Introduction to Oil Industry Operations

Wednesday 19 June – Friday 21 June

This course is designed as a general introduction to the whole range of oil industry operations from the search for oil and gas to the delivery of products to the customer. It will include an appreciation of the principal functions of the different parts of the petroleum industry and the inter-relationship between them. It is likely to be appropriate for:

- Participants from within the oil companies whose experience is limited to one function of the industry and who require a broader perspective of the industry's activities.
- Participants from financial and commercial institutions, other energy industries, analysts, suppliers, service companies and contractors; and government organisations who need an informed 'birds eye view' of the oil industry.

Topics to be covered during three days will include:

Changing Perspectives in the International Oil Industry	Exploration for Oil and Gas
Natural Gas	Petroleum Production
Basic Concepts of Drilling	Introduction to Marketing/Distribution/Retail Markets
How Technology Serves the Business	Supply
Marine Transportation	Refining

This is a self-contained course but is followed by:

Introduction to Petroleum Economics

Monday 24 June – Wednesday 26 June

This course is designed as a general introduction to the economics of the oil industry and may be particularly valuable to companies who do not hold their own in-house induction courses covering this subject. It is likely to be appropriate for:

- Participants from within the oil industry whose experience is limited to one function of the industry and who require a broader perspective of the economic factors affecting the industry.
- Participants from financial institutions, government, other energy industries and the supply and service industries which want to obtain an informed and concise introduction to the economic and commercial background to the industry.

Topics to be covered during the three days will include:

Geopolitics of Oil	The Oil Markets	Structure of the Oil Industry
OPEC/Middle East	Crude Oil Markets	Development of Major Oil Companies
Asia and Pacific Region	Product Markets	The National Oil Companies
Eastern Europe and the Former Soviet Union	Oil Price Reporting	
North America	Oil Futures Market	
North Sea Basin	Oil Supply and Price – the Outlook	

*For copies of the registration forms for both courses please contact
The Conference Department, The Institute of Petroleum, 61 New Cavendish Street,
London W1M 8AR. Tel: 0171 467 7100 Fax: 0171 255 1472*