

PETROLEUM REVIEW

IP



THE INSTITUTE
OF PETROLEUM

December 1996

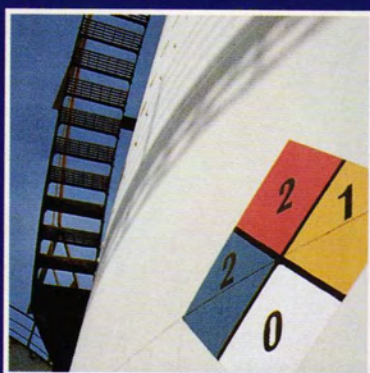
Gulf of Mexico
Production begins from
subsalt Mahogany

Oil loss control
Updated survey of
marine oil losses

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An overview of the
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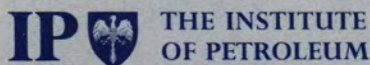
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COVER PHOTO

Working on the Mahogany installation
Photo courtesy of Phillips Petroleum Co

News in Brief

10 October

Information Handling Services Group Inc in Colorado has acquired Petroconsultants, the Geneva-based publisher of information databases and related publications covering oil and gas exploration and production outside the United States and Canada.

Amoco has extended its involvement in the Dutch downstream gas market with the formal signing of contracts with Gasunie for the conversion of the largely depleted Alkmaar gas field into an underground gas storage facility. The first project of its kind in the Netherlands, the new storage facility will have an annual working capacity of 250 mncum and is scheduled to be available in the winter of 1997-98 (see *Petroleum Review*, January 1996).

21 October

BP Chemicals and Shanghai Petrochemical Company have signed a letter of intent for a \$2.5bn joint venture 650,000 tonnes per annum ethylene cracker and certain derivative plants. The deal represents the largest investment that BP has made in China to date and is the largest joint venture project to be undertaken by the Chinese company.

British Petroleum has vehemently denied media allegations attempting to link the company with human right abuses in Colombia.

22 October

Yukos is to increase its interest in YuganskOil, and hence its stake in the Sortymoskoye oilfield development in West Siberia from 20 percent to 30 percent. Yukos is Russia's second largest oil company with production of around 700,000 b/d.

23 October

The Amerada Hess-operated Telford field has come onstream some two months ahead of schedule, 10 months after receiving DTI approval. Peak production of 30,000 b/d is expected by the end of the year.

Shell Expro has awarded a £25m subsea EPIC contract for the development of the Kingfisher field to McDermott Marine Construction Limited.

Ranger Oil has announced that the Kiame 4 appraisal well in block 4 offshore Angola has encountered over 60 feet of good quality oil-bearing reservoir above the oil water contact and has been suspended without testing.

United Transport (UT) has secured two new contracts with Shell Oils and AGA Gas. The AGA Gas contract, under which UT will provide traction for three of the company's gas tankers, represents the haulier's first move into the industrial gases market.

Fisher-Rosemount has formed a new subsidiary, Fisher-Rosemount Petroleum, that will concentrate solely on providing precision measurement solutions to the hydrocarbon industry.

24 October

Premier Oil has paid \$33m for a 15.79 percent interest in a gas field in Pakistan.

Al Mansoori Production Services of Abu Dhabi and Aberdeen-based Expro Group have formed an alliance to provide enhanced well testing capability in the United Arab Emirates.

Pogo Producing Company has discovered additional hydrocarbons on its East Cameron Block 334 field offshore Louisiana.

25 October

Dana Petroleum has made a IRE3.05m bid for the entire share capital of Petroceltic which has exploration interests offshore Ireland, western Australia and West Africa.

ABB has won a \$500m plus contract from Essar Oil Limited to build one of India's first private sector oil refineries. The Jamnagar-based plant will produce 9 million tonnes of products per year.

A South Korean consortium comprising Korea Gas Corporation (Kogas), Samsung, Hyundai, Daewoo and Yukong is to acquire a 5 percent stake in Oman LNG. The deal follows the signing of an LNG supply contract between Oman LNG and Kogas.

28 October

Brown & Root Energy Services is to triple capacity and create over 60 new jobs at its underwater construction company, Rockwater's pipeline bundle fabrication yard at Wester Site near Wick in Scotland.

29 October

Able Instruments & Controls is to supply a cargo transfer metering system to the Schiehallion FPSO.

30 October

Kvaerner John Brown Ltd is to supply engineering and project services for design and procurement and support for installation and commissioning of the Interconnector compression facilities at Bacton in Norfolk. It is also to undertake the design and procurement of the reception terminal at Zeebrugge, Belgium.

Paktank Oil Nederland has announced that it plans to restructure its organisation. Some 75 jobs are expected to be lost as a result.

31 October

Argentina's second largest oil and gas producer, Perez Companac, has acquired rights to exploit hydrocarbons in Lot X in the Cuenca de Talara in Peru, reports the *Financial Times*.

The UK government has given its consent for the construction and operation of a 700 MW combined cycle gas turbine power station at Killingholme in north Lincolnshire.

Ranger Oil has completed the \$49m purchase of Chevron's interests in the Ninian, Hutton, Lyell and Murchison fields as well as the Columba B and E Terraces. Oryx has purchased the remaining 65 percent.

4 November

Sedgwick Azeri Limited has signed an agreement to provide risk management advice and insurance broking services to Azerbaijan's state oil company SOCAR and its affiliated companies in the operation and development of its upstream and downstream facilities.

Exxon Chemical Company and Sinopec Jinzhou Petrochemical Co have officially inaugurated their Jinzhou Jinex Lubricant Additives Co Ltd joint venture in Jinzhou, China.

5 November

Singapore-based Far East Levingston Shipbuilding has signed an agreement to repair and upgrade oil rigs in the Caspian Sea, reports *Lloyd's List*.

6 November

Dana Petroleum's Sortym-skoye oilfield in Western Siberia has produced first oil ahead of schedule.

Ranger Oil has acquired a 20 percent interest in UK Central North Sea licence P748 covering blocks 29/2c, which includes the Kyle discovery, and 22/26b from Mobil. In exchange, Mobil has acquired Ranger's interest in block 48/22a.

7 November

Elf, Amoco and Repsol have signed a production sharing contract with the government of the Republic of Trinidad and Tobago for block S11(b) off the south coast of Trinidad.

The Trent and Tyne fields, located in North Sea blocks 43/24 and 44/18 respectively, have produced first gas just 18 months after gaining Annex B approval.

News in Brief

9 November

SLP Engineering and DSND Oceantech have formed a joint venture company, Oceantech SLP, that will cooperate exclusively on floating production and large sub-sea development projects, reports *Lloyd's List*.

11 November

Ingersoll-Rand has secured a \$40m contract to supply air compressors and related infrastructure for a new oil recovery facility being built by India's Oil & Natural Gas Corporation in Santhal, India.

Chevron Petroleum

Technology Company has entered into licensing agreements with Compagnie Générale de Géophysique and PGS for use of its seismic data compression technology. It has also awarded a commercial licence to Landmark Graphics Corporation to incorporate the technology into its data processing and interpretation systems.

Ingersoll-Dresser Pump

Company has been awarded a \$12m contract to supply pumps to Aramco in Saudi Arabia.

12 November

Spain has announced the sale of the state's 3.8 percent stake in Gas Natural as the first disposal of the new government's privatisation programme, says *Lloyd's List*.

British Gas has withdrawn

writes which were taken out against the UK Department of Trade and Industry but not served. The company is now satisfied that Gas Levy Act 1981 legislation requiring the payment of levy on gas from particular UKCS fields purchased under certain contracts had been applied correctly.

The pilot of the Sea

Empress which ran aground off Milford Haven in February has been cleared of incompetence after an appeal.

Stolt Comex Seaway has

secured a \$68m, four-year contract from Petrobras for diving and ROV support services using the *Seaway Harrier* on the deepwater Campos Basin oilfield.

OMV has announced three

new oil and gas discoveries in the Vienna Basin, Austria. The exploration wells are situated near existing infrastructure which, together with the lower drilling depths, will reduce development costs. The additional production will help stem the decline in OMV domestic production.

13 November

Chevron has signed a letter of intent with the Bahrain National Oil Company to evaluate the potential for upstream ventures. The arrangement will also provide further opportunities to examine enhanced oil recovery techniques for the Bahrain oilfield.

14 November

Egyptian General Petroleum Corporation, Botas Petroleum Pipeline Corporation of Turkey and Amoco Egypt Oil Company have signed an agreement to export up to 7.3m tonnes of LNG per year by tanker to Turkey from the year 2000, reports *Lloyd's List*.

The French government

has sold the bulk of its remaining 9.85 percent stake in Elf Aquitaine to Fingestval, the indirectly owned subsidiary of the French oil group, for some FF10bn.

Rosneft and Shell Caspian

are to form a new joint venture, Rosneft-Shell Caspian Ventures Limited, to acquire an interest in the Caspian Pipeline Consortium project. Rosneft will hold a 51 percent stake in the new company, Shell holding the remaining 49 percent. The joint venture will have an option to acquire a 7.5 percent interest in the pipeline consortium.



THE INSTITUTE
OF PETROLEUM

Luncheon

Tuesday 18 February 1997

The luncheon, which is being held during IP Week 1997, provides an excellent opportunity to hear from one of the most senior figures in the oil and gas industry.

Guest of Honour and Speaker

Mr Lucio A Noto

Chairman of the Board and Chief Executive, Mobil Corporation

Lucio Noto joined Mobil in New York in 1962 as a member of Mobil Petroleum's Regional Planning Analysis Group. There soon followed various posts within the Mobil Corporation in places such as Tokyo, Italy and Saudi Arabia. Mr Noto was appointed to his present position in 1994.

In addition, Mr Noto is also a Director of International Business Machines Corporation and a Member of the American Petroleum Institute Management Committee, the Business Council and the Council of Foreign Relations.

**For a copy of the ticket application form, please contact Pauline Ashby,
The Institute of Petroleum, 61 New Cavendish Street, London W1M 8AR
Tel: 0171 467 7100 Fax: 0171 255 1472**

Elf, Gulf and Murco merge UK downstream operations

Elf, Gulf and Murco are to merge their UK refining and marketing interests in a bid to improve efficiencies of scale, streamlining their refining facilities at Milford Haven in South Wales.

Part of a continuing rationalisation of the oil and gas downstream sector in both Europe and the United States as it strives to cope with excess supply of refined products, growing costs of environmental regulations and fierce market competition, the three-way merger is expected to save the companies £50 million a year.

Some 500 jobs out of a workforce of 1,322 are also expected to be lost — it is thought that most of these will be shed through early retirement, voluntary redundancy or limited redeploy-

ment within the shareholder companies.

The as yet unnamed venture will operate a network of some 1,500 service stations and hold an 8 percent share of the UK market, making it the fourth largest retail marketing venture after Esso, Shell and the recently agreed BP/Mobil merger.

Subject to final agreement expected early next year, Gulf and Elf will each take a 41.25 percent stake in the new company, with Murco holding the remaining 17.5 percent interest.

Each company will continue to market fuel and lubricants in the United Kingdom and Ireland under its own brand for the time being, although unification under a single brand has not been ruled out at some

point in the future.

The joint venture plans to consolidate its refining interests in Milford Haven, South Wales, by retaining the 108,000 barrels per day (b/d) Elf/Murco refinery and ceasing production at the 115,000 b/d Gulf refinery — although this could be utilised for storage or blending purposes.

Gulf also proposes to sell its 50 percent interest in the Pembroke Cracking Company to Texaco, its joint venture partner in the project.

David Setchell, currently Managing Director of Gulf Oil (Great Britain) Ltd and IP President, will be appointed Chairman of the new company, while Christian Cléret, Managing Director of Elf Oil UK Ltd, will become Managing Director, and Steve Wylie, Finance Director.

Australia revamps diesel rebates

The Australian government plans to revamp its diesel rebate scheme whereby excise on diesel fuel used to pay for road building and maintenance is refunded when diesel is used by the mining industry, including oil and gas operations, outside public roads. Proposed changes to legislation include the scrapping of rebates for vehicles under 3.5 tonnes (four-wheel drives, landcruisers and utility vehicles) and sea activities.

Acting Executive Director of the Australian Petroleum Production and Exploration Association, Peter Cochrane, commented that the government's proposed changes were 'a major disappointment' to the oil and gas industry. 'In particular, the decision to exclude sea activities ... represents a fundamental failure on the part of the government to understand the operational nature of the petroleum industry,' he said.

Mr Cochrane also said that, unlike land-based mining operations, the use of vessels to service and support offshore exploration and production installations is a 'crucial element' of day-to-day mining operations.

'How the government can decide to tax a vital input to such an important industry which already makes an enormous contribution to export income and tax revenue, while at the same time retaining the excise rebate for a range of other industries, is difficult to understand,' he concluded.

New dates for UK gas market

Ofgas, gas suppliers, shippers and British Gas have agreed the launch date of phase two of opening up the UK domestic gas market. Competition will start in Dorset and Avon on 10 February 1997 and in Kent, East and West Sussex on 7 March 1997, slightly later than originally planned. A total of 1.5 million customers will be affected.

North Sea asset swap

Enterprise Oil and Amoco have agreed an asset exchange involving a number of blocks in the North Sea.

As a result of the exchange, Enterprise will gain a further two percent interest in the Banff field, a 25.77 percent stake in block 13.21a (of which it is now operator) and a 32 percent interest in block 22/13a (of which it plans to become operator subject to approval by the UK Department of Trade and Industry).

In return, Amoco will gain an additional 25.77 percent interest in blocks 30/11b and 30/12b which contain the Appleton and Halley discoveries. The company will also receive a further 6.03 percent interest in block 22/18, excluding the Montrose and Arbroath field areas, and a 0.23 percent stake in block 15.22, excluding the Scott and Telford unit areas. As part of the transaction, Amoco will fund a limited share of Enterprise's costs on the 22/18-6 well drilled in November and a limited share of costs on the next wildcat/appraisal well on block 15/22.

Troll plans for increased production



Troll platform tow-out (photo courtesy of Norske Shell)

Norsk Hydro has submitted a NOK15.9 billion plan to the Norwegian government to expand oil production from the Troll field. The PDO plan comprises a new floating production platform Troll C, modifications to the existing production platform Troll B and 50 new horizontally drilled production wells.

The Troll C platform is scheduled to begin production in September 1999. A plan for the construction and operation of a new oil pipeline to shore will be submitted to the authorities at a later date.

The 50 production wells, 12 of which are planned for

multilateral completion, will be in nine groups. Oil produced from the three southernmost well groups will be routed to Troll B for processing and export by the existing pipeline to Mongstad. Associated gas will be exported to the Troll A platform. Oil from the six northernmost well groups will be routed to the new Troll C platform from where it will be exported to shore. Production is expected to reach 120,000 barrels of oil equivalent daily.

Associated gas will be exported to Troll A through a new pipeline or into the existing pipeline between the Troll A and Troll B platforms.

Gas to come ashore at Bacton

The UK government is supporting a plan put forward by Shell and Elf to land gas from three new fields in the North Sea — Elgin, Franklin and Shearwater — at Bacton in Norfolk rather than at Teesside.

UK Trade and Industry Secretary Ian Lang said that the pipeline proposal was the 'cheapest solution' and would 'keep down the cost of extracting the oil and gas by some £200 million'.

He continued by saying: 'Without this pipeline route the Shearwater project would not be economically viable and therefore might not go ahead'.

He also stated that development of the three fields and the new pipeline would produce wide economic benefits for the United Kingdom as a whole. Indeed, the government expects the UK offshore industry to win more than three-quarters of the £2.5 billion in contracts to be awarded for development of the projects.

The Shearwater Development Consortium, an alliance between Amec Process and Energy and Heerema, secured a £300 million contract from Shell Expro in October for the design, construction and installation of the main processing platform and topsides for a wellhead jacket for the Shearwater field.

A separate £20 million

contract for the design and construction of a 2,000-tonne wellhead jacket was awarded to SLP Engineering Teesside Limited.

Lewis Offshore in Stornaway is building two wellhead platforms and a drilling template as part of an overall contract worth over £40 million for the Elgin/Franklin project.

Barmac and a consortium comprising Kvaerner John Brown and UIE Clydebank are competing for the project's £400 million main process platform contract.

The government's decision also allows BP Chemicals to go ahead with a £500 million expansion of its Grangemouth plant in Scotland, which will receive hydrocarbon feedstock from the fields via the existing Forties pipeline.

Teesside's petrochemical industry is also set to benefit. Shell and Elf have agreed to incorporate the necessary equipment to accommodate a pipeline connecting to the Central Area Transmission System to pipe feedstock to the area after the year 2000 if commercial conditions are favourable.

The government is also supporting the establishment of a Long Term Feedstock Supply Group that will consider the interests of the UK chemical industry as the North Sea is further developed.

British Gas released from undertakings

The UK government has released British Gas from undertakings given after the Monopolies and Mergers Commission Inquiry in 1988 relating to the supply of gas to large industrial and commercial users in the United Kingdom.

Corporate and Consumer Affairs Minister John Taylor said part of the undertakings concerned activities only in the period 1 June 1989 to 31 May 1991. The remainder were

largely superseded by voluntary undertakings given in 1991 which increased the amount of gas other suppliers should be able to supply from 10 percent to 60 percent.

'These have now been completely overtaken by subsequent developments in the market for the supply of gas to large industrial and commercial users,' he said. 'The undertakings therefore no longer serve any useful purpose.'

Figures for UK offshore accidents

Offshore deaths and serious injury rates on UK installations increased last year, according to a recent report published by the UK Health and Safety Executive (HSE). Figures show that the year ending March 1996 saw five fatalities, 42 serious injuries, 375 injuries requiring more than three days sick leave and 519 dangerous occurrences, compared with one death, 41 serious injuries, 270 over three-day injuries and 594 dangerous occurrences in 1994/95.

However, the HSE states that the increase should be 'viewed

with caution' as the database is too small to distinguish random fluctuations from actual trends. 'The combined fatal and serious injury rate, while slightly higher than last year's (the lowest rate since 1980), still compared favourably with rates of up to 284.7 recorded in the previous four-year period 1989-90 to 1992-93', it said.

The HSE pointed out that the statistics should be viewed against a high level of activity in 1995 — 'a record year for new field developments' with estimated offshore population rising some 7 percent.

Falkland Islands licensing round

British Gas and Argentinian oil company Yacimientos Petroliferos Fiscales (YPF) failed in their bid to obtain exploration licences in the Falkland Islands first Oil Licensing Round. Their bid was largely unsuccessful for commercial reasons rather than nationalistic or political concerns, it was stated. British Gas and YPF signed an agreement in November 1995 to undertake joint bidding for the most popular, most northern blocks available. These blocks were awarded to a consortium headed by Amerada Hess which will explore tranche A and Shell and Agip which have the rights to tranche B.

The British Gas/YPF bid was said to have failed because it was limited to the two most popular tranches and would have, apparently, explored a smaller area and drilled fewer wells than the successful companies.

The agreement between the two companies was seen in a positive light for improving relations between the two countries still in dispute over ownership of the Islands.

Desire Petroleum achieved the most significant awards with 100 percent interest in tranches I and L, while also holding a 25 percent interest in tranche C through the Lasmo consortium. Desire was financed by a debenture share issue to Falkland Islanders which means that if the exploration is successful there should be some wealthy locals.

However, not all the Islanders are happy about an oil industry being created so close to home. Concerns about potential environmental damage and the £20 million raised annually from fishing licences which already affords the community a high standard of living does not, to some, necessitate the development of an oil industry.

The revenue from the exploration will initially come from acreage rentals totalling around \$1.8 million over the first five years. However, if oil is found in commercial quantities, the Falkland Islands government can expect royalties and corporation tax of 41 percent.

Other successful companies were Lasmo, (tranches C and D), International Petroleum, (tranche F), and Desire Petroleum (tranches I and L). The remaining tranches for which bids had been sought were not awarded.

The area to the south and southeast although available, was not bid for because of the deeper waters and the present lack of geological information.

The next licensing round to take place will possibly be the area of special cooperation with Argentina, situated to the southwest of the Islands, which crosses the median line with Argentina. However no timescale has been fixed due to work needed to be done by both the British and Argentinian governments.



Use of composites offshore

British Gas Research and Technology (BG R&T) and Marinetech Research recently launched the final phase of their £1.7 million joint industry project addressing the cost-effective use of composite materials offshore.

Sponsored by over 20 companies worldwide, including users, suppliers and regulatory bodies such as BP, Shell, Statoil, Ameron, SLP Engineering and the UK government, the programme is gathering performance data in a bid to overcome the critical issues currently restricting the wider use of composites offshore.

The final phase incorporates a design and engineering study of the structural applications of composites in the construction of topside modules, assessing both the cost of the most promising solutions and the practicalities associated with fabrication.

'Composites offer a flexibility in design and durability in service that metals cannot match,' states Paul Hill, Senior Engineer at BG R&T. 'Combining these advantages with a modular approach to design gives us the potential to revolutionise the design and construction of offshore platforms for the new millennium.'

Barents Sea licensing round

Some 45 blocks in six areas of the southern Barents Sea are to be included in Norway's Barents Sea licensing round.

Some regions will initially be defined as seismic areas, with production licences to be determined, within the boundaries of these areas, at a later date.

The deadline for production licence applications is 5 February 1997 with awards expected in March or April the same year.

Exploration has taken place in the Barents Sea since 1980 but no commercial discoveries have yet been found.

Analysis of North Sea decommissioning bills

Decommissioning of the North Sea's existing oil and gas installations, as well as those under development and probable future developments, could cost the oil industry some £8.7 billion, according to a new report from consultants Wood Mackenzie.

A total of 14 fields are expected to cease production before the year 2000, seven of which will be sub-sea developments, three platform developments, three floaters and one extended reach well development. The first of these may be the Unocal-operated Heather platform and Amoco's North West Hutton field in 1998.

The majority, however, are expected to occur in the period between 2007 and 2018.

The study shows Shell to

have the greatest decommissioning liability, estimated at £1.2 billion in 1996 terms (compared with an average total abandonment cost of £123 million). The combined abandonment liabilities of Shell, Esso and British Petroleum alone represent some 40 percent of the estimated total abandonment expenditure on the UK Continental Shelf.

Final abandonment costs for individual companies could be greatly reduced through tax relief, which in some cases may amount to as much as 70 percent of decommissioning costs.

In addition, many operators are working to cut abandonment costs. According to the study, 15 of the top 22 companies have cut such costs by between £100 and £300 million, or 35 percent of their

previous forecasts.

The report also confirms that a structural change is taking place in the North Sea oil industry as opportunities arise for 'second tier' companies to acquire mature assets. In some instances, the smaller operational bases of such companies may allow them to realise greater value from the remaining potential in mature fields.

Recent examples of purchases of 'tail-end production' include BP's asset disposal of three out of four of the MAST (Mature Asset Team) fields — Beatrice, Buchan and Clyde — to Talisman Energy last August and Oryx's acquisition of Chevron's interest and operatorship of Ninian plus further equity in the mature Hutton, Lyell and Murchison fields in September.

Texaco and Conoco agree to swap North Sea interests

Conoco and Texaco have agreed plans to exchange a number of assets in the Southern and Central North Sea. Under the arrangement, Conoco will acquire Texaco's interests in Southern North Sea blocks 48/9a, 44/13, 44/23b, 49/14a and 43/28a. In exchange, Texaco will acquire a 20 percent interest in block 16/6a-N (Sedgwick), a 60 percent stake

in both 9/11b and 9/12c and a 25 percent interest in block 15/30, excluding that part of the Britannia gas condensate field that lies within the block. All of Texaco's new acquisitions lie within the Central North Sea.

Conoco says that its interests in Britannia will remain unchanged following the swap.

The asset exchange 'adds an important dimension to

Conoco's business in an area of increasing significance to the company,' said George Watkins, Chairman and Managing Director, Conoco (UK) Ltd. Meanwhile, Texaco Managing Director Upstream York LeCorgne said that the trade offered 'excellent synergy with existing assets, making good business sense, both tactically and strategically.'

Conoco plans deepwater drilling in Gulf of Mexico

Conoco and drilling company Reading & Bates have formed a joint venture to carry out a five-year drilling programme in the deep waters of the Gulf of Mexico.

In order to be able to drill in water depths of 2,000 to 10,000 feet, the new company has commissioned the construction of a state-of-the-art deepwater drillship at a cost of \$200 million. The vessel will have the latest dynamically positioning systems — specialised seabed and satellite positioning systems that provide signals to computers controlling six high-powered thrusters capable of holding the vessel exactly on target.

The construction contract has been awarded to Samsung Heavy Industries of Korea.

While Conoco has deepwater acreage off Norway, Ireland, Nigeria, United Kingdom and in the Caribbean, it is planned initially to concentrate on the Gulf of Mexico, where the company has recently acquired 60 blocks in water depths ranging from 2,000 to 9,000 feet.

Speaking in London, Rob McKee, Executive Vice-President, Exploration and Production, Conoco Inc said: 'Advanced technology such as this will give Conoco the ability to extend its exploratory efforts beyond traditional offshore

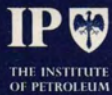
shelf areas so that deeper fields can be developed economically We view deepwater exploration and production as a cornerstone of our future.'

The 721-foot long double-hulled drillship will have facilities for extended well test, with 100,000 barrels of oil storage, crude storage and offloading capacity, provision for simultaneous drilling and testing in any weather conditions.

The design also allows for its eventual conversion to a floating production storage and offloading vessel, if required.

This new vessel will be operated by Reading & Bates. Three or four wells per year are planned, beginning in 1998.

Diary Dates



Exploration and Production Discussion Group

Review of 1996: forecast for 1997

Thursday 16 January, tea at 17.00 for 17.30 until 19.00

By Ms Amanda Battersby, Deputy Editor, Euroil

IP contact: Jenny Sandrock



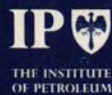
Energy Economics Group/British Institute of Energy Economics

'Middle East Megaprojects after the Millennium — the need to start now'

Tuesday 18 February, at 15.15

By Mr Pierre Shammam, President, APS Group
At the Caledonian Club, 9 Halkin Street, London SW1

Contact: Mary Scanlan, 37 Woodville Gardens, Ealing, London W5 2LL
Fax: 0181 566 7674



London Branch

'Transport for the Millennium'

Tuesday 18 February at 17.30 for 18.00

The Freight Transport Association and Transport 2000 will put forward their points of view and lead an open discussion on UK transport policy.

IP contact: Mike Wood



Energy Economics Group

The Rt Hon the Lord Fraser of Carmyllie, UK Minister for Energy, will address a meeting of the EEG.

Tuesday 18 March, 17.00 for 17.30 until 19.00

IP contact: Jenny Sandrock

All meetings are held at the Institute of Petroleum unless otherwise stated.
Please tell the IP contact if you plan to attend any of these free meetings
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Shell to reduce gas flaring in Nigeria

Shell Petroleum Development Company (SPDC) of Nigeria Limited has awarded a £320 million contract to a consortium comprising Japan Gasoline Company and Saipem for the construction of a new gas processing plant that will utilise gas previously flared in the Niger Delta.

The new plant is part of a complex of gas facilities to be built in the Soku area in Rivers State that will gather gas from the Soku, Ekulama and Nembe Creek oilfields at a total estimated cost of £1 billion.

Once completed, the Soku complex will deliver an average of 450 million cubic feet (mncuft) of gas per day to the liquefied natural gas plant currently being built at Finima on Bonny Island. Some 200 mncuft/d of this will be gas from the company's flare lines, a percentage SPDC plans to increase in the future.

The Soku project is one of a series of initiatives planned by SPDC on behalf of its joint venture partners NNPC, Shell, Elf and Agip to end unnecessary gas flaring in the Niger Delta.

The joint venture also plans to develop two other

projects which, together with Soku, will collect in excess of 380 mncuft/d from flare lines — more than one-third of the volume of gas currently flared by SPDC.

An associated gas processing plant is to be centred at the Odidi oilfield, 30 kilometres west of Warri. Scheduled to come onstream in 2000, the plant will initially supply 80 mncuft/d into the Nigerian Gas Company's Escravos-Lagos pipeline. It will have the potential to increase the volume to 160 mncuft/d if required. The gas to be collected is currently flared at the Odidi, Egwa and Batan oilfields which produce some 60,000 barrels of oil per day.

A further 100 mncuft/d of associated gas will be diverted from SPDC flares to fuel a new aluminium smelting plant currently being built at Ikot Abasi, in Akwa Ibom state by the Aluminium Smelter Company (Alscon).

SPDC has completed the conceptual design of new facilities at its gas plants at Alakiri and Obigdo North which will deliver associated gas from more than 10 fields to the Alscon plant in 1999.

Subsea first for Kingfisher field

The UK government has given Shell Expro the green light for £220 million development of the Kingfisher field located in blocks 16/8a and 16/8c in the Central North Sea. The field comprises three separate reservoirs and will be developed using six production wells. Reserves are estimated at some 56 million barrels of oil/condensate and 368 billion cubic feet of gas.

Due onstream late next year, production will be processed on the nearby Marathon-operated Brae B platform. Oil and condensate will be exported through the Brae-Forties pipeline to Cruden Bay and Kinneil, while gas will come ashore at St Fergus. Output is expected to peak at 37,000 barrels per day of condensate and 160 million cubic feet of

wet gas per day. Field life is estimated at about nine years.

The project involves the seabed deployment of a high integrity pressure production system (HIPPS) that will protect the pipeline from the high pressures that will be present in some of Kingfisher's wells during the first two or three years of production. According to Shell Expro, 'installation of the HIPPS system allows the wall thickness of the production pipelines to be reduced, without compromising safety of the system'. While such systems have been used on platforms before, they have never been used in a subsea application before.

The project is being undertaken by an alliance involving Shell Expro, McDermott Marine Construction and Kvaerner FSSL.

Global 10-year oil production forecast

World crude oil production will rise to a record 78.02 million barrels per day by the year 2005 from 63.02 million b/d in 1995, according to a recent report published by Petroconsultants.

The study, which projects oil and condensate output for each of the world's 95 significant producing nations during 1996-2005, also predicts that demand among producing nations will grow by an average of 2.3 percent per year during the 10-year study period.

The three main consuming regions of North America, Western Europe and the Far

East/Australasia are expected to end the period in long-term decline, while output in the Middle East, Africa, Latin America and Eastern Europe will increase markedly. A strong resurgence in production in the Former Soviet Union — where output is currently somewhat depressed — is also forecast.

Dependence on exported oil is predicted to increase generally, with most of the world's swing export capacity supplied by the Middle East.

Offshore output, too, is expected to grow. However, it will still comprise only 33 percent of global supply by 2005, states the report.

British Gas and Ofgas reach agreement

Ofgas and British Gas Trading have reached agreement on the final proposals for controlling prices charged to British Gas domestic customers from April 1997 to March 2000. As a result, the average domestic gas bill of around £325 will be cut by £7 in 1997-98 with further reductions thereafter.

The main proposals are:

- A three-year price control period.
- Continuation of the RPI-X price control on supply, meter reading and profit margins, with X set at 4.
- Full pass through to customers of gas purchase costs and transportation costs.
- Service standards to remain in place but with an

increase in the minimum compensation payment from £10 to £11.

● Ofgas will set caps on each of British Gas' existing tariffs: DirectPay, OptionPay, Standard and PrePayment. Beyond these British Gas will have the freedom to introduce new tariffs for particular customer categories.

Commenting on the decision, Deputy Chairman, British Gas Philip Rogerson said, 'When the initial proposals were put forward in June we had a number of serious concerns. Although we still believe the proposals are tough, we expect to accept them as long as they are unchanged following the statutory consultation period.'

Obituary — Sir Eric Drake



Sir Eric Drake, Chairman of British Petroleum between 1969 and 1975, has died at the age of 85.

A graduate of Cambridge University, he joined the Anglo-Persian Oil Co, later Anglo-Iranian Co, as an accountant in 1935. He subsequently held a variety of managerial posts, including General Manager in Iran at the time of nationalisation in 1951. After other foreign postings, he then became Managing Director of BP in 1958, Deputy Chairman in 1962 and then Chairman. He was made a CBE in 1952 and knighted in 1970. He was awarded the Cadman Medal in 1976.

Post-election US energy policy: benign gridlock or...

Gridlock won the recent US election, handily. Voters returned President Bill Clinton to the White House. They also left Republicans firmly in control of Capitol Hill. Neither political party is claiming a mandate. The electorate, investors, politicians, and the oil and gas industries generally find this reassuring, at least for now. Perhaps this is unwarranted.

By Peter S Adam

The received wisdom among the energy cognoscenti is that federal government gridlock 1997-99 style will have a benign impact on the industry and developments in the international hydrocarbon sector. Washington is expected to continue to follow a bi-partisan, incrementalist, progressive approach to oil and gas. Selective reforms will be the order of the day. And there are no major initiatives in the pipeline.

Whether or not the consensus proves on the money, vis-a-vis energy, and politics and policy more generally, is an open question. Recent remarks made by Kyle Simpson, Associate US Deputy Secretary of Energy, to the International Association for Energy Economics/American Association for Energy Economics annual meeting in Boston, shed light on the approach the administration may take with regard to energy, if events allow, over the next four years. Mr Simpson also touched on the reasons why they, and it, may not. Hedging bets would be prudent.

Which past is prologue?

US oil and gas executives have not been known as stalwart FOBs — Friends of Bill. In the opening days of the Clinton administration intense industry lobbying contributed to its first stinging defeat — failure to get Congress to enact a BTU tax. Thereafter the White House, representatives of the US petroleum industry and Congress reached a *modus vivendi* on oil and gas issues. This was particularly true during the final months of the last legislative ses-

sion during which the administration supported many things the industry wanted.

According to Mr Simpson, the Clinton administration takes credit for:

- lifting the ban on Alaska crude exports
- passage of the Deepwater Royalty Relief Act
- prodding along energy sector deregulation
- encouraging the growth of gas use
- mounting an effective defence of the Strategic Petroleum Reserve.

It also worked with Congress to amend the Oil Pollution Act of 1990, easing the burden of financial responsibilities for companies operating offshore oil and gas facilities.

So far so good

Mr Simpson noted though that during a second Clinton administration the Alaska Natural Wildlife Reserve (ANWR) coastal plain would remain off limits to the drill bit; no surprise here. Even though, as industry representatives point out continually, the footprint left by drilling operations there would be insignificant; the environmentalists will continue to hold the trump card on this one.

Between Iran and polling places

Mr Simpson also discussed the major bone of contention between the administration and the industry — the sanctions that preclude US oil companies (but not their foreign competitors) from doing business with Iran. He pointed out, accurately, that some of the administration's opponents

support far more onerous measures.

The lifting of restrictions would, of course, be music to US oil and gas industry ears. Mr Simpson acknowledged, without elaboration, that effectiveness of the restrictions is questionable. However, there is no evidence that the Clinton administration wants to lift them. Even if there were support within the White House for doing so, the administration's room to manoeuvre has been constrained by Senator Al D'Amato, Chairman of the Senate Banking Committee, who has supported tougher measures against Iran than those the administration has enacted.

But this could change

The election's results revealed that he may be more vulnerable than anyone had thought. He did not have to run this time but is up for re-election in two years. A staunch Dole supporter early on, Senator D'Amato had hoped to be able to 'deliver' his state. Instead, the Dole campaign effort fell apart there. President Clinton swept New York and exit polls there indicated voter displeasure with the senator's performance.

In response, Senator D'Amato has, of late, adopted a much more conciliatory tone in dealings with the Clinton administration.

Whether, and the extent to which, the vagaries of politics in the state of New York could factor into removing or relaxing sanctions is highly conjectural. New York's large and politically active Jewish community strongly supports the senator's stance on the issue of sanctions and this is unlikely to change, unless something dramatic and unexpected happens in Iran. However, should Senator D'Amato be ousted from office, it could help pave the way for a change in US policy in the Gulf. This is particularly true if a new foreign policy team takes a different view of US-Middle East relations. With no clear indication of the likely successor to outgoing Secretary of State Warren Christopher or whether National Security Adviser

Tony Lake will stay on, it is pure guesswork.

But considering the post-election fate of sanctions brings into sharp focus one of the major implications of Mr Simpson's remarks: politics is policy. US international oil policy turns, and will continue to turn, on precinct politics in major US cities, the byzantine world of Capitol Hill personalities and federal foreign policy just as much, if not more so than on developments in the Middle East.

Policies in the pipeline

The industry and the Clinton administration (and the powers that be on Capitol Hill) may never see eye-to-eye on sanctions but all parties seem to

concur strongly in another aspect of current US international energy policy — pipelines out of Central Asia. Everyone favours multiple export routes. This will continue. Mr Simpson pointed out that while multiple lines are not economically optimal, transport flexibility will be necessary to ensure security of supplies from the hydrocarbon-rich countries of this region.

Politics as (un)usual?

So things seem likely to remain relatively be-calmed on the US energy policy front. Or do they?

Perhaps, but only if crude prices do not continue to climb and the economy does not sour. Given the enormous import dependency of the United



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States, if prices climb this will have an impact on the balance of payments, the dollar's value and interest rates; energy policy debates will become contentious as the economy feels the impact. The current expansion is long in the tooth, equity markets are going from one high to another; inflation remains in check but the best of all possible investment environments cannot persist indefinitely. A slowing economy, tumbling markets and rising crude prices would quickly undo the present tenuous political accommodation.

The experts' current complacency offers only the coldest comfort. Crude right now is, after all, much firmer than most analysts prognosticated — up 30 percent over the last 12 months.

Before the election, price surprises caused much consternation in political circles and more recently they have dampened industry performance.

'Energy did not figure'

A short-lived surge in gasoline last summer prompted the administration to move up a congressionally mandated

release from the Strategic Petroleum Reserve and the Republican challenger called for the repeal of a minuscule increment to the federal tax on gasoline. After crude eased, energy did not really figure in the campaign at all. However, in order to make sure it did not, the Secretary of Energy engaged in talks with industry representatives early in the autumn when it appeared that expectations of shortages in some parts of the country were causing the price of fuel oil to go up. The companies re-allocated stocks somewhat.

This was fairly easy. The industry has been having a tougher time though managing stocks in order to keep profitability up. As oil companies wholeheartedly took up just-in-time inventory management and went short, reflecting expectations that the United Nations would allow President Hussein to open the valves — albeit on a closely-supervised and limited basis — he acted in an unacceptable fashion, again. The sale was therefore postponed indefinitely, prompting oil markets to rally. Thus, while third-quarter profits were up sharply over last year's comparable period, they were

down from first and second quarter levels.

Also, despite a feeling of relief concerning the present political balance, gridlock's record has been uneven — at best. It is far from a safe bet that its current incarnation will not prove virulent. US voters supposedly ended a previous bout by giving President George Bush the thumbs down. And the next infestation came to a head when Speaker of the House Newt Gingrich attempted to act as prime minister. Cornered in a budget battle with the administration, he blocked funding of the government and there was a shutdown. The Republicans took the heat for this unpopular move which, along with a fairly robust economy, paved the way for President Clinton's recent victory over Senator Robert Dole. The Republican challenger, despite a campaign which never gained any traction, finished only two percentage points shy of the popular vote that President Clinton received in the 1992 presidential election. What would have happened if 1996 had been a recession year? What will happen to the industry and to energy policy and prospects generally, if 1997 is?

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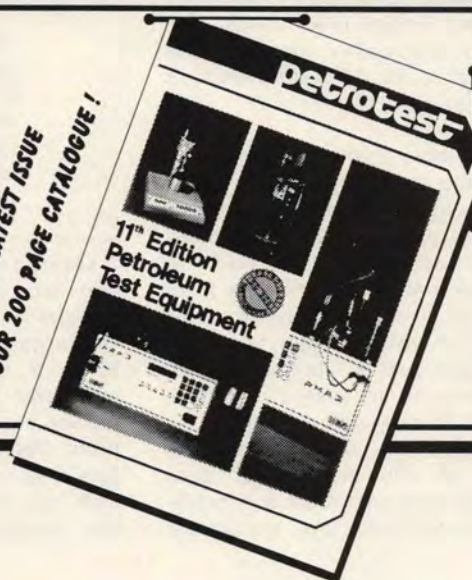
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Crude oil marine loss survey update

The IP PM-L-4A crude oil marine loss database panel collects and analyses worldwide crude oil shipping data with the objective of improving loss control through a better understanding of loss patterns and trends.

Panel members submit their company data which are analysed confidentially. An annual report is issued individually to all members that provides analysis of the individual company data together with a global analysis of the entire annual data set.

Results from the global analysis published in *Petroleum Review* in February 1996 gave details of the analysis of 1994 data, together with historical results and some observations regarding vessel experience factors and vessel load ratios. The following discussion presents the findings from the 1995 data analysis and compares them with 1994 results.

Data for over 5,000 individual voyages were submitted by 17 major oil companies in 1995 with bills of lading totalling in excess of 3.5 billion barrels. Of these almost 4,000 had full bill of lading and out-turn data from which the loss information was derived. The volume total for these voyages was over 2.7 billion barrels, representing an increase in database volume of 22 percent over 1994.

The value of the information depends on the amount of data submitted. New members are therefore very welcome and companies

**By Paul S Harrison
Consultant to PM-L-4A**

interested in joining the panel should contact the chairman of PM-L-4A via the Institute of Petroleum.

Overall loss comparison

In order to compare overall results from one year with those from previous years a representative 'basket' of crudes has been established based on world production and the areas covered by the member companies. This is used to weight net losses by crude type each year to arrive at an overall comparative figure. Over the last seven years overall weighted differences between Net Standard Volume (NSV) measured at out-turn and bill of lading have been calculated as follows:

Year	NSV Loss
1989	-0.34%
1990	-0.32%
1991	-0.30%
1992	-0.30%
1993	-0.29%
1994	-0.25%
1995	-0.22%

Losses continue to reduce but the two large falls in 1994 and 1995 are unusual and require explanation.

A large part of the reduction in losses from 1993 to 1994 was due to improved figures for loadings of Iranian Heavy and Light from Kharg Island (NSV loss fell from -0.46 percent and -0.47 percent to -0.32 percent and -0.41 percent respectively). Because of the volumes involved both these crudes

are weighted heavily in the representative 'basket' calculations. Similarly Brent figures from Sullom Voe improved from -0.13 percent to -0.04 percent, again a significant change in a heavily weighted crude.

The reduction from 1994 to 1995 is again largely due to significant improvements in losses for a small number of key crudes. In particular losses for Arab Light from Juaymah reduced from -0.51 percent to -0.33 percent and figures for Bonny Light and Medium improved from -0.34 percent and -0.35 percent in 1994 to -0.17 percent and -0.01 percent in 1995. Again these crudes are weighted heavily in the representative calculation. It should be noted that improvements at Bonny can be attributed to cooperation between the terminal operators and one of the panel members towards improved practices.

The figures are still subject to statistical uncertainty, although most are derived from a significant number of voyages.

It must be remembered that these figures, although termed 'NSV losses', are not for the most part real losses of crude oil but are largely the result of differences in measurements between load and discharge port. However, these differences or 'apparent losses' have an important financial impact.

Loss distribution

The frequency distribution of losses for individual voyages is sufficiently close to the theoretical 'normal distribution' to allow detailed statistical analysis and comparison of the results to be performed with a high level of confidence. The NSV loss distribution for 1995 is almost identical to that for 1994 and both are shown in **Figures 1 and 2**. The

Table 1

ANALYSIS BY CRUDE OIL TYPE 1995

Crude Type API Gravity OVERALL VOLUMES (NSV) CALCULATION BY VOYAGE

Crude Type	API Gravity	1994		CALCULATION BY VOYAGE						
		1995	Total Barrels	Barrels Loss	Barrels Loss%	NSV Loss % Mean	NSV Loss % St.Dev.	NSV Loss % No.	Mean	St Dev.
Alaskan North Slope	30.0	229,691,004	-225,482	-0.10	-0.09	0.22	277	-0.08	0.17	311
Alba	20.0	13,793,451	12,265	0.09	0.09	0.44	27	-	-	-
Amna	37.3	25,136,940	-34,605	-0.14	-0.14	0.25	44	-0.10	0.25	34
Arab Ex Lt	36.2	42,134,257	-47,839	-0.11	-0.13	0.46	44	-	-	-
Arab Heavy	28.1	35,959,154	-96,752	-0.27	-0.24	0.64	56	-0.16	0.24	56
Arab Light	32.9	262,302,774	-688,758	-0.26	-0.20	0.40	267	-0.17	0.28	129
Arab Medium	30.7	90,044,519	-307,629	-0.34	-0.25	0.33	82	-0.22	0.32	39
Belayim	28.1	25,924,960	-78,981	-0.30	-0.31	0.36	53	-0.24	0.29	65
Bonny Light	35.5	35,111,818	-59,754	-0.17	-0.17	0.31	33	-0.34	0.41	25
Bouri	26.1	18,838,015	-63,992	-0.34	-0.34	0.38	32	-0.35	0.46	31
Brent	38.0	75,940,840	-58,736	-0.08	-0.08	0.17	115	-0.04	0.22	90
Bu Attifel	40.5	47,144,558	88,913	0.19	0.19	0.36	76	-0.26	0.49	52
Cabinda	32.9	42,049,569	-36,214	-0.09	-0.08	0.30	45	-0.19	0.33	36
Djeno	26.8	17,452,952	-32,010	-0.18	-0.18	0.32	27	-0.07	0.20	21
Dubai	31.7	24,721,117	-28,393	-0.11	-0.15	0.23	36	-	-	-
Ekofisk	39.3	72,712,780	-40,596	-0.06	-0.05	0.15	115	-0.09	0.13	75
Es Sider	36.7	23,674,167	-105,198	-0.44	-0.45	0.20	43	-	-	-
Escravos	35.8	57,168,997	-53,209	-0.09	-0.10	0.32	59	-0.25	0.58	65
Flotta	37.3	41,799,603	-136,837	-0.33	-0.31	0.18	65	-0.32	0.21	50
Forcados	29.5	26,873,994	-18,427	-0.07	-0.07	0.35	33	0.01	0.33	32
Forozan	30.8	19,661,546	-40,972	-0.21	-0.23	0.44	33	-	-	-
Forties	40.5	101,044,740	-134,986	-0.13	-0.12	0.21	131	-0.11	0.18	86
Fulmar	40.3	33,477,306	12,057	0.04	0.04	0.28	46	-0.05	0.21	29
Furrial	30.0	16,948,617	-51,985	-0.31	-0.30	0.33	32	-	-	-
Gulfaks	32.9	157,761,779	-293,219	-0.19	-0.19	0.15	199	-0.20	0.19	226
Iranian Heavy	30.6	68,363,504	-239,553	-0.35	-0.35	0.39	98	-0.28	0.31	56
Iranian Light	33.5	42,545,082	-129,379	-0.30	-0.28	0.35	65	-0.32	0.33	25
Isthmus	32.9	12,890,947	-27,548	-0.21	-0.19	0.28	25	-	-	-
Kuwait	31.1	31,319,912	-20,056	-0.06	-0.08	0.49	35	-0.24	0.34	23
Leona	24.2	9,760,492	9,426	0.10	0.18	0.47	22	-	-	-
Maya	21.8	95,877,080	-167,111	-0.17	-0.19	0.34	133	-0.13	0.38	96
Murban	39.3	22,671,521	-65,785	-0.29	-0.27	0.18	35	-	-	-
Olmecca	38.5	50,321,370	-151,451	-0.30	-0.30	0.24	94	-0.32	0.25	47
Oseberg	36.2	45,098,812	-73,114	-0.16	-0.17	0.18	63	-0.19	0.20	58
Sahara Blend	45.5	42,990,101	-49,420	-0.11	-0.11	0.21	71	-0.20	0.25	57
Sarir	37.6	17,983,967	-32,059	-0.18	-0.17	0.28	33	-0.35	0.32	34
Souedie (Syrian Blend)	24.1	17,819,796	-21,733	-0.12	-0.14	0.34	39	-0.19	0.28	37
Russian Export Blend	32.2	71,183,285	-120,333	-0.17	-0.15	0.34	120	-0.16	0.33	136
Statfjord	38.6	174,451,793	-599,409	-0.34	-0.34	0.17	209	-0.32	0.16	194

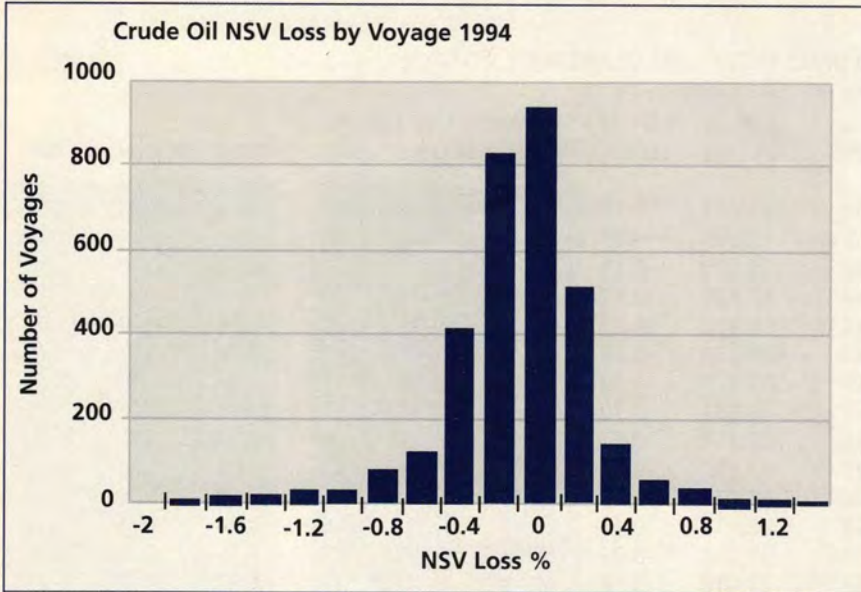
mean NSV loss was -0.19 percent and the standard deviation was 0.36 percent compared with -0.20 percent and 0.34 percent in 1994. In statistical terms the two data sets are identical. Note that these are unweighted figures.

The standard deviation defines the 'spread' of the results in that 95 percent of all losses can be expected to fall within +/- 2 standard deviations of the mean. For 1995, 95 percent of losses will be within the range -0.91 percent to +0.53 percent.

Loss comparison for individual crude oils

Losses or measurement differences are found to correlate strongly with crude type, load port and discharge

Figure 1



port. The data base analysis therefore includes calculations based on grouping voyages under these headings.

Table 1 gives mean NSV loss and standard deviation for shipments of the most popular crudes in the data base (20 or more voyages with full data). The mean of the reported API

gravity is also given together with the overall percentage loss based on total barrels shipped.

For comparison, figures for NSV Loss calculated by voyage are given for 1995 and 1994. Nine additional crudes are included this year but Qua Iboe and Sirtica are no longer tabulated as the number of data sets for these

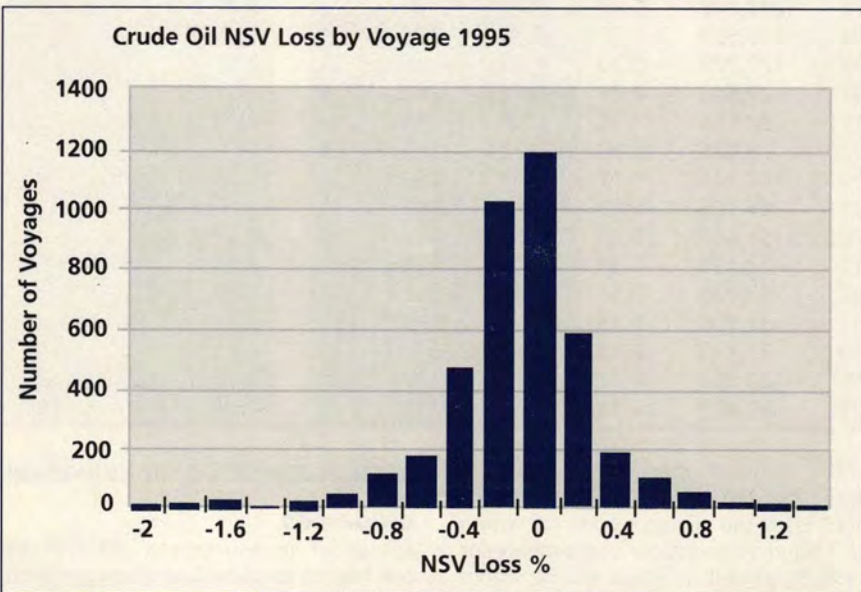


Figure 2

crudes has fallen below 20 for 1995.

It is interesting to note that the overall NSV Barrels Loss percentage is in most cases very close to the mean average NSV Loss calculated on a per voyage basis. However, for Arab Light and Arab Medium there is a significant difference with overall losses higher than the voyage mean. This indicates that larger losses are occurring with larger parcels than with smaller ones. Under normal circumstances the opposite effect is apparent. A closer inspection of the detailed data indicates that the difference is due to a number of smaller parcels which undergo secondary shipment with very low losses.

Detailed loss analysis

In addition to NSV loss figures, the database contains details of all measurements made through each voyage. This enables more detailed analysis to determine where losses are occurring and again sets realistic performance limits for each stage in the measurement process.

Nett standard volume (NSV) is the volume of crude oil, corrected to 60°F, with sediment and water quantities (free and dissolved) deducted. Total calculated volume (TCV) is the NSV plus sediment and free dissolved water.

Overall results for each of the main measurement differences are shown in **Table 2**, comparing unweighted figures for 1995 with those for 1994.

As shown for the NSV Losses there is no significant statistical difference in any of these figures between 1994 and 1995.

NSV and TCV losses are simple comparisons between bill of lading and out-turn figures.

Load and discharge differences are the differences between ship received/delivered TCV and shore TCV measurements at loading and discharge. These are not currently corrected for VEF (Vessel Experience Factor). However, VEFs are held in the database and one of the topics which the panel has been considering in 1996 is publi-

Table 2

	1995		1994	
	Mean	Std. Dev.	Mean	Std. Dev.
NSV loss %	-0.19	0.36	-0.20	0.34
TCV loss %	-0.12	0.35	-0.14	0.32
Load difference %	+0.17	0.39	+0.16	0.43
Ship loss %	+0.03	0.21	+0.01	0.22
Discharge difference %	-0.31	0.41	-0.31	0.43
Water loss %	-0.07	0.20	-0.06	0.21
ROB difference %	+0.04	0.15	+0.03	0.17

cation of VEF corrected figures.

Ship loss or 'transit difference' is the difference between ship TCV measurements at the load port before sailing and at the discharge port on arrival.

Water loss is the difference between Bill of Lading and Out-turn water and sediment, adjusted for ROB/OBQ water difference where figures are available.

ROB difference is the difference between the TCV measured on the ship prior to loading (OBQ) and that remaining after discharge (ROB).

Conclusions

Analysis of 1995 data indicates that a continued reduction in losses though

the large fall in the weighted overall loss is largely due to significant improvements in a small number of high volume crudes. Continued understanding, control and improvement in the marine loss situation is the result of cooperation between individual loss control groups, inspection companies, Intertanko and, of course, the producers.

Weighted average NSV loss for 1995 stands at -0.22 percent.

References

1. Survey Confirms Continuing Reduction in Crude Oil Marine Losses, *Petroleum Review*, February 1996

Any questions or comments on the content of the paper or any other aspects of the activities of the panel should be addressed to the chairman of PM-L-4 panel at the Institute of Petroleum.

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The structure of the world's oil tanker fleet is undergoing a gradual change following the implementation of new legislation promoting the operation of double hulled vessels in recent years. All new tankers trading in US waters have had to have double hulls since June 1990 in order to meet the requirements of the Oil Pollution Act 1990 (OPA-90) while the International Maritime Organisation (IMO) made it mandatory for all new tankers trading worldwide to be double hulled in July 1993 under IMO MARPOL 73/78 Annex 1 Regulation 13F. As a result, both shipowners and operators have had to consider new aspects in design, operation and maintenance of their tanker fleets and much research has been, and continues to be, undertaken in determining the relative merits of double hulled tanker designs over their single skinned counterparts.



Double hulled tankers — an overview

Fatigue analysis and design

Due to the requirement in MARPOL to segregate ballast, the main dimensions for post-MARPOL ships have changed compared to pre-MARPOL vessels. This results, on average, in an extending breadth and depth for post-MARPOL tankers compared with pre-MARPOL tankers to give normally lighter scantling for deck plates etc. Furthermore, it is important to note that because the fatigue strength is nearly the same in high tensile steel and mild steel, higher stressed high tensile steel structures are more at risk from cracking if the detailed design of vessels remains as for mild steel structures. It should also be pointed out that when high tensile steel is utilised, the critical buckling stresses will often result in a more limited acceptable corrosion reduction at the periodical survey of a post-MARPOL tanker compared with pre-MARPOL (International Convention on the

Prevention of Pollution from Ships 1973/78) designs.

The cause of fatigue cracking is the variable (dynamic) local stresses, for example, at weld toes. These local stresses are the product of nominal stresses and stress raisers caused by the structural geometry, weld geometry and small weld defects. Grinding of small, initial cracks may postpone the development of cracking — however, the only way to achieve maintenance-friendly ships in terms of limiting fatigue cracking is to ensure that the scantlings and details are correct from the beginning. This can be done, for example, through the use of T-type longitudinals instead of the traditional L-type in order to reduce stress concentrations at the intersections between longitudinals and transverse frames and bulkheads and the fitting of soft type stiffeners or brackets to support the longitudinals at these intersections.

Fatigue analysis is thus of critical

	Ship No 1 Double Hull	Ship No 2 Single Hull Post- MARPOL	Ship No 3 Single Hull Pre- MARPOL	Ship No 4 Single Hull Pre- MARPOL
Length (L)	320	315	340	365
Breadth (B)	58	57.2	51.5	56
Depth (D)	31	30.4	26.7	26.7
Draught (T)	20.8	20.8	20.8	20.8
Cargo Capacity	345 936	330 796	335 126	391 204
Ballast Capacity inside cargo area	93 132	92 910	26 446	30 872
L/B	5.5	5.5	6.6	6.5
L/D	10.3	10.4	12.7	13.6
T/D	0.67	0.68	0.78	0.78

Table 1: Note: Existing single hulled tankers are divided into pre- and post-MARPOL tankers. This refers to compliance with MARPOL 73/78 which was adopted in 1980. Therefore, it can broadly be said that tankers built prior to 1980 can be termed pre-MARPOL ships and those built between 1980 and 1993, as post-MARPOL vessels.

importance in tanker design. The loads that hulls will be subjected to during their operational lifetime are most accurately assessed by direct wave load analysis, a process which is heavily dependent on the designer's skill and on the applied methods and tools. The analysis should include all realistic loading conditions. As a minimum, worldwide average wave climates for tanker trading routes should be considered while, for vessels intended for long-term trading of specific sailing routes, it may be necessary to base analysis on harsher wave climates.

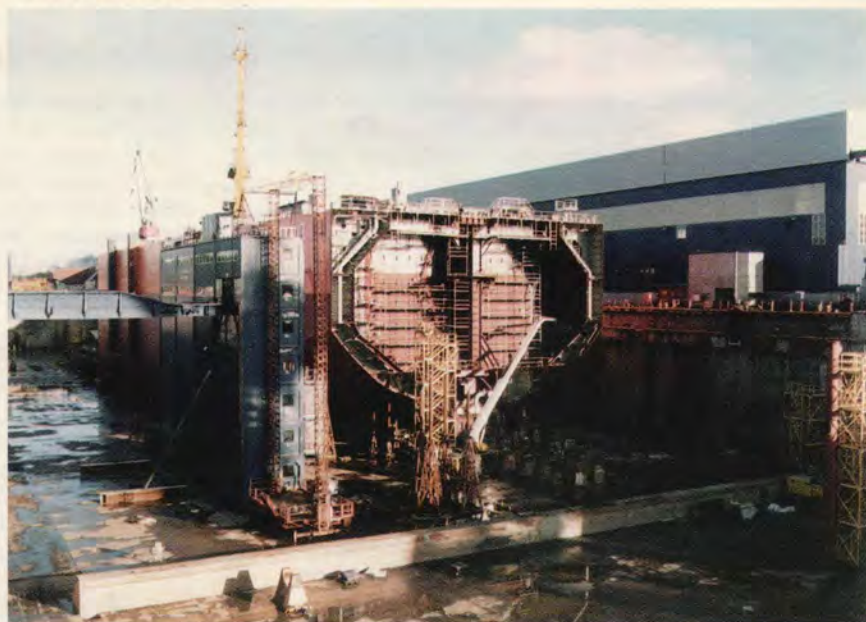
Some rules of thumb are:

- Just 10 percent uncertainty in stresses results in 30 percent uncertainty in fatigue life
- For the same stress level, fatigue life of high tensile steel is the same as for mild steel as far as welds are concerned
- A corrosive environment reduces the fatigue life by 50 percent
- A symmetrical construction/design will have an increased fatigue life compared with unsymmetrical
- Vessels trading worldwide have a typical fatigue life of 20 years; those trading in the waters of the North Atlantic/North Sea have a 10-year fatigue life or just five years in a corrosive environment

Various other dimensional changes arise when moving from a single skinned to a double hulled tanker design. Ballast volume, for example, may be greater for the latter, especially for smaller vessels due to the minimum requirements of 2 metres height of double bottom (breadth/15) and 2 metres width of side tanks. This said, no change in ballast volume is noted in vessels above 80 to 100,000 dwt, although the area exposed for ballast is between two to three times that exposed in a single hulled tanker. Like the reduction in scantling, this has a great influence on corrosion rates and limits and emphasises the

A double-hulled tanker under construction

Photo by Jouni Saaristo



importance of the use of corrosion protection systems, including coatings, and access to the hull structure for inspection and maintenance in such designs.

Stability study

The problems of double hulled tanker stability can be summarised as follows:

- The stability of at least some double hulled tankers can be insufficient during certain loading conditions
- This can, and has, resulted in incidents where double hulled tankers suddenly heel over while transferring cargo and/or ballast
- Such incidents are dangerous to life, property and the environment
- There are currently no international regulations covering intact stability of tankers

The problem of tilting and lolling arises for double hulled tankers up to Suezmax (in the region of 140,000 dwt and above) designed without longitudinal subdivision inside the cargo tank section. This increases the free surface effect tremendously. If a tanker is loading cargo and discharging ballast simul-

taneously (or vice versa), there can be a free surface in both cargo tanks and ballast tanks, which of course will have a negative effect on the stability.

Pollution prevention

Both accidental spills from tankers as well as pollution from tanker operations are relatively small sources of oil pollution to the sea; just 4.7 percent and 6.5 percent of total pollution respectively compared with sources such as industrial wastes (60.8 percent) and other shipping (14.4 percent), according to 1990 data from the UN Environmental Programme. Indeed, pollution from these two sources has been significantly reduced over the years.

Much of the argument in favour of the use of double hulled tanker designs has focused on the increased likelihood of their hulls not being breached in a collision or grounding and thus, cargo not being released into the surrounding waters. Probabilistic calculations on four ship designs — one double hulled and three various single hulled designs — are illustrated by **Figures 1 and 2**. Design parameters for the four vessels are outlined in **Table 1**.

As can be clearly seen, there is a big

Lengthening tanker life — double hulls and alternatives

Under the requirements of IMO MARPOL 73/78 Annex 1 Regulation 13G, which entered into force in July 1995, any single hulled crude oil tanker over 20,000 dwt or product tanker over 30,000 dwt built before 1993 must be fitted with a double hull or equivalent arrangements when the vessel reaches 25 or 30 years of age depending on its present compliance with MARPOL Annex 1.

The basic requirements of Regulation 13G are:

- All tankers within its remit must be subjected to an enhanced survey programme.
- Post-MARPOL tankers can trade to 30 years old at which time they must be provided with a double hull or taken out of service — ie no alternatives to double hulls are permitted.
- Pre-MARPOL tankers, on the other hand, must cease carriage of oil or be provided with a double hull or alternative arrangements when they reach 25 years old.

Four alternative options are available to pre-MARPOL tankers:

Designating a certain proportion of cargo tanks as non-cargo carrying (empty) spaces. These spaces must cover at least 30 percent of the side of the ship for the total cargo tank length and be at least 2 metres in breadth or cover at least 30 percent of the projected bottom area of the total cargo length and have a depth of at least B/15 or 2 metres, whichever is the lesser.

Converting tanks to segregated ballast tanks (SBT) or dedicated clean ballast tanks (DCBT). The ballast arrangement must meet the 30 percent ruling as well as the requirements of IMO Resolution A.495 (XII) 'Revised Specifications for Oil Tankers with Dedicated Clean Ballast Tanks'.

Installation of longitudinal bulkheads to provide a double side or fit a double bottom, either of which would achieve the 30 percent shell protection required.

Adopting approved hydrostatically balanced loading (HBL) patterns, which makes use of the difference in density between crude oil and sea water so that in the event of the shell being breached water enters the ship rather than oil escaping to cause pollution. The HBL arrangement must provide an equivalent level of protection to the 30 percent rule. The level to which oil may be carried is determined by a formula that includes the tank depth, cargo density and inert gas overpressure. The protection equivalence is established by the calculation of Equivalent Oil Spill (EOS) numbers which represent the hypothetical outflow of oil for defined damage cases as a percentage of the cargo carried in each configuration.

It should be noted that, while HBL does not require any alteration to the tanker's structure or to its pumping and piping systems, in some cases there can be potential structural problems due to the sloshing of the cargo at partial filling levels. However, many VLCC (very large crude carriers) have been built with swash bulkheads at mid-cargo tank length and these will effectively negate sloshing in the pitch mode.

Comparison of cargo carrying capacity

To compare the cargo carrying capacity offered by each of the above options, consider a pre-MARPOL, 1975-built VLCC of 260,000 tonnes dwt as an example. For hydrostatically balanced loading, the estimated loss of cargo carrying capacity is 5 to 15 percent although, in the case of lighter cargoes this could be reduced further. In the case of wing tanks being empty as designated non-cargo carrying tanks, the estimated loss of capacity is a fraction higher at between 15 to 20 percent. For the DCBT/SBT option, the loss of capacity can be even higher, up to 20 to 25 percent.

While the installation of longitudinal bulkheads results in the smallest loss of cargo carrying capacity of only between 2 to 5 percent, steel weight could increase by up to 800 tonnes or, if the double bottom option is chosen, about 1,800 tonnes. Furthermore, the structural feasibility of fitting a double hull structure within a primary structural system designed for a single hull needs careful consideration.

Numbers of tankers involved

Assuming that (a) all tankers built after 1983, but prior to 1993, are provided with segregated ballast tanks in accordance with MARPOL, (b) all tankers built after 1993 have double hulls and (c) all tankers under 30,000 tonnes dwt will opt to trade as product carriers only, then the total number of ships over 30,000 tonnes dwt in the worldwide fleet that will be affected by Regulation 13G is 2,199. Of this total, 1,105 tankers are pre-MARPOL and will require a double hull when they are 25 years old, or the alternative arrangements discussed above, in order to trade for a further five years until 30 years of age.

The remaining 1,094 tankers are post-MARPOL and can trade to 30 years old without modification. On reaching 30 years of age, these vessels must fully comply with the double hull arrangements of Regulation 13F or cease trading.

The majority of ships affected will be 25 years old between 1998 and 2002.

This article is based on a paper presented by Alan Gavin, Senior Principal Surveyor for Class Services, Lloyd's Register of Shipping, at the Seatrade Tanker Industry Convention held in London, 29-30 October 1996.

Top: Figure 1 Below: Figure 2

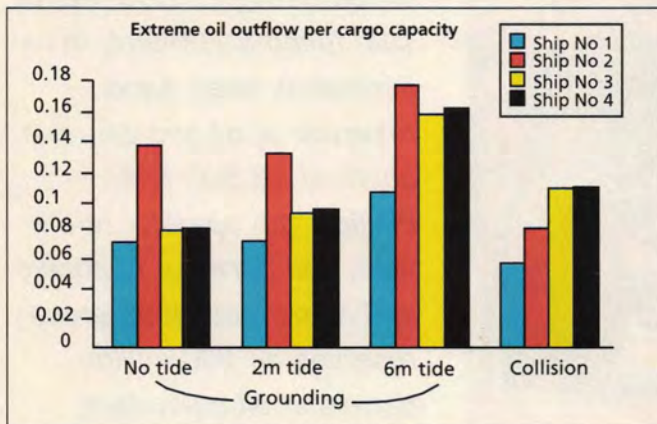
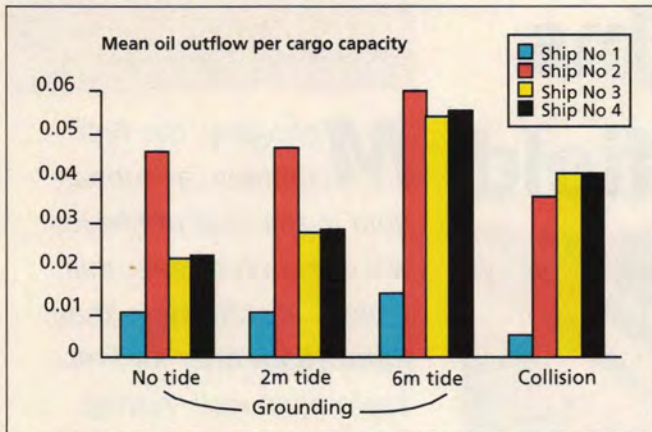
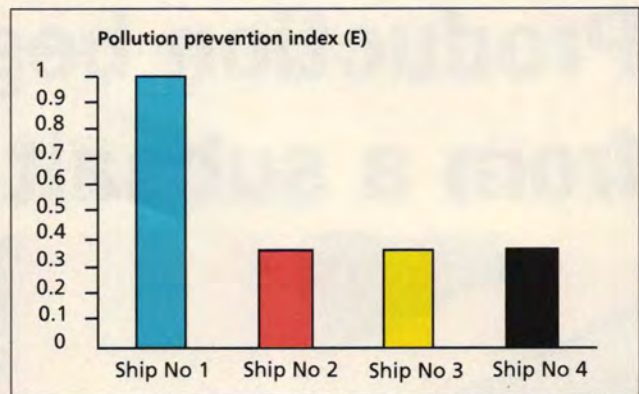


Figure 3



difference in levels of pollution predicted between single hulled and double hulled designs both in the collision and grounding mode, especially when tide is taken into account. The final pollution prevention index E is given in **Figure 3** and, once again, the double hulled tanker design shows a marked improvement over the single hulled designs. Readers will note that the index for the three single hulled designs is about the same, indicating

that the segregated ballast had a limited effect on accidental pollution. This is mainly because of the length/depth (L/D) ratio and as a consequence of the depth/draught (D/T) ratio change from pre-MARPOL to post-MARPOL ships. **This article is based on a paper presented by Wilhelm Magelssen, Vice President and Head of Department Ship Classification, Det Norske Veritas at the Seatrade Tanker Industry Convention held in London, 29-30 October 1996.**

Double hulled tankers — advantages and disadvantages

Advantages

- Cargo discharge and tank washing much easier than single hulled designs
- Less cargo residue in tanks
- Fewer pitting problems in the bottom of cargo tanks
- Piping system segregated (ballast pipes in ballast tanks and cargo pipes in cargo tanks)
- Less cargo heating required
- Less washing of cargo tanks leads to less cargo vapour released to the atmosphere
- Less pollution when grounded or in collision
- Rescue of grounded double hull tankers not normally more difficult than single hull. Tide is essential

Disadvantages

- Cargo leakage to ballast tanks. However, from an explosion point of view, ballast tanks are inherently gas dangerous

Mud accumulates more easily in double bottom tanks due to cellular structure

Ballast area increased two- or three-fold. This makes corrosion coating a particularly important consideration

Good access to structures is of paramount importance to facilitate maintenance of coatings

Pipe replacement is more difficult

Stillwater bending moment is close to limits in sagging and hogging conditions

Higher initial cost for double hull

Stability problems may arise for double hull tanks without longitudinal bulkheads in the cargo area

Double hull tankers less than 80,000 dwt require more ballast volume

Ventilation of ballast tanks more problematical

Fire fighting more difficult due to less heat transmission

Production begins from a subsalt field

By Judith Gurney



Mahogany, the first commercial subsalt field in the Gulf of Mexico, will come on stream this month, slightly more than three years after its first exploration well, having drilled through 3,800 feet of salt, found a 200-foot, thinly laminated, shaly sand reservoir of oil and gas at a depth of 16,500 feet. Phillips, the operator of the field, and partners Anadarko and Amoco, estimate gross reserves as 100 million barrels of oil equivalent. They expect production to average 22,000 barrels a day (b/d) of oil and 30 mncuft/d of gas in 1997 and to peak subsequently at 45,000 b/d of oil and 100 mncuft/d of gas. Mahogany is a notable success in the often frantic, and often unsuccessful, pursuit of subsalt projects in the Gulf of Mexico by a handful of companies over the past few years.

Gulf salt formations

Salt formations, often of immense size, are a persistent feature onshore and offshore in the Gulf of Mexico. Some are monumental columns of salt, known as piercement domes, which rise up for miles through various sedimentary strata, some extending eight miles above the bed of salt that formed them, with gently curved domes two miles or more in diameter. There are more than 500 known salt domes inland and along the coast.

The source bed for all this salt probably began forming in the Jurassic period. It moved as the Gulf was loaded by the rapid deposition of sediments from the Mississippi River and is estimated to cover as much as 40 — 60 percent of the basin, culminating in a great salt wall called the Sigsbee Escarpment, 100 miles from the coast.

For many years, all Gulf salt structures, onshore and offshore, were believed to be piercement domes rooted to a deep source bed. Later, it was discovered that offshore salt formations often have more width than depth. Many horizontal layers of salt — technically known as allochthonous salt sills — have been found over large areas of the Outer Continental Shelf in water depths of less than 1,000 feet, and some in deeper waters as well. These are extremely irregular in shape and size, ranging from a few feet thick in places to several thousand feet thick in others.

Early subsalt exploration

Although offshore oil and gas reserves had long been found in association with salt formations, it was only in the mid-1980s that the potential of hydrocarbon reserves underneath offshore salt formations was recognized. In 1985, Diamond Shamrock drilled a well which logged 1,000 feet of sand nearly 3,000 feet below a salt structure, indicating that sands which might contain hydrocarbons existed beneath horizontal salt formations. (Later wells established that, while sands above salt formations are mostly deltaic, sands below such formations are often fine-grain turbidites.) But with the exploration

Significant Subsalt Wells Drilled in the Gulf of Mexico

Location, Operator, Name of Project	Date Drilled	Depth (feet)	Results*
West Cameron 505 Gulf	1984	18,500	P&A
Vermillion 356 Amoco	1987	17,000	P&A
Miss. Canyon 211 Exxon (Mickey)	1990	14,670	O&G
Bay Marchand Amoco	1991	18,277	P&A
Garden Banks 156 Chevron	1992	18,000	P&A
Ship Shoal 349 Phillips (Mahogany)	1993	16,500	O&G
South Marsh Is. 169 Amoco (Mattaponi)	1993	18,020	P&A
South Timbalier 260 Phillips (Teak)	1994	16,610	O&G
Vermilion 349 Anadarko (Mesquite)	1994	16,146	P&A
Garden Banks 128 Shell (Enchilada)	1994	17,477	O&G
Ship Shoal 360 Unocal (Rhino)	1994	19,000	P&A
Ship Shoal 250 Japex	1994	17,772	P&A
South Timbalier 289 CNG (Cypress)	1994	18,034	P&A
Ship Shoal 368 Amerada Hess (Citation)	1994	—	P&A
Vermilion 308 Amoco (S. Anna)	1995	20,399	P&A
Miss. Canyon 292 Texaco (Gemini)	1995	17,976	O&G
Garden Banks 119 Oryx	1995	—	P&A
Ship Shoal 361 Phillips (Agate)	1996	16,163	O&G
Ship Shoal 337 Phillips (Alexandrite)	1996	17,851	P&A

P&A = Plugged and abandoned

O&G = Oil and/or gas find



technologies available at that time, companies were unable to accurately image subsalt areas. The main problem was that seismic sound waves travel at a much faster rate through salt than they do through a typical sand or shale deposit and there was no way then to correct for these phenomena.

Despite this difficulty, several companies, notably Phillips, were bidding in federal lease sales for blocks that they believed could hold subsalt deposits. They were able to acquire these relatively cheaply and banked on the development of new techniques which would allow them to image subsalt areas accurately before the expiry of their leases.

Advanced technology in the early 1990s associated with the development of higher resolution, three-dimensional (3D) seismic overcame some of the problems which 2D seismic could not handle, and improved subsalt imaging. New processing techniques were developed to convert seismic images in terms of actual depth, rather than travel time, through a process called depth migration. 3D pre-stack depth migration has

become one of the leading tools for imaging subsalt formations because of its ability to account for lateral changes in the velocities at which sound travels through subsurface strata. It allows analysts to deal with the difference in speed in which sound travels through salt and rock — and also with the irregularity of salt shapes and depths. Another key to unlocking the structure of subsalt formations was the development of extremely powerful computers. Full-volume 3D pre-stack depth migration involves huge amounts of data processed through a number of stages in iterative procedures which enable the removal of sounds from sources irrelevant to the seismic image, removal of signal distortions and correction for time differences, position and depth.

Subsalt discoveries

In 1990, Exxon and Conoco drilled a subsalt well in their Mickey prospect in Mississippi Canyon Block 211 in nearly 4,000 feet of water and found five productive oil sand prospects, between

10,000 and 13,000 feet, underneath 3,000 feet of salt. Two earlier subsalt exploration wells, by Gulf Oil in 1984 and by Amoco in 1987, had been unsuccessful. The Mickey discovery established, for the first time, that hydrocarbons, and not just sand, could exist beneath horizontal salt formations. The unknown question for every prospect, however, remained the timing of the formation. If hydrocarbons moved up towards the surface from their source before the salt was horizontally injected, there was probably little chance for reservoirs to exist beneath the salt. On the other hand, chances would be much better if the salt arrived before the hydrocarbons began, or completed, their upwards migration.

Enthusiasm regarding subsalt prospects followed the news of the Mickey discovery. The success of Mickey was not quickly repeated, however. In 1991, Amoco drilled a dry well in a subsalt prospect, as did Chevron in 1992. And in 1992, Exxon and Conoco announced that despite estimated reserves of 100-200 million barrels of oil equivalent, they viewed development of Mickey as uneconomic because of the field's depth.

Mahogany discovery

The break came in September 1993, when Phillips and its partners, Anadarko and Amoco, announced that they had made a significant subsalt discovery on South Shoal South Addition Block 349, in relatively shallow water depths of 370 feet, some 80 miles off the coast of Louisiana. Phillips had acquired the lease on South Shoal Blocks 349 and 359 at a federal government lease sale in March 1990 for \$1.1 million. Anadarko, an independent oil and gas company, took a 37.5 percent interest in the leases in December 1992

and Amoco a 25 percent interest in March 1993, leaving Phillips, as operator, with a 37.5 percent equity.

The partners' first exploratory well, using a semisubmersible drilling rig, drilled to a depth of 16,500 feet and found pay sand that drill-stem tested at a rate of 7,256 b/d of oil and 7.3 mncuft/d of gas. A six-slot template was installed at the site and a second, appraisal well was drilled on the same block a year later to a depth of 19,100 feet. This well tested at 4,366 b/d of oil and 5.315 mncuft/d of gas.

On the strength of these discoveries, Phillips and its partners declared the Mahogany field commercial in April 1995 and announced plans to construct and install a platform capable of producing 45,000 b/d of oil and 100 mncuft/d of gas. They estimated total development cost, including exploration and drilling costs, at more than \$200 million.

Two further wells were drilled before the installation of the platform. The third well, drilled on Block 359 in 1995 to a depth of 17,400 feet, successfully encountered the primary zone tested in the first well but did not find a commercial discovery in deeper sands. The fourth well, drilled in May 1996 on Block 359 to a depth of 19,094 feet, was reported to have encountered a gross pay interval of more than 180 feet between depths of 14,976 and 15,158 feet, thus increasing estimates of reserves.

Mahogany platform

The steel-jacketed Mahogany platform was installed over the drilling template on Block 349 in about 375 feet of water in August. Built by Aker Gulf Marine at its Ingleside fabrication yard near Corpus Christi, Texas, it consisted of an eight-pile jacket and a three-level, 5,000-tonne deck able to support up to 20 wells. The top level is the drilling deck, some 100 feet above the surface of the sea. It supports a drilling rig capable of drilling to 20,000 feet, crew quarters for 20 persons, two platform cranes and a helideck. The middle level is the production deck with oil and gas process-

ing facilities. These are based on fairly standard Gulf of Mexico technology and include oil-gas-water separation, crude oil dehydration, compression for flash and sales gas, and testing facilities. The bottom level supports the facility's utilities.

The jacket and topsides were transported and installed by Heerema vof, a partnership of Heerema Nederland and a unit of J. Ray McDermott of New Orleans. Once the platform facilities were in place, a platform rig connected the seafloor wellheads of the four predrilled wells back to the platform, treated the downhole producing formations and installed production equipment in each predrilled well. In time, the rig will drill more wells.

Oil production will be transported to shore through the Poseidon pipeline system which passes less than 1.5 miles from Mahogany platform. A unit of Texaco operates Poseidon through the Poseidon Oil Pipeline Co, a joint venture of Texaco and Leviathan Gas Pipeline Partners of Houston. Wet gas production will be transported by Leviathan through the Louisiana Offshore Gathering System, 9 miles distant, which it reaches via a 16-inch, Leviathan-operated pipeline to a sub-sea tie-in at Ewing Banks Block 990.

Disappointed hopes

The Mahogany discovery led to a surge of optimism regarding the existence of accessible, commercial subsalt deposits in the Gulf of Mexico which some estimated to contain at least 2 billion barrels of oil equivalent. Companies bid furiously, some extravagantly, in the federal Minerals Management Services Lease Sale 147 held in March 1994, for acreage in the Central Gulf which was believed to have subsalt potential. Anadarko, Phillips and Amoco, the Mahogany partners, were in the forefront of the high bidders. They were by no means alone. One block received nine bids and others seven, six, and five bids. Anadarko secured Ship Shoal Block 337 with a \$40 million bid; subsequently Phillips and

Amoco bought into this prospect which came to be known as Alexandrite. Anadarko made 25 other high bids in this lease sale; all but two of these were for blocks believed to have subsalt possibilities.

The high hopes for subsalt discoveries were not realized in the first years that followed the Mahogany find. Amoco, in partnership with Oryx, Amerada Hess and Petroleo Brasileiro, drilled a dry hole in their Mattaponi prospect in December 1993; Anadarko, with partner Phillips, drilled a dry hole in their Mesquite prospect in May 1994. Other dry holes in 1994 and 1995 were drilled by Unocal with partner Conoco; by Japex with partner Vastar; by Consolidated Natural Gas Producing, with partners Mobil, Vastar, and Louisiana Land and Exploration; by Oryx; by Amerada Hess and partner Shell; and by Amoco with partners Vastar, Shell and BHP.

Drilling nightmares

A dry hole in subsalt exploration was doubly discouraging because of the costs resulting from problems of drilling through and beyond salt formations. Within the formation, there were difficulties with drilling muds that tended to dissolve salt and with pressures that required heavy walled casing. Then there were difficulties resulting from the very high pressures encountered immediately upon exiting the salt and from the character of the unconsolidated sands found there.

These difficulties made subsalt wells expensive to drill, especially as most had to be drilled to a depth of 16,000 to 20,000 feet. The experience of Phillips and Anadarko in their Teak prospect, in South Timbalier Block 260, 80 miles offshore Louisiana, was a sobering one for the industry. Their wildcat well in 295 feet of water ultimately reached a depth of 16,610 feet in July 1994 after great difficulties in drilling through the salt sheet and coping with high pressures below salt. Mechanical problems, many arising from casing wear and tear, led to cost and time overruns. Drilling took eight months instead of the



expected three to four, with another two months needed for testing. The cost of the well, estimated at \$12 million, was \$20 million in the end. To make matters worse, although oil and gas was found, the commerciality of the discovery was in question as it appeared that hydrocarbons had leaked out of the structure.

Some good news...

The speed and ease with which Mahogany has been developed comes partly from its two great advantages in terms of cost — the fact that the field was found in relatively shallow water and that it was within easy reach of existing oil and gas pipelines. Despite the lack of these advantages for other subsalt prospects, many still consider the Mahogany field as just the first of a series of important subsalt producing fields. There are three other discoveries whose commercial

development seems fairly certain. Shell Offshore, with partners Amerada Hess and Pennzoil, have announced plans to develop their subsalt Enchilada prospect in Garden Banks Block 128, described as a cluster of oil and gas discoveries with estimated recoverable reserves of 400 billion cubic feet of gas and 25 million barrels of oil, at a development cost of \$240 million, with production scheduled to begin early next year. And Texaco and partner Chevron have announced plans to develop their Gemini subsalt field gas strike in Mississippi Canyon Block 292. They believe that the field is capable of producing 80 mncuft/d of gas but production is unlikely before the end of the century due partly to the water depths involved of 3,939 feet.

Another success has been the discovery, announced in March by Phillips and partner Anadarko, of a find in their Agate prospect, which lies six miles

south of Mahogany. Production from Agate may be possible through the Mahogany platform.

... and some bad news

There were high hopes for the Alexandrite prospect, located in Ship Shoal Addition Block 337, five miles northeast of Mahogany, for which Anadarko paid \$40 million in a 1994 lease sale, with Phillips later taking a share. The first wildcat well, drilled in the spring and summer of 1996 to a depth of 17,851 feet, and at a cost of \$11 million, found no hydrocarbons. The partners made it plain that this failure did not affect the prospects for their Mahogany field but the Alexandrite dry well was undoubtedly a severe blow for all subsalt enthusiasts. Despite the assistance of advanced technologies, subsalt exploration still has many unknowns and many risks.

Low-sulfur diesel — scramble over deadline

The European oil industry has been working frantically to have 0.05 percent sulfur diesel fuel on the market and 'fit for purpose' in time for the introduction of low-sulfur autodiesel fuel under the auspices of the 'Euro 2' legislation in October.

It was no surprise that a new tough sulfur limit on diesel fuel had to be met; in fact it has been known since Community Directive 93/12/EEC was adopted in April 1993. But on the day of implementation some refineries were still deciding how to tackle the

challenge of diesel fuel lubricity in the absence of a standard that was generally recognised by industry.

Lack of an industry guideline has meant decisions were not always straightforward. Most oil companies have set internal lubricity targets which they have chosen to meet by the use of additives.

Delayed by complexities

Some other companies have refinery streams which may not require the use of additives — or perhaps only occasionally. A further group has been delayed by the complexities of arranging additive injection at either refinery or marketing terminal. There has also been the problem of confirming compatibility with other fuel components as there is still little industry experience at predicting additive

needs on the basis of fuel properties.

In Germany, the low-sulfur diesel market is now a year old, and hence provides a model from which others can learn. Results from a recent Paramins market survey (see **Figure 1**) show average German diesel lubricity (measured in the high frequency reciprocating rig test (HFRR) — see later) to be about 425 microns and not far above its historical level with higher sulfur fuel. However, an independent survey has revealed that ex-refinery average (without additive), shown in the left hand bar in Figure 1, has risen to somewhat above 550 microns, indicating that most German refiners have chosen the additive route.

Driving force is air quality

Over a number of years, improvement in air quality has been the major driving factor behind low-sulfur autodiesel (ADO), both in Europe and the United States. In 1994 the European Union introduced a maximum sulfur content of 0.2 percent and the latest 'Euro 2' legislation supersedes all national specifications for ADO to require a maximum of 0.05 percent sulfur to be pre-

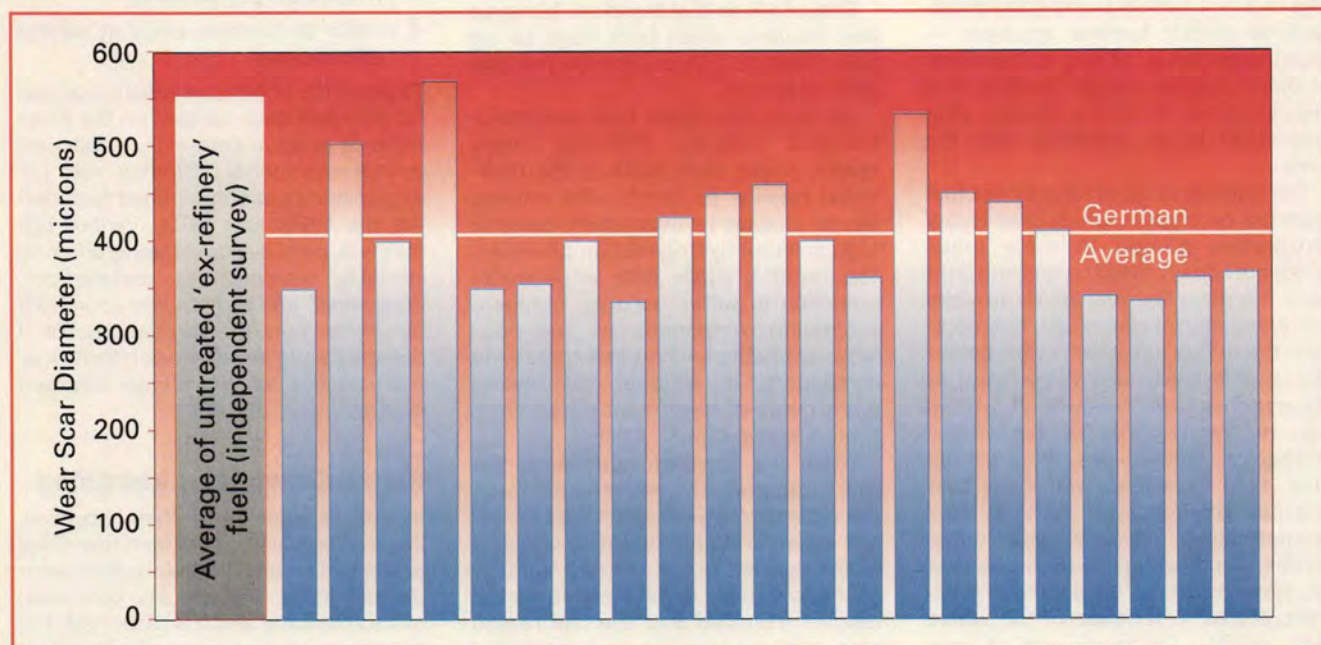
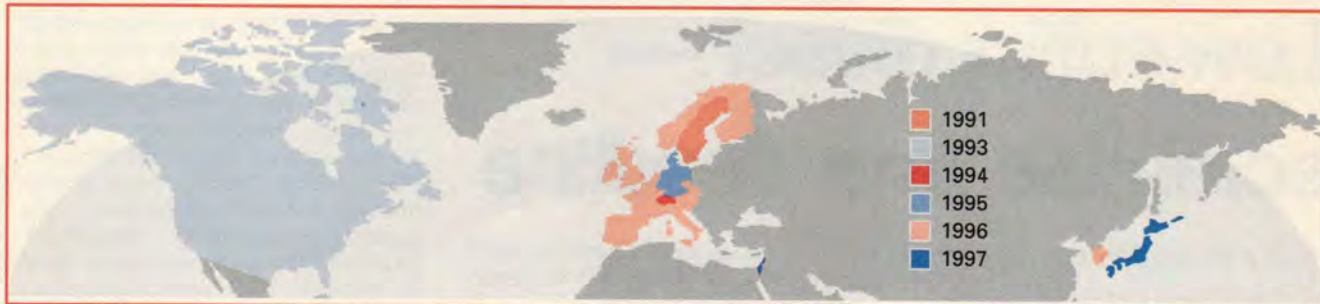


Figure 1: German diesel fuels lubricity ex-refinery and in market-place

Figure 2: Introduction of low-sulfur diesel fuel around the world



sent. Future legislation is expected to call for even more stringent sulfur limits (0.035 percent in the year 2000) and this will further enhance the criticality of diesel fuels lubricity.

Dissimilar to standard diesel

Sweden was among the first to introduce low-sulfur 'city diesel' in the form of its Class 1 and Class 2 fuels in 1991 (see Figure 2). To take account of higher manufacturing costs and to encourage the use of 'city diesel', the Swedish government gave the product tax advantages. With their extremely low sulfur and aromatic content, these fuels were quite dissimilar to standard diesel. Due to this, a further unexpected disadvantage quickly became apparent — catastrophic wear of key components of diesel injector pumps leading to a high incidence of vehicle failures after only 20-30 hours operating with the fuels.

This original series of failures was first reported on engines which used rotary distribution pumps. In these units, which are usually fitted to cars and light vans, it is solely the fuel which provides the lubrication. Failures did not occur with the in-line injection pumps generally used in trucks and larger vans, as these pumps have separate oil lubrication of the majority of the critical mechanical components. But, at the time, field inspections did show that internal scoring and marking had become more prevalent with in-line pumps — indicating the problems that are now occurring on a longer time-scale. More investigation of the whole area swiftly followed and it was

realised that the problem could be resolved using additives.

The US market moved to 0.05 percent sulfur ADO in response to legislation in 1993 and it was introduced to Switzerland in 1994. The following year low-sulfur ADO was launched in Germany exactly 12 months ahead of the legislated 'Euro 2' date.

Further afield, South Korea introduced a 0.1 percent sulfur level at the beginning of 1996 and Japan plans to move to 0.05 percent in 1997. Israel, too, plans to reduce sulfur content to 0.05 percent in 1997. Generally pressure to achieve a reduction in ADO sulfur is not as great in the Asia/Pacific Region as in Europe and the United States — often because of the use of local low-sulfur crude.

Exceptions to that trend are Malaysia and Thailand which both hope to cut their levels to 0.05 percent by the year 2000 or before.

All low-sulfur diesel fuels are manufactured utilising different, more severe, routes than ADO of the traditional quality. To do this the refinery has to change to using both low and high pressure hydrogenation processes. The result is ADOs with considerable reduction in sulfur, viscosity, nitrogen-containing compounds, bi- and polycyclic aromatics and oxygen-containing compounds. In addition, the boiling point range of these fuels differs from that of 'conventional' ADOs.

After the Swedish experience, the sulfur compounds were thought to be the anti-wear agents and it was generally assumed that it was their removal which resulted in the reduced lubricity of the low-sulfur diesel fuels. However, research revealed that the real reason was not so simple and probably

involved an interaction between polar materials, polycyclic aromatics and oxygen-containing components acting together as boundary lubricants.

But the whole problem was made much more difficult to resolve because there was no standard test for the evaluation of diesel fuel lubricity.

It was realised that any test of ADO lubricity should meet the following criteria:

- Reproduction of field wear mechanism — predominantly scuffing
- Low frictional heating of fluid
- Flooded contact points as in fuel injector pumps
- Repeatable and reproducible results
- Discrimination between fuels of known field performance
- Ability to function easily at various temperatures.

The majority of previous research on fuel lubricity had been centred on the properties of aviation kerosenes. It followed serious operational difficulties with jet-engine pumps and hydrofined fuels during the 1960s and 1970s. Various test methods were evaluated using differing contacts, temperatures, metallurgies, load, speed and atmosphere conditions but, at the time, the only test capable of demonstrating any degree of discrimination was the ball on cylinder lubricant evaluator (BOCLE) test.

Major drawbacks identified

In the 30 years since then, however, major drawbacks have been identified in the BOCLE test. Its results show poor discrimination. They are also very sensitive to humidity and it is suspected that the wear mechanism encountered in

the rig is not the same as that in fuel pumps operating in the field. Furthermore, the contact points are not fully flooded with fuel as they are in the field situation and, finally, steel cylinders used in the test are expensive.

Another test method, the HFRR, had been developed since the appearance of the BOCLE. The HFRR system provides a quick and inexpensive method of assessing lubricity under low speed, repeated pass sliding. Its design ensures that frictional heating of the sample and hydrodynamic film formation are negligible and low loads are used so that good discrimination can be achieved.

The test is conducted on a rig where a 6mm ball bearing is moved with a reciprocating motion over a static steel plate. The contact points are in flooded lubrication and the metallurgies, temperature, load, frequency, stroke length and ambient conditions are specified. The size of the wear scar produced on the ball bearing is used as a measure of the fuel's lubricity.

Only small, inexpensive components are required for the HFRR test and, using electrical contact resistance changes, it can monitor film formation by boundary active components. Instantaneous and average friction outputs provide a signature trace for the fuel that can be used for quality control.

Assessment of wear with the standard specimens requires only one simple measurement and, consequently, time spent on testing is short.

The HFRR test's emergence on the scene was opportune and it quickly

established the reputation of being able to provide a useful indication of diesel fuel lubricity. In doing so, it suggested that most 0.05 percent sulfur base fuels do not have sufficient 'natural' lubricity but that additives can restore the protection against wear.

In 1994 the CEC selected the HFRR, after Round Robin testing, because of confidence in its ability to discriminate between borderline pass and fail conditions. The results also correlated well with those from Bosch pump tests and field tests and the HFRR test was subsequently granted CEC 'T' status (see **Figure 3**).

Following some minor modifications to improve precision and discrimination (and with the October 1996 introduction of the 'Euro 2' legislation imminent) the HFRR test was granted CEC 'A' status in July after showing excellent correlation with field experience.

On the other side of the Atlantic during this period the HFRR test was encountering stronger competition from the SWRI version of the BOCLE test. ASTM (formerly the American Society for Testing and Materials) had held an indecisive ballot and a final resolution is expected in the near future.

The HFRR test's acceptance by the European standards organisation CEN was not so straightforward but the organisation finally granted a European Standard designation in July. The International Standards Organisation (ISO) has also approved the HFRR test — but not a level of lubricity.

Lack of consensus on lubricity

With opinions on an internationally accepted test for measuring ADO lubricity slow moving toward greater conformity, the problem remaining is the fundamental one of achieving a consensus on what is an acceptable/desirable range for ADO lubricity itself. In the United States the engine manufacturers have agreed on a HFRR wear scar (the measure of the fuel's lubricity) of a maximum of 450 microns; in Europe diesel pump manufacturers recommend an HFRR level of below 400 microns but some members of the international oil industry have argued for a limit of 550 microns or higher. This spread makes a consensus difficult to reach. ISO member countries were voting on a 450 micron limit as *Petroleum Review* went to press.

Over five years have passed since the first troubled introduction of low-sulfur ADO in Sweden. The route to 'Euro 2' has been long and fraught with technical setbacks and procedural difficulties, while complications concerning measuring and restoring lubricity have now been superseded by difficulty in agreeing test limit values.

Acknowledgment

This article is based on one which first appeared in *Paramins Post* and is reproduced with kind permission of Exxon Chemical Ltd.

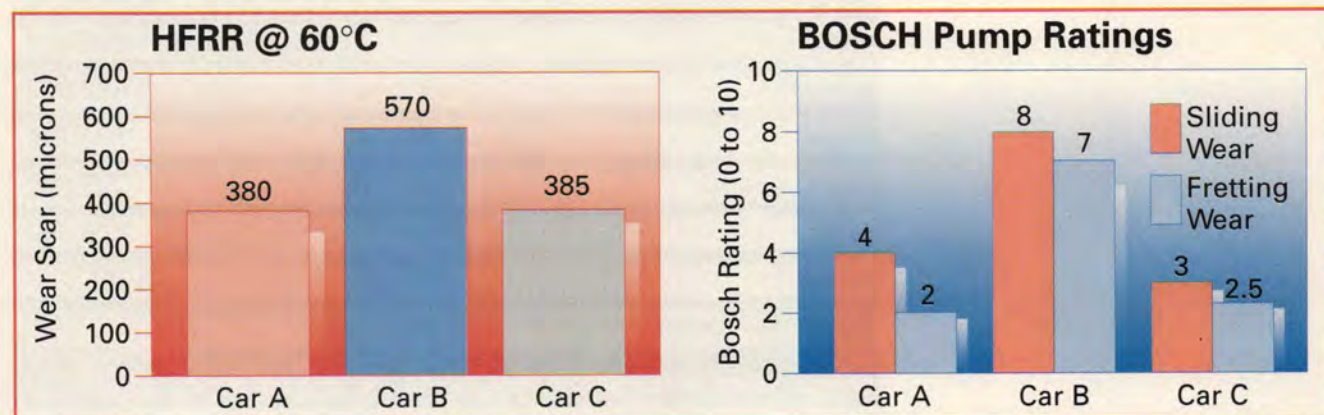


Figure 3: Comparing fuels and diesel injector pump wear

The Gulf controls a meagre share of the world tanker fleet

As of the beginning of July, the Gulf countries owned 91 tankers with a combined capacity of about 8,796,300 (dwt), thus controlling a meagre share of 2.8 percent of the world tanker fleet and 3.1 percent of its tonnage. In addition, the Gulf countries possessed 14 liquid gas (LNG/LPG) carriers, totalling some 1,329,500 cubic metres (cum), or 1.4 percent and 5.5 percent of the respective world totals. These shares are disproportionate both in relation to the region's petroleum reserves and resources, as well as its production and export levels.

**By Dr Naji Abi-Aad,
Energy Consultant**

Prior to 1985, most of the Gulf countries had ambitious fleet expansion programmes, while adopting a long-term objective of achieving a minimum share of 40 percent of their seaborne trade including petroleum exports, in line with the UNCTAD Cargo Sharing Code. However, the two Gulf wars have caused the fleet growth to be much below initial expectations and objectives. The position has been aggravated by the prolonged recession in the tanker market. But steps recently taken by some countries towards developing their natural gas industries have paved the way for them to acquire (or charter) more LNG and LPG carriers.

Bahrain has the smallest fleet in the Gulf with only one 95,064-dwt crude oil tanker. This tanker has even been on loan to the Arab Maritime Petroleum Transportation Co (AMPTC). This is a pan-Arab joint venture sponsored by the Organisation of Arab Petroleum Exporting Countries (OAPEC) which arranges external charter operations on behalf of member countries. A number of carriers have been chartered by the company and re-chartered to countries that own its shares (Saudi Arabia, Kuwait, Qatar, Libya, UAE, Iraq, Algeria, Bahrain and Egypt). In the middle of this year, the AMPTC chartered fleet consisted of 11 tankers with a total capacity of 482,300 dwt.

Iran has the largest tanker fleet of any Gulf or OPEC country. This is operated by the National Iranian Tanker Co (NITC), a wholly owned subsidiary of

Gulf Tanker Fleets (1 July 1996)

Country	No of vessels	Total dwt
Bahrain	1	95,064
Iran	23	3,088,849
Iraq	17	1,493,010
Kuwait	19	2,422,062
Qatar	2	190,165
Saudi Arabia	14	728,892
UAE	15	778,256
Total	91	8,796,298
% of the World	2.8	3.1

Source: *World Tanker Fleet Review*, Jacobs and Partners Ltd, Jan-Jul 1996



the National Iranian Oil Co. In the middle of this year, the NITC fleet consisted of 23 crude and refined product tankers with a total capacity of 3,088,849 dwt, as well as one 12,100-cum LPG carrier.

During the second half of the year, the profile of the NITC fleet was expected to change radically, since it was due to receive two of five 300,000-dwt Very Large Crude Carriers (VLCCs) ordered in January 1994 from the South Korean shipyards of Daewoo. The other three tankers are scheduled to be delivered by the middle of next year. Meanwhile, late in 1994, the NITC announced ambitious plans for purchasing a further 16 tankers — six 80,000-dwt, five 280,000-dwt, and five 160,000-dwt — to update its ageing fleet. However, no firm timetable for their acquisition was announced.

Because the NITC does not have sufficient capacity of its own, it charters tankers to carry part of the crude exported by its parent company. Its

chartering activity has sharply increased following the termination in mid-1995 of crude lifting contracts by American companies which mostly handled their own transport. Some sceptical market observers suggested that the new chartered capacities were required as floating storage for the crude for which the NIOC had not yet found alternative outlets.

In **Iraq**, the petroleum tanker fleet currently consists of 17 crude carriers totalling some 1,493,000 dwt, of which 10 have capacities of between 118,000 dwt and 155,000 dwt, and the other seven are 35,000-dwt vessels.

Around half of the Iraqi fleet was badly damaged during the conflict over Kuwait in 1990-91. The Iraqi Oil Tankers Co that operates the fleet, claimed \$675 million in 1993 from its insurers to compensate both for its lost assets and for the operating losses it had incurred as a result of the international sanctions imposed on Iraq since August 1990. The

company disclosed that it had lost \$500 million since then and was continuing to lose \$6 million per month.

Kuwait in the early 1980s adopted ambitious plans to move at least 70 percent of its petroleum exports through its national fleet tankers, either owned or chartered. However, the situation in the Gulf since the mid-1980s has persuaded the emirate to change these plans towards a more restricted area of operation.

The Kuwaiti tanker fleet, operated by the state-owned Kuwait Oil Tanker Co, presently comprises 19 crude and petroleum product tankers totalling around 2,422,100 dwt, as well as six LPG carriers with a combined capacity of about 430,700 cum. Two 300,000-dwt VLCCs are to join the Kuwaiti fleet in late 1997 or early 1998. The Kuwaiti petroleum product tankers are mainly used for carrying refined products to Rotterdam for distribution through the European marketing outlets of the Kuwait Petroleum Corp.

One of KOTC's tankers Copyright: OPEC

Qatar has a small tanker fleet, which consists of two carriers with a combined capacity of about 190,200 dwt. The fleet is operated by the newly established Qatar Shipping Co working side by side with the Qatar National Navigation and Transport Co which is responsible for supplying the feedstock of the Umm Said refinery and distributing its output.

In another development, Qatargas, the venture developing part of the huge reserves of the North Field gas field, has set up a new subsidiary,

Vela International, the marine transport subsidiary of Saudi Aramco.

Vela has considerably expanded its fleet of crude tankers over the past three years, by placing orders for new Ultra Large Crude Carriers (ULCCs) and VLCCs. In addition, the company, which has until now contracted out the operation of its tanker fleet to international ship management companies, decided in October 1994 to take over full managerial responsibility for its fleet with effect from next year. It has set up a specialist subsidiary

vessels with a total capacity of around 728,900 dwt. In addition, Vela owns and operates one 76,700-cum LPG carrier.

Only **Abu Dhabi** from the emirates has been investing in tankers; the other emirates continue to rely on foreign-owned carriers to provide their oil shipping requirements.

Most of the oil and gas shipping activities in Abu Dhabi are carried out by Abu Dhabi National Tanker Co (ADNATCO) which is a joint venture between Abu Dhabi National Oil Co and UAE citizens. In mid-1996, the




Qatarship, to move its exports of LNG. Qatarship is to operate a fleet of seven 135,000-cum methane tankers from early 1997, rising to 11 once the third Qatargas liquefaction train comes on stream in 1999. The original plan was for Qatarship to purchase new tankers built to order but Qatargas subsequently decided to charter tankers instead. To that end, Qatarship signed in October 1993 a 25-year contract with five Japanese shipping lines (Mitsui QSK lines, Showa Line, Nippon Yusen Kaisha, Kawasaki Kisen Kaisha, and Kaiun Kaisha).

In **Saudi Arabia**, much of the crude, products and LPG is currently exported in tankers belonging to or chartered by

in Dubai that is gradually taking over the running of the fleet during the 1995-96 transition period.

At the beginning of this year Vela ceased to have a monopoly within Saudi Arabia on the transport of oil and gas when the National Shipping Company of Saudi Arabia took delivery of the first of five doubled-hulled, 300,000-dwt ULCCs ordered from Mitsubishi Heavy Industries at the beginning of 1994. The other four tankers are scheduled to be delivered before the beginning of next year.

According to Jacobs and Partners Ltd, the tanker fleet of Saudi Arabia in the middle of this year consisted of 14

ADNATCO fleet consisted of 15 vessels totalling some 778,300 dwt. The company also operates the chartered LNG and LPG (three 79,600-cum tankers) carrier fleet of Abu Dhabi Liquefied Gas Co, for carrying its gas exports to Japan. In 1991, ADNATCO decided to acquire eight 135,000-cum methane tankers — four from Japan's Mitsui Engineering and Shipbuilding Co and the others from Kvaerner SA. The Mitsui carriers were delivered between August 1994 and November 1995 and the first two of the Kvaerner tankers in the first half of this year; the other two are scheduled for delivery next year. 

A visitor's view of the Middle East

By Jeremy Cresswell

Middle East states remain deeply critical of plans by a number of industrialised nations to implement carbon taxes and claim that many have quietly ditched the idea. *Rakad bin Salem bin Rakad, current President of the Organisation of Petroleum Exporting Countries (OPEC), claimed at the Middle East Gas Summit in October that the reason why some countries still wanted to tax oil imports was to rake in additional revenues, implying environmental considerations were secondary. He warned that such countries — inevitably high energy consumers — would suffer a scarcity of supplies if they went ahead with their taxation plans.*

'The understanding and cooperation of both sides of the equation, be they producers or consumers, will guarantee the interests of both sides, maintaining a harmonious economic growth and mutual security for supply and demand and a high and viable return on capital

investment,' he told the gas summit held in Abu Dhabi.

But it was claimed that the bright outlook was threatened by a lack of clarity on price, taxation and environmental policies adopted by industrialised nations. 'This will make producing countries reluctant to provide or secure the necessary investments for the expansion of production capacity, which could lead to a crisis of supplies of energy in the future,' he added.

Emphasis on gas

Setting the stage for gas sector development over the next few years, the OPEC president said that, because it was not governed by conventional trade norms, growth for this relatively undervalued hydrocarbon resource would continue to lag when compared with other sources of energy. To achieve greater, more effective utilisation of OPEC's huge gas resources would require long-term commitment and contracts in which consumers, producers, governments and international funding agencies were all partners.

The simple fact is that Middle East producers capable of stepping up oil and gas output are eager to do so, although some projects, for instance the Oman-India and Iran-India gas pipelines, have been shelved.

A graphic illustration of the commitment to invest is the Gulf Cooperation Council's declaration of 12 October that its members would plough some \$43 billion worth of investment into the oil and gas sectors over the next few years.

While some Western observers are cynical, dismissing this as a grandiose number plucked from the air, the fact that the formal green light was given in October for the \$1.8 billion revamp to double throughput to 240,000 barrels per day (b/d) of the Ruwais refinery complex operated by Abu Dhabi National Oil Co (ADNOC) is proof of the determination that exists.

That determination has unquestion-

ably been helped by this year's oil price bull run that has already pumped windfall revenues of an extra \$20-25 billion into OPEC members' coffers, according to estimates by the Centre for Global Energy Studies (CGES) in London.

Needless to say, contractors are battling to get on to pre-qualification lists and bid for contracts. For example, in October, Enron was putting a \$4 billion LNG deal in place, having already won Qatari approval to market 5 million tonnes of LNG annually from 2001 under a joint venture arrangement. The final go-ahead is expected by the end of the year, with production of LNG scheduled by 2001. The source of this gas is the North Field whose reserves are estimated at 530 trillion cubic feet of gas.

A source said that India would be an important market for Enron and that the US corporation was looking for two more buyers in India — Oil India and Essar Group — to complete the customer portfolio. Enron is building a \$2.8 billion power plant in the Indian port of Dabhoi which will need at least 2 million tonnes per annum.

An emphasis on gas developments is evident as well as on new crude producing capacity and refining expansion. Crude output has increased in recent years but as a result of ruling prices on world markets, government revenues have not shown corresponding increases. While Arab oil exports increased 37.3 percent from 9.4 million b/d to almost 15 million b/d between 1984 and 1995, their value plummeted 39 percent. The Organisation of Arab Petroleum Exporting Countries (OAPEC) oil revenues, in 1995 US dollar terms, slumped from a record \$296.8 billion in 1984 to a mere \$92.6 billion in 1995.

Last year saw the beginnings of a recovery, with OAPEC members experiencing an 11.15 percent increase in export earnings to the \$92.62 billion mentioned above and this year has seen all members hastily revising forecasts on the basis of the now year-long bull run. If the CGES forecast of a hefty

revenue windfall is correct, then many Arab producers will be able to make big inroads into now chronic deficits.

While it is generally acknowledged that more than 60 percent of the world's known crude reserves are located in the Middle East — some 645.32 billion barrels proven at the end of last year — production is outstripping reserves replacement and has been doing so since August 1990 when the United Nations embargoed Iraq.

The most recent statistics produced by the 11 members of OAPC show that, in 1995, Arab states produced 18.38 million b/d or 27.6 percent of world output, compared with 21.9 percent in 1986.

But, how the proportions change over the next year or so is down to whether or not OPEC raises its quota ceilings at the end-November session and how much more non-OPEC producers pump next year — 'easily' another 3-4 percent, according to the latest CGES forecast.*

No-one can be certain which way the game will pan out over the next few months, let alone after that. Some analysts have said of late that now OPEC members have re-acquainted themselves with higher oil prices, it would be to the advantage of members to restrict output to keep them up, rather than to try to grab market share and once again depress prices.

At the same time no-one is sure what will happen when Iraq is allowed to resume exports or to make \$2 billion worth of sales to underpin humanitarian aid programmes. Meanwhile, the UN ban remains firmly in place with no clear indication of when it will be lifted.

Saudi and Iranian projects

But Middle East producers are not sitting back and waiting before making plans to ramp up output. For instance, Saudi Arabia is proceeding with its 7 billion barrel Shaybah super light crude development, which should be under way by the end of this year.

The plan was to have it onstream by October 1999 producing 500,000 b/d, but Saudi Aramco has advanced the start-up date to June 1998. The state operator has taken on another two

drilling rigs and was at the last count negotiating leases for three more from Nabors. Five Shaybah core contracts have gone to Bechtel (upstream), Techint (pipeline to Abqaiq), Technip (downstream facilities), CCC (infrastructure) and GTE Government Systems (telecommunications).

This is just one big project. But there are many more, not least the Sirri development offshore Iran, where Total stepped into the breach after Conoco was obliged to pull out when the US government last year imposed an embargo on Iran.

Total signed a \$600 million deal to develop Sirri A and E in the first 'buy back' deal offered by Iran to foreign participation. At the last count, at least 10 more buy-back schemes were slated for the project by partial privatisation of the Iranian oil and gas industry.

Paralleling this is the progressive privatisation of the Iranian contracting sector, which was previously totally state-controlled but in which a growing number of companies are known to be anxious to grab a stake, now that US companies are out of the frame, barred by President Bill Clinton.

Gas prospects

Focusing on natural gas, output has pushed upwards strongly over the past few years for all Arab producers — from 286.98 billion cubic metres (bncum) in 1990 (11.1 percent of world total) to 352 bncum in 1995 (12.7 percent of world total).

Everywhere one looks, there are big gas projects under way or on the drawing board, many of them LNG based.

India was mentioned earlier. The subcontinent is becoming an increasingly important and logical market for Gulf states, as are Asia-Pacific and Europe, which accounted for 99 percent of the 68 million tonnes world LNG demand in 1995.

But there is little or no market cohesion, while the battle rages on as to how best to export product, especially in the context of the Indian subcontinent. For now at least, the Oman-India link is off because of technological problems regarding the deepsea pipeline. At the same time the Iran overland line to

India is on hold for political reasons.

Indeed summit delegates were told that mastering deepsea pipeline technology was crucial to the gas industry if a breakthrough was to be achieved in terms of developing a global supply of natural gas.

At least within the Middle East, there are significant infrastructure projects under way or up for bid. One is the 120 km Abu Dhabi-Dubai gas pipeline which will transport gas to the Jebel Ali Free Zone. Dubai has slender hydrocarbon reserves and needs to import.

Refining

While raw hydrocarbon output has been rising, total refining capacity in the region has in fact stagnated, remaining more or less constant for the past four years.

The current refinery count in the region is 60, with a total capacity of 6.05 million b/d of which 5.45 million is OAPC. A new study by the Arab Petroleum Investment Corporation (Apicorp) indicates that current refinery projects scheduled onstream from now to the millennium will swallow \$14.6 billion, mostly on expansion and upgrades of existing facilities.

More than a third of this will in fact be spent beyond the Middle East region on overseas interests (such as Saudi Aramco's facilities in the United States and the rumoured purchase by ADNOC of Copenhagen-based Borealis); \$3.7 billion is earmarked for Saudi Arabia, leaving just \$4.4 billion for the other Arab states.

In the case of ADNOC, there is already a link with Borealis through a \$1 billion joint venture formed in June to build and operate an ethylene and polyethylene plant in Abu Dhabi's Ruwais free port zone.

But the planned level of investment falls far short of the sums that will be needed if Middle East refining capacity is to stay in step with rising output of oil and gas, in order to satisfy those who say that far more emphasis should be placed on adding value through home-based processing, rather than simply exporting raw feedstock worldwide.

* *Petroleum Review* went to press before OPEC convened at the end of November.

UK government proposes further crackdown on marine pollution

By Kim Jackson

The UK government recently unveiled its latest plans for the prevention and control of marine pollution in UK waters. The proposed Merchant Shipping and Maritime Security Bill, published in the House of Lords at the end of October, implements many of the remaining recommendations of the Lord Donaldson Inquiry into the grounding of the Braer off the Shetland coastline on 5 January 1993 in which some 85,000 tonnes of crude oil was lost. The bill aims to tighten up existing legislation and includes measures to make ship operators liable for the cost of cleanup programmes following an oil spill off the UK coastline.

The Bill contains a number of minor and technical amendments to merchant shipping legislation as well as a number of changes of interest to readers of *Petroleum Review*. These include measures that will:

- Provide powers for the establishing of temporary exclusion zones at sea to allow ships or oil and gas structures to be isolated from other vessels on the grounds of safety and/or pollution
- Widen the UK Coastguard's intervention powers to cover any risk of significant pollution
- Give wider powers for the inspection and detection of substandard vessels in UK waters
- Seek powers to charge for maritime functions such as emergency pollution response and standard-setting activity in line with the 'polluter pays' and 'user pays' principles
- Increase fines for the illegal discharge of oil from £50,000 to £250,000. Fines for other substances will be increased from £5,000 to £25,000
- Require shipowners calling at UK ports and harbours to have insurance to cover third-party liabilities
- Give powers to the Secretary of State to give directions to a ship to move on if it poses a threat to safety or the environment
- Implement measures to improve safety standards of fish processing vessels or 'klondykers'.

The Bill also includes clauses to implement the primary legislation required for the 18 new measures to combat marine pollution from ships, as

announced by UK Shipping Minister Lord Goschen in January. These measures included a call to all UK ports and harbours to prepare waste management plans that will improve waste reception facilities which, in turn, will encourage shipowners not to dump waste (be it general garbage or oil) at sea.

Other new clauses take into account the responses received following the publishing of a draft consultation paper on substandard and uninsured ships in June. At the same time a consultation paper on oil pollution response was also issued, focusing in particular on the role of local authorities, harbour authorities and oil terminal operators. However, the new Bill does not, at present, contain any clauses in relation to this, although an announcement on the outcome of the consultation is expected in due course.

The cost to business


The UK government states that the majority of measures in the new Bill have 'either no compliance costs or insignificant compliance costs for business'. The main exception is the provision to extend the scope of charging for maritime services which at present is funded by general taxation. If the powers are exercised, the maritime sector as a whole could be faced with costs of £20-30 million per annum.

Indeed, while generally supporting the basic tenet of the new Bill, the Chamber of Shipping has taken issue with this funding provision. According to the Director of Marine Services, Edmund Brookes, while the provisions regarding funding have 'not come as a complete surprise', the remit in the Bill has been extended above and beyond that indicated in the draft consultation document issued this summer. This

allowed for shipping to pay only for the standard-setting role — a provision that the Chamber of Shipping criticised at the time. Furthermore, the proposal to take powers to wind down the General Lighthouse Fund came as a 'complete surprise', said Mr Brooks. He continues to have 'grave doubts' regarding the provisions which he feels, if exercised, 'will be a tax against the United Kingdom' that will have a detrimental effect on the competitiveness of the UK shipping industry as a whole.

Exercising the powers to improve planning, provision and use of waste

facilities at harbours will increase costs for shipowners and operators, while the implementation of the Hazardous and Noxious Substances Convention — which sets out international rules and procedures for determining liability and compensation in respect of incidents involving such substances — would mean an increase in shipowners' insurance costs and cargo interests would be required to pay levies to the international compensation fund. The amounts involved will be determined by the number of maritime incidents involving these substances.

Despite any objections voiced by the industry regarding additional costs, the government looks pretty much set to proceed with the new Bill which is likely to reach the statute book next spring. Indeed, it has stated that 'For all of the measures in the Bill which are enabling powers, a detailed compliance cost assessment will be carried out if and when the powers are exercised to identify and, where possible, minimise, the impact on business'. As to whether the shipping sector feels enough efforts are being made to reduce such costs remains to be seen. 

An energy scenario for 2006

Replacing reserves is likely to be the most important upstream issue facing companies in the next 10 years, while downstream the main concerns are not surprisingly poor margins and overcapacity in north-west Europe.

These are some of the conclusions in a research study, entitled *Energy 2006*, carried out for Ernst & Young.

The researchers undertook in-depth interviews with 88 senior executives from 55 companies, thus ensuring a wide perspective. The interviewees were promised and received complete anonymity — quotes are not attributable to any person or company.

These interviews took place in the early part of this year — before crude price rises gained a hold on the market and while competition in the UK retail market was at its most intense stage. This needs to be taken into account when reading the final report which was published last month.

Executives who were interviewed

thought that replacing reserves would be their main concern over the next 10 years, followed by oil price changes. These reserves would in all likelihood come from the former Soviet Union (FSU), although the associated risks might divert attention to South America and the United Kingdom.

The majority of the companies had experimented with new methods of working — outsourcing and alliancing/partnerships were frequently mentioned. For the future, more sharing of services was forecast. A majority opinion was that 'good strategic partnerships', involving the 20 largest companies, were likely to develop over the next three years.

Questioned about improving the exploration process, participants replied that they were looking to standardise technological or exploration methods and to introduce new seismic techniques.

Many participants put supermarkets as their main competitor. As one said: 'The supermarkets have high volume and fewer sites so there are genuine economies of scale plus the ability to operate on the back of grocery margins. That's the main threat, their ability to price the way that makes life difficult for everybody.'

Nevertheless, the major brands were confident of their future, forecasting

that in three years time they would retain a 50 percent marketshare, with the supermarkets expanding to 30 percent. However, over 10 years, they did not see any increase in the supermarket share but believed that their own share would rise to 60 percent.


While acknowledging the importance of non-fuel sales, participants agreed that fuel margins remained crucial; without it, 'you need to sell a lot of Mars bars,' said one commentator.

On current refining problems, a drop in northwest European capacity of 13 percent over 10 years was forecast.

In the gas sector few surprises were evident — the survey participants believed that price of gas was the most important issue, followed by concern over dealing with TransCo/Network Code.

In the long term, their concern centred on the opening of the European gas market via the Interconnector.

On the demand side, the forecast annual rise of 3 percent was attributed mostly to new gas-fired power stations. A few forecast an increase in demand from the transport sector.

Possible new products and services ranged from combined heat and power boilers through 'intelligent meters' to general insurance and personal finance. 

Carol Reader

Trials of catalytic converters in urban bus fleets

In cities and towns, including some of Britain's most beautiful historical centres such as Oxford and Bath, buses are an important means of public transport and source of tourist income. Because of their high public profile, they are under constant scrutiny by those who live and work along their routes. Inevitably, where they operate with high rush-hour frequency in large fleets, they are a potential source of local environmental pollution. However, UK and International trials of catalyst technologies demonstrate that buses can be run cost effectively with minimum emissions and high air quality.

By Ian Berrido
Account Director,
Berrido & Co

The public is becoming increasingly aware of the health risks associated with diesel, the fuel that still powers most bus fleets. In some parts of London with exceptionally dense traffic, residents are mounting campaigns for better air quality in response to the high incidence of childhood asthma. The fine particulate in black diesel smoke, so visible to the public as buses stop and start, can carry airborne toxins deep into human lungs and has been identified as a potential carcinogen.

Reduced quality of town life and tourism is another outcome of diesel pollution. Damaging sooty deposits build up on Britain's historic buildings and monuments costing large sums in cleaning and repair.

Summer and winter smogs are becoming more common in the United Kingdom, not dissimilar to the more extreme weather conditions widely reported in California and South America.

Bus operators can greatly improve this situation by reducing diesel particulate emissions from their vehicles using retrofit catalyst technology. The expense incurred should not be considered altruistic because the benefits of running clean performing vehicles include greater acceptance of routes by the community and an enhanced reputation for buses as an environmentally friendly alternative to car use. In the case of older vehicles, retrofit technology may be essential to meet increasingly strict emission regulations and to gain acceptance for route tenders.

South American trials

One company, Engine Control Systems (ECS) has successfully demonstrated the benefits of retrofit catalyst technology with bus operators in the United Kingdom, Chile and Argentina. In the South American countries, economic conditions, ageing bus fleets and unforgiving climates for emission dispersal, show diesel pollution problems at their extreme. Legislation is less advanced in these countries but the press and governments are increasingly aware of the issues. Average vehicle lifespan is significantly longer, so it takes many years for newer, less contaminating vehicles to come into service. Maintenance of older vehicles is often economically undesirable or not performed because of the lack of equipment and trained personnel.

In Chile and Argentina, it was shown that the application of catalytic technologies can be both affordable and beneficial for bus operators, the public and legislators. In these trials, the catalyst was specially formulated for the local vehicle emissions profile.

An urban bus demonstration programme was carried out in Santiago for the Chilean government, local bus organisations and a Chilean distributor. All demonstration results and independent test data were submitted to the Chilean government.

Argentinian officials were also interested in the new technology. In the province of Mendoza, 65 percent of the population uses public buses which are responsible for 55 percent of the city's air pollution. Previous attempts to clean up their emissions had been disappointing. Conversion of almost 200 buses to natural gas operation was costly and yielded mixed results — particulate emissions decreased upon average but gaseous emissions were significantly increased.



With the Argentinean distributor and local bus organisations, a 120 bus demonstration of the purifier technology was carried out. A 53 percent reduction in opacity (a test that measures visible smoke by light obscuration) was found at the start of the programme and 63 percent at the end of six months. The results showed that if all the buses were equipped with purifiers, only a 6 percent non-compliance rate to the city's desired 15 percent free acceleration opacity regulation would be attained. This compared with a 45 percent failure rate if converters were not used. Many Ministry of Transport bus spot checks confirmed that buses equipped with the new technology were consistently amongst the least polluting buses. This finding was true even when compared with natural gas fuelled buses.


To date over 160 buses in Mendoza have been equipped with the purifier technology with no reported system

failures in the two years since installation of the first units. Recent government decisions in Mendoza have led to the declaration that the purifier qualifies as an equivalent to natural gas technology conversion and is an acceptable alternative for bus operators. The Mendoza project is likely to serve as a template for the expansion of emissions regulations throughout the country.

UK catalyst trials

The UK government is more active in transport policy and air quality regulation than ever before. Leaside Buses which operates bus routes in northeast London has carried out trials of catalyst and filter technology. For example, recently Leaside has fitted ECS' new generation catalyst to a Routemaster bus. This reduces smoke opacity by 80 percent providing visibly cleaner air for

bus users and the local community. Leaside has found the new catalyst easy to retrofit and requires very little maintenance. The simplicity of the technology means the system is cost effective and provides a universal solution for bus fleets with a variety of vehicle types, engines and bus ages.

After 10 years of deregulation for buses, it is now reported that some degree of re-regulation is likely to be announced this year. Plans backed by the Bus Working Group, an industry consultative group set up by Steven Norris, Minister for Local Transport and Road Safety, include a requirement to run low polluting vehicles. Catalyst technologies, demonstrated in the United Kingdom and South America, provide a way to ensure vehicles are low polluting at costs significantly lower than new vehicle purchase or engine conversion to alternative fuels, according to the catalyst manufacturer. 

Diesel buses make pollution control essential in South American cities

People

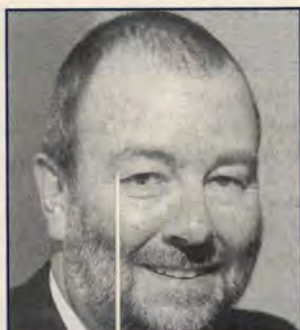
Mr Tim Eggar, who resigned as Minister for Industry and Energy in July 1996, has taken up the Chairmanship of MW Kellogg Group Ltd. Mr Eggar's responsibilities as Chairman will include leading project development and financial structuring for all Kellogg entities and associated companies.

Marathon Oil Company has announced the appointment of **Mr David E Smith** to the position of President, Marathon Oil UK Ltd and Vice President, Production, United Kingdom. Mr Smith succeeds **Mr John V Parziale** in both positions and will be based in London. Mr Parziale has been elected to the new position of Vice President, Planning, and will be based in Houston.

Mr Francis Gugen, Managing Director of Amerada Hess Ltd has succeeded **Mr Mike Curtis** as chairman of offshore industry initiative body CRINE. Mr Gugen joined Amerada Hess Ltd in 1982 and was elected to the Board in 1989 and became Managing Director in 1995. He is co-author of *UK Oil and Gas Taxation and Accounting*.



Mr Paul Grayling has been appointed Managing Director of ICL Edacom Ltd. Mr Grayling will also remain responsible for the sales and marketing of ICL Edacom Group products throughout Europe. He takes over from former Managing Director, **Mr Richard Beattie**.



Mr Chris Moorhouse, head of BP's international aviation business since March 1992 has taken over from **Mr John Orange** as Chief Executive of BP Oil UK Ltd. Mr Orange has retired from the company after 29 years.

Enterprise Oil has announced the appointment of **Mr Archie Thompson** as the General Manager of Enterprise Oil Gulf of Mexico Inc. and Enterprise Oil Louisiana Inc. Mr Thompson will be based in Houston and will be responsible for overseeing the development of Enterprise's interests in the Gulf of Mexico.

Mr Frank Shrontz, chairman of the Board of The Boeing Company, has been elected to Chevron's Board of Directors.

Mr Steve Jacobs was appointed director and President of Tracer Petroleum at its first Board meeting. Mr Jacobs had previously served as operations manager of Talisman (Ogan Komering Block).

Mr Ray Galvin, a corporation Vice President and President of Chevron USA Production Co, will retire at the end of February 1997. He will be replaced by **Mr Peter Robertson** who is currently the corporation's Vice President of strategic planning and quality. **Mr Greg Matiuk** has been elected a corporate Vice President to replace Mr Robertson.

Mr David R Martin has retired as President and Chief Executive Officer of Occidental Oil and Gas Corporation and from the Board of Directors of Occidental Petroleum Corporation. Occidental's President and Senior Operating Officer, **Dr Dale R Laurence**, will serve on an interim basis as the President and CEO of the company's oil and gas unit in addition to his current duties.

The Board of Scottish Enterprise has announced two new appointments. **Mr Ian Robinson**, Chief Executive of Scottish Power plc, formerly Director and Chairman, Energy Division, Trafalgar House, and **Mr Jim Sillars**, Assistant Secretary-General, Arab-British Chamber of Commerce and former Member of Parliament for Glasgow Govan holding the seat on behalf of the Scottish National Party.

Mr Ian Dundas, Alwyn Area Manager of Total Oil Marine, has been appointed to the Board of Directors. Mr Dundas joined the TOTAL Group in 1977 and has been with Total Oil Marine in various senior management roles since 1983.

Mr Adrian Hodgson, previously Commercial Manager for Total's Gas Transportation and Processing unit, has been appointed Gas Transportation and Processing Manager replacing **Mr Christian Pech** who is taking up a new appointment overseas.

Mr John Catlow has been appointed Non-operated Assets Manager, replacing **Dominique Chauvin** who has been appointed General Manager of TOTAL Colombia.

The Institute of Marine Engineers has appointed Australian marine engineer **Mr Alan H Taylor** as President to commence from March 1998. It is the first time in the Institute's 107 year history that a



Mr Emmet Brown has been appointed as Managing Director of Tuskar Resources plc. Mr Brown has been a Director of Tuskar since 1992 and is a former Chief Executive Officer and Managing Director of Atlantic Resources plc, former Chairman of the Irish Offshore Operators Group and former Managing Director of Upstream Energy Services.

President has been appointed outside the UK. Mr Taylor is currently Environmental Manager of BHP Transport in Melbourne and has been involved in the design and construction of over 30 ships.

Mr John d'Ancona CB has been appointed a non-executive Director of international exhibition organisers, Spearhead Exhibitions Ltd. Formerly Director General of the Department of Trade & Industry's OSO (Oil and Gas Projects and Supplies Office), Mr d'Ancona has worked with Spearhead Exhibitions Ltd in recent years as Chairman of the annual Caspian Oil and Gas Conference in Azerbaijan and of IOCE '96.

Deputy Chairman of OMV, **Dr Wolfgang Rutenstorfer**, succeeds **Mr Kurt Bushati** as Member of the Executive Board responsible for Exploration and Production and Gas. Mr Rutenstorfer is currently responsible for finance, controlling and chemicals; his position of Deputy Chairman will not be affected. Mr Bushati will be retiring at the end of the year.

Technical Report

REFINING AND MARKETING

Guidelines for the Control of Hazards Arising from Static Electricity has been balloted and the draft amended to incorporate the comments. The Working Group may be reconvened to resolve some of the issues raised.

The structure and format of guidance on operational and technical matters at service stations is being reconsidered by HSE in conjunction with their plans to produce replacement petroleum legislation. Publication of this guidance is not now expected until the second half of next year. Comments received on a consultation document on technical guidelines are being considered by the working groups.

A trial of the model for Environmental Risk Assessment of Petrol Filling Stations which examines possible soil contamination has been developed by the Institute and is being tested by the working group members.

IP has representation on a DoE working group for Environmental Risk Assessment of Major Installations. Consideration is currently being given to a joint IP/EA publication of the IP Guidance document on this subject developed last year.

Additional material is being added to the current revision of the Marketing Safety Code to cover industry practice with regard to safety and environmental matters.

The industry working group on VOC Emission Compliance Testing is investigating means of raising truck operating pressures on trucks handling to ensure that a five-arm loading capability can be obtained without loss of vapour. In addition they have drafted a test protocol to determine the maximum permissible loading rates with acceptable VOC emissions and are preparing to carry out trials early next year.

Plans have been made for trials of a method for testing the resistance to tyre fires of materials used in mudwings of petroleum road tankers.

A contract has been placed for development of a replacement to the calculation procedure identified in the present Area Classification Code. This will be based on existing models used by the major oil companies and will also cover LPG operations.

A guideline for Portable Electrical Apparatus has been developed for the control of potentially dangerous portable electrical apparatus in the petrochemical industry. It applies specifically to refineries but can be extended to terminal operations, though it is not suitable for service stations.

AVIATION

Work on the Aviation Fuel Field Dirt Survey continues with co-operation between IP and API on revising the API 1581 document on fuel filtration. Analytical work on behalf of API is also progressing but completion is delayed pending receipt of some samples from airports around the world.

ENVIRONMENT

A successful workshop on 'Oil Spill Response' was held in September when a number of important issues relating to the degree of clean-up required were raised and some new clean-up techniques described.

The Institute now has a representative on the Steering Group for the DoE-sponsored project to develop a document for the 'Management of Harm to the Environment.'

New Guidance on the Installation of Turbine Meters in Loading Gantries was published in July.

MEASUREMENT

The new Code of Practice for the Calibration of Reference Meters Used for Gantry Meter Proving: Sub-section 7.1 Small Volume Prover Method was published in August.

A new draft Petroleum Measurement Manual on Meter Proving, providing guidance for the calibration of additive injection systems on road-loading gantries has been balloted. Comments are being reviewed.

HEALTH

A successful workshop on 'Environmental Epidemiology Strengths and Weaknesses' was held at the Institute in October. Researchers of national standing attended the workshop and held discussions with representatives from the UK and European oil industry and the regulatory authorities.

The guidelines on Medical Standards for Fitness to Wear Breathing Apparatus have been completed. The Advisory Committee on Health will reconsider whether these guidelines are appropriate for general publication.

MICROBIOLOGY

The Guidelines for the Investigation of the Microbial Content of Fuel Boiling below 390 °C and Associated Water, now being printed, will shortly be available from the IP.

TEST METHOD STANDARDISATION

The 1997 IP Test Method Book will include 11 new parts of BS 2000, four new IP methods as well as a new CEC test method.

ISO Central Secretariat are working to reduce a backlog of international standards. Many of these will then be adopted as IP methods and as part of the BS 2000 series.

A successful CFR Gasoline and Diesel Fuel Engine workshop was held in October.

UPSTREAM

A proposal has been agreed to carry out full-scale experiments in the complex three-dimensional geometry of heat exchangers. It is expected that seven companies will support this research and a Joint Industry Project Participation Agreement has been developed. The work is expected to start before the end of the year and the majority of the £220,000 project cost will be funded by the HSE and the Institute, with the IP managing the research through a Task Group. The Mechanical and Process Engineering Department of Sheffield University will carry out a complementary, £99,000 research project funded by the Engineering and Physical Sciences Research Council. The IP study will provide the data that forms an integral part of the Sheffield work. With the £220,000 funding from the HSE and industry, the total cost of the study will therefore be £319,000.

The Safety Conference entitled 'People & Changes, Costs and Challenges' was held in September with an excellent programme of speakers.

Following the resignation for career development reasons of the Technical Officer involved in the upstream standardisation activities, a replacement has been recruited who started work in October.

John Hayes,
Technical Director

Forthcoming Events

December

2nd-3rd

London: 'World Baseoils'.
Details: ICIS-LOR
Conferences, The Coach
House, 21 St Johns Road,
Richmond, Surrey
TW9 2PE.
Tel: 0181 332 7689
Fax: 0181 332 7690

2nd-6th

Singapore: 'Improved
Bulk Liquid
Measurement'.
Details: Abacus
International, 214
Inchbonnie Road, South
Woodham Ferrers, Essex
CM3 5WU.
Tel: 01245 328340
Fax: 01245 323429

2nd-6th

Paris: 'MESUCORA: The
International Exhibition of
Measurement, Control,
Regulation, Automation,
Engineering and Industrial
Information Technology'.
Details: Promosalons, The
Colonnades, 82 Bishops
Bridge Road, London
W2 6BB.
Tel: 0171 221 3660
Fax: 0171 792 3525

3rd-4th

Aberdeen: '1st European
Oil & Gas Best Practices
Benchmarking Conference'.
Details: Jane Oliver,
Offshore Management
Centre, The Robert Gordon
University, Aberdeen.
Tel: 01224 263101
Fax: 01224 236100

3rd-5th

Ghana: 'Oil & Gas Africa
1996'.
Details: FSG
Communications Ltd, Vine
House, Fair Green, Reach,
Cambridge CB5 0JD.
Tel: 01638 743633
Fax: 01638 743998

3rd-5th

London: 'PETEX '96'.
Details: PESGB, 2nd Floor,
17/18 Dover Street,
London W1X 3PB.
Tel: 0171 495 6800
Fax: 0171 495 7808

3rd-6th

Vienna: 'GASTECH '96'.
Details: Gastech
Secretariat, London RAI,
Glen House, 200/208
Tottenham Court Road,
London W1P 9LA.
Tel: 0171 436 9774
Fax: 0171 436 5694

4th-5th

London: 'Land Resources:
On the Edge of the
Malthusian Precipice'.
Details: Science
Promotion Section, The
Royal Society, 6 Carlton
House Terrace, London
SW1Y 5AG.
Tel: 0171 839 5561
Fax: 0171 451 2693

4th-6th

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

5th-6th

London: 'Controlling
Carbon and Sulphur;
International Investment
and Trading Initiatives'.
Details: The Royal
Institute of
International Affairs,
Chatham House, 10 St
James's Square, London
SW1Y 4LE.
Tel: 0171 957 5700
Fax: 0171 957 5710

9th-12th

Amsterdam: 'Industrial
Corrosion: Fundamentals,
Control, Prevention'.
Details: The Center for
Professional
Advancement, Oudezijds
Voorburgwal 316A, 1012
GM Amsterdam, The
Netherlands.
Tel: +31 20 638 2806
Fax: +31 20 620 2136

10th

London: 'BIOMASS:
Fuelling the Future'.
Details: The Conference
Department, The
Institute of Energy,
18 Devonshire Street,
London, W1N 2AU.
Tel: 0171 580 0008
Fax: 0171 580 4420

11th

London: 'Transformation
in the Gas Industry:
Meeting the challenge of
competition'.
Details: The Economist
Conferences, 15 Regent
Street, London SW1Y 4LR.
Tel: 0171 830 1116
Fax: 0171 931 0228

11th

London: 'Managing &
Trading Gas at the Beach'.
Details: AIC Conferences Ltd,
2nd Floor, 100 Hatton
Garden, London EC1N 8NX.
Tel: 0171 242 2324
Fax: 0171 242 2320

12th-13th

London: 'Subsea '96
International
Conference'.
Details: Knighton
Enterprises Ltd, 2
Marlborough Street,
Faringdon, Oxon SN7 7JP.
Tel: 01367 242525
Fax: 01367 241125

12th-13th

Dallas: 'Managing Fuel
Risk'. Details: The Center for
Business Intelligence, 70
Blanchard Road, Suite 4800,
Burlington, MA, USA 01803.
Tel: +1 617 270 6200
Fax: +1 617 270 6216

Call for Papers

Petroleum Geology of NW Europe 5th Conference and Exhibition Barbican Centre, London

26th-29th October 1997

Papers required on:

- NW Europe Tectonic Development/Basin Evolution
- Regional Offshore Norway to Offshore Ireland
- Faroes/Shetland Area
- Salt Related Plays
- Mature Basins (North Sea) Exploration and Production
- Successful Applications of Sequence Stratigraphy
- Chalk Renaissance
- Subtle Traps
- Carboniferous
- HP/HT Plays
- Heavy Oil Fields
- Advances in Reservoir Characterisation
- Late Field Life/Cessation of Production
- Integrated Field Development and Reservoir Management
- Applications of Geophysical Technology
- Applications of New Techniques in Development/Production Technology
- Basin Modelling Applications in Reducing Risk and Maximising Reserves

Those interested in submitting papers/posters should submit titles for consideration as soon as possible. Abstracts (maximum 250 words) should be submitted by 15th January 1997

Correspondence should be addressed to: The Chairman of the Technical Committee

Dr Stephen Boldy, Amerada Hess Ltd, 33 Grosvenor Place, London SW1 7HY Tel: 0171 823 2626 Fax: 0171 887 2199

Sponsoring Organisations: The Geological Society, Institute of Petroleum, PESGB and JAPEC. Endorsed by: Oil and Gas Directorate of the Department of Trade and Industry, Irish PAD, UKOOA, BGS, AAPG and SPE.

Technology News

Vertical gravity separator for oily waters offers lower operating costs

The new Mozley vertical gravity separator (VGS) can be left on line longer, and at peak efficiency, than more conventional oily water separator designs which clog and are difficult to clean, states manufacturer Richard Mozley Ltd. Designed for applications such as oil refineries and service stations, the VGS and accompanying skimmer are capable of handling most effluent streams to discharge clean water meeting strict international standards and leave oil and low density solids that can be reclaimed or recycled.

The unit can be cleaned in seconds without requiring the use of high pressure washing and is also said to require less routine maintenance thereby reducing operating costs.

Liquid effluent entering the VGS through an inlet leg flows up the unit through a

low pressure zone in the centre of an inverted V-shaped multi-leaved baffle spiral. Here, free oil and impurities float to the surface and into an overflow tank.

An innovative design causes numerous directional changes in the fluid, states the manufacturer, to ensure that non-emulsified liquid impurities fall out of suspension and into the low pressure core. Heavy contaminants fall into a sludge holding area in the base of the unit, which is regularly drained off, while low density impurities move to the centre and rise to the surface where they enter the overflow tank.

Stirring paddles at the top of the tank also agitate the liquid in two directions to ensure that sludge build-up on the surface is broken up. This process also removes any contaminants that have adhered to the baffle spiral.



Mozley VGS

High speed oil containment boom

The new Uniboom S-Series oil containment boom from Unitor is suitable for both inshore and offshore applications. Stored on a reel for immediate deployment where speed may be essential, boom operation

requires minimal training and manpower.

It offers excellent wave following characteristics and has a buoyancy/weight ratio of 23:1 to ensure good oil entrapment and containment, states the company.



Uniboom S-Series oil containment boom

Correction: The Technology News section of *Petroleum Review's* November issue featured the latest developments from Wayne Dresser. We would like to point out that the tank testing system described in the text is the

Wayne PSL Tank and Line Testing System and not the ISM Nucleus which is a combined point of sale and forecourt control system incorporating an integral wetstock management feature.

Smart temperature transmitter

Rosemount Measurement, part of the Fisher-Rosemount group, has unveiled a 'smart' head-mounted temperature transmitter incorporating HART digital field communications as part of its drive to develop equipment meeting the needs of the field-centred control system of architecture currently being promoted by industry.

The Model 644 transmitter can be remotely programmed for use with a variety of sensor types. Furthermore, all internal

diagnostics are accessible via HART, enabling the device to be fully tested without the need to visit the field.

A special feature is unrestricted span setting within the range of the selected sensor, states the manufacturer. The tool also features internal ambient temperature characterisation to reduce measurement error over a wide range of operating temperatures and is said to exhibit good stability specification at 0.1 percent of reading or 0.1°C for a period of 12 months.



Model 644 head-mounted temperature transmitter

Technology News

New generation paging system

Philips Projects has upgraded its PS6000 radio paging system for use in industrial applications with new Generation III transceivers.

The transceivers provide two-way voice communication between individual pagers and the system controller or to other pagers on the system plus a range of messaging options. Some 14 different normal and intermittent beep patterns indicate priority, action etc and the units can be provided with or without dial pads, allowing users to send messages back to the operator

and to other users.

The transceivers incorporate an intrinsically safe option approved to EExib IIC T6 and T4 classifications for operation in hazardous environments. They are also splashproof to IP64 for use in rugged industrial applications. Optional features include tear out, knock down and no movement alarms to warn if users are incapacitated.

The paging system can also be linked to monitoring systems which automatically page selected staff if key equipment fails.



Upgraded PS6000 radio paging system

Precision sea floor mapping system

Racal Survey is to launch a seafloor mapping system next month which has been designed to provide cable route surveys and other subsea tasks with more accurate seafloor maps than offered by conventional survey techniques which can have problems when difficult seabed conditions are encountered.

The SeaMARC[®] system provides true-range, high resolution backscatter imagery which is perfectly registered with precision swath bathymetry, explains the manufacturer.

Although the system has been designed specifically for cable route surveys, it also has applications in other fields such as hydrocarbon exploration, marine mining, hazard mapping, research and marine salvage.

The system uses two different sonars to cover the full range of water depths required for cable route surveys. A deep tow sonar operating at 50 kHz is tailored for plough-route water survey depths down to 2,000 metres, while the second sonar, operating at 12 kHz, is designed for deep water route selection from 500 metres depth to full ocean depths.

Use of a fibre optic tow cable allows the incorporation of techniques such as multiple-beam side looking sonar and synthetic aperture sonar. Dual towfish launch and recovery by one person are possible, thereby extending the system's adverse weather capabilities and reducing the risks to both equipment and personnel, states the manufacturer.

Radar marine gas tank gauging system

The latest marine tank radar gauge from Saab Marine Electronics measures tank level, tank pressure, vapour and liquid temperatures as well as trim and list of LNG, LPG and other liquefied natural gas tankers.

Conventional level gauges for gas tankers use intrusive methods, such as floats or capacitive sensors, where the sensor element is in contact with the liquid. Furthermore, gauges for LNG tanks have been duplicated for each tank in order to ensure a level measurement in case of repair or replacement of one gauge.

In contrast, the new TankRadar gauge has no moving parts, is intrinsically safe and has only its stainless steel cone antenna in the

tank vapour. The antenna fits into still pipes of about 100 mm diameter which direct the microwaves so that the gauge can measure reliably even when the liquefied gas is boiling. A microwave transparent pressure seal in the top part of the antenna cone enables the radar electronics to be quickly and safely replaced during operation in case of any failure.

'In this way, one reliable TankRadar gauge may replace duplicated level gauges on LNG tankers,' says the company.

Gauge performance can be verified under full operational conditions when the unit is set in test mode — this is not possible with other gas tanker level gauging systems, says Saab.

Multiwarn multigas detection

Up to 35 different gases can be monitored with the new Draeger Multiwarn II multigas detector.

Capable of detecting toxic and explosive gases as well

as oxygen deficiency or enrichment, the unit is said to be the only portable monitor to combine infrared capability with up to four additional, interchangeable sensors. It can be configured as a one to four gas measuring instrument by selecting three electrochemical sensors plus a fourth sensor for the detection of flammable gas and features a comprehensive graphics display, audible and visual alarms and simple push button operation.



Multiwarn gas detector

Universal vapour control valve

Oil tankers are fitted with a range of vapour control valves which allow sampling and dipping under pressurised, safe and inert gas conditions. The valves vary in size and diameter and often restrict which type of electronic measurement tape or sampling equipment port authorities or cargo oil inspectors can use when a vessel calls at port.

With this in mind, UK Sampling Gauges has developed a Universal Vapour Control Valve that is said to be compatible with any type of such devices currently available.



Universal vapour control valve

Technology News

Reducing hazardous storage emissions

The new Series 9700 emergency vent from Anderson Greenwood provides severe service pressure relief on hazardous storage tank applications, while cutting emissions to meet stringent environmental and safety requirements.

The unit combines the simplicity of a weight-



Series 9700 emergency vent

loaded device with the performance of a pilot operated pressure relief valve to provide bubble-tight seat integrity at operating pressures up to 95 percent of set pressure, thereby virtually eliminating fugitive emissions caused by seat leakage. Premium seat tightness is provided by a Teflon film seat backed up by Goretex.

An enhanced lifting capability allows full relieving capacity to be achieved with no more than 20 percent overpressure, compared with 100 percent overpressure for traditional weight-loaded devices, states the company. This enables the use of higher set pressures, increasing the gap between tank vapour pressure and opening point.

Speedpass for quick fuel purchases

Mobil has introduced a new transaction system similar to the 'toll tags' used by many bridge toll booths at 50 of its St Louis-area self-service petrol stations. The Mobil Pegasus Speedpass™ system allows customers to fill their vehicles with fuel without having to go to the kiosk to pay for it, thereby reducing the time required to refuel.

An electronic system located in the pump 'talks' to a miniature radio-like device (transponder) issued to the

customer. Fuel purchases are automatically charged to a chosen credit card when the customer completes a simple application. Credit card security is ensured as Speedpass is operated by the customer's transponder identification code, with the credit card number remaining outside the signal system, says the oil company.

The system comes in three formats — a tag attaching either to a key ring, the car's rear window or a wallet card.

Continuous control of oil slicks

A system for the continuous monitoring and control of oil spills and run-offs from petrochemical complexes and industrial sites close to waterways and shipping activities within harbours has been unveiled by Ionics.

The detector works continuously, projecting a light beam on to the water and sensing any difference in reflectance characteristics. Once predetermined limits are exceeded, the system initiates corrective action such as the lowering of booms or closing of sluice gates. The

unit can measure thicknesses of oil as low as 0.1 micron.



Touch-free car wash system

For those drivers who prefer to handwash their vehicle rather than use automatic brush or jet washes, Ryko International has introduced the Elite car wash system in which no part of the equipment touches the surface of the vehicle.

An internally mounted



Elite touch-free car wash

manifold applies a presoak detergent foam bath that completely covers the vehicle's surface. This loosens the dirt and helps to reduce overall wash-time.

A high impact water spray then removes the dirt. Ultrasonics determine the correct positioning of the robotic pivoting wash manifold and wash spray arm to obtain optimum clearance from the sides of the vehicle during the high impact portion of the wash.

An optional rocker panel blaster is also offered, which directs concentrated water on to the underside and cill sections of the car.

A wheel blaster is also offered which cleans the whole tyre area as well as the wheel arches.

The system monitors its various equipment functions to reduce machine downtime.

Increasing well productivity

Two new perforator charges have been unveiled by Western Atlas Logging Services. The Predator™ Deep Penetrator charges are said to provide a 33 percent average increase in penetration compared with other charges on the market, resulting in up to 50 percent greater well productivity potential.

Meanwhile, the new Jumbo Jet® Big Hole perforating system provides an increased open-to-flow area through large casing entrance holes and spiral shot phasing. The additional reservoir exposure reduces sand production, thereby reducing well intervention costs and increasing reservoir producibility.

Contacts

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Draeger	01670 352891
Racal Survey	01344 388062
UK Sampling Gauges	01780 64477
Anderson Greenwood	0161 494 5363
Ryko International	01403 240364
Mobil Corporation	+1 703 846 2500
Ionics	0161 866 9337
Western Atlas	+1 713 789 9600

Institute News

NEW MEMBERS

Mr M K A Al-Jassar, Kuwait Petroleum (GB) Limited
Mr I A Awatai, Wembley
Mr J L Bahoshy, ME Consultancy Partnership
Captain A Banerji, India
Mr A J Best, Hemel Hempstead
Mrs P Brown, The Sumitomo Bank Limited
Miss C J Burton, Sawbridgeworth
Mr B Carnoy, Belgium
Mr W R Carpenter, Reading
Mr N Cherry, IBM UK Limited
Mr G N M Clare, GCL
Mr D L Coleman, Texas
Ms W M Collier, Arthur Andersen & Company
Mr B Coppersthaite, Manchester
Mr A Cuttall, Spectrum Energy & Information Tech Limited
Mr C Dolan, Coflexip Stena Offshore Limited
Mr J Echevarria, Castrol Espana SA
Mr V E Eromosele, Nigerian National Petroleum Corporation
Dr N L Evans, Caminus Energy Limited
Mr K Fletcher, Shetland
Mr B R Gillon, Leighton Contractors (Asia) Limited
Mr J G K Glass, Western Atlas International
Mr R Griffith, Robert Fleming Securities Limited
Mr I Hillier, Baker Hughes Inteq
Ms S Holroyd, Oakwood Environmental Limited
Mr H L Jones, Motor Trade Business Network
Mr L T Kalunga, Kalunga & Company
Mr G D Knowles, PanCanadian North Sea Limited
Mr N P Lloyd, Norfolk
Mr N Lowes, Woking
Mr B E Moss, Stanford-le-Hope
Mr N J Neville, London
Mr R J Newman, Great Missenden
Dr O Noreng, Norway
Mr B G Ogisi, Feldman International
Mr N Oshio, Jetro-London
Dr R J W Peters, West Lothian
Mr M Pickering, Arthur Andersen & Company
Mr A Roberts, Arthur Andersen & Company
Mr S Sahmat, Petronas Carigal (Vietnam)
Mr V Sathar, State of Qatar
Miss P A F Smith, Oakwood Environmental Limited
Mr Z Stefanovski, Reading
Miss S Stevenson, Stevenson Wheeler
Mr G Symeou, Manolis & Socratous
Mr P P Taylor, Rochford
Mr T Tester, Haywards Heath
Mr A G Wheeler, Stevenson Wheeler

STUDENTS

Ms S Braithwaite, Oxford,
Mr J G Frynas, University of St Andrews
Mr E K Mukoro, City University
Mr K N Nwosu, Dundee

STUDENT PRIZEWINNERS

Mr C C Opara, Centre for Petroleum & Mineral Law
Mr A Stickel, London
Mr S Archer, Aberdeen
Mr R J Haley, Marlow
Mr S C York, Cheltenham

DEATHS

We are sorry to announce the deaths of the following members:

	Born
Mr M S Fraser	1925
Mr R N Jackson	1940
Mr E G Jones	1923
Mr P Tymanowski	1950

AROUND THE BRANCHES

Aberdeen

10 December: *Atlantic Frontier Developments*, speaker from BP

Midlands

6 December: Christmas Social Evening

South Wales

11 December: *Refinery maintenance*, IEE and BP Joint meeting with the Institute of Electrical Engineering



Ms Beverley Ireland receiving the 1995/96 IP Student Prize from Mr Ian Ward, which she was awarded for attaining the highest marks on Petroleum Policy and Economics course and International Environmental Law and Policy at Dundee University



Ms Mirian Omalu receiving the 1994/95 IP Student Prize from Mr Ian Ward, which she was awarded for attaining marks of distinction in eight courses whilst on the LLM course in Resources Law and Policy at Dundee University

OBITUARY



Walter Clifford Greaves OBE, FInstPet, 1917-96

Walter, or Cliff, joined BP at Llandarcy in his native Wales in 1933. He had an expert knowledge of both the technical and commercial sides of the industry which later brought him to prominence in research as well as line management, moving to BP International Research Centre at Sunbury and then to senior positions in the Refineries Department at Head Office in London.

Systems analysis was beginning to move from the technical to the operating and planning functions of BP and Walter became the spearhead of this seminal change, first as Assistant General Manager of the pivotal Supply and Development Department and then in 1967 as General Manager of the new Central Planning Department. It is at that time that my own vivid memories of Walter were formed since I also transferred to Central Planning the same day — when the Arab-Israeli six-day war broke out, followed by the six-year closure of the Suez Canal. Walter was immediately put in charge of the entire crisis mechanisms of the BP Group and for the next few months his remarkable energy meant our feet did not touch the ground. For this *tour de force* he was awarded the OBE. However, the citation did not show that the demands he put on his team were always with a personal touch and a willingness to do away with protocol if anyone came up with a point of substance.

After a lifetime of service with BP, Walter as a family man and fervent supporter of London Welsh Rugby Club might well have followed the path of many colleagues and retired but that he did not is no surprise to those who knew him. He became Managing Director and then Chairman of Associated Octel and subsequently consultant to Czarnikow Schroder.

He still found time to be an active member of the Institute of Petroleum, organising many conferences on the development of oil into the world of commodity trading and futures. He was a committee member of the Energy Economics Group since its inception. His work for the IP was recognised by an Award of Council in 1987. The citation noted: 'Walter is 70 years young and still doing what he had always been interested in — analysing the market at the sharp end.'

This recognition extended to Walter's teaching and on-line training of this new direction of the industry. Alban Brindle, a former director of the International Petroleum Exchange, writes: 'Walter was an extremely active and energetic proponent of the use of futures for energy risk management right from the earliest days of the industry. He was closely involved in the formations committees for both the gas oil and Brent crude oil futures contracts listed at the IPE where his foresight and understanding was to prove invaluable to the eventual success of the contracts. Once the IPE was established, Walter was often called upon to contribute to the strategic planning process where his inventiveness and originality of thought could always be relied upon to provide a fresh approach.'

Paul Horsnell, Assistant Director of the Oxford Institute for Energy Studies, writes: 'Walter had a close association with the Oxford Institute for Energy Studies. He helped many young researchers with advice that was always direct and clarifying. His enthusiasm in discussion was unbounded and infectious, as was his commitment to the principle that it was essential to really understand the mechanics of each problem from a sound base. He had a strong commitment to the value of research and donated his very considerable library of books on oil and futures markets to the Institute's library.' Let it be a symbol that his inspiration remains.

Tony Scanlan

New members of staff

Conference Department

Ms Jane Hill has been appointed Conference Manager, with responsibility for scoping and devising programmes for conferences and other events. The Conference Department has recently been restructured, with Ms Pauline Ashby becoming Conference Administrator.

Library and Information Service

Miss Catherine Pope has been appointed Assistant Librarian. Mr Chris Baker has come as Senior Information Officer; he will work with Miss Raj Multani, who joined the Institute as Information Officer in July, and Mr Peter Rooney, who was appointed Information Assistant in October.

Technical Department

Mr Martin Hunnybun has been appointed Technical Officer.

Correction

We regret that an error occurred in last month's issue. The authors of the article on 'Elevated flare emissions measured by remote sensing' were JC Boden, BP Oil Technology Centre, K Tjessem, Statoil, and AG Wootton and JTM Moncrieff, Spectrasyne Ltd.

UK Deliveries into Consumption (tonnes)

Products	†Sep 1995	*Sep 1996	†Jan-Sep 1995	*Jan-Sep 1996	% Change
Naphtha/LDF	218,746	236,378	2,131,698	2,109,771	-1
ATF - Kerosene	727,555	748,494	5,755,698	6,060,971	5
Petrol	1,800,328	1,806,100	16,238,956	16,527,349	2
of which unleaded	1,161,488	1,230,037	10,208,291	11,107,122	9
of which Super unleaded	74,980	48,454	718,577	545,857	-24
Premium unleaded	1,086,508	1,181,583	9,489,714	10,561,265	11
Burning Oil	215,458	230,937	1,920,179	2,351,516	22
Derv Fuel	1,140,710	1,204,728	9,934,759	10,656,455	7
Gas/Diesel Oil	567,014	605,949	5,400,444	5,698,148	6
Fuel Oil	528,967	553,172	6,018,149	5,080,035	-16
Lubricating Oil	74,552	73,745	674,342	654,036	-3
Other Products	701,691	742,647	6,715,274	6,591,049	-2
Total above	5,975,021	6,202,150	54,789,499	55,729,330	2
Refinery Consumption	556,477	536,078	4,771,971	4,899,449	3
Total all products	6,531,498	6,738,228	59,561,470	60,628,779	2

† Revised with adjustments * preliminary



THE INSTITUTE
OF PETROLEUM

IP Week 1997 Conferences

Monday 17 February

Financing the International Oil Industry — the continuing challenge

A look at the ever-growing requirements and some current solutions for financing new developments and trade

Tuesday 18 February (morning)

The 10th Oil Price Seminar: Managing the short-term risk

The IP takes its annual look at developments in oil trading and exchange

Thursday 20 February

Achieving Competitiveness through Innovation and Value Engineering

How the lessons of the upstream can be applied to the downstream and beyond

For further information please contact:

Conference Department,
Institute of Petroleum
61 New Cavendish Street
London W1M 8AR UK
Tel: +44 171 467 7100
Fax: +44 171 255 1472



PETROLEUM
EXPLORATION
AND DEVELOPMENT
COURSES

OXFORD ENGLAND

from
THE COLLEGE OF PETROLEUM
AND ENERGY STUDIES

Exploration and Production Fundamentals – for the Non-Technical Professional

Code: EP10 24 – 28 February 1997

Exploration and Production Economics and Risk Analysis

Code: EP11 3 – 7 March 1997

Contracts with Governments, Customers and Suppliers – Managing Concessions, Agreements, Partnering and CRINE

Code: EP12 10 – 14 March 1997

Petroleum Reserves – Definitions, Assessment and Production Planning

Code: EP13 17 – 21 March 1997

Joint Interest Ventures in Oilfield Operations

Code: EP14 24 – 27 March 1997

Petroleum Negotiations Skills Workshop

Code: EP15 1 – 4 April 1997

Modern Oil and Gas Asset Management – Acreage, Reservoirs, Facilities and People

Code: EP16 7 – 11 April 1997

Oil and Gas Field Development Workshop

Code: EP17 14 – 18 April 1997

Exploration and Production – Financial Analysis, Business Processes and Performance Measurement

Code: EFA 28 April – 1 May 1997

Petroleum Exploration and Development, Planning and Economics Diploma

The exploration and production courses listed above are modules within the **Petroleum Exploration and Development, Planning and Economics Diploma** offered by The College, but may also be taken as individual training programmes.

For Further Information

Please Contact:

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Direct: (+44) 1865 260203

Fax: (+44) 1865 791474

e-mail: jenny@colpet.ac.uk

web: <http://www.colpet.ac.uk>

Consultants Handbook 1996-97

Members of the Institute of Petroleum offer consultancy services in a wide range of petroleum industry areas. Currently about 400 members offer 65 different categories of expertise.

A handbook of all consultants indexed by category is available from the Institute for £15.

- ▲ Additives Technology
- ▲ Allocation
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- ▲ Economics & Pricing
- ▲ Energy Efficiency
- ▲ Environment - General
- ▲ Environment - Marine Pollution
- ▲ Expert Witness Services
- ▲ Finance
- ▲ Fuels & Fuel Technology
- ▲ Gas
- ▲ Government & EC Relations
- ▲ Health & Hygiene
- ▲ Heat Transfer
- ▲ Human Resources
- ▲ Industrial Relations
- ▲ Information Services
- ▲ Information Technology
- ▲ Installation Security
- ▲ Laboratory & Test Method Advice
- ▲ Legal Advice
- ▲ Loss Prevention
- ▲ Loss Prevention - Marine
- ▲ Lubricant Technology
- ▲ Maintenance & Inspection
- ▲ Management Organisation
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- ▲ Marketing - Operations
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- ▲ Microbiology
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- ▲ Oilfield Chemicals
- ▲ Oilfield Development
- ▲ Oilfield Machinery & Equipment
- ▲ Oilfield Subsea Development
- ▲ Petrochemicals
- ▲ Pipeline Planning & Management
- ▲ Planning & Economics
- ▲ Plant Design
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- ▲ Production
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- ▲ Reliability
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- ▲ Risk Analysis - Financial
- ▲ Road Transport
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- ▲ Safety Critical Systems
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