PETROLEUM REVIEW

IP THE INSTITUTE OF PETROLEUM

February 1995

China
New accent on onshore exploration

Vapour recovery
Report from Brussels

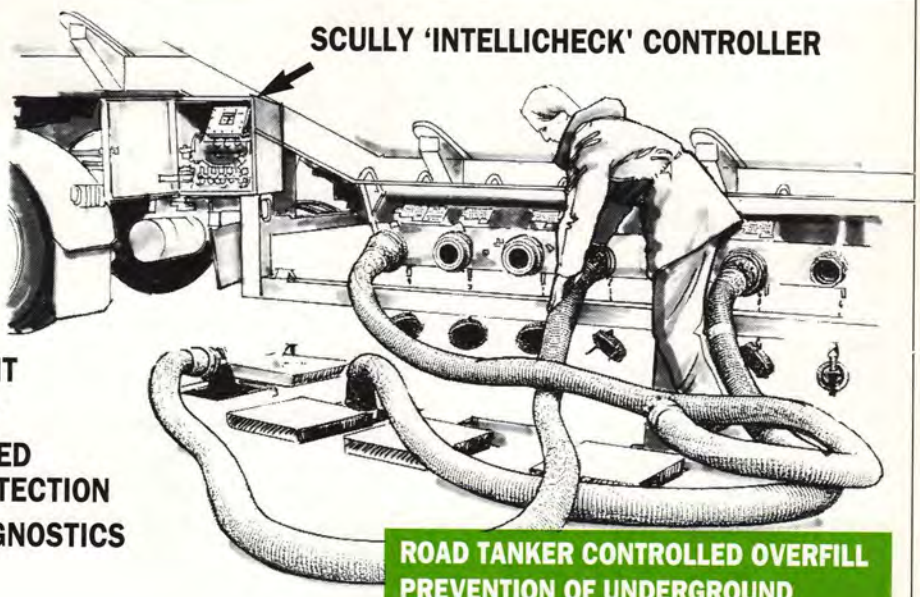
Coalbed methane
Make or break year for coalbed methane companies

Distribution
Logistics planning models for the downstream industry

DRIVER CONTROLLED DELIVERY SYSTEM WITH INTELLIGENCE

- SAFETY INTERLOCKS
- TRANSPARENT MONITORING
- UNAUTHORISED DELIVERY DETECTION
- REMOTE DIAGNOSTICS

SCULLY 'INTELLICHECK' CONTROLLER



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- RETAINED PRODUCT INDICATION
- VAPOUR RECOVERY INTERLOCK

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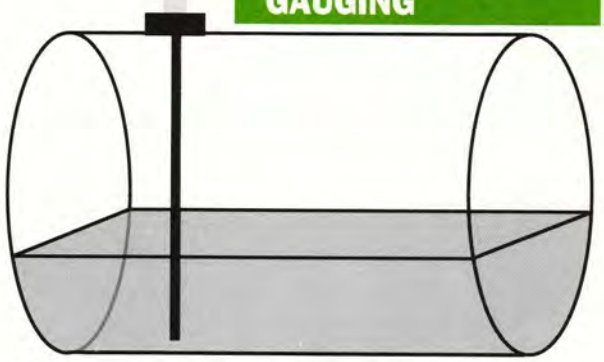
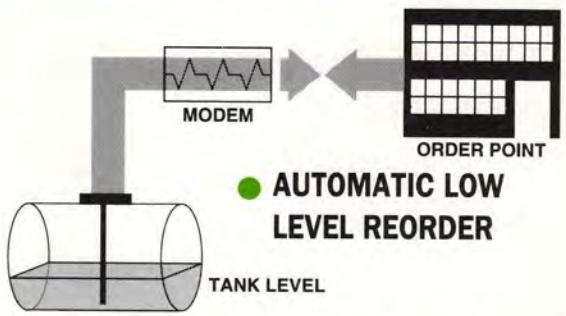


REMOTE MONITORING FACILITY



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COVER PHOTO
Seismic survey in northwest China

NEWS IN BRIEF

16 December
Britain appears to have won its battle to thwart attempts by the European Union to impose an EU-wide carbon energy tax. Environment Ministers agreed to allow member states the right to adopt their own individual approaches to meeting specific emission targets.

Stolt Comex has called off talks with McDermott International over a merger that would have created the world's largest oil and gas subsea engineering group. The breakdown, described by both sides as 'amicable', resulted from doubts over marketing strategy.

17 December
The European Energy Charter aimed at encouraging investment in the former Soviet Union has been signed by 46 nations.

19 December
The US accused Iran of breaking the Iraqi oil embargo and has threatened to take UN action to stop it, according to the *Middle East Economic Survey*.

British Gas and the Gas Authority of India have agreed to set up a gas supply joint venture company in Bombay. The plan is to connect over 600,000 customers to a new distribution network over a period of 12 years.

Trafalgar House launched a £1.2bn bid for Northern Electric. Northern Electric, in turn, rejected the bid as inadequate.

BP overtook BT to become the largest company by market capitalisation on the London Stock Exchange.

Stena announced that the $230m merger between subsidiary Stena Offshore and Coflexip was complete.

20 December
The £1.5bn Britannia gas field development was given the green light by UK Industry and Energy Minister, Tim Eggar. Kinetica later confirmed it has contracted for the largest share of gas.

Stena is to take over the management of Texaco's 17-strong international fleet. Under the new agreement, the two companies will also take joint responsibility for Texaco's international crude and product movements via a new joint venture firm, Stentex.

Elf has discovered new reserves on the Elgin field with the 22/30c-13 well drilled in the UK central North Sea.

Over $10bn is to be cut from the US Energy Department budget over the next five years, according to the White House.

21 December
Amoco is to increase its capital investment and exploration spending by 27 percent in 1995. This takes the 1994 figure of nearly $3.3bn up to $4.2bn this year.

John Brown has been awarded a contract by British Gas for the detailed design of the Armada export pipelines.

22 December
Shell has received the go-ahead from the UK government for its £262m Schooner gas field development in the southern North Sea. The entire output of the field will be sold directly into the UK domestic market.

Statoil is planning to lay a 900km, NKr9bn gas pipeline from the Norwegian North Sea to Dunkirk.

27 December
Chevron reported that its Angola unit discovered four new offshore oilfields during 1994, representing up to 300m recoverable barrels.

29 December
Dana Exploration's plans to exploit oil reserves in Western Siberia received a boost when the Russian Ministry of Economy confirmed the registration of YoganOil as operator of the South Vat-Yoganskoye field. Dana has a 50 percent stake in the company.

Helikopter Service has clinched a NKr90m deal with BP Norway to service the Ula and Gyda fields, together with the company's exploration drilling programme on the Norwegian Continental Shelf.

China's first single point mooring (SPM) oil terminal was officially opened by Vice Premier Zhou Jia Hua. The $23.5m project is a joint venture between Fortune Oil and Maoming Petrochemical Corporation.

30 December
A $1.5bn lawsuit has been filed against Texaco by a group of Peruvian Indians. The Indians claim that 20 years of drilling by the company have created an 'international toxic disaster'. A similar lawsuit was launched in 1993 against Texaco by a group of Ecuadorian Indians.

1 January 1995
Saudi Arabia almost doubled local petrol prices overnight and raised electricity charges for larger consumers in an attempt to cut down on energy consumption.

Storm damage forced a shutdown on Chevron's North Sea Alba field when electrical systems on the FSU were knocked out.

3 January
Denmark's fourth offshore licensing round attracted 17 bidders. Energy Minister Svend Auken said the response was 'particularly positive'.

100 workers were evacuated from Shell's Brent Delta platform in the North Sea after a leak was detected in the gas-processing module.

HMIP has served an enforcement notice under the Environmental Protection Act on Esso of Fawley, Hampshire, following an unauthorised discharge of bunker fuel oil into Southampton Water.

4 January
Permission to drill for oil in the grounds of Windsor Castle has been granted to Canuk Exploration. After a heated debate, Berkshire County Council voted to allow the exploratory well by nine votes to three.

Repsol has acquired Shell's 33 percent stake in two Egyptian production concessions in the Gulf of Suez.

Nigeria has signed an agreement to supply Benin, Togo and Ghana with natural gas. The deal, which is dependent upon the completion of a pipeline in 1998, could eventually be extended to include Cote d'Ivoire.

5 January
Schlumberger has formed a joint venture with Cable & Wireless to provide worldwide communications solutions for the oil and gas industry.

Pentex Oil joined the London stock market with a value of £22m.

A Shell UK road tanker transporting lubricating oil overturned on a Shetland-bound ferry, crushing nine cars. The accident took place during gale-force winds.

6 January
Two Bills which would bring to an end the 22-year-old ban on exports of Alaskan North Slope crude have been filed at the US Senate and the House of Representatives.

9 January
Exxon has finally signed a $40bn deal with Pertamina to develop the huge Natuna gas field in the South China Sea.

The Scottish drilling firm, Albion Drilling Services, was fined £1,000 at Dingwall Sheriff Court after breaching safety regulations. The fine followed an incident last year in which a 19lb boulder crashed into a hotel during a blasting exercise.

Creditors of the Aberdeen offshore company, Horne Subsea, have effectively wound up the debt-stricken company by refusing to allow the administrators an extra £15,000.

10 January
Premier Consolidated launched a £102m bid for rival explorer, Pict Petroleum. Amerada Hess has strongly backed the move, which would involve selling its 48.3 percent stake in the company to Premier.

Gulfstream Resources has announced that the North Dome field offshore Qatar contains over 800m barrels of estimated recoverable oil.

A delegation of councillors from Highland, Fife, Grampian, Clydebank and Tyneside met Industry Minister Charles Wardle to demand subsidies equal to those available in other European Union countries.

NEWS IN BRIEF

11 January
John Brown claimed to be the first western contractor to be awarded engineering licences in Russia. The licences were awarded by the Russian Technical Inspectorate, Gosgortekhnadzor.

Shell's $3bn joint venture with Montedison of Italy has won approval from the US Federal Trade Commission. The new company, which will be known as Montell Polyolefins, is set to become the world's largest polypropylene manufacturer. It is due to be launched in March.

Shell is to sell two of its explo- ration and production companies in Colombia because they 'no longer fit the company's worldwide portfolio'. Hocol and Homcol own extensive exploration acreage in the upper Magdalena valley and the central Llanos area.

12 January
Phillips Petroleum and Conoco have received governmental approval for the Alison gas field in the southern North Sea.

Statoil has awarded Aker Engineering a contract to assess possible development solutions for the Haltenbank region. A feasibility study, covering the Midgard, Smobukk and Smobukk Sor fields, must be completed by the end of March.

The United Nations has renewed sanctions against Iraq for at least another 60 days.

13 January
OPEC President Ida Bagus Sadjana has pledged to seek a solution which would allow Gabon to remain within the organisation. Gabon threatened to quit OPEC because it could no longer afford membership contributions.

A contract worth about NKr200m a year for maintenance and modification work on the Gullfaks field has been awarded by Statoil to Kvaerner Installasjon and Kvaerner Engineering.

Repsol has signed an exploration contract with YPFB to explore the so-called Secure block, in the lower Andes of Bolivia.

14 January
Shell has pulled out of the diesel wholesale market in Hungary. Officials said tax dodging by competitors had made honest business impossible.

15 January
Shell has signed a deal with Trinidad and Tobago for onshore exploration in north Trinidad's Caroni basin. The licence area covers 114,000 hectares.

The Gas Consumers' Council confirmed it was considering stripping British Gas of its charter mark, awarded under the Citizen's Charter for standards of service.

16 January
Demonstrators gathered outside Shell International's headquarters to demand that the company use its influence to halt the murder trial of Ogoni leader Ken Saro-Wiwa. They claim that Mr Saro-Wiwa, who led the Ogoni opposition against Shell's operations in Nigeria, has been falsely accused of murdering other Ogoni leaders by the Nigerian government.

Plans for a $40bn US-backed bailout package for Mexico would use future oil export revenues as collateral, according to government officials in Mexico City.

17 January
British Gas has discovered further significant reserves of gas offshore Tunisia in the Gulf of Gabes. The well, Hasdrubal-2, tested at 20m cu ft of gas and 1,400 barrels of condensate per day.

The merger between Britain's Offshore Contractors' Council and the Offshore Manufacturers' and Constructors' Association has been finalised.

18 January
Iraq's oil capacity is fully restored to pre-Gulf War levels, according to Oil Minister Safa Hadi Jawad, who also claimed that Iraq would become the world's second largest exporter of crude as soon as sanctions were lifted.

19 January
Six people were killed when a flash fire hit Mobil's Ubit offshore oil platform in Nigeria.

'A gallon of petrol and a crate of beer please'

Service stations across England and Wales could soon be selling alcohol, following the launch of a major battle against current licensing laws by the petrol retailing industry.

The Petrol Retailers' Association (PRA) is demanding a change in the Licensing Act of 1988, which actually bars filling stations from applying for an alcohol licence.

'Hypermarkets get a licence as a matter of course,' said PRA Director Bruce Petter, 'yet the petrol industry has a huge number of convenience stores collectively and convenience stores stock alcohol. We simply want equality under the law to apply like anybody else.'

The first stage of the campaign, which has the financial backing of Burmah, Elf and Conoco, concentrates on those petrol stations whose primary earnings come not from petrol sales but from their forecourt shops.

Four test cases have already been presented to local licensing justices across Britain. As *Petroleum Review* went to press, one case had been won and another lost. The PRA expected to win three out of the four cases.

All in all, the PRA hopes to win more than 50 such cases over the next few months, before widening its campaign to include all forecourt shops, irrespective of where their profit centres lie. This second stage, targeted for March, will involve a major political lobbying campaign and already has the support of several oil companies and the drinks industry.

The campaign does not cover Scotland, which already allows petrol stations to apply for alcohol licences.

The PRA rejects the argument that the sale of alcohol at forecourt shops could encourage drink-driving. 'People have this image of a driver holding a pump in one hand and a can of beer in the other yet there is absolutely no evidence that motorists behave in that way,' said Mr Petter.

A spokesman for the Association of Chief Police Officers said it was firmly opposed to any change in the law.

Could alcohol be sold here in the future?

Elf fined over Piper Bravo fire

Elf Enterprise Caledonia was fined £5,000 at Aberdeen Sheriff Court last month following a fire on the North Sea Piper Bravo installation last year.

The company pleaded guilty to two breaches of the Health and Safety at Work Act for failing to ensure, so far as was reasonably practicable, the safety of one of its own employees, and the safety of a contractor's employee.

The court heard that on March 18 last year the two men were draining hydrocarbon fluid from a seal pot using buckets. A fire began in on of the buckets and spread to the mens' clothing. Neither was hurt and the fire was rapidly extinguished.

The company admitted that the buckets had not been bonded to earth. Whilst it was the individuals involved who were responsible for the incident, Elf accepted that it had a duty to stop unsafe practices developing.

Helicopter in North Sea crash

As *Petroleum Review* went to press, investigations were underway after a Bristow *Tiger* helicopter was forced to land in the North Sea.

The craft was travelling to Marathon's Brae Alpha platform, when it appears to have been struck by lightning. All 18 on board were safely rescued.

Abandonment warning

British oil companies are being warned that they may have to disclose the total cost of abandoning North Sea platforms, under a new accounting standard.

Ernst & Young believes this could have a major effect on the balance sheets of some oil firms.

COSHH goes offshore

The Control of Substances Hazardous to Health Regulations (COSHH) now apply offshore as well as on.

The Regulations, which have also been updated to include the latest European Community requirements, should bring greater consistency between offshore and onshore practice.

Guidance on specific aspects of applying COSHH offshore has been prepared by the Health and Safety Executive, in consultation with the oil industry.

The new regulations also set new or revised Maximum Exposure Limits for nine substance groups.

National Power turns to Orimulsion

National Power is planning to burn Orimulsion at its Pembroke plant in Wales.

The power generation company has already applied to both the DTI and Her Majesty's Inspectorate of Pollution (HMIP) for permission to build flue gas desulphurisation (FGD) equipment, which must be in place if Orimulsion is to be burnt.

It is the latest example of the growing popularity of this cheap Venezuelan fuel, which is already burnt by Powergen at two other British stations – Richborough and Ince B.

In 1993, National Power decided against burning the fuel at Pembroke after HMIP insisted FGD technology had to be fitted first. A spokesman said the change of heart was due to the fact that FGD equipment has now been fitted by more power stations in Britain.

He also stressed that National Power intended to burn a range of emulsified hydrocarbon fuels at Pembroke, of which Orimulsion was only one.

Bitor Europe confirmed it is currently negotiating a major supply agreement with National Power for around 4 million tonnes of Orimulsion a year, subject to the necessary permits.

New Russian export ruling brings 'chaos'

Russia's decision to abolish oil export quotas and licences has brought chaos to the region and will do little to boost oil output, according to the Centre for Global Energy Studies (CGES).

The new ruling, which replaces export quotas for Russian companies with domestic quotas from the beginning of 1995, was issued in a decree from President Yeltsin himself last year.

However, the government's failure to clarify the situation has left the Russian oil industry in a state of confusion. 'The situation out there is one of total chaos,' said a CGES spokesman. 'No-one really knows what's happening.' A corresponding reduction in export tariffs from 30 ECUS to 21 ECUS per metric tonne has only added to the chaos, creating huge delays at customs.

Under the old system, export quotas averaged around 35 percent of output. Under the new system as it is understood at the moment, Russian producers are required to allocate 65 percent of their output to domestic refineries. It is therefore difficult to see how this change will have any real impact on exports.

Moreover, any rise in exports would be hampered by a lack of capacity, according to the CGES. Most of the country's export network of pipelines and ports is operating close to full stretch, with frequent accidents and loading delays at export terminals.

One exception to this is the Druzhba pipeline into Eastern Europe, which has not been fully utilised since the dissolution of the Soviet Union. However, the collapse of oil demand in the countries it served means that throughputs are unlikely to increase significantly in the next few years.

Europe's reluctance to increase its dependence upon Russian oil represents another bar to the country's export ambitions. 'It is not enough for Russia to simply extend the Druzhba pipeline further into Western Europe,' said the CGES spokesman, 'without also linking it to export ports.'

Not all sections of the Russian government are even in agreement over pushing for an immediate increase in crude oil exports. A debate has developed at governmental level in recent months, with some arguing that the funds invested upstream could be put to better use in the downstream sector in boosting the value added to Russia's oil resources and in rebuilding the domestic market.

Overall, the CGES concludes that Russian oil exports in 1995 will remain close to the levels of the previous two years. Overall, exports of oil from the former Soviet Union to Western markets have stabilised in recent years at a level slightly above 2million b/d.

Reduced role for Britain's standby vessels?

Britain's oil companies have almost certainly won their fight to change the law governing standby vessels.

According to industry sources, new regulations covering fire, explosion and emergency response offshore no longer place standby ships in such a central role.

Whereas the original draft of the regulations required each operator to provide a standby vessel 'unless equally or more effective arrangements are made', the final version apparently makes no reference to standby vessels at all.

Instead, in line with a more goal-setting approach, the Health and Safety Commission has changed the regulations so that they simply require 'effective arrangements for rescue and recovery'. Nevertheless, as industry sources point out, standby vessels are still mentioned in the Accompanying Code of Practice, which makes it clear that there are certain circumstances where only a standby vessel will do.

The alteration was made after strong lobbying from the oil companies, which argued that they should be allowed to apply risk assessment techniques to rescue and recovery in line with the Cullen Report and then choose the most cost-effective solution *(see Petroleum Review, October 1994)*. This could mean helicopter cover, for example.

The Standby Ship Operators' Association (SSOA), which spearheaded the campaign against any legal changes, has mixed feelings about the new regulations. 'It was about the best we could hope for,' said Chairman Jeremy Daniel. 'Indeed, the fact that there must now be "good prospects" for rescue and recovery actually strengthens the regulations.'

Whether the Prevention of Fire & Explosion and Emergency Response Regulations (PFEER), which are now with ministers, will actually reduce the number of standby vessels on the UK Continental Shelf remains to be seen. SSOA believes not, provided one crucial new phrase in the regulations is 'interpreted intelligently'.

'PFEER stipulates that rescue response times must be "reasonable". But does this mean 15 minutes, as we would advocate, or an hour?' said Mr Daniels.

The PFEER Regulations, which are unlikely to undergo further changes at ministerial level, are due out in May.

Agip refuses final Tiffany payment

AMEC and Agip have entered into delicate negotiations over the Tiffany oil rig contract, after Agip refused to make the final payment.

Agip's cash shortfall, estimated at around £50 million, is in protest at having to pay for alterations made at sea, according to industry sources.

The entire contract, which was for the construction of an oil rig for the North Sea Tiffany field, is estimated to be worth around £550 million.

An AMEC spokesman stressed that relations between the two companies were far from acrimonious and that both sides fully expected the situation to be resolved without resorting to the courts.

'A certain amount of wrangling is only to be expected on a project of this size' he told *Petroleum Review*.

The disagreement had not affected working relations, he added. 'AMEC has won work from Agip on entirely different projects since the real difficulties began.'

UK drilling forecasts rise again

The latest forecast for UK drilling levels in 1995 is higher than ever, despite fears that the removal of PRT relief would harm exploration rates.

Over 130 exploration and appraisal wells are due to be spudded in the course of this year, according to Arthur Andersen. This figure, which represents a rise of almost 20 percent on 1994 activity levels, is also significantly higher than the 100 wells predicted by Andersens just three months ago. *(See Petroleum Review, December 1994.)*

In sharp contrast, Norway, The Netherlands, Denmark, Germany and Ireland have barely left the starting box, according to the survey. Britain's European rivals have firm plans to drill just 37 wells between them.

Britain's fortunes will continue to look bright throughout the rest of the century, according to Arthur Andersen. The report predicts activity levels of 100-150 exploration and appraisal wells per annum for the next five or six years.

Most of the interest on the UK Continental Shelf will be centred on the central and southern North Sea next year. West of Shetlands will be another popular location – 20 wells are due to be drilled here during 1995.

Amerada Hess has announced that it will be involved in up to 12 of these wells. The company is planning both new exploration drilling and further appraisal of the Schiehallion and Clair fields, and the 'Solan' and 'Strathmore' discoveries in Quadrants 205 and 204.

Amoco adds to world's reserves

Amoco claims it added more energy reserves worldwide than it produced in 1994.

The majority of the reserves were added through successful exploration programmes off the coast of Trinidad, in the Gulf of Mexico, the North Sea and Colombia.

The company expects that, when final calculations are made this month, it will have an overall 1994 worldwide oil and gas production replacement rate of about 110 percent.

Amoco claims it also added substantial reserves through extension drilling, primarily in Canada, Egypt and Argentina, and through improved recovery techniques in Egypt and the United States.

Price shock at French pumps

French motorists saw prices at the pump rise by an average of 5.5 percent at the beginning of this year as the result of an increase in a consumer tax on petroleum products.

The French claim the double record of having the most taxed petrol in Europe (fiscal duties accounting for 82 percent of the retail price) and, in contrast, the cheapest 'ex-refinery' prices.

France's retailing association, Syndicat National des Distributeurs de Carburants (SNCD), estimates that a litre of unleaded petrol in France now costs FFr5.58/litre compared with FFr4.49/litre in the United Kingdom and FFr5.31/litre in Germany. By contrast, diesel has gone up by only four centimes/litre, taking the retail price to FFr3.84/litre.

The SNCD warns that the petrol increases are likely to lead to more and more consumers using supermarket outlets in order to obtain lower prices, resulting in the continued decline of France's service station network and shrinkage in the coverage of outlying districts.

New Years Honours

The Rt Hon. Tim Eggar MP, Minister for Industry and Energy, DTI

The Rt Hon. Tim Eggar MP

Sir Ronald Claus Hampel, Chief Executive, ICI

Sir John Royden Maddox, Editor, Nature

CW Beveridge CBE, Chief Executive, Scottish Enterprise

CP King CBE M Inst Pet, former Chairman, BP Europe

Mrs Christine Wheeler

D Edwards OBE, Managing Director, SLP Engineering

JH Markham OBE, General Manager, Surfactants Group, Albright and Wilson

MJ Vint OBE, Chairman, Buildings Energy Efficiency Confederation

Mrs CMK Wheeler OBE F Inst Pet, Chairman, CW Energy Tax Consultants

P Wildblood OBE, Chief Executive, International Petroleum Exchange

DG Kitts MBE, Head, Draughting Office, Kerr-McGee Oil UK

GE Ling MBE, District General Manager, Sheffield, British Gas

C Reid MBE, Board Member, Offshore Petroleum Industry Training Organisation

DJ Stanbury MBE, Chairman, Field Studies Council

Mr Peter Wildblood

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EEG Discussion Group — Joint meeting with BIEE

Arab-Israeli Rapprochement & Middle East Hydrocarbon Development – The Case for a Middle East Energy Charter

By Pierre Shammas, Chairman, APS Energy Group

Monday 13 February 1995, 17.45 at The Caledonian Club, 9 Halkin Street, London SW1

If you plan to attend please advise Mary Scanlan, BIEE 37 Woodville Gardens, Ealing London, W5 2LL Fax: 0181 566 7674

THE INSTITUTE OF PETROLEUM

London Branch – Environment Discussion Group Joint Meeting

Assessment and Clean-up of Hydrocarbon-Contaminated Soil and Groundwater

By Mr J Stevens, Groundwater Technology International

Tuesday 14 February 1995, 18.00 at the Institute of Petroleum

John Stevens will review techniques used in the assessment and clean-up of petroleum-contaminated soil and groundwater. Illustrated case studies will emphasise the importance of carrying out a detailed assessment of the risk posed by the site and, where necessary, the technologies available to remove this risk in a verifiable and cost-effective manner.

Tea and biscuits will be served at 17.15. Light refreshments will be available afterwards, kindly sponsored by Groundwater International.

Enquiries: Mrs E Walker, Hon Secretary, London Branch, Tel: 0926 404768 or Mr J M Wood at the Institute, Tel: 0171 467 7128

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EEG Discussion Group

Your Future in Their Hands? — using derivatives in upstream risk managment

By Philip Rand, Treasurer, Monument Oil & Gas plc and Ted Robson, Director, Global Swaps & Options Group, BZW

Monday 20 February 1995, 17.00 for 17.30 - 19.00 at the Institute of Petroleum

If you plan to attend, please advise Jenny Sandrock at the IP. Tel: 0171 467 7104 (direct line) Fax: 0171 255 1472

THE INSTITUTE OF PETROLEUM

EEG Discussion Group

Retailer Contracts — How do they Work?

By Dr Cristina Caffarra, Consultant, London Economics Ltd

Tuesday 21 March 1995, 17.00 for 17.30 - 19.00 at the Institute of Petroleum

If you plan to attend, please advise Jenny Sandrock at the IP. Tel: 0171 467 7104 (direct line) Fax: 0171 255 1472

Stage 1 Vapour Recovery Directive

By B Smithers, BP Oil Europe

Just before the end of last year the Stage 1 Directive was finally agreed and adopted by both the European Parliament and Council, almost four years to the day since the European Commission first issued its working document on gasoline emission controls.

The UK government, along with the other Member States, now has a year to transpose the Directive into national legislation. During this time the details of implementation will be established and these will be reported in *Petroleum Review* once finalised. The start of the implementation period, which has been split into three phases of three years each, will thus be at the beginning of 1996.

The purpose of the Directive is to control the emissions of motor gasoline in the supply chain from refinery finished product storage, through primary supply by road, rail or barge to distribution terminals, and up to and including offloading at service stations. Volatile products other than motor gasoline are not included in the scope of this Directive.

Vapour emission controls during the loading of sea-going vessels are not requirements in the current text. However, the Commission will probably propose amendments to include them in the first of its reports, which will be written every three years, on the implementation of the Directive.

The Directive defines the technical measures to be implemented, although alternatives can be adopted by a Member State (which then has to report to the other Member States and the Commission) if it can be demonstrated that they are as efficient as those mandated.

The phase during which a facility must install controls depends upon the greatest annual motor gasoline throughput over the previous three years and if this is in excess of defined limits. The exception is for newly built facilities, which must install controls irrespective of their throughput. The phasing periods and the throughput limits for each of the measures mandated and outlined below are shown in **Figure 1**.

Above-ground gasoline storage tanks

The requirements mandated for storage at a refinery or terminal are:

- Fixed roof tanks must either have their vapour spaces connected to a vapour recovery unit (VRU) or be fitted with internal floating roofs (IFRs).
- External floating roof (EFR) tanks must be fitted with secondary seals.

The seal systems for IFRs and EFRs must achieve vapour containment efficiencies of 90 percent and 95 percent respectively compared with a fixed roof tank of the same size fitted solely with pressure/vacuum (P/V) relief valves. Because measurements are both technically very difficult and costly, and this is a comparative efficiency with a theoretical tank, it is anticipated that emission calculation methods will be permitted to demonstrate that floating roof installations meet these requirements.

IFRs fitted into newly built tanks at sites at which a VRU is mandated must be fitted with secondary seals.

For tanks fitted with either an IFR or an EFR, the shell and roof must be painted in a colour with a radiant reflectance of 70 percent or more. Repainting may be undertaken as part of the normal routine maintenance, as long as it is within three years of the end of the phase in which tank emission controls were required. The need to paint tanks in very light colours may be waived if the tank is within a 'special landscape area' ie for the United Kingdom within Areas of Natural Beauty, the New Forest, the Broads and the National Parks.

Gasoline loading at terminals and refineries

Because the collection of vapours is less efficient when top rather than bottom loading, this latter method of loading road tankers will be mandated. However, only one bottom loading gantry need be available initially, all loading only having to be undertaken in this way at the end of the third phase.

Top loading of rail tankers will be retained although the loading arms will have to be modified to permit vapour collection. In addition, rail tankers will have to be modified to permit them to be depressurised prior to loading. European practice is to install a 4-inch self-sealing coupling next to the loading hatch for this purpose. Gantries will thus need a matching hose to permit the vapours released to be fed to the vapour collection system.

The emission limit for VRUs is 35 g/ m^3 as a one-hour average. For units installed before 1 January 1993 in the United Kingdom, the limit is relaxed to 50 g/m^3 until the end of the third phase. Compliance testing will be required on a regular basis. In addition, vapour collection systems will need to be inspected for leaks.

For terminals with gasoline throughputs less than 25,000 t/a, instead of a VRU it is permitted to install vapour balancing from the road loading gantries back to the storage tanks. The vapours must then be subsequently vapour balanced back

to the supply tanker during tank filling and returned to a terminal with a VRU. Where the supply mode to such a terminal is by rail, then the rail tankers used must be equipped with suitable pipework to permit vapour balancing operations.

Vapour balancing at service stations

Within the first phase, service stations are included which are located under living or working accommodation, irrespective of gasoline throughput.

Once installed the system must be functional and used for each offloading.

Phasing Periods and Site Throughput Limits

	Phase 1 1996-1998	Phase 2 1999-2001	Phase 3 2002-2004
Terminals Storage Controls	**> 50, 000 t/a**	**>25, 000 t/a**	**All Storage Tanks**
VRU + Bottom Road Loading	**>150, 000 t/a into Road, Rail, Barge**	**>25, 000 t/a into Road, Rail**	**> 10, 000 t/a into Road, Rail**
	One Road Gantry	**One Road Gantry**	**All Road Gantries**
Service Stations Vapour Balancing (Stage 1b)	**>1000 m^3/a + all sites under accomodation**	**>500 m^3/a**	**>100m^3/a**

Road tankers

Road tankers built after 1995 or existing tankers retrofitted for bottom loading have to be designed and operated so that residual vapours are retained after offloading, except for releases through P/V valves. Another exception is emissions during dipping which will be permitted indefinitely for existing tankers and those built up to the end of 1999.

Road tankers will have to be regularly tested for vapour tightness and their P/V valves inspected for correct functioning. The latter also applies to rail tankers and barges which load at terminals fitted with VRUs.

The terminal vapour collection and recovery system is permitted to generate a back pressure of 55 mbar at the tanker side of its vapour collection coupling. Thus the maximum number of loading arms which can be operated simultaneously, when this pressure is applied, without vapour loss through the tanker P/V valves must be identified and displayed on a plate on the tanker.

The location and sizing of the bottom loading and vapour collection couplers are given. These are in accord with the IP Code of Practice. In addition, the types of overfill detection systems and safety interlocks to be installed are specified.

Stage 2 debate continues

As debate continues between the oil companies and car manufacturers over the final responsibility for Stage 2 of the EC Vapour Recovery Directive, *Petroleum Review* talked to David Kerr, Engineering Manager for Wayne Autocourt, a supplier of vapour recovery pump technology in Europe and Scandinavia.

'The big issue in the whole debate,' said Mr Kerr, 'is who will be made to accept legal responsibility for vapour recovery and have to shoulder the inevitable cost that will go with it.

'Canisters fitted to customers' cars would seem to present the cheapest option but the onus would be on the large number of different car manufacturers to fit them across the board.

'Vapour recovery pump technology has now come a long way. Early prototypes were based on a balanced system, whereby bellows fitted to the nozzle formed an airtight seal when the nozzle was inserted into a car's petrol tank. The flow of petrol through the hose then displaced any vapours back into the pump and underground tank.'

These balanced system pumps, according to Mr Kerr, were heavier and slightly more cumbersome for the customer and the bellows, which were easily damaged, would not provide the guaranteed level of efficiency needed.

'The new Assist system pumps are much better – delivering well over 90 percent efficiency which will be required if the Directive becomes law. Fitted with a vacuum pump inside the unit, vapours are immediately sucked back into the pump as soon as the fuel starts flowing. The pumps are far more user friendly and appear little different to the customer than ones already used widely on the market.

'Assist pumps are proving extremely efficient in Europe and Scandinavia and we have already fitted out one site in the UK. If the UK industry takes its lead from Europe and oil companies are given Stage 2 responsibility, it is the Assist pump which will be introducing at our customer sites throughout the UK'.

The role of logistics planning models in the downstream industry

By T N Sear, Sear & Associates

In today's climate the customer differentiates between suppliers as much by price as by brand. Minimisation of total supply chain costs therefore remains a high priority for petroleum product marketing companies. This article describes key logistics planning decisions facing the marketing company. The role of Logistics Planning Models in supply chain optimisation and marketing strategy are indicated.

Logistics involves product acquisition and product transportation, finishing with delivery to the customer tank. Minimisation of the total cost of logistics is an important task which is best achieved using a logistics planning model. Planning models are particularly effective for medium- and long-range planning. They are also used for short-term planning where the transport infrastructure is fixed and product supply decisions dominate.

Logistical costs accrue as products pass from source to the customer's tank. The essential components of the logistics chain are:

a) Refineries – the ultimate sources of petroleum products. Product prices vary, within a fairly narrow band, between sources. Platts pricing is a cause of this transparency.
b) Distribution terminals – supplied in bulk from refineries by primary transport. e.g. pipeline, rail, ship.
c) Customers' premises – receiving delivery by secondary transport, usually a road tanker, loading at a distribution terminal.

Producing the required logistics plan is largely concerned with selecting the least-cost option from the large number of possible alternatives. A sharp focus on the key planning decisions, around which the planning model should be built, is an important ingredient of success.

Decision possibilities

In order to maximise opportunities for cost minimisation, it is essential to identify all the decision possibilities available. It is easy to ignore some possibilities and artificially restrict the scope for cost minimisation. The key decision areas, ranked in probable order of importance for the integrated refiner and marketer, are listed below. A good logistics planning model should provide clear and detailed answers to all of the questions posed:

1. What quantities should be (a) acquired from own refineries and (b) purchased from third parties?
At the outset the planner must be aware of the sources, products, relative prices and quantities available for the planning period. The quantities will be those *before* any exchange deals are made. Exchanges have the effect of reducing the net amount available at own refineries.

A refining and marketing company may be expected to source some of its supplies internally. But third-party sources may also be used, as must be the case for the non-refiner. Operational and practical difficulties can arise with purchases from third parties. Product prices are dependent upon the source, while source locations determine onward transportation costs.

2. Which product exchanges should be arranged?
An exchange sources product from a competitor. Exchanges are an important feature of today's industry. An exchange is defined in terms of the exchange locations, products, quantities and timescale. There may also be a cash transfer between the parties.

As a simple example, Company A may agree a tonne-for-tonne exchange with Company B. For Company A the effect is to reduce its net product availability at one of its locations in return for a corresponding gain at one of Company B's locations. Both companies acquire product nearer to their respective customers and consequently make transport cost savings. The cost advantage to A may be partially offset by a reduction in sales margins because B now has greater market accessibility, and vice versa.

Exchanges can be complex in their structure, however, as can be seen by extending the above example. Company A, having obtained product under exchange with B, could use that product to make a further exchange with Company C. Compound exchanges greatly multiply the number of possibilities open to the planner seeking to gain maximum advantage. It is not surprising that exchange opportunities are easily missed.

The identification of all potentially beneficial exchanges requires a systematic approach and invites a degree of lateral thinking. Accurate economic evaluation of exchanges requires a logistics planning model of the whole logistics network. The model will determine the opti-

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mum level of a proposed exchange and simultaneously calculate its financial benefit. Additionally, skilful use of the model will greatly facilitate the search for exchange possibilities. Attractive options may be revealed which otherwise would go undetected.

3. Which primary transport routes should be used?
The fact that distribution terminals can often receive products from more than one source adds a further complication to the jigsaw. Two questions arise: *which* existing routes should be used and *how much* of each product should flow along each route? These questions are normally answered by the planning model, not prejudged.

There may be benefits in using new routes, or using existing routes to a much greater extent. Examples of new routes are the adoption of military pipelines for civil use. Some options may require capital expenditure. As an example, a pipeline built to deliver crude oil to a UK refinery was modified for reverse flow enabling the removal of products from the refinery.

4. Which distribution terminals should be used?
Distribution terminal decisions can be classified:

Continuance of use – which terminals should continue in use and at what levels of throughput?

Discontinuance of use – which terminals should be closed?

New use – where should new terminals be built ? Which competitor terminals could beneficially be used in return for payment ?

5. Where should the boundaries of distribution terminals be located?
What are the exact locations of the boundaries within which each terminal's vehicles should operate?

Practical aspects

Logistics optimisation requires active use of a purpose-built computer model. The wide range of interlocking decisions (above) present many options which the computer must sift to find the least-cost solution. Also, in a dynamic commercial environment, opportunities require speedy and accurate evaluation as they arise, making the use of computers essential. It is possible to construct special purpose software, running on a powerful PC, that enables the planner to keep on top of the task. An application in Europe by one of the major companies has recently facilitated logistics savings of £20 million per annum.

A planning model does not replace the decision maker but it does make him much more effective. The number-crunching is left to the model, freeing him to use his time more productively – negotiating product supplies, product exchanges and examining possible infrastructure modifications etc. Marginal-cost information produced by the model is invaluable in guiding decisions. Marginal costs point to purchase agreements and exchange deals which should be extended or reduced. Cost bottlenecks in the supply chain are also highlighted.

Planning models have proved invaluable in the guidance of logistics chain restructuring. Recent years have seen all components of the chain affected, particularly distribution terminals. The practice of companies sharing terminals has become commonplace in order to reduce fixed costs. Many terminals have closed. The boundaries of those remaining have been redrawn, enabling significant manpower reductions. One small comfort when faced with tough restructuring decisions is that successful implementation is always visible, unlike the less tangible areas of management control.

Key marketing information

The previous section focused on minimising the cost of logistics to meet a company's existing customer demand. The achievement of this goal is of obvious benefit to corporate profitability. But logistics planning models can provide information which is invaluable for guiding the selling effort. Within the commercial market, detailed average delivery cost information for individual customer sites provides a basis for estimating profit when combined with standard price and rebate information. Detailed marginal delivery cost information provides a basis for estimating 'contribution to profit'. Using this information can be expected to have a gradual impact on regional market shares as the company's trade locates towards more profitable customers and loss-making customers are lost when offered unattractive rebates. In the retail market, cost information of the type described is an essential requirement when constructing the offer to dealers and when assessing site acquisition capital cases.

An extension of the argument applies when building a marketing plan from first principles. New market entry requires this. So does the company contemplating complete or partial withdrawal from part of a market where it already has a widespread presence. In such a case the complete 'marketing mix' is open to challenge:

Where should we market?

What products should we market?

What proceeds (price) will we obtain?

The logistics optimising model provides essential cost information enabling financial viability to be estimated in advance of taking the plunge.

Finally, rigorous competitor analysis can be greatly assisted with a logistics planning model. The model must be tailored to represent the competitor's logistics chain, which is, by and large, visible. Visibility enables it to be modelled. Estimates of demand and cost data, as previously indicated, are needed. A useful insight into the competitor's average and marginal costs, in locational detail, is the result.

Acknowledgement

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Procedures for the quantitative analysis of polycyclic aromatic hydrocarbons

By Philip Shore, Senior Applications Chemist, Lubrizol and Chairman of IP ST-G-10

Polycyclic aromatic hydrocarbons (PCAs) are of concern because some are known to be carcinogenic in tests on laboratory animals. They are found in trace levels in the combustion products of many hydrocarbon fuels; for example they are emitted from coal-fired burners, wood stoves even the burning of garden waste. They are also emitted by internal combustion engines operating with either spark-ignition (ie gasoline engines) or compression ignition (ie diesel engines). Typical emission levels of the most biologically active species are often less than one gram every million miles, so the procedures required for the quantitative collection and analysis of PCAs must be very sensitive and able to determine the PCAs in the presence of much greater levels of other types of hydrocarbons. Fortunately, appropriate analytical techniques are available, and the Institute of Petroleum's ST-G-10 panel has undertaken work to identify the suitability of a number of techniques both in terms of sensitivity and reproducibility, specifically in the analysis of PCAs in the particulate emitted by diesel engines.

Description of round robins

Three round robin experiments were undertaken, and are summarised in **Table 1**.

The philosophy behind the selection of samples for the round robins was as follows:

In the first round robin, identical portions of a solution of PCAs in acetonitrile were sent to each participant. Each laboratory analysed the solution as though it were a diesel particulate extract. Since the concentrations of PCAs in the solution were certified by the National Institute of Standards and Technology (NIST) in the United States, a round robin of this type allowed the accuracy of each laboratory to be assessed. Ideally, the solution would also represent a very 'easy' sample, since it contained moderately high levels of every PCA on the US EPA Priority Pollutant List with no potentially interfering compounds.

The second round robin moved on a stage from the first, in as much as a real extract of diesel particulate was involved. However, in order to reduce variability as a result of different calibration solutions being used in each laboratory, a certified solution of PCAs in acetonitrile was included in the second round robin for calibration purposes. The particulate extract was prepared in toluene from the bulk extraction of several particulate samples, consequently each laboratory received identical portions of a single combined sample. However, the 'true' concentration of PCAs in this particulate was not known.

Finally, the third round robin was essentially identical to the second, except that the particulate extract was prepared from a sample of particulate with certified values of some PCAs from the US NIST. As in the second round robin, the extract was prepared by one laboratory which then distributed identical portions to each participant to be analysed as an 'unknown'.

Thus, these round robins were designed to show both the accuracy and variability of PCA analysis in the participants' laboratories. By using only solvent extracts, the round robins specifically excluded variability arising from the collection of particulate, the extraction of PCAs into an organic solvent, and the preliminary stages of sample preparation including rotary evaporation. Any error or variability would, therefore, arise only from the handling and purification of the extract, the analysis of the extract and subsequent quantitation of the PCAs.

Each laboratory was allowed to use its own favoured procedure in all round robins but all analytical details were reported so that the causes of any systematic effects and variability could potentially be identified. Sample chromatograms were also supplied to a central laboratory to allow evaluation of analytical quality to be undertaken. In particular, in the third round robin, where statistical analysis was carried out, poor results were rejected both in terms of statistical and chromatographic considerations.

Table 1
Summary of PCA Round Robins

	No. of Labs	*Description of samples*
First	17	Diluted solution of PCAs, certified reference material obtained from US NIST to be analysed as an 'unknown'.
Second	13	Two samples; one portion of certified reference material (as in first round robin), to be used for calibration one portion of toluene extract of diesel particulate to be analysed as an 'unknown'.
Third	16	Two samples one portion of certified reference material (as in first and second round robins), to be used for calibration; one portion of toluene extract of particulate sample supplied by NIST with certified PCA levels to be analysed as an 'unknown'.

Results

First round robin

Seventeen sets of results were submitted in the first round robin although only 16 laboratories were involved, one participant providing results by two

different procedures. Eleven sets of results were obtained using high performance liquid chromatography with fluorescence detection (HPLC/fluorescence), and three sets of data were each provided using gas chromatography with flame ionisation detection (GC/FID) and gas chromatography with mass spectrometric detection (GC/MS). Sixteen PCAs were present in the sample but only two compounds (fluoranthene and pyrene) were analysed by all participants. Most PCAs were analysed by 10-15 laboratories but for three of the 16 compounds only four to six laboratories provided results. In some instances, results were reported as co-elutions and are not reported here.

Detailed statistical analysis of the data was not undertaken. However, it was clear that results from a small number of laboratories were grossly in error. Since the true concentration of each PCA in the solution was known, it was generally possible to select a 'sub-set' of laboratories which achieved data within a reasonable range of the true values.

Table 2
Summary of Results from First ST-G-10 PCA Round Robin
microgram/millilitre

Compound	No of labs Sub.	Total	Mean of subset	SD of subset*	TRUE VALUE	% diff.*
Naphthalene	5	9	0.3610	0.0705	0.4554	20.7
Acenaphthylene	3	4	0.3077	0.0090	0.3714	17.2
Acenaphthene	3	6	0.4677	0.0488	0.4575	2.2
Fluorene	3	6	0.1165	0.0208	0.1102	5.7
Phenanthrene	7	10	0.0856	0.0256	0.0805	6.4
Anthracene	6	10	0.0211	0.0065	0.0172	22.5
Fluoranthene	12	17	0.1771	0.0392	0.1785	0.8
Pyrene	10	17	0.1927	0.0434	0.1927	0.0
Benz(a)anthracene	11	15	0.0882	0.0133	0.0906	2.6
Chrysene	8	16	0.0866	0.0160	0.0849	2.0
Benzo(b)fluoranthene	9	14	0.0940	0.0132	0.0957	1.8
Benzo(k)fluoranthene	10	14	0.1036	0.0179	0.1081	4.2
Benzo(a)pyrene	11	15	0.1176	0.0185	0.1132	3.9
Dibenz(a,h)anthracene	10	15	0.0757	0.0084	0.0837	9.5
Benzo(g,h,i)perylene	10	15	0.0923	0.0195	0.0865	6.7
Indeno(1,2,3-cd)pyrene	9	14	0.0893	0.0096	0.1005	11.1

*SD - standard deviation
*% diff - difference between true value and mean result of subset

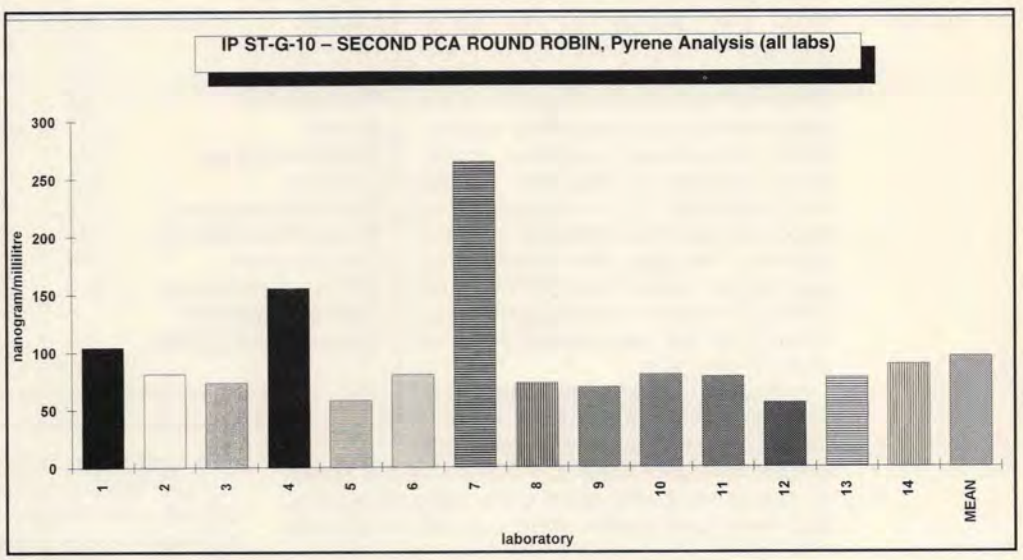
A summary of the 'sub-set' of data is shown in **Table 2**. This shows that typically one-third of results were excluded in order to achieve a relatively satisfactory set of data and that within the remaining two-thirds the mean value was within 5 percent of the true value for most compounds but only within 20 percent for a small number of species. The variation in the quality of data from one PCA to another may indicate that the analytical conditions used by various laboratories were optimised for some PCAs at the expense of others. There was no clear benefit associated with any of the three analytical procedures used; for example many of the results closest to the true values were obtained by HPLC/fluorescence but so was the single set of results furthest from the correct values.

Second round robin

The second and third round robins involved the analysis of extracts in toluene of real diesel particulate but in order to reduce variability, all participants used the same standard reference material for calibration. In the second round robin, the true concentrations of PCAs in the extract were not known, so it was possible to study variability but not accuracy. Thirteen sets of results were provided. The measured concentrations of the PCAs were typically at the picogram per microlitre level which is representative of particulate samples from modern diesel engines. This means that for a typical injection volume of 10 - 20 microlitres, detection limits of a few picograms would be required for some components. Consequently, several laboratories had difficulty in detecting some compounds, even when using HPLC/fluorescence. However, this was not a fundamental problem with this technique as other laboratories were able to detect these levels with relative ease. One laboratory used HPLC with ultra-violet detection, but this yielded unusually high results, almost certainly indicating that it was seriously affected by interferences. Similarly, no laboratory used GC/FID because of its inadequate sensitivity and selectivity.

As with the first round robin, it was possible to identify a 'sub-set' of laboratories which generated broadly similar results. This is summarised in **Table 3.** Generally, the standard deviation expressed as a percentage of the mean result was between 30 percent and 60 percent which is rather disappointing,

Figure 1



although perhaps not surprising in view of the complex material under analysis and the low levels of PCAs.

As an example of the data obtained, **Figure 1** shows the supplied results for pyrene.

Table 3
Summary of Results from Second ST-G-10 PCA Round Robin
microgram/millilitre

Compound	No of labs Sub.	Total	Mean of subset	SD of subset*
Naphthalene	4	5	0.026	74%
Acenaphthylene	4	4	0.014	129%
Acenaphthene	3	4	0.008	62%
Fluorene	7	7	0.012	72%
Phenanthrene	9	10	0.146	33%
Anthracene	10	11	0.008	106%
Fluoranthene	12	13	0.056	35%
Pyrene	12	13	0.083	32%
Benz(a)anthracene	11	12	0.016	69%
Chrysene	10	12	0.022	26%
Benzo(b)fluoranthene	12	13	0.006	49%
Benzo(k)fluoranthene	9	12	0.002	34%
Benzo(a)pyrene	10	12	0.004	40%
Dibenz(a,h)anthracene	4	6	0.002	97%
Benzo(g,h,i)perylene	8	9	0.006	35%
Indeno(1,2,3-cd)pyrene	6	8	0.008	68%

*SD - standard deviation expressed as a percentage of the mean

Third round robin

In the third round robin, the same general procedure was used as in the second round robin except that the toluene extract was prepared from a certified material (US NIST Standard Diesel Particulate, SRM 1650), in which five PCAs were completely certified. However, there was evidence that the extraction procedure was not entirely effective, so 'true' values were not considered reliable.

A thorough analysis of the results was undertaken at TNO in the Netherlands. Before statistical evaluation, the quality of the chromatograms was assessed by an independent expert chromatographer. Some of the chromatograms were considered to be completely unsatisfactory (inadequate resolution, inadequate signal/noise ratio etc) and the corresponding PCA concentrations were consequently removed from the data set. The data also strongly supported the view that GC/FID and HPLC/UV were inadequate techniques for the analysis of PCAs in diesel particulate.

Statistical evaluation to identify and reject outlying values resulted in a further reduction in the data set which is summarised in **Table 4**. Variances in this subset of results were still often quite large, indicating that some participants were not able to identify and quantify the PCAs with sufficient accuracy.

In this, as in all round robins conducted so far, each laboratory used its own in-house method. The schematic diagram of these methods (**Figures 2 and 3**) reveals a large variation in purification and analysis procedures. Because of this and the fact that each laboratory provided only a single result for each PCA, it is impossible to make definitive conclusions about the suitability of methods for the analysis of PCAs. Intralaboratory variance, due to poor performance within a laboratory, and inherent method variance are indistinguishable and it is difficult to identify causes of systematic effects and variability.

Conclusions

Some participants in the round robins were able to detect key PCAs at low picogram per microlitre levels in extracts of diesel particulate. Both GC/MS and HPLC/fluorescence were appropriate techniques, although the data strongly suggest that GC/FID and HPLC/UV are inadequate techniques for the analysis of PCAs in diesel particulate.

Even amongst those laboratories using GC/MS and HPLC/fluorescence some results were inadequate, and examination of chromatograms indicated that this was often due to poor quality peaks sometimes arising from an insufficiently sensitive detection system. In the view of an independent chromatographer who examined the chromatograms from the third round robin, HPLC/fluorescence may be the most adequate method for all 16 PCAs, although difficulties can be experienced in the analysis of several compounds, especially those eluting at the very beginning and at the very end of the chromatogram. For the early-eluting compounds in particular, GC/MS with an internal standard appears to be the most reliable procedure.

Table 4
Summary of Results from Third ST-G-10 PCA Round Robin
microgram/millilitre

Compound	No of labs Sub.	Total	Mean of subset	SD of subset*
Naphthalene	5	6	0.163	56%
Acenaphthylene	3	4	0.022	96%
Acenaphthene	4	4	0.082	139%
Fluorene	5	5	0.030	93%
Phenanthrene	12	12	0.176	84%
Anthracene	9	12	0.012	79%
Fluoranthene	14	17	0.114	35%
Pyrene	15	16	0.091	43%
Benz(a)anthracene	13	17	0.023	42%
Chrysene	11	14	0.052	55%
Benzo(b)fluoranthene	12	16	0.016	36%
Benzo(k)fluoranthene	12	16	0.006	42%
Benzo(a)pyrene	14	17	0.004	68%
Dibenz(a,h)anthracene	6	11	0.002	58%
Benzo(g,h,i)perylene	8	16	0.011	21%
Indeno(1,2,3-cd)pyrene	6	11	0.011	13%

*SD - standard deviation expressed as a percentage of the mean

In both the second and third round robins, subsets of the participants could be identified where the standard deviation of the results was about 30-60 percent for each PCA. Whilst this level of variability is relatively poor, it must be remembered that the analysis is not an easy one, since it involves the determination of very small amounts of PCAs in the presence of large amounts of other compounds. Consequently, it is considered that the results provide an encouraging starting position from which to develop improved industry standard procedures. However, in order to have more robust methods, it will be essential for laboratories to examine their procedures carefully and to critically assess critically all peaks in each chromatogram. Also, optimised conditions should be proposed by the ST-G-10 Steering Group for any future round robins, (eg for HPLC methods - the specification of appropriate fluorescence conditions), and each laboratory will be required to provide at least two sets of results for each sample to help identify intralaboratory variability.

Further work on PCAs is not planned by ST-G-10 in the immediate future but will be undertaken later this year.

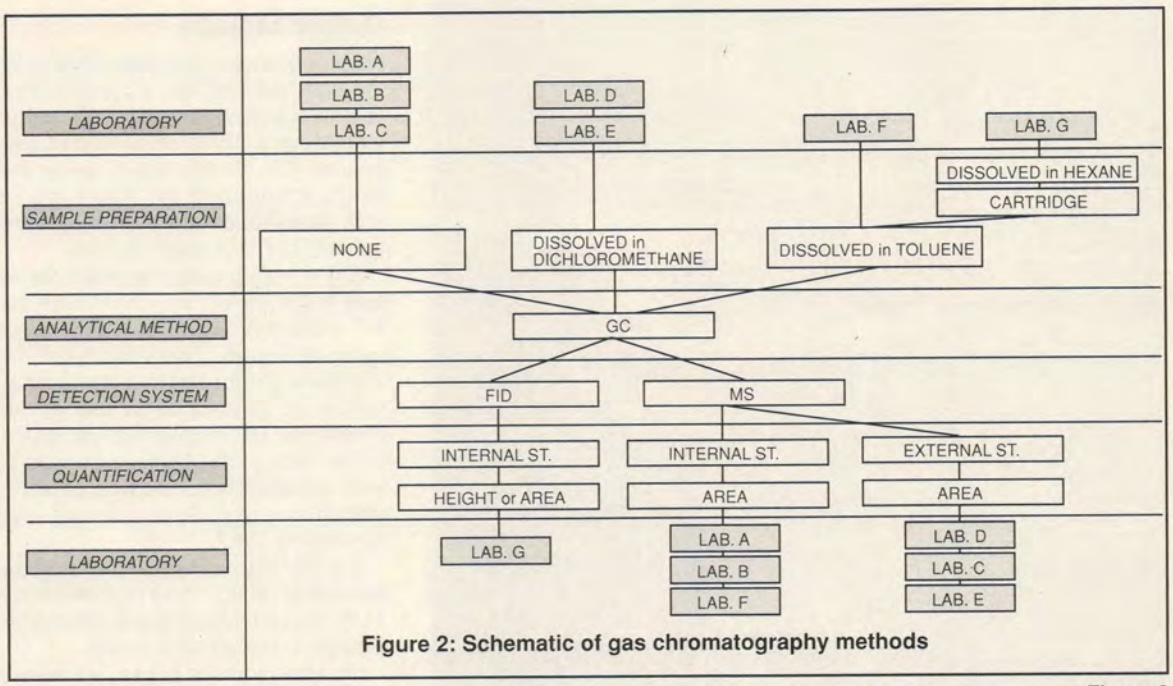


Figure 2: Schematic of gas chromatography methods

Figure 2

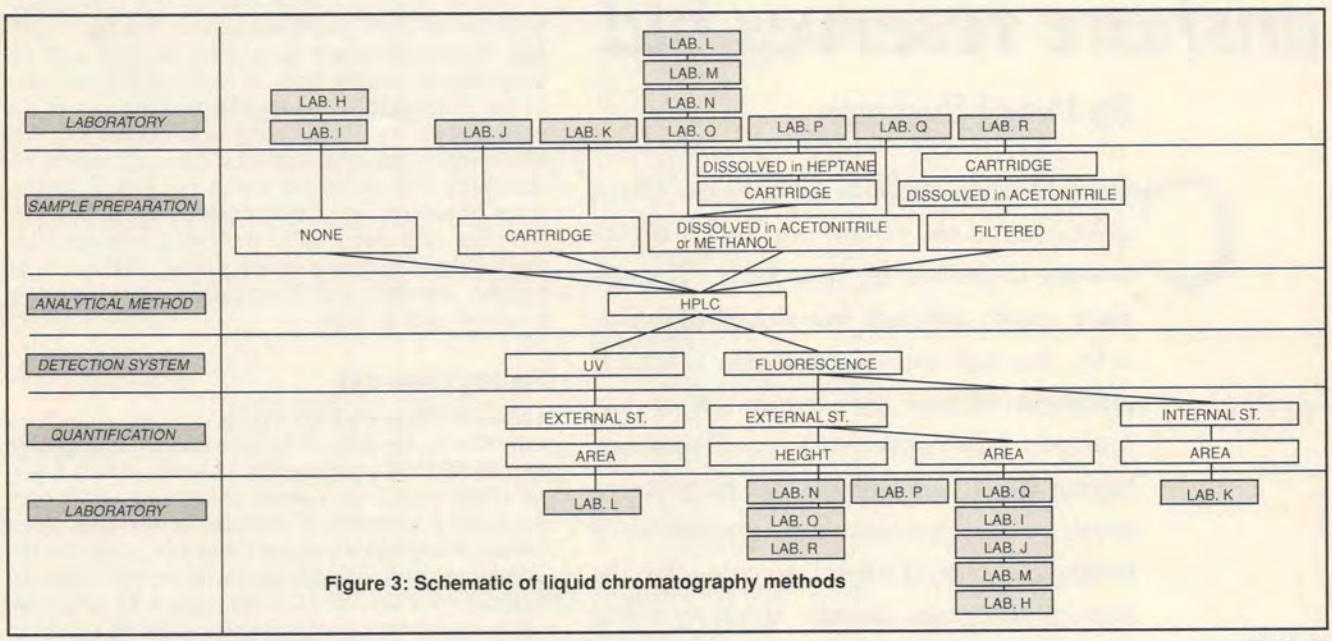


Figure 3: Schematic of liquid chromatography methods

Figure 3

Acknowledgements

Participants in one or more round robins were AVL, BP (UK and Germany), Esso, Euron, Technical University of Darmstadt, IFP, KHD, Neste, PSA, Renault, Ricardo, Shell, Warren Spring Laboratory, TNO and Total.

All of the participants made a valuable contribution towards the development of improved methods for the analysis of PCAs in diesel particulate. The huge amount of work undertaken by Peter Tritthart of AVL and Diane Hall of BP as Chairman and Secretary respectively of the Organic Sub-Group of ST-G-10 is acknowledged. Finally, the efforts of Carl Jemma of Ricardo in organising the first and second round robins and Carola Heeremans and Wim Oussoren for organising the third round robin and performing the analysis of data are greatly appreciated.

China makes new onshore reserves bid

By David Buckman

Concerned about declining oil reserves, China is looking to the remote northwest of the country to provide big new fields. The offshore sector, although still viewed optimistically, has not met expectations. China is pushing to increase the contribution of natural gas. Not many years ago China was hoping that its under-exploited oil reserves would for the foreseeable future provide a valuable source of export revenue. By the start of the present decade, however, it had become apparent that output projections would have to be scaled down. The published goal for 1995 was trimmed to only 2.9 million b/d, the ambitious plan for 4 million b/d by 2000 was scrapped and in its place forecasters put a tentative 3.5 million b/d.

Output plateau

China's problem was that major established fields in the east had reached a production plateau or were tailing off. Plummeting well productivity and an increasing water level were particular problems. To counter the decline the Chinese drilled many infill wells, introduced advanced recovery techniques and developed satellite fields – costly measures, unlikely to make much impact.

China was paying the price for too-rapid expansion in the 1970s. By 1976 crude output was almost 1.7 million b/d, sufficient for domestic needs with some for export. Two years later production topped 2 million b/d for the first time and China envisaged sustaining its position as one of the world's major producers. The momentum established by a number of big finds in the 1960s and early 1970s continued well into the 1980s. Between 1983-87 crude output growth was over 5 percent/year, reaching 2.68 million b/d by 1987.

But the big new finds and continued growth did not follow. Since 1988 output has largely stagnated. At the current rate of production proved reserves are enough to last about 22 years.

Chinese planners began to realise that the country – with an economic growth of 10-12 percent /year – by the mid-1990s could be a net importer again. Latest figures suggest this crucial stage has been reached. Output for 1994 is projected at 2.96 million b/d with demand at 3.25 million b/d and imports sharply up. Total output in 1995 is put at about 3.03 million b/d, with demand as high as 3.46 million b/d.

Both on land and at sea much will depend on the input of overseas oil companies, fund managers and technical experts. At the time of the Communist takeover in 1949, crude output was less than 3,500 b/d. The breakthrough came a decade later with the discovery of Daqing field, in Heilongjiang province in the northeast, development fanning out in the early 1960s. By 1963 output was almost 137,000 b/d, meeting much of domestic demand, which traditionally had relied on Soviet imports. A further surge of success arose with exploitation of fields on the edge of Bohai Gulf in the mid-1960s. In 1964 Shengli and Dagang were found, followed by Liaohe, Huabei and Zhongyuan, all prompting hopes of rapid growth.

Policy reversal

Offshore China realised that it must go abroad for expertise to develop a huge, virtually unexplored area swiftly and competently. This would be a reversal of the largely go-it-alone philosophy of the past. According to James P Dorian, of the East-West Center, Honolulu, there have been six stages in the development of co-operation with foreign agencies offshore. The first, in 1979-80, called for geophysical reconnaissance surveys over 420,000 sq km in the South China Sea and southern Yellow Sea. Up to 1982 a second stage saw five contracts signed with overseas companies covering blocks in the Bohai Gulf and Beibu Gulf areas and Yinggehai Basin.

A key development during the 1982-84 third stage was the issue of Regulations on the Exploitation of Offshore Petroleum Resources in Co-operation with Foreign Enterprises and other decrees, and the awarding of 19 search contracts under the first

licence round. The second round began late in 1984, resulting in nine contracts, followed by five more plus a geophysical prospecting deal in 1986. This fourth stage lasted until 1989.

The fifth stage of offshore development saw China in the early months of 1989 completing its third offshore bidding round. China National Offshore Oil Corporation (CNOOC) and the Finance Ministry provided flexible negotiations and royalties to encourage firms to bid for the seven blocks offered in the Pearl River Mouth Basin.

Finally, the sixth stage, in 1992-93, began when the fourth bidding round opened in June 1992. This time the stage opened two areas in the East China Sea for inclusion, limited prospecting by the Chinese having produced encouraging results. The two areas opened for exploration were 18,800 sq km, 230 km east of Shanghai, and 54,000 sq km, 110 km east of Wenzhou in Zhejiang Province. Financial terms were improved over earlier rounds for the East China Sea. The 18 contracts that resulted from this round covered investments totalling at least $300 million.

China now appears to be taking a more empirical view of its offshore future. In March 1994 CNOOC President Wang Yan said that Beijing would decide additional joint ventures through negotiation and had no intention of staging a fifth offshore licence round.

Offshore successes

By 1988, almost a decade after foreign interests were encouraged to take a look offshore, China had two fields on stream there, Chebei and Wei 10-3, yielding a mere 13,130 b/d of oil. However, seven more were due to be tapped by end-1992 and since then other discoveries have been declared commercial. The East China Sea has not proved as rewarding a prospect as initially hoped but Texaco is one firm that remains confident. Texaco senior vice-president Peter Bijur lately named it as a target area, along with the more established Bohai Basin, his company with partners having identified at least 16 prospects in the East China Sea with potential reserves of several billion barrels.

A handful of offshore fields will help lift output in the next few years. CNOOC's marine production figure for 1994 was 130,000 b/d.

The latest field on stream in the South China Sea is Phillips Petroleum's Xijiang 24-3, which started up in November. Initial production was 20,000 b/d, with a peak of just over 65,000 b/d expected within two years when a second reservoir comes on stream. Phillips began exploring the area in 1984, found 24-3 in 1985 and Xijiang 30-2 in 1988. An agreement to develop the two reservoirs was signed in 1991. One platform is in, and a second – at 30-2 – will be sited early this year about 13 km from the first. This $600 million investment employs a floating production, storage and offloading system (FPSO), a modified tanker holding 1 million bbl, Nan Hai Kai Tuo, able to feed shuttle tankers and associated hardware.

In mid-1994 Amoco Orient Petroleum disclosed contracts amounting to almost $80 million for development of Liuhua 11-1 oilfield in the South China Sea (project contractor Reading & Bates). A semi-submersible drilling rig will be converted in Singapore to a floating production system (FPS), with completion by April, to be renamed Nan Hai Tiao Zhan. Amoco expects Liuhua 11-1 production to begin in 1996, initially building to 50,000 b/d, rising in a few months to 65,000 b/d. Produced oil will be processed and stored for shipment to a Chinese port on board a FPSO, capacity well over 700,000 bbl. Liuhua will cost $650 million to develop. Although it is the biggest oilfield found off China, with more than 1 billion bbl in place, the crude is heavy, so recovery, even using horizontal sections in the shallow reservoir, is likely to be only 70-100 million bbl, Wood Mackenzie estimates.

Accommodation module for Phillips Petroleum's Xijiang platform in South China Sea

Also in the South China Sea Agip, Chevron and Texaco – known as the ACT group – have been developing a number of Huizhou fields. ACT's Huizhou 21-1 went on stream in 1990, followed by 26-1 late in 1991. They shared FPSO facilities at the Pearl River Mouth Basin, with a joint peak production set at 60,000 b/d in 1992. Wei Liucheng, CNOOC's deputy president, announced late last year that a group of Japanese banks would lend $50 million for the development of three South China Sea fields: Amoco's Liuhua and ACT's Huizhou 32-2 and 32-3. The latter two are due on stream by late 1995, producing around 27,500 b/d.

A notable offshore development will be the tapping of Shanghai Petroleum Development's Pinghu field in the East China Sea. This should provide 800,000-1.2 billion cubic metres/day (Bcmd) of gas over 15 years, the reservoir being estimated to hold some 1.7 million tons of oil and condensate. Partners in Shanghai Petroleum include the city of Shanghai, Ministry of Geology and CNOOC. They had hoped to attract partners from abroad and had Texaco interested in taking a 49 percent stake until negotiations broke down a year ago. The American firm could not agree terms that would make the scheme 'commercially viable'. Completion is now expected in 1996. Following a feasibility study a pipeline is being laid to shore to the Pudong area.

> *'Chinese planners began to realise that the country by the mid-1990s could be a net importer again.'*

Gas prospects

To date China has failed to exploit considerable reserves of natural gas. Proved reserves are put at

Drilling rig on the Karamai oilfield

over 1,670 Bcm, sufficient for over a century at current demand. In the 20 years 1973-93 production only rose from 7.33 Bcm to 16.22 Bcm, gas making a minuscule contribution to overall energy needs, which are dominated by coal, with oil in second place. Out of just over 712 million tons of oil equivalent (mtoe) in 1993, coal contributed over 541 mtoe, oil almost 143.5 mtoe, gas just over 14 mtoe, slightly more than hydro-electric power, with nuclear energy making only a token showing.

'Onshore oil and especially development of the remote Tarim Basin in the northwest of the country are probably the key to China's petroleum well-being in the forseeable future'

The other significant gas development under way is exploitation of the Yacheng 13-1 reservoir off Hainan Island, in the South China Sea. Arco found it in 1983 and from 1985 began seeking a commercial outlet for its 90 Bcm of gas and gas liquids. The solution was a heads of agreement signed early in 1992 for gas deliveries to Hong Kong beginning in January 1996. Additional gas plus liquids will go to Hainan Island, where gas will be used for local industry, liquids being sold on a spot market basis for local or export use.

The main 707-km, 28-inch trunkline from Yacheng 13-1 field to Hong Kong was completed in 1994 by European Marine Contractors' Semac I semi-submersible lay barge, Saipem's Castoro V shallow-draft pipelay vessel handling the remaining 70 km in the Pearl River estuary. Semac I also installed the 100-km, 14-inch line to Hainan Island. Two platforms are needed for the $1.2 billion project. One was completed last April and the other, still under construction in Singapore, will be installed in May this year.

'Liuhua – the biggest oilfield found off China'

Yacheng will produce its reserves over several decades at a peak of 336 million cubic feet a day (about 9.5 Bcm/day) to Hong Kong and 60 million cubic feet a day to Hainan. A power station and a gas pipeline around Hainan Island have both been proposed. Arco has just signed a deal to explore near Hainan, CNOOC's hundredth such agreement with a foreign firm and Arco's sixth.

China founded a new state enterprise to manage its gas industry about two years ago. China National United Oil and Gas Corporation (Sinoil) is owned by CNPC and China National Chemicals Import and Export Corporation and has hopes of becoming a major world player.

Onshore gas

Big developments in gas are under way onshore, too. Sichuan Petroleum Administration will implement an almost $950 million upgrade to revitalise gas production and distribution in the east and centre of the province, with a large input of World Bank funds. The scheme will raise gas flow by around 68 Bcm in the 20 years from 1995 and enhance and expand a 2,800-km transmission and distribution system. Sichuan accounts for all but 10 percent of China's non-associated gas flow and almost 45 percent of total gas supplies.

Mitsubishi Corporation and Tokyo Gas are to provide technology support for a 900-km gas line to Beijing from Jingbian in Shaanxi Province. This will make 1 Bcm/yr available through a line which will be completed in October 1997.

Onshore oil and especially development of the remote Tarim Basin in the northwest of the country are probably the key to China's petroleum well-being in the foreseeable future. The northwest was of great importance in establishing a Chinese oil industry, with fields such as Karamai developing in the 1950s. Significantly, foreigners are now being offered onshore acreage. Until 1993 the only land areas available to them covered mainly unexplored acreage in the southern 11 provinces.

In addition to the half-dozen production-sharing contracts signed there, China has opened acreage thought to have much greater potential in 10 other provinces and autonomous regions under a second round which closed on 28 October 1994. As well as 26 blocks for exploration in areas that include Heilongjiang, Inner Mongolia, Hebei, Henan, Shandong, Hubei, Gansu, Qinghai and Tinjin, the authorities offered 11 blocks for enhanced oil recovery in producing fields such as Shengli, Dagang, Hebei, Jianghan, Hena, Jiangsu and Jilin.

In Tarim Basin several deals have already been made with overseas firms. Located in southern Xinjiang, Tarim – almost the size of Texas – is one of the world's biggest and least explored inland sedimentary basins. Chinese geologists estimate reserves at up to 74 billion bbl of oil and 283 trillion cubic feet (some 800 Bcm) of gas. Before the 1980s exploration was sporadic, mainly on the outskirts, and two fields were found.

In April 1989 CNPC set up Tarim Oil Exploration Development Bureau. Since then more promising discoveries have been made. CNPC has laid plans for a $1.4-billion, 2,000-km pipeline from Korla to Sichunto to supply a large refinery in Mianyang. The line will have a capacity of 200,000 b/d at least, to go on stream in the mid-1990s, and this could be doubled. Production from Tarim was about 30,000 b/d in 1993 and could exceed 100,000 b/d by 1996.

With companies like Exxon, Agip, Texaco and BP involved in Tarim and with the Chinese lately boosting capital investment there, exciting developments can be expected. William Doyle, director of Texaco China, has described its acreage as a 'world class opportunity'.

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Large 3D seismic surveys completed in Chinese desert

By Michael K Seaver, Vice President, Opseis Inc

Seismic crews, working through the blazing summer in the northwest Chinese desert, conducted one of the country's largest 3D seismic surveys ever in record time using a radio frequency (RF) telemetry acquisition system. The 11,232-shot survey covered 743 square kilometres (km), with full 3D seismic coverage over a 300 square km subsurface area in less than three months. 'The system worked without fail through rough transport, extreme heat and dry conditions,' said Mr Chen Dugong, Bureau of Geophysical Prospecting (BGP) chief engineer, who directed the Mo Suo Wan survey.

Mo Suo Wan Desert, China: Seismic Acquisition Remote Unit.

BGP 4th Division won the large, multi-channel 3D seismic survey contract from Xin Jiang Petroleum Bureau and decided to use the Opseis Eagle System, supplied by Opseis Inc of Bartlesville (originally a division of Phillips Petroleum Co).

The need for 3D

The Chinese were exploring a Jurassic hydrocarbon-bearing structure, interleaved in Triassic and Permian structures, about 5,000 to 6,000 metres deep. Xin Jiang Petroleum Bureau said they needed this detailed 3D survey because its crews had already drilled several exploratory wells, based on 2D survey data, with mixed results – some wells produced both oil and gas, while others were dry holes.

Since this was China's first extensive multi-channel 3D survey in the challenging desert environment, BGP managers decided to use their latest radio frequency (RF) telemetry equipment – the Opseis Eagle System.

Chinese geophysicists said that this RF telemetry acquisition system worked flawlessly, despite air temperatures of 40° to 45° Celsius, and surface temperatures reaching 70° to 75° C.

Desert survey conditions

Mo Suo Wan is a desert about 150 km northwest of Urumqi, capital of Xin Jiang Uigur Autonomous Region in northwest China. It is dotted with high sand dunes – averaging 70 to 80 metres high. A true desert, Mo Suo Wan has only about 150 millimetres of rainfall per year.

The crew made the journey by truck from eastern China over 4,200 km of very rough roads across five provinces and autonomous regions in 10 days. Despite the extreme heat and isolated area, a manager who worked with the crew said, 'It was tough, but that's the nature of seismic surveys for oil in remote corners of the globe.'

The Mo Suo Wan survey used dynamite and recorded 520 channels of seismic data from six geophone lines per shot. Seismic Acquisition Remote (SAR) units were set 600 metres apart at 100 metre group intervals. Each survey line was 38 km long and the crew used a weighted geophone array, according to Mr Ma Yuliang, BGP 4th Division instruments and equipment section manager, who supervised the Mo Suo Wan survey.

'The subsurface structure in this area is very complicated with a lot of small fractured faults,' Mr Ma said. 'The location of small fault blocks is hard to determine with precision in a 2D survey. Also, signal-to-noise ratio was low in the 2D data reflected from the deep horizon, making it difficult to define the deep structure patterns and distribution of the fractured faults.'

Seismic crews faced problems not only deep underground but on the desert's surface as well, since the area's high dunes sometimes made it difficult to establish good line-of-sight radio contact between SARs.

The Chinese determined that RF data could be

Workers participating in one of China's largest-ever 3D seismic surveys gathered around one of their Seismic Acquisition Remote (SAR) units.

transmitted between 20 and 28 km to the CRS truck by SARs equipped with *yagi* ('H'-shaped directional) antennas. This extended RF reception range permitted the Chinese to conduct the total survey while moving the CRS truck only five times during the entire three-month survey.

Fast reliable system

BGP 4th Division used the system to collect data from 520 channels, with two-millisecond sample rate and six-second records on two radio frequencies. Chinese officials said the highest daily production under these conditions was 360 shots and the crew collected detailed data from every shot.

With their solar panels and low power consumption, the SARs ran for more than three weeks without battery recharging. Batteries were charged only when crews changed survey lines and wanted to ensure that all SARs would operate as needed.

Subsequent surveys conducted in China with this system have also collected detailed 3D seismic data from rugged mountains in the southeast and the marshy wetlands of the east coast. Altogether this RF-telemetry system is now being used in 10 Chinese provinces, while Chinese crews have also taken it to Peru.

The speed of these 3D surveys is greatly increased because the system does not require cables to transfer data from the SAR units to the central recording station. These quick surveys are assets to a country which must provide energy for nearly one quarter of the world's population.

The selection of staff for North Sea petroleum installations

By Fiona Whyte, Georgina Slaven & Rhona Flin, Offshore Management Centre, The Robert Gordon University

Selecting personnel for offshore work is a challenging task. In the UK sector, companies are endeavouring to reduce costs through initiatives such as CRINE (Cost Reduction in the New Era), yet changes in the legislative regime have pushed safety high up on the agenda. The offshore workforce is currently estimated at around 34,000 (DTI, 1994) working on over 150 installations, many of which are 100 miles or more from the Scottish mainland.

In 1992, we conducted a detailed examination of the methods used to select Offshore Installation Managers (OIMs), following Lord Cullen's Report on the Public Inquiry into the Piper Alpha disaster (Flin & Slaven, 1994). The findings showed that OIMs were selected predominantly on the basis of personal recommendations, interviews and past performance records. Given the highly responsible and safety-critical nature of the OIM's post, the paucity of more objective assessment methods such as psychometric testing and assessment centres was surprising considering the evidence from other research which suggests their use is increasing for management selection elsewhere in British industry (Shackleton & Newell, 1991; Williams, 1994). The only previous published research on the methods used to select other types of offshore workers identified the best indicators of future performance for roughnecks and roustabouts. Livy and Vant's (1979) study of 129 offshore workers identified teamwork and physical aptitude as key selection criteria. On the basis of this research they devised a weighted application form and practical group tests to improve selection methods, though there is little evidence that these ideas have been widely adopted.

Latest survey of selection methods

Last year, we conducted a small-scale survey of UKCS companies to obtain the most up-to-date information on selection methods currently used in the North Sea oil industry (see Flin et al, in press, for more detail). Personnel specialists in 35 of the larger, long-established organisations within the Aberdeen area were contacted in order to identify and confirm the existence of unique trends within this specific industry. Of the 23 respondents who completed the questionnaire,10 were from major operating companies, five were from drilling contractors, and the remaining eight either diving or service companies. In terms of company size, five organisations had less than 200 employees, 13 had 200-500 offshore employees and five had an offshore workforce of 500 or more. They represented organisations from a variety of countries, including those with both European and US origins. Respondents were asked to complete both qualitative and quantitative questions concerning the factors relating to both the candidate's ideal qualities and organisational selection policy. Questions covered sections on company characteristics, selection methods and selection criteria for offshore occupations (knowledge, skills, personal qualities, training completed).

Selection methods

All 23 companies used application forms and interviews as part of their selection processes and most (83 percent) supported this with curricula vitae and factual checks. Equally significant was the prevalence of personal recommendations (83 percent), a factor cited as typical of the American influence of the 'buddy system' within the industry (Anger, Cake & Fuchs, 1988). The majority (78 percent) also made use of character references. One-third (typically the larger operators) used psychometric testing, though only two used assessment centres. Telephone screening was employed by seven of the companies and work sampling by four. Twenty one companies (91 percent) reported a preference for internal promotion when selecting for senior offshore positions. This was also reflected in the results of our survey into OIM selection, where the majority of companies much preferred to 'grow their own' future OIMs.

When asked what attempts were made to ensure the effectiveness of the selection process within the organisation, just seven of the 23 companies formally validated their selection procedures. This included:

- 'Systematic performance appraisal programme; identification of training needs/skills gaps; training and development policy (proactive)'
- 'Competency based assessment'
- 'The Safety Management System required that critical orientation/adaptation to the job be formally assessed after six months'.

This reflects the increasing emphasis in the United Kingdom on formal competence assessment, particularly following the introduction of the Safety Case regime, and the development of formal standards of competence for certain offshore posts by the industry with assistance from the Offshore Petroleum Industry Training Organisation.

The findings appear to support those from previous onshore research, indicating an increase in the use of psychometric testing, though not assessment centres. Industry selection methods still seem to be dominated by personal recommendations for internal candidates, which may be a reflection of the American culture of many of the parent companies. The increasing trend of using more formal and objective selection methods is encouraging, though the persistence of personal recommendations, particularly given the safety-critical aspects of offshore work warrants an examination of this source as a valid indicator of performance.

Selection criteria: offshore industry specific requirements

The hazardous nature of the offshore work environment, the inhospitable location (North and Irish Seas), and nature of offshore work rotations (usually two weeks on and two weeks off) may make particular demands on the workforce compared with onshore jobs and hence the industry may require individuals with certain special characteristics. Companies were asked to complete a number of questions on the characteristics of suitable offshore personnel. In terms of personal qualities, companies placed great emphasis on maturity and reliability, with an element of extroversion and the ability to work well in a team. Given the close-knit community on offshore installations with individuals living and working with their colleagues 24 hours a day for 14 or more days, it is not surprising that ability to work as part of a team is rated highly. The following quotations illustrate the desired qualities companies were looking for:

- 'From work carried out in consultation with managers and supervisors we have identified work ethic exemplified by effort, reliability, concentration, problem-solving and loyalty. In addition team focus, learning and ambition, confidence, thinking, planning and organising. Numerical reasoning, mechanical aptitude, and verbal reasoning emerged as essential abilities'.

- 'We look for ability to deal with stress in oneself and ability to recognise symptoms of excessive stress in others. Calmness; maturity; lack of impulsiveness; steadiness under pressure; above average intelligence; integrity; conscientiousness; flexibility; group orientation high.'

- 'One for all and all for one" attitude'
(From separate sources.)

Operating companies preferred candidates with previous offshore work and/or petro-chemical experience, while those with a marine, or armed forces background were preferred by drilling and service companies. The latter experience presumably 'selects in' those who have experienced a structured work environment with a strong emphasis on teamwork, involving long periods away from home. A common factor for offshore work was the requirement for candidates to be available for work on short notice (82 percent), and a quarter of companies required flexibility with respect to relocation and international travel, reflecting the global operations of oil and gas companies.
The United Kingdom Offshore Operators Association (UKOOA) stipulates criteria for medical fitness for offshore workers, which are generally considered as the minimum requirements (UKOOA, 1992). A recent addition to these medical checks is pre-employment drug screening, mentioned by several companies as organisation policy, though it is not part of the UKOOA medical criteria. This again may be a reflection of the American influence of US companies in the United Kingdom. In addition to guideline criteria for medical fitness, UKOOA also stipulate that all those who work offshore on a regular basis should undergo a four-day combined survival and fire-fighting course, with refresher training every four years. Approximately half of the organisations expected candidates to have such fire-fighting and offshore survival certificates before applying to the company, though the remainder provided this as part of the employee's induction procedure.

Conclusion

The offshore work environment presents a very special combination of work pattern, location and hazards which requires individuals with certain characteristics who can easily adapt to and function in such a working environment. This small-scale survey of the methods used to select offshore workers builds on previous offshore research and highlights the special qualities employers are looking for in prospective candidates for offshore work. The findings also confirm the growing trend that companies are using objective indicators of future work performance such as work sampling and psychometric tests. With the increasing emphasis on formal competence assessment for safety-critical posts, it will be interesting to see how selection methods develop.

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Potential for the development of UK coalbed methane

By J Craig Creel, Cawley, Gillespie & Associates Inc

The UK coalbed methane industry could be dated to begin in the mid-1960s with the utilisation of mine vent gas at various collieries within the country[12]. The generally accepted date, however, is 1991 when, during the Fourth Round of Licensing, nine licences were awarded which targeted CBM as the resource. By the Sixth Round in 1992, over 2.4 million acres had been targeted for CBM development. Subsequent disagreements with British Coal on ownership and requested tariffs has delayed the growth of the industry, resulting in only four wells having been drilled by July 1994. Passage of the Coal Industry Act in July 1994 clarified the ownership and related issues. The industry is now poised for a continuation of its growth.

Theory of coalbed methane

Coalbed methane (CBM) is fundamentally different from natural gas found in conventional petroleum reservoirs. In CBM reservoirs, the gas molecules are physically attached to the carbon atoms located within the matrix of the coal. As pressure is reduced in the coal seam, the low energy physical bonds are broken and the gas molecules diffuse through the coal matrix until they reach a natural fracture. Once in the fracture network, the molecules flow toward the wellbore to be produced (**Figure 1**).

Four essential reservoir properties are required for this process to occur:

- coal must be present
- gas must be in the coal
- the gas must be able to diffuse
- a natural fracture system must exist.

In any new area of CBM exploration, reasonable estimates of the first three properties can be established prior to drilling. The last property, the existence of a natural fracture system, can currently only be determined by testing a well after it is drilled.

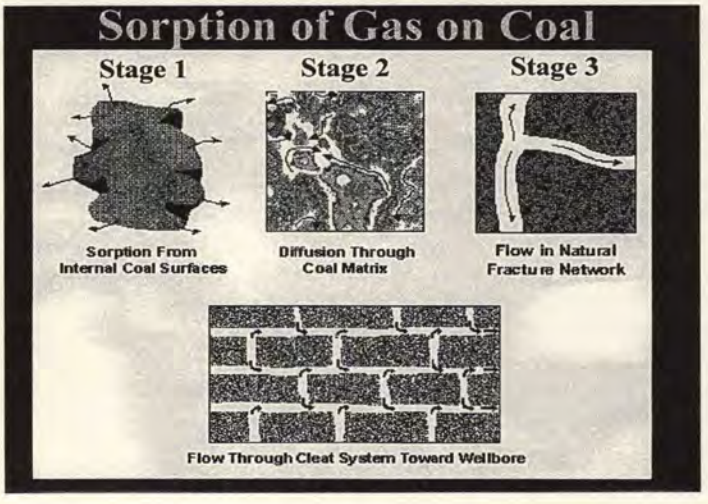
Within coal, a sorption isotherm is the measure of the gas storage capacity. Adjustments to the sorption isotherm for pressure and ash content (non-carbon material) can easily be determined. Typically a coal seam will have an average ash content of from 5 to 30 percent. The actual gas storage within a coal seam may not be equal to the gas storage capacity[4].

As an example, if a given coal seam were discovered at 1,400 psi and 0 percent ash content, the coal matrix would have the capacity to contain 380 SCF/ton. A reduction in the reservoir pressure to 700 psi (through production) would reduce the gas storage capacity of this seam to 340 SCF/ton. This reduction of capacity by 40 SCF/ton is the gas volume that is available for production. If the coal seam were discovered at 200 psi and 0 percent ash content, the coal matrix would have the capacity to contain 225 SCF/ton. A reduction in the reservoir pressure of this seam to 100 psi would reduce the gas storage capacity of this seam to 150 SCF/ton.

Note that in each example given, a 50 percent reduction in reservoir pressure was assumed. In the first example, this pressure reduction resulted in 10.5 percent of the gas-in-place being available for production. In the second example, a 50 percent pressure reduction resulted in over 33 percent of the gas being released from the coal seam. The shape of the sorption isotherm and these examples point out the necessity of a low pressure producing environment for CBM wells. Therefore, in almost all cases, compression will be required before the sale of the gas to customers.

The use of the term SCF/ton is unfamiliar in the petroleum industry. A CBM reservoir can contain over 50 percent more gas per unit volume than a conventional reservoir at the same depth.

Figure 1



Review of US CBM industry

The origin of the coalbed methane industry in the United States can be traced to one of three dates, depending on definition. In the early 1900s a Wyoming rancher used the gas produced from a shallow well completed in coal seams to provide heat to outbuildings. In 1953 Phillips Petroleum completed a well into the Fruitland Formation of the San Juan Basin in response to gas shows which are now known to have come from the coal seams. However, the early 1980s is generally accepted as the date when companies intentionally completed wells for the purpose of extracting the gas contained within coal seams.

Although coalbed methane wells have been drilled in almost every coal basin in the United States, over 85 percent of the CBM wells drilled to date have been in either the San Juan Basin of New Mexico or the Black Warrior Basin of Alabama.

On composite, the modest gas production rate observed in the early 1980s from CBM wells has steadily increased. US CBM production doubled from 1991 to 1993. Total US CBM production in 1993 was reported to be approximately 700 BCF per year – almost 4 percent of total US gas production.

By the end of 1993, the US CBM industry had compiled an impressive set of statistics.

- Approximately 6,600 wells in production
- Over 2 trillion cubic feet of production to date
- Comprises 8 to 10 percent of the US gas reserves
- Daily production of over 2 billion cubic feet.

This equates to the arithmetic average CBM well in the United States producing approximately 300 MCF of gas per day, with a median production rate of 150 to 180 MCF per day. The significance of the impact of the CBM industry on the US petroleum sector is clear.

Review of UK petroleum industry

Historical gas production from conventional petroleum reservoirs within the United Kingdom has been on an upward trend since 1982, with significant increases in the last two years. These production rate increases are predicted by various sources[5,6] to peak in either 1994 or 1995 and subsequently to decline rapidly. Within 10 years, gas production from conventional UK reservoirs is forecast to be at pre-1973 levels.

Correspondingly, annual capital expenditures within the United Kingdom have increased rapidly within the last five years to a peak of £5.4 billion in 1992. The Department of Trade and Industry[5] predict, within the next five years, a decrease from the 1993 level of £4.8 billion to less than £3.5 billion. Arthur Andersen predict that by 2002 capital expenditures in the UK sector of the North Sea will have dropped to £1 billion[1].

The annual rate of onshore drilling peaked in 1985. Total annual well drilling in the United Kingdom peaked in 1988. In 1993, both total and onshore well drilling had decreased to pre-1981 levels.

Each of these figures indicate different, but related, components of an industry that has reached a mature level of activity in the United Kingdom.

UK coalbed methane industry

The first licences targeting the exploration and production of coalbed methane in the United Kingdom were awarded during the Fourth Round of Licensing in 1991. By the Sixth Round of Licensing in1992, over 2.4 million acres of licences targeting CBM had been awarded **(Figure 2)**.

Previously unforeseen questions concerning ownership of CBM, access to the resource and requested tariffs resulted in the stagnation of the fledgling industry. Only four wells were drilled and only three wells were completed during this period of conflict. The rates of production from the three wells completed have been kept confidential. Fortunately, the issues and questions which stagnated the industry were resolved with the passage of the Coal Industry Act in July last year.

The Act will also allow, in certain areas, exploration and production of CBM from older, non-CBM targeted licences **(Figure 2)**. This could double the area for potential CBM development.

Currently, the approval of wellsite locations by local planning authorities is viewed by most UK CBM operators as the major remaining hindrance to development. Wellsite approval is particularly a problem with the planning authorities in environmentally sensitive areas. By definition, CBM wells will be located in coal basins. These same basins promoted the growth of heavy industry and mining during the last century. As a result, planning approval in these areas can be, and has been, obtained on numerous occasions by operators.

Figure 2

Forecast for UK coalbed industry

Using the development of the CBM industry in the United States as a model, predictions for the potential impact of the CBM industry on the UK petroleum industry can be estimated with the addition of two assumptions. The first additional assumption required is the magnitude of well drilling that could occur. As many as 20 wells are planned this year. Various difficulties with funding or planning approval may postpone some of this activity. The 1995 target of 10 wells allows for those potential difficulties.

An increase in drilling to 25 wells is forecast for 1996. Drilling is expected to continue to increase until 1999 when 150 wells are forecast. This is twice the maximum annual amount of wells ever drilled onshore in the United Kingdom, and 13 times the 1993 onshore drilling level. If offshore drilling remains at a 200 well per year level, then 150 onshore CBM wells could be the peak drilling activity seen. However, with the forecast continued decline in well drilling/capital expenditures, a peak drilling of 300 CBM wells per annum in 2002 is an obtainable, though optimistic, goal.

Based on gas production from an assumed average well, the annual production rates could be from 80 BCF to 115 BCF within 10 years **(Figure 3)**. The production from these projects will be available at a time when gas production in the United Kingdom will be reduced from current levels and could, in fact, be used to offset possible imports. For the 150 well maximum case the gas production rates and gas reserves are roughly equivalent to a North Sea field such as Raverspurn North, yet at a reduced capital requirement.

The potential impact of the development of the CBM industry in the United Kingdom is shown in **Figure 4.** Depending on the drilling scenario, production from CBM wells could constitute 2 to 4 percent of UK natural gas production within 10 years. CBM wells typically generate a production profile that is very flat, yielding long producing lives. Within 20 years, the percentages shown would be greater.

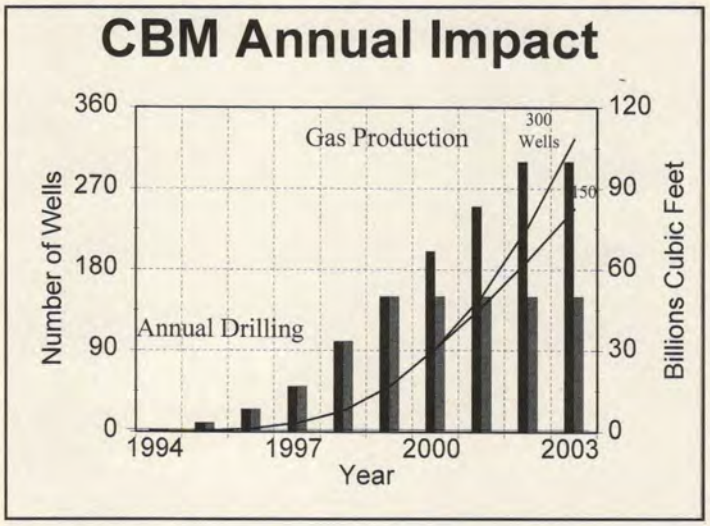


Figure 3

A much more significant importance may be observed in the area of capital investments. If one assumes that capital investments for the conventional petroleum industry will, contrary to Arthur Andersen estimates, remain in the range of £2 billion annually, then the CBM industry could constitute 3.5 to 7 percent of the total investments, as shown in **Figure 4.** Should the Arthur Andersen estimates be accurate, then the importance of CBM investments would double to 7 to 14 percent.

Under either maximum well drilling scenario, CBM will be important to the UK petroleum industry.

Production and economic assumptions

It is has been shown from earlier studies[3,11] that the prediction of production rates from CBM wells drilled in previously unexplored basins should be viewed as a statistical exercise until a sufficient number of wells have been drilled to allow the reservoir permeability to be estimated for the remaining undrilled locations. Until such time that an adequate number of wells have been drilled in each coal basin, the only available basis for the estimation of gas production rates is through analogy with the CBM industry in other countries.

The CBM industry gas forecast shown **(Figure 3)** is the arithmetic average of the three potential production rate schemes. The three potential gas production rate schemes were determined using reservoir simulation to arrive at the previous average well values used **(Figure 5)**. These rate schemes are simplistically described as the high, medium and low cases. The common reservoir properties of these rate cases are shown on **Table 1**. The impact of variations in these properties on the production from CBM wells is discussed in more detail elsewhere[4]. Only the permeability of the six seams was varied between the three cases. The high rate case represents each seam having a permeability of 10 millidarcies. The low and medium cases are I and 5 millidarcies, respectively. The typical US CBM well produces from 150 to 300 MCF per day depending on the averaging technique used. The initial CBM wells drilled in the United Kingdom are rumoured to support the ranges shown.

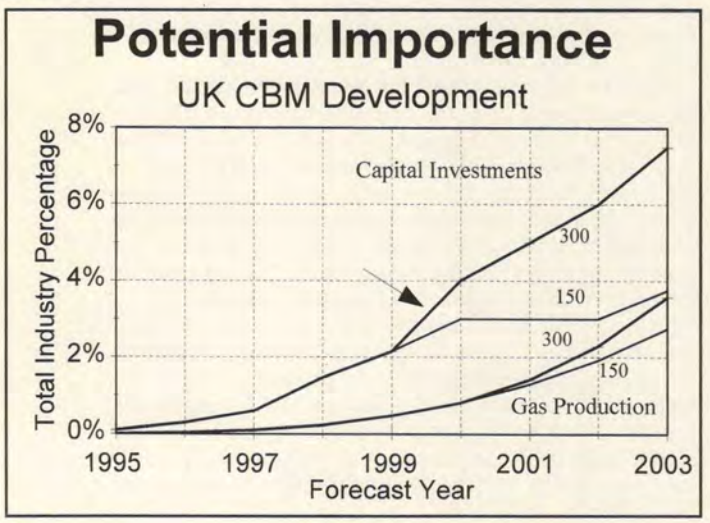
Table 1
Reservoir Properties
Coalbed Methane Simulation

Property	Value
No. of Seams	6
Depths of Seams:	1100 feet
	1500 feet
	1750 feet
	2100 feet
	2850 feet
	3300 feet
Values per Seam:	
Net Coal	5 feet
Ash content	10%
Porosity	1%
Pressure	0.43 psi/foot Depth
Water filled cleats	
Saturated with Gas at reservoir pressure	
Langmuir Values:	
Pressure	278 psi
Volume	740 SCF/Ton
Reservoir Area	640 Acres
Producing Conditions	50 psi Flowing Bottomhole Pressure

Table 1

The resultant individual well economics for the three production rate schemes used are summarised in **Figure 6**. The rate of return (prior to corporate taxes) is a commonly used criteria to access the viability of a project or well. Capital investments for UK CBM wells are estimated to range from over £500,000 for the drilling of an initial well in an area to less than £100,000 for the recompletion of an existing well to the behind pipe coal seams. Using the UK economic assumptions shown in **Table 2**, the rates of return for the three production rate schemes are shown on **Figure 6**. The high rate scheme yields an adequate rate of return for the range of investments envisioned. The medium production rate scheme performs best when the capital investments can be low-

Figure 4



ered from the £500,000 range. A lowering of the necessary capital investments for new well drilling could be envisioned in an area of active CBM development. An adequate rate of return for a low production rate scheme requires an investment below £100,000. Investments of this magnitude are likely only from existing well recompletions.

Table 2
UK Economic Assumptions

Property	Value
Gas Price	2.00 £ per MCF
Operating Expense	2000 £ per Month
Water Disposal Cost	0.50 £ per barrel
Production Tax	6.50%
Ownership	100%
Capital Cost	Variable

Table 2

Conclusion

CBM has become an important part of the US oil and gas industry, comprising 4 percent of gas production and 8 to 10 percent of gas reserves. There is an equivalent potential for CBM in the United Kingdom where effective control of costs will increase its profitability.

Definitions

SCF/ton = Standard cubic feet per ton

BCF = Billion cubic feet

MCF = Thousand cubic feet

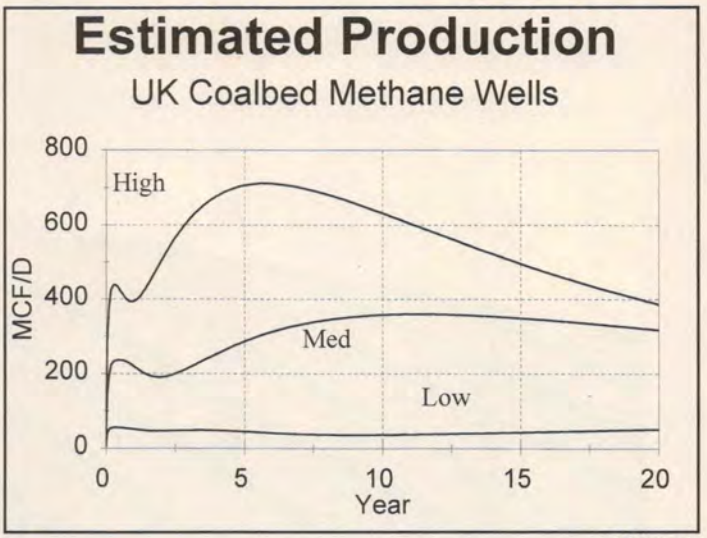


Figure 5

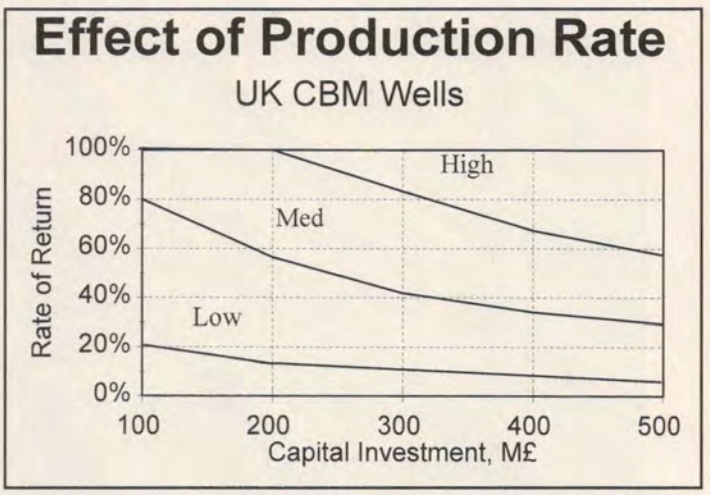


Figure 6

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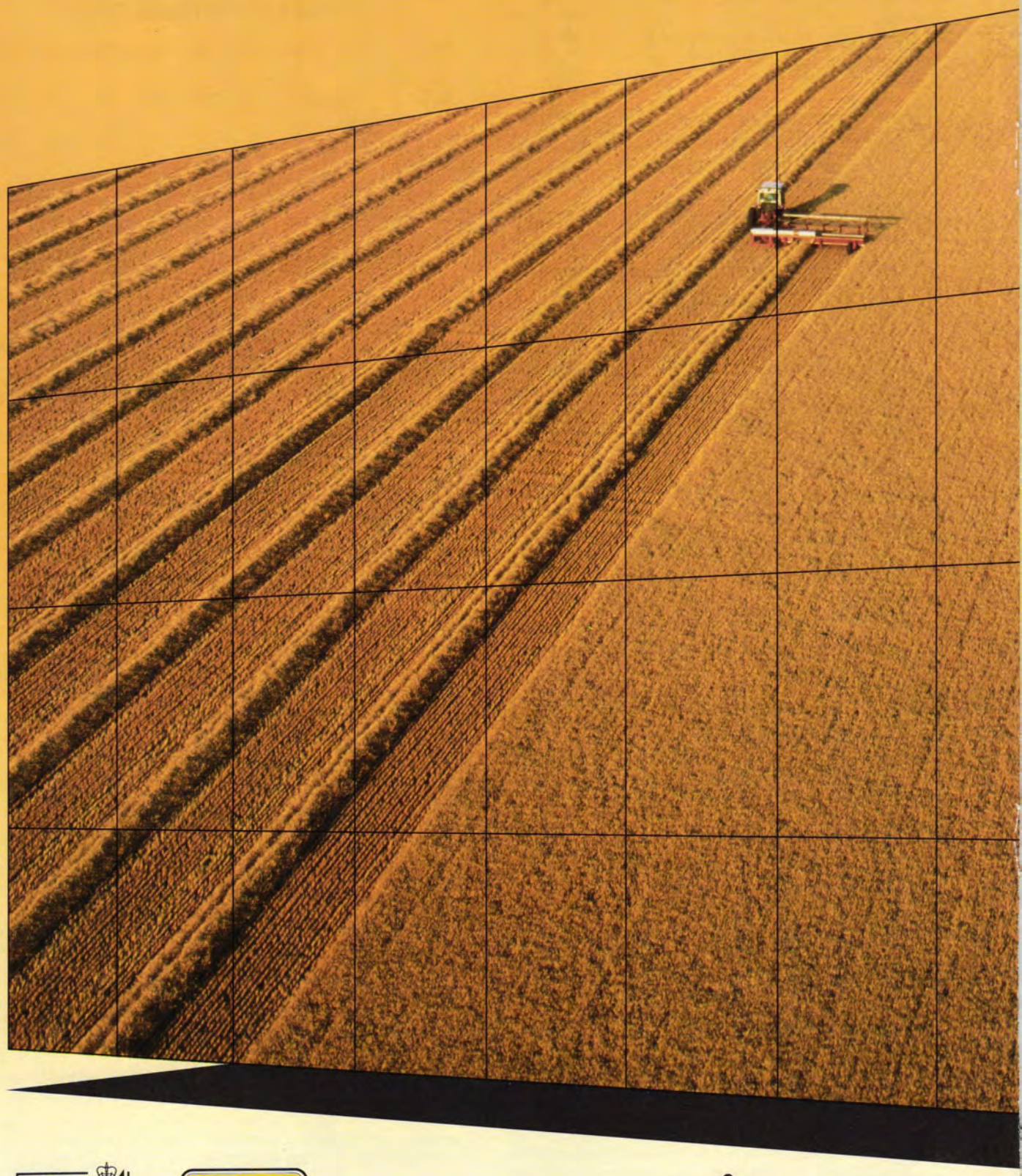
KEEPING A NATURAL BALANCE



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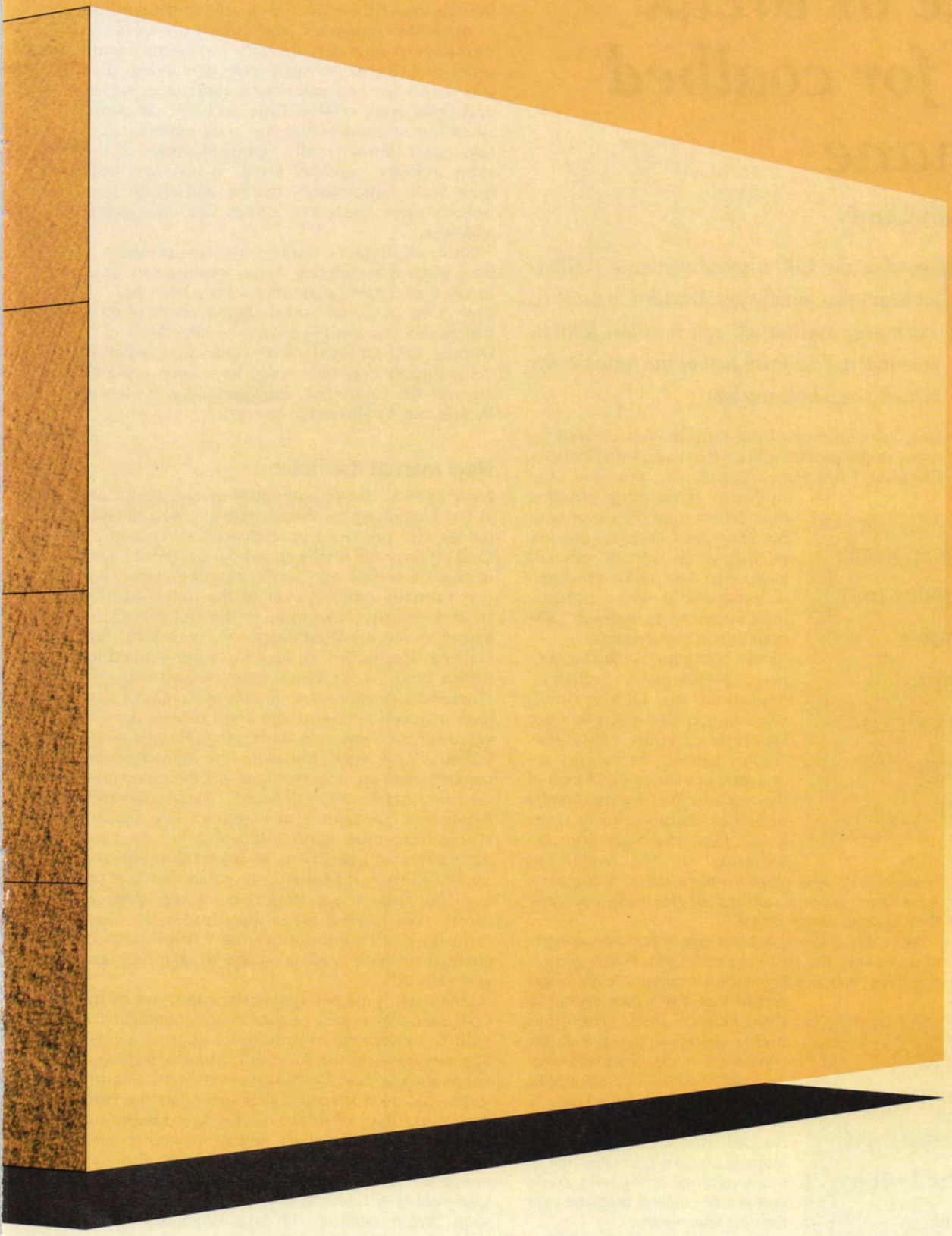


We've been careful with additives for 60 years . . .

Make or break year for coalbed methane

By Susannah Cardy

Now that the UK coalbed methane (CBM) industry has finally got British Coal off its back once and for all, can it at last fulfil its potential as 'the fossil fuel of the future'? Or is it all just a little too late?

Yes, last summer's Coal Industry Act cleared up many of the problems that were threatening Britain's fledgling CBM industry and, yes, the new Coal Authority is far more obliging than British Coal (BC) ever was. But three years of delays and bitter wranglings with BC officials have taken their toll on the dozen or so companies which currently hold licences to extract CBM from Britain's coal seams.

'There were some bloody battles and all the time nobody quite knew why British Coal was acting as it was'

'In the beginning, we had a rampant, enthusiastic industry,' explained Mr Henry Boyd, Secretary of the UK Onshore Operators Group (UKOOG). 'Today, parts of the industry are in a state of exhaustion.' Much of the capital raised by the smaller firms has disappeared in overheads. Even the larger firms are unhappy at the waste of resources. As one industry source put it, 'Companies have been paying salaries all this time and now they're rather browned off'.

Inevitably, there have been one or two management changes over the past three years too. Power generation firm, Babcock Energy, for example, is no longer certain that it will ever exploit its CBM licence areas. 'There has been a change of direction in the company's management philosophy', admitted Sales Director Mike Band. ' We haven't carried out any drilling yet and we haven't decided what we're going to do.' Industry sources estimates that as many as three companies could pull out of coalbed methane over the next few months.

'The industry's lost momentum - now it's really got to take the bull by the horns'

The problems with British Coal between 1991 and 1994 are well-documented. Whilst the Department of Trade and Industry (DTI) was busy promoting coalbed methane in Britain and handing out licences to prospectors, British Coal was insisting that coalbed methane was simply not the government's to give away. It became necessary to apply for a second licence from British Coal itself and, to the surprise of the CBM companies (and indeed the DTI), the terms were onerous. Royalty payments in the order of £10,000 per well were demanded, data was expensive and notoriously difficult to access and firms were offered little security. 'It astonished the Americans that two state entities could take such diametrically opposed views of the same industry,' said Mr Boyd. 'It was very odd: there were some bloody battles, and all the time nobody quite knew why British Coal was acting as it was.'

All in all, Britain's coalbed methane prospectors have taken a hammering. Some would go so far as to say that certain opportunities have been lost forever. 'One of the greatest disappointments of all is that Britain has lost the chance to take the lead in Europe,' said Mr Boyd. 'A few years ago, expertise demonstrated over here could have been exported all over the Continent, and especially to Eastern Europe, but it's almost too late now.'

New man at the helm

Nevertheless, lost opportunities or not, things are at last looking up for those coalbed methane companies still prepared to stick with it. Last July's Coal Industry Act finally sorted out the thorny issue of coal ownership and, at the end of October, this was formally handed over to the newly-formed Coal Authority. The man at the helm is Chief Executive Neville Washington. He is ex-army, ex-National Health Service and has *never* worked for British Coal. As Mr Washington himself explains, 'There was an enormous amount of emotional baggage involved in the transfer and I believe the DTI was keen to show that the Coal Authority represented a fresh start'. Certainly, the attitude of the coalbed methane operators towards their new master could not be more different. 'Things are much better now,' according to Kinetica's Ken Carson. 'There have been various hiccups, but the Coal Authority is at least trying to solve the problems.' Mr Washington diplomatically points out that the Coal Authority is operating under a very different remit. 'We have a clear duty under the Coal Industry Act to encourage the exploitation of coalbed methane and we intend to take that duty very seriously.'

One major problem now being ironed out by the Coal Authority is lack of data. Some information is held by independent mining companies whose licences pre-date the Coal Bill. Much interpretive information is held by consultancies. One industry source has even suggested that some data has been destroyed. 'Piles of it,' he claims, 'were burnt and dumped down mine shafts and we've had to enter into a wild goose chase in order to find it'. But most operators now seem satisfied with access and the Coal Authority hopes to have the situation resolved soon. 'We're dealing with large quantities of data held in a variety of different places but we've employed additional staff and plan to have it accumulated in a few months,' said Mr Washington.

Unfortunately, there are many more stumbling-blocks to a thriving coalbed methane industry that are quite beyond the power of any Coal Authority to

solve. Mr Ian Thomson is Director of Evergreen, the most active coalbed methane operator in Britain. He believes one of the greatest difficulties lies in adapting US technological techniques to UK conditions. 'We have yet to find the best ways of drilling, perforating and de-watering and it will take a very long time,' he told *Petroleum Review*. 'It took 15 years in the States.'

Another major headache for the CBM operators is the cost of drilling. The United States has a far more developed onshore drilling infrastructure which means rigs are cheaper. As one operator put it, 'You can virtually go down to your local store for a new piece of equipment in the States.' UK rigs are also designed to drill far deeper than is necessary for the coalbed methane industry. Smaller, faster, air-driven rigs are available in the States, but they're noisy and may require a change in UK safety regulations. Mr Boyd believes the case for air drilling approval is watertight. 'It may be rather noisier than conventional drilling, but it's so fast that it can be carried out within daytime hours.' Drill sites also need to be far smaller, although Evergreen is forging the way here, having already halved the size of its drill sites since 1993.

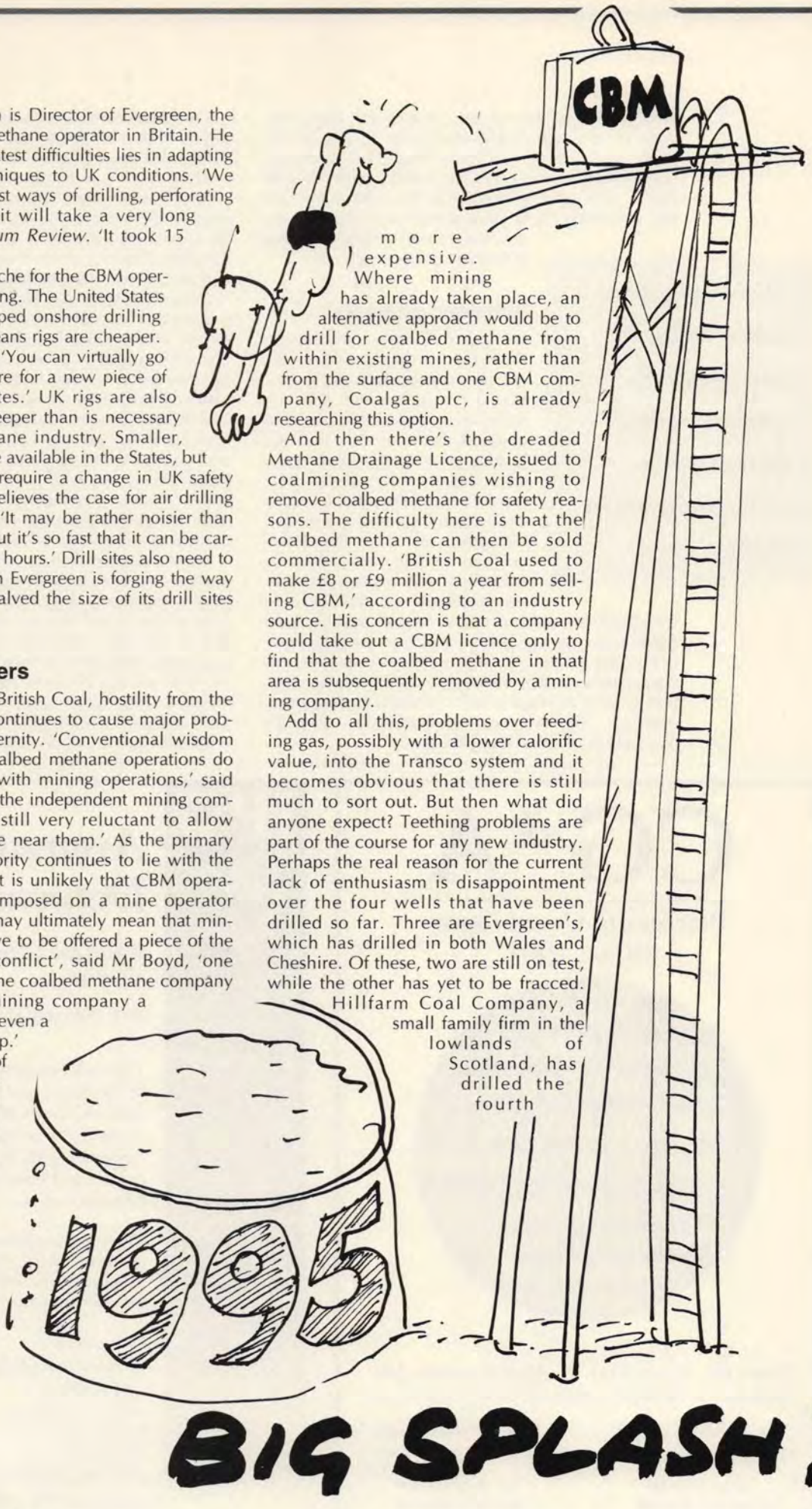
Conflict with miners

Despite the demise of British Coal, hostility from the coal mining industry continues to cause major problems for the CBM fraternity. 'Conventional wisdom in the States is that coalbed methane operations do not generally conflict with mining operations,' said Mr Boyd, 'but some of the independent mining companies over here are still very reluctant to allow CBM drilling anywhere near them.' As the primary duty of the Coal Authority continues to lie with the coal mining industry, it is unlikely that CBM operations would ever be imposed on a mine operator who opposed it. This may ultimately mean that mining companies will have to be offered a piece of the pie. 'Where there is conflict', said Mr Boyd, 'one solution would be for the coalbed methane company to offer the nearby mining company a commercial interest or even a joint venture partnership.'

The miners' dislike of coalbed methane operations, however, is not simply a knee-jerk reaction – in some cases, they genuinely fear for their roof-bolts! The problem is 'fraccing', which is the process by which CBM operators pump a fluid into the coal at high pressure to hydraulically fracture the seams. Some coalminers maintain this is damaging to the surrounding rocks, making subsequent mining more expensive. Where mining has already taken place, an alternative approach would be to drill for coalbed methane from within existing mines, rather than from the surface and one CBM company, Coalgas plc, is already researching this option.

And then there's the dreaded Methane Drainage Licence, issued to coalmining companies wishing to remove coalbed methane for safety reasons. The difficulty here is that the coalbed methane can then be sold commercially. 'British Coal used to make £8 or £9 million a year from selling CBM,' according to an industry source. His concern is that a company could take out a CBM licence only to find that the coalbed methane in that area is subsequently removed by a mining company.

Add to all this, problems over feeding gas, possibly with a lower calorific value, into the Transco system and it becomes obvious that there is still much to sort out. But then what did anyone expect? Teething problems are part of the course for any new industry. Perhaps the real reason for the current lack of enthusiasm is disappointment over the four wells that have been drilled so far. Three are Evergreen's, which has drilled in both Wales and Cheshire. Of these, two are still on test, while the other has yet to be fracced. Hillfarm Coal Company, a small family firm in the lowlands of Scotland, has drilled the fourth



well, which is also on test. But as yet, there has been no positive public statement on any of the operations. 'It's natural there should be some disappointment that no one has made a great deal of money yet,' said Mr Boyd. 'On the other hand, it's still very early days. The first half dozen wells in any new CBM development are likely to be more or less experimental.'

'We're confident that 1995 will prove once and for all that coalbed methane is a viable industry in Britain'

'We need pioneers'

Mr John Garratt, Managing Director of Octagon Energy, believes that the industry's slow start is connected with Britain's failure to understand the nature of coalbed methane. 'It's not like looking for oil in the North Sea – it's an industry that requires a great many wells. We're still thinking in conventional oil and gas terms.' Octagon is one of the few British coalbed methane companies in existence, the vast majority of companies with UK licences being US subsidiaries. It had hoped to gain backing from British energy groups but has now been forced to look across the Atlantic for a joint venture partner. Mr Garratt believes that Britain's coalbed methane companies need to adopt a more pioneering, risk-taking approach. 'The industry's lost momentum – now it's really got to take the bull by the horns.'

So what of the future? Many in the business believe this is make or break year for coalbed methane. 'Unless we make progress in 1995', said Mr Carson, 'nothing is going to happen in this industry'. This is a view echoed by many others. However, drilling forecasts for the coming year are quite reasonable – ranging from six to 10 wells. It is not a huge number but the general feeling is that it would only take one success story to turn the whole industry around.

Some companies may be moving off to more 'sexy' projects this year but there are others which have been quietly but confidently biding their time. Concorde Gas, for example, believes it has suffered no ill-effects from the industry's sticky start. 'We had a lot of data to gather and we weren't ready to drill till now anyway,' said Director Berwyn Edwards. 'We've also learnt a lot from the wells that have been drilled already and I'm very positive about the future.' The company plans to begin drilling one well in Cheshire next month and hopes to have it producing by July. It also intends to apply for planning permission from Cheshire County Council to drill another three to four wells.

Those companies that are serious about coalbed methane are keen to point out that this is never going to be a bonanza business. They prefer to describe it as a 'bread and butter' industry, one source even referring to it as 'mundane'. But they insist that for the smaller companies with their low overheads there is money to be made and that things are now starting to happen. As Kinetica's Ken Carson put it, 'We're confident that 1995 will prove once and for all that coalbed methane is indeed a viable industry in Britain.'

Challenges facing the financing of oil production capacity in the Gulf

By Naji Abi-Aad, Energy Consultant

The estimates of the required capital for maintaining and expanding oil production capacity in the 'Big Five' producers in the Gulf (Iran, Iraq, Kuwait, Saudi Arabia and the United Arab Emirates) are large numbers. In fact, looking at the total cost of raising the Gulf oil production capacity from 18.5 million b/d in 1990 to 26.8 million b/d in the year 2005, the eventual sum is likely to end up at around $192 billion (1990 $) of which about $150 billion will be required as normal investment to maintain current output levels, and a further $42 billion will be necessary to develop new capacities. In short, the Gulf countries will need to spend an average of $12–13 billion per year to maintain current production and to raise some 8.3 million b/d of new capacity by 2005.

The dilemma does not relate to the cost per barrel which is one of the lowest in the world, offering very rapid paybacks (a gross payout rate of two years maximum). But concerns have been raised about the ability of the oil industry in the region to generate funds, or to access the international financial markets for capital. These concerns seem to arise out of two factors, namely the financial constraints of producing countries, where the costs of bringing new production capacity account for only part of their huge capital requirements, and the effects of future oil prices.

Following the nationalisation of the Gulf petroleum industry in the 1970s, the sovereignty in oil activities was transferred to the host states which since have controlled their petroleum sectors through their national oil companies (NOC) and have claimed for themselves the bulk of the oil rents. That implies the transfer of the responsibility for generating capital for the oil industry from the oil sector itself to the state, while the NOCs are now treated as revenue collectors for the governments. Because NOC finance emanates from governmental allocations, the financial situation of the Gulf states directly affects the position of their respective NOCs.

Gulf financial constraints

The financial situation of the Gulf countries and therefore their ability to provide capital for the NOCs internally has recently become more of a problem, partly as a legacy of the weaker oil markets of the late 1980s, because petroleum and especially oil exports still generate the major part (or around 90 percent) of these countries' revenues.

The financial constraints of the Gulf countries have been aggravated by many other factors, including the marginalisation of OPEC and Gulf supply and the continuous weakening of the value

Table 1: Macro-economic Indicators of the Gulf Countries, 1971-92

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1971-81 Annual Average Growth	1982-92 Annual Average Growth
GNP at current market prices ($billion)	353	352	358	364	370	315	305	326	298	267	309		
Annual growth (%)	-2.4	-0.1	1.5	1.8	1.5	-14.8	-3.1	6.8	8.4	-9.7	15.6	31.1	-1.3
Current account ($ billion)	20.8	-6.9	-3.6	0.3	-11.7	-1 4	-1.6	7.0	5.5	-58.6	-20.2	-	-
Total exports (fob) ($ billion)	138	102	89	80	54	66	65	83	101	88	96	36.5	-3.7
Petroleum exports (fob) ($ billion)	129	92	80	71	44	56	55	70	88	76	84	35.6	-4.4
Share in Total (%)	93.5	90.2	89.9	88.7	81.5	84.8	84.6	84.3	87.1	86.4	87.5	-	-
Total imports (cif) ($ billion)	80	78	69	55	48	49	56	60	61	70	78	37.7	-0.3

Source: Data compiled from OPEC Annual Statistical Bulletin 1992.

Table 2: External Debt Indicators of the Gulf Countries, 1980-1992

Country	External Debt ($ billion) 1980	External Debt ($ billion) 1992	Debt/GNP at current market prices[6] (%) 1980	Debt/GNP at current market prices[6] (%) 1992	Debt/Exports (fob)[6] (%) 1980	Debt/Exports (fob)[6] (%) 1992
Iran	6.2[1]	25.0[1]	6.5	20.2	44.3	144.0
Iraq	-	82.0[2]	-	123.9*	-	561.6*
Kuwait	-	9.0[3]	-	37.1*	-	78.4*
Saudi Arabia	-	50.6[4]	-	45.6	-	99.7
UAE	-	12.0[5]	-	31.9	-	56.9
Total Gulf	**6.2**	**178.6**	**1.9**	**49.2**	**3.2**	**154.8**

*Based on 1989 figures.

Sources:
1. Platt's Petroleum Insight, December 13, 1993
2. MEES, February 3, 1992
3. Arab Oil and Gas Directory, 1993
4. AOG, September 16, 1992
5. EIU, the UAE, Country Profile 1992/93
6. Author's calculations based on data from the OPEC Annual Statistical Bulletin 1992

of US the dollar. The declining worth of the dollar has a direct impact on the value of the Gulf revenues. These countries' foreign exchange earnings are almost entirely in US dollars, since nearly all their exports involve oil sales priced and generally paid for in dollars. Their imports, on the other hand, come from a variety of sources and are thus only partially denominated in dollars. The financial difficulties have also resulted from the costs and consequences of two major conflicts in the region within a decade.

'The financial difficulties of the Gulf governments have placed heavy pressure on their NOCs'

Indeed, after the war between Iran and Iraq, both countries have been urgently in need of external capital for reconstruction. Since then, Iraq's requirements have substantially increased as a result of the conflict over Kuwait and it is now concentrating on ways to finance its huge and costly reconstruction programme after paying dearly for the cost of its own liberation. For its part, Saudi Arabia's past strength in internally satisfying the investment requirements of its economic sectors has now been weakened by the government's heavy arms purchases and its contribution towards the costs of liberating Kuwait. The UAE, while not so badly affected by the military developments in the region, has had to bear the impact of weak oil prices and the financial difficulties of its Bank of Credit and Commerce International.

The financial difficulties of the Gulf producers have been clearly shown in the macro-economic performance of the region (Table 1). Between 1982 and 1992, the aggregate gross national product (GNP) at current market prices of the Gulf countries had grown at a negative rate of 1.3 percent annually on average, compared with 31.1 percent between 1971 and 1981. In the period 1983–88, the total Gulf current account had posted a continuous deficit (with the exception of 1985). It showed positive balances in 1989 and 1990 but far lower than those reached in the late 1970s and early 1980s. The deficit returned spectacularly in 1991 and 1992.

Between 1982 and 1992, the total Gulf exports (fob), and particularly of petroleum which are by far the largest source of governmental revenues, sharply decreased by 3.7 percent and 4.4 percent annually on average respectively, in line with the fall in volumes exported and their prices. Comparatively, the rate of average annual growth of total exports and petroleum exports during the 1971–81 period reached highs of 36.5 percent and 35.6 percent respectively.

Moreover, between 1982 and 1992, and as a result of austerity policies and economic recession, total imports (cif) of the essential goods for a fast-growing population and equipment and materials needed for the development of economic sectors including oil, fell marginally at a rate less than the rate of fall in total exports.

The financial difficulties of the Gulf governments have placed heavy pressure on their NOCs, forcing them to modify their strategies and policies by reducing the availability of exploration and development funds. Oil projects with long lead-times and high risks have to compete with the rest of the economy for funds and especially with sectors that are politically sensitive (such as defence, security and public services), or have to find the needed financing elsewhere.

Less assets and more borrowing

In the light of their financial constraints, the Gulf producers have adopted a double-approach strategy of partly financing their expenditures and therefore the expansion of the oil sector through the NOCs without involving foreign investment and control. This strategy is basically relying on the expectation that oil prices will rise steeply in the future and is assuming considerable risk-taking by governments, and managerial and technical capabilities of NOCs. The first financing approach consists of depleting overseas assets and financial reserves acquired dur-

ing the boom years, while the second allows the borrowing of capital from international markets.

Forced by an urgent need for capital, Gulf governments have decided to disinvest some of their overseas assets, which are usually defined as the government's liquid foreign assets and reserves plus other investments overseas. This is considered as a risky approach due to the fact that, in principle, depleting government-led foreign assets, apart from making disposals of non-core investment assets in appropriate circumstances, could disrupt the investment strategy and affect the profits expected from these investments. Depleting overseas assets and financial reserves is limited by nature, however.

The recourse of Gulf governments and NOCs to large-scale borrowing to overcome their financial constraints started in the mid-1980s and is based on the assumption that budget deficits can no longer be easily covered from reserves. The total external debt of the Gulf countries had consequently increased from $6.2 billion at the end of 1980 to $178.6 billion in 1992, representing 1.9 percent and 49 percent of GNP (at current market prices) respectively. It accounted for the equivalent of 3.2 percent of the total value of exports in 1980 and 154.8 per cent in 1992 (Table 2).

Some governments and NOCs in the Gulf, for instance the UAE, prefer the borrowing approach that helps them to retain total control over their oil resources and not to deplete assets in a depressed market. However, in addition to the heavy burden on the economy, the financing costs, primarily interests, are technically adding to the overall cost of development, reconstruction and expansion, whereas any fluctuations in oil prices, exchange rates and interest rates will have adverse effects.

With the availability of funds from external sources becoming increasingly important, the Gulf governments and NOCs seem to follow the path of the international petroleum industry that has established itself firmly as a premier borrowing sector in the international financial markets. Bank loans are now the most important source of external funding for the petroleum industry. In 1991 the oil sector raised $80 billion through syndicated loans.

Indeed, while Europe and North America's major oil companies continue to access the loan market as their main source of financing, with a steady flow of new international borrowings, their peers from other areas of the world, such as Latin America and the Middle East, are in the process of positioning themselves in the market as regular borrowers and have become an important new source of fee income for bankers.

However, in attracting the capital needed for its development, the oil upstream investment in the Gulf and worldwide – estimated at $750 billion (1990 $) over the 1990s – must compete with financial requirements in sectors other than petroleum and also with investments in the downstream sector and in other primary sources of energy such as natural gas. It was estimated that over the 1990s, some $100 billion would have to be spent on tankers, $80 billion on pipelines, $240 billion on refining and $190 billion on storage, marketing and distribution. Investment in maintaining and expanding gas production capacity is currently thought to be running worldwide at an annual rate of some $200 billion, with the prospect of this huge outlay rising even further in the years ahead in part because of the clear environmental advantage of nautral gas over both oil and coal.

As a consequence, there is a widespread fear that demand will by far exceed the availability of capital and that many projects will not materialise simply because of a lack of funds. Such a fear might not be justified because big projects have long lead times and therefore the funding needs can be spread over a number of years. Real interest rates are also projected to remain high throughout the decade. This, however, should not be a major obstacle for capital investments in general. Good projects will always find financing. Higher costs-of-capital should not create insurmountable hurdles. Therefore, for projects in the petroleum sector, among others, a careful selection is needed on the basis of their anticipated returns and of the risks involved.

'The recourse of Gulf governments and NOCs to large-scale borrowing started in the mid-1980s'

The country risk and creditworthiness of the potential borrowers becomes very important at a time when there is keen competition for capital between different parts of the world. Perhaps the biggest challenge of all is developing confidence, so that risks are acceptable in those countries which are emerging as candidates for foreign investment or have problematic historical credit profiles. There is an understandable scepticism about the durability of recent liberalisation moves in some countries. Financial institutions which were burned by the LDCs debt crisis of the early 1980s will be particularly difficult to persuade.

Indeed, the LDC debt crisis has sobered financial institutions, views on country risk. Subsequently, resistance to finance projects in countries with poor credit histories is strong. Many banks now even ask whether they should be in the business of taking country risk at all, and seek political risk insurance, which is an expensive and finite commodity. That fact has encouraged the recourse to project finance which involves the financing of a viable independent economic unit which is expected to generate sufficient revenues to cover all operating costs, debt servicing and an adequate return to the sponsors. Project financing consists of various types of lending that share the common characteristics that they are for long-term capital investments and that the lenders accept to a large degree all or certain categories of the risks without recourse to the sponsors. That also partly explains why export credit and multilateral agencies, such as the World Bank, are increasingly called upon.

'There is a widespread fear that demand will by far exceed the availability of capital'

The World Bank, as far as energy is concerned,

is taking a more active stance and has abandoned its laissez-faire view that oil companies and national governments could generally be left to look after themselves. It is gradually adjusting to the changing needs of the emerging markets by adopting their insurance programmes and political risk coverage.

'The economic and financial situation in the region is expected to remain critical for many years to come'

Future prospects

The future evolution of the economic situation in the Gulf largely depends on the oil prices, at a time when the region's still almost totally dependent on oil as a source of revenue and a means of economic development. In 1994, each $1/barrel fall in oil prices meant a loss of over $2.8 billion in annual Saudi oil export revenues, around $1 billion for Iran, $850 million for the UAE and some $750 million for Kuwait. The inflation rate and the value of the US dollar also have some indirect effects on the economic performance of the region.

The uncertainty over the direction which oil prices (and to a lesser extent the exchange value of the US dollar) will take is playing havoc with the Gulf's budget projections for the next few years. Those countries which are accustomed to issuing budget forecasts around the beginning of the year are faced with the unenviable prospect of reconciling themselves to the market conditions and modifying ministerial budgets.

Nevertheless, a new situation seems seems about to develop where oil prices are expected to remain subdued for some time to come. When Iraq starts exporting oil once again, possibly sometime this year, this will add 1.5 million b/d to world output with the potential rising to 3 million b/d in 1996. Oil supplies from many other producers will further rise as a result of increased exploration and development. Even a sustained upturn in world demand for oil would not test the limits of OPEC production capacity, at least over the coming few years. The presence of excess capacity would consequently keep oil prices under pressure.

In time, however, world oil demand is bound to respond to lower oil prices, while production from the high cost oil wells will start to decline. Furthermore, the financial squeeze due to lower oil prices will make it difficult for many oil producing countries to maintain their targeted level of production capacity. Eventually, the dynamics of world oil supply and demand will become supportive for higher oil prices but that is still several years down the line. Accordingly, the economic and financial situation in the region is expected to remain critical for many years to come, although the level of constraints will differ from one country to another.

INSTITUTE NEWS

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INSTITUTE NEWS

Around the Branches

Essex Branch
8 February: *Environmental Management Systems by Rick Kelly of BSI*

Aberdeen Branch
14 February: *AGM at RGU Centre of Offshore Management*

North East Branch
14 February: *Abandonment of Offshore Oil and Gas Fields, A McEwen Subsea Manager, Stena Offshore Ltd*

Northern Branch
14 February: *AGM followed by Aviation Lubricants, Brian Raynor*

Yorkshire Branch
14 February: *AGM, guest speaker Ian Meadows, President of BLF*

Midlands Branch
15 February: *AGM at BBC Pebble Mill, Birmingham*

Humber Branch
16 February: *AGM, and Three Dimensional CAD and Modelling for Offshore Platforms, Jim Tonge of Conoco UK Ltd*

South Wales Branch
24 February: *AGM and Reflexology, Mrs Linda Knight*

Edinburgh & South East Scotland Branch
28 February: *Unmanned Offshore, speaker from BP Exploration*

DEATHS

We regret to annouce the deaths of the following members:-

	Born
J Authurs	1924
P P A Davey	1925
W J T Edmundson	1939
G F Henderson	1920

IP Director General Ian Ward shakes hands with Anders Hammer, Secretary General of the Norwegian Petroleum Society, after they signed an agreement for co-operation between the two organisations (see Petroleum Review, November 1994).

The Annual Dinner of the Aberdeen Branch was held on 25 November and attended by just under 400 people. The audience was treated to two excellent speeches. The first by Sir Ian Wood combined a light-hearted and humorous introduction at the expense of Aberdeen Journals with a serious message to the industry, especially the service sector. Sir Ian foresaw a need for capital investment of $250 billion to meet global needs for oil and gas development for the next 25 years. "This is a vast market opportunity", he said, pointing out that Aberdeen was much better placed to act as the springboard into the future than ever before, though full critical mass had not yet been achieved by Europe's Oil Capital.

The second speaker, Doug Duthie, a police inspector currently seconded to the Safer Cities Project, closed the proceedings with a hilarious lecture on the art of 'Briefing'. During the coffee break £1,440 was raised for the Children in Need Appeal. Aberdeen Journals kindly sponsored the menu cards but after the torment they received from Sir Ian they might not do the same next year!

UK Deliveries into Consumption (tonnes)

Products	*†Nov 1993*	**Nov1994*	*†Jan-Nov 1993*	**Jan-Nov 1994*	*% Change*
Naphtha/LDF	272,251.0	277,935.0	2,784,140.0	2,560,815.0	-8
ATF – Kerosene	543,729.0	536,750.0	6,588,285.0	6,681,320.0	1
Petrol	2,135,640.0	2,073,389.0	21,868,812.0	21,004,813.0	-4
of which unleaded	1,135,902.0	1,233,380.0	11,459,806.0	12,077,995.0	5
of which Super unleaded	129,480.0	100,686.0	1,345,758.0	1,278,614.0	-5
Premium unleaded	1,006,422.0	1,132,694.0	10,114,048.0	10,799,381.0	7
Burning Oil	284,456.0	227,056.0	2,315,135.0	2,330,760.0	1
Derv Fuel	1,161,440.0	1,312,471.0	10,909,772.0	11,861,540.0	9
Gas/Diesel Oil	750,228.0	623,427.0	7,108,878.0	6,895,335.0	-3
Fuel Oil	990,152.0	655,058.0	9,576,395.0	8,327,846.0	-13
Lubricating Oil	72,118.0	69,893.0	743,097.0	737,944.0	-1
Other Products	662,532.0	737,300.0	7,308,944.0	7,838,896.0	7
Total above	**6,872,546.0**	**6,513,279.0**	**69,203,458.0**	**68,239,269.0**	**-1**
Refinery Consumption	553,378.0	516,120.0	5,821,048.0	5,682,177.0	-2
Total all products	**7,425,924.0**	**7,029,399.0**	**75,024,506.0**	**73,921,446.0**	**-1**

*† Revised with adjustments *preliminary*

Underwater connection

The MSS45 series of metal shell connectors and penetrators from Hawke Connection Systems is designed to offer reliable and cost-effective electrical connection and penetrations under the most severe environmental and subsea conditions.

The series is available in standard shell sizes accommodating between one and 66 channels. Provision can also be made for more channels and hybrid configurations. Connector plugs and penetrators may be straight or right angle-moulded to outboard cable. Connector receptacles and penetrators are available as bulkhead or flange/panel mounted.

Pressure ratings are to 4,500 psi (open face) with working depths to 6,750 feet unmanned and working temperatures between -40°C and +150°C.

Reliable and cost-effective subsea connections from Hawke

Safety alone

DiriCall from Cass Alarmwatch is an intrinsically-safe alarm that pinpoints lone workers by using patented low frequency radio transmissions.

This enables colleagues to quickly and accurately identify the location and identity of individuals as soon as an alarm is triggered.

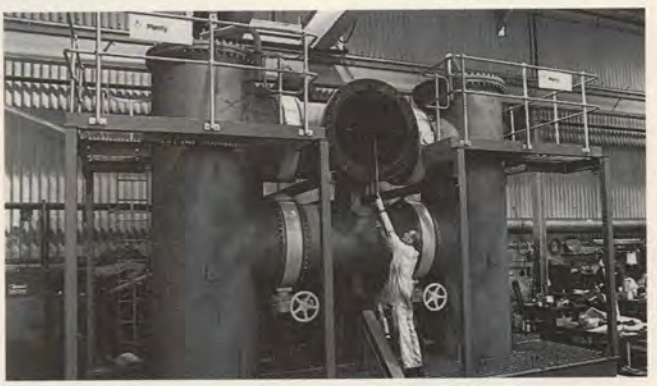
The alarm can be sounded quickly by the lone employee simply by pushing a button on his or her individual portable unit, or by pulling the rip-cord. If the employee is rendered unconscious, a built-in sensor will detect and report non-movement. The portable transceivers can also be contacted passively to track the whereabouts of lone employees.

Large fabricated dual duplex strainers

By utilising fabricated assembly, Plenty Filters claims it can now offer the world's largest examples of Duplex strainers for oil pipelines, sea water intakes for power stations, desalination and other process plants. At 42 inch bore, these strainers are said to be over 10 percent larger than others on the market and will appeal particularly to pumping operations where a flow rate of approximately 7,000 m^3/hr is required.

These new units, which can be supplied complete with skid base and walkways already assembled and integrated, can be simply dropped into position and bolted into existing pipeline runs. Available either with or without automatic valve changeover, the models are designed for applications where interruption to the flow for cleaning is impossible.

Valves may be manual or automatic, or can suit project specifications. A valve position indicator is also available as an additional feature when automatic changeover valves are incorporated.



New 42-inch bore Duplex strainers

Control and safety-related systems

Lintott has introduced two new control and safety-related systems for both offshore and onshore applications.

The LCP9400 programmable system and the LCS9400 solid-state system complement the company's expertise in hydraulic and electro-hydraulic safety system solutions for offshore wellhead control and related applications. The systems are equally applicable to offshore, onshore, manned and unmanned installations.

The overall package is designed to provide system solutions which can combine a number of different configurations, including simplex, duplex and triple modular redundancy. The system architecture features distributed intelligent nodes and open-systems connectivity.

These solutions are applicable to both control systems, which cause the system to operate in the desired manner, and protection systems, which deal with defined fault conditions and generate the correct outputs to minimise the likelihood of hazardous consequences.

One of the key sectors addressed by the LCP9400 is that of triple modular redundant (TMR) solutions. The powerful communications, speed of operation and physical diversity of the company's TMR technology is inherent in its design.

The triplicated hardware and software system operates in a totally unified and structured manner using automatic self-checking techniques and high-speed diagnostics to levels not previously available. In this way, most common-cause failure modes are eliminated. A final output 'voting' system, operating on the principle of 'two out of three', is said to guarantee the highest possible availability for plant control and safety-related applications.

According to Sales and Marketing Director Stewart Brammer, 'Not only do TMR systems save on the initial purchase price but they also cut commissioning time and offer lower operational and maintenance costs in the long run.'

Rail mounting safety barrier

New from Measurement Technology is an ultra-slim rail-mounting safety barrier which can also double as a field terminal.

The MTL7000 series safety barrier is only 7mm wide – much thinner than conventional barriers. It features an optional integrated disconnect facility for isolating safe and hazardous area circuits and doubles as a field terminal, saving on both cost and space.

The device is designed to prevent ignition and subsequent damage to plant and staff, and is aimed at applications involving flammable materials.

Expandable, compressed air filter

The Swedish company, Sundstrom Safety AB, has introduced a flexible, compressed air filter for turning ordinary compressed air into breathing air.

The SR79 compressed air filter is provided with a patented centrifugal-type preliminary separator and a principal filter comprising approximately 500 grammes of activated charcoal and double P3 particle filters in accordance with measuring standard EN143.

The filter, which can be connected to any mobile or fixed compressed air network, can easily be expanded to two or three filter cartridges. This makes it possible to clean up to 2,700 l/min and provides nine to 10 people with clean breathing air by way of compressed air-supplied breathing protection.

Clean breathing air for up to 10 people

International fuel card

Fina has introduced a new international fuel card 'to help take international transport operators into the next century'.

Fina Eurotrafic, which is managed in Britain by Dieseline, has been developed to give the customer a choice over what the card can be used for. The choice ranges from basic items, such as fuel and lubricants, right up to a full service package with fleet management reports.

The card can be used at more than 4,000 sites across Europe. It includes complex built-in security features that guard against misuse and can be blocked if lost.

Additional service options will include toll and tunnel payments, 24-hour breakdown and recovery service and international VAT recovery as well as a comprehensive fleet management reporting system.

Plug with a pod

Cabot Safety has come up with an exciting new concept in hearing protection which promises to improve comfort levels and hence compliance with safety regulations.

The Express Pod Plug is a foam earplug which combines the benefits of a slow recovery foam which expands gently in the ear canal to form a custom fit with the push-in convenience of a pre-moulded plug. The result is a plug which is extremely comfortable to wear, claims Cabot, and which provides excellent attentuation with minimal distortion of sound, even of speech and machinery working at low frequencies.

The key lies in the patented InstaSeal™ System, which incorporates a specially shaped polyurethane (PU) foam pod and a soft easy-to-grip stem which allows the pod to be inserted quickly and easily into the ear canal without the need for rolling the foam.

Counting by particles

A new laser particle counter from Parker Hannifin Corporation's Filtration Group is said to represent a major breakthrough in fluid contamination monitoring.

Called the PLC-2000, the new device helps eliminate the problem of fluid contamination which is the main cause of failure in hydraulic systems.

Using advanced laser technology based around the light blockage technique, the device is able to achieve 'laboratory quality' results, with the fully automatic one touch testing procedure taking just 90 seconds.

To ISO and NAS cleanliness classifications, particle counts are provided on a print-out or LCD display in the following micron ranges: 2+, 5+, 15+, 25+, 50+ and 100+. If required, the analysis results can also be downloaded to an external PC via an integral RS232 interface port.

Making routine field or service centre analysis both affordable and practical, the new counter provides the user with an immediate analysis of fluid condition. By identifying contamination problems at an early stage, the counter also reduces the likelihood of costly machine repairs and downtime.

Compatible with petroleum-based fluids and phosphate esters such as Skydrol, the counter is suited to a wide variety of applications.

One additional feature of the counter is its ability to operate without the need for special connections or equipment.

Testing the foam

The Seta-Air 150 has been designed specifically to assess the tendency of oils to foam at 150°C. It is unique because it uses air as a heating medium – a much safer alternative to oil which can leak, overflow and give off fumes.

The unit comprises a fan-assisted heated air bath with capacity for a removable 1,000mL graduated cylinder. It is designed to maintain a sample at 150°C ±1°C.

Temperature is digitally set and controlled via the keypad and a separate thermal cut out is included for added safety. A double-glazed viewing window and integral lighting allows for easy reading of foaming levels.

Bath warm-up time to 150°C is just 10 minutes.

The Seta-Air 150

New semi-automatics for welding

The welding company Esab has introduced a number of new products which supplement and complete the semi-automatic A10 series – already well-known and well-established in the welding industry.

The new products are the LAW 400 and 500 power sources and MEK4 feed unit. They have been developed for heavy welding for both indoor and outdoor use.

According to the company, the welding characteristics offered by these machines have never been better when it comes to welding with flux-cored wire. Crater-filling and digital instruments are functions which the previous generation did not have. With extension cables and intermediate feed units, these new semi-automatics have a working radius of up to 60 metres.

The new power sources have equally good welding characteristics with mixed gas and pure CO_2 and can be supplied with or without built-in water cooling. They are equipped with large wheels and powerful lifting eyelets and have a frame which has been adapted to permit lifting by fork-lift truck.

LEK power source and MEK unit

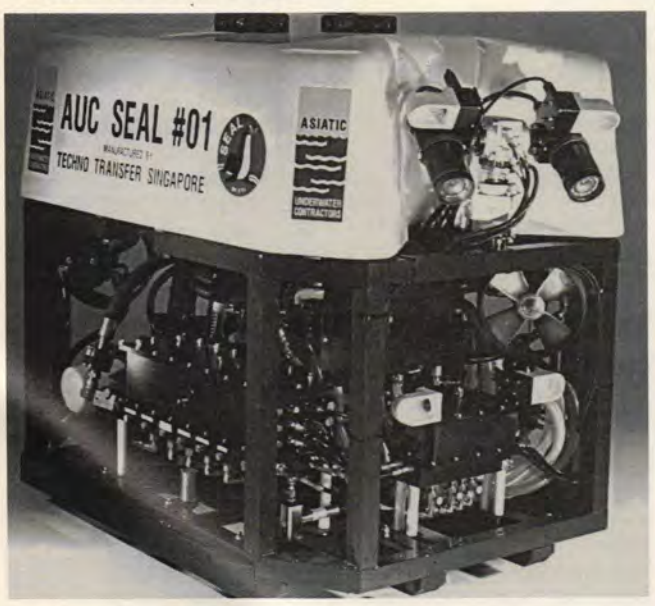
Seal found in Singapore

An advanced new light work class ROV (Remotely Operated Vehicle) has been developed in the Singapore design workshop of Racal Techno Transfer Industries.

The new Seal is a 50 hp free swimming vehicle capable of carrying out a wide variety of tasks at depths of up to 600 metres. It also offers a degree of flexibility which puts it at the head of its class for this type of ROV.

In addition, it offers a range of user benefits which include a pan and tilt unit with up to three cameras and four lights, survey sensors, hydraulic power tools, work skids and the option of three, five or seven function manipulators.

The Seal has been load tested to 3,500 kg, which is twice its maximum working load. Measuring 1.5 metres x 1 metre x 1 metre, this compact vehicle also has two manipulator arms, an echo sounder, cameras and lights and gyro compass. The frame is constructed from stainless steel hollow sections forming a rigid box.



An advanced new light work class ROV

Steel goes metric

The National Association of Steel Stockholders (NASS) has announced that imperial sheet and plate sizes will no longer be treated as standard.

Following consultation with customers and the principal European producers, NASS has introduced a range of true metric standard dimensions for sheet and plate.

The association believes that metric standards mean that customers will enjoy a higher 'in-stock' frequency as stockholders will be able to hold larger amounts of fewer size.

Rapid pipe inspection

Dramatic savings in time and expense can now be achieved for routine inspections of pipes and vessels under lagging, according to Newson Gale.

The company's new Q-C Plug system enables an inspection point to be accessed quickly, without tools or the attendance of skilled engineering staff.

Already well proven in Europe, the plugs replace the traditional system of sealed, screwed-on, sheet metal plates and are suitable for operations of up to 260°C. They eliminate the need for painstaking initial installation and sealing, claims the company, as well as the expensive, time-consuming act of panel removal and replacement by maintenance staff during inspections.

With the new system, inspections become a one person operation. For each observation, the plug can be removed and re-inserted quickly, to give a watertight seal. The system allows for innumerable inspections without any damage to either access points or the insulating material.

Rubber plugs are available in two and a half inch and five inch diameter sizes. Each plug comes complete with aluminium supporting ring and seal.

CONTACTS

Hawke Connection Systems Division	01229 587366
Cass AlarmWatch	01784 436266
Plenty Filters	01635 42363
Lintott	01603 745621
Measurement Technology	01582 23633
Sundstrom Safety	010 46 8 767 9085
Dieseline	01933 460555
Cabot Safety	01625 878320
Parker Hannifin	0442 238100
Stanhope-Seta	01932 564391
Esab (UK)	01992 765815
Newson Gale	0115 982 2422
Racal Survey	01734 669969
NASS	021 632 5821

FORTHCOMING EVENTS

February

12th-15th
Texas: 'SPE Symposium on Reservoir Simulation'. Details: SPE Meetings and Exhibitions Dept, P O Box 833836, Richardson, Texas 75083-3836.
Tel: 1 214 952 9393
Fax: 1 214 952 9435

13th
London: 'Financing the International Oil Industry - An Impending Problem'. Details: Conference Dept, The Institute of Petroleum, 61 New Cavendish Street, London W1M 8AR.
Tel: 0171-467 7100
Fax: 0171-255 1472

13th-16th
Washington DC: 'US Geological Survey - Energy and the Environment'. Details: US Geological Survey McKelvey Forum, Mail Stop 934, Denver Federal Center, Box 25046, Denver CO 80225-0046.
Tel: 1 303 236 5769
Fax: 1 303 236 8822

14th
London: 'Influences on Future Markets'. Details: Catherine Cosgrove, The Institute of Petroleum.

14th
London: 'Refinery Hydrogen Requirements – 'Make' versus 'Buy''. Details: Professor Keith Guy, F Eng, Director of Marketing, Air Products – Europe.
Tel: 01932 249591
Fax: 01932 253950

14th-17th
Texas: 'SPE International Symposium on Oilfield Chemistry'. Details: SPE Meetings and Exhibitions Dept, P O Box 833836, Richardson, Texas 75083-3836.
Tel: 1 214 952 9393
Fax: 1 214 952 9435

14th-17th
Austria: 'Centerex 95 - Central & Eastern European Engineering, Manufacturing & Investment Exhibition'. Details: Exhibitors, Sterling International, 86/88 Edgware Road, London W2 2YW.
Tel: 0171 915 9600
Fax: 0171 723 5908

15th-17th
France: 'Economics and Management of Exploration and Production'. Details: Mrs Josée Foucault, ENSPM FI, Economie et Gestion, 232 avenue Napoleon Bonaparte, BP311, 92506 Rueil-Malmaison Cédex France.
Tel: 33 1 47 52 72 93
Fax: 33 1 47 52 70 66

16th
London: 'North Sea Facilities Abandonment'. Details: Susan Ashton, The Institute of Petroleum.

21st-22nd
Caracas: 'Joint E&P Forum/PDVSA, Health Safety & Environment Workshop'. Details: Mr C L Corrie
Tel: 582 708 4203
Fax: 582 708 4941

22nd-23rd
Vienna: 'Financing the Oil and Gas Sector in the Former Soviet Union'. Details: Ulrike von Lonski, Business Seminars International Ltd, The Old Court House, Hurst Green, East Sussex TN19 7QP.
Tel: 0171 490 3774
Fax: 0171 490 8932

22nd-24th
France: 'International Crude Oil and Products Trading'. Details: Mrs Josée Foucault, ENSPM FI, Economie et Gestion, 232 avenue Napoleon Bonaparte, BP311, 92506 Rueil-Malmaison Cédex, France.
Tel: 33 1 47 52 72 93
Fax: 33 1 47 52 70 66

23rd-24th
London: 'Oil & Caviar in the Caspian'. Details: Menas Associates Ltd, PO Box 513, London E17 6PP.
Tel: 0181 520 8067
Fax: 0181 520 1688

23rd-24th
Texas: 'Tension Leg Platform Technology'. Details: Malcolm Sharples, Society of Naval Architects and Marine Engineers, Texas Section, P O Box 25045, Houston, Texas 77265.
Tel: 1 713 558 7180
Fax: 1 713 558 2098

24th
London: 'Energy Now and the Next Fifty Years'. Details: The Conference Manager, The Watt Committee on Energy, Burlington House, Piccadilly, London W1V 0LQ.
Tel: 0171 434 3988
Fax: 0171 434 3989

27th-28th
London: '1998 - The Future of the Electricity Market'. Details: Paul Grant, EuroForum, 14 Bowden Street, London SE11 4DS.
Tel: 0171 793 1230
Fax: 0171 793 8544

27th-2nd
California: '1995 International Oil Spill Conference'. Details: 1995 International Oil Spill Conference, 655 15th Street, N.W., Suite 300, Washington DC, 20005 USA.
Tel: 202 639 4202
Fax: 202 347 6109

27th-3rd
Houston: 'Improved Oil Recovery – Unit 1: Conventional Injection Methods'. Details: OGCI Training, Inc., PO Box 35448, Tulsa OK 74153-0448, USA.
Tel: 918 742 7057/800 821 5933
Fax: 918 742 2272
Telex: 6734499OGCI UW

28th
London: 'International New Ventures Conference'. Details: Simon Petroleum Technology Ltd, Llandudno, Gwynedd, LL30 1SA
Tel: 01492 581811
Fax: 01492 596674

28th-2nd
Amsterdam: 'SPE/IADC Drilling Conference'. Details: SPE Meetings and Exhibitions Dept, P O Box 833836, Richardson, Texas 75083-3836.
Tel: 1 214 952 9393
Fax: 1 214 952 9435

March

1st-3rd
Vietnam: 'PetroVietnam 95'. Details: SPE Meetings and Exhibitions Dept, P O Box 833836, Richardson, Texas 75083-3836.
Tel: 1 214 952 9393
Fax: 1 214 952 9435

5th-8th
Houston: '1995 AAPG Annual Convention - Petroleum Technology of the World'. Details: AAPG Convention Dept, PO Box 979, Tulsa, Oklahoma, 74101– 0979, USA.
Tel: 1 918 584 2555
Fax: 1 918 584 2274

6th-10th
Houston: 'Geophysics for Engineers'. Details: OGCI Training, Inc., PO Box 35448, Tulsa OK 74153-0448, USA
Tel: 1 918 742 7057/800 821 5933
Fax:1 918 742 2272
Telex: 6734499OGCI UW

8th-9th
London: 'Pricing Offshore Access in Oil & Gas Transport, Storage & Processing'. Details: SMi Ltd, 2nd Floor, 45 Curlew St, Butlers Wharf Business Centre, London SE1 2ND.
Tel: 0171 417 7790
Fax: 0171 417 7791

FORTHCOMING EVENTS

8th-10th
California: 'SPE Western Regional Meeting'. Details: SPE Meetings and Exhibitions Dept, P O Box 833836, Richardson, Texas 75083-3836.
Tel: 1 214 952 9393
Fax: 1 214 952 9435

12th-16th
Cairo: 'Sandstone Mapping Workshop'. Details: OGCI Training, Inc., PO Box 35448, Tulsa OK 74153-0448, USA
Tel: 1 918 742 7057/800 821 5933
Fax: 1 918 742 2272
Telex: 6734499OGCI UW

20th-24th
Canada: 'Basic Well Testing'. Details: OGCI Training, Inc., PO Box 35448, Tulsa OK 74153-0448, USA
Tel: 1 918 742 7057/800 821 5933
Fax: 1 918 742 2272
Telex: 6734499OGCI UW

22nd-23rd
Vienna: 'Distribution of Oil and Gas in the Former Soviet Union'. Details: Lisa Bilby, Business Seminars International Ltd, The Old Court House, Hurst Green, East Sussex TN19 7QP.
Tel: 0171 490 3774
Fax: 0171 490 2362/8932

23rd
London: 'Looking over the fence – profit improvement by understanding the fuels/ petrochemicals interface'. Details: Caroline Little, The Institute of Petroleum.

23rd-26th
Australia: 'The AusIMM 1995 Annual Conference'. Details: The Australasian Institute of Mining and Metallurgy, PO Box 660, Carlton South, Victoria, Australia 3053.
Tel: 613 662 3166
Fax: 613 662 3662

27th-3rd March
France: 'Planning and Economics of Refinery Operations'. Details: Mrs Josée Foucault, ENSPM FI, Economie et Gestion, 232 avenue Napoleon Bonaparte, BP311, 92506 Rueil-Malmaison Cédex, France.
Tel: 33 1 47 52 72 93
Fax: 33 1 47 52 70 66

28th-29th
Istanbul: 'Oil and Gas Pipelines in the Central Asian Republics'. Details: Lisa Bilby, Business Seminars International Ltd, The Old Court House, Hurst Green, East Sussex TN19 7QP.
Tel: 0171 490 3774
Fax: 0171 490 2362/8932

30th
London: 'Financing the Frontier – the City's role in the West of Shetlands' Oil Development'. Details: Caroline Little, The Institute of Petroleum.

30th-31st
Norway: 'The Bergen Conference on Oil and Economics '95'. Details: Gerd Jæger, Norwegian Petroleum Society, P O Box 95, 5049 Sandsli, Norway.
Tel: 47 55 99 72 35
Fax: 47 55 99 72 38

April

4th-8th
Moscow: '3rd Moscow International Oil & Gas Exhibition & Conference'. Details: Byron House, 112a Shirland Road, London W9 2EQ.
Tel: 0171 286 9720
Fax: 0171 286 0177

27th
London: 'The Bottom of the Barrel – how to dispose of it , and still make a profit'. Details: Caroline Little, The Institute of Petroleum.

PEOPLE

Ernst & Young, the international accounting and consultancy firm, has reinforced its commitment to the energy industry with the appointment of *Michael Lynch-Bell* (above) as Chairman of the firm's International Energy Group and *Dr Michael Horder* (below) as head of their UK Energy Practice.

Graeme Crombie is the new chairman of the government-owned ferry company Caledonian MacBrayne. The appointment from 1 January will last three years. He succeeds **Mr Sandy Struthers.**

John Walmsley, one of the founding directors of Enterprise Oil, is to become chief executive of Hardy Oil & Gas, the UK's largest oil explorer, from the beginning of January.

Mr Mike Cloughley has taken over as Executive Secretary of the E&P Forum replacing **Mr Geoff Thorp** who retired on the 15 December 1994.

Jim Morgan has been appointed as General Manager – Aberdeen Operations – at the OCS Technology Group Offices in the recently opened Aberdeen Offshore Technology Park.

Hartmann & Braun has strengthened its UK Digital Systems Division. **David Pridgeon** joins them from Siemens UK as Senior Account Manager – Energy. **John Waring,** Senior Account Manager joins from EDS. **Ian Walker** is the third appointment who joins as Proposal Engineer.

The 97th Meeting of the OPEC Conference unanimously appointed the former Nigerian Minister of Petroleum & Mineral Resources, **Dr Rilwanu Lukman**, as Secretary General for a period of three years, beginning 1 January.

Diamond Offshore Drilling Inc have appointed **Mr David Williams** as Senior Vice President Contracts and Marketing, effective 5 December 1994.

Martin Bishop, Managing Partner of Franklin & Andrews has announced that **Wilson G Mills** is to become Manager of its newly established Glasgow office.

The UK Offshore Operators Association's (UKOOA) Executive Officers for 1995 have been announced. The President will be **Mr Michel Romieu**, Chairman and Managing Director, Elf Enterprise Caledonia Ltd. Vice Presidents are **Ms Patricia Horsfall**, President and Managing Director, Oryx UK Energy Company and **Mr Heinz Rothermund**, Managing Director, Shell UK Exploration and Production. Honorary Secretary is **Dr George Watkins**, Chief Executive, Conoco (UK) Ltd and **Mr Lance Johnson**, President, Mobil North Sea Ltd is Honorary Treasurer.

John Shanley is to become Managing Director of Mobil Gas Marketing (MGM), one of the leading independent UK gas marketers. He succeeds **Ted Trafford**, whose appointment as head of the newly-formed Mobil European Gas Company (MEGAS) was announced recently.

Professor Keith White-Hunt has been appointed to **His Highness Sheikh Isa bin Salman Al-Khalifa, Amir of Bahrain,** Chair in Technology Management at Arabian Gulf University, which is the principal regional Postgraduate University for Saudi Arabia, Kuwait, United Arab Emirates, Oman, Qatar and Bahrain.

David McManus has become ARCO British Limited's new Commercial Director, replacing **Len Smith**, who is leaving to take up the position of Manager Power Generation Development and Vice-President of ARCO Asia Pacific Ltd in Hong Kong.

***Dr Alan M Ebner* is the new vice president and general manager of Raytheon Engineers & Constructors new International Operations Center in Houston.**

Brisco Engineering Ltd have appointed **Brian Green** as Sales Director responsible for worldwide sales & marketing activities.

Angus Murdoch has joined Smedvig Resource Management, the production contracting company as Manager, Production Services Division.

Thermal Designs International Ltd have made two new appointments to strengthen their European sales team. **Anthony Webber** has joined the company to take up the post of Technical Sales Manager and **Matt Croft** has been appointed Internal Sales Liaison. They are based at the new larger site at Atworth in Wiltshire.

Lloyd's Register has appointed **Ann Nussey** as director of information technology with effect from 23 January. She will be a member of the Management Committee.

Mr Malcolm Stone has decided to resign as Non-Executive Vice-Chairman from Fortune Oil plc, in order to devote his full energies to COM-TEK Resources, Inc. where he has recently become Executive Chairman.

Fluor Daniel, the principal subsidiary of Fluor Corporation has announced the appointment of **Martin van Buren** as Vice-President, Marketing and Sales, Europe.

Ramco Energy plc, the international energy group, has appointed three new Directors to the company's Board. **Mr Peter Everett** and **Mr Herbert Denton** are Non-Executive Directors and **Mr Michael Burchell** has been appointed Executive Director.

***Mark M Fermor* (above) has joined Water Management Consultants as UK Environmental Manager, based in the company's Shrewsbury offices. He will have particular responsiblity for developing WMC's environmental capabilities, and also help manage the growth of their European business. Water Management Consultants has also named *Jonathan Wyatt* Director of both Water Management Holdings Ltd in the UK and Water Management Consultants Ltd in Chile.**

EUROPEAN INVESTMENT BANK

The **EIB,** the financial institution of the European Union, is currently seeking for its headquarters in **LUXEMBOURG** an:

Energy Economist (m/f)

(with 3 to 5 years of practical experience)

Duties: he/she will be responsible, as a member of EIB project evaluation teams, for the economic appraisal of energy projects located in the European Union and EFTA countries.

Qualifications: candidates should possess a university degree in economics (MA, MBA or Phd) and possibly a post-graduate qualification in energy economics. A strong background in quantitative analysis and experience both in the economic evaluation of energy projects and the preparation of energy sector studies is required. Experience in the oil and gas industry, including refinery economics would be appreciated.

Languages: as the working languages are **English and French**, it is essential to have perfect knowledge of one and a good command of the other. Knowledge of other languages would be an advantage.

The EIB offers attractive terms of employment and salary with a wide range of welfare benefits.

Applicants, who must be nationals of a Member Country of the European Union, including Austria, Finland and Sweden, are requested to send a detailed curriculum vitae in English or French, together with a photograph, **quoting the appropriate reference,** to:

EUROPEAN INVESTMENT BANK
Recruitment Division (Ref.: ET/PM 9501)
100 boulevard Konrad Adenauer
L-2950 LUXEMBOURG. Fax: 4379 3360.

Applications will be treated in strictest confidence and will not be returned.

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Now the European community is following the US lead on environmental protection. Strict laws will govern safe containment and recovery of hydrocarbon vapour.

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KALDAIR's process is based on activated carbon beds, which trap the volatile organic compounds. An air-cooled chiller recovers these dangerous emissions back to a usable liquid form.

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If you load, store, or unload motor fuels, you're probably paying a double penalty.

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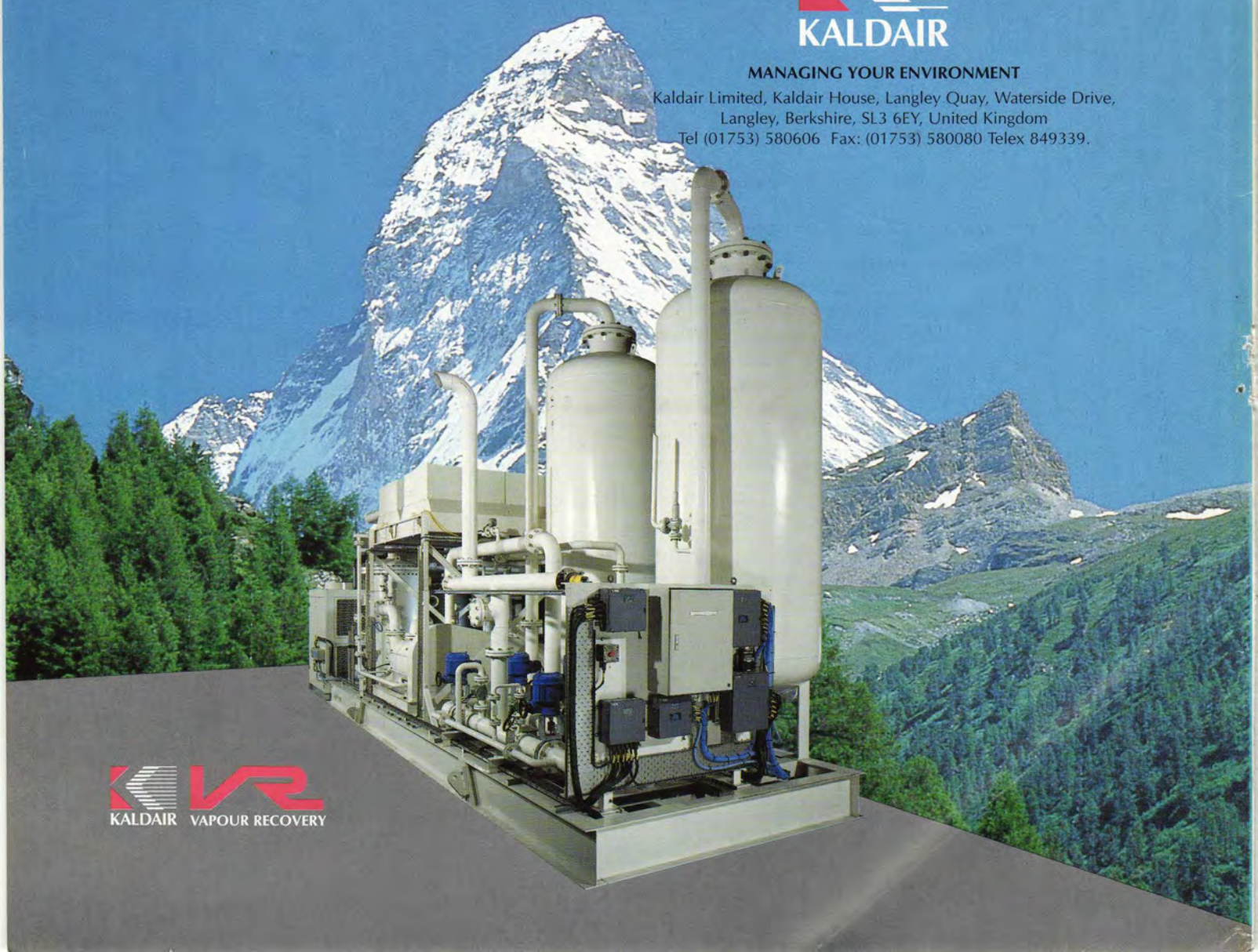
Langley, Berkshire, SL3 6EY, United Kingdom
Tel (01753) 580606 Fax: (01753) 580080 Telex 849339.



KALDAIR VAPOUR RECOVERY