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The Institute acquired its crest, designed by the College of Heralds, in 1949. Its motto, 'Conjunctione Potiores' (strength through unity), supports a shield portraying the Archaeopteryx, an avian fossil which was found in Jurassic strata similar in age to important oil-bearing formations in the North Sea.

EDITORIAL

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Cover: Peter Everett, Managing Director, Shell UK Exploration and Production, right, was photographed in his office in London with Geoffrey McMullen, Manager, Information Services, and the desk top information system now used by senior management. Information on all exploration and production activities is displayed instantly through the easy operation of the mobile white 'mouse' seen in the foreground. Photo: Geoff Bruce. Article page 4.

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The Institute of Petroleum

IP WEEK 1988
15th–19th FEBRUARY
London

The Programme of Events organised by The Institute of Petroleum for IP Week 1988 is as follows:

Monday 15th February

Meeting of the IP Energy Economics Group, at the Institute, at 5.30. **Massood V Samii, JF Kennedy School of Government, Harvard University,** will speak on 'OPEC and the Oil market'.
IP Contact: Gwen Douglas

Tuesday 16th February

Half-day morning meeting of the IP Information for Energy Group on **Oil Price Information**, at the Institute.
IP Contact: Jean Etherton

Luncheon Meeting, at The Inn On the Park Hotel.
Dr Juan Chacin Guzman, President of Petroleos de Venezuela will be the speaker.
IP Contact: Caroline Little

Half-day afternoon seminar on **Oil in Latin America.** Speakers from **Brazil, Colombia, Ecuador, Mexico, Venezuela. Dr Alirio A Parra, Member of the Board, Petroleos de Venezuela, SA,** will be in the Chair.
IP Contact: Caroline Little

Meeting of the IP London Branch, at the Institute, at 6.00.
Mr C Johnson, Marketing Operations Manager of Esso Petroleum Co Ltd, will give a presentation on 'Terminal Automation — Plants of the Future'.
Contact: Edith Walker on 01-408 6215

Wednesday 17th February

Annual Dinner at Grosvenor House. The Principal Guests will be the **Secretary of State for Energy, The Rt Hon. Cecil Parkinson, MP,** and **Mr Arne Øien, Minister of Petroleum and Energy, Norway.**
IP Contact: Caroline Little

Thursday 18th February

Half-day morning seminar at the Institute on **The Oil Industry in Latin America — Prospects for Equipment Suppliers**, in association with the Offshore Supplies Office.
IP Contact: Caroline Little

Luncheon Meeting, at The Dorchester Hotel.
Mr Nader Sultan, President of Kuwait Petroleum International Ltd., will be the speaker. **IP Contact: Caroline Little**

Meeting of the IP Exploration and Discussion Group, at the Institute, at 5.30, on the subject of 'Dorset Oil – The Wytch Farm Story' chaired by **Mr RTL Mowll, Development Director, Dorset, BP Petroleum Development Ltd.**
IP Contact: Charlotta Juhlin

For further information on any of the events during IP Week 1988, please contact The Institute of Petroleum, 61 New Cavendish Street, London W1M 8AR. Telephone: 01-636 1004. Telex: 264380. Fax: 01-255 1472.

Headlines

9 December

BP buys 15 per cent stake in Britoil and announced a tender offer to bring its holding up to 29.9 per cent.

Petrobras and Texaco sign joint agreement to drill up to 18 wells on outer continental shelf of Gulf Mexico.

Delegates to OPEC conference pessimistic that they could reach accord strong enough to sustain $18 a barrel price let alone higher one.

10 December

Four major N Sea operators swap assets in deal to give Enterprise Oil new operatorship while Chevron and Conoco increase stakes in new oil and gas fields.

Iranian Oil Minister says unless 12 other OPEC members accept min $2 rise in reference price of barrel, Iran would refuse to sign 1988 pricing and production agreement and would boost its production, trading higher output at spot rates.

11 December

Kuwait Investment Office confirms its stake in BP has risen from 10.44–11.52 per cent, analysts expect its holdings to reach 15 per cent.

Britoil sends letter to shareholders spelling out firm opposition to take over, especially by BP.

Deal enabling Statoil to transport N Sea gas to Austria via W Germany's Ruhrgas system close to approval after long stalemate.

14 December

Elf Aquitaine makes hostile £134.7m cash bid for Tricentrol.

NAM discovers substantial natural gas deposit under site of Shell Netherland BV Pernis oil refinery near Rotterdam.

Asian Development Bank approves technical assistance grant to Pakistan for feasibility study of oil terminal.

Iran throws OPEC into confusion when changes tack as agreement seemed imminent by demanding cut in output quota to 15.8mb/d as condition to agreeing that present oil price be maintained.

15 December

Chinese state councillor says country must double oil processing capacity by end of century to meet rising domestic demand.

Chevron/Texaco consortium expected to be first of six international oil grps to reach agreement with Indian govt for long-term offshore oil exploration contracts.

OPEC members, except Iraq, patch together compromise which will continue production sharing pact, set at 15.06mb/d.

17 December

Tricentrol formally rejects Elf takeover bid as 'wholly inadequate'.

AGIP Spa announces it signed contract with Sonatrach to jointly exploit part of Rom oil field in Algeria.

Irish govt in final stage of negotiating $200m deal with Nigerian govt under which Nigeria would invest in Whitegate oil refinery.

NYMEX set to launch unleaded gasoline options contract after receiving regulatory approval.

Elf Aquitaine chairman calls on EEC to harmonise taxes paid on petrol sales to prevent distortions in trade between members.

18 December

Burmah Oil announces it has bought UK petrol business from ICI for £21m increasing its share of retail mart to 5 per cent.

International Petroleum Corp of Canada signs contract with Indian govt to explore for oil in Bay of Bengal offshore east coast India.

NAM BV spokesman says well drilled in Dutch N Sea flowed natural gas at rate of 800,000 cubic m per day.

Chevron Corp says it's involved in negotiations with Sudanese govt aimed at restarting oil development work in country.

21 December

Britoil to submit arguments to takeover panel on why BPs takeover bid should be disallowed.

British Gas places £60m contract with company owned by Press Offshore and McDermott International, to build two drilling platforms for Morecombe Bay gas field.

22 December

BP discloses it is applying for formal permission to develop Miller prospect offshore Aberdeen with first oil expected to flow in 1991.

UK govt will give further help to N Sea oil industry in 1988 through extended tax relief grant system.

Canadian Industry Minister approves acquisition of Dome Petroleum by Amoco Canada Petroleum pending shareholder and creditor approval.

Indian govt signs three contracts with Texaco/Chevron consortium for offshore oil exploration in Krishna Godavari and Palar basins.

Union Texas Petroleum announces 3 onshore crude oil discoveries, part of 14 well joint venture exploration prog with Neste Oy.

23 December

Panel on Takeovers and Mergers approves BPs £2.7bn offer for entire share capital of Britoil.

Esso Expro Australia and BHP Co Inc say that recent oil excise changes permitted development of Tarwhine and Seahorse fields in Bass Strait.

Gulf states that have violated OPEC oil production quotas are preparing to cut back by as much as 700,000b/d say reports.

29 December

Consolidated Gold Fields takes step toward diversifying into N Sea oil and gas by acquiring 50 per cent interest in Klienwort Benson Energy.

Bangladeshi Energy Minister says his country will sign production sharing agreement with Scimitar Oil Co for drilling and exploration in its only oil field.

Saudi Arabia warns OPEC colleagues it will not act as swing producer to compensate for other countries excess oil output and support prices.

30 December

Britoil set to unveil major N Sea oil discovery in Eocene Sands, appraisal wells expected to confirm its importance.

Ultramar to set up Canadian onshore exploration effort following new joint venture agreed with Japanese grp, Canpex.

Several oil cos warn Saudi Arabia it will risk severe cut in production in 1988 unless it offers discounts on official price.

Gulf Cooperation Council says it should stick to OPEC price and output accord, and called for an end to price discounting.

4 January 1988

Traders say Transworld Oil acquired all available cargoes of Brent blend due to be loaded in next three weeks from Sullom Voe, and that the co is demanding premium of around $1.25 a barrel from refiners and intermediaries who need the oil to meet commitments.

Several leading N Sea oil projects put on industry's 'back burner' in 1987 owing to weak oil price likely to be brought forward.

Head of Norway's Petroleum Directorate calls for Norwegian Soviet collaboration on offshore safety in Barents Sea along same lines as N Sea sector clubs.

World reserves recoverable oil are 27 per cent bigger than estimated 12 months ago says Oil and Gas Journal.

5 January

ARCO continues buying Britoil shares and announced it has raised its stake in the company from 21.21–21.25 per cent.

Islamic Development Bank says it has extended a loan of $15m to Morocco for the import of crude oil from Kuwait.

Statoil says it has struck gas on Barents Sea block 7226/11 the easternmost well yet drilled in northern Norway's Arctic waters.

Delegation of Iranian technical experts to arrive in Ankara on 11 January to begin final negotiations for a pipeline to pump Iranian crude through Turkey.

6 January

Market linked price formulae are dominating Australian domestic crude supply contracts for first year under decontrolled pricing say sources.

Norwegian PM rules out privatisation of any part of Statoil following controversy over massive cost overruns in the company.

Shell International Chemical Co says it offered to buy govts 50 per cent stake in Petrochemical Corp of Singapore.

7 January

Hectic dealings in BP shares result in Kuwaitis increasing stake in co to around 20 per cent.

Report released on Jan 6 says oil drilling activity in N Sea picked up sharply in last 4 months of 1987 tripling to 39 exploration and appraisal wells.

Northern Michigan Exploration Co announces second significant oil discovery in Ecuador, achieving a cumulative daily prod rate of 2,102b/d.

State of California files suit in federal court of San Francisco seeking to block attempts by National Oceanic and Atmospheric Admin to change way state regulates offshore oil projects.

8 January

Efforts by Brazilian nationalists to exclude foreign cos from distributing petrol and oil products in the country have collapsed.

Total CFP signs four year industrial cooperation agreement with Indian Oil and Gas Commission to help India explore and develop its hydrocarbon resources.

BP Australia Ltd says it's made a large gas discovery in Papua New Guinea which could contain 1.5 trillion cubic feet of gas.

Texaco Inc is negotiating to sell an interest in its Euro refining operations to Venezuelan national oil co as part of strategy to contribute certain Texaco assets to joint ventures.

11 January

UK Treasury moves to quell speculation over intentions of KIO by announcing the Kuwaitis pledged not to seek control of BP.

Indian govt raised petrol prices by 14.4 per cent at weekend in attempt to curb rapid growth in consumption.

Gulf tanker war triggers 'pipeline fever' in region with oil producing states scrambling to build overland lines to reduce dependence on ships to export oil.

To interpret data from three dimensional seismic surveys in the North Sea, Shell Expro has recently acquired a third party system from The Landmark Corporation.

Computing in the upstream comes of age

Geoffrey Mayhew reports

Geoff McMullen, Manager of Computing for Shell Exploration and Production (Expro), is describing the advances in the use and control of information technology in exploration and production by Shell UK. 'If you look at the situation in the mid 60s, when Shell became active in the North Sea,' he said, 'you can detect three strands of activity:

- The first was the early use of computers for signal processing and seismic analysis.
- The second was the use of computers to replace people in basic administrative and bookkeeping tasks.
- The third, by the late 60s, was the early use of computers for applications such as economic evaluation and for helping managers to make better decisions.

'All three of these aspects are still visible, although the technology has moved on dramatically,' he said, and he pointed out the essential changes.

'Seismic processing and reservoir evaluation are now essential to the running of the business.

The basic administration of a company of this size and complexity is a task which would be unimaginable without

The Landmark third party system is an example of computer equipment becoming more compact. The process unit is little larger than a suitcase. An LP disc, being inserted, has a capacity equal to two million A4 sheets.

computers.

The use of the computer in a tentative form for economic analysis and decision making has turned into a personal computing revolution, which means that in Expro we have nearly 3,000 computer terminals and work stations with a total staff population of just over 5,000.

Almost all the onshore staff have computer terminals, and use them for data collection, running the business, running economic and technical applications, and for the electronic mail systems which are beginning to take over the internal mail functions within the company.

The main difference between the management of the company in the 60s — as compared with today — is that computing then was the domain of the specialist. It was undertaken by, and largely used by, individual projects, and there was little appreciation of the overall effect of the computer, or its applications, on the future of the company either by the people developing those projects or the management for whom it was being done.

Nowadays, in Shell Expro, we see computer systems as an important part of the business and as an important capital investment.

This emphasis on the computer as an investment within the business, coupled with the desire to see how it affects the business, is a recognition of the fact that computer activities are now so organised that applications from their start, and through their development, are not seen as a specialist service function, but as a task done by people who work within a body of the business.

We have steering committees which coordinate the activities of these units and three times a year these are reviewed by the Executive Committee.

We also have the willingness on the part of the management to sponsor innovative and investigative work, as well as potentially important computer applications. Management Information projects that have a high visibility for the company are also very important.'

Video conferences

In progress on the fourth floor of Shell-Mex House in London is a visual example that anyone can understand. It shows how information technology, that complex science, is helping individuals to be more cost-effective in the exploration and production of oil and gas.

Three people are sitting in a row, their files on the polished table before them. They are in the middle of a meeting. They act as though others are present, and one of them is talking across the table about a seismic trace — which evidently all can see.

In Shell-Mex House, London, Shell Expro staff are holding a video conference with three people in the Aberdeen office, using a diagram — and saving time and expense.

But who is he talking to? The other side of the table is empty. Where is the rest of the meeting?

It happens to be in another similar room in the Shell office in Aberdeen. We have intruded upon a video conference.

Each half of the meeting, 600 miles apart, can see the other participants on a colour screen mounted in a large cabinet on the other side of their table.

Each cabinet also carries a second screen. This can be used to show a white board, which is also in the room, or to show documents which are placed in front of a camera used specifically for that purpose and which has a zoom facility. People at the meeting may need to use either of these facilities suddenly to illustrate a point. They can thereby swap illustrated ideas.

Adjacent to the cabinet is a fax machine if copies need to be exchanged within a minute or so.

Clearly, within quite a brief time things were being discussed here which might otherwise have taken weeks.

Shell initiated this service between Shell Mex House, Aberdeen and Lowestoft in February 1987 as an experiment. Very soon the question was: how soon can it be expanded?

The savings in travelling costs and time have been large.

A video conference with 12 people participating costs about £200 an hour. The saving on the travelling cost between London and Aberdeen makes it an attractive proposition.

Interestingly, it is also leading to a different style of management. For example, at either end of the meeting extra people can be called to give their advice or information. Other documentation can be provided. There is little need for adjournments.

The meeting is more concentrated, less discursive. It has been found to have more immediacy than telephone calls.

As such units are at present rare, it is likely, as with other information technology, that its costs will fall as applications develop. In five years, Shell experts estimate, the video conference will be operable between the mainland and offshore.

Remarkable developments

It hardly needs to be said that Shell Expro, which also acts as operator in the North Sea for Esso, would be unable to carry out either of its exploration or production functions without the use of computers.

Having said this, what must be added is that the information technology developments which Shell Expro is now adopting or testing or considering, to help its staff to get more business done, are remarkable.

The amount of information stored in such an organisation is vast and complex.

Continued overleaf

As the means of obtaining information by computer gets better, the means of retrieving and co-relating what would otherwise be an overwhelming mass of statistics must be better still. At the same time, the time of the manager himself becomes increasingly limited.

Instant access

In June 1987 a project was set in motion which would give senior management an instant, press-button, desk-top information system on all exploration and production activities.

By September a software model had been devised that allowed very detailed cross examination of the information, which could be displayed in different colours on the terminal screen. Speed and ease of use was enhanced by the introduction of a 'mouse'. This is a small electronic pad which can be moved across a flat surface to select which information is displayed, and which is much quicker and easier than using a traditional keyboard.

Two important features are the coloured graphics and the use of colour to display variance from expected results. Some information on the system is only two days old, and is produced in-house. The back up team is small — a few technicians, and staff who collate the data, which is already available. Eventually, all information will be put into the Shell system once.

Electronic mail

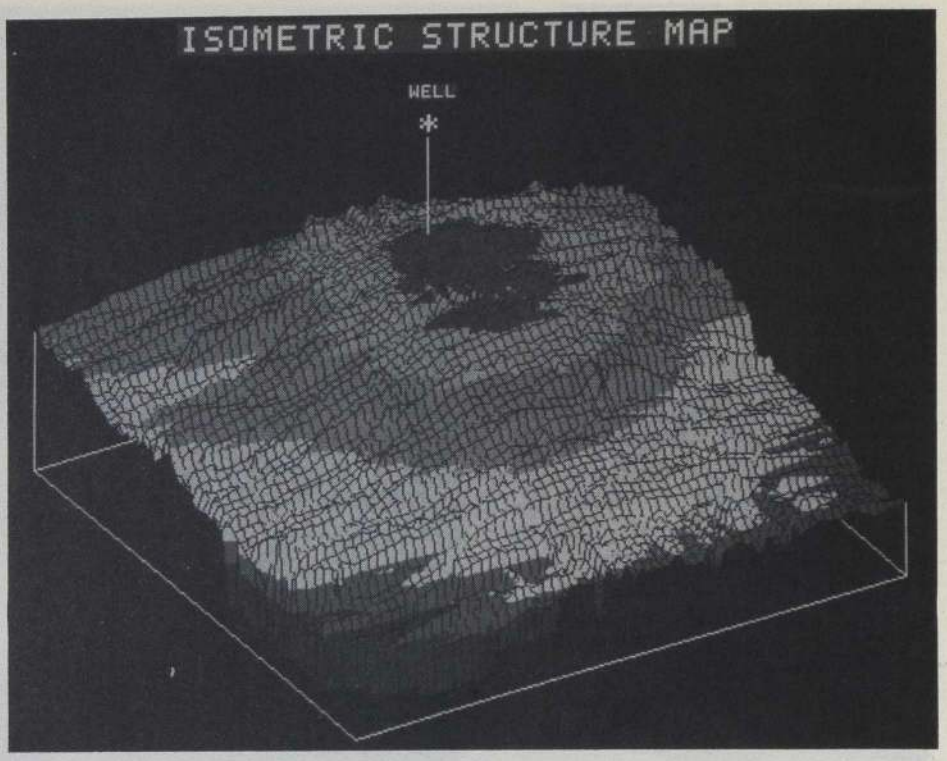
Electronic messaging is being seen increasingly as the best method for the urgent, and a good deal of the most important correspondence. Using his desk top computer keyboard, the manager can reach all the North Sea platforms with his electronic memo. 1,000 people within the company now have the facility.

The message is tapped out and can be edited as with a word processor. Once initiated, the unit will repeat all the documentation automatically on subsequent messages. These are filed automatically by the system.

The essence of an electronic message, for example: 'Can I attend the next safety drill?' is all the manager needs to tap out. Received instantly offshore, and by those copied, the reply of 'Yes — 12 March' can be spelled out and sent off instantly. The efficiency of this method compared with a telephone call or normal memo is obvious.

3D for smaller fields

Seismology is a major subject of in-house information technology at Shell Expro, employing software developed by Shell International for the processing of seismic survey data. Three dimensional (3D) surveys, used for several years in appraisal, are now being used in the exploration search for smaller fields. Again vast amounts of information are gathered as, in the North Sea, the dynamically navigated exploration vessels move down tracks 27 metres apart recording the reflections received from beneath the sea bed.



The shape of a reservoir as a result of processing three dimensional seismic data by the computer. Considerable information is given about the size, shape and type of the reservoir.

To help interpret this data from seismic reflections into geological structures Shell has recently acquired a third party system from The Landmark Corporation. It is another example of how computer equipment is becoming cheaper and more compact. The processing unit is placed beside or beneath a desk. It is little larger than a suitcase. The two screens on the desk top are of average size, but its colour reproduction is capable of minute detail. Despite its size it can store the seismic data of a large field like Brent several times over, and show any of this data on its screens instantly.

These units are heavily used, often reworking seismic data acquired in the past in order to take advantage of the new processing capabilities. The next move will be to replace the magnetic tapes currently used for storing this type of information with optical discs. These LP sized discs have a data capacity equivalent to 2,000,000 A4 sheets.

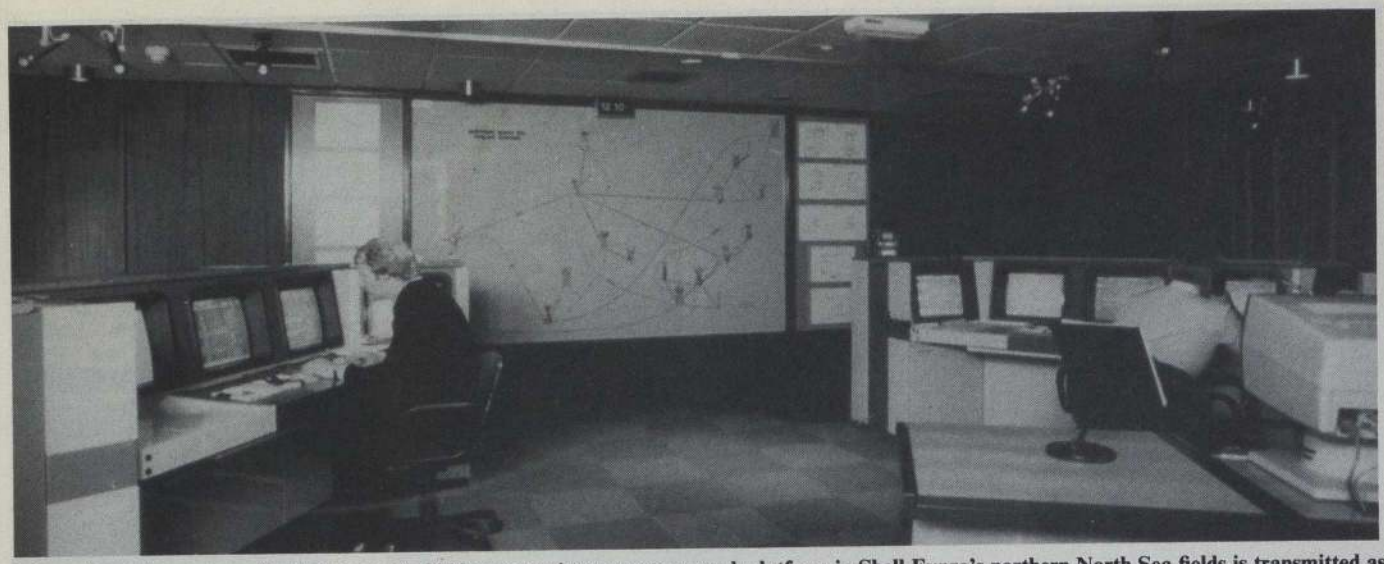
What is more, that information will be immediately retrievable on the screen. The screen can show a multi coloured map of sub-sea strata, the human interpreter using his skill to search for the structures which indicate a possible reservoir, or to refine the understanding of an existing field to find out if more oil can be extracted.

Pictures from 10,000 feet below the sea

At will, he can obtain greater definition of any particular area. To help his visual field examination, he may choose to adjust the colours to assess the picture of rocks more than 10,000 feet below the sea.

An oil operator knows he must have the latest information technology to assess his production and the reserves. Apart from efficiency, he is aware his partners in any enterprise are doing the same thing. Large scale finance can be involved in agreeing assessments about hydrocarbons. An example is where a field lies beneath more than one licensed block; another where a partner wants to realise some of his assets. The highest quality information is vital if costly mistakes are not to be made.

One of Petroleum Engineering's most important uses of information technology lies in detailed geological mapping, often in 3D, of small areas of special interest. Petroleum Engineering's responsibility is the appraisal of an oil find, the generation of development plans — which will include an assessment of



Information taken automatically from up to 2000 separate instruments on each platform in Shell Expro's northern North Sea fields is transmitted as frequently as once every 10 seconds to the Aberdeen Operations Control Centre, where it is further processed by computer to provide an overview of the entire system — with close-ups of individual systems on demand.

the number and location of wells, the number of platforms, pipelines etc — and the economic evaluation of these options.

Following instruction by a Project Team, the responsibility for field management will later revert to Petroleum Engineering. A great deal of data is essential throughout the life of a field to monitor the production, its efficiency and the life of the reservoir.

Information tools used world wide

To assist Petroleum Engineers, Shell has developed a standardised set of information tools and software which are used world-wide. It saves engineers the time of learning a new system when posted elsewhere. These tools include basic facilities such as the phase behaviour of hydrocarbon mixtures, how particular wells behave, and a system for evaluating well logs.

Reservoir Engineers often use a simulation model of a reservoir to assist in reservoir engineering studies. To be realistic, the simulation model must include information on faults in the structure and the variation of porosity, permeability and fluid saturations across the field. Assembling all this information can be a time consuming exercise, but once available the simulation model is a valuable tool in managing the reservoir. An improvement of, say, one percent in the production of a big field adds substantially to assets. Simulation models are run on Shell's large Cray computer in Manchester.

Geological maps which once were hand drawn, taking weeks to produce, can now be turned out quickly through the use of computer systems. Shell Expro can produce these computer drawings at the rate of 2,000 a month, with 200 different variations. This ability to put mapping onto a digital basis has been improved strongly in recent years and it is now possible to calculate reservoir values on much finer grids. As a result volumetric measurement of reservoirs can now be made much more accurately.

The geologist remains in a position to edit the coloured display of the strata on his desk top, however, as he gets a better deal from what he sees on the screen about the geological conditions below the sea. At the end of the day it is only by drilling, as in the past, that the answer can be found. Drilling leads to the update of the picture.

Structural engineering advance

Shell Expro's Engineering department uses huge amounts of information in major constructions, operations and the maintenance of fields. At any time a project will be dealing with thousands of objects, some enormous, some minute.

Each object is itself the subject of computerised information planning. Interestingly, information technology developments are taking place in this respect. For example, through simulation it has been the practice to calculate the steady state of existing plant. Now the dynamic state can be tested before the plant is actually built — much cheaper than the cost of any rectification later.

Structural engineering models can show at once how offshore platforms would react to changes in the weight carried — through, for example, the desire to replace equipment.

An advance on this would be the technique of computer engineering design, which is now receiving much attention in Shell Expro. This has been developing strongly over a decade and the spread of desk-top computers among engineers has assisted it. With this type of information technology engineers can test engineering conceptions on a vast scale, and also compute the costs.

It follows that in this need to iron out problems ahead of large scale investment, that knowledge-based information systems will be necessary. Here the computer is given, with less programming, a high level of intellectual input — and rules to complement this. While such a system is not to be described as intelligent, it can give information — it may even be possible to call this advice — in response to a deep level of questioning about what would happen if this or that course was followed.

At present it is experimental, but in a year or two it is likely to be another of the information tools used by Shell Expro to increase its cost-effectiveness.

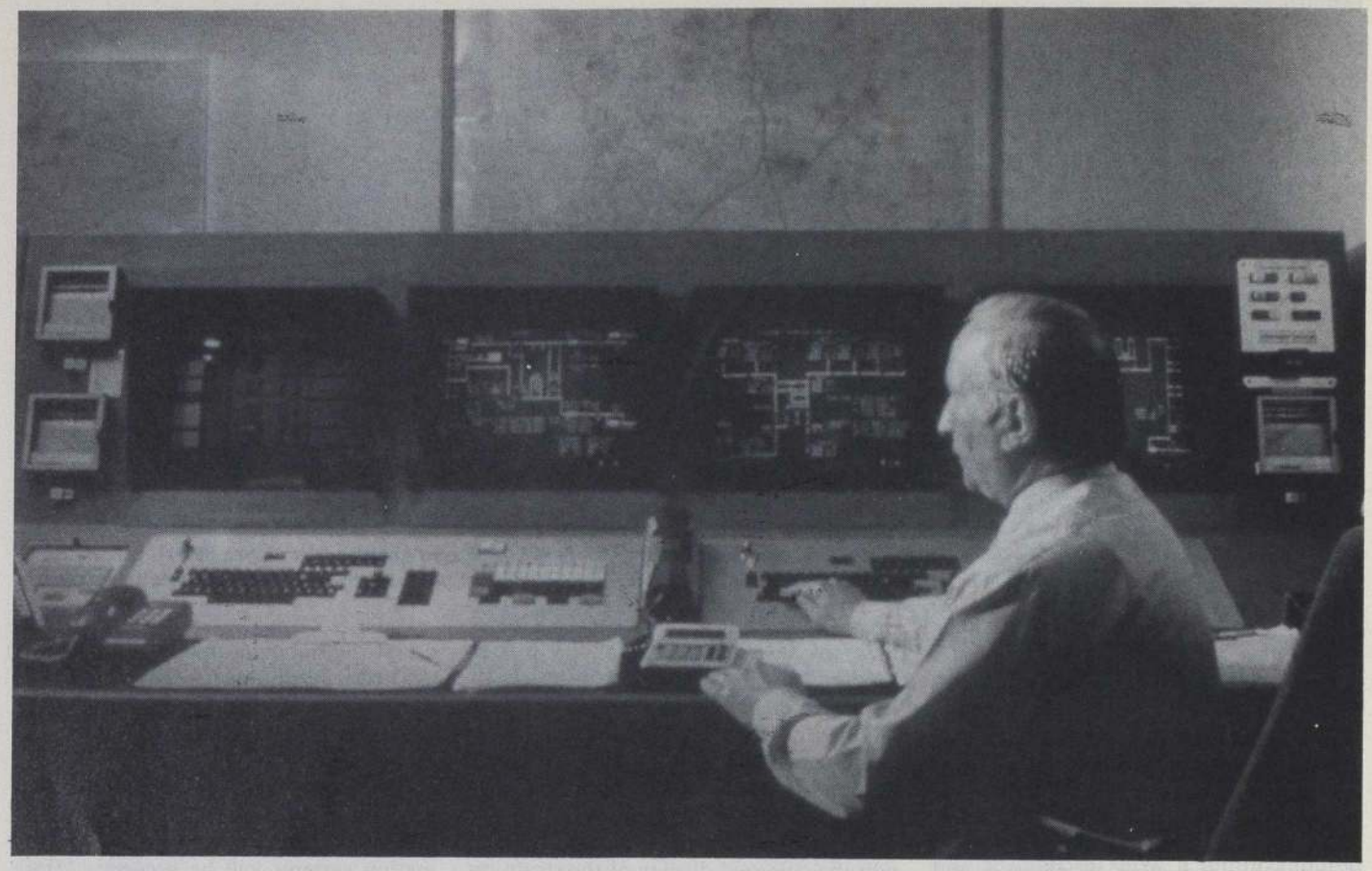
Computer operations are now basic

Geoff McMullen gave this view to sum up Shell's activities.

'We are clearly moving towards a future in which it will be impossible to differentiate within a given department the computer people and other users.

For example, we have engineers who are experts in the development of computer systems. Computer people in the department tend to have increasingly a very good knowledge of the business which they serve. They are increasingly qualified within the discipline they serve and we are spending time and money to educate them.

Information Technology has come of age. It is melting into the business. It has become so basic that, in effect, you cannot see it any more. It is an organic part of what the company does.' ●



UK pipeline control room at Esso UK Fawley refinery demonstrating process control via long distance telecommunications.

Information Technology for competitive edge in marketing and distribution

Ian R Glenday, Manager, Communications and Computer Services Department, Esso UK

Esso UK has invested in information technology for its marketing and distribution activities for over 20 years.

Nevertheless a major topic of conversation in any meeting of oil industry people today is how fast and how far should we invest in further information technology.

Whilst the opinions are many and varied, it is accepted that the onslaught of new technological opportunities is not going to go away and it does need managing.

Our prime experience as a company is the use of information technology for cost efficiency. Every part of our operations has benefited, from the marine fleet operation through to the retail forecourt. Current competitive fleet manning levels owe much to advanced process control applications as do refinery manpower, energy efficiency and plant optimisation.

Customers benefit

Information technology in distribution for Esso is exemplified by sophisticated pipeline control and management applications together with increasingly automated marketing terminals.

Our customers have benefited. They are pleased both with retail forecourt automation and the increasing use of automated order taking and delivery scheduling systems. The latter is a good example of technology being used for cost efficiency and improved service to our customers.

In reducing costs we have invested heavily to reduce clerical overheads in our sales accounting and other financial systems. These functions have been greatly reduced in manpower since the 1960s by the continuous application of major business systems technology.

The recent successful start-up of our Purfleet based computer controlled lubricants packaging and blending facility, with the automated warehouse, represents more major investment in Information Technology. The automation and robotics involved were justified by cost savings. However, such integrated technology can respond faster and more flexibly to our customers choice of lubricant grade and package size so providing a route to improved customer service.

Today, the availability of personal computers on every desk and the presence of advanced telecommunication links between these and central mainframe data bases poses new challenges.

This time the challenge is to find the appropriate manning levels for supervisory and management groups and to implement new and more effective organisational structures.

Profit benefit

Thus far the pursuit of competitive edge by cost efficiency has dominated information technology applications. Whilst many new efficiency applications exist, the move from cost savings to using this technology for new profit opportunities is a major challenge today.

Instead of the comfort of hard cost savings we are faced with the need to seek equally hard profit benefit if we are to use this for competitive edge. Naturally what we want is the competitive edge which is permanent rather than temporary ... that piece of magic which prevents competition ever catching up.

One of the important criteria for moving into this difficult area of profit opportunity rather than cost saving is the need to demonstrate proven success, proven economic success, in the use of existing technology. Only companies who can demonstrate that will build up the confidence to reach out for new opportunities.

It is important then to recognise that the examples of the application of technology to marketing and distribution which we see around us today are real and they have worked. It is a fact, too, that we have learnt how to manage this technology realistically.

The pace of achievement is set by competitive pressures, by available technology, by finance and by the ability of people to implement and cope with the change. These people can be technologists, our own marketing and distribution staff or they can be customers and suppliers that we work with. At any point in time any of these issues will limit the pace of achievement.

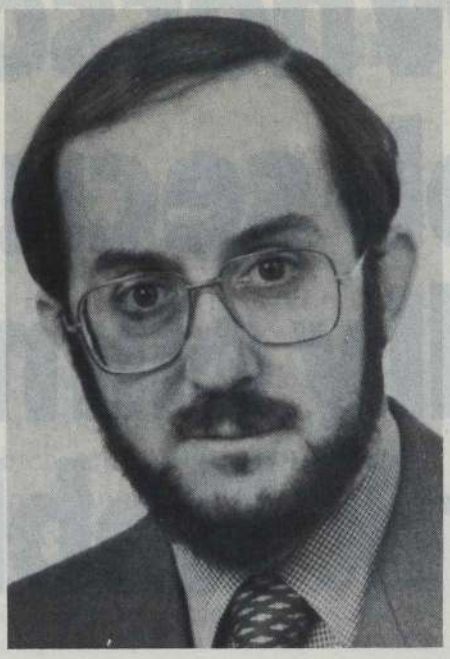
Literate people

Let's think about people. Information technology is a labour and intellectually intensive activity. This means that the most valuable people in this area are those who are literate both in business and in the significance of the computing technology which can be applied to the business.

As a consequence computer awareness programmes for business line staff and business awareness programmes for computing professionals are very heavy parts of our programmes for information technology in Esso UK.

It is clear that there is a proliferation of proven technology available now. There are however, questions about whether the commercial cost of that technology is yet appropriate to give us adequate return on the investment. An area where commercial opportunities do unquestionably exist is in the use of the major cost effective telecommunications facilities now available.

Telecommunications enable us to reach out to each other in the company and to our customers and suppliers in totally new ways. We are addressing for example what new customer services this can provide as well as doing todays task of marketing more efficiently. This technology has already killed the choice of centralisation or decentralisation of services; we can and do have both at once!



Management opportunities

In all this it is clear that ownership of the technological change must be with the line management.

The opportunities we know about mean that as President Reagan said, 'we ain't seen nothing yet!' The technological opportunities available to us mean new applications within Esso UK are limited only by the vision of our people. They are also limited by the industry and the people we work with having a sheer courage to make the changes necessary.

Information technology is clearly not an easy ride. Changes which are needed are fundamental, uncomfortable and require energy to succeed. Nevertheless, technological opportunities are not going to go away and within the industry we know that there will be leaders who pick up the ball and run with it.

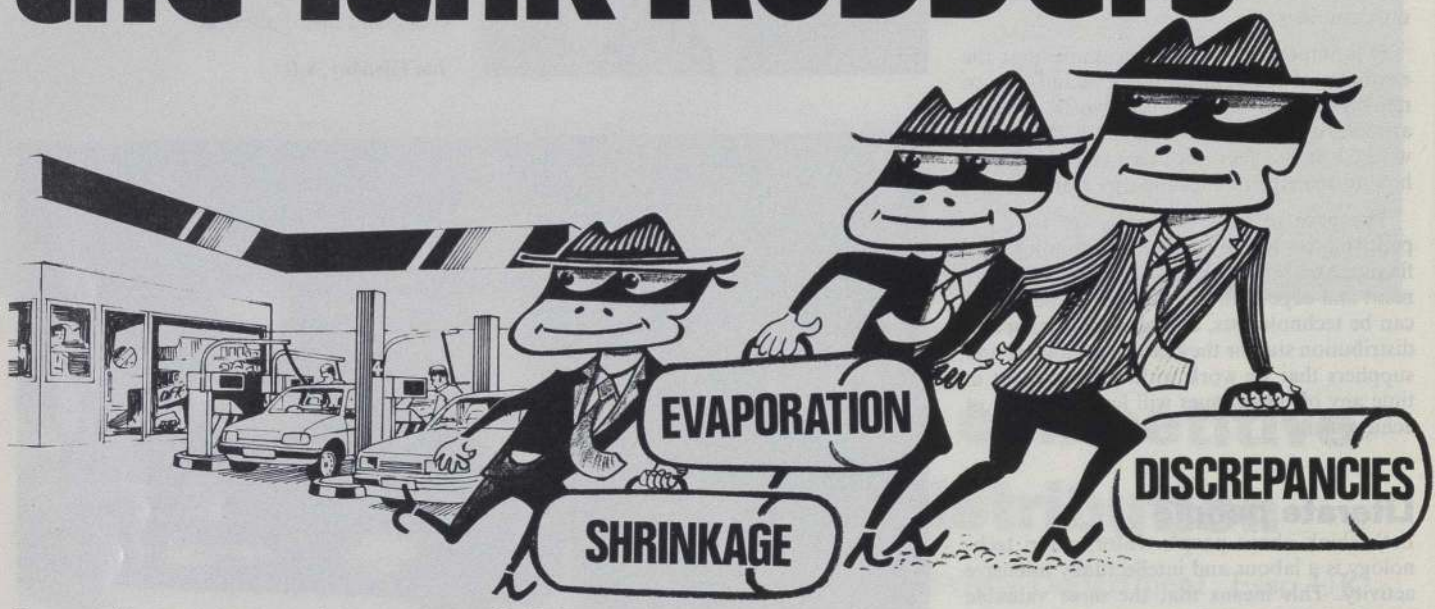
Esso intends to be that leader in information technology for competitive edge in marketing and distribution.●

Ian Glenday, left

Use of an Esso UK marketing delivery card reader. This is part of a comprehensive automation package to track events from customer order to delivery of the oil.

An Esso automated retail site, from the retailer's point of view. Data is centrally captured.

Now, Whessoe Control-security virtually eliminates the Tank Robbers



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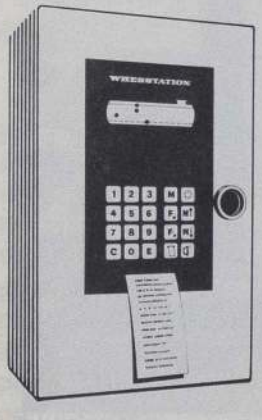

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No other tank-policing principle combines the accuracy and reliability of WHESSTATION's electronic sensor system. Yet despite its sophistication (so sensitive it even detects "slow" leaks) WHESSTATION is simple in operation. Maintenance is minimal.

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Whatever your wet stock management needs, WHESSTATION is designed to match it. Fully compatible with all audit control and POS systems, and extendable to meet future needs. WHESSTATION keeps your costs – *and* your stock – under total control.

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London Office, 40 Broadway, London, SW1H 0BR. Tel: 01-222 9311 Telex: 23821 Fax: 01-222 9319.

OPEC fails to come to terms with Gulf War

By Paul McDonald

OPEC's decision in December to go on defending an official pricing structure based on a price of $18 per barrel has done nothing to diminish the pressures inside the organization that are causing it to become increasingly disunited.

A good deal of attention has recently focussed on the relations between Saudi Arabia and Iran, particularly since the OPEC agreement of 5 August, 1986, which reintroduced production sharing after the abandonment of restraint some months earlier, which eventually brought prices below $10 per barrel.

The August agreement was largely credited to Iran at the time and subsequently analyses have often pointed to the supposed military strength of the Iranians and suggested that the other countries in the Persian Gulf were somehow cowed into accepting Iran's proposals for production discipline by fears of continuing Iranian advances in the Gulf War.

Further support for this theory comes from the often repeated notion that Iran is a belligerent and opportunistic power and thus better able to impose its will on its cautious and conservative Arab neighbours including, of course, Saudi Arabia.

Another explanation

The events of 1986 and the period since then, however, admit of another explanation, and one which is the opposite of the view outlined above. Whilst it is certainly true that the Iranians were in a good position militarily during the summer of 1986, following the establishment of a bridgehead on the Faw peninsula the previous February, Iran's economic situation was far from satisfactory.

A private memorandum circulated by OPEC in July of that year estimated Iran's oil income for the first half of 1986 at $2.9 billion: less than half the figure for the same period in 1985. Indeed, the OPEC figures may be said to have overstated the size of Iran's actual income, since the Iranians were then obliged to import refined products following earlier Iraqi air attacks on their refineries at Teheran, Tabriz, Shiraz, Isfahan and Kermanshah.

With the price of Iranian Light crude down to $8.40 during July, 1986 and that of Iranian Heavy as low as $7.50, Iran was anxious to see a rise in oil prices at the earliest opportunity. So, it is true, were her Arab neighbours — but most of them had a further option, which was denied to Iran, namely to increase oil output in order to compensate for falling prices.

Thus it was that Iran proposed that its co-belligerent, Iraq, should be exempt from the production quotas that were reintroduced by OPEC following the ministerial meeting of 28 July–5 August, 1986. Having been forced into making such a concession by Iraq's Arab allies, Iran's oil minister, Mr Gholamreza Aghazadeh, announced on 4 August that Iran would, if necessary, use its military strength to force a cut in Iraqi oil production.

Far from falling, Iraq's production has, on the contrary, been rising since 1986, from 1.8mbd in the summer of that year to over 2.8mbd late in 1987. Furthermore, repeated attempts by Iran since the August agreement to bring Iraq back within the collective output system or, in default of that, to have Iraq suspended from OPEC, have also foundered on Arab opposition, including that of Saudi Arabia.

Unrealistic option

Whilst it is undoubtedly true that there are those inside the Saudi government who would prefer the Kingdom to pursue a cautious foreign policy, avoiding confrontation with Iran, the combination of the Gulf War and the return by OPEC to fixed pricing makes this an unrealistic option for the Saudis.

Fixed prices for crude oil in the volatile market conditions of the late 1980s do not have a uniform effect on all 13 members of the OPEC cartel. Their greatest impact is on the large oil producers whose exports are predominantly crude oil that is sold by state oil companies at fixed prices.

Most buyers in such a market will tend to rely on spot priced crudes, their own equity production and even direct purchases of refined products as their baseload supply, leaving the fixed price crude sellers for their marginal requirements. The three countries potentially at the greatest risk of such marginalization within OPEC are Saudi Arabia, Iraq and Iran.

Iraq and Iran have adapted to this situation by making their crude oil prices more market responsive, leaving Saudi Arabia more or less isolated as the major seller of fixed priced crude. Unfortunately for the Saudis (and, indeed, for the rest of OPEC) the Kingdom's financial situation no longer allows such a state of affairs to continue.

Despite the efforts of a number of government departments to reduce Saudi Arabia's dependence on oil, the non-oil sector of the economy has failed to perform as well as was hoped, notwithstanding the optimistic report from the finance minister, Sheikh Mohammad Ali Abalkhail, at the end of 1987. This year's budget requires oil to provide some 65 per cent of the country's total revenue, and the target for non-oil revenue is nearly $0.5 billion lower than last year's.

Full quota needed

With part of the Kingdom's oil revenue already appropriated in advance for certain strategic and defence projects, Saudi Arabia is likely to need the whole of its 4.353mbd OPEC quota during 1988 in order to balance the budget as planned, especially since non-oil revenue may well fall below target, following problems early in the year with the Finance Ministry's proposals for income taxes and bond sales.

Given the virtual abandonment of fixed pricing by its Persian Gulf neighbours, Saudi Arabia could well be tempted into offering discounts of its own in an attempt to keep its exports up to the level required to service the present budget.

This, in turn, would bring it into conflict with Iran, whose official position is that prices should be raised as soon as possible.

Many Iranians blame Saudi Arabia for the oil price collapse of early 1986, regarding the whole episode as a Saudi-led attempt to undermine Iran's war effort against Iraq. Price discounting by Saudi Arabia during 1988 would be likely to attract a similar charge, regardless of what was happening to prices elsewhere in OPEC.

The increasing politicization of the

production and pricing policies of the Gulf states makes for increasing instability within OPEC as a whole. Many member countries from outside the Gulf have privately expressed their frustration at having ministerial conferences dominated by events in the Gulf.

Threat of split

Moreover, the longer the Gulf War continues, the more likely it is that the cartel will split into an inner and an outer group: the Persian Gulf versus the rest.

Furthermore, the dominance of Gulf policies inside OPEC is likely to lead to more and more dissension and instability within the organization, not only as a result of the commercial rivalry between Saudi Arabia, Iraq and Iran, but also because of a host of lesser, but still very important sources of friction elsewhere in the Gulf region.

The first of these is the conflict between the mainly crude oil exporting countries and those that export a large proportion of their oil as refined products, either via their own refining systems (eg Kuwait), or through processing deals (eg Qatar).

Another serious source of disunity within OPEC is the increasingly (dis)United Arab Emirates, where Dubai and Abu Dhabi are locked in dispute over how the country's production ceiling should be divided between them.§

Effect on price

All these geopolitical tensions, in turn, effect the price of oil. In the light of what has been said above, price instability looks set to continue during 1988 and, almost certainly, into the 1990s. On the other hand, it may be possible to assign certain limits to the movement of crude oil prices during this period of turbulence.

The steady state theory that is proposed below suggests that the oil market will tend to settle in one of three steady states. Long term (ie not day-to-day), changes of state will be prompted largely by alterations to the balance of power within the Persian Gulf group of countries within OPEC.

State 1 assumes agreement within OPEC on a system of production-sharing and some sort of commitment by Iraq to a collective output system — even if the Iraqis are not brought formally back inside the quota system. Such a state would support a price of around $18 (the crude blend considered in each case is North Sea Brent). Some cheating on production quotas is regarded as inevitable and is allowed for under the terms of the model.

State 2 assumes an OPEC agreement without either the inclusion or even the goodwill of Iraq, but formal output restraints on the other 12 members (eg OPEC's most recent agreement of 14 December 1987: see **Tables 1 and 2** for details). Cheating is more widespread than in **State 1**, since Iraq is regarded as having a free ride within OPEC and other Persian Gulf countries in particular regard themselves as being entitled to increase their own production as a result. **State 2** is characterized by an oil price of nearer $15/bbl, though a slight overshoot is possible to take account of such temporary phenomena as sudden snaps of cold weather.

State 3 is OPEC's nightmare: a free for all on production, accompanied by price discounting and a failure to remedy the situation at one or more ministerial meetings (which, during **State 3**, vary in frequency in inverse ratio to the price of crude oil). At the bottom end of **State 3** is a price of $10.

When this floor is breached, the collective pain suffered by the OPEC producers is sufficient, according to the model, to induce a return to production discipline and prices rise once more towards the $15 mark, from where they can be increased to $18 by the sort of measures that are outlined under **State 1**. A sustained increase in prices above $18 is thought unlikely as long as the geopolitical considerations outlined above remain in force and this, in turn, could mean that OPEC has to live with the 10-15-18 model not only during 1988, but in the following year and, perhaps, even into the 1990s. ●

Table 1
OPEC's official price basket

Bonny Light (Nigeria)	18.92
Saharan Blend (Algeria)	18.87
Tia Juana Light (Venezuela)	17.62
Minas (Indonesia)	17.56
Arabian Light (Saudi Arabia)	17.52
Fateh (Dubai)	17.42
plus Isthmus from non-member Mexico	18.07
Basket price	18.00

Table 2
OPEC's production quotas, first half 1988

	th b/d
Algeria	667
Ecuador	221
Gabon	159
Indonesia	1,190
Iran	2,369
Kuwait	996
Libya	996
Nigeria	1,301
Qatar	299
Saudi Arabia	4,343
UAE	948
Venezuela	1,571
TOTAL (excluding Iraq)	**15,060**

§*For further details of this quarrel, see Paul McDonald's article on the UAE on page 32 of Petroleum Review for December, 1987.*

A storage industry view of the modern oil market

By Christopher N Malcolm, C.I.M. UK Representative

The C.I.M. complex at Le Havre

The modern oil market has evolved as a fragmented and unpredictable beast, hurting most of those who have tried to tame or play with it at one time or another. Fluctuations in price, production and demand call for all those involved in the trading of oil to have a new type of innovative thinking, rapid response and a high level of information flow.

Recently the market has witnessed a substantial build-up of crude oil stocks in North West Europe as the United States embargo on Iranian oil imports into the US forces the National Iranian Oil Company to seek new customers within the North West European sector.

So large are the quantities and so slow are the sales and relative rates of consumption that land-based tankage in North West Europe has, at least temporarily, reached capacity.

Negative response

More recently, the negative response by the oil market to OPEC's December 1987 meeting in Vienna has knocked up to $1.50 per barrel (at time of writing) off a substantial volume of stored crude oil which, combined with the low and somewhat shaky value of the US dollar, could have serious worldwide repercussions. It is thought that this recent decline in the value of oil will deter sellers from moving this oil out of storage whilst hoping for a revival in price and therefore exacerbating the storage availability situation.

Storage and the flexibility it affords has become an increasingly important commodity for all those involved in the trading of crude oil and clean petroleum products on a worldwide basis but more so perhaps in the North West European area.

It is to serve the ever-changing and demanding needs of this industry that C.I.M. strives.

Founded in 1922 to satisfy the storage and distribution needs of the French oil industry C.I.M. had tankage of some 50,000 cubic metres constructed at Le Havre. As demand has grown, so too has the company's capacity, which now stands at some five million cubic metres in its Le Havre complex.

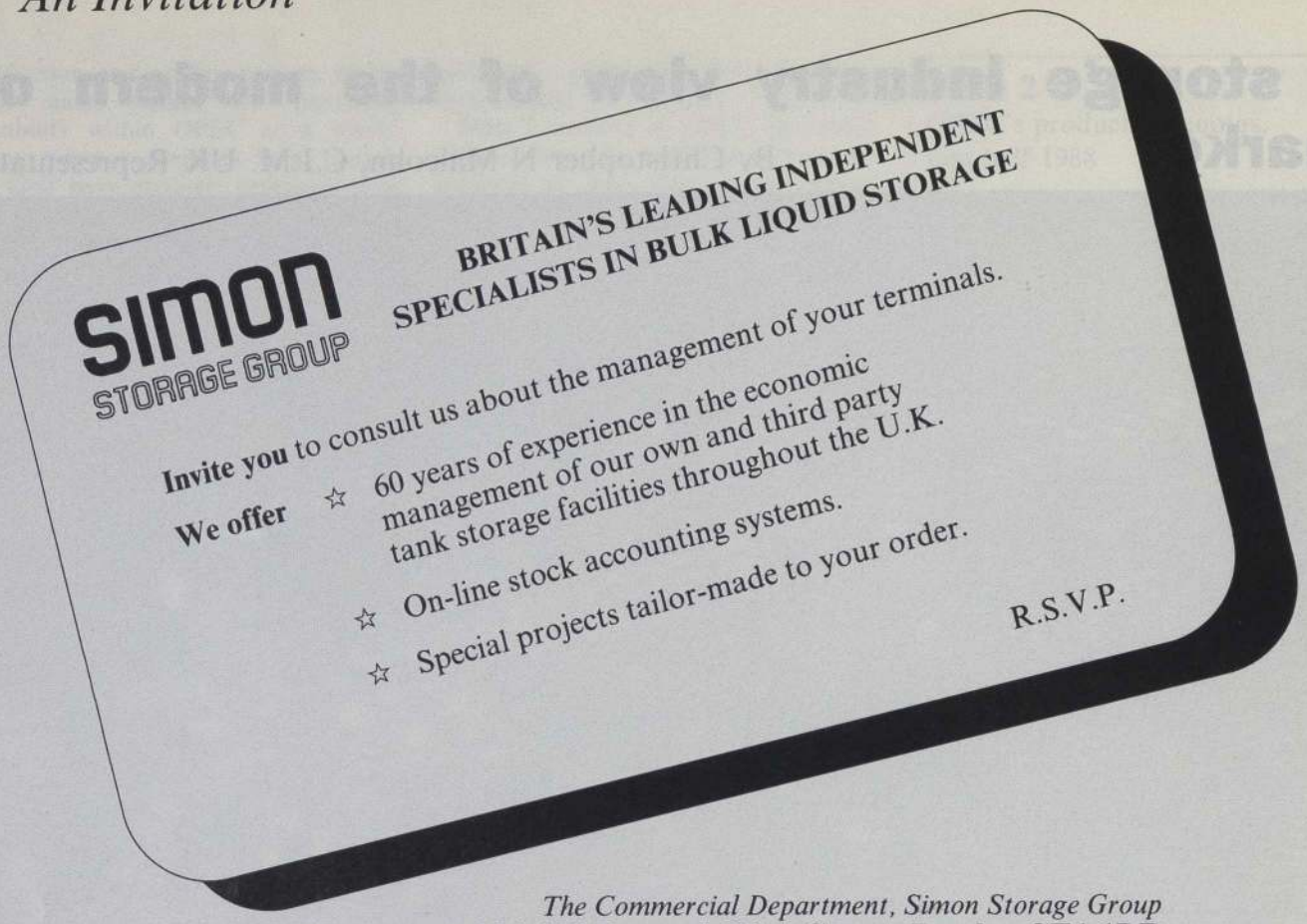
As the size of oil tankers grew, so the demand for a deepwater port increased and C.I.M. responded by having a deepwater terminal specially designed and built at Antifer.

This terminal, which has a 3,512 metre sea wall, a 25 metre draft availability and a turning basin of 1,450 metres was designed to accept shipbuilders' dreams of 700,000 ton deadweight oil tankers.

Satisfy demand

Antifer was opened in 1976 (the first vessel to discharge being a French ULCC of some 545,000 tons deadweight) with a storage facility of 655,000 cubic metres and of course, the ability to transfer

An Invitation



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Bernard Salaün

crude oil to the tanks in Le Havre, 26.5 kms distant, utilising a specially designed pipeline system. More recently, to satisfy demand, modifications were implemented to allow oil from the tank farm at Antifer to be back-loaded onto vessels in excess of 250,000 tons deadweight.

Direct access to the French refineries by pipeline and another direct link into the Trapil pipeline system adds further versatility to the complex as a whole.

In 1985 the de-regulation of crude oil imports into France came into effect and once again C.I.M. responded by instituting a new marketing approach designed to serve the oil industry on an international basis.

Flexibility

Without exception, traders require as much flexibility as they can obtain in order to fulfil their commercial aims. In this context C.I.M. has adopted a policy of total flexibility giving traders storage options of all descriptions linked with other facilities such as 'in tank' title transfers, cargo swaps, blending etc.

Other criteria regarded by C.I.M. as essential parts of the 'perfect storage package' include: A quick turnround for vessels loading and discharging; minimal cargo losses; computerised cargo handling and tank gauging; cargo security; total privacy of clients' commercial activities and a rapid response system to deal with requests from existing and potential clients. Quite a tall order — unless you have a modern, efficient terminal operated by a first class commercial and technical team.

To take the points mentioned above one by one: a quick turnround for vessels is vital in today's market, where delivery dates are essential and vessel delays costly. Both Le Havre and Antifer are open to the sea, no time-wasting locks to pass through, whilst being almost totally sheltered from the elements. The Port of Le Havre Authority, which controls shipping movements in both Le Havre and Antifer, has a highly trained team with a wealth of experience which all adds up to no delays.

When dealing with clients' oil, C.I.M. prides itself in keeping cargo losses to an absolute minimum. The combination of clean tanks and pipelines produces accurate calibrations and reduces losses by clingage.

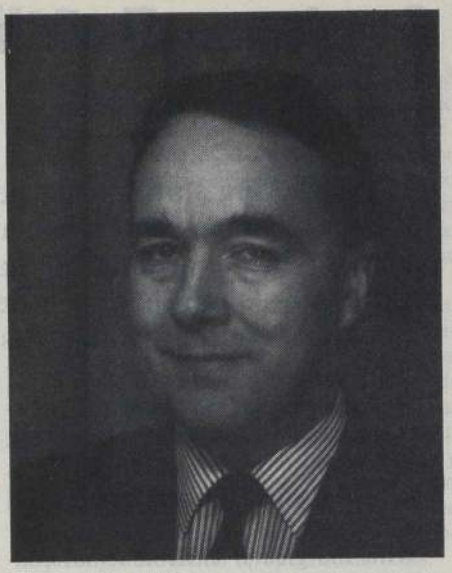
Sophisticated

Computerised cargo handling, tank gauging and automatic sampling equipment have been developed by C.I.M. and is now at a very sophisticated stage. This modern and efficient system provides technicians with accurate and up-to-date information at all times, coupled with a hard copy print out which is retained for a pre-determined period in case required by clients. The computer calibrations are constantly checked by manual 'dipping' of the tanks and this service is also available for clients upon request.

The modern and efficient equipment, coupled with a high degree of expertise and pride in the complex, affords the client all the cargo security required and expected of a first class operator.

Cut and thrust

In the cut and thrust of modern oil trading, secrecy and discretion with regard to clients' activities are of paramount importance. All cargoes entering the complex are held in a customs bond. As such, C.I.M. are the registered 'custodians' of the cargoes whilst the actual titles to the various cargoes are kept strictly confidential.



Christopher Malcolm

Again looking at the art of modern oil trading, the speed and accuracy at which traders must operate portrays the pressure under which this particular sector of the market has to work.

As discussed earlier, flexibility and innovative thinking play an important role in assisting traders and therefore obtaining storage contracts. Bernard Salaün, Marketing Manager, says: 'If the traders tell us what special requirements and flexibilities they require we can, most of the time, accommodate them and on occasions improve on the situation by innovative thinking on our part.'

It is appreciated that the storage market is an ever-changing situation playing an increasingly important role in the oil industry and C.I.M.'s team of experts are always on hand to meet these constantly changing and challenging demands. ●

Onshore fields: crude storage and movement

By Mike Wells

Field gathering stations are generally the single most sensitive issue for local residents when an onshore oil or gas field is being planned. Once a drilling site has been built, the well drilled and production begun there is little to object to — especially as the innocuous 'nodding donkey' is facing replacement by the down hole pump.

But the field processing and storage location is not only larger but more visible, and sometimes it is associated with tank trucks on rural roads.

With the greater environmental consciousness of today oil companies go to lengths unequalled by any other industry to not only bury its pipelines but all but hide completely its field gathering stations. Wytch Farm is an excellent case in point.

The total of 17 planning approvals required for the £300 million expansion of the BP-operated Wytch Farm field from 6,000 to 60,000 b/d were all granted last year and all the work is due for completion by the last quarter of 1989. News reports recently have concentrated on approval for the main 56-mile export pipeline from Wytch to Southampton Water. However, approval was obtained in addition in seven other main applications by BP covering the expansion of certain well sites, in-field pipelines, the rail terminal, access roads and construction sites — and the field gathering station, the largest single development within the project.

The field's current oil storage is located at the field gathering station, and at Furzebrook rail terminal for export by rail. Wytch Farm expansion requires some enlargement of the area of the gathering station but further storage tanks will not be required as production will feed into the new main line to Hamble. The rail terminal at Furzebrook, which currently handles crude exports, was in the original concept to be converted to LPG storage and export.

Local worries about LPG storage being located relatively near housing has resulted in the storage idea being abandoned, and LPG is now to be stored at the gathering station.

Currently LPG is transported to customers by one or two road tankers daily. This will continue until completion of the main export line when LPG will be piped to Furzebrook, via the conversion of the current crude line from the gathering centre.

Methane production, upped to 10 million cfd, will be moved by a British Gas pipeline which will be laid from the gathering station in the same trench as the main oil line as far as Sopley, north west of Christchurch. There it will join the national gas grid.

New plant

The largest single site development in the Wytch Farm expansion is the £7 million enlargement and reorganisation of the field's gathering station. The expansion of the field will go through an interim phase production scheme at the 12,000 b/d level.

The interim scheme will also involve the increase of gas output from the 0.425 mmcfd currently supplied to Southern Gas to an expected 1.7 mmcfd, which will be transferred to BGC. The additional propane and butane will be used to drive two new turbines, one of which will be used on the on-site plant. The 6 MVA power from the other will be fed through to the Southern Electricity grid.

In the next few weeks work will start on the drilling of the 46 new wells into the Sherwood reservoir at around 5000 ft. This will supplement current output from the smaller Bridport sands 3000 ft above. Well locations will be a second, new site on Furzey Island in Poole Harbour — where only just over five acres of the island's 32 acres will be needed in total — and current sites including an expansion of existing well sites F and A. These are located, respectively on the Goathorn Peninsula south of Furzey, and between F and the field gathering station. A 26-inch pipeline will be laid under the bed of Poole Harbour from the new Furzey Island site to site F and on to the gathering station.

Humbly Grove marking time

Carless Exploration's Humbly Grove field in northern Hampshire is the only non-BP producing field of any size onshore in Britain. Here output is currently at 1,300 – 1,400 b/d, being restricted by the high gas volumes present in the reservoir. Carless are looking at various ways to produce and sell the gas, but apparently no decision is likely in the near future.

Humbly Grove has no storage at the wellsites and all production is flowlined and collected at the Hollyhouse export terminal near Alton some 4 miles away. There the crude is stored in two 10,000 brl tanks and loaded onto rail cars for movement to Fawley refinery.

The company's Humbly Grove satellite field discovery at Herriard is still being evaluated, and test oil is sent by road tanker to Western Common rail terminal. Carless says that its Horndean oil discovery to the south appears to be commercial but has no current plans for development. Planning approvals have been granted but the complex Oolite limestone, similar to that at Humbly Grove is still being evaluated.

East Midland fields pumping new oil

In BP's historic UK onshore field area of the East Midlands, eleven fields are in production nowadays with a current total output of approximately 4,000 b/d. The Welton field, whose production of about 2500 b/d makes it the country's largest field after Wytch Farm, contains a gathering centre which also takes some 500 b/d from the nearby Nettleham and Stainton fields with the latter's output being trucked to the centre.

The three other gathering centres in the BP fields area are at Gainsborough which handles an average of 965 b/d; Egmanton with 165 b/d and Bothamsall 70 b/d.

Gainsborough terminal receives pipelined crude from the Gainsborough field itself, Beckingham, Corringham and small test quantities trucked from the recent Glentworth 1 discovery.

Egmanton field centre also handled tanker loads from Farleys Wood and South Leverton fields which is then piped to the rail siding at Tuxford, which also receives truckloads of the Bothamsall output.

Total production from the four main area gathering centres is sent by rail car to Simon Storage Group's tank farm at Immingham. From there it is piped to the neighbouring Conoco refinery under contract with BP.

Three other BP discoveries in the southern section of the fields' area — Kirklington, Rempstone and Long Clawson are currently under test.

The only small quantities of exportable gas are from the Gainsborough field, where supplies go to the local school, swimming pool and a factory. ●

Rotterdam focuses on oil tomorrow

Initiating the recent First Rotterdam Oil Symposium, Jan van Wingaarden, Chairman of the Dutch Association of Companies for the Distribution of Energy Supplies (NVE), said that the Netherlands in general and its key port in particular would have to regain their brilliance concerning petroleum. Mr van Wingaarden also stressed that:

- the open market quotations of Rotterdam are still of great importance for Western Europe's petroleum market
- the fact that the greater part of the international trade market of Holland's greatest port has moved to London is primarily due to the disposal of an Arabian centre and the 'futures' market
- Rotterdam now has a good opportunity to build up a 'future' market but a joint effort is required in order to achieve it

Among the many presentations at the symposium on the general theme of Oil Tomorrow, Jaap Metzlar, Director External Relations, van Ommeren, was one of several speakers contributing to A Logistical View on Oil Tomorrow. In his address, *Tank Storage Terminal Operations*, he said in part:

I would like to give you an insight as to how a tank storage terminal starts its activities. Three main factors influence the decision to go ahead or not, and consequently its success or failure: market research, base load contracts and speculation.

Market research is carried out as a result of a number of factors which give us the incentive to start this research. First there is the direct approach. This method is based, mainly, on the feeling that in a certain area developments or conditions indicate there could very well be an opportunity for an independent tank storage terminal in that area and consequently a market study follows.

Secondly, there is the total information which we should gather by visiting various existing or potential customers worldwide, to gauge their interest as possible customers should there be, in or near that area under consideration, a storage terminal already available.

Change of politics

Thirdly, effective market research is best begun when we are informed, on a regional basis, of indications for industrial or port developments or both. Going deeper still, a change in politics can give us reason to start a study. This change of politics may include the fact that a state monopoly for the storage and distribution of petroleum products will be eased by opening the market to third parties, and with that, hopefully, the decision to give private enterprise including foreign companies the possibilities to invest and be at least a 50% shareholder with the free transfer of profits.

Last, but certainly not least, there is the possibility that there is probably a nearby office performing other activities such as marine, or shipping, or forwarding, or trade that can point out to the storage division local developments that indicate an opportunity for tank storage developments. In that case we have local firsthand knowledge.

Under base-load contracts I could indicate the existing or growing need for maintaining readily available stocks such as government initiated strategic stocks in the event that the normal supply is interrupted. I am not only referring to the unfortunate event of war, but also those events of an unpredictable act of nature, or accidents on the supply routes of inland waters.

Further, with base-load contracts there is the growing trend on the part of national or locally established oil companies to have a storage terminal available for the continuous availability of storage space for their oil movements.

Then there is another type of base-load contract, and that is the long term cooperation with local producers or consumers (and sometimes even sea going tanker owners) who decide to have port-based storage activities performed by independent storage companies rather than do it themselves.

Speculation carries with it a number of assumptions in addition to those elements I have already mentioned. We do, sometimes, have to make decisions for the 'go' or 'no go' on a basis which gives us no guarantee for the amount in which the terminal is going to be used. More often than not, a decision is based on the oil streams, not only mineral oil, but all liquid products such as chemicals, gases, vegetable oils, fats, molasses, and all other liquid cargoes already in existence or which can be expected.

There may be times when you can speculate that, although tank storage capacity in certain regions is already available, that with the commercial leads you have through business relationships from your own other terminals in the world, there is for you also a market-share present.

Werner Schürmann, Director Schweizerische Reederei und Neptun AG, Basel, provided a presentation entitled *Is there a Future for Barges in Oil Tomorrow?* He said in part:

The question whether there will be a future for barges in oil tomorrow has to be looked at from two sides. The one side is the offer and the availability of cargo to be moved by inland water transportation in the coming 20 years.

The other side of the question about the future of barging in oil is the position of inland water transportation in relation to other means of transportation, such as the railways, road transportation and the pipelines in the traffic of liquid products.

In the field of inland water transportation, especially in Rhine shipping between Rotterdam and Basle, considerable efforts have been made in the past two decades to modernise the fleets by making use of new technical methods in ship building, better navigational and operational systems and a rigorous safety control. Thus, technical progress and improved operational knowledge have effected a quicker turnround of ships and consequently a reduction of operational costs.

Value and importance

In order to rate correctly the value and the importance of inland water transportation for industry and commerce, and specially for the oil business in Europe, compared with rail and road traffic, one has to look at some statistical figures.

The Federal Republic of Germany had a total consumption of oil products in 1986 of some 120 million tons. Of these 29% have been moved by inland water transportation, 18% by rail, 13% by road and 40% by pipelines. For other European countries, such as Switzerland, the share of inland water transportation in the total consumption is even higher. Some 43 million tons of oil products were transported on the Rhine in 1986.

It is not only the high technical standard of inland water transportation and the impression of these statistics which make me believe in a prosperous future for oil barging but also some other convincing facts:

- inland water transportation is the most energy-saving means of transportation
- the transhipment operations in the ports, especially at Rotterdam, take on the average only one third of the time to load or to discharge a barge instead of a truck or a railway waggon
- inland water transportation protects the environment because fuel consumption is low and inland waterways are normally situated far away from urban agglomerations
- waterways have a self-purificating power
- the cargo aboard the ships is at any time under direct human control and with permanent contact to customers and authorities
- as far as oil transportation is concerned, nearly all storage facilities and distribution centers are situated in inland waterways ports
- many refineries have direct access to waterways

Even with a rather cautious look into the future you will admit that barging and inland water transportation on European waterways have a challenging and promising future. ●

Two storage tanks left unexploded in the Mexico City disaster. Firemen may have prevented further explosions, but the extensive damage caused by the intense heat of the fire can clearly be seen.

Storage spheres enveloped in flame in the Feyzin disaster. The conflagration at the Feyzin Refinery, France, caused initially by an operating error, took 48 hours to bring under control.

Training new generations in handling LPG bulk storage

It appears that liquefied petroleum gas, the most common hazardous substance in use today, is a fuel that everyone is using. Most households have it in some form, a good example being the barbeque aerosol.

This fact was used recently by the Health and Safety Commission to highlight the need for training and re-training in storage and handling in industry, where much greater volumes are distributed.

'The fact that most people handle it without realising they are doing so is a testimony to the good safety record in Britain,' commented Dr John Cullen, Chairman of the Health and Safety Commission.

He was speaking at the launch of the LPG training package for industry which has become available as LPG is being carried increasingly in larger volumes over greater distances worldwide. It is being marketed by the Institution of Chemical Engineers. BP Gas International assisted in its compilation.

'While the overall safety record of the LPG industry in the UK has also been good, there has been a number of serious incidents worldwide such as those at Feyzin, Mexico and the Spanish camp site, from which lessons can and should be learned,' said Dr Cullen. 'It is vital that the lessons are fully appreciated by new generations.

'I am sure that this training package will play a positive role in helping to ensure that those dealing with LPG in industry are aware both of the good practice to be followed and the consequences of not doing so. I welcome it.'

The video training module *Safe Handling of LPG* demonstrates for industry the latest safety measures and encourages discussion and participation by trainees through eight case studies of accidents.

Three of these were the disasters at: Feyzin storage depot explosion in France in 1966, when 18 were killed and 81 were injured when propane spilled during routine maintenance; the Los Alfaques camp site, Spain, 1978, when 214 were killed and 67 injured, when a road tanker over filled with liquid propylene burst on an adjacent road; and Mexico City, 1984, when a LPG distribution depot blew up, two of the nine explosions measuring 0.5 on the Richter scale, 500 being killed and 7,000 injured.

'The good safety record is due to the industry's responsible attitude to safety and to the wide range of legislation and guidance that has been developed over the years to control the storage and use of this and other hazardous materials,' stressed Dr Cullen.

'But continuing safety is dependent not just on good location and a high standard of containment but on the proper systematic training of those operating the installations.

'In developing the video training package, the Institution has been able to draw on the experience and expertise of the Health and Safety Executive and a number of large companies. As a training aid it is unique, including as it does, a combination of video texts, case studies, slides and guidance notes.

'It will be of value for the training of new recruits and of in-service personnel alike. One important characteristic is that it has been developed by engineers — who are well placed to assess the hazards and the practical aspects of training that need to be addressed.'

In the eight detailed case studies, participants are given the role of investigator and are asked to identify the causes of the incident and suggest solutions.

The module has been designed for in-house training, because that is more favoured by companies, and it is said to be ideal for mixed training sessions involving managers as well as supervisors and operators.

'Using the training package, a company can bring home to its employees just what the dangers are and the catastrophes that result when things go wrong,' said the ICEE.

In examining the problems that arise in pressurised bulk storage and road and rail loading, the training package looks at siting, safety equipment, maintenance, fire protection and operating procedures. The recommendations in the training programme are in line with the latest guidelines on LPG published this year by the Health and Safety Executive, it examines in detail what preventative measures are available, and goes on to show what action can be taken in the event of an accident.

The IP's LPG code

As Peter Jones wrote recently the 1987 publication of the new IP LPG code *'Liquefied Petroleum Gas Model Code of Safe Practice Part 9 Volume 1 Large Bulk Pressure Storage and Refrigerated LPG'*, breaks important new ground in having taken cognisance of the tremendous developments that have occurred both in the UK and elsewhere in the world, in the size and scale of LPG installations, and in particular in the sphere of refrigerated storage — for which guidance has hitherto been limited.

A major change from earlier codes concerns the criteria for establishing safe locations for new plants and equipment based upon consequence analysis related to likely incident scenarios. In conjunction with this, a 32-page appendix presents an updated approach to the estimation of thermal radiation flux levels that could arise where such incidents involve a fire, and based upon data that has become available (some published as recently as July 1987) on fire characteristics, flame surface flux and the geometry of flame and target for this type of material.

Having been prepared jointly by the Institute, the Institution of Gas Engineers and the Liquefied Petroleum Gas Industry Technical Association, it should also serve a wide international field, which has been waiting for such a code.

It is available from John Wiley & Sons Ltd., Chichester, **£35.00 ($69.00)** Telephone: (0243) 779777, Telex: 86290, Fax: (0243) 775878. ●

Thinking small about retail markets

by David Broom, Retail Division, CACI, London

Any company operating a retail network must sell successfully in many diverse locations.

Basic concepts of successful site selection and the tailoring of merchandise to reflect local demand lie at the core of profitability.

This article looks at how the ever growing field of 'market analysis' addresses these issues, and assesses its application in the planning of forecourt retailing.

What is market analysis?

Market Analysis is all about understanding and quantifying markets down to very local levels and is based on 1981 Census statistics for 130,000 enumeration districts across the country. Added to this are neighbourhood classifications, sterling market size estimates for local areas, information on purchasing patterns, address lists, and up-to-date figures on car ownership and population age structure.

The results is a detailed description of markets in areas of any shape or size across the country. The power of the method comes from relating variations in market characteristics to the variation in the performance of retail outlets.

David Broom

Estimating local markets

Aggregate market size and share estimates are routine coinage for business planning. When dealing with the network on an outlet by outlet basis however, importance is then focussed on markets within local catchments. The census, along with other demographic sources, provides wide-ranging information on people living within, say, a one mile radius of an outlet. Market research on purchasing patterns, such as that available through Target Group Index or the RBL Motorists Panel, can then be used to translate demographics into sterling market size estimates.

Table 1 shows annual motor spirit volume for different neighbourhood types in the London region. The actual volume generated by any specific area within their region can then be estimated based on the different neighbourhood types and car ownership levels within that area.

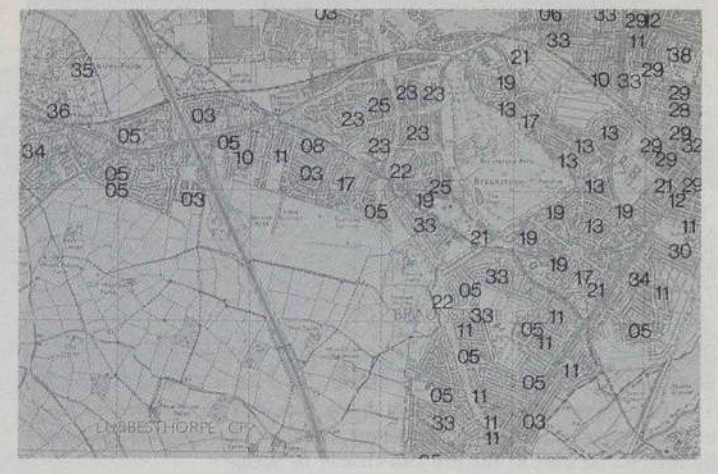
The same process can be followed for the full range of products sold through the retail outlets — motor accessories, car wash, videos and cassettes, books and magazines, convenience grocery, etc. Even within product categories, lifestyle indicators allow neighbourhoods with different purchase patterns to be identified; an example is neighbourhoods where car owners have an above average likelihood of changing their own motor oil.

Market modelling and throughput forecasting

Major investment decisions regarding new or upgraded sites require accurate throughput forecasts. Demand-based models, as normally applied by the market analysis consultancies, allocate the available market between outlets on the basis of their level of service and locational advantage vis-a-vis the competition.

In concept the approach is similar to that used by many high street and edge of town retailers. Fairly unique to petrol modelling however is the distinction between transient and local demand, with the proportion of through put being determined by location type. While some sites will be wholly transient, others will draw much of their trade from a very local catchment, and will depend on repeat visits from their clientele.

The split between local and transient demand at trading sites can be measured by collecting customer addresses, either through simple market research surveys or through competitions such as prize draws. Once such a list is assembled it is then possible to automatically plot out on maps where customers live or work.



The map shows an area of London which has been classified according to their neighbourhood types and car ownership levels. Having obtained the *actual* motor spirit volume for this area, manufacturers can then accurately estimate the volumes generated in other areas of Great Britain which have been classified similarly by their neighbourhood types and car ownership levels.

Each postcode in the country has been assigned an ordnance survey grid reference by the Post Office; this means that from the postcode each customer can be located on the ground and classified according to the type of neighbourhood in which he or she lives.

Once the local-transient split is quantified for different location types, demand for individual sites is then dictated by the relative quality of the competition. Knowledge of the demand split has much wider implications for planning however, and influences the complete retail mix at outlets.

Table 1 Motor Spirit Volumes for Different Neighbourhood Groups — London ISBA Region

ACORN GROUPS		ADULTS 1985	MOTOR SPIRIT VOLUMES 1985
A	Agricultural Areas	31,413	26·4
B	Modern Family Housing, Higher Incomes	1,060,201	850·4
C	Older Housing of Intermediate Status	651,827	335·1
D	Poor Quality Older Terraced Housing	180,627	67.2
E	Better-Off Council Estates	1,020,934	420.8
F	Less Well-Off Council Estates	494,760	122.1
G	Poorest Council Estates	471,200	96.8
H	Multi Racial Areas	918,841	173.2
I	High Status Non-Family Areas	808,894	336.8
J	Affluent Suburban Housing	1,837,682	1,367.0
K	Better-Off Retirement Areas	314,134	121.8
TOTAL		7,790,513	3,917.6

(Annual volumes reported in kilotonnes)

Ancillary services

The need to expand the retail base at outlets has blossomed into many new and enhanced concepts. Car washes, rapid lube facilities and C-stores are examples. Of equal importance to profitability is the more careful merchandising of forecourt shops to reflect the pattern of demand passing through individual outlets.

Again choosing the right location is essential; however good your local management, a C-store or car wash cannot be made to pay in the wrong type of location.

But detailed knowledge of local markets can have much broader implications than just sales forecasting. The merchandising of forecourt shops can be improved by classifying outlets according to local-transient demand and the market structure of the local catchment; an appropriate merchandise profile, tailored to actual demand, can then be plugged into a specific shop. As well as lending itself to strong central profit control, the strategic planning of merchandising sets the basis for scientifically evaluating space planning and new retail concepts.

Probably the most sophisticated classification system in operation is that used by WH Smith Wholesale, Britain's largest newspaper and magazine distributor. For distribution purposes 17,000 newsagents were classified under such evocative headings as 'pager 3' and 'Sloane Ranger'.

Merchandising is also at the core of successful C-store operations, especially when secondary demand on top of petrol must also be catered for. Unlike most other retail operations, C-stores do not have a dominant product; to yield the best returns they must sell a range of product types which vary from store to store in line with local demand. At one site convenience grocery or DIY might be a core element while on an in-bound commuter route news might be the essential magnet to customers.

Knowledge of local markets can also form the basis of traffic building through sites. Leaflet distributions can, for instance, be accurately targeted to high potential neighbourhoods to help tap the latent demand for car wash use, especially if there is national brand advertising concurrently. Value building, based on getting customers to be more loyal to a particular outlet, can be achieved by improving the quality of personal service at sites with very local demand.

The local dimension

In a retail network corporate success depends on profit measurement and control on an outlet-by-outlet basis. The importance of evaluating local markets has proved itself for high street and edge of town retailers both in assessing new sites and in evaluating the performance of the existing network. For oil companies there seems little doubt of the cost effectiveness of the methods for ancillary services. Questions about how individual retail brands relate to the total market place, particularly in respect of local catchment areas, are now being addressed by individual oil companies.●

Pressure on the Middle Ground

by Clive Callow, of Sheppards, London

The takeover fever currently buzzing around the UK oil industry raises the possibility that the 'middle ground' of the UK oil scene is about to be vacated. Hopefully this will not be the case. But if some of the well known names of the British oil industry are about to vanish, smaller players will strive to come forward to replace them and fill the gaps.

Making sense of the UK independent oil industry has never been an easy task — especially when trying to match up asset values with their respective quoted share prices. The latest activity of companies trying to buy oil and gas assets via the London Stock Market and Wall Street have added further to the diversity of opinions about the true worth of these companies, especially the smaller or 'second force' exploration groups.

Two levels

The corporate activity appears to be taking place on two levels. Firstly there is the straight company to company activity such as BP-Arco/Britoil and Elf/Tricentrol bids.

On a separate level is the Kuwait 18.4 per cent stake built up in BP. Assurances have been given by Kuwait to the UK Treasury that this is a long term investment. But as has been pointed out, BP is Britain's biggest company, a major force in North Sea oil production and has substantial US interests. Concern has also been expressed about Kuwait's proximity to Iran and the possible political implications.

Potential predators

Ironically when the oil price collapsed in 1986 it was widely expected to lead to the virtual disappearance of the UK medium sized and small independent oil company. In the event numerous strategic stakes have been established in various groupings but outright bids of any substance (apart from Enterprise/Saxon) largely failed to materialise in the UK sector.

The subsequent recovery in oil prices in late 1986/87 eased the pressures on the independents and some of the speculation lessened as well.

But potential predators have taken up positions.

It is difficult to find a UK independent where a significant shareholding relationship is not already in place. These include RTZ/Lasmo, Burmah/Premier Consolidated, London Merchant Securities/Carless Capel, ICI/Enterprise, Home Oil/Sovereign, Norwich Union/Goal, Amarada/Pict and Weston Holdings/Clyde.

Eventually those interests are likely to be unravelled either by bids or the stakes being passed on to other parties and thus possibly opening the way for alternative corporate action.

Now the more recent global stock market crash has provided, it would appear, a second chance for the stronger majors to try and pick up the smaller companies 'on the cheap'.

Asset values

There has always been a rather healthy suspicion — even disdain — held by oilmen for the City financial experts especially when it comes to putting a value on an independent oil group.

There cannot be many London financial oil analysts who have not been the subject of irate phone calls from managements berating them for being too cautious about a 'potential' discovery or 'missing the point' about undrilled acreage.

Even so, even the most cynical oilman must be puzzled by the apparent disparity between widely accepted asset values and the share prices currently prevailing particularly in the 'second force' oil sector.

The trend

Interestingly, BP which seems to have dominated the UK oil news for the past year or so signalled the trend back in early 1987 when it bid for the remaining minority in Standard Oil. One of the key reasons given at the time by BP for the purchase of the remaining Standard holding was the benefit to be derived from the cash flow.

This was clearly a strong factor, but some industry observers also saw the move as a comment on the difficulty in finding significant oil reserves in commercially viable areas.

In this context the recent bid by BP for Britoil is understandable and the attractions for the bidding party have been well chronicled elsewhere in various financial columns. But the additional involvement of US Arco group as a rival bidder shows that the North Sea is still viewed by international groups as a very prospective oil province.

Whether a new version of the Government's 'golden share' can be reconstructed remains to be seen. The role of the golden share would appear to have mixed blessings. The criticism that the golden share artificially depresses the share price would appear to have some validity in the sense that it puts off would be investors. After all, before the first BP bid of 300p a share for Britoil, the share price was languishing at nearly half this level. This was despite a widely circulated City valuation of nearer the initial BP bid price.

But at that time the world stock markets were dumping BP shares following the unsuccessful Government sale. Thus the two different worlds of the oil industry and the financial markets could not have been more clearly underlined.

Independents

One of the reactions to the recent takeover developments, is the comment that this marks the end of the UK independent oil sector. In one sense this may be true. The independents argue that they are responsible for up to 60 per cent of drilling activity and the majors tend to follow them in after their initial efforts.

This is possibly the case in areas such as North America, but not so in regions such as the UK continental shelf where high operating costs have made the majors more dominant. But even in the North Sea there have been notable successes by smaller groups which have been involved in either drilling up or developing discoveries now known as the Brae, Miller and Emerald fields. After all, first UK North Sea oil production was by an independent.

Onshore UK the independents can claim a better success rate with discoveries in the south of England, East Midlands and a significant 50 per cent participation in the major Wytch Farm oilfield.

This is despite a distinctly discouraging attitude engendered by the UK onshore system towards independents. The Hampshire Humbly Grove oilfield, for example, took nearly six years to come on stream from the initial discovery well.

Independents do tend to have a limited life-span and rely upon either a small dynamic management team or even one dominant character who leads the company. As a result there is very little chance to build up teams of management to succeed the original entrepreneurs.

But to say the independent sector is about to be eradicated is too pessimistic. Other independents will grow with newcomers and the cycle will continue. Furthermore, the present 'second force' companies will not give up without a fight. The UK oil scene would be a dreary place without them. ●

Oil and the inner cities

History is peppered with examples of private sector charity benefiting the community at large. The ancient Greek civilisation spawned the word philanthropy and private individuals often considered the well-being of those less fortunate than themselves. Noble Romans bequeathed much to their fellow citizens.

Major oil companies receive reams of requests for sponsorship. They also keep a weather eye on and considerable budget in hand for publicity opportunities. What is far less well known is the amount of purely philanthropic input many of the oil giants supply. In Britain, this can manifest itself in a wide variety of ways but one issue, possibly above all others, seems to attract their donations of money, expertise and interest—the problems of inner cities.

How they go about tackling such problems, which areas of interest appeal to them most and the reasons why they are involved at all vary from one oil company to another.

Clive Wright, Esso's Manager Public Affairs, believes that 'enlightened self interest' is the simplest explanation.

'Just as no individual can shut himself off from the wider concerns of the community, so a corporation must be involved, must care and must support the community. Without the concern and support of individuals and of companies, society will be impoverished, which is in no one's interest,' said Mr Wright.

Integral part

'Esso is an integral part of the community: an investor, a creater of jobs, provider of a vital resource. As such Esso has an interest in the health of the community.'

As Clive Wright points out, there are other considerations. Private enterprise can often fill the gaps which occur in even the most comprehensive state welfare system. Large companies can often make a valuable contribution to society from a reservoir of specific knowledge and, Clive Wright believes, a leading company like Esso must always be aware of the power of the example that it sets.

So, what kind of schemes is Esso involved with in Britain's inner cities? Job creation is certainly first and foremost but, as Mr Wright puts it: 'We like a project to have a variety of aspects, not only job creation but also perhaps environmental concerns or energy savings.'

In many regions which have been hit by a decline in industry, self-employment becomes crucial. With this need in mind, Esso has been committed, since 1986, to supporting the Prince's Trust Youth Business Initiative, a scheme in which the Prince of Wales plays an active part. This is a nationwide project which assists, with financing and professional guidance, young people to set up on their own.

Project North East, a Newcastle-based venture, is a classic example of what Clive Wright dubs 'pump priming'. This can be defined as giving early support to enterprise and job creation schemes to enable them to get off the ground. In some cases the help is committed for a number of years which fashions added stability.

The Newcastle scheme involved establishing a computer data base to provide information for people wishing to set up their own business. Again nationwide expansion is envisaged.

Esso has also supported Instant Muscle, another organisation aimed at supporting young unemployed people hoping to set up on their own account. Esso is helping to fund Instant Muscle's Wandsworth Youth Enterprise Scheme in Tooting, South London.

'We are particularly, but not exclusively, concerned with enterprise agencies,' said Clive Wright. 'Also, any department in the company is eligible to adopt a Youth Training Scheme and one is found for any who opt to do so. We have brought in groups of unemployed people for periods up to six months, during which time they are provided with specific hands-on training to perform a particular task. They also gain basic office skills, learn how to work in a proper business environment and most leave to find a job or with greatly improved chances of doing so.'

Esso is also supporting a pilot project in the West Midlands which is part of Neighbourhood Energy Action, whose basic function is to provide satisfactory insulation for low-income households. Unemployed people carry out the work, thus learning a new skill as well as contributing to the worthwhile cause of saving energy.

Yet another initiative to which Esso adds the weight of its support is the Outward Bound Trust. Although best known for its character modelling courses run in an outdoor environment, the Trust recently undertook several inner city projects. These use the same principles within local communities and Esso is helping to set one up in the Moss Side district of Manchester.

Expertise

Esso staff seconded on these kind of projects invariably possess senior managerial expertise. A senior Esso manager is now working on a full time basis with UK 2000 in Scotland and another with Business in the Community in the Northwest.

Also founded in the Northwest is The Groundwork Trust, to which Esso has seconded a senior manager for a period of two years. Groundwork's main thrust is to tackle environmental problems in the inner cities.

Starting from an experimental project known as Operation Groundwork in St. Helens and Knowsley in 1981, a further five Groundwork Trusts were formed in the Northwest in 1983. The Groundwork Foundation was set up in 1985 with Government backing as a charitable body to coordinate and spread the movement's work throughout the UK. Now there are over 12 trusts formed around the country with as many in the pipeline.

These trusts have seen the need to involve people of all ages in the local projects, as ultimately the responsibility for the environment has to be shared by the whole community. Consequently not only did 6,000 volunteers participate in Groundwork projects last year but also 17,000 school children and 700 young unemployed people on MSC schemes were involved, receiving training as they worked on the local environment.

Job creation

Education and training are seen as crucial to the long term solutions and unemployment is also seen as part of the problem. This has led to the setting up of enterprises marketing associated goods and services leading to creation of over 80 new jobs last year.

This integrated approach, encompassing education, training, job creation and urban environmental renewal coincided closely with thinking within Esso. It was agreed that Esso should second a senior manager in the Northwest to help coordinate the work and develop future financial self-sufficiency. Further support has been given through company publicity, including featuring Groundwork in Esso's 1988 calendar and at the local level by using the Salford and Trafford Trust to help improve land near the company's distribution terminal in Manchester.

One of many ways in which Shell helps to solve inner city problems falls under the umbrella of the Phoenix Initiative. The Phoenix Initiative has been set up by the private sector and with the support of Government to promote public and private enterprise in urban renewal and regeneration. This is seen to require a constructive partnership approach, very much on the US model. The national Initiative concentrates on setting up 'Phoenixes'.

Chris Ledger, who has been with Shell since 1974 and is a former Manager of the Public Affairs Division of Shell Expro, has been seconded to the Phoenix initiative since June 1986 as London-based chief executive.

Mr Ledger defines each local Phoenix as basically: 'An urban development corporation whose genesis and support comes from all sectors of the community in which it operates.

'My passion is to get communication between opposite factions like the public sector, local and national, and the private sector. I see us as having a catalytic role, a sort of ACAS if you like. We never approach anyone in the first place, we are always invited in.'

The first city selected for the Phoenix partnership touch was Manchester and subsequently nearby Salford.

'Manchester has been a tremendous success,' said Mr Ledger. 'You've got to build regeneration on reality.'

As far as Manchester was concerned, that reality was to utilise Phoenix as, in Chris Ledger's words, 'a conduit of advice' to give a new

lease of life to a one-mile stretch from Piccadilly to Deansgate, near the Rochdale Canal.

The Manchester Phoenix Initiative was formed at the end of 1986 and went into action January last year. The Government gave an early assurance of its financial support to the tune of £40,000. A Steering Committee was set up and private sector sponsorship quickly reached £100,000. A dozen developers also committed themselves in principle to schemes costing a total of £67.57 million. The City of Manchester was also supportive.

There are many fine Victorian and Edwardian buildings within the zone chosen for a facelift. These include the Refuge Building in Oxford Street, designed by the architect, Alfred Waterhouse. The canal itself is intended to be developed into an attractive waterway with improved mooring facilities. The Rochdale Canal Basin, although close to Piccadilly Station and the aorta of the city, is virtually derelict. The plan here is to make full use of cleared sites to erect Piccadilly Village, an area for residential and recreational use as well as a place of work. The estimated total cost of this project has been set at £23.8 million.

Wheels in motion

The wheels are now in motion and a confident Raymond Gerrard, the Manchester Phoenix chairman, predicted recently that: 'It won't be long before everybody can see the benefits. We need finance here first, to tackle the problems of Moss Side, for instance. We have to provide the heart that will pump blood out into the entire body and that heart will come from people with access to capital.'

Mr Gerrard's counterpart in the Salford Phoenix, Geoffrey Wilson, describes the pre-Phoenix situation as one in which progress was blocked because there were 'too many agencies taking too little account of each other. Local authorities have achieved a great deal, but inevitably their budgets are limited. There is no national policy for the inner cities and we need a cohesive strategy. Phoenix hopes to bridge that gap.'

The first site selected in Salford was the Kersal high rise housing estate. Work is expected to commence this year on turning a veritable wasteland which conjures up images of Bob Dylan's *Desolation Row* into a top quality student campus with shops, launderettes and a community centre.

It has also been mooted that the old tramways depot in Salford might be revamped as a series of workshops. Located adjacent to one of English Estates' new science parks where local academic work is brought to practical fruition, the scheme could dovetail neatly.

Another Phoenix has already begun to ascend from the ashes of Bristol. Other English towns earmarked for similar possible action are Wolverhampton, Barrow-in-Furness, Middlesbrough and London east of the LDDC.

Concepts like Phoenix are comparatively new to Britain and have taken the successful example of comparable partnerships in America as something of a role model. Efforts to amalgamate dual-sector expertise is not enough but the US schemes also proved rather conclusively that where public money and

'Just as no individual can shut himself off from the wider concerns of the community, so a corporation must be involved, must care and must support the community'

commitment is effectively applied up front, private money, like Mary's lamb, is bound to follow.

Under the chairmanship of Sir Colin Corness, a former president of the National Council of Building Material Producers and chairman of Redland, the Phoenix Initiative is rapidly proving that its aims and beliefs are justified; that it can and does offer a viable recipe to sever red tape and provide impetus and motivation to back the renaissance of Britain's inner cities.

The question then remains, what is Shell involved for? The answer goes beyond the parameters of obvious publicity and philanthropy according to Chris Ledger.

'We break down the barriers of communication,' he pointed out. 'Giants like Shell can benefit from numerous contacts and feedbacks involved in all this which can be tremendously important if one is going to proceed professionally.'

Over at BP International, the inner city projects given oil injection are very similar but the policies and reason behind undertaking them does differ.

Robin Heal, Manager — Community Projects, said that BP involvement is seen as a long term investment in the British economy which will in turn inprove the overall market place in which BP operates.

'We're looking for a return on every pound that's spent,' said Mr Heal, 'rather than how many column inches we're likely to get out of it. That return may be long term, and would include social as well as financial benefits, but it is still an investment rather than a charitable act. The PR side certainly doesn't do us any harm but it's not what this is all about as far as I'm concerned.'

BP's community projects fall into three main areas: education, employment and inner city development. It was a founder member of the London Enterprise Agency (LEntA), one of the first such agencies to be formed in this country. This is a wholly private sector body working with government at a central as well as local level. LEntA's inner city projects receive funding from the Department of the Environment.

Among the many other community groups which BP is a part of are Groundwork, Project Trident, Project Fullemploy and Business in the Community. With a current budget of £1·1 million, the BP Community Projects Unit needs to be selective. 'Wherever and whenever BP provides money we feel a responsibility to our shareholders to make sure that this money is wisely spent,' said Mr Heal.

In fact, over half the budget is spent on secondment. There are 36 secondees reporting back to Britannic House at the moment. The usual tour of duty is for two years and, while many secondees are senior staff nearing retirement, with a lifetime of experience and expertise to offer, a lesser number opt for secondment at an early career stage.

BP's average donation to an enterprise agency, for example, is £5,000 and BP is involved with between 35 and 40 nationwide. 'The company will only sponsor them when we can have a certain amount of influence over their policies,' Mr Heal explained. There are several other criteria to be met or aimed for before BP agrees to come on the scene.

The company avoids duplicating the work of existing resources. It also prefers projects which intend to establish their own independent financial viability at some point in the future. Another feature is the involvement of local BP personnel.

Mr Heal usually expects to be able to hand over ownership of a project to BP's local management in three months to a year after the initial contact. Of course, it's not always easy to enthuse local BP management but usually, once aboard, they get very wrapped up in it all.

Regional presence

Another BP policy is to choose projects where it has a strong local or at least regional existing presence. The company also avoids, as far as possible, taking the lead in a particular project, preferring to (in Mr Heal's words) act as a 'facilitator rather than as a catalyst.'

A prime example of BP's contribution to an area in which it has had a strong influence is the 1,500-acre site of its Llandarcy refinery near Neath, in South Wales.

Despite the expansion of its bitumen plant, following the closure of the main fuel refinery in April 1986 there have been 90% redundancies. In a bid to create jobs in an area where the current unemployment rate hovers around 16% a separate company, D'Arcy Development Limited, with Robin Heal as its chairman, was created. BP Oil put in an initial £1 million and an additional £3 million is being sought in the form of grants and loans from both public and private sectors.

The company intends to re-develop the site in a number of ways, including a small industrial park, leisure and tourism facilities and environmental improvements. Six former refinery staff have already been seconded to the scheme.

'Llandarcy is our home,' Mr Heal points out. 'It is where BP lives and works. We should not think of economic regeneration as something that is entirely the responsibility of the Government.'

The problems of Britain's inner cities cannot be dismissed lightly, nor solved easily. They benefit greatly from the lubricating effect of multi-national oil company effort. As Robin Heal puts it: 'There's real chemistry at work and I'm a firm believer in the networking of ideas.' Each company might choose a different mode of operation, goal or reason for trying but the results appear both tangible and positive. ●

Jim Berry

North Sea taxation for the 1990s

by Michael Saunders, The Institute for Fiscal Studies

Dissatisfaction with the UK North Sea tax system is not new, but concern that it may discourage investment has heightened since the fall in oil prices ushered in a new era of lower profitability. Moreover, as development moves to smaller reservoirs and deeper waters, costs will inevitably rise, so that more projects will be at the margin of commercial viability.

Thus the scope for the tax system to discourage new developments is greater — hastening the UK's decline as a major oil producer. The effects of the North Sea tax system, together with proposals for reforms, were the subject of a recent report published by The Institute for Fiscal Studies* with the 15 March Budget in mind.

In assessing the North Sea tax system, a starting point is to consider its main objectives. These are to raise revenue, while minimising any discouragement to companies from undertaking projects that are profitable before tax. In addition, stability is important, as frequent changes in the tax system make forward planning more difficult.

Stability not achieved

The frequent changes that have been made to the North Sea tax system suggest that the objective of stability has not been achieved. We might hope, though, that the tax system that has evolved would satisfy the first two aims and so prove more stable for the future.

However, the current tax system is still not wholly based on profit (eg licence royalties are essentially a charge on revenue).

In addition, there is a wide variation between the ability of companies to claim allowances for development expenditure on one field, the value of which depends on having taxable profits generated on other fields.

Several aspects of the North Sea tax system are discussed in the report, including overall tax revenues, average tax rates on profits and the tax treatment of abandonment costs.

However, we concentrate here on the effects of the tax system on the incentive to invest in new projects — both new oilfields and incremental investments to existing fields.

The chart shows the effect of the tax system on the profitability of several hypothetical investment projects. We assume, for the purposes of examining the tax system, that companies require a real internal rate of return (IRR) of around 10 per cent on investments, so all of these projects are at the margin of profitability before tax.

If the tax system reduces the IRR significantly below 10 per cent, then it would discourage companies from investments.

Projects **A** and **B** are new fields, both based on actual fields. **B** is a medium sized field, with total recoverable reserves of 250 million barrels. **A** is smaller, with 80 million barrels. We consider the development of each of these fields by two different companies.

Case 1 is a company which has no other PRT liabilities and so is unable to make use of the PRT cross-field allowance. The **Case 2** company is able to make use of this allowance, by which a portion of development expenditure can be set immediately against other PRT liabilities as an alternative to the uplift and carry forward provisions. The chart shows that, for the **Case 1** company, the tax system acts as a disincentive to investment in new fields, reducing the IRR of both fields to well below 10 per cent.

The problem is largely due to the less generous system of capital allowances for Corporation Tax introduced in the 1984 Budget.

For **Case 2** companies, the PRT cross-field allowance offsets this disincentive. Whilst most larger companies will be in the **Case 2** position, many smaller companies and new entrants will be in the **Case 1** position.

Moving down the table, project **C** is an incremental investment project on an existing mature field (ie one that has reached 'payback' for tax purposes). Project **D** is similar, but has a higher proportion of drilling costs, which qualify for more favourable treatment under Corporation Tax. Incremental investments, such as satellite developments, sidetracking schemes and the use of enhanced oil recovery techniques, are a potentially important source of future production. However, our analysis shows that there is a severe disincentive to incremental investment on mature fields, with the post tax IRR reduced to under four per cent. The scale of this disincentive is such that a project that is currently viable, pre-tax, at an oil price of $20 per barrel would require, post-tax, an oil price of $25 per barrel (at current exchange rates). This disincentive is principally due to licence royalties, which are still charged on oilfields developed before April 1982 and, again, Corporation Tax.

Many changes to the North Sea tax system have been proposed. We have combined several small changes into two alternate packages each of which, without altering the basic structure of the North Sea tax system, would remove most of its worst features.

Both would require the abolition of licence royalties. The abolition of licence royalties for new oilfields in 1983 betrayed an implicit acceptance that they are inappropriate.

In addition, the first package would provide a 10 per cent PRT uplift for post payback capital expenditure, and the extension of the existing PRT cross-field allowance into a non-wastable form, so that companies without PRT liabilities can claim this benefit for development expenditure on new fields. These extra PRT allowances would offset the disincentive effects of corporation tax.

Rather than introduce these new allowances, our second package would combine the abolition of Licence Royalties with the reintroduction of 100 per cent first year allowances against Corporation Tax for capital expenditure in the North Sea. With this change the PRT cross-field allowance would no longer be needed to rectify the deficiencies of Corporation Tax and so could be withdrawn. This second approach has the advantage of removing the *cause* of the problems rather than trying to counteract their *effects*.

Both of these packages would dramatically improve the incentive to invest in new projects, although the second would be more robust to changes in the oil price. Both would reduce government revenues from the North Sea by less than 10 per cent even if they did not lead to extra investment. If increased investment did result, then the effective cost to the Exchequer would be even smaller.

Replace tax on cash flows

Other directions for reform are also analysed in the report, including replacing, for new fields, the current system by a tax based on cash flows. This would introduce a tax based on the flow of funds to and from the company, with no distinction between capital and current items and no allowance for interest costs.

Such a tax would be efficient at collecting revenue while minimising the discouragement to investment. But even if such radical changes are ruled out, more limited measures such as those contained in the two packages outlined here can produce a tax system that is more stable and efficient for the 1990s. ●

**North Sea Taxation for the 1990s (IFS report no. 27), by Stephen Bond, Michael Devereux and Michael Saunders, is available from the Institute for Fiscal Studies, 180 Tottenham Court Road, London W1P 9LE, Price £10.*

TABLE The effects of the Tax System on the Incentive to Invest

	Project A	Project B
a New Fields		
Pre-tax IRR	10.0	10.0
Post-tax IRR		
Case 1: no other PRT liabilities	8.1	7.3
Case 2: with other PRT liabilities	9.8	9.6
b Incremental Investment to mature fields		
	Project C	**Project D**
Pre-tax IRR	10.3	10.3
Post-tax IRR	2.7	3.3

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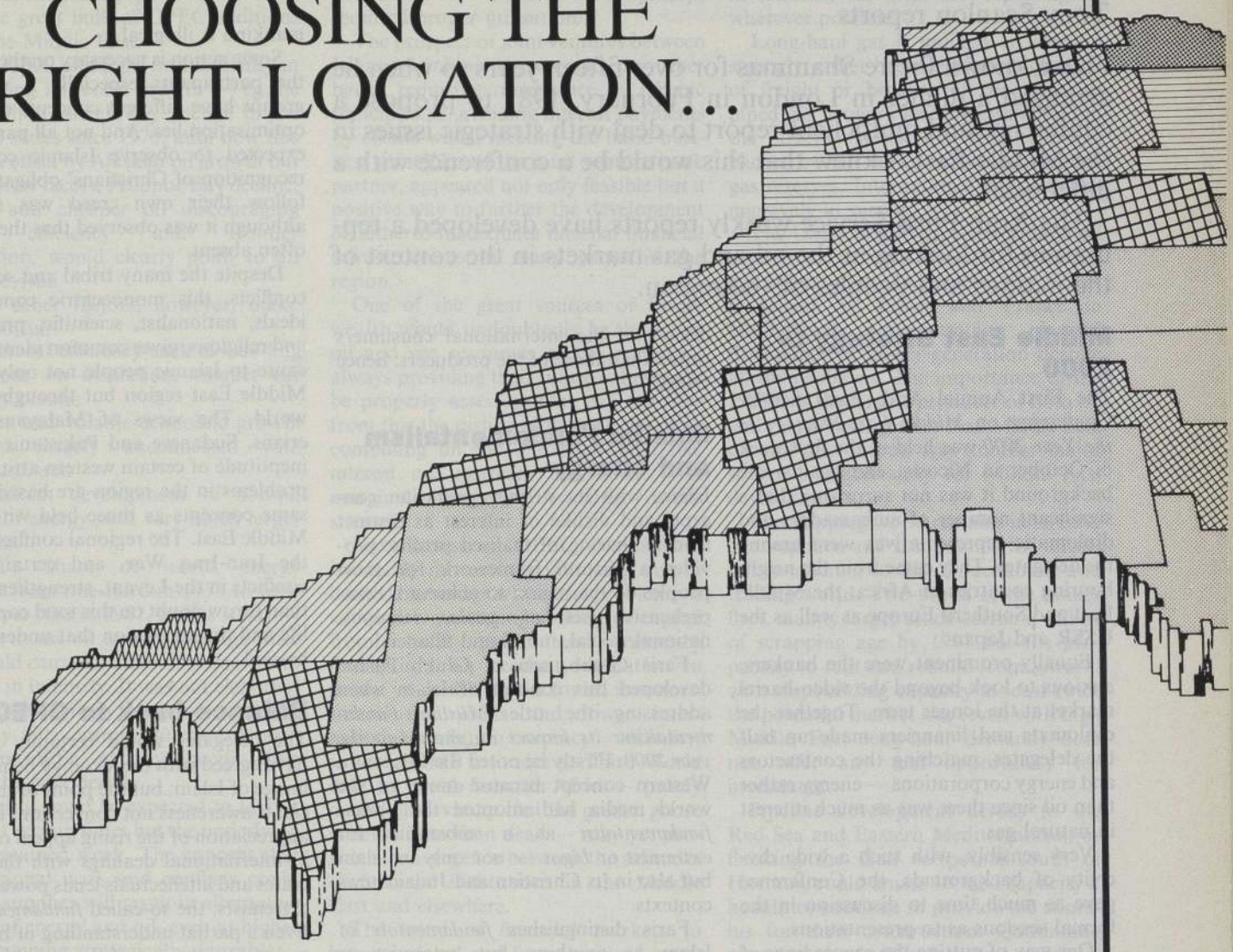

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A new forum for Middle East analysis

Tony Scanlon reports

I have known Pierre Shammas for over fifteen years so when he arranged a dinner in London in February, 1987 to propose a conference and multiclient report to deal with strategic issues in the Middle East, I knew that this would be a conference with a difference.

His Arab Press Service weekly reports have developed a reputation for looking at the oil and gas markets in the context of the nations and peoples of the region.

Middle East Strategy to 2000

The First Annual Arab Press Service Conference on *Middle East Strategy to the Year 2000* was held in the first week of October in Nicosia, and against the background it was not surprising that a significant number of ambassadors and diplomatic representatives were among the delegates. They came from the neighbouring countries in Africa, the Middle East and Southern Europe as well as the USSR and Japan.

Equally prominent were the bankers, anxious to look beyond the video-barrel market at the longer term. Together the diplomats and financiers made up half the delegates, matching the contractors and energy corporations — energy rather than oil since there was as much interest in natural gas.

Very sensibly, with such a wide diversity of backgrounds, the Conference gave as much time to discussion in the formal sessions as to presentations.

One way of putting the proceedings of a conference looking to the end of the century in context may be to reflect momentarily on the location of the Turkish Army at the beginning of the century.

The Ottoman Empire then covered the Arabian peninsula and oil had not yet been discovered in the region. The end of empire and the secularisation by Ataturk left aspiring Arab and other ethnic groups or tribes to pursue their own goals, not only with nationalism and new boundaries, but also with Islam and with the new oil wealth and the economic influence from OECD — first Europe, then the USA and recently Japan.

Iran and Egypt, by contrast nations of long ancestry, also experienced similar external economic pressures, the latter not so much oil developments as from the impact of the Suez Canal as the lifeline of the Raj.

Control of their own destiny as nation states depended on acquiring some say in their economic resources. A free market appears anti-thetical as meeting the desires of the international consumers rather than those of the producers: hence OPEC.

Muslim Fundamentalism and energy

Islam, with its strong egalitarian concepts and dislike of interest as distinct from a sharing of realised profits, provides a natural framework for most peoples of the region to achieve a comprehensive set of goals, religious, national, social, moral and financial.

Faris Glubb, son of Glubb Pasha, developed this concept of Islam when addressing the title *Muslim Fundamentalism: its impact on energy to the year 2000*. Firstly he noted the title was a Western concept because much of the world media had adopted the phrase *fundamentalist* as a substitute for *extremist* or *bigot* — not only in Islam but also in its Christian and Judaic news contexts.

Faris distinguishes *fundamentals* of Islam as anything but extremist or narrow-minded.

The delegates were informed of the very high place education is given in Islam. Unlike the Christian world, the *secularisation* of science had not occurred over the last 100 years (since Darwin for example).

On the contrary, science promoted the religious concept, so Islam was fully receptive to the new technology as the communications explosion heralds the 21st century.

If freedom of choice is not seen, as in the west, to be based in a secular concept which feels it has to put religion aside, but is instead seen as new gifts of the creator, then moral values have not been automated, as it were, but freedom of information leads to higher levels of moral perception and personal responsibility.

It follows that, in a truly scientific world, the concept that markets which are completely self-adjusting can automatically produce optimum solutions for mankind is illogical.

Some action is necessary on the part of the participants especially if different groups have different concepts of where optimisation lies. And not all parties are expected to observe Islamic concepts: recognition of Christians' obligations to follow their own creed was stressed although it was observed that these were often absent.

Despite the many tribal and sectarian conflicts, this monocentric concept of ideals, nationalist, scientific, pragmatic and religious, gives common identity and cause to Islamic people not only in the Middle East region but throughout the world. The views of Malayans, Nigerians, Sudanese and Pakistanis on the ineptitude of certain western attitudes to problems in the region are based in the same concepts as those held within the Middle East. The regional conflicts, even the Iran-Iraq War, and certainly the conflicts in the Levant, strengthen rather than throw doubt on this total concept of life and the conviction that underpins it, he said.

Balance back to OPEC?

The delegates would certainly not all have agreed with the ideology behind this image of Islam; but the point of the exercise is awareness not conversion. Lack of appreciation of the rising appeal of Islam in international dealings with the moderates and intellectuals lends power to the extremists, the so-called *fundamentalists*. Even a partial understanding of how the region sees the rest of the world helps us all. Once we have admitted self-interest in trying to understand, how does the Middle East perceive the geopolitics of energy over the next decade? Will the balance of trade swing back in favour of OPEC?

The answers were complex but some clear lines of approach emerged.

Oil resources. The OPEC nations, especially the Middle East members, are likely to dominate world commercial reserves even more than in the past, supported by Venezuela/Mexico and the USSR/Arctic.

Additions to reserves are beginning to come more from better technical recovery from giant fields in particular than from the exploration frontier.

Kuwait and Venezuela had already shown how uprating large reserves in just two areas outweighs five years of global discovery at current rates and Iran and Iraq are following suit.

If, as is expected, Saudi and UAE also uprate recovery factors, OPEC could end up with 80 per cent of proven world oil

reserves (excluding USSR) while new non-OPEC discoveries fail to keep pace with consumption. Apart from Venezuela the great bulk of OPEC additions are in the Middle East.

Non-OPEC oil might find difficulty in maintaining its recent growth — eg the three million barrels/day decline in the lower 48 states since 1970; until now this has been offset by Alaskan oil growth but this too now faces a Prudhoe Bay decline.

This, and cheaper oil discouraging energy efficiency and frontier exploration, would clearly point to an OPEC revival.

Three other factors, however, make this doubtful:

(*a*) structural efficiency such as building regulations on insulation, smaller car assembly plants;

(*b*) lower and volatile economic growth prospects largely unconnected with energy use, and

(*c*) persistent development of non-oil sources of energy with very much larger resources.

OPEC's share of world energy dropped from one-third in 1973 to little over 10 per cent in 1987, so this is hardly the time to use oil reserve leverage since this would cause all these three factors to increase in intensity. It was not clear that oil's share of energy growth would substantially alter current downward pressures on OPEC at any specific time during the next decade.

Volatility could be expected to favour OPEC at certain times but the underlying trend remained weak. The concept that intra-regional wars and conflicts could unsettle supplies will result in alternative sources of energy and oil, even at higher cost, remaining strategically desirable.

And for those who persistently declare that strategic oil has no economic meaning may one ask if they always buy the cheapest car or the one with the best warranty?

Islamic banking

Financial developments which had grown rapidly within the Middle East in the decade of high oil revenues were faced with equally volatile conditions.

(*a*) shrinking oil revenues and currency fluctuations

(*b*) substantial technical changes in international financial structures

(*c*) small or underdeveloped regional financial markets and

(*d*) the rise of Islamic banking not only in the oil states but in Pakistan and African nations.

The overriding need was expressed that Middle East banks should identify precisely what business they are in.

Many of these institutions suffering on current account from weak oil prices nevertheless still had massive capital portfolios for which Islamic precept required proper utilisation.

The prospect of joint ventures between Islamic banking houses and the other banks requiring observance of Islamic principles, ie, avoiding interest payments by clients whilst meeting the basic business principles of the joint venture bank partner, appeared not only feasible but a positive way to further the development of hitherto inadequate internal financial infrastructures in many states in the region.

One of the great sources of future wealth would undoubtedly be the rising oil and gas resources of the region — always providing their future value could be properly assessed. One can perceive from this the dislike of western practices combining on the one hand high risk interest on upstream investment with marginal commodity pricing downstream.

Nevertheless as OPEC downstream inevitably moves internationally due to limited internal markets, the problems of adequately protecting committed capital from both price and currency fluctuations on product realisation in future years still persist for all investors. Interest-free loans and lower international inflation/currency volatility, softening IMF attitudes to Third World debt, eg in sub-Saharan Africa — purely on the observation that the golden goose is better lean than dead — may yet provide a convergence between the attitudes of financial institutions in the Middle East and elsewhere.

The trend of financial markets to become global and for securitised international Euroloans and equity fund flows across frontiers to replace international bank loans — very marked in the regions' financial institutions — may provide further opportunities for Islamic acceptance of terms of loan classed as asset or profit-sharing rather than the client incurring interest payments out of income.

Downstream

Apart from upstream investments, the scope for downstream construction plant, eg petrochemicals may be more limited in future now that the first wave of regional industrialisation is established.

No major new technologies in the oil and chemicals sectors are expected to require redevelopments of plant before the turn of the century: the markets themselves in the region are however expected to enjoy good growth on the basis of existing plant capacity.

This may point the way to further international oil downstream investments, with increasing natural gas investments for local use, replacing oil wherever possible.

Long-haul gas is unlikely to develop strongly, either because of the high costs of freight or because of the intensive piped gas network already established in the USSR westwards into Europe, backed by half the known world's proven gas reserves. International coal remains massively in surplus.

The USSR is also expected to hold oil exports as a result of internal market gas substitution. In nuclear, the USSR is joined by Japan and France in unflinchingly maintaining planned dominance of power-generation despite all the problems. The importance of the USSR as the largest producer of both oil and gas, in total greater than Middle East oil and gas output, was another major source of uncertainty for Middle East developments.

The shipping world remains inherently oversupplied and compounds the uncertainty inherent in the oil, economic and trading world. Two-thirds of the tanker fleet, mainly larger crude carriers, will be of scrapping age by 1997 but the propensity to refit and rebuild from a world with shipbuilding capacity at least twice the potential market size (even with high Middle East long-haul demand) does not offer any real opportunity for investment.

Pipeline development across to the Red Sea and Eastern Mediterranean, or flanking the Gulf to points south of Hormuz, could amass 10 mbd capacity if hostilities continue to provide the stimulus for their construction. Continuing abundance of shipping and minimal freight costs are good news for Middle East exporters. Prices are still likely to be set in the Atlantic basin and Far Eastern product markets which favour netbacks to shorter haul producers: low cost freight reduces the locational problem for Middle East exporters.

Perhaps the saddest note of the Conference was the comment that an end to conflict, in the Gulf War, in the internecine strife in Israel or the attrition in the Lebanon, would most probably only be a lull with further outbreaks before the year 2000.

The APS Conference in 1988 will be 27-28 September, an annual review of vital factors in the world's key region of uncertainty.●

Tony Scanlon founded Associated London Energy Consultants after 30 years with BP International. ALEC gives macro-economic risk analysis on world energy problems with deep roots in geopolitics and statistics.

WPC organisers go offshore Brazil

by Derek Payne, Secretary-General, World Petroleum Congresses

At meetings in Rio de Janeiro at the beginning of December the first steps were taken in planning the 13th World Petroleum Congress to be held in Buenos Aires in October, 1991.

Dr Klaus Mai, WPC President and M. Pierre Jacquard, Chairman of the Scientific Programme Committee, later led a WPC group which visited the Pampo Field, the southernmost field in the Campos Basin, 63 miles offshore from Macaé.

Petrobras has 7,000 personnel working in the Campos Basin of whom 4,300 are offshore, plus contractors. Exploration is now taking place in water depths of up to 6,000 feet. Rigs drilling at present include two jack-up rigs, nine semi-submersibles and one dynamically positioned. There is one drill ship. There are also seven fixed production platforms. Petrobras also has 24 helicopters and 72 work boats in the area.

Albacora, the first giant oilfield discovered by Petrobras off Rio de Janeiro State, in the Campos Basin, entered commercial oil production with an initial flow of 2,500b/d, and is now producing 7,550b/d. Thus, Brazil's oil output rose to 610,000b/d, a level which was again exceeded in November with an increase of more than 6,300b/d. Petrobras thereby achieved a new oil production record with 616,000b/d, surpassing the previous record of 611,000b/d recorded in March 1986.

The Albacora superfield is located in water depths which range from 200 to 2,000 metres, with oil reserves estimated at 2.5 billion bbl. From it 110,000 cubic metres per day of natural gas are also being extracted. The field's first development phase encompasses six oil wells in waters from 250 to 419 metres deep, with an output forecast of 18,000b/d of crude and 250,000 cubic metres of natural gas per day.

With the coming onstream of the well number 4-RJS-328 off Rio de Janeiro, in waters of 419 metres, a new world record was established for completion and production in deep waters. The previous record was held by the well number 3-RJS-294 in the Marimbá field, located in waters of 411 metres.

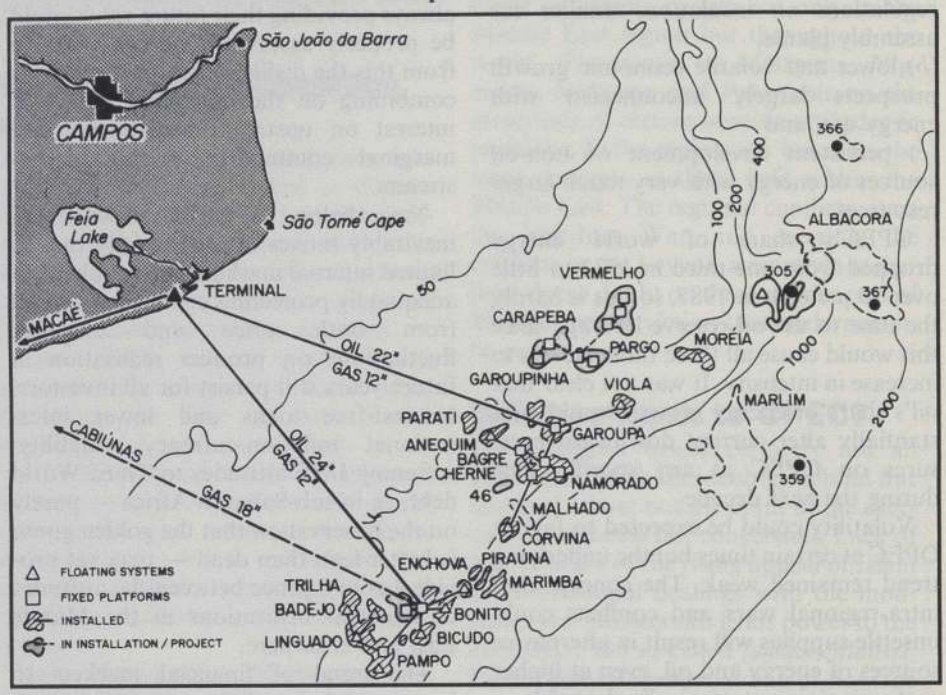
Albacora's present production is being piped to the Prudente de Moraes ship, recently modified and adapted for oil and natural gas processing. Next, the oil is transferred by a submerged flexible line to a tanker which carries it to shore. The gas is compressed and sent to the Garoupa central platform.

Albacora's first development phase will absorb investments of the order of US$100 million, not including well drilling costs, which occurred during the initial operations of exploration and reservoir delineation.

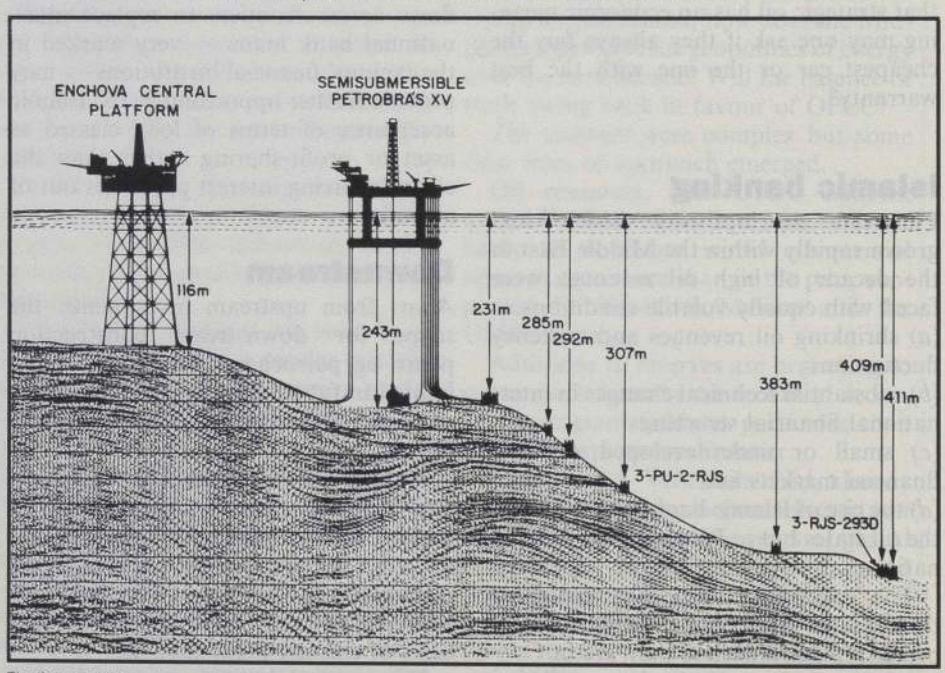
In November last year, Petrobras successfully concluded the assessment of the 4-RJS-382 well. Although the drilling of new wells is needed, it may lead to a 180-square kilometre giant oil field with oil reserves roughly estimated at one billion or 1.5 billion bbl. The said well, located in waters of 1,119 metres, showed an initial flow of 3,000b/d. Under regular producing conditions, it may surpass 10,000b/d.

The 25 deg API crude was found in three reservoirs each measuring 50 metres thick. These discoveries were made in sandstones as deep as 2,700 metres. The pay zones are the same as these detected in the Marlim giant field to the north. However, the oil is lighter and richer in dissolved gas, presenting greater productivity per well. ●

The Campos Basin in 1987



Pirauna/Marimbá Floating Production System



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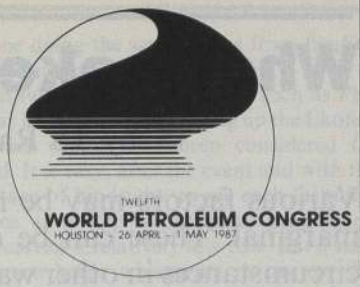

The Program of the Congress has been designed to promote a full and free exchange of knowledge and ideas, on a worldwide basis, among petroleum scientists, senior managers of the petroleum industry and specialists in allied fields. In this inter-disciplinary and international context, the Congress Proceedings cover technical subjects, related managerial issues and their wider economic and social implications.

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What makes an offshore project marginal?

by TS Radford, Senior Petroleum Engineer, Barclays Bank PLC

Various factors may be responsible for classifying a project as marginal. These can be economic, but they may relate to the circumstances in other ways. Most important, they are not static and some projects which were considered to be sub-economic in past years are now capable of being developed profitably. The reverse is also true.

Few projects are immediately and obviously recognised as profitable and attractive to all the parties concerned, the sponsors, the host governments and also the banks, who in the end usually have to provide the finance, in some form. Many more, whilst they can be recognised as having the potential for becoming profitable (if certain factors work out in the end to be favourable), obviously carry so much risk that they are not considered to be economic and never make it off the drawing-board.

Some definitions

In between these two extremes lie the majority of oilfield projects currently under consideration (and potentially, some of those currently under construction). There is always a degree of subjectivity when the term *Marginal* is applied to such projects and it is as well to consider exactly what we mean by the term.

For some analysts, the main criterion is the rate of return calculated from a single case of cash flow incorporating the most likely production profile, the operators estimates of costs, current economic conditions and the current tax regime. A 'real' rate of return (ie deflating the cash flow, before the rate of return is calculated), of 20% or more makes a project attractive. One of, say, 10% to 20%, used to be considered marginal. These days, the threshold tends to be drawn at a lower level but each company has its own yardstick, and even these change with time, as the opportunities to make alternative profitable investments arise, or recede.

Other analysts acknowledge that there is a risk that a range of different scenarios might arise. They might consider, instead, a weighted average of the rates of return, calculated according to the probabilities of each case arising. Even more complicated techniques might be employed, such as Monte Carlo simulation or Dynamic Programming using Markov chains. Alternatively, other criteria may be selected, such as time to pay out or Net Present Value at a fixed discount rate. The results, in each case being compared to a target figure which represents the corresponding corporate objective. The projects which pass some, but not all, of such corporate hurdles are usually classified as *marginal*. In some cases a marginal project is defined as one which could achieve the target figure with some minor reduction in capital costs, increase in oil or gas prices, or a favourable tax break.

For a company with a large portfolio of potential projects and limited resources of manpower and capital, such an approach makes good sense. It also allows for a ranking of the opportunities and an unbiased choice between projects, or options within projects, free from the politics of their sponsoring departments or subsidiaries based in different countries. I suspect, however, that it is less often used than the rather more pragmatic definition, proposed by one American independent operator, that a marginal project was one which 'he could not take to his bank to be financed'.

Non-numerical considerations

Non-quantifiable factors often loom larger than those which can be calculated by a computer. Anyone who has attempted to assign spreads of values and their respective probabilities, to the whole range of factors, from reserves and production rates, through cost overruns and project delays to the price of oil and currency exchange rates, knows how subjective the process can be. Even the choice for authority to quote on those areas outside his own expertise can introduce a significant bias into the result. At a time such as this, with more economic uncertainty than was ever the case in recent years, especially with regard to North Sea operations, even deciding on the parameters for a 'base case' can be fraught with subjectivity. It is tempting at this point to be cynical and consider that the word marginal is a declinable adjective as in 'my project is viable, yours is marginal, his is a wild flight of fancy.'

Let us examine some of the different pressures which could influence an organisation's judgement as to which projects to classify as viable, marginal or sub-marginal. These pressures may be different according to that organisations role in relation to the project in question.

The operator — majors

The operator of the project might well be a subsidiary of one of the major oil companies, who, in 1986, were laying off well qualified and experienced geologists, engineers and operations staff. They would still have the incentive to provide projects to justify their remaining a relatively large E and P workforce.

The majors can afford to take a longer term view and they may still have access to reserves of capital which are large compared to those of their co-participants. A steady and planned stream of profitable projects is an effective way of using all the resources at their disposal. They recognise that this year it is not so easy to justify expenditures to their parent company as it was, but they all 'want to be in a position to take advantage of the upturn when it comes.'

The parent company may have acquired petroleum reserves by taking over less fortunate companies, or by purchasing their assets. Where there are proved, but as yet unexploited reserves in their portfolio, there will always be pressure to find viable projects to produce those reserves, in a profitable and economical manner.

The smaller operator

If the operator is not one of the larger companies, then the pressures could be even greater. A willing pool of engineers and other experienced personnel is available to be recruited and, if a project team does not already exist, now may be a good time to build one up. This is especially the case if a whole series of projects can be identified. The management may feel that being actively engaged in a development project is the best way to secure their jobs in the event of a future merger, or takeover, and certainly, it will be an asset when bidding for exploration areas in future licencing rounds.

On the other hand, the shareholders may have had to put up with dramatically reduced dividends (if any), and raising capital from the equity market is currently far from easy for the smaller E and P companies. The recent spate of large equity issues and privatisations in the UK market has shown that the money is there and some investors are prepared to buy shares.

There are even a fair number who saw 1987 as a good time to buy back into the petroleum sector, but events in the first quarter of 1986 showed that oil prices can fall dramatically, as well as rise. Events in the last quarter of 1987 illustrated the downside potential of the equity markets quite dramatically. Quite understandably, the upstream company which is dependent on a small number of development projects and with exploration commitments is seen to be at risk.

Limited recourse project finance may be an option open to the company but, of course, this can take many forms and it could lead to restrictions on the other activities of the company as well as the manner in which it operates its projects.

Either way, one would expect that the effect will be to impose a more cautious approach on the smaller independent operator than would have been the case in the years prior to 1986.

TS Radford's paper was first presented at the *Marginal and Deepwater Oilfield Development Conference* jointly organised by the Institute of Petroleum and Lorne & MacLean Marine in London recently.

Of course, there are exceptions and no doubt we will be hearing more — if not at this conference, then elsewhere, about projects such as the Emerald field development, where the risks, and rewards, are shared between the field participants, the purchasers of their oil, and the contractors and their sources of finance.

Being an operator, of course, still gives a company some advantages over the next group to be considered but, in the end, the final commitment to go ahead with a project depends on the agreement of all the participants in a venture.

The non-operating participants

The non-operating participants, depending on their size, exploration commitments, financial circumstances and judgement of the operators technical capabilities, may have a significantly different view of the viability of the project. They might wish to reduce their exposure to the risks associated with a particular project by farming out a part of their interest. Such a move can make up the difference required to make a project viable for the company concerned. Some will be tempted to dispose their interest altogether, expecially if a willing buyer is found, who is prepared to pay the right price. It is, of course, in the interests of all the groups involved in the petroleum industry that such trades can take place.

It is to be hoped that the outcome of the current dialogue between the government, on the one had and Brindex and UKOOA on the other, will result in a regime in which both the exploration companies can realise the rewards of their risk taking and those who wish to acquire interests in discoveries they make with a view to their development, can do so without undue interference or taxation.

The non-operators will, of course, not be able to use the project to carry some of their overheads, or justify recruiting staff. They will still have to raise their share of the capital costs of the facilities.

In the case of some marginal projects, because of their relatively short life, abandonment may not be such a remote event as with other developments. The non-operating participants will share in the financial commitments associated with this but they may disagree with the operator as to how these commitments are to be discharged. Again, the operator will have a minor advantage over them since it is his staff who will engineer the abandonment and he will have a greater say in when and how and by whom it is carried out.

All of the participants, including the operators, are conscious of their relationships with the government agencies and their desire for the industry, as a whole, to keep up (or regain?) the momentum provided by a continuous flow of work to their respective construction yards, supply industries and fleets of offshore vessels. Future licensing rounds may be another factor in the timing of announcing development decisions.

Banks

The banks, when approached to finance one, or more, of the parties' interests in a project, tend to look at it from a different perspective altogether. The banks' viewpoint will be considered in more detail, since, if we accept the definition of 'marginal' quoted above, it is significant.

Oil industry projects are far from being the only objects of the banks capacity to raise funds and there are other, competing and totally unrelated, calls on their resources, including their capacity to absorb risk. The petroleum industry is only one sector of their activity and in general, providing limited recourse finance for petroleum related projects is considered to be the riskier end of the spectrum of the banks' activities.

In almost all cases, if the project provides its sponsors with a higher income than predicted, the banks will have nothing to gain from this feature but they take much of the risk of making a loss. It follows from this that there is an emphasis on the avoidance of risks, except where specified risks so accepted in exchange for appropriate rewards. These rewards are usually in the form of fees or interest rate margins. The mechanisms for achieving reduction in risks include parent company guarantees, completion tests, company guarantees against specific areas of risk, maintenance of cover ratios and the charging of assets.

Just as each reservoir has its own specific characteristics, with no two being exactly similar, so also with Project Finance. No two borrowers have identical requirements and there is an extremely large number of combinations in which the features listed above can be assembled so as to meet the objectives of both borrowers and lenders. No two banks will offer exactly the same package.

Despite the downturn in oil prices last year there is still an element of competition between the banks to provide the finance for good projects. This competition helps to establish what is an acceptable price and upper limit for each class of risk. It also influences the upper limit to the total level of risk which can be financed at any specific time.

Compared with the first generation of facilities offered to the industry to finance North Sea Projects, however, and even compared with those offered as little as five years ago, the borrowers are still being offered relatively easy terms. This is due to two factors. Firstly, following a period of intense competition amongst lenders for projects to finance, the industry and the banks which serve it have become accustomed to relatively low interest rate margins and the possibility of, say, completion risks being borne by the lenders, rather than the borrowers.

The second factor is a dangerous familiarity with the form of the typical projects and their environment.

Feasibility

The public at large have now accepted the general concepts involved in offshore operations. There is, furthermore, a generally held view that, provided there is a strong enough commercial incentive, any project, devised by engineers, can eventually be made to work. After all, if men can be put on the moon, anything should be possible.

As little as twenty years ago, the idea of platforms in the middle of the North Sea producing oil and gas as a matter of daily routine would have been considered as science fiction, let alone doing the same things from floating production facilities.

Even two years ago, a project such as Phillips has just completed, jacking up the Ekofisk platforms would have been considered far fetched. It is easy, after the event and with the advantage of hindsight, to see each technical advance as a step in a logical progression which carries a relatively low risk. But a nagging voice keeps whispering in my ear the words 'Box girder bridges'. Many of the projects involve extending existing technology to the limits of its previous application, and beyond. There are also some which incorporate radically new techniques. I am flattered by the faith that the general public has in the profession of offshore engineering, but I know that technical failures can, and do, occur.

Of course, the significant words are 'provided the commercial incentives are strong enough. . . .' This phrase not only covers the forecasts of rate of return and income profile associated with the project, but also the risks that they project will fall short of these forecasts. Naturally, the perceptions held by different analysts of these risks can vary quite widely. For those very close to a project familiar with its detail, especially if there is a degree of commitment, there is the chance of certain risks being understated, whilst others are perceived as being greater than they are, in fact, because they related to a particular problem area which is currently under close scrutiny.

The banks are very aware that cost overruns can ruin the economics of a project and also that projects can fall short of their technical objectives, but for some of them, the layman's familiarity, mentioned above, can leak through into their judgement in any particular case. It is now quite common to hear of projects completed 'on schedule and within budget'; I tend to ask 'which schedule?, which budget?'. The significant ones are those approved by the participants at the project's inception and those on which the finance was agreed. Other banks have made it their business to become better informed on technical matters and look more closely at the design and planning of a proposed project taking appropriate outside expert advice, if the detail requires it.

Where a radically new concept or technique is being employed combined with the fact that there has not yet been a major default under a project financing, due to the failure of a North Sea project and no project in this area has yet been abandoned by its sponsors, this superficial familiarity with the overall environment can also lead to an underestimation (by those not directly involved) of the risks being faced. We are, after all, at this conference, addressing the problems of project's with a level of associated risks somewhat above the average.

One or two spectacular failures would of course very possibly lead to an overreaction in the other direction. It is a regrettable fact of human nature that we tend to see things as either all black or all white.

Reservoirs

Rather more disturbing is the view that all offshore reservoirs are as predictable and profitable in their exploitation as were the first generation of North Sea fields.

The reservoir engineers, who originally estimated the reserves of those early fields, knew that very high well rates were achievable (most platforms were designed with this in mind) and also suspected that the recovery factors would be high. With caution bred from experience, they still made their forecasts on the low side. In some cases this caution was justified, but in others the estimates of reserves have been extended, from time to time, so that now, with the fields nearing their final declines, what appear to be dramatic increases in the remaining reserves are, in some cases, recorded. The rates of production were, if anything, harder to predict and, in several cases, these were considerably overestimated.

Those first large fields had very good quality reservoirs with continuous sandstone formations of high porosity and permeability, which lead to ideal conditions for pressure maintenance by waterflood. In many cases a process of diagenesis below the oil water contact led to the reservoir also being overpressured. A few such reservoirs are still being found but not, usually, so large and not nearly so often. Each new reservoir has its own characteristics and the assumption that they are all like Piper or Brent, only smaller, is just not valid. Of course, if the reservoir contains gas condensate, the problems of forecasting its production profile are exacerbated by the possibility of retrograde condensation and the compositional changes in the produced wellstream to be expected from such fields as their pressures decline.

Costs

It is true that the first generation of oilfields in the northern North Sea were substantially underestimated both in capital and operating costs. Their facilities were constructed in an environment which was competitive, in terms of resources, to an extent which has hardly been the case, in peace time in this century.

There was also the perception, at the time, that the oil reserves of the world were rapidly running out. The subsequent rapid rise in the price of oil, fortunately, more than compensated for the cost overruns. This compensation need not have happened to the extent that it did, and future historians will almost certainly judge that it is the high level of oil prices in the late 1970s and early '80s which was anomalous. As things turned out it was also fortunate for the development of the North Sea.

Examples

Two of the field developments, from that era, which are, today, acknowledged as being amongst the most profitable developments in the North Sea, could be given as examples of perceived risk which might make them be considered as marginal, if the circumstances were to be repeated. The first, and most obvious, example is Hamilton's Argyll field. I remember when their floating production facility was described to the Society of Petroleum Engineers, the feeling amongst the audience was 'it is a great idea, let's see them get through their first winter before we would even consider it for our fields.' The reason given, for not committing to a fixed platform was that the reservoir was of uncertain size and quality. Here we had a project, the first of its kind, and furthermore it was to be used to exploit a risky reservoir!

The second example is the financing of Thomson's interests in the Piper and Claymore fields. At the time, this company was seen as being especially vulnerable to cost overruns and the size of the facilities were such that the parent company was unable to provide a completion guarantee, given the other circumstances under which it was operating at the time. Accepting this risk was considered, to justify a special royalty to the banks. It is not inconceivable that such a mechanism may be resorted to again in future project financings but it has not featured in any, recently, in the North Sea.

Of course, as it turned out, Hamilton did have quite severe practical problems during their first winter and they successfully overcame these. The cost overruns incurred by the participants in the Piper and Claymore developments, especially at the Flotta terminal, were also very significant. In both cases there were risks which had been foreseen and which transpired but, as it turned out in the end, were outweighed by other factors, the most significant of which, of course, was the rise in oil price in the 1970's.

Project financing

The banks, in assessing a project prior to financing it, will calculate how and when they are to be repaid, taking into account the expected interest rates and cashflow stream associated with the project. Normally the period after completion during which repayment occurs is less than 5 years making a total maximum life of the facility around 8 years. There is another limitation which is usually imposed on an oil or gas field development and that is that a tail of around 40% of the reserves should remain to be produced when the final repayment is made.

Normally, this would impose an upper limit on the amount which could be made available to finance a smaller field. If the repayment period is much longer there are usually very special circumstances. It is not unusual for facilities to be repaid or rescheduled well within the agreed period as circumstances of a company and its projects change and new opportunities arise.

Any really large financing becomes the subject of syndication between a group of banks and the Agent bank, which organises it, is always obliged to consider what would be accepted by the most conservative member of the syndicate in terms of risk. Usually, the Agent bank can find the necessary participants at the desired levels, but it is not as easy as it used to be, even with more restrictive terms imposed on the borrowers than a couple of years ago, when there was a boom in energy project financing.

Whereas, only a few years ago, any company with an interest in a petroleum discovery in almost any part of the western world found the banks were beating a path to their door, now even proved reserves with a viable conventional development project may considered to be risky. The reasons are not hard to find. Not only has the oil price fallen dramatically, but the circumstances which caused the fall still prevail. Despite the relative stability in international oil markets since the turn of the year, there is still a large overhang of productive capacity over a world demand for crude which may be rising (slowly) but is at a much lower level than was the case, say, ten years ago. The confident assumption of regularly increasing oil and gas prices during the period covered by any likely financing can no longer be made.

However, there is still a large element of competition amongst those few banks, who are still committed to the energy industries, to find good project financing opportunities. It was these banks which did not overreact in the boom years of the early 1980's and have maintained a consistent approach to the industry who are still in the market. With the trend towards more innovative methods of spreading risks between the sponsors and other parties, combined with the technical features being engineered into the projects to reduce the overall capital and operating costs all the signs are that there are still a significant series of projects which sponsors can take to their banks to be financed. The old criterion of testing marginality by working out a single rate of return, based on one case of cash flows, if it was ever the case, now most certainly no longer applies. A marginal field might better be described as 'one whose viable project has not yet been engineered.'

Most of the fields, which are today considered marginal, will be developed eventually. It is up to the engineers to select candidates and design projects which are appropriate to the conditions prevailing at the time and make the best use of the technical resources available. ●

IP Energy Economics Group

Forthcoming meetings

15 February 1988

OPEC and the Oil Market
Speaker: Dr MV Samii
JF Kennedy School of Government
Harvard University
at IP, 5 for 5.30 pm

21 March 1988

Alternative Motor Fuels
Speaker: EI Williamson
Director, The College of Petroleum Studies
at IP, 5 for 5.30 pm

Please contact Ms G Douglas on 01-636 1004 if you wish to attend.

Letters to the Editor

Prof. Gold rebuts conventional viewpoint

Sir,

The letter in the November 1987, issue, entitled 'Gold's hypothesis' by Prof. Arthur Whiteman contained numerous misconceptions. Your correspondent was not aware of either the theory on which the Swedish drilling was based, nor of the facts as we knew them at the beginning of the enterprise or as we know them at the present stage. He merely gave the conventional viewpoint of the origin of oil and gas, and the 'explanations' that would have to be invented to account for the occurrence of these substances deep in an area of granite.

Firstly the theory: I do not and never have proposed that methane was incorporated into the earth and that its subsequent polymerisation results in petroleum. What I do consider to be the process is that solid, heavy hydrocarbons were incorporated when the earth formed, like those we see in the meteorites. Under heat and pressure at a burial depth of 100-300 kms these substances will form a variety of molecules of petroleum. Your correspondent is quite wrong when he thinks this to be not in accord with thermodynamic theory. It is in fact the opinion of most, possibly all of the modern thermodynamicists who have concerned themselves with the problem of the equilibrium configuration of hydrogen and carbon in the pressure-temperature regime in this depth range. The erroneous (and I thought by now antiquated) notion of the instability of petroleum molecules already at quite shallow depths was apparently based on the failure to recognise the important stabilising effect of the very high pressures that accompany the elevated temperatures.

How anyone could judge that gases coming out from the interior of the big earth could be present in 'extremely low concentration' only, is not clear to me. Methane streaming out from the vents in the deep oceans is generally considered to originate deep below and with gases clearly derived from mantle depths. The quantities are by no means small, and could fill all the known gas fields of the world in a very small fraction of their ages. And, of course, the other planets show us enormous abundances of methane and other hydrocarbons, which even your correspondent would not consider to be of biological origin.

The investigations of the Swedish meteorite crater have shown that sediments of the ring-shaped depression are nowhere deeper than 300 metres. None of the boreholes in the interior region, including the principal one to 6.4 kms, showed any traces of sedimentary material mixed down by the impact; nor would any such downward mixing be expected from an impact, which is largely an excavation and rebound process.

The entire crater area in the interior of the ring as well as five exploratory boreholes gave evidence of outgassing of hydrogen and methane, well recognised and documented before drilling commenced, by several experts of the petroleum industry. If such a rate of outgassing had been in effect for even a small fraction of the 360 million year age of the crater, a gasfield equalling the world's largest would long have been exhausted. Similarly, the oil seeps of the area imply an outflow which could not be maintained by any known oil reservoir over the age of the crater.

Abundant helium

The well that has now been drilled to 6.4 kms depth showed hydrogen and hydrocarbon gases entering the wellbore, largely in step with each other and with abundant helium. The quantities of helium are far larger than could have been generated by radioactivity of the local rock and a flow from deeper levels is implied. Equally, the quantities of hydrogen, sometimes at combustible levels in the returning drilling fluid, cannot be accounted for by any local production. Among the hydrocarbon gases pentane became particularly prominent at the deeper levels, where its abundance beat that of methane some twenty-fold, while at the shallow levels methane had been some hundreds of times more abundant than pentane. Such a reversal is regarded as typical of upward seepage through a rock in which the larger molecules suffer a greater hindrance.

It is by no means true that the petroleum industry is uniformly opposed to the venture. In fact *all* the numerous experts from the US petroleum exploration industry, whose advice was sought by the Swedish authorities, expressed themselves very strongly in favour of continuing the drilling operation. Among them, Mr RA Hefner III, a well-known petroleum geologist who is credited with the discovery of a major fraction of the deep gas resources of Oklahoma, writes: 'Siljan is a natural gas and oil prospect which contains every single positive indication available to the industry before drilling, other than the existence of sediments. The Siljan prospect is therefore a world class prospect, and there is no question that it must be drilled.'

I would prefer if those who wish to criticise this important endeavour would acquaint themselves more directly with the theory and the findings, and argue the disputable points rather than publicise mere reiterations of beliefs, however passionately held, or personal attacks.

Those of your readers who would like to study the subject further, may wish to do so with my book *Power from the Earth* which was published recently by Dent.

Yours sincerely

Professor Thomas Gold
36, Madingley Road
Cambridge CB3 0EX

Support from Down Under

Dear Sir,

Your correspondent, Professor Arthur Whiteman, informed your readers that Professor Thomas Gold should be dismissed as a Jules Verne – Velikovsky type (*Petroleum Review*, November 1987, Gold's Hypothesis). Perhaps your readers should also know that this same Thomas Gold, whose opinions they are asked to dismiss so lightly, has, in his scientific career, been able to sweep up such scientific honours as a Fellowship of the Royal Society, Membership of the US National Academy of Sciences, Fellowship of the American Academy of Arts and Sciences, a Professorship at Harvard and at Cornell University, a Gold Medal of the Royal Astronomical Society, an Honorary Fellowship at Trinity College, Cambridge, etc., etc. Perhaps he swims in a bigger pond than that with which your correspondent is acquainted.

Yours sincerely,

Prof. H. Messel,
School of Physics,
The University of Sydney,
NSW, 2006,
Australia.

Corrosion in fuel storage tanks

by Dan C Hanks, Product Manager — Fuels Preservatives, Water Management Chemicals Ltd

Almost all storage tanks containing fuels such as motor spirit, gas oils, kerosene, derv and crude oils will have water associated with them. The size of the storage tank is immaterial and can vary from a 20 gallon tank to a crude oil storage facility containing 250,000 barrels or more. It is this water which can support the bacterial and fungal growth responsible for fuel fouling, fuel degradation and corrosion of the storage tanks.

Source of water

1 Tank sweating

As a storage tank is alternately filled and emptied, moist air is drawn into the tank. The moisture then condenses and collects in the base of the tank to form the water-bottom. The presence of a floating roof, designed to reduce vapour loss, can aggravate the problem because the roof can dislodge water and microbiological contamination from the walls.

Tank sweating can also occur when temperature changes are encountered in the tank during hot weather.

2 Pipeline repairs

When pipeline repairs are made, water is injected into the pipe to test the system. Once the repair is completed, the water is allowed to continue downstream, thus contributing to the water-bottom.

3 Barge or sea fed depots

The source of water in barge or sea fed depots is often the barge or ship itself. Having discharged its cargo, the vessel would normally take on as ballast the locally available water supply. This may be a river, canal or the sea. Unless this water is completely removed when the next cargo of product is taken on, the water remains and can get transferred to the storage tanks.

4 Water content of the fuel

The product will have associated with it a small amount of water as delivered from the refinery. Although the quantity is relatively insignificant under normal circumstances, conditions in a storage depot may be conducive to fuel/water separation.

5 Rain water

Although not too common, it has been known for rain water to enter the tanks. This will carry with it a multitude of various bacteria and fungal spores sufficient to contaminate any sterile system.

Water-bottoms

Almost all tanks are fitted with a drain facility at the base of the tank to remove water and prevent the build-up of water-bottoms. If the tanks are drained regularly, it should, in theory, be possible to maintain a relatively water-free environment.

However, unless the tank has a conical base and the drain hole is situated at the base of the cone, it will not be possible to remove all the water. In many cases, the tanks have flat bases with a drain hole fitted very close to the base. The problem here is that with a base, flat rarely if ever means totally flat and pockets develop which trap the water-bottoms. Also the drain hole normally has to be a fraction of an inch above the base to allow for pipe connections. This will allow several thousand litres of water to remain in the tank.

In some instances the drain hole is several inches above the base of the tank, which could leave several tonnes of water in the tank.

Good housekeeping will help prevent the build-up of water. However, the statement from a terminal manager 'I run dry tanks' is highly unlikely to be strictly accurate and may indicate a certain amount of complacency or lack of understanding of the effects that bacteria can have on fuel quality and tank corrosion.

Method of corrosion

Pure water in itself, when found in association with product, will not create a problem. Unfortunately, it would be very rare to find pure water and a more likely story is described below. The water entering the tank by any of the means described above will contain salts, bacteria and fungal spores and often nutrients for biological growth. The presence of the fuel acts as a source of nutrients and will allow the bacteria and fungi to proliferate, especially at the fuel/water interface, **Figure 1**. Even the presence of leaded gasolines does not prevent microbiological growth; a somewhat surprising fact in view of the high lead content of the product.

It is the fungi, especially *cladosporium resinae*, which are mainly responsible for the fuel fouling and the presence of slimes and biological debris in fuels.

However, our main concern here is corrosion. The species responsible for vastly increased corrosion rates are the anaerobic bacteria of which Sulphate Reducing Bacteria (SRB) are the most important. For those interested in the technical aspects, the mechanism is thought to be as follows.

The SRB are able to reduce the sulphate molecules to the sulphide ion:

$$4H_2 + SO_4 = S^{2-} + 4H_2O$$

The sulphide ion is then able to form the very corrosive gas hydrogen sulphide

$$S^{2-}{}_{(aq)} + 2H^{+}{}_{(aq)} = > H_2S$$

In heavily contaminated systems, it is the presence of hydrogen sulphide that is probably responsible for the foul odours. Under anaerobic conditions, the hydrogen sulphide will react with iron to form the sulphide

$$Fe^2 + H_2S = > FeS + 2H^+$$

The attack of the surface would stop there because the hydrogen produced should polarise the surface, preventing further dissolution. Unfortunately, the SRB are able to utilise the hydrogen, allowing a fresh metal surface to be presented for dissolution, thus:

$$Fe^{2+} + 2OH^- > FeO + H_2O$$

Evidence of bacterial corrosion can be seen quite clearly as pitting in the floor or walls of a storage tank. **Figure 2** shows a typical corrosion pit as seen under a microscope.

A more serious case of bacteria-induced corrosion can be seen in **Figure 3**. This shows pitting in a storage tank in the UK after grit blasting. The $\frac{1}{4}$" steel plate of the tank base has completely corroded.

Identification of bacterial contamination

Identification of microbiological contamination is

Figure 1

Figure 2

Figure 3

not always possible by visual inspection. A lack of slimes and fungal debris in the fuel does not automatically infer that the SRB are also absent. The best method is to analyse samples taken from water-bottoms or the fuel as close to the water-bottoms as possible.

Elimination of Sulphate Reducing Bacteria

The elimination of the Sulphate Reducing Bacteria is fairly simple by the addition of a biocide. The biocide can be effective at very low dose rates, typically 1–3 active ingredient. The biocide should be deactivated by the presence of high levels of organic growth and should be effective over a broad spectrum of bacteria and fungi. It is important that the biocide be capable of eliminating microbiological contamination in both the water and the fuel phases. Failure to have duel solubility will result in only a partially sterilised system. Biocides based on isothiazolinone are able to partition to a small extent into the fuel phase, thus giving all-round protection.

Prevention

Without water, the bacteria and fungi will not proliferate. However it is very difficult, if not impossible, to run a storage depot or tank without the presence of some water. Therefore, the removal of as much water as possible is most important. Unless the tank has a conical base with a central drain facility, a small amount of water will remain. Unless this water is removed or treated with a biocide, biological growth will almost certainly be evident.

Preventative action is the best medicine. All water-bottoms should be drained regularly and a system of tank maintenance introduced. In addition, the presence of a low level of biocide will inhibit biological growth and maintain a sterile system.

Coating of the tanks will certainly help to reduce the rate of attack, provided the coating is complete. The slightest hole or crack will allow bacteria and fungi to obtain a foothold. In addition, corrosion of the tank at the point will be vastly increased, due to the electrochemical effect. ●

Multi-pulse additive injection system

A compact, easy to install, additive injection system that can be used in Zone 1 hazardous areas, has been developed by Hyrolec Technical Services Ltd.

Designed with the utilisation of already proven components the equipment, known as the Multi-Pulse Additive Injector, it is claimed it has many advantages over less sophisticated systems. Among these are the inclusion of a comprehensive control package, with full electronic enhancement, to provide injection of multiple additives to all forms of liquid including petroleum products, at varying rates; built-in manual checking facilities, and the choice of alternative material to the standard PTFE used for all seals. The system offers an adjustable displacement cylinder with PTFE piston and seals, a stainless steel sub-base mounted slide valve with manual override, a stainless steel solenoid valve. All pipework and fittings are stainless steel as standard.

The Multi-Pulse Injector operates when the solenoid valve is energised by an electrical pulse, this causes pressure to be applied to the slide valve which changes position driving the displacement cylinder piston to one end of the cylinder which introduces additive into the product line.

De-energising the solenoid causes the slide valve to return to its original position which by reverse action displaces more additive into the system. ●

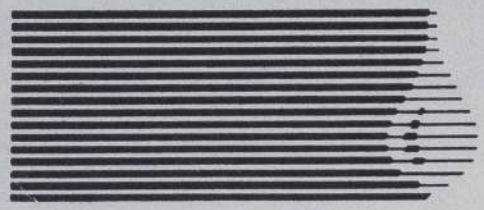
Fluid loss reducing agent launched

A new fluid loss reducing agent for the oil and gas industry has been developed and put on the market by AVEBE Foxhol, Netherlands. The new product, Stabotemp HT, is a special cross-linked polymer and is universally applicable in water-based drilling muds.

Special feature

One of the special features of Stabotemp HT is that it is thermally stable to a temperature of 150°C under an extended temperature load of 16 hours or longer. Under shorter temperature loads it can be used at temperatures up to 170°C. This means that the product is suitable for drilling holes down to a maximum depth of 6,000 metres. Stabotemp HT has excellent suspension properties and is readily soluble without the risk of lump formation. As a filtration control agent, the new product is universally suitable for diverse drilling conditions and is usable both for onshore and offshore drilling. The product is highly stable at high calcium, potassium and sodium salt concentrations and other chemicals such as drilling cuttings. Another important feature is its stabilising effect on the rheological properties under high temperature load. ●

3rd International Conference on Stability and Handling of Liquid Fuels



LONDON
13th-16th
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Conference Papers covering the following subject areas will be presented:

Reports, studies, surveys, experience gained, of fuel stability during storage and use

Handling and processing of fuels during and after storage — hardware

Chemistry of fuel instability

Predictive test procedures for fuel stability

Refinery processes to enhance fuel stability

Additive treatment to enhance fuel stability

Stability of fuels at elevated temperatures in storage and during use — thermal stability

Microbiological effects during fuel storage — means of monitoring and control

Stability of residual fuels

Storage of crude oils

For a copy of the registration form, which will be available early March 1988, please contact **Caroline Little**, Conference Officer, The Institute of Petroleum, 61 New Cavendish Street, London W1M 8AR. Tel: 01-636 1004. Telex: 264380. Fax: 01-255 1472.

The Institute of Petroleum CONFERENCES AND MEETINGS 1988

February 16	**Luncheon Meeting** Speaker: Dr Juan Chacin Guzman, President, Petroleos de Venezuela
February 16	**Oil Price Information Seminar**
February 16	**Oil in Latin America Seminar**
February 17	**Annual Dinner**
February 18	**Luncheon Meeting** Speaker: Mr Nadar Sultan, President, Kuwait Petroleum International Ltd.
February 18	**The Oil Industry in Latin America — Prospects for Equipment Suppliers**
April 21	**Microbiological Update for the Petroleum Industry**
May 17–18	**Seminar on the Remote Sensing of Oil Slicks**
May 24	**Petroleum Retailing**
June 8	**The Trend Towards the Privatisation of Energy Companies World-Wide**
June 29–July 1	**Introduction to Oil Industry Operations Course**
July 4–6	**Introduction to Petroleum Economics Course**
September 13–16	**3rd International Conference on Stability and Handling of Liquid Fuels**
September 28–30	**Oil Industry Nurses Symposium**
October 18	**Documentation Control in the Energy Industries**
November 1	**Oil Supply and Price**
November 17–18	**The Third Oil Loss Control Conference**

For further information, please contact **Caroline Little**, The Institute of Petroleum, 61 New Cavendish Street, London W1M 8AR. Tel: 01-636 1004. Telex: 264380. Fax: 01-255 1472.

Highly sensitive infra-red detector for smoke and oil mist developed

A new device, originally developed to warn of oil mist releases on North Sea platforms, has been modified by Shell at its Thornton Research Centre to detect smoke.

It uses an infra-red beam which can detect fine liquid sprays, particles or smoke. The device's core is a microprocessor which allows sensitivity and alarm response time to be chosen to meet individual requirements. Wormald Engineering who market the detector on behalf of Shell Research Ltd, claim its development has widened the commercial application of the principle considerably, and the new dual purpose detector, which is intrinsically safe, is an important safeguard against fire.

Multi-purpose

The detector can be used wherever the failure of plant would result in the release of mist, steam or smoke. In the oil mist or particle mode, it can be used in the oil and gas, mining, chemical industries or in any industrial processes which present a potential hazard. But the widest market is for use as a smoke detector, where it can be applied in all industries, especially those where the possibility of an inflammable atmosphere requires the use of intrinsically safe equipment.

Offshore, safety is the first priority of operation, and a wide range of detection devices is used to cover the possibility of oil or gas leaks. Shell UK Exploration and Production, who commissioned the new detector, continually reviews its systems to ensure maximum effectiveness, and has decided to strengthen its armoury by producing one sophisticated enough to concentrate on a single potential hazard, the escape of oil from a high pressure line, which could build up into an explosive concentration. No detector marketed met those requirements, so the company asked Shell Research Ltd at Thornton to develop such a device.

Solution

The solution the Thornton scientists devised was to use a light emitting diode to project a beam of modulated infra-red radiation to a target of retro-reflective material.

This reflects the beam back along the line of incidence to an infra-red receiving diode mounted adjacent to the transmitter. The target, which may be up to 164 feet (50 metres) away is positioned so that the beam projected by the detector crosses the area to be safeguarded.

The intensity of the signal reflected by the target is a measure of the optical density of the measurement path. Using a microprocessor to monitor the intensity, the team was able to program the detector to distinguish between a change in intensity due to a build-up of oil mist, from that produced if platform staff or objects pass temporarily through the beam.

Test results

Laboratory and field tests have shown that the unit is suitable for use up to about 328 feet (100 metres), although in practice, the maximum range likely to be required is not more than 98 feet (30 metres). In those circumstances, where the optical path of the beam for the journey to the reflector and the return to the transmitter will total 196 feet (60 metres), a loss in light transmission due to fouling of at least 90 per cent can be tolerated without loss of sensitivity.

Once the limit of compensation has been reached and cleaning of the optical surfaces is required, a warning is communicated to the alarm monitoring station by a change in supply current and, locally, by means of an LED mounted above the transmitting and receiving apertures.

As a result of the success of Thornton's testing and development programme, a licence to manufacture the oil mist detector was granted to Wormald Engineering. At the same time as a production model for the oil mist detector was under way, Thornton worked with Wormald to develop the system further for the application which would give it the widest commercial value-smoke detection.

Beam detectors are growing in popularity because they provide economic, large-area coverage, without suffering the disadvantages of dead-spots and poor still air response, problems encountered by point smoke sensors. But perhaps more importantly, they provide a much better change of early detection. This is because point smoke sensors depend on convection currents to carry the smoke to them, whereas with a beam system it will be detected if it enters the beam at any point along its path.

Although the Thornton device was developed initially to detect oil mist releases, the measurement technique is equally sensitive to all visible (ie mist, dust, or smoke) particles. In fact, a theoretical analysis has shown that the sensitivity is at maximum for particles in the 0.1 to 10 micrometres range.

To take full advantage of the benefits of this technology, a new program was developed for the microprocessor to ensure that the detector complies with the most recent British Standards.

In its production form, the dual purpose unit has achieved the objective of a low installation cost. It contains both the transmitting and receiving elements, supplied via a two wire system. Another prime consideration in designing the production model was to ensure ease of alignment when commissioning on site.

As the unit is highly sensitive to the slightest visible change, the software is written so that it will accept up to four settings, dependent upon the area to be monitored. The settings are easily link selectable via the seven pin plug supplied with the unit. No manual circuit adjustment is required during installation or subsequently. The detector is industry compatible and will hook up to most types of control and indicating equipment. ●

New pipelining

An innovative method for pipelining oil has just been successfully tested by the TRANSOIL Group (comprising BP Canada Inc, AEC Pipelines and BP Canadian Holdings Ltd). The method used was to employ a heavy water in oil emulsion, first discovered in 1983 by scientists working at the BP Research Centre in the UK, as part of a collaborative R&D programme with INEVEP of Venezuela. The process uses controlled mixing of heavy oil with low concentrations of commercially-available surfactants to produce heavy oil-in-water emulsions. These emulsions contain oil droplets with a narrow and well-defined size range. This results in greater stability during long distance pipeline transportation, since there are no very large droplets which could settle out. As there are also no very small droplets, this unique technology allows easier separation of the oil from the water by the customer.

Re-orientation in the oil industry

World Oil Trends 1987–88: Arthur Anderson & Co: Cambridge Energy Research Associates, London. 128 pages. Available from John C Norton, Arthur Anderson & Co, 1 Surrey St., WC2R 2PS, price $50.

Many countries still want to find one forecast with which to guide their strategies into the 1990s, concludes the essay that introduces the survey. But a powerful lesson of the last decade and a half is the complexity of factors that shape the oil industry environment. Thus, companies seeking to make durable strategies need to test them against scenarios that capture the basic forces at work in the oil industry.

In this 1987–88 edition the authors seek to show the forces that brought about the 1987 price reversal and the new OPEC management system. They delineate the trends that suggest how supply and demand and OPEC strategies may play out in this new price environment, and analyse their impact and interaction on the structure and organisation of the industry. In a data study they organise thinking about the re-orientation of the oil industry in: Marketing Fundamentals; Market Results; and Market Structure.

Underground gas storage

Contributions in Petroleum Geology and Engineering 3: Underground Storage of Natural Gas: Complete Design and Operational Procedures, by MR Tek. Published by Gulf Publishing Company, distributed by Kogan Page Ltd, 120 Pentonville Road, London N1 9JN. 389 pages. Price: £55 (hardback).

This, the third volume in the series, Contribution in Petroleum Geology and Engineering, contains many new operational procedures and reveals previously unpublished documentation, making it one of the most comprehensive sources of information on underground storage. Background, information and theory are combined with design methods and everyday operation. Information on choosing a site designing and developing storage systems and diagnostic and prognostic measures relating to leaks are also covered.

Intended primarily for practising engineer, the document also serves as a reference for geologists and anyone interested in underground storage.

Offshore register

Lloyd's Offshore Register. Available from MIPG, Lloyd's Register of Shipping, 71 Fenchurch Street, London EC3M 4BS. Price: £50 plus forwarding charge of £4 (£3 plus VAT in UK).

The Register of Offshore Units, Submersibles and Diving Systems 1987–88 is the only publication to cover as diverse and extensive a range of mobile offshore equipment. It includes an independent section listing details of almost 1600 owners and managers of offshore support vessels, as well as technical data on mobile drilling rigs, drillships, purpose built ships and jack-up rigs. There are also sections on LR classed or certified diving systems and work units.

Reference compilation

Bibliography on Engine Lubricating Oil, by MF Fox, MJ Hill and Z Pawlak. Published by Gower Technical Press, Gower House, Croft Road, Aldershot, Hampshire, GU11 3HR. 248 pages. Price £45.00.

A compilation of over 3,000 references from scientific and engineering literature, journal articles, conference papers, research reports, patents, books and standards. This bibliography has an author index and eighteen subject sections covering composition, additives, degradation, emissions, microbiological problems, recycling, future trends etc. A comprehensive reference tool drawing together in one volume literature scattered throughout a variety of sources and often difficult to locate.

NDT of large pipes

Nondestructive Testing of Large Diameter Pipe for Oil and Gas Transmission Lines, edited by FJ Weisweiler and GN Sergeev. Published by VCH Verlagsgesellschaft, Postfach 12 60/12 80 Pappelallee 3, D-6940 Weinheim. 262 pages. Price: DM 250.00 (£84 approx.)

Owing to the extreme temperature and terrain variations and high safety requirements that need to be met, stringent demands are made on the piping used in transcontinental oil and gas pipelines. The study discusses non destructive testing methods that allow these demands to be met. It also provides information on the use and manufacture of oil and gas transmission line pipe, and on the equipment needed for on line non destructive testing.

The information contained in the book has been accumulated during the large scale production of line pipe, and thus reports first hand on methods for assuring operational pipeline reliability, and contains information on recent trends and developments.

The 12 year crisis

The Arabs and the Oil Crisis 1973–1986 by Ali A Attiga, OAPEC Secretary General. Published by The Information and International Relations Department, OAPEC, PO Box 20501 Safat, 13066 Kuwait. 473 pages. Price: KD 4.500 or US$18 (postage extra).

Since the beginnings of the 'oil crisis' in the mid-seventies, views expressed on the subject have come mainly from the buying countries. In this collection of 50 lectures and other papers accumulated since 1973, the Secretary General of OAPEC offers a balance to that bias, reflecting the selling countries' view and building a historical perspective which traces the problem's origins to the importers' policies and the recent lack of cohesive policy among the exporting countries.

In conclusion to his arguments, Dr Attiga stresses the need for an increase in regional and international cooperation between Arabian oil exporters and other developing countries, and the major oil importers as vital if market stability is to be encouraged and energy resource development and economic growth worldwide is to be enhanced.

Safety management

Safety in the Offshore Petroleum Industry: The Law and Practice for Management, by Brenda Barrett, Richard Howells and Brian Hindley. Published by Gulf Publishing Company, distributed by Kogan Page, 120 Pentonville Road, London N1 9JN. 250 pages. Price: £35 (hardback).

Focussing on occupational health and safety in the offshore, the book identifies current offshore safety regulation technologies and draws on Britain and Norway's legislative systems for examination and comparison. Taking into account the 1987 Petroleum Act, the book studies the close relationship between national governments and offshore operators in the establishment and maintenance of safe working systems.

Oil and gas predictions to 1990

World Offshore Oil and Gas Industry, 1986–1990, a report by Mackay Consultants. Available from Mackay Publications, Balloan House, Inverness, Scotland. 515 pages. Price: £470 (US$750).

Prospects for offshore oil and gas will improve steadily from 1988 onwards according to this report, based on two years research through 119 countries. It analyses the problems leading to the 1986 price crash, and estimates that between 1986 and '87 total expenditure fell from £41 billion to £35 billion a 10% drop. However, during the next two years the report forecast a distinct upturn in the industry with annual expenditure reaching £51 billion by 1990.

In addition to world offshore oil and gas production forecasts, the study includes 119 separate reports on individual countries' prospects. The North Sea is expected to remain fairly stable, while the best prospects are to be found in the Far East and Africa.

John Kemp (above) has been appointed Director and General Manager, Southern Operations for Conoco (UK) Ltd. He replaces **David Branch** who has returned to Conoco's headquarters in Houston.

Owen Jenkins has been appointed Managing Director and Chief Executive Officer of Texaco Ireland Ltd. As a result of his appointment the following changes have taken place: **Tony Price** has been promoted to General Manager Marketing; **Neil Lambert** becomes Manager, Retail Sales; **Barry Ashman** has been appointed Manager of Star Service Stations; and **Peter Riches** has been made Manager Marketing Development.

Occidental Petroleum (Caledonia) Ltd has announced the appointment of **Thora Johannson** as Vice-President, Exploration with responsibility for the Company's UK activities.

Doy F Cole (above) has been named Managing Director of MW Kellogg Ltd London, Vice-President European Operations, MW Kellogg Houston, and a member of the company's nine man Executive Committee.

Liquid Carbonic Industries Corporation (a wholly owned subsidiary of CBI Industries Inc, has named **Robert J Daniels** as its President and Chief Executive Officer.

Two senior appointments have been announced by OY Edacom of Finland. **Seppo Virtanen** has been appointed Managing Director and **Heikki Kemppainen** Development Director.

The title of Professor Emeritus has been conferred by the Court of Heriot-Watt University upon **Professor Cecil W Nutt**, retired Head of the Department of Chemical and Process Engineering, and **Professor Alan Thompson**, until recently holder of the AJ Balfour Chair of Economics of Government at the University.

Following his retirement as Technical Director for Moore, Barrett and Redwood, **Peter Jelffs** has been appointed Senior Oil Loss Consultant for the group.

Matex Nederland BV has announced the following personnel changes at its Rotterdam headquarters: **Ben Vree** becomes Commercial Manager, **Jet Van Ruitenberg** has been appointed Sales Manager as has **Rick Muller**.

The UK Offshore Operators Association has announced the appointment of its executive officers for 1988. **Keith Taylor**, Managing Director, Esso Exploration and Production UK Ltd has been named President of UKOOA; **DJ Ogren**, Chairman and Managing Director of Conoco (UK) Ltd, becomes UKOOA Vice-President; **EL Johnson jr**, President of Texaco North Sea UK Company, also becomes a Vice-President; **TL Sandridge**, Chairman and Managing Director of Philips Petroleum Company UK Ltd, has been appointed Honorary Treasurer; and **EA Blair**, Vice-President, Engineering and Operations, Hamilton Brothers Oil and Gas Ltd, becomes Honorary Secretary.

At its recent AGM, the United Kingdom Onshore Operators Group (UKOOG) elected **Olaf Karlsen** as Chairman and **Colin Vost** Vice-Chairman of the Group. Mr Karlsen is Exploration Manager UK for Tricentrol Exploration UK Ltd, and Mr Vost Manager UK Land of BP Petroleum Development Ltd. The Executive Committee now comprises: OAC Karlsen, CF Vost, JHE Butterfield, JM Bowen, R Thiers, GO Jackson, DW Ellenor and RL Makin.

Terry Moore has been appointed Group Managing Director and Chief Executive Officer of Conoco Ltd, with responsibility for the company's refining and marketing activities in the UK and Europe. His previous position of Managing Director, Supply and Trading Europe has been filled by **David Watts**.

Comptech Systems Ltd announced the appointment recently of **Dr Jonathan Williams** as Technical Director.

Costain Petrocarbon Ltd has appointed **Neville Roscoe** as a senior project manager within its Process Engineering Division.

Detlev Lehning has been named Managing Director of Deminex UK Oil and Gas, and its subsidiary companies. He succeeds **Paul Haseldonckx** who has been appointed to the board of directors in Germany as Director with responsibility for international exploration.

Texas Eastern Corporation has announced the appointment of **HD Church** as Executive Vice-President of the Texas Eastern Gas Pipeline Company.

Peter Dicker has been named as Engineering Director of Wallace and Tiernan Ltd, measurement and control specialists.

George Christie (above) has been appointed Safety Manager of the KCA Drilling Group. He takes over from **Bob Pawsey** who has retired after 12 years.

UEG, CIRIA's Underwater and Offshore Research Group, has announced the appointment of **John de Prey** as Research Manager, Underwater Engineering,

John Stonall has been appointed UK Spares Sales Manager for Wier Pumps.

Mohammed H Al-Mady has been named as President and Senior Saudi Executive of SABIC Marketing Services Ltd, a subsidiary of the Saudi Basic Industries Corporation. SABIC also announced the appointment of **Duncan H Colville** as Vice-President Marketing for SABIC Marketing Ltd.

CBI Industries has announced the appointment of **John E Jones** as President and Chief Operating Officer.

John Brown Engineering has announced the appointment of **Sava Medonos** as Supervising Engineer.

The picture, above, shows **Dr Tom Johnston** (left), Principal and Vice-Chancellor of Heriot-Watt University, receiving a cheque for £10,000 from **Peter Reeks**, Head of Engineering, Britoil plc. The money will be used for the establishment of the Britoil Petroleum Engineering Library at the University.

North Sea activity on rising trend

After the sharp downturn in activity which followed the plummeting oil price of early 1986, there have lately been optimistic signs about work trends in the North Sea in 1988. They are evident in statistics of wells and fields being brought forward for development, in statements by leading industry and government figures and especially in detailed forecasts of exploration and production trends.

In the closing days of last year the UK Department of Energy approved plans for Occidental Petroleum's £35 million Chanter, North Sea Sun's £62 million Glamis and Amoco's £114 million oilfields. Shortly before this Minister of State for Energy Peter Morrison, claiming that 'confidence is returning to the North Sea', pointed out that already in 1987 his department had approved 10 development projects on- and offshore, with a further 11 offshore and three onshore schemes under consideration.

Drilling highest since March '86

Almost simultaneously, the president of Mobil North Sea and current president of the United Kingdom Offshore Operators' Association Carl Burnett was telling Aberdeen oilmen that 'exploration and appraisal drilling in the North Sea is now at the highest level since March 1986. The trend is definitely upwards and nearly all operators are planning increased programmes for next year.' Burnett put 1987's exploration and appraisal well total at about 110–115 wells, similar to that of 1986. 'I would guess we should see about 130–135 wells next year.'

Burnett noted that the success rate had been encouraging. Certainly it has tempted a cluster of oil companies, mostly European and American, to move in to seek North Sea acreage. The recent jostling for the limited assets available for sale have not lacked many newcomers to what is a mature area and one generally regarded to be past its peak.

Longterm production decline

The signs of longterm production decline are unmistakeable. Last summer, for the first time in five years, UK North Sea oil output dipped below 2 million b/d. With the big key oilfields such as Brent, Forties, Ninian and Piper now past their high point, the 1985 output summit of 2.6 million b/d is unlikely to be reached again. It has been envisaged that these big fields will be replaced only by smaller, higher-cost reservoirs, such as Glamis and Chanter—fields nevertheless invaluable in replacing reserves for long-term needs.

However, as Burnett pointed out, 'one of the beauties of the North Sea is its capacity to continue to surprise us.' Two principal surprises on the UK shelf in 1987 were Chevron's Alba field, which London stockbroker Schroder Securities reckons could contain 700 million barrels of recoverable reserves; and Kerr-McGee's Gryphon reservoir, which the same analysts estimate contains up to 500 million barrels of recoverable oil plus 0.75 trillion cubic feet of recoverable gas. That such potential giants remain to be probed and proven up some 23 years since the first UK North Sea well went down must be one reason for the play's resilience after the shock of early 1986.

Although the North Sea presents hostile and costly conditions to be surmounted, it has long been seen to offer great advantages of a politically stable climate. Oil companies seek certainty and continuity. The UK sector may have revealed most, if not all, of its big oilfields by now, but the knowledge that there are worthwhile reservoirs to be sought over the next few decades is assuredly another reason for the sharp upturn in activity again last year.

Greater potential

A recent profile of Aberdeen by the Scottish Development Agency (SDA) suggested that the potential exists for greater capital expenditure and employment than has occurred in about two decades. Operating companies surveyed believe that they will remain in Aberdeen for at least 40–50 years. The report indicated about 50% of recoverable reserves from the 33 oilfields brought on stream in the UK sector remains to be produced, apart from other reservoirs waiting to be tapped.

The UK self-sufficiency date continues to be prolonged, which is another bullish factor. Energy Minister Peter Morrison recently dismissed 1991 as the date when Britain would become a net importer, foreseeing self-sufficiency well into the 1990s. Carl Burnett echoes this optimism. Burnett believes that the UK North Sea will still be producing 2.2 million b/d by 1995 rather than 1.5 million b/d as has popularly supposed.

Scottish analysts Mackay Consultants not long ago foresaw a steady buildup in exploration investment in the North Sea and Western Europe over the rest of this decade. This last year's low of $1.09 billion was foreseen to rise to a new plateau of $1.48 billion by 1990. The UK, Norway and the Netherlands were rated second, third and eleventh in the total-of-global-expenditure league in the period 1986–90, with outlays of just over $37.7 billion, $35.4 billion and almost $7.4 billion respectively (constant 1986 prices).

Peak levels of 1984 attained again

Edinburgh stockbrokers Wood Mackenzie shortly after saw revived UK drilling activity continuing to increase, so that by 1992 peak levels of 1984 would be attained again. The rise in price of oil to around $18 a barrel had prompted companies to concentrate on building future reserves rather than just conserve cash flow, being increasingly confident about future oil prices and the quality of drilling acreage following recent good finds.

The downturn in drilling had set rig rates back to $14,000 a day in 1986, but these had picked up several thousand dollars a day. Wood Mackenzie foresaw that by 1992 the 1987 overcapacity of 45% in rigs could be substantially eroded, with rig rates rising. By 1992 rig rates might have risen enough to encourage the building of new units.

Several other recent surveys have pursued this bullish line for the short to medium term. Schroder Securities in its 'Oil Industry Trends in 1988' wide-ranging end-of-the-year survey noted that 89% of respondents saw exploration budgets up in 1988 on 1987, a similar percentage expecting more North Sea developments to proceed (based on an oil price average of $16–20 a barrel). Aberdeen analysts, Petrodata, expect North Sea drilling may be returning in 1988 to 1985 levels, with a 40% upturn on 1987. Increasing demand for both semis and jackups will stretch available supply in the spring and summer season, with UK deepwater mobile rig activity rising by up to 60%.

Perceptively, New York-based analysts E F Hutton include among the reasons for the predicted upturn in 1988 drilling a potential gas supply shortfall in the UK in the early to mid-1990s and tax concessions aimed to encourage new drilling programmes. Twenty years after the UK North Sea's initial surge of exploration in the southern basin, recent months have seen greatly revived interest in the area. New finds are constantly being made. Indications are that increasing unitisation will be needed to allow development of clusters of fields, and a new trend in this area could be Anglo-Dutch exploitation of median line-nudging gas reservoirs.

Peter Morrison is already confident that 'most, possibly all' of Britain's remaining gas needs for the 1990s 'can be supplied from new developments on the UK continental shelf. Gas production from UK fields is already at record levels and is set to continue to rise.' Sales opportunities are 'probably greater than they have ever been.'

Whatever happens to the oil price following December's OPEC meeting, a strong surge of North Sea drilling seems assured until summer 1988. The revival was under way by mid-1987 after the low point of around April, and budget lead times being what they are, continuity is guaranteed for several more months.

After that, a serious rise in the price of crude would have a marked effect should it occur. A price of some $18 a barrel has been enough to justify the recent exploration revival. However, it is known that $25 a barrel is still needed to nudge forward several pending projects, notably in the Dutch sector.

Information sharing

US commodities exchanges and clearing associations, under a recently signed agreement, will soon begin to share financial information on common clearing member firms. The Board of Trade Clearing Corporation has developed the computer software to enable exchanges to share margin credit and debit information of common clearing members, and other exchanges are putting systems in place to input/receive the information on a daily basis.

Retail competition problems in Spain

Two years ago, Spain signed the Treaty of Adhesion and so joined the Common Market; giving competitors 'freedom of establishment'. But would-be foreign competitors are grumbling that this is not happening.

In the petroleum retail market in Spain, where there has been a Spanish monopoly for 60 years, a number of international oil companies have been surprised to find they are being frustrated in their attempts to develop brand petrol outlets and in the marketing of their branded lubricants.

As a consequence representations alleging discrimination have been made to European governments and to the Commission of the European Community in Brussels, where there is reported to be concern about misunderstandings.

The opening of new petrol stations is one of the problems. Non-Spanish brands have found that urban legislation and planning under the Spanish monopoly system can, for example, prohibit the building of another outlet within 20 miles.

The Spanish authorities therefore withhold permission for fear that if they did allow a competitor to break that rule and develop a foreign brand station within such a limit, an existing Spanish retailer would sue them — the monopoly.

Until the current transitional period of entry into the Common Market ends, on 1 January, 1992, when deregulation in Spain must be complete, intending competitors must process their plans for development under the monopoly system.

Spain accepts imported main products according to a quota, but with the proviso that their monopoly company markets them. Competitors contend that if the import of finished petroleum products is allowed, it is reasonable for these to be marketed by the competitive brands, especially as Spain accepted the principles of competition in the EEC when it joined.

Where the marketing of non-Spanish brand lubricants is permitted, the volume of the quota is small and the monopoly system directs the pricing and the packaging. This does not give the foreign competitor the freedom it says it needs.

Government funds new method of testing for oil

The Department of Trade & Industry has awarded development funding of more than £30,000 to hi-technology instruments' supplier Bartington Instruments Ltd to continue the development of electromagnetic probes for borehole and subsea measurements for use in oil and mineral exploration.

The Stage Two SMART award from the DTI represents 50% of the anticipated research costs expected at this stage of the programme's development which, if successful, will radically affect the way sub-sea oil exploration is undertaken.

A joint agreement between Bartington and TENNECO Oil to cover research and development of magnetic susceptibility measurements for use in Offshore Hydrocarbon Exploration has been in operation during 1987.

In support of the DTI funding for the borehole and subsea measurement project, TENNECO will add a further $50,000 for the development of a tow-along version of the seabed susceptibility measuring instrumentation. This will be designed for the rapid susceptibility measurement of the seabed at speeds compatible with those used in seismic surveying. The aim is both to develop a borehole susceptibility probe with data output compatible with 'nuclear-type' probes, which can be marketed to larger logging companies for incorporation into their suite of downhole measuring probes, and to develop a susceptibility measuring instrumentation system which could be 'tacked on the back of existing seismic surveying programmes'.

NYMEX crude oil the most active commodity

At the end of a year when crude oil became the world's most actively traded physical commodity, the New York Mercantile Exchange (NYMEX) reported an overall trading volume of 25.7 million contracts — an increase of 74 per cent over the 1986 total volume of 14.8 million. It marked the best year in the 115-year history of the Exchange.

IPE record year

Recently released figures show the IPE had a record year in 1987. For the first time over one million lots were traded in the calendar year, with the final year end volume for gas oil of 1,102,148 lots (each of 100 tonnes) being recorded. This gives a growth of 120% since January 1986 and an increase of more than 18% over the year. December 1987 also saw a new monthly record volume for gas oil being established.

Growth in gas use

Worldwide natural gas consumption has increased dramatically from 36 quadrillion Btu (quads) in 1970 to more than 60 quads in 1986 — 66.4 per cent — according to analysis from the American Gas Association. AGA President George H Lawrence said the study reveals that natural gas is becoming the fuel of the future and is playing a growing role in the world's energy planning. The analysis reports that natural gas use grew at an annual rate of 3.2 per cent worldwide between 1970 and 1986. During that period, gas consumption by major industrial countries (excluding the United States) tripled, while US consumption declined 24 per cent. It also reveals that gas use in Western Europe grew at the annual rate of 6.5 per cent during that same time period and that the Soviet Union increased its gas usage at the rate of 7.7 per cent a year, going from 6.2 quads in 1980 to 20.2 quads in 1986.

Copies of the complete analysis are available from: AGA's Public Information Office, 1515 Wilson Blvd., Arlington, VA 22209.

Britoil in Indonesia

Britoil has been awarded a 100% interest in a large new exploration block in Indonesia by Pertamina, the Indonesian State Oil Corporation. This is the company's first operatorship in the area.

BP win top environmental award

The World Environment Centre recently named BP winner of its 1988 Gold Medal for International Corporate Environmental Achievement.

BP was selected from the nominees by an independent jury, headed by Dr Joel I Abrams, University of Pittsburgh, for the company's 'comprehensive and total commitment to its structured and systematic Environmental Protection Management programme'.

EPM is employed by using strict assessment monitoring, review and auditing procedure currently applied to all BP's projects worldwide.

The Wytch Farm project was singled out by the jury as an example of how 'industry and government can work constructively to protect the environment'.

Humber turnaround

Five hundred thousand manhours were squeezed into five weeks' work, as 1900 contractors worked 24 hours a day to give Conoco's Humber Refinery a spring clean.

Major improvements and maintenance work were carried out on several critical units during the shutdown.

New reactor cyclones were fitted to the fluid catalytic cracker (FFC) which processes a mixture of gas oils to produce petrol and light cycle oil, and final tie-ins were made on the FCC turbo expander. Repairs were carried out on process furnace refractory systems and piping on the crude units, cokers and white oils complex. Decks and structures on the number two coker coke drums were replaced — the refinery can produce 2150 tonnes of raw coke per day — and work was carried out on the 'X' coke project which is designed to produce higher quality premium grade petroleum coke.

Grangemouth

Following completion of contracts for dismantling damaged plant and providing engineering support for the Hydrocracker Rehabilitation Project at BP Oil's Refinery at Grangemouth, Press Construction has now been awarded a contract estimated at £450,000 to prepare for the main rehabilitation programme.

16–17 February Kent
Sira basic course on safety in hazardous areas. *Details:* Sira Ltd, South Hill, Chislehurst, Kent BR7 5EH. Tel: 01 467 2636. Tx: 896649.

21–26 February Moreton-in-Marsh
Handling of Emergencies. *Details:* Petroleum Training Federation, Room 326, 162/168 Regent Street, London W1R 5TB. Tel: 01 439 2632.

25 February Dallas
SPE/114 DC Drilling Conference. *Details:* Society of Petroleum Engineers, Meetings Dept, PO Box 833836, Richardson, Texas 75038-3836, USA. Tel: 214/669-3377. Tx: 730989 (SPEDIAL).

25 February London
Symposium on 'Wire Rope in Offshore Applications.' *Details:* Divisions Administration Officer, The Institution of Mechanical Engineers, 1 Birdcage Walk, Westminster, London SW1H 9JJ. Tel: 01 222 7899 ext. 219.

29 February–4 March Birmingham
Electrex '88. *Details:* Wix Hill House, West Horsley, Surrey KT24 6DZ. Tel: 0483 222888. Tx: 859460 ELECTX 9.

2 March Abington
Workshop on NDT Reliability and Liability. *Details:* Conference Department, The British Institute of Non-Destructive Testing, 1 Spencer Parade, Northampton NN1 5AA. Tel: 0604 30124/5. Tx: 31612 OT55 G.

7–10 March Bahrain
SPE Middle East Oil Show. *Details:* SPE Meetings Dept., PO Box 833836, Richardson, Texas 75038-3836 USA. Tel: 214/669-3377. Tx: 730989 (SPEDIAL).

8 March Brighton
Oceanology International 1988. *Details:* Judith Patten Public Relations, 34 Ellerker Gardens, Richmond, Surrey TW10 6AA. Tel: 01 940 6211. Tx: 265871/265451 MONREF G.

8 March London
Warren Spring Symposium on Environmental Pollution — An Integrated Approach to Monitoring, Control and Abatement. *Details:* Dr HJ Prosser, Warren Spring Laboratory, Gunnels Wood Road, Stevenage, Herts SG1 2BX. Tel: (0438) 741122.

20–23 March Houston
1988 AAPG Convention, hosted by the Houston Geological Society. *Details:* The AAPG Convention Department, PO Box 979, Tulsa, OK 74101. Tel: ‡918 584 2555.

8–10 March Amsterdam
Petrotech '88, international trade fair and conference for the oil and gas industry. *Details:* International Exhibition and Congress Centre, Europlein, 1078 GZ Amsterdam. Tel: 020 5411 411. Tx: 10613.

14–18 March Zurich
Short course on Modelling of Multi-phase Systems for Industrial Applications. *Details:* Prof. G Yadigaroglu, ETH-Zentuar, CH-8092, Switzerland. Tel: 141-1-256 4615.

20–24 March Dubai
The 3rd Arabgas and oil technology exhibition. *Details:* John Fletcher, International Conferences and Exhibitions Ltd, 29 Dering Street, London W1R 9AA. Tel: 01-499 7774. Tx: 21591 CONFEX G.

21–24 March Birmingham
Materials and Testing '88 Exhibition. *Details:* Judy Aspden, Mack-Brooks Exhibitions Ltd., Forum Place, Hatfield, Herts, AL10 0RN. Tel: 07072 75641. Tx: 266350 macbex g.

22–24 March Birmingham
CADCAM '88. *Details:* EMAP International Exhibitions Ltd, 12 Bedford Row, London WC1R 4DU. Tel: 01 404 4844. Tx: 24878 EMAPEX.

22–24 March Aberdeen
Offshore Computer Conference. *Details:* Offshore Conference & Exhibitions Ltd., Rowe House, 55–59 Fife Road, Kingston-upon-Thames, Surrey KT1 1TA. Tel: 01 549 5831. Tx: 928042 SPEARS G.

25 March Edinburgh
The North Sea in the 1990's: Economics and technology. A joint meeting of the Scottish branches of the Institute of Chemical Engineers and Institute of Petroleum. *Details:* The Conference Section, The Institution of Chemical Engineers, 165–171 Railway Terrace, Rugby CV21 3HQ. Tel: 0788 78214. Tx: 311780.

28–30 March Manchester
2nd International Conference on Developments in Valves and Actuators for Fluid Control. *Details:* Mrs Lorraine Grove, The Conference Organiser, 2nd Valves and Actuators, BHRA, The Fluid Engineering Centre, Cranfield, Bedford, MK43 0AJ. Tel: 0234 750422. Tx: 825059 BHRA.

6–7 April London
Two day conference on 'Subsea Control and Data Acquisition for Oil and Gas Production Systems'. *Details:* Rosamund da Gama, The Institute of Measurement and Control, 87 Gower Street, London WC1E 6AA. Tel: 01 387 4949. Tx: 943763 CROCOM G.

12–14 April Leeds
Short course on Diesel Particulates. *Details:* Mrs CP Shirley, Department Adult and Continuing Education, The University, Leeds LS2 9JT. Tel: (0532) 435036 or 444806.

13–14 April London
Offshore Update '88 – A new concept for a changing market. *Details:* City Exhibitions & City Conferences Ltd, 8 Dukes Close, Alton, Hampshire GU34 1PH. Tel: 0420 87303.

16–20 April Tulsa
SPE/DOE Enhanced Oil Recovery Symposium. *Details:* SPE Meetings Dept, PO Box 833836, Richardson, Texas 75038-3836, USA. Tel: 214/669-3377. Tx: 730989 (SPEDIAL).

17–20 April Norway
Intervention '88, an international exposition and technical conference. *Details:* Ms Oddveig Eilertsen, Det norske Veritas, Box 4252, Nygaardstagen, N-5028 Bergen, Norway. Tel: (47-5) 215413. Tx: 42913 dnvbgn.

Some short courses

The College of Petroleum Studies at the University of Oxford will be running various petroleum related courses over the next 12 months. Details are available from: The College of Petroleum Studies, Administrative Offices, Sun Alliance House, New Inn Hall Street, Oxford OX1 2QD, England. Tel: Oxford 250521. Tx: 838950 COLPET G.

A course schedule for the Offshore Fire Training Centre is available by applying to: Course Booking Unit, Offshore Fire Training Centre, Forties Road, Montrose, Angus DD10 9ET. Tel: 0674 72230. Tx: 76104 PIT BMT G.

The University of Bradford is running three short courses to be held in Amsterdam during the Spring. Details from: Dr L Svarovsky, Deputy Chairman, Postgraduate School of Studies in Powder Technology, University of Bradford, Bradford, West Yorkshire BD7 1DP. Tel: (0274) 733466 ext 378 or 380. Tx: 51309 UNIBFD G.

Redwood International Training Courses will be held during the first six months of this year. Details are available from: The Course Manager, Redwood International Consultants Ltd., 29 Cambridge Park, Wanstead, London E11 2PU. Tel: (01) 989 5191. Tx: 897164 supvis g.

Studies on lubricity of hydrocarbons and effect of additives on lubricity

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Introduction

Petroleum liquid fuels are widely used in the world at present as an important energy source in various engines. However, liquid fuels, particularly the jet fuels, also have the function of lubrication of feed pumps in the fuel system in jet engines. The lubricity of jet fuels has a direct effect upon the life of feed pumps and flying safety. For instance, the No. 1 Daqing hydrogenated jet fuel and the No. 1 Shenli jet fuel (acid, alkali and electrochemically refined), both of which have relatively low lubricity, caused serious wear in the pumps and inefficiency in the turbo-jet engine operation. Troubles also occurred when No. 1 Shenli jet fuel (acid, alkali and electrochemically refined as above) was used in the Turbojet-6 engine in China, causing a decrease in rotating speed of the turbine while the engine was operated at low speed. On decomposition of the feed pump ZB-10A, it is found that the plungers of the pump were seriously worn out, some plungers with their heads completely flattened, others with broken rims giving off metallic powder or wear particles of various shapes. These wear debris create troubles in the valves of starting mechanism, resulting in a decrease of turbine speed.[1]

Beginning in the Sixties of the Twentieth century, scientists in western Europe first noticed that the feed pumps of turbojet engines were seriously worn out when using hydrogenated jet fuels. From that time on, lubricity of jet fuels has been studied with increasing interest and methods for improving lubricity of jet fuels were proposed. In China, a rather comprehensive study on lubricity of jet fuels began in late 1975. Wide research has been carried out on methods of determination of lubricity of jet fuels, on lubricity of jet fuels from various crude oils, on effect of refining processes on lubricity of fuels, and on effect of addition of various additives, including static dissipator additives, fuel system icing inhibitors, anti-burning additives, and anti-friction additives such as 6929, T305, T306[2-8]. However, research work on lubricity of individual hydrocarbons has been little reported. Thus, in this paper effort is made on exploring the lubricity of individual hydrocarbons, lubricity of blends of individual hydrocarbons in various proportions, as well as the effect of additives including CS_2, T501, T305, T306, etc and HP-8 turbojet engine oil on lubricity of hydrocarbons.

Experiments

The regular procedure for testing lubricity of jet fuels adopted in the present experiments[3] is known as the ring-and-block testing machine method which was established by Chinese Academy of Petrochemical Sciences in Beijing. The method has good reproducibility for lubricity of jet fuels and high sensibility to effect of different additives, as well as to same additive with different concentrations, or jet fuels of different origin. The testing results by this method are generally conformable with results obtained by full-sized fuel pump bench tests, and are well related to field performance.[5] The testing machine used is Model MHK-500 Ring-and-Block Testing Machine made by Chi-nan Meterial Testing Machine Co, Shangtung, China.* Size of block is $12.35^{+0.01}$ mm × 19 mm; Ring size is $\phi 49.24^{-0.011}$ × 12.7 mm; both ring and block surfaces are polished to ▽7. Hardness of material HRc is 58 ~ 62. Type of metal: GCr 15.

Testing condition: rotating speed: 200 rpm
time of testing: 5 min
rate of flow: 40–50 ml/min
way of sample flow: once for each sample
load: 1 kg (except for few hydrocarbons with very low lubricity using 0.1 kg)

Experiments were carried out under specified conditions. Hydrocarbon samples are allowed to flow over moving joint of the ring and block (with ring sliding over the block), which produce boundary lubrication and finally the wear width was measured with care.

Experimental results are expressed as follows:

1. For hydrocarbons whose lubricity are too low to be measured by wear width results are expressed as seizure.
2. For most hydrocarbons, anti-friction index Km is used, which is the ratio of wear width of standard dimethyl benzene in mm to that of the sample (mm), ie

$$Km = \frac{b_{st}}{b_{hc}} \times 100$$

where Km——Anti-friction Index
b_{st}——wear width of standard dimethyl benzene
b_{hc}——wear width of hydrocarbon sample

Obviously, the greater the Index Km is, the better is the lubricity. Jet fuels with Km over 90 have good performance in use, therefore the lubricity of hydrocarbons tested by this method are considered good when their Km are over 90. Each ring is used at least twice to give duplicate results for comparison (except for samples of heavy seizure) and a new ring is used for every new sample. Total number of experiments amounts to 230. Measurement of wear width is made by a 25× two directional caliper, the breadth being measured at two ends and in the middle and a mean is taken for the three values.

Testing results and discussion

(1) Lubricity of individual hydrocarbons

All hydrocarbons tested were analytically pure. Lubricity results of the paraffins, cycloparaffins and aromatics are listed in **Table 1**. As shown in the Table, under a load of 1 kg, all paraffins tested lighter than $C_{11}H_{24}$ gave seizure and squeak, showing very poor lubricating property. To further differentiate these paraffins, the load was reduced to 0.1 kg, other conditions being unchanged. Under this condition, only n-hexane and n-heptane gave seizure and squeak. Other paraffins passed through the test and the wear width were measured. For paraffins, it can be seen that the lubricity of individual hydrocarbon increases as number of carbon atoms in the molecule increases, and only paraffins heavier than $C_{11}H_{24}$ (including $C_{11}H_{24}$) have better lubricity.

Cycloparaffins: the lubricity of cyclohexane is not quite good, but its lubricity increases when a methyl group is introduced onto the ring. Bicyclic cycloparaffins have higher lubricity than monocyclic ones.

Aromatics: the lubricity of aromatic hydrocarbons is generally better than other hydrocarbons. Among the aromatics, the lubricity of benzene is better than that of methyl or dimethyl derivatives. Bicyclic aromatics have higher lubricity than monocyclic.

When compared with same number of carbon atoms, the paraffins have the lowest lubricity, while the cycloparaffins have medium and the aromatics the highest.

(2) Lubricity of Blends of Individual Hydrocarbons

Laboratory results of lubricity of blends of individual hydrocarbons are shown in **Table 2**. From the Table we can see that:

A. When a hydrocarbon of higher lubricity is added to one of lower lubricity, the lubricity of the latter increases. The more the former is added, the more the latter increases.

B. When the quantity of addition of hydrocarbon of high lubricity amounts to ca. 30 per cent of the blend, the resulting lubricity of the blend will increase to a level to meet present specifications. For instance, the anti-friction index of either n-hexane or isooctane (two hydrocarbons of very low lubricity) increases to over 90 when benzene is added up to 30 per cent.

C. Lubricity of blends of hydrocarbons depends on the lubricity of its components, eg cyclohexane which has a better lubricity than n-hexane or isooctane gives a higher anti-friction index of 101 on addition of 30 per cent benzene then n-hexane (Km = 95) or iso-octane (Km = 97).

***The ring-and-block Testing Machine is a modified Timken Machine which is widely used in testing laboratories.**

(3) Effects of Additives on Lubricity of Hydrocarbons

Various additives are added to turbojet fuels in China, including antiburning additive (CS_2), static dissipator additive T1501, fuel system icing inhibitor T1301, lubricity additives T305, T306 and anti-oxidants 2,6-ditertiary butyl p-methyl phenol (T501). Among the above additives, the static dissipator additive and icing inhibitor have already been proved to show negligible effect on lubricity of jet fuels by previous work.[6]

Thus, in the present work, experiments were carried out on addition of CS_2 to hydrocarbons of higher lubricity to observe its detrimental effect, on addition of anti-friction additives T305 and T306 to hydrocarbons of lower lubricity to observe their effect of increasing lubricity of the hydrocarbons, and on addition of antioxidant T501 to jet fuels to observe its effect on change of lubricity.

Anti-friction additive T305 (containing naphthenic acid) and antifriction and corrosion inhibitor T306, both are recognized as effective additives to increase lubricity of fuels by forming protective films on metal surfaces. The lubricity of No 1 jet fuel from Shengli Oilfield which has usually very poor lubricating property, increased considerably when 15 ppm of the above additives were introduced. To further examine their effects on individual hydrocarbons, 15 ppm of the above additives were admixed with n-octane, i-octane and methyl cyclohexane respectively. The lubricity changes of the above hydrocarbons are presented in **Table 3**.

As seen from **Table 3**, both n-octane and i-octane produced squeak with seizure when no additives were added. But when 15 ppm of either additive was added, squeak and seizure disappeared, showing an obvious improvement of lubricity. In particular, anti-friction and corrosion inhibitor T306 gave an anti-friction index of 130 as compared to 73 with T305. As to methyl cyclohexane, the hydrocarbon is less sensitive to the above additives.

Previous work showed that when antiburning additive CS_2 was added to jet fuels, the lubricity of the fuels would worsen.[9, 10] In this paper, CS_2 is added to methyl benzene, n-$C_{13}H_{28}$ and n-$C_{16}H_{34}$ which have quite good lubricity and results of lubricity change are listed in **Tables 4, 5 and 6.**

As seen from **Table 4**, lubricity of methyl benzene decreases rapidly on addition of CS_2 and its anti-friction index decreases as the amount of CS_2 added increases. There exists almost a linear relation between the two which shows that methyl benzene is quite sensitive to the addition of CS_2.

Experimental results listed in **Table 5** showed that the lubricity of n-$C_{13}H_{28}$ gave practically no change on addition of CS_2 with a concentration up to 0.12 per cent. But when CS_2 addition reached 1 per cent, wear width rapidly increased to 0.839 mm, while colour of sediment on surface changing to greyish black.

From **Table 6**, it can easily be seen that n-cetane has such a high lubricity that its wear width gave practically no change on addition of CS_2 up to 5 per cent.

The intensity of detrimental effect of CS_2 on lubricity of hydrocarbons depends greatly upon the lubricity of hydrocarbons themselves, ie the better the boundary lubrication property of the individual hydrocarbon is, the less will be the amount of CS_2 absorbed on the metallic surface. In addition, hydrocarbons of better lubricity will adhere more firmly to the metallic surface thus preventing direct contact of metals. Therefore, the temperature due to friction of direct contact of metal surfaces is lower for hydrocarbons of higher lubricity.

Table 1 Lubricity of Individual Hydrocarbons

Hydrocarbon	Wear Width (1 kg) b (mm)	Wear Width (0.1 kg) b (0.1) mm	Anti-friction Index* Km
n-hexane	squeak and seizure at no load	—	—
n-heptane	squeak and seizure at no load	—	—
n-octane	squeak and seizure	0.914	—
i-octane	squeak and seizure	0.923	—
n-decane	squeak and seizure	0.852	—
n-$C_{11}H_{24}$	0.659	—	107
n-$C_{12}H_{26}$	0.655	—	107
n-$C_{13}H_{28}$	0.529	—	133
n-$C_{16}H_{34}$	0.349	—	201
cyclohexane	0.948	—	74
methyl cyclohexane	0.943	—	75
decahydro-naphthalene	0.725	—	97
benzene	0.625	—	112
methyl benzene	0.702	—	99
dimethyl benzene	0.698	—	100
β-methyl naphthalene	0.471	—	148

*Wear width for standard dimethyl benzene is 0.703 mm.

Table 2 Lubricity of Blends of Hydrocarbons

Samples	n-C_6H_{14}:C_6H_6			i-C_8H_{18}:C_6H_6			cyclohexane C_6H_{12}:C_6H_6		
Ratio	7:3	1:1	3:7	7:3	1:1	3:7	7:3	1:1	3:7
Results									
Wear Width b (mm)	0.732	0.710	0.674	0.732	0.710	0.665	0.693	0.688	0.637
Anti-friction Index Km*	95	98	104	97	98	105	101	101	110

1 Wear width for standard dimethyl benzene is 0.698 mm.
2 All ratios are given in volume proportions.

Table 3 Effect of Anti-friction Additives T305, T306 on Lubricity of Hydrocarbons

Hydrocarbon	Additives Added	Wear Width b (mm)	Anti-friction Index** Km	Remarks
n-octane	— 0	*	*	*squeak with seizure
	T305 15 ppm	0.858	82	
	T306 15 ppm	0.581	121	
i-octane	— 0	*	*	*squeak with seizure
	T305 15 ppm	0.967	73	
	T306 15 ppm	0.539	130	
methyl cyclohexane	— 0	0.943	75	
	T305 15 ppm	0.903	78	
	T306 15 ppm	0.737	95	

Wear width for standard dimethyl benzene is 0.703 mm.

Table 4 Lubricity change of Methyl Benzene on addition of CS_2*

Sample	Methyl Benzene	Methyl Benzene +0.03% CS_2	Methyl Benzene +0.06% CS_2	Methyl Benzene +0.09% CS_2
Wear Width b (mm)	0.702	0.839	0.924	1.131
Anti-friction Index Km	93	78	71	58
Colour of Surface Sediment	light grey	grey	grey	greyish black

CS_2 addition is in weight per cent. Wear width for standard dimethyl benzene is 0.653 mm.

Table 5 Lubricity Change of n-$C_{13}H_{28}$ on Addition of CS_2

Sample	$C_{13}H_{28}$	$C_{13}H_{28}$ + 0.12% CS_2	$C_{13}H_{28}$ + 1%CS_2
Wear Width	0.529	0.533	0.839
Anti-friction Index Km	123	122.5	78
Remarks	Surface clean no sediment	Surface clean	Greyish black sediment

**CS_2 addition is in weight per cent. Wear width for standard dimethyl benzene is 0.653 mm.*

Table 6 Lubricity Change of n-cetane on Addition of CS_2

Sample	n-$C_{16}H_{34}$	n-$C_{16}H_{34}$ +0.1%CS_2	n-$C_{16}H_{34}$ +1% CS_2	n-$C_{16}H_{34}$ +5% CS_2
Wear Width b (mm)	0.422	0.420	0.443	0.429
Anti-friction Index Km	155	155	147	152
Remarks	Surface relatively clean	Surface relatively clean	Surface relatively clean	Surface light grey sediment

**CS_2 addition is in weight percent. Wear width of standard dimethyl benzene is 0.653 mm.*

Table 7 Effect of Jet Lubricating Oil (HP-8) on Lubricity of Iso-octane

Sample of Fuel	i-C_8H_{18}	i-C_8H_{18} +0.1% HP-8	i-C_8H_{18} +1% HP-8	i-C_8H_{18} +3% HP-8	i-C_8H_{18} +5% HP-8
Wear Width b mm	—	—	—	0.764	0.762
Anti-friction Index Km*	—	—	—	85	86
Remarks	squeak seizure	squeak seizure	squeak seizure	—	—

**Wear width for standard dimethyl benzene is 0.653 mm.*

Table 8 Effect on CS_2 on Lubricity of Jet Fuel

Sample	Wear Width b mm	$S_0 = S_1 - S_0$
1 Jet fuel No. 2 from Daqing (Blank), S_0	0.555	0.198
2 Jet fuel No. 2 from Daqing +0.1% CS_2, S_1	0.753	
3 Jet fuel No. 1 from Shenli (Blank), S_0	0.754	0.318
4 Jet fuel No. 1 from Shenli +0.1% CS_2 S_1	1.072	

Since lowering of lubricity of hydrocarbons with CS_2 comes mainly from decomposition of CS_2 at high temperatures, a lower temperature at the point of contact of the friction pair means less decomposition of CS_2 and produces less effect on the lubricity of individual hydrocarbons.

This is also true for CS_2 addition to jet fuels of different lubricity. Jet fuels of high lubricity is much less affected by addition of CS_2 than jet fuels of low lubricity, which can be seen from **Table 8**. In the Table, it is shown that the lubricity of jet fuel (No. 1) from Shenli Oilfield which has a low lubricity itself, decreases much more on addition of 0.1 per cent CS_2 than that of jet fuel (No. 2) from Daqing Oilfield, which has a rather high lubricity.

It has been suggested that a small amount of turbojet lubricating oil be admixed to jet fuels to improve lubricity of the latter. In this experiment a small amount of commercially available jet engine oil HP-8 (the kinematic viscosity of which is approximately 8cSt at 50°C) was introduced into isooctane, a hydrocarbon of relatively poor lubricity. The experimental results are given in **Table 7**.

It is clearly seen from **Table 7** that the effect of addition of jet engine oil HP-8 on lubricity of i-octane is very slight until an amount of 3 per cent. A relatively large quantity of engine oil must be added to improve lubricity of the fuel whose physical properties might be seriously affected by the addition. So it is not advisable to use jet engine oil to improve lubricity of fuels for above reasons.

Conclusions

1 Among hydrocarbons of same number of carbon atoms, the aromatics have the highest lubricity, the naphthenes have medium and the paraffins the lowest. In the production of jet fuels, it is advisable to keep a certain amount of aromatic hydrocarbon content in the fuel from the point of view of lubricity.

2 Lubricity of paraffins increases as number of carbon atoms in the molecule increases. Paraffinic hydrocarbons above $C_{11}H_{24}$ ($C > 11$) have usually good lubricity. Thus raising the end point of jet fuels to include heavier fractions will benefit lubricity of the fuel.

3 Lubricity of cycloparaffins will be slightly improved when paraffinic radicals are introduced to the ring. Bicyclic naphthenes usually have better lubricity than the monocyclic.

4 Benzene has a higher lubricity than methyl or dimethyl benzene. Bicyclic aromatic hydrocarbons give higher lubricity than the monocyclic.

5 Blending a hydrocarbon of high lubricity with a hydrocarbon of low lubricity will increase the lubricity of the latter. The lubricity of the blend will be quite satisfactory when the quantity of the former exceeds 30 per cent. This suggests that a jet fuel of poor lubricity can have its lubricity greatly improved by adding a certain portion of jet fuel of good lubricity.

6 Adding carbon disulfide to an individual hydrocarbon will lower the lubricity of the latter, and the extent of lowering depends on the lubricity of the hydrocarbon itself. Hydrocarbons having poor lubricity will show a larger decrease in lubricity on addition of CS_2. Benzene is quite sensible to the addition of CS_2.

7 Antifriction additives T305 and T306 can be used to improve lubricity of individual hydrocarbons. Either n-octane or i-octane has very poor lubricity showing squeak with seizure on a load of 1 kg. But both octanes show an obvious increase in lubricity when T305 or T306 is added to the hydrocarbons. In comparison, T306 has a greater effect than T305 in improving lubricity of hydrocarbons.

8 Adding jet lubricating oil to a jet fuel may improve the lubricity of the latter to some extent, however, apparent effect will not be obtained unless the addition exceeds 3 per cent, which seems impractical in fuel production.

9 2,6-di-tertiary p-methyl phenol shows no apparent effect on lubricity of jet fuels, and fuel producers need not worry about adding T501 to the fuel as an antioxidant.

References

1 *Chinese Air Force Publications: Lubricating Properties of Chinese Jet Fuels. 1982, 1*

2 *Chinese Air Force Fuel and Oil Research Institute: Causes and Resolutions for Serious Abrasive Wear of Fuel Feed Pump on Jet Engine WP-6. 1978, 9*

3 *Chinese Academy of Petrochemical Sciences: Method of Evaluating Lubricity of Jet Fuels (The Ring-and-Block Testing Machine Method)*

4 *Chinese Academy of Petrochemical Sciences: Descriptions for Method of Evaluating Lubricity of Jet Fuels.*

5 *Chinese Academy of Petrochemical Sciences: General Inspection of Chinese Jet Fuel Qualities in 1979. 1979, 8*

6 *The Logistical Engineering College: A Study on Lubricity of Chinese Jet Fuels 1982*

7 *Chinese Air Force Fuel and Oil Research Institute: Report of Experiments on Additive T305. 1979, 12*

8 *Chinese Air Force Fuel and Oil Research Institute: Report of Experiments on Antifriction Corrosion Prohibitor T306. 1979, 12*

9 *Chinese Academy of Petrochemical Sciences: Research on Effect of Organic Sulphur Compounds on Lubricity of Jet Fuels. 1981, 1*

10 *Chinese Academy of Petrochemical Sciences: Research on Reaction Mechanism of the Detrimental Effect of Carbon Disulphide on Lubricity of Jet Fuels. 1982, 7*

Around the Branches

Aberdeen
9 Feb: Annual General Meeting.
8 Mar: 'Early Experiences of the Scapa Development', speaker to be advised.
18 Mar: Annual Dinner Dance, Dyce Skean Dhu.

Edinburgh and South-east Scotland
18 Feb: 'Onshore Product Distribution by Pipelines', by a speaker from the British Pipeline Agency (joint meeting with the Pipeline Industries Guild).
17 Mar: Spouses' Evening: 'Out of Sight, Out of Mind', by Ms MP Henton of Aspinwall & Co.

Essex
10 Feb: AGM followed by 'Members' Corner', by Richard Baker, M Inst Pet, 'A Policeman's View of Transportation of Dangerous Substances'.
9 Mar: 'Third River Crossing — The New Thames Bridge'.
18 Mar: Annual Dinner Dance, De Havilland Suite, Airport Moat House, Southend-on-Sea.

Humber
11 Feb: AGM.
4 Mar: Annual Dinner, Beachcomber, Humberston.
24 Mar: Lecture to be announced.

Irish
23 Feb: One-day seminar on 'Offshore Early Production Technology'.

London
16 Feb: 'Terminal Automation — Plants of the Future,' by C Johnson, Marketing Operations, Esso. Venue: IP at 1800.
23 Mar: AGM. 'The Evolution of Commercial Diving and Its Impact on the North Sea Oil Industry,' by R Wharton, Wharton and Williams. Venue: IP at 1800.

Midlands
17 Feb: Film Night, preceded by the AGM at 1830 hours.
16 Mar: 'Gas Exploration in the North Sea', by D Cole, Shell Expro. At 1800 hours.

Northern
16 Feb: AGM, followed by 'The Biodegradation of Oil', by Dr G Morton, Lancashire Polytechnic.
15 Mar: Joint Meeting with Stanlow Branch at the Lord Daresbury, Chester Road, Daresbury, Nr Warrington at 1930 hours. 'Synthetic Lubricants', by Dr Louise Makin, ICI.

Shetland
9 Feb: AGM followed by address from Mr David McKenzie, Manager Sullom Voe.

Southern
25 Feb: Inter-Institute Skittles Match. Venue: Bold Forester, Marchwood at 1900 hours.
30 Mar: Visit to BOC at Fawley at 1730 hours.

South Wales
18 Feb: AGM. Venue: Werndale Hotel, Bancyfelyn.
17 Mar: 'Diesel Engine Development', by a speaker from the Ford Motor Co. Venue: University College Swansea.

Stanlow
17 Feb: Joint Meeting with Institute of Energy. Speaker: R Martin. Project Manager, Barrow Terminal. Venue: Ladbroke Hotel, Chester at 1930 hours.
15 Mar: Joint meeting with the Northern Branch.

West of Scotland
18 Feb: Evening: JS Carlton, Senior Surveyor, Lloyds Register of Shipping, 'Advanced Engineering Research Programme'. Annual General Meeting.
1 Mar: Professor Ian Fells, University of Newcastle-Upon-Tyne, 'Alternative Energy'. Joint Meeting with Wind Energy Association.
17 Mar: Evening, Petroleum Dinner, Hospitality Inn, Glasgow.

Yorkshire
9 Feb: AGM. Hot-pot Supper with guest speaker.
9 Mar: Joint Meeting with the Institution of Energy.
25 Mar: Annual Dinner and Dance at the Crown Hotel, Harrogate.

New members elected by Council

Members
Allen, Fraser H, Petro-Economics Inc., 28834 Hasty Rd, Evergreen, Colorado 80439, USA.
Baker, Francis J, Department of Defence (Army), RAAOC Centre, Milpo Bandiana, Victoria 3694, Australia.
Brookes, Raymond, Abercromby Associates Ltd, 17 East Abercromby St, Helensburgh, Dunbartonshire G84 9HZ.
Bruce, Scott W, c/o Officers Mess, Linton Military Camp, Palmerston North, New Zealand.
Carlton, Nigel R, 82 Queen Mary Ave., Cleethorpes, South Humberside DH18 5BN.
Casey, Peter TL, Reed Tool/Camco, PO Box 2119, Houston, Texas 77252 USA.
Delater, Pascal, SGS — Qualitest, 16 Rue Du Louvre, BP275 — 75024, Paris, Cedex 01, France.
Eade, David, 75 Westmacott St, Newburn, Newcastle-Upon-Tyne NE15 8NA.
Fielder, David PL, Sworn Measurers & Weighers (UK) Ltd, GPO Box 74, Hong Kong.
Findlay, Edward G, 10 Netherburn Ave, Craigends, Houston PA6 7NF.
Fukaya, Makoto, Arabian Oil Co Ltd, 61 Brook St, London W1Y 1YE.
Gillam, Andrew H, CBR International Corp., PO Box 2010, 9865 West Saanicm Rd, Sidney, British Columbia, Canada V8L 3S3.
Gracas De Deus, Manuel O, Cabinda Gulf Oil Co Ltd, c/o Mail Centre, 2 Portman St, London W1A.
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Wilson, John ST, St Donat's, Dairy Hill, Halesworth, Suffolk.
Wood, Graeme G, 18 Essenden Rd, South Croydon, Surrey CR2 0BU.

Students
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