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EDITORIAL

Editor: *Carol Reader*
Assistant Editor: *Scheherazade Daneshkhu*
Special Features Editor: *Geoffrey Mayhew*
Sub-Editor: *Jane Thompson*

ADVERTISING

Advertisement Director: *Paul Wade*

Advertisement Manager: *Jim Slater*

Jackson Rudd & Associates Ltd.
Oldebourne House,
46-47 Chancery Lane,
London WC2A 1JB
Telephone: 01-405 3611/2. Fax: 01-831 8030

American Agent: *Tony Halbert*

Halbert Co, 3024 Sandage,
Fort Worth, Texas 76109, USA
Telephone: Fort Worth (817) 923-9832

RECRUITMENT ADVERTISING

Advertisement Director: *Tony Miller*

Advertisement Manager: *Derek Amner*

MB Advertising
Miller-Brand & Co. Ltd.
36 Spital Square,
London E1 6DY
Telephone: 01-377 5661. Fax: 01-377 5437

PUBLISHERS

Published Monthly by
THE INSTITUTE OF PETROLEUM

Director General: *Ted Williams*

Executive Director: *Derek Payne*

Honorary Editor: *Peter Ellis Jones*

61 New Cavendish Street,
London W1M 8AR
Telephone: 01-636 1004. Telex: 264380
Fax: 01-255 1472
For details of membership, including Petroleum Review at no extra cost, please apply to the Membership Department.

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Contents

Cover photo of Sir Peter Walters, Chairman of the British Petroleum Co plc. Photograph by Jon Whitbourne.

. . . news in brief

12 October

The Iraqi Ports Authority has awarded a $558m contract to a local construction firm to expand the southern port of Umm Qasr.

Conoco has taken a crucial step in revising its development plans for the Norwegian Heidrun field by confirming its original choice of a floating concrete platform for this project.

Taiwan's coal imports will fall this year while oil imports rise due to the greater use of oil in energy generation.

13 October

The New Zealand court decision confirming government ownership of the Ngaere onshore oilfield has cast doubt over the future of the nearby Waihapa field and all New Zealand oil exploration.

Petroleum production from the Norwegian North Sea is expected to remain unchanged in 1990 after rising by more than a fifth to reach 104m tonnes of oil equivalent in 1989.

16 October

Petronas and Shell have applied for licences to build and operate their own power stations in Malaysia under a planned deregulation exercise.

UK oil deliveries to West Germany dropped by one-third during the first eight months of 1989, compared with the corresponding 1988 period.

17 October

A multinational consortium including Shell, may construct an eighth LNG carrier in preparation for a planned increase in LNG production from the North West Shelf project.

18 October

A consortium headed by Foster Wheeler is to build a $1.8bn oil refinery at Balongan, on the northeast coast of West Java, for Pertamina.

Unocal Corp have reached agreement with the Petroleum Authority of Thailand for its Unocal Thailand unit to develop additional natural gas fields in the Gulf of Thailand.

US carmakers and oil companies announced a joint research and test programme to study alternative fuels called for under the President's Clean Air Act proposal.

19 October

ICI has joined the British electricity industry and Enron Corporation of the US in planning a chain of gas-fired power stations in the UK after the privatisation of the electricity market.

The US Administration will stop buying Mexican oil for the US emergency stockpile early next year.

20 October

The Monopolies and Mergers Commission has been given until 20 December to complete its investigation into the British petrol market.

Society Nationale and Elf Aquitaine have signed a preliminary agreement with PetroZaire to set up a joint company to market petroleum products and lubricants.

23 October

Two large LNG carriers which Shell plans to charter from US owners will be used to transport Algerian gas to the US.

An oil and gas pipeline under construction in Western Siberia exploded and thousands of people were evacuated after a build up of 'heavy gases'.

24 October

Shell and Esso have formed Quadrant Gas, a joint venture company which will compete with British Gas for contract customers.

Amoco and Ultramar have agreed a straightforward asset exchange, with Amoco UK Exploration Co acquiring a further interest in the North Sea Everest field and Ultramar Exploration taking a 50% interest in four onshore licences in the UK.

Ecuador will soon tender 1.6m hectares of jungle and coastal area for oil exploration contracts according to the Energy Minister.

Exxon filed a counter-claim against the State of Alaska for alleged negligent interference with efforts to contain the Exxon Valdez spill.

25 October

LASMO intends to buy a 25% working interest in four newly awarded oil exploration blocks in the Algerian Ghadames and Illizi basins.

The first commercial hydrocarbons from Papua New Guinea could begin to flow by 1991 after an application by BP to develop the Hides gas field is approved.

26 October

Petrobras is to reduce Brazil's crude oil stocks to a maximum of 40 days in an attempt to improve its cash flow.

Iran plans to spend $13.4bn on oil, gas and petrochemical projects in the next five years and is, according to the Oil Minister, ready to accept foreign investment for production and export of LNG.

27 October

Texaco Inc have signed a definitive agreement with BP Co which will establish a refining joint venture in Rotterdam. The venture joins Texaco's Pernis refinery and BP's Europort refinery.

Chevron has reportedly entered negotiations with Japanese interests for a major construction project for VLCCs in the mid-1990s.

30 October

LASMO has sold its stake in the Patricia gas field, off Australia, to Shell. The deal is part of LASMO's planned sell-off of assets in the east of the country in a move to concentrate on west and northwest Australian offshore activities.

31 October

Production has begun on the BP Ravenspurn South gas field in the North Sea at an initial 70m cubic feet per day.

Amoco Canada Petroleum Co Ltd has signed a letter of intent with Petroleum Corp of New Zealand Ltd to sell oil and gas assets in the Provost area of Alberta.

Esso Italiana Spa inaugurated a new reformer aimed at improving unleaded gasoline output at its Augusta refinery in Sicily.

1 November

Total has signed an exploration and production sharing agreement in Gabon.

Idemitsu Kosan has concluded an agreement with the Myanma Oil and Gas Enterprises for the prospecting of oil resources in Myanma (formerly Burma) and will begin exploration in May 1990.

Soviet scientists have discovered a new oil deposit in the Kyzylkum desert in Central Asia that will triple oil production from Uzbekistan in several years.

2 November

The first large-scale gas pipeline and transmission system to be privately built in the UK is to be constructed by Gas Transmission UK, for an estimated £150m.

Burmah Oil has entered the Chilean fuels market through the acquisition of a 30% stake in Comar, owner of more than 100 service stations nationwide, for about £6m.

Shell Nederland Chemie BV said it plans to replace the solid epoxy plant at Shell's Pernis, Rotterdam, refinery complex and to modernise and extend the liquid epoxy resin plant.

3 November

A consortium of four energy companies proposes to develop a new Australian LNG project, based on gas from the Gorgon and West Tryal Rocks natural gas field, in the late 1990s that could produce up to 6m tons of LNG a year.

South Korea has begun drilling for natural gas off its south east port of Ulsan.

6 November

China has made a 'major breakthrough' with the discovery of oil in the middle of the Tarim Basin, in the far western province of Xinjiang.

Statoil has agreed with Conoco Norway Inc to explore the possibilities of setting up a methanol plant in central Norway.

Saudi Aramco announced the discovery of 'substantial' quantities of high quality crude oil in an area south of Riyadh.

7 November

Repsol is building a new coker at its Puerto Llano refinery to increase yield of lighter petroleum products and cut fuel oil yields.

Venezuela has failed in its efforts to have a substantial portion of its liquid hydrocarbon production classified as condensate, rather than crude oil, under definitions agreed with OPEC for the purpose of assigning quotas.

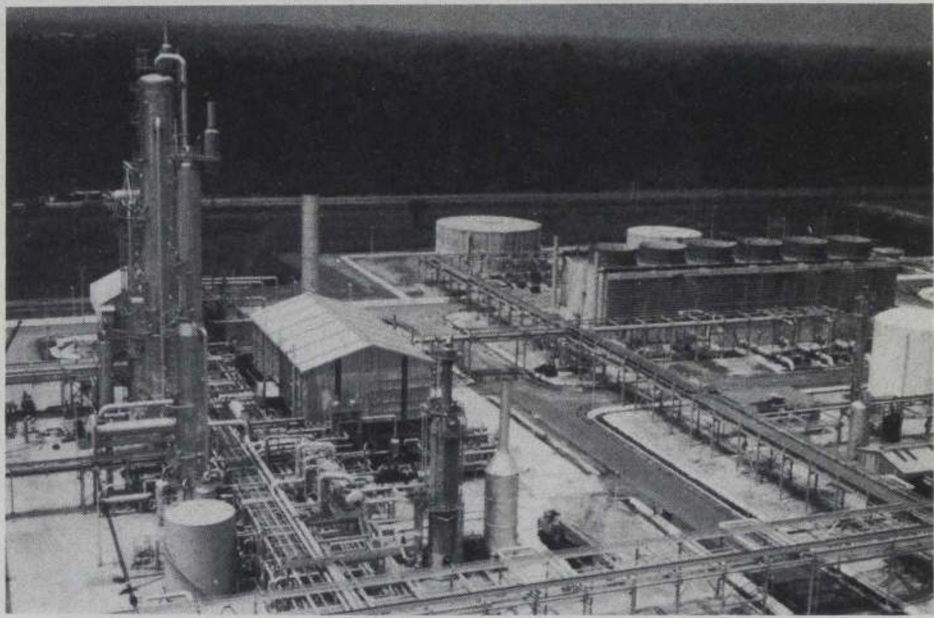
8 November

Pertamina has made an oil and natural gas discovery at a well near Jakarta.

AKZO NV has formed a 50–50 joint venture with PQ Corp of the US to produce and market silica-based products in Europe.

The Chairman of Shell UK, Mr Bob Reid, called on the UK government to re-examine the tax governing offshore oil production to encourage investment in older, declining fields.

Nigerian fertilizer complex sets performance record



NAFCON's grassroots fertilizer complex at Onne, Rivers State, Nigeria.

Alhaji Hassan Adamu, NAFCON's chairman of the board of directors, has spoken about the good performance record of the NAFCON fertilizer complex in Rivers State, Nigeria, saying the ammonia unit had an onstream factor of nearly 100 percent and an overall production rate of 112 percent during its first two years of operation. 'Despite this impressive performance, it will not be possible for the company to solve the national problem of fertilizer shortages unless the plant is expanded,' he said. 'At best, we can supply a third of the nation's requirement from our present capacity.'

NAFCON will soon give the Government of Nigeria the first payment against foreign loans made for the project. Mr Adamu said it is very unusual for a Nigerian company to begin loan paybacks after such a short time in operation. From the time it went onstream in July 1987 to July 1989, the average onstream factor for the 1,000-ton-a-day, Kellogg-designed ammonia unit was 97.7 percent, compared to an average of 80.8 percent for large capacity ammonia plants of all design operating worldwide.

The NAFCON complex, which also includes a 1,500-metric-ton-a-day urea plant and an NPK (nitrogen-phosphorous-potash) mixed fertilizer facility, was put in place by a multinational consortium headed by The MW Kellogg Company, a technology-based engineering and construction subsidiary of Dresser Industries, Inc. Other consortium members were Kawasaki Heavy Industries Ltd, Marubeni Corporation, Nissho Iwai of Japan and Jacobs Engineering Group of the United States.

In a separate move the recently formed joint venture company, Nigeria LNG Limited, has awarded the contract for the preparation of a project specification for a Liquefied Natural Gas plant in the Rivers State of Nigeria, to a consortium of Technip and MW Kellogg. A letter of intent has been signed by all parties and is regarded as a major step towards the realisation of the Nigerian LNG project.

NYMEX natural gas

The Board of Directors of the New York Mercantile Exchange (NYMEX) have approved the Sabine Pipe Line Company's Henry Hub in Erath, Louisiana, as the delivery site for its planned natural gas futures contract.

Natural gas futures trading at NYMEX will commence pursuant to Commodity Futures Trading Commission (CFTC) approval, which is expected in about three months. Futures trading will provide a means to shift and hedge price risks for suppliers, distributors, and users of natural gas and will generate publicly available competitive prices, thereby assisting the entire industry, say NYMEX.

Amoco in Congo

Amoco Production Company has announced plans to install two platforms and drill as many as 22 wells to develop major oil reserves it has discovered in the Atlantic Ocean, about 25 miles off the coast of The People's Republic of Congo.

Production is expected to be about 40,000 barrels of oil per day after the drilling programme is completed.

Shell gas

SGL Ltd, the holding company for Shell Gas, has acquired its tenth gas distributor, the East Anglian company, Butagas.

Quadrant gas

A new company, Quadrant Gas Limited, has been launched to market natural gas in the United Kingdom. It will compete with British Gas in selling to industrial and commercial users in the contract gas market.

Quadrant's shareholders, Shell and Esso, have been jointly involved in North Sea oil and gas exploration and production since 1964. Currently, they supply more than 20 percent of Britain's gas needs.

The aim of Quadrant Gas is to participate actively in the contract gas market. Ninety percent of the gas from current producing fields is contracted to British Gas. However, Quadrant says that its immediate access to supplies will enable it to build an initial portfolio of customers over the next one to two years as it establishes its position in the market.

Aruba refinery

The Coastal Corporation has announced that a Coastal subsidiary has signed a definitive agreement with the government of Aruba in the Caribbean calling for the reactivation of the former Exxon refinery in Aruba.

Start-up of refinery operations is projected to begin in October 1990, at a processing rate of 150,000 barrels of crude oil daily. Coastal said additional processing units may be installed at the facility in the future to produce higher octane gasolines and other finished products.

North Sea safety

Despite major expenditure on safety, the North Sea oil and gas industry has so far claimed 485 lives. Statistics suggest it has a higher fatal accident rate than any comparable offshore area of the world and it is difficult to point to any significant overall downward trend in UK accidents this decade. These are amongst the findings of a new report by UK energy consultants Smith Rea Energy Analysts. Published in their *Offshore Business* series, the report takes a hard look at the economics of safety in the offshore oil and gas industry.

The authors note that both the Dutch and UK statistics fail to accurately express the true extent of the accident rate offshore. 1986 UK official offshore statistics record three fatalities and exclude the Chinook helicopter crash in which 45 lives were lost, as it occurred more than 500m from an offshore installation. Apart from Piper Alpha, helicopters have been the largest single identifiable cause of UK offshore fatalities.

In addition to the human tragedy, the financial costs of an offshore accident can be enormous. Smith Rea estimate safety failures cost the industry an average of £180 million per annum, but in 1988, Piper Alpha and other incidents raised this to £1,170 million.

£40 million contracts for subsea field

Contracts with a potential value of more than £40 million have been awarded to two Aberdeen firms to design and provide equipment for the £700 million Shell and Esso Gannet development.

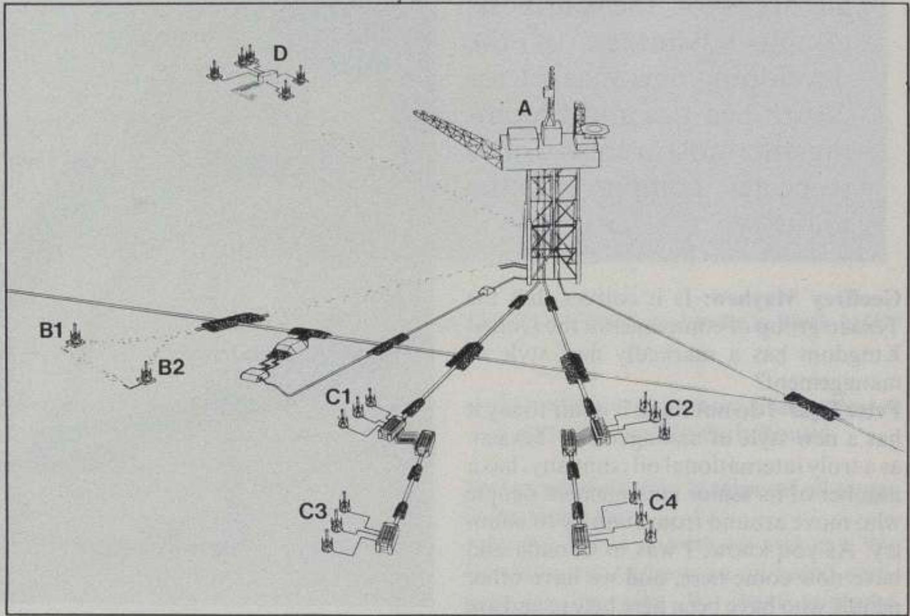
The contracts have been placed by Shell UK Exploration and Production, the operator for Shell and Esso in the North Sea. They were awarded to Vetco Gray Limited of Aberdeen, for the design and construction of Christmas trees and manifolds, and FSSL Limited for subsea electro-hydraulic control systems, including platform elements.

Gannet consists of four fields about 112 miles (180 kilometres) east of Aberdeen. They are estimated to contain 170 million recoverable barrels of oil and condensate and 700 billion cubic feet of gas. Their development will provide some 2,000–3,000 construction jobs and production is to start in late 1992.

The contracts are for equipment for the three subsea fields in the Gannet project. Thirteen wells are to be pre-drilled before first production. Provision will be made for up to 11 more wells, to be drilled by the year 2000, whose equipment will come from the same contractors.

The concept of the Gannet field development makes it by far the largest subsea development currently planned in the UK sector of the North Sea.

The focal point for the Gannet complex is Gannet A, the location for a processing and production platform which will serve all four. The fields lie in an average water depth of 300 feet (91 metres).



The layout of the Shell/Esso Gannet field, as planned in October 1989.

Mixed news for UK gas industry

National Utility Services (NUS) *1989 International Gas Price Survey*, reveals that an overall reduction of 7 percent in United Kingdom gas prices has been, in part, funded by increases of up to 60 percent for heavy industrial gas users.

This means that, out of nine industrialised nations surveyed, the United Kingdom remains the most expensive country for heavy industrial gas users.

These high costs faced by the manufacturing industry coupled with high interest and exchange rates are taking their toll amongst UK exporters, who are now faced with even more pressure on their ability to compete effectively in Europe and throughout the world, according to the survey.

However, customers who are totally reliant on gas, and are charged on a 'firm' gas supply agreement, are slightly better off, with a 7 percent decrease in their gas prices which is good news for many small and medium-sized companies.

$13 million BC

The October sale of oil and gas drilling rights brought $13 million in revenue to the province of British Columbia, Canada. The total paid so far this year now amounts to $79 million.

Making the announcement, Energy Minister Jack Davis said, 'There is a boom in B.C.'s natural gas industry. Strong economic growth here and in the US, plus natural gas' environmental benefits as a clean-burning fuel, are the driving forces. Some big finds have rewarded companies' exploration efforts. This adds up to a very good outlook for the industry.'

German gas pipeline

Wintershall AG, Kassel, West Germany, a BASF Group company, plans to build a natural gas pipeline across West Germany. To be known as the MIDAL, its route, some 560 kilometres in length, will extend from Rysum near Emden, where the Norpipe (North Sea natural gas pipe) reaches the coast, to Ludwigshafen. Based on current estimates, the pipeline will cost about DM750 million.

When fully completed the MIDAL pipeline will be transporting eight billion cubic metres per year. It is expected to begin carrying natural gas from the North Sea in 1993.

'We want to be a company that is known for excellence'

In an interview with *Petroleum Review*, Peter Bijur, the new chairman of Texaco Limited, discusses:

- His management philosophy — which is committed to the development of the concept of excellence in all areas of business.
- His objectives — which include making Texaco an effective competitor in all areas of the business, taking advantage of the developing new market for North Sea gas and becoming the most admired and respected company in the industry.

Texaco Ltd Chairman Peter Bijur at Canary Wharf where the new UK head office will be built.

Geoffrey Mayhew: Is it correct that the Texaco group of companies in the United Kingdom has a markedly new style of management?

Peter Bijur: I do not think it is fair to say it has a new style of management. Texaco, as a truly international oil company, has a number of its senior management people who move around from country to country. As you know, I was in Canada and have now come here, and we have other people who have been here before and are now in the United States and elsewhere. We each have a management style which is instilled into us through the Texaco system but which also allows us to develop our own individual styles.

I would, however, agree that this company now has a different personality. I may not be the best person to ask about what that personality is. I did not work in the organisation that my predecessor headed up. All I can do is to speak for myself and say what my goals and objectives are and somebody else will have to tell you how that compares with anybody else.

What are your goals and objectives?

First and foremost we need to be an effective competitor in everything that we do. We want to be a respected, admired company. That is part of Texaco's worldwide vision and certainly we share that in this company.

But beyond that we want to be a company that is known for excellence. We want to be a company with employees who have pride in our operations. We are very concerned about such things as the environment, employees' safety and the quality of the products that we manufacture.

Everything that we do should be oriented towards these objectives.

Have these objectives been dictated by outside circumstances?

Clearly Texaco has been through one of the most difficult periods in any corporation's history since the beginning of organised business.

Its problems in the United States over the Pennzoil matter were extremely difficult and threatening to the company. The company, I am pleased to say, dealt with it in a superb fashion. The management brought the company through a period of intense threat to the point where we are now on the road to success again.

When you go through a period of darkness, such as our company experienced, you come out with a new vigour; you come out with the adrenalin really flowing. Adrenalin was used during that period to parry the threat to the company and it was done successfully.

The task of the management today is to take that continuing adrenalin flow and redirect it to do something else. We have chosen to redirect that flow into creating for the company a reputation for excellence; creating a quality image; creating dedication to wanting to do the right things right, and a dedication to wanting to be the most admired company in the industry.

How is it being achieved here?
It is a process which requires inculcating the entire staff with that type of thought process. It starts at the top and it filters down through the organisation. Through everything we do we are trying to instil in people a pride in their jobs.

There are many ways in which we are demonstrating our commitment to excellence. One example is that we have recently announced that we are moving to a new office building in Canary Wharf in mid-1992. The internal design of that building will be managed by our own people and will provide our employees with one of the highest quality office facilities available anywhere in the world.

That is just one example of our commitment to quality and excellence, and it is through these types of demonstrative actions that employees and customers as well as other audiences will begin to view the company as being something different.

We are doing other things, such as human resource development activities, where we are taking an intense interest in developing the younger people within the organisation, by giving them an opportunity to grow, to learn new trades and new techniques of management.

In addition, we are in the process of commencing what within industry today is popularly known as a 'quality' programme.

Texaco has been using this programme elsewhere for quite a while. Indeed our Pembroke refinery has been running a quality programme for several years. It will be a very significant programme to improve our image of ourselves and to improve further the quality of our products which are already amongst the highest quality products in the industry.

All this has but one real purpose — to give us, as best we can achieve it, a competitive edge in the marketplace.

And that will be the measurement of it?
It sure will!

Did this approach apply in your success in the Eleventh Round where you gained a large increase in acreage?
We worked very diligently in preparation for the awards in the Eleventh Round and we were very gratified by the government's awards to us. We think those awards were, to a very great extent, reflective of the excellence that was demonstrated by our people in the preparation of the packages to go forward.

I think we have a tremendous opportunity through this 33 percent increase of our acreage to explore, and explore successfully. We think there are some very good opportunities, good fields for us there, and the programmes that I have described to you will enhance the work that will be done on the part of the explorationists as they review the prospects and decide where to drill wells and, hopefully, turn exploration potential into success in terms of production.

The Highlander subsea production facility was installed in over 400 feet of water in Block 14/20, eight miles from Tartan.

Will there be many kinds of new technologies needed to develop the North Sea over the next decade or two?
We are already leaders in subsea technology at this point in time, which is a matter of great pride for us.

Of course there will be new technology utilised in the North Sea and we intend to maintain our position on the leading edge of that type of technology, particularly in the subsea area.

Is that why you sought to increase your acreage substantially?
I would not say that is why. We sought to increase our acreage in the North Sea because we intend to be in business for the long haul. We have been relatively successful in the North Sea in the past and the most important ingredient in a successful exploration programme is acreage. We were at a point where we wanted to have some more prospects to explore and, consequently, that is why we were active in the Eleventh Round.

Do you see the future in terms of oil or gas in the North Sea?
I see the future in both oil and gas. We have historically been an oil-based company in the UK. We have explored actively for oil and we have been successful in finding it. I think it is safe to say that most, if not all, of the easy oil has been found, and that is true not just of the North Sea but pretty well true around the world.

We are continuing our efforts to find additional reserves of oil and always will, but we do see that there are big markets for natural gas. We are good natural gas finders as well.

We have not previously turned our sights on gas to the extent that some others may have done, and we will be increasing the amount spent on gas exploration as compared with the past.

Will the market for the sale of gas become more easy, more interesting, through privatisation?
Clearly that is true. It provides an opportunity for companies such as ourselves and that is what we intend to pursue.

'We believe that unleaded fuel is the way to go'

How do you see the prospects for gas from the North Sea over the next decade or so?
Clearly, with British Gas having been privatised and the ending of its monopoly, we see an increasing market in which all the energy companies are going to have the opportunity to be involved. Gas is going to be competitive with coal and nuclear fuels in power generation.

Older nuclear plants are going to be shut down and phased out and I think everyone would agree that the likelihood of bringing on new nuclear plants is low, given the image that the nuclear industry has, and the high cost of investing in that energy source.

If some coal mines are no longer operating because they are either played out or the facilities are no longer capable of efficiently producing the coal, and if there is no increase in the net number of nuclear plants, then consequently there is going to be a market for gas, particularly for electricity generation. And that market can be filled very effectively through co-generation facilities.

I think in the short and medium term, if not the long term, that gas should play an important role in power generation — for reasons of price, supply and demand and environmental regulations — and we and all our competitors are studying that very carefully and in depth.

Do you think it possible there might be more foreign entrants in the UK retail market?
We have essentially a free market in this country and it will be free throughout Europe by 1992 which will clearly provide an opportunity for anybody to come into the marketplace. Where markets provide reasonable returns for the participants, I think you will see them come.

Could it happen in the realm of joint ventures?
It clearly has in the United States. Texaco is involved with the Saudis in a major joint venture in the marketing and refining business on the east coast of the United States. There are other opportunities, I am sure, for joint ventures between producing countries and consuming countries along the lines of the Texaco-Saudi joint venture.

When you have consuming countries that do not have secure supplies of raw materials and you have producing countries on the other side who have tremendous supplies of raw materials but little consumption capacity, that is a perfect environment for that type of joint venture.

There are many people who think that Texaco's joint venture with the Saudis was somehow directly a result of Texaco's problems with Pennzoil.

That is not true. It was something that had been considered for a long time as being a possible strategy for the company in the future.

If the Saudis wished to establish a joint venture in the United Kingdom, would that be the sort of thing in which Texaco could be interested?
I would not even hazard a guess on that. I can just tell you that we are always interested in whatever opportunities we can develop that will meet the objectives that I have indicated. We are interested in maintaining our profitability and if there are opportunities for us to do so through joint ventures of one sort or another, we are always open to that. But I would not address the issue of whether Texaco and the Saudis might do anything here. I just do not have any feel for that.

In refining, is unleaded petrol likely to become a tight situation in Europe as a whole?
There is more and more unleaded petrol being manufactured every day and most refineries are certainly capable of manufacturing it. The fact that there is spare refining capacity around in Western Europe would indicate that there should not be any particular tightness in the mogas market with respect to unleaded petrol for the moment.

We have gone from a position where unleaded petrol was less than 2 percent of the UK market eight months ago to a point where it is over 25 percent today. That is pretty fast growth and the industry is certainly able to keep up with that. We have a refinery in Pembroke that is capable of producing large quantities of unleaded petrol, so we certainly do not see any problem meeting our demand.

You have not followed the super unleaded producers?
We sure have not! We were a leader in introducing unleaded petrol and were the first company to have it available throughout our chain of service stations.

We believe that unleaded fuel is the way to go. However, we believe that separate grades of unleaded fuels are very confusing to the motoring public at the present time. We would like to see the unleaded market running at 100 percent rather than the current 25 percent. To do that, we have to cut through the remaining confusion. Research Texaco conducted with the RAC showed that 6 out of 10 motorists still do not know whether they can run unleaded petrol in their cars or not. We believe that the introduction of a super unleaded at this point can do nothing but confuse them further. The fact of the matter is that the government would like to see unleaded fuels burnt in vehicles and we do not think this desire should be confused by a variation in grades. Consequently, we at this point are not introducing super unleaded fuel.

However, we are watching the situation very carefully and if from a competitive standpoint (although we don't see it yet) it appears that the public wants two grades of unleaded, then Texaco will be right there meeting the demand.

Does the introduction of the car catalytic converter enter into your calculations in gauging the future?
Not really, and the reason that it does not is that we have a lot of experience, as all the international companies do, with the catalytic converter in that they are standard on all automobiles in North America. We have the capability of meeting the demand that we foresee in the future for unleaded fuels and whether lean-burn technology or catalytic converter technology is used makes not a great deal of difference to us. We are going to manufacture the unleaded fuel that is capable of being burnt in those engines.

On the retail side, do you think there will be an upsurge in diesel sales perhaps following the proposed tax changes relative to petrol and diesel?
There is certainly every indication that if the tax equalisation that is currently being considered by the EC were to be placed into effect, there would be an increase in demand for diesel. We have brought this to the attention of the Commission and we certainly hope that they will recognise that some of the taxation programmes currently under consideration could have very serious effects on some of the investment projects that are either on the drawing boards now or even under way within the European refining system. What they are considering could have a significant effect on the demand for diesel and mogas.

Have you proposed a different tax structure?
We have discussed it with them.

Would you see a sudden rise in demand for diesel as a bad thing in this country?
It is not that we would see it as a bad thing

per se. It is just that we have been oriented for a long time towards motor gasoline production and we have made investments in that way, and if they *are* going to make the changes which are currently on the table, then we need to be prepared to deal with the increase in demand for middle distillate. Consequently this has to be taken into consideration sooner rather than later.

Is the Commission showing signs of listening?

I think so. I have been to Brussels several times now and met with people from the Commission. I find them to be very understanding. They have a great appetite for information, for input from the industry, and we are trying to help them in every way we can by providing that input. We have people in Brussels who deal with them, answer their questions and provide research data to them on a continuing basis.

After 1992 a bigger drive for cleaner emissions and cleaner fuels from refineries is expected. This will touch on your achievement of excellence in refining in Pembrokeshire?

Absolutely, and we are very mindful not only of the environmental requirements of, for example, sulphur specifications but of the US requirements because there are times when we supply motor gasoline into the world market. We have to be very aware of all the standards and regulations which exist. We have several projects under way at the refinery which will enhance our ability to produce a wide spectrum of products that match up to these requirements and we continue to upgrade our refinery with that in mind.

Finally, turning to an announcement that recently made the headlines, was the decision to move to new headquarters in Canary Wharf a recent one?

Yes, the final decision was made quite recently but it had been under study for three years. The start of this project predated me by about two and a half years. There was an intense analysis undertaken by this company as to where to locate in the United Kingdom. I came in at the tail-end of it and was in the position to make the decision.

In doing so, you were able to relate it to your standards of excellence?

Yes. We felt pretty strongly that we did not want to split the upstream from the downstream. We felt there were synergies in being together. We also feel for our own purposes — and I know some of my competitors have chosen to go elsewhere outside London — that it is important to stay in the capital city.

Equally important, since we had to move because the lease on our current Knightsbridge offices is expiring, we wanted to do so in a way that created the least personal disruption to our employees.

When we considered the various alternatives, the move to Canary Wharf provided by far the least potential disruption. We are only moving five miles from where we are sitting right now, as opposed to alternatives which moved the company 30, 40 or 50 miles out into the country. Of course I am very familiar with all the perceived problems of transportation into and out of Canary Wharf, but these will be greatly resolved by the time we move in there. I am very confident of that.

I believe that we have made the right decision for our employees and the right decision for our business. We are going to remain in the centre of the capital city's business community in an outstanding environment which will help our employees enjoy their work and be proud of their company.

Sir Peter Walters receives the Institute of Petroleum Cadman Medal

Full circle: past events and future distractions

Sir Peter Walters, the Chairman of the British Petroleum Company plc, gave the Institute of Petroleum 1989 Cadman Memorial Lecture on 31 October. The lecture took place at the Institute of Directors, of which Sir Peter is President. Among the large and distinguished audience were other holders of Cadman Medals — Dr Paul Frankel CBE, Sir Eric Drake and Sir Alistair Down. The lecture was followed by a celebratory dinner, held at the Tallow Chandlers' Hall.

Sir Peter retires next March after 35 years with BP, having been a managing director of the company for 17 years and its chairman since 1981.

Sir Peter said:
To be associated with the name of Cadman is to be associated with one of the undisputed giants of the industry. At the time of his death, in 1941, he was still chairman of what was then the Anglo-Persian Oil Company, subsequently BP, having become chairman 14 years earlier. His career spanned momentous events, including the whole of the First World War and the perilous early years of the Second; events which make our own times seem almost tame by comparison.

There is a moral here. In one sense, everything to do with contemporary business seems more complex and uncertain than it ever was before. Modern communications and the media ensure that events become known very quickly and demand instant reactions. The expectations of both consumers and governments rise to ever higher levels. We have almost too much technical, financial and geological information upon which to base our decisions.

On the other hand, there is nothing new under the sun. I suspect we don't have it any easier, or more difficult, than our predecessors. In any case, it is only with hindsight that problems and events can be seen in their perspective.

It is so easy to be mesmerised by the fashionable issues of the moment. However, the real competitive prizes go to those who can identify today what future historians will claim to have been decisive and to shape strategy accordingly.

Cadman had that gift. To have one's name linked to his — and indeed to previous Cadman lecturers — is a great honour. And I must confess that it assumes an additional poignancy for those medallists whose careers have been with BP.

Naturally, in thinking of what I might say this evening, I refreshed my memory of some past Cadman lectures. In a way, I wish I hadn't done so. Not only were they of an alarmingly high quality; they were also almost foolhardily brave!

After all, they were looking forward to events of which we in this room now have first-hand experience. They reflect the anxieties and concerns of the time, and provide a fascinating insight into how the oil industry then perceived the future. Some of the problems they identified are still with us. Some they missed, or they have proved not to have been as important as was then thought.

But in re-reading them, I was certainly struck by the hazards of prescribing solutions to problems that have not yet arisen. That, of course, is in the very nature of the oil industry. Waiting to see how the wind blows may be acceptable in politics but it is disastrous in business. Nevertheless, we're not normally asked to put our heads on the chopping block of public soothsaying.

So one of the tasks that I have set myself in this lecture — 'Full circle: past events and future distractions' — is to consider how unexpected developments may make some of today's widespread assumptions about the future seem either irrelevant or fanciful by the turn of the century. We have to look to the future, if only because of the enormous lead-times associated with our investment decisions. But I think we have learnt to do so with a measure of scepticism and humility; and it is in that spirit that I now proceed.

Looking back

My first inclination is to cast my mind back to the period of the two increases in oil prices during the 1970s. This period was momentous on two levels. First, and most obvious, were the economic implications.

But there was the psychological impact as well. I wonder whether any business has ever had to face so sharp or so sudden a re-writing of the rules. Strategies; organisations; planning assumptions; somehow nothing was left intact at the end of the 1970s. Oil companies didn't just have an economic problem; they had to discover a totally new and fresh way of doing business.

And the biggest readjustment of all was in coming to terms with the fact that the oil industry was no longer master of its own destiny. Both its access to crude, and its freedom to market the commodity, were under threat: and this led the oil industry to abandoning what in the trade was known as its 'vertically integrated' approach.

Shorter-term trading; quickness on the feet; survival in the market-place — these were the realities which now supplanted traditional oil company values. A new culture was introduced which laid emphasis upon value maximisation and freedom of action.

This, in the end, was of more consequence to the oil industry than the dramatic increase in oil prices which took place over such a short period of time. Because of nationalisation of the bulk of the world's oil reserves, the oil industry lost its independent source of supply.

From henceforth, exploration and development activities in those areas could be carried on by private companies only at the behest of producer governments. It was clear, moreover, that this was an ability which the producer governments wished to develop for themselves.

This was the upstream picture. And the reaction of many consumer governments, particularly those with energy resources of their own, was to impose similar controls themselves in their own domains. Corporatism, you will remember, was still highly fashionable. In fact, everything was fashionable except trust in market forces.

Thus, to take the United Kingdom as an example, the then Labour government was the architect of a whole range of controls and arrangements which ensured that, in the UK sector of the North Sea, no single commercial decision could be taken by the oil industry without prior consent from government.

Participation agreements gave the state ownership of 50 percent of the oil produced. Britain's state oil company, the British National Oil Corporation, was the instrument through which government intended to enlarge its control of the decision-making process.

And not only upstream. Legislation was enacted which drew an uneasy distinction between 'emergencies' and normal periods, and which gave government extensive powers over the marketing and distribution of oil and gas as well. Here again it was envisaged, at least by some politicians, that BNOC ultimately would have a central role.

Sir Archibald Forster, (left), presenting the Cadman Medal to Sir Peter Walters

The primary motive behind all such moves was to guarantee security of supply. Western politicians baulked at their countries' economic and strategic dependence upon a single supply point, like the Gulf, for their main energy source in a politically unstable area of the world.

This was enough to convince governments of many political persuasions that oil was too important to be left to the oil companies. On the principle that 'if you can't beat them, join them', governments set out to imitate the activities of Middle East governments in their own countries.

Indeed, I sometimes shudder at the consequences that would have flowed from implementing some of the more restrictive policies under consideration at the time.

For example, one of the obsessions of the late 1970s in Britain was the so-called North Sea export bulge. The worry was that far too much North Sea oil was likely to be produced and exported in the decade ahead, leaving a serious shortfall in the 1990s when oil was expected to command far higher prices than ever before.

Hence the enthusiasm for depletion controls. It was thought that by keeping oil in the ground, Britain would be better placed to survive 'once the oil started to run out' — either by consuming it ourselves, or by exporting it at a wildly high premium.

We know now what would have happened if this advice had been taken. Britain would have forgone the oil revenues at their peak; and the oil industry would consequently have been denied the financial strength which alone has made possible the extension and enhancement of this country's own indigenous oil reserves. Not to mention the invisible earnings from overseas investments which now so usefully help to offset the direct trade imbalance.

Some of the worst dangers, therefore, were happily escaped. But this was not enough to alter the fact that, in the late 1970s, the oil industry was faced with a general erosion of its worldwide opportunities. As a result, it could not afford to take any chances. The prospect of losing control at both ends of their business forced most oil companies to look around for other activities to take their place.

Diversification

Their natural response was to look beyond their 'core' businesses and seek out opportunities in wider fields. In the later 1970s, there certainly seemed no shortage of choices.

Some went outside the energy field altogether, with not very happy consequences. One thinks, for example, of office equipment or packaging as diversifications which had nothing to do with the energy business, let along oil and gas. Nuclear power, minerals and coal were also on the list on the basis that a natural synergy existed between them and an oil company's traditional oil and gas activities. Such was the psychological trauma that had been induced!

In the light of recent experience that would not be the general view today. Diversification is no longer attractive anywhere — partly because of its track record; and partly because potential investors are quick to notice the benefits of selling off fringe assets to the people with the inclination, knowledge and experience to manage them more effectively.

This marks a fundamental change of attitude from 10 years ago. The wheel has turned full circle, with most oil companies now concentrating upon their traditional core activities. Some, it is true, still have coal and minerals interests. But there is little question that oil and gas constitute the principal thrust into the future.

Will, however, the industry be saying the same in 10 years' time? I certainly think that what has happened would have surprised some of the Cadman lecturers of the past. But might I be equally surprised at the end of the 1990s to discover that our current core businesss are not as 'core' as we thought?

The move away from core activities in the 1970s was therefore partly a response to political — as opposed to commercial — events.

There was, however, an energy rationale as well. Not for the first time, there was much talk of the 'oil running out'. As a consequence, the political and economic case for developing alternative energies and entering new businesses ffppeared unanswerable. Every possible remedy was on the agenda — with one exception. Not many people were prepared to place faith in the price mechanism!

Such thinking is outdated today. Although one can argue about the efficiency of market forces, most people are agreed that they have a central role which politicians ignore at their peril. This is all the more true of a global business like energy.

But that doesn't mean that governments won't be provided with new reasons for intervention, or that fears for supply security won't be resurrected. The politics of 'greenery' could produce fundamental changes in the business environment. Today's combination of rising demand and declining non-OPEC supply may once again excite fears of import dependence and long-term security.

Thus no government can afford, politically, to be inactive in the energy field — even though its capacity to do harm is infinitely greater than the likelihood of its finding the right answer!

Apart from the last three years, when there have been definite signs of a resumption, the 1980s have been notable for a total absence of sustained oil growth. But there are now signs that despite the dramatic improvement in efficiency gains which is expected to continue for the rest of the century, demand for oil will continue to grow, albeit modestly, but enough to raise questions once more about future events.

On the supply side, conventional non-OPEC production is still highly significant, and, to borrow an expression more normally associated with the lately departed Chancellor of the Exchequer [Mr Nigel Lawson], is expected to continue at similar levels 'for some little time'. For example, BP's best estimate for the UK Continental Shelf alone is that it contains some 7 billion barrels of oil and some 40 trillion cubic feet of gas which are yet to be found.

Future uncertainties

First, there is the likely level of oil prices. Of all the uncertainties that the oil industry has to address, this is the most important. It is the one which can have the most immediate, and dramatic, impact upon company plans. It is the one where there is the greatest scope for discussion and argument. And it is the one which every oil company most wants to get right.

If ever the oil price collapsed to levels which reflected exclusively the costs of developing oil in the Middle East, we would be faced with some very interesting choices and problems!

There are other uncertainties too, however. Geological assumptions; likely cost levels in non-OPEC areas (which reflect, in turn, technological developments and environmental compliance regulations); government policy regarding access — all these, and more, will help determine the extent to which non-OPEC production continues to make a significant contribution to satisfying energy demand.

At present, non-OPEC production during 1989 is of the order of some 26 million barrels per day (bpd). OPEC's own production is around 22 million bpd. With demand running at almost 50 million bpd, this is reasonably well balanced with exports from the Centrally Planned Economies making up the shortfall.

Sir Peter Walters giving the Institute of Petroleum Cadman Lecture

By the middle of the next decade, however, OPEC is likely once again to become the dominant supplier. That is why some of the arguments which were heard in the late 1970s may ring familiar bells during the mid-1990s.

After all, cast your minds back to that period. Twice in the 1970s we saw OPEC supply and demand stretched to full capacity. It only needed two significant political events — the Yom Kippur war in the first instance and the fall of the shah in the second — to precipitate the two price shocks that are still sharp in our collective memories.

I don't know what the political shocks of the 1990s will be. But I'm sure there'll be some. If so, could we find ourselves in the same position again — at the mercy of political upheaval, only to experience yet another example of the wheel turning full circle?

Certainly, I think the view is gaining ground that a combination of rising demand and declining non-OPEC supply will see the oil price strengthening with the possibility of a further, albeit accidental but no less damaging, price spike.

But so much could happen to either strengthen or weaken this likelihood. Consider, for example, the United States and its increasing dependence upon oil imports for its supplies.

When this was last on the agenda, President Jimmy Carter saw the battle to win energy self-sufficiency as the moral peacetime equivalent of war. It was the oil price collapse of the 1980s, amid growing fears for the environment, which changed the nation's perception.

But now, with oil imports once again accounting for half US requirements, and with all that this entails for its balance of payments, OPEC could once again be in the position to regain the initiative. Might this have the consequences for the 1990s that were originally predicted for the 1980s?

Perhaps. But neither can one entirely discount the possibility of OPEC breaking up or at least losing the cohesion which is essential for its management of oil prices.

While on the subject of the energy equation, there is the potential of gas to consider. It is easier to find, and more evenly distributed around the globe, than oil. But it is equally severely handicapped by the lack of infrastructure and its transport costs.

Nevertheless, if environmental and supply security concerns are to be dominant — as, at least in the case of the environment, it is very likely — the use of gas will be promoted both from commercial and political considerations.

Perestroika and glasnost

This opens up another enormous area of political speculation — the role in all this of *perestroika* and *glasnost*. Could they have the same disruptive effect on energy thinking as, for example, they have had recently on the assumptions underlying Western defence strategy?

While it is still early days, already it is clear that we shall have to question assumptions and values which have remained unchanged since the Second World War. The consequences of successful reform in Russia and Eastern Europe are potentially very far reaching. Economic reform and the introduction of market forces in a market of around 400 million people with enhanced consumer expectations could create enormous new opportunities to do business and for investment.

This is particularly true of the energy sphere.

The Soviet Union is already a major exporter of oil to the West, and has greatly expanded gas exports in the past 10 years. But there are considerable uncertainties over the role of the Soviet energy sector in the medium term.

Economic reform should lead both to faster growth and more efficient use of energy, so how will these conflicting trends work out in the end?

The truth is that *perestroika* means in economic terms 'consumerism', albeit of a kind adapted to socialist market forces. And the point about consumerism is that it has to be paid for in hard currency earnings.

The development of Russia's enormous reserves of natural gas for supply to Western Europe could provide her with such currency. It could also provide opportunities for the West. European industrial know-how could contribute to the regeneration of Russia's industries, while gaining almost unlimited supples of 'clean' fuel into the bargain. Customer power in the East would be the safeguard against any political turning-off of the taps.

The impact of all this upon the future of the European Economic Community can hardly be exaggerated either. The EEC is no longer — of course, it never was — synonymous with Europe. But if the barriers between the old and antagonistic trading blocs of East and West are about to break up, this will have a momentous impact upon greater Europe's economic environment, and upon the opportunities for 'access' enjoyed by global companies. The prospect of free economies in the Warsaw Pact countries is much more exciting and important in the longer term than the machinations of the Brussels bureaucracies.

Middle East

But before we get carried away, there is one reality that has not been altered. In 1979, the Middle East accounted for nearly 60 percent of the whole world's proven oil reserves. Almost exactly the same is true today. Moreover, if one looks back over the past 20 years, it is from the Middle East that most of the increase in oil reserves — some 450 billion barrels — has come.

This is a geological reality which neither economists nor politicians seem able to overturn! No new provinces such as Mexico or the North Sea can be expected. All this means that, despite our hopes for continuing non-OPEC discoveries and production, the political and economic stability of the Middle East is crucial to the energy outlook.

It is an outlook which still depends upon oil, more than any other energy source, to satisfy the main bulk of increased energy demand. And the number of countries supplying that incremental oil to the international market is very limited.

I have now said enough about the future to run the risk of being proved wrong in 10 years' time! So let me get my excuses in first, and consider some of the reasons why we might all find ourselves surprised by the end of the decade — 'as our forefathers were before us'!

'The prospect of free economies in the Warsaw Pact countries is much more exciting and important in the longer term than the machinations of the Brussels bureaucracies.'

Future prospects

Firstly, I would like to make a general point about forecasting. In one important respect, we differ from our predecessors in the way we view the future. We are no longer surprised or dismayed to be proved wrong. There is no longer the expectation that what seems incontrovertible today will not be questioned tomorrow.

This manifests itself in the fact that our planning procedures are no longer directed at making forecasts. Rather, their aim is to map out the most likely scenarios given stated assumptions. That means that when the unexpected happens, we are prepared for it — even though we couldn't tell in advance what it would be. A senior cabinet minister was once kind enough to describe BP as a 'nimble giant'; and that's certainly the quality which is needed. Adaptability to change is as important, if not more so, than the ability to predict.

With this in mind, let me turn to what might rock the boat over the next decade. I've already mentioned the oil price, and its importance cannot be exaggerated. But it is substantially outside the industry's control to influence. All we can do is to identify certain realities which no amount of price manipulation can, in the long term, overturn.

Environment debate

Other uncertainties, however, are growing in importance as well. Concern for the environment is becoming — or should be — one of the most potent factors in any commercial decision. What perhaps is less well understood are the far ranging implications of this concern; and how the energy outlook could be altered fundamentally, and to the world's detriment, if too many hasty decisions are taken in this area.

It is sometimes assumed that measures to protect the environment are, *ipso facto*, against the interests of business and that most business decisions and actions are in turn hazardous to the environment. I don't accept that at all. Even on the most mundane of levels, the political fallout of an environmental accident is so serious that all sane companies are constantly striving to reduce the risks as far as it is possible to do so.

In any case society has a right to raise its environmental expectations just as in the past it has raised its expectations of wealth creation. The growing political interest in the subject is a response to the scientific evidence which all of us, as citizens, are bound to take into account.

One of the problems, however, is that not all societies enjoy the level of prosperity which allows this evidence to be treated equally seriously. I doubt, for example, whether 'green' candidates, particularly of the more extreme kind, would win many votes in a subsistence economy. Indeed, I believe the developed world needs to be very sensitive to the danger of a global 'greenery' which denies many people the material advance that the West has enjoyed for so long.

The two are not mutually exclusive. But it is nevertheless a disagreeable reality that the problems of the environment can only be overcome by a process of wealth creation which itself holds out dangers of exacerbating the environmental problem.

The oil industry happens to find itself at the centre of this whole debate. In extracting oil; in transporting it; and in consuming it, there can be significant risks to the environment. There is no point in denying that, although statistically we do a pretty good job.

But the crucial question is how we should proceed from here. How can we reduce the environmental risks without, at the same time, reducing our energy security and without threatening living standards throughout the world? And particularly, the living standards in countries which now aspire to the comforts and amenities which we, in the West, have taken for granted for so many years?

The complexity of the issues affords no easy solutions. And that is why the danger lies not in society's concern for the environment, but in the impetuosity of some of the so-called remedies.

We scarecely need to remind ourselves of the recent *Exxon Valdez* incident which continues to reverberate throughout the whole of the oil industry. By any standards this was a serious ecological incident; and there is no doubt that it has served to reawaken latent suspicion felt towards the oil industry in Alaska and in other parts of the United States.

Unfortunately, however, *Exxon Valdez* may be remembered not only for the incident itself, and on the correct focus that it stimulated, but also for the irrational arguments it unleashed.

Hardly the moment, one would have thought, when import dependency is reaching the 50 percent level, to discourage the development of energy resources at home. And yet, one effect of the *Valdez* incident has been to push even further into the future the opening up of exploration in the Arctic National Wildlife Refuge in Alaska and other frontier areas that have geological promise. The retaliatory taxes imposed hastily by the Alaskan legislature have, for example, already caused us to halt the development of at least one new prospect in that state. Alaska and other offshore areas still hold out a reasonable hope of replenishing some of the United States' oil reserves and of reducing its import dependence. At a time of continuing concern for the US balance of trade deficit, here are two good reasons for allowing activity to go ahead.

The environmental risks are cited as justification for taking the opposite view. But it is far from certain, even from the 'green' perspective, that this attitude makes sense. An oil spillage is, after all, just as likely to occur through importing oil from the Middle East as moving oil around in Prince William Sound. Some might say more so.

'Transport policy, like the environment, could upset many of today's assumptions.'

Certainly, the US government is in a better position to enforce environmental safeguards on its own nationally-built, nationally-owned and nationally-operated tankers than those from foreign countries. And so, a policy which causes oil imports to increase might well exacerbate the environmental risks as well.

Here, therefore, is a classic illustration of how the best intentions can produce the worst results. I fear that the environmental debate is very prone to this tendency. It could hold out some nasty surprises for the years ahead.

I have no desire to minimise the responsibilities of industry in this context. I believe in the concept of 'sustainable development' and have no doubt that economic progress and concern for the environment ought to be interdependent. Industry has no right to run unnecessary risks, or cut environmental corners; and responsible companies know that there is no commercial incentive to do so either. But if concepts like 'unlimited liability' and 'the polluter pays' are stretched to such limits that companies become frightened of making investments, of undertaking research or even of being forced out of business, it will not be the environment that stands to benefit. Eventually, there will be a backlash as people realise how superficial were the diktats which put up costs unnecessarily and which, in the wider industrial context, have perhaps merely transferred much higher levels of global environmental hazards to developing countries who, understandably, are more concerned with wealth creation than with the niceties of ecological balance.

Transport policy

Another major source of uncertainty, this time of a more immediate and practical nature, is transport policy, which like the environment, could upset many of today's assumptions. The two are closely linked. Measures to improve the atmosphere impinge directly on the way we consume fuel and design engines.

Since 1986, growth in passenger car fuel demand has exceeded expectations both in the United States and even more so in this country. And that is to say nothing of the continuing aspirations of the developing countries. If anything, future long-term growth will probably be higher than is normally assumed. The fact is that customer preference for comfort and speed is not always consistent with greater car efficiency.

But transport also happens to be one of the growth areas in politics. It raises the question whether there are not some issues that fall directly into the hands of government to solve; for here at least is a problem that the private sector seems incapable of addressing on its own — at least until certain rules have been changed.

We could debate whether the desperate plight of transport in the southern half of this country is the consequence of too much, or too little, regard for market forces. If every mode of transport was made to bear its own costs, was free to make its own investment, set its own prices and was expected to remunerate that investment, it might be easier to arrive at the 'integrated' transport policy so beloved by central planners.

That would mean, for example, that a price had to be paid for the privilege of consuming congested road space in urban centres; that tourist buses occupying scarce road and parking space in London should bear the cost of doing so; that building contractors should be made to think twice before taking up half the road with their debris; and that heavy vehicles should pay directly for the wear and tear on roads. Then, many more of us might even be tempted or persuaded to travel on a revitalised railway system.

I say *might*. When all is said and done, there are good reasons why people use their own cars in preference to trains. Cars leave at times of the driver's own choosing; they have boots to carry luggage; and they don't require taxis or buses to and from the station. It is no mystery why cars bankrupted the railways. Since the lead time of alternative forms of transport is immense, I rather suspect that cars are here to stay — though it ought to be for the market to judge!

It is for this very reason that an immobilised and frustrated car-owning democracy may soon demand of its political leaders some urgent action to solve the transport problem. How this impinges upon energy we must wait to see. But transport policy is undoubtedly high on any metropolitan agenda.

Role of companies

There are many issues against which future generations will determine our

'The field of companies equipped to sustain an international role in the future may be very small indeed.'

sagacity and foresight, or suffer the consequences of our failure. We have touched on a few already.

Another is the possible change of attitude by at least some host governments in recognising once again the traditional role and competence of the international companies when it comes to exploring for, and developing, new sources of oil.

There is no doubt, that the fiscal regimes of the lesser developed countries, and their readiness to give international oil companies access to their exploration areas, are a key issue. We are playing for high stakes. Potential additions and extensions to existing non-OPEC reserves could turn out to be as much as 86 billion barrels — some 80 percent of the estimated proven and probable reserve base. But in the way of all forecasts I am told that this figure is subject to a wide margin of error — some plus or minus 50 percent!

Technology advances

One underlying theme is technology. Scientific and technical breakthroughs can transform, and undermine, traditional realities — whether in exploration, production, consumption, or the environment.

In particular, recent technological breakthroughs have allowed oilfields to be developed which, in earlier years, would have been considered impossible both on technical and economic grounds. Fields are now being developed at cost levels which were almost unimaginable at the time of their discovery.

Clearly, this is a development which has not yet reached its climax. And the emphasis upon technology is more important than ever. Both the technical and economic challenge of the next few years is to achieve lower unit costs for much smaller fields.

Major cost-saving improvements offshore are currently being exploited, covering such activities as platform construction and installation techniques, pipelaying and drilling.

We can now, for example, perform a much higher proportion of construction work *on* as opposed to *off*shore thanks to our greatly enhanced offshore lift capability. This reduces costs significantly.

In pipelaying, we are benefiting from a dramatic improvement in steel properties; and when it comes to actually laying the pipes themselves, we can do this much faster than before with a single, specially constructed vessel capable of performing the work traditionally done by two barges on day rate contracts over a much longer period.

And finally, drilling techniques have been transformed. Wells can be drilled more quickly, and extended reach drilling helps to minimise the number of platforms or subsea installations that are necessary. If we were developing the Forties field now, we would only need two platforms. In fact, we've got five.

These types of breakthrough don't happen overnight. But they can have a far greater impact on the long-term realities of the business than any politician.

Distractions

And that brings me to the second underlying theme of my remarks. So many past expectations have been altered by the actions of governments throughout the world. Decisions have been distorted, and game rules have indeed been changed halfway through the game. In the end market forces always seem to assert themselves. But sometimes not without a great deal of unnecessary cost and effort.

The title of my lecture refers to 'past events and future distractions'. Taking everything into account, I believe that past events show that the oil industry has served the world well in recent years. We have ensured the supply of a vital resource. Considerable risks — both human and financial — have been run. Billions have been spent in investing for the future.

However, there have been moments when we have been distracted from our task. Many of these distractions have been concerned with political developments. This may be unavoidable. To be in the oil industry is to be involved in politics at the highest level. We are all too often a convenient target, or scapegoat, which is used to distract attention from other issues. Politicians operate on a shorter time-scale than business, and have more diverse constituencies to consider.

Nevertheless, the reality is that politics and scientific advances together can upset the best-made plans.

Wheel of change

The other question my lecture has posed is whether or not the wheel is turning full circle — or perhaps whether we are in the process of re-inventing it.

Earlier, I talked about the 'culture change' which was forced upon us by the oil price increases of the 1970s, of the move away from vertically integrated company structures, and how as a result value maximisation had become the oil industry's guiding principle.

I can't see the added value principle disappearing. But I doubt very much whether we have seen the last of oil industry restructuring. Operational and technological developments are occurring at such a pace and at such a level of complexity that only the strongest and most able companies will be able to keep up. The field of companies equipped to sustain an international role in the future may be very small indeed.

This development may be accompanied, perhaps a little later, by a move back to integration. As the balance between supply and demand grows tighter, strong economic pressure will be exerted to bring the best downstream operators and key upstream producers together.

Already there is enough evidence of this beginning to happen to justify querying the durability of the organisational changes in the oil industry over the past 15 years. Strategic alliances between producers and operators will raise practical problems of structure and organisation.

And of course it will also affect the role of OPEC. It is wonderful what a little contact with the market can do to sweep away some of the more fanciful ambitions of pricing policy.

I suspect, however, that restructuring and the forging of new alliances is set to become an inescapable fact of our industry's life — and in the end there may be only three or four major international oil companies left to tell the tale.

However, I must be careful. I am very fond of a quotation from the British Prime Minister, Lord Melbourne. He once said that:

> 'What all the wise men promised has not happened, and what all the d-d fools said would happen has come to pass.'

I can think of examples to back up this assertion! There is always a danger of being 'too clever by half' on the one hand, and of refusing to think the unthinkable on the other.

But provided we all recognise our limitations, and accept Lord Melbourne's maxim as our guiding principle, I am sure that the oil industry will see its way through all the problems and uncertainties I have failed to identify this evening!

Once again, may I say how greatly I appreciate the honour you have done me tonight.

Birth of the LNG industry in Australia

By DCK Allen, Managing Director, Woodside Petroleum Ltd

This article is taken from the address which Charles Allen gave to a joint meeting of The Institute of Petroleum and the Society of Petroleum Engineers on the evening of 24 October, prior to the IP Conference entitled 'Trends in World Natural Gas Trade', when Mr Allen chaired the morning session. Acknowledgement to the Society of Petroleum Engineers.


DCK Allen

On 28 July, the first liquid natural gas tanker, the *Northwest Sanderling*, left Withnell Bay on the maiden journey from Australia of a new export to Japan. More than 25 years after exploration commenced off this remote corner of a vast continent, another dimension was added to Australia's foreign trade. In one fell swoop, a new trade has been established of the same magnitude as the other major elements in Australia's exports: beef, wool, wheat or iron ore. The North West Shelf will represent some 5 percent of Australian exports. Significantly it has been established entirely by a group of Australian and international companies led by the smallest of them, Woodside.

Frustrated by lack of success in Victoria, in the southeast of Australia, in 1963 Woodside applied for and obtained exploration permits offshore Western Australia totalling some 367,000 square kilometres. This vast area was not only remote from existing centres of habitation but it also covered very deep water. Subject to cyclones for more than half the year, it was better known to Indonesian pearl fishermen than to Australian oil explorers.

Recognising that the company did not have the ability to explore and develop such a vast and remote area itself, Woodside sought a 50 percent partner. At the 11th hour, both Burmah and Shell sought to join Woodside, so the partnership was split three ways with Burmah, the first to apply, becoming operator. Both Burmah and Shell then immediately diluted their interests to one sixth each by bringing in BP and Chevron (California Asiatic Ltd at that time).

There are probably few if any areas of Mesozoic and younger sediments of this size in the world which do not contain commercial hydrocarbons, but it was almost 10 years (1971) before major accumulations were found. Unfortunately the discoveries were of gas, and the first of them at North Rankin and Scott Reef were not particularly rich in condensate. The following discoveries, in Goodwyn and Angel, were, however, richer in condensate, running at 45 and 55 barrels/mscf respectively — and they had the advantage of being close to the North Rankin discovery.

But whilst disappointed at not finding oil in such a remote spot — 130 kilometres offshore in 130 metres of water — the venturers were encouraged by the gas volume, particularly in North Rankin where the gross column was nearly 600 metres. Clearly a major hydrocarbon province had been found with enormous gas accumulations. But the challenge of developing it was going to be as significant as the original step of exploring the area.

Gas and the early 1970s were, in fact, not a bad mix because that was the period when Japan was deciding, for reasons of pollution and diversity of energy supply, to increase its imports of LNG significantly. It was already receiving supplies from Alaska and Brunei and was set to expand its imports from Indonesia dramatically.

Japan was a market clearly complementary to Australia's production capability. However, there was a sleeper in the equation — in the form of politics — which hindered plans for exporting gas for almost a decade. The Labor government under Gough Whitlam was not in favour of exporting any gas and in the absence of a market of substance in Australia (the Western Australian population was less than one million at that time) there was insufficient backing for the development of the gas fields.

It was not until some time after a change of government that the potential to develop the fields on the back of an LNG export project became politically viable. By that time, supplies of gas to Western Australia from an existing field, Dongara, could be seen to be limited. Thus a project was developed to supply gas to Western Australia where an expanding market existed, based largely on the aluminium industry, coupled with a three train 6.5 million tons/annum LNG plant. Markets for LNG were sought in Japan, Korea and the west coast of the United States. The latter closed in 1977, because of environmental constraints.

About the same time as the government changed in Canberra, Burmah was withdrawing from Australia (and much of the oil industry). It sold its interest in the North West Shelf to the Broken Hill Proprietary Co Ltd (BHP), the largest company in Australia. Realising its limitation in the field of oil operations and particularly LNG, BHP split its interest in Woodside-Burmah with Shell, giving birth to the new company Woodside Petroleum Ltd, in which BHP and Shell each owned 21.3 percent (the old Burmah had 43 percent of Woodside-Burmah) and which was now both the operating company for the North West Shelf exploration permits and the holder of a 50 percent interest (the old Woodside one third plus the Burmah one sixth) in those permits.

This brief history illustrates the risks which are present in any resource development and which need to be carefully analysed and spread if a viable project is to grow from nothing.

Mammoth challenge

For Woodside, a company with negligible income, the challenge of developing the offshore gas fields into a viable project was particularly daunting. With 50 percent ownership, the financial exposure was enormous. When the company sought funding from a syndicate of banks, the size of the risk was emphasised. For myself, coming from the sheltered confines of a major operating subsidiary of one of the world's financially strongest multinationals, it was a revelation. Most of the judgements must have been sufficiently conservative because Woodside survived. I believe that even if the most exposed company had failed, the project would still ultimately have gone ahead — but with a different ownership and to a different timetable.

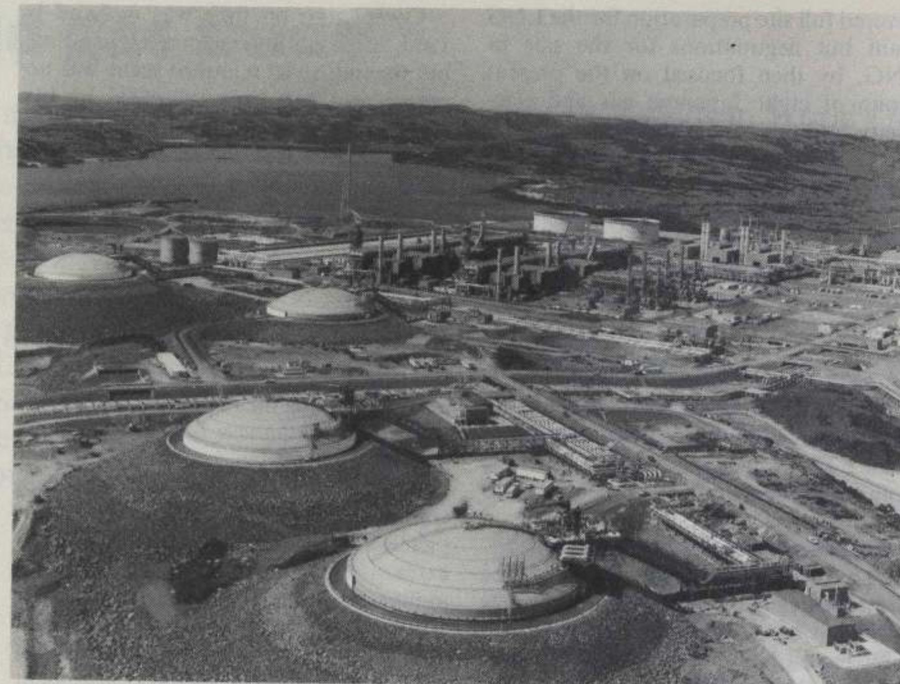
Now the starting point on the economics of any project, when analysing the risk, is to take the downside case and then run sensitivities against this. In most major international companies which have a spread of cash flows and fund their projects centrally, a less conservative position might be taken.

But for a company like Woodside — seeking to fund its 50 percent participating share on a non-recourse basis without a completion guarantee — the banks, in this case initially 62 international banks led by Morgan Guarantee Trust as agent (or prime bank in the syndicate), relied on the fundamentals of the project for their security. Standing second to other venture participants they needed to be very confident of their and our analysis of the basic risks of the investment.

We have already touched base with several of these basic risks. Political risk was very real in the early 1970s but by the end of the decade there was bi-partisan support for the project. Australia is a stable democracy which was and is expanding its resource development. Hence the political risk, which can be significant elsewhere, was minimal.

The market for gas in Japan in the 1970s was strong and the expectation of demand in Western Australia was also considerable, with the alumina industry expanding fast. Take-or-pay contracts reinforced the security of the cash flow, particularly in the early years, and were crucial to the confidence not only of the venturers but also of the banks.

But markets are fickle and are, of course, dependent on the overall world economy. The world economy looked and was strong in 1977–79 when the North West Shelf Project feasibility study was being carried out. But the second oil price rise in 1979/80 very rapidly put a different complexion on the world's economy. By 1981/82 a recession had driven forecasters back to their computers.



LNG plant site.

Development plans and problems

After further drilling carried out since 1971, it was decided to develop two, and possibly three, major gas accumulations (North Rankin, Goodwyn and Angel), all of which lay reasonably close to each other, 130 kilometres offshore from the coast at Dampier/Karratha.

North Rankin has proven to be a very large and prolific gas field, with the gas, some 7.1 trillion cubic feet (tcf), being contained in north dipping Upper Triassic sandstones. Structurally Goodwyn was very similar, although the gross gas column was considerably less — only 100 metres compared with 600 metres. However, the field was of greater extent and had higher condensate ratios. Goodwyn has 4.0 tcf proven reserve. Both fields were sealed by Jurassic shales at the unconformity and structurally are very similar to many of the North Sea fields.

The proposed project required installation of a major platform on North Rankin, commencing in 1980 for initial deliveries against a 400 mscfd take-or-pay contract to the State Energy Commission of Western Australia (SECWA), commencing in 1984. A second platform was planned on the northern part of the North Rankin field and a third platform, on Goodwyn, would be installed in the mid-1980s.

LNG production was planned to commence in 1986, rising to plateau levels of 6.5 mta by 1989. The LNG quantities were later reduced to 6 mta and 650,000 tpa of LPG was to be produced.

The gas was to be brought ashore at Withnell Bay in a 1,016 mm two phase flow (gas and condensate) pipeline. At Withnell Bay, on the Burrup Peninsula, a two train plant to process the gas to pipeline quality for SECWA would be constructed. This also had condensate stabilisation and two 77,500 cubic metre condensate storage tanks.

The gas is received onshore into the slugcatcher for initial liquid separation. Adjacent to the domestic gas plant, a three train LNG plant, water cooled with steam-driven turbines would be constructed. There were to be four 65,000 cubic metre double integrity LNG storage tanks and four similar but smaller LPG tanks, two for propane and two for butane. The jetty, some 800 metres long, would provide loading for LNG, LPG and condensate.

Separate from the venture developing the gas fields and the onshore plant, a shipping organisation was being established to transport the LNG to Japan in a fleet of seven LNG tankers. In 1980, the plan was for Woodside to sell its LNG fob to Shell and BHP, who would onsell cif or delivered sale into Japan.

By September 1980, when the contract was signed with SECWA, it was already clear that the 1986 target date for LNG was looking decidedly doubtful. In discussion with the banks, Woodside was able to obtain a facility of US$1,450 million — sufficient for its 50 percent share of North Rankin, the pipeline to shore, the domestic gas plant and a condensate loading facility. It also covered full site preparation for the LNG plant but negotiations for the sale of LNG, by then focused on the present group of eight Japanese gas and electricity utilities, were only at an early stage. In retrospect this was a most fortuitous situation.

With the delay to the LNG deliveries, the second platform on the northern end of the North Rankin field was deferred indefinitely. Meanwhile, as construction commenced, Australia was gripped by vicious inflation, compounded by settlements handed down by federal and state arbitration commissions, which are central elements in the Australian wages scene. The wages of a welder on the domgas site increased 80 percent over 18 months, as a result of 11 arbitration awards which could not be overturned.

The estimated capital cost of the domestic gas plant increased rapidly; the estimated capital cost for the proposed three train LNG plus LPG plant became unacceptably high.

To add to the difficulties, when the 28,000 tonne jacket for the North Rankin platform was being piled to the sea floor, the piles sank into the sea floor almost undriven. We could no longer prove to the satisfaction of our insurers that the platform would be able to meet the design criteria — in particular, with respect to withstanding the 100-year storm wind and wave conditions.

Furthermore, the world recession of 1981/82 severely affected the aluminium market and energy demand in Western Australia. Faced with an apparently ballooning shortfall in gas requirements, and hence high gas payments coupled with low sales, to say nothing of potential funding costs for unsold gas, SECWA sought revisions to the contract, introducing a new category of gas at a lower price to alleviate the political pressure upon them.

Needless to say, the bankers to Woodside — the 50 percent participant in the project as it then existed — were looking somewhat ruefully at their borrower.

By 1983/84, on the technical side, there were serious reservations about the foundations of the North Rankin-A platform but the North Rankin reservoir gave no cause for concern. In the market, volume was looking distinctly depressed but price was holding around US$28 and the political scene, particularly in Western Australia, was unfriendly because of the take or pay shortfall.

The oil price had fallen back from US$32 to around US$28/barrel and no longer was US$40/barrel considered possible by 1990. Indeed, the pessimistic view of US$20/barrel proposed by one of the original lead managers in 1980 was no longer discarded as a joke.

Completion on time was in hand by 1984, after some firm project handling, but the industrial relations scene was not secure and had been unsettled by two fatalities on site. Costs on the two domestic gas trains had blown out and their extrapolation to the future LNG plant made the possibility of Woodside funding its 50 percent out of further borrowings and sales revenue remote.

LNG exports

But the owners and operator had not been idle during the four years of turmoil. By 1984 the Japanese LNG market was firming and a Memorandum of Intent signed in 1981 was converted into firm contracts. The LNG plant was completely redesigned and the separate extraction of LPG discarded. A$1,000 million was cut from the capital cost estimates. Ownership was restructured with Woodside bringing in a new joint venture participant — MIMI (50 percent Mitsubishi and 50 percent Mitsui) — and also selling down part of its interest to Shell and BHP so that an equal one sixth structure for the LNG project existed. Shell and BHP also increased their interest in Woodside at this time to 40 percent each.

One of the critical points to remember in any project is that the risks are always there — and they will occur, good or bad. They can be minimised by planning, covered in part by insurance, or spread by changing ownership. But they cannot be removed entirely. Thus the restructuring changed the distribution of risk, spreading it wider but lengthening it by Woodside moving downstream into the shipping and marketing of LNG as an equal one sixth shipper and seller of LNG.

July 1985 saw a turning point in the project. The domgas plant had been selling gas to SECWA for a year, gas recycling had been agreed for North Rankin to utilise spare North Rankin capacity, well capacities had been increased from 66 to 100 mcfd, drilling in the northern part of the Goodwyn field was to show far greater condensate levels than had been seen before, and the take-or-pay contracts had been agreed with the Japanese.

With the firming of the LNG market, the redesigned air-cooled gas turbine LNG plant was approved. Reservoir performance and 3D seismic had shown that a second platform in North Rankin would not be required, the total field being drainable with long reach wells. 3D seismic, coupled with drilling and production experience, had also increased the proven reserves in Goodwyn and North Rankin. Gradually, some of the upside was appearing — although the collapse of the oil price in December/January 1986, when the ink was hardly dry on Woodside's refinancing, was another blow. But, tense and difficult as these times were, the hurdle had been cleared. Given imagination and resolution, management skill and steady nerves, the project was now moving inexorably forward. The time had come for it to be initiated.

With maximum emphasis on site safety, the two LNG trains costing some A$3,000 million were completed on budget and ahead of time. The first ship was also ready three months early so that cargoes could commence immediately. The second platform, third LNG train and last two tankers of the fleet of seven have all been approved. The LNG plant is operating faultlessly, North Rankin capacity has been increased to 1,650 mcf/day, and even the market for gas in Western Australia is greater than predicted in 1979.

New discoveries

In 1988, exploration drilling recommenced after a pause of two years. This resulted in two significant discoveries: one at Echo, being the richest gas condensate yet discovered; and the other at Wanaea, being a significant light oil discovery with a gross oil column of 103 metres.

Although satisfactory earnings are a long way off, the upside potential of the North West Shelf is beginning to appear. Many of the risks are behind us and although significant challenges still have to be overcome, we can confidently look forward to becoming the major Australian hydrocarbon producer by the middle of the 1990s — selling gas to Western Australia, LNG to Japan, condensate and probably oil from Wanaea to Australian refineries and for export.

Capital investment, already at the A$6,000 million mark, will continue at a very high level with commitments for Goodwyn, the third LNG train and ships six and seven currently standing at around another A$3,000 million.

By the time we reach plateau LNG production and delivery in 1993/94, it will have been over 30 years since the first steps were taken into the North West Shelf, including 15 years of continuous capital investment on a scale rarely seen in the world, let alone Australia.

But gradually the rewards — both for the companies directly involved and for Australia — are beginning to be visible on the horizon. It will be up to Woodside as operator and major participant to see that they continue for many decades repaying the immense risks which have been carried for so long.

Trends in world gas trade

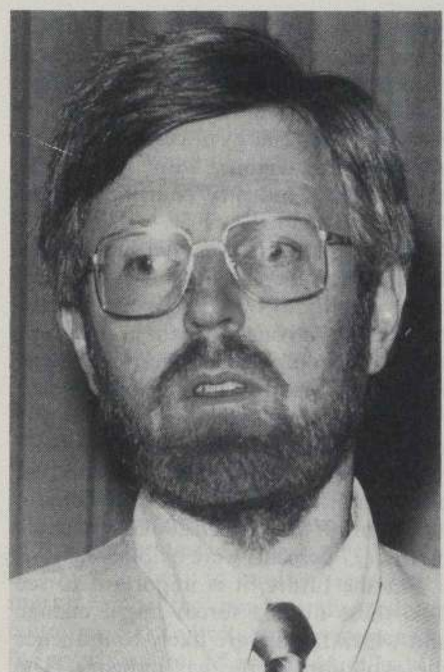
Eighty delegates attended the Institute of Petroleum conference, entitled 'Trends in World Gas Trade', held on 25 October. The speakers covered many aspects of the international oil trade, pointing out the recent dramatic growth in gas utilisation, the security of supply and the high cost of production, processing and transport, leading to long-term contracts. They shared a belief in an optimistic future for the industry, especially since gas is 'clean' in environmental terms. Moreover, as Charles Allen, Managing Director of Woodside Petroleum Ltd, said, 'More and more gas will be developed with the advances in gas to fuel technology.'

The keynote address on 'The Longer-Term Perspective', by Michael Clegg, and the papers by Dr Mikhail Korchemkin, entitled 'Soviet Gas Potential' and 'Competitive Economics of Natural Gas Applications' by Geoff Pyke are reproduced here in full, while the other papers are summarized. The whole proceedings will be published early next year.

James Allcock

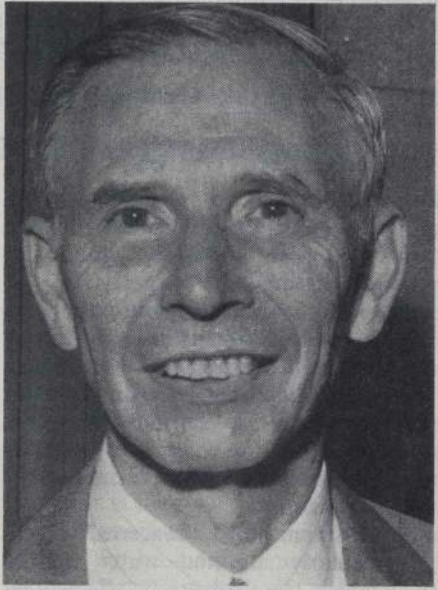
Mr James Allcock OBE, HQ Director of Gas Supplies, British Gas, spoke on 'The UK Outlook within Europe'. Initially he commented on the British government's strategy for gas — or lack of it. He said that with the end of the British Gas monopoly, the present policies of the company were confidential. British Gas would buy what gas it needed when it needed it. The total size of the UK gas market was going to be largely influenced by the rate of economic growth and by the development of new markets for gas, the path that oil prices were likely to take in the 1990s and the relationship between gas and oil and electricity prices. A substantial new market could be power generation. For the 1990s the total supply and demand balance will need to be looked at in a European context, without necessarily a direct Channel link. On open access transportation, Europe was going to wait and see how successful the UK 'pilot' experiment was. Similarly, the European Commission feels it can learn from British experience in price transparency. Mr Allcott concluded that the future of gas in Europe might just be spectacular.

Dr Helge Ole Bergesen, Nansen Institute, Norway, in his paper 'Medium and Longer Term Trends in Norwegian Development', described how Norwegian gas exports have developed in the last 20 years; he reviewed the size of reserves and the domestic forces behind the 'need to sell more gas'. The paper focused on the relations between the government and the Norwegian and international companies. The problem of coordinating gas production and sales was considered in detail. Dr Bergesen analysed the future prospects for Norwegian gas exports.



Dr Helge Ole Bergesen

Mr Ototake, Tokyo Electric Power Co, referred to the advance of the Socialist Party in the Upper House of Parliament in Japan and the reported emphasis on natural gas as the means of displacing nuclear power for electricity generation. He discussed briefly the factors which are influencing the trend of demand for electricity and the choice of fuels for the future and pointed to the uncertainties arising from concern about the greenhouse effect, the risks of nuclear power and the trend in world costs of fossil fuels. He concluded that in the face of these uncertainties, Japan will maintain a wide range of options in the fuel resources used for the generation of electricity, while giving priority to securing public acceptance of nuclear power.



RB Kalisch

Robert Kalisch, Director, Gas Supply and Statistics, American Gas Association, spoke on 'The US/Canadian Natural Gas Trade'. Although both the United States and Canada have for several years had a surplus natural gas production capability, it was Canada that raised its exports into the United States, as a result of regulatory decisions, the economics of gas production in Canada and the desire of US consumers for diversified supply sources. Studies show that this trend is likely to continue, possibly doubling by 2010, with both markets continuing to grow. However, Canadian exports will be limited in size by development and transport costs.

Natural gas — the longer-term perspective

By Michael W Clegg, Consultant, Cambridge Energy Research Associates

As we approach the final decade of the 20th century, it is probably true to say that never before has the natural gas industry displayed so much confidence in its future. A steady growth of demand over the past 15 years, which has led to a 50 percent rise in world natural gas consumption over that period, a steadily growing resource base that is spread around the world more equitably than oil, a favourable perception of natural gas as an environmentally acceptable fuel together point, at least superficially, towards the continuing health of the gas business in the 1990s and the 21st century.

But a word of caution is necessary — the dangers of extrapolative forecasting were exposed by the oil crises of 1973 and 1978/79, so it is right to question whether or not such a simplistic view of the natural gas business is justified, and if it is, what are the factors that may significantly upset or modify such a view. In order to do this, a quick look will need to be taken at the driving forces that have contributed to the expansion of the natural gas business and its increased importance in the world energy scene.


MW Clegg

The driving forces

Four main factors contributed to the growth in natural gas consumption in the 1970s and early 1980s throughout the world, excluding North America:

- **energy security**, including the need to diversify energy supply sources, and in particular to reduce individual countries' reliance on oil;
- the desire for continued **economic growth** and a conviction that this necessitated ever increasing energy supplies;
- **environmental concerns**, particularly air and water quality which were adversely affected by acid gas emissions resulting from the use of hydrocarbons;
- **the resource base** of natural gas which grew from 1,700 trillion cubic feet (tcf) in 1970 to 3,950 tcf in 1988.

The initial momentum for the development of major expansions of the natural gas industry outside North America came in the 1960s, as the world started to realise that its apparently insatiable appetite for energy could not be satisfied by oil alone. In 1965 the United States accounted for over 60 percent of the world's natural gas consumption compared with 28 percent today. The events of 1973 and 1978/79; the desire for secure and diversified sources of energy to avoid economic recessions triggered by an absence of adequate energy supplies; and an expectation of ever increasing energy prices, all served to intensify the vigour with which the natural gas industry outside North America expanded.

The consequence was that natural gas consumption increased by about 50 percent over the 1973–1988 period, with particularly strong growth in the centrally planned economies, Western Europe and Japan, which far outweighed the decline in North America. At the same time, the level of internationally traded gas increased from less than 60 billion cubic metres in 1973 to 260 billion metres in 1988, of which 200 billion cubic metres (77 percent) were by pipeline.

For the future, it is important to see how these driving forces might change and which factors are likely to influence the evolution of the gas industry. The world of the 1970s and early 1980s — a world of confrontation between the various power blocs — has been superseded by a mood of *détente*, co-operation and collaboration coupled with a rapidly changing political scene, especially in the Soviet Union and Eastern Europe. The political landscape of the 1990s will therefore be quite different from that of the 1970s and early 1980s.

However, the key strategic issue has not changed. Security of energy supplies remains the major concern of the industrialised world, for without it, the ability to sustain their economic well-being is called into question. This requires the continuing diversification of both the range of energy supplies and their source. But the developing countries, driven by rapidly growing populations and the desire to catch up with the developed world, are just as concerned.

The other driving forces for natural gas remain, and grow even stronger. Public demands for cleaner energy have dramatically raised the profile of environmental issues with extensive coverage in the press and television. The potential consequences of global warming have alerted politicians of the industrialised countries to the importance of immediate action, as a measure of their 'green-ness'.

This increased perception, rightly or wrongly, of the contribution of energy usage to the world's environmental problems, has made future energy supply even more complex. The Chernobyl disaster has turned much of the world's population away from nuclear power. With the exception of the United Kingdom and France, no new commitments to nuclear power plants have been made since the accident. The growth of awareness of the possible relationship between carbon dioxide and other gaseous emissions, and the earth's temperature, leading to the possibility of global warming, has led people to question the consequences of continuing fossil fuel use, particularly coal.

Within this broad framework natural gas is seen as an environmentally friendly fuel for a number of reasons:

- the relative ease with which sulphur can be removed prior to combustion, and the consequent near zero SO_2 emission levels;
- the high thermal efficiency with which natural gas can be utilised;
- the low carbon emission levels per unit of useful energy compared with other fossil fuels.

Substitution of natural gas for other hydrocarbon fuels is therefore seen as desirable from an environmental point of view. However, it should be noted that this in no way solves the potential global warming problem; it merely reduces its severity and lengthens the time-scales.

Natural gas markets

At a recent conference on LNG in Nice, a number of speakers gave their views on the problems of natural gas penetrating certain markets, the theme being that, notwithstanding the special qualities of gas, it has to be competitive, on a thermal basis, at its point of use. This has been well demonstrated in the United States over the past few years, as oil prices fell away from their previous high levels. Consumers with dual-firing capacity switched between fuel oil and natural gas as their relative economies changed, leading to wide variations in both gas and fuel oil demand. In Japan, by contrast, where gas import prices are closely linked to crude oil rather than product prices, the penetration of gas into the industrial sector has been rather slow.

The market for natural gas is wide, provided it can be delivered to the consumer at a competitive price level. But the driving forces for development of the natural gas industry, may lead governments to enhance this competitiveness, for example:

- the development of the transmission and distribution systems in countries or regions in which little or no gas industry exists, may be financed by governments as, for example, in Spain;
- security of supply, and diversification of energy supply sources, may lead governments to accept higher energy prices than those justified on economic grounds. Examples include the Japanese decision to generate a growing proportion of their electricity from gas-fired power stations and the emerging gas industry in Korea. In the United Kingdom and the Netherlands, government policy ensured that gas in the residential sector was competitive with other fuels and it quickly achieved a dominant share in that sector;
- the decision, particularly in the developing countries, to develop indigenous gas resources for industrial and power generation uses, even though they may be more expensive than imported fuels. The balance of payments considerations, and industrialisation benefits of developing a natural gas business, are likely to dominate the policy decisions.

The desire of governments to respond positively on the environmental issues is likely to lead to both unilateral and multilateral actions in the next few years, which should provide some stimulus for the gas industry. These could range from overall limits on carbon emissions for particular countries (Sweden has already set targets for 2005) to differential taxation/excise duties for different fuels.

'The market for natural gas is wide, provided it can be delivered to the consumer at a competitive price level'

Even without these stimuli, there are still many market opportunities for gas in established and newly evolving areas such as Europe, where today natural gas supplies only 15.5 percent of primary energy for Western Europe (it is 17.5 percent in the EEC countries). Given the large resource base for natural gas within and around Europe (some 50 trillion cubic meters if the USSR is included), there seems no real reason why gas penetration should not achieve 20 percent or more in the coming decades, compared with 24 percent in the United States today. In addition, the development of gas distribution systems in Spain, Portugal, Turkey, Greece and Sweden will open up new opportunities in all sectors.

The Far East is another important market since the newly industrialised countries seek to protect their economies by diversification of energy supplies. In South America too, indigenous supplies exist, but since the economics of development are difficult, the balance of payments effects could be dominant for those nations with large overseas debt problems.

Two further factors will be important in determining the future markets and market opportunities for natural gas. The first is technology. Developments and advances in technology could affect all parts of the gas chain, from production through to final consumer.

The costs per unit of energy production for off-shore developments have been reduced substantially in the past decade. Subsea completions and lighter-weight modules have allowed developments to take place today that were deemed uneconomic when energy prices were 50 percent higher than today.

In conversion of gas to electricity, the development of combined cycle gas turbines has meant that efficiencies approaching 50 percent can be achieved. Higher efficiencies for the residential/commercial user of central heating boilers and cookers are another development, this time in end-use applications. And, in the liquefaction process for the overseas transportation of LNG, improvements in design, and the development of larger compressors, have led to some significant decreases in cost, an important factor in the wider commercial development of LNG trade.

There is scope for further advances in technology and the current low level of energy prices provides some incentive for innovatory developments to be made in order to improve the competitiveness of gas. The other factor that is likely to be important is the evolution of the institutional framework of the natural gas business. Changes have occurred over the past few years, most notably in the United States, and the debate is now on in Europe, in the context of '1992'.

It could be argued that one of the reasons for the slow-down in the growth of the gas business in Europe over the last few years is the structure of the industry itself. Monopolies or quasi-monopolies control the business in most countries, with a large amount of government ownership thrown in. Since a large proportion of the European gas business is supplied by a small number of producers, in Norway, USSR, Netherlands, the United Kingdom and Algeria, the scene is set for a comfortable relationship between producer and gas company. The security and benefits of long-term deals may be mutually desirable for producer and gas company, but the consumer is not necessarily best served by such arrangements.

Within Europe today, the overall business environment is one that is moving steadily towards the removal of trade barriers and open market competition. The present structure and *modus operandi* of the European gas industry are out of tune with this vision of post-1992 Europe and some changes will undoubtedly have to occur in the coming years. These should take place in an orderly manner and not through a suddenly imposed scheme from Brussels or the European Court. The consequence of greater transparency and freedom of gas movement, is likely to be a more rapid growth of the industry in Europe as resource owners in and around Europe seek to exploit their resources. The consequences of the changes in the structure of the UK gas industry will be closely monitored by the other EEC members; it will be most surprising if the result is not a higher demand for gas in the 1990s than recent forecasts have predicted.

'At today's level of energy prices, grass-roots LNG projects are unlikely to be economically feasible'.

The uncertainties

Experience has taught energy forecasters that any predictions about future energy demand and supply are subject to considerable uncertainty. Today there is a generally euphoric attitude within the gas industry, as it looks forward to a period of growth in the 1990s and beyond. Natural gas is plentiful; it has many environmental advantages over other fossil fuels; there is an established infrastructure in most of the industrialised countries, and a growing desire amongst other countries to develop their own industries.

But the fundamental characteristic of gas is that it is, in general, used only when it is competitive at the burner tip. Some exceptions to this rule, noted above, will be small in total, relative to the global gas market. Therefore, the economics of the gas industry are going to continue to be a dominant factor in its future. Technology and the modifications to the institutional framework of the industry, if they are successful, can allow gas to achieve that competitiveness and lead to growth in gas demand and hence, because of the location of resources, to growth in international gas trade.

Apart from the possibility that such changes may not occur, however, there is a bigger uncertainty that should be acknowledged. This concerns the absolute level of energy demand in the coming decades.

The impact of the world's response to its present, and growing, concerns on the environmental consequences of energy use, particularly carbon emissions, could lead to somewhat lower energy demand growth into the 21st century than conventional wisdom suggests. An emphasis on energy conservation, the more efficient use of energy, and accelerated development of non-fossil fuel energies could more than outweigh the effects of continuing growth in US energy imports, population growth and the aspirations for real economic growth in the developing countries. The era of surplus energy could be prolonged, and energy prices may not turn upwards in the late 1990s as so many forecasters predict. Such an upturn in real energy prices in the 1990s lies at the heart of the bullish expectations for some parts of the international gas trade, particularly LNG. At today's level of energy prices, grass-roots LNG projects are unlikely to be economically feasible, except in very special situations, such as Nigeria, where access to cheap shipping may make an export project viable. In a world of surplus energy supply, there will be strong competition between suppliers and natural gas will be fighting hard to maintain its position. Given the costs of transportation for gas, incremental international gas trade could be a victim of such a scenario.

Conclusion

In conclusion, the driving forces for natural gas which steered the growth of the 1970s and 1980s are even stronger today. The auguries for natural gas are therefore very favourable and the optimism of the gas industry seems justified, provided that it is able and willing to meet the competition at its point of use. In an environment of growing energy demand, increases in gas demand will almost certainly require a growth in international trade. Potential advances in production and transportation technology are likely to assist that growth.

But a warning note needs to be sounded in the event that, as happened after 1973 and 1979, the response, this time to the environmental pressures rather than cost pressures, leads again to a significant response on the demand side and a continuing surplus of energy. In such an environment, the expectations for natural gas, and international trade in gas, could exceed the reality.

Competitive economics of natural gas applications

By Geoff Pyke, Director, Chem Systems International Ltd

This paper presented at the IP Natural Gas conference, considers the competitive position of natural gas in its major end-uses and discusses the implications for future demand growth. Much of the analysis presented relates to the West European market. However, consideration is also given to the wider global perspectives and to the possible implications for future gas and gas-based trade.

Implicit in the views presented are assumptions about the future price of crude oil, this being the single most important determinant of gas competitiveness. A graph presenting current crude oil scenarios to the year 2000 is presented in **Figure 1**. Under the Baseline Scenario crude oil price (Arab Light fob) is projected to climb to around $23 per barrel (1988 $) by the end of the century. This implies heavy fuel oil prices in the 1990s broadly in the range of $2-3 per mmBtu. Heavy fuel oil being a key benchmark for gas pricing, gas prices to major users are expected to be of the same order.

Geoffrey C M Pyke

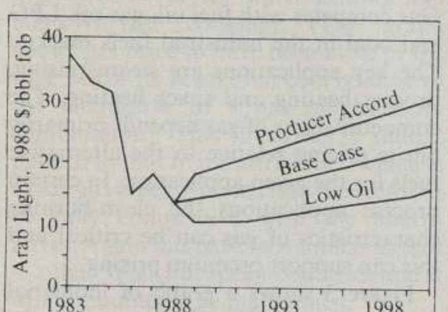


Figure 1: 1989 Oil price lines Source: Chem Systems

Natural gas utilisation

Recent estimates made by CEDIGAZ, of the natural gas end-use pattern are presented in **Table 1**. A key point to note is that the pattern of gas use varies markedly between regions and, indeed, between countries. It is influenced by many factors, notably gas availability, pricing policy, state of industrial development and climate.

Use in power generation accounts for around 25 percent of global consumption but with wide variations between countries and regions. Japan's position is unique with approaching 70 percent of its gas (predominantly imported as LNG) being consumed in this application.

Other energy sector use accounts for around 15 percent. This covers consumption in the production, processing (including liquefaction and NGL's extraction) and pipeline transport of gas and also covers reinjection.

Industrial fuel use is the leading segment (just) of the global end-use pattern, accounting for around 28 percent. This covers steam generation, direct process heating and space heating.

Feedstock use is the smallest segment of the end-use pattern accounting for around 6 percent of global consumption. This is predominantly for the production of ammonia and methanol. Ammonia is used mainly (approaching 90 percent) in the production of fertilizers but also in the production of synthetic fibres, plastics, resins and explosives. Methanol has a wide range of chemical and solvent end-uses but a derivative of rapidly growing importance, MTBE, an important replacement for lead in gasoline, now accounts for approaching 15 percent of its consumption. In addition to the above, is petrochemical consumption of NGLs — natural gas liquids — (ethane, propane, butane, condensate) extracted from gas. This is counted under energy sector (hydrocarbon processing) use. The major product is ethylene with approaching 40 percent of world production being NGL-based. Propylene also figures, with somewhat under 10 percent of its production being gas derived.

Residential, tertiary and other consumption accounts for around 26 percent of the global total, again with wide variations between countries. This covers space heating and cooking, use in transport (compressed natural gas) and various other uses such as grain drying in agriculture.

	Global	W Europe	N America	Japan
● Power generation	25	12.5	14	67
● Other energy sector use	15	6	13	1.5
● Industrial fuel	28	27	29	7.5
● Feedstock	6	6	4	1.5
● Residential, tertiary and other	26	48.5	40	22.5
	100	100	100	100

Table 1: Natural gas end-use (percent) *Sources: CEDIGAZ/BP*

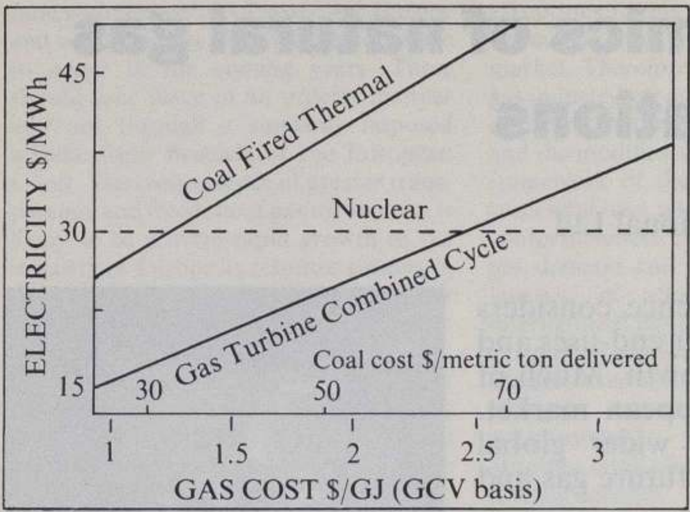


Figure 2: Economics of base load power generation

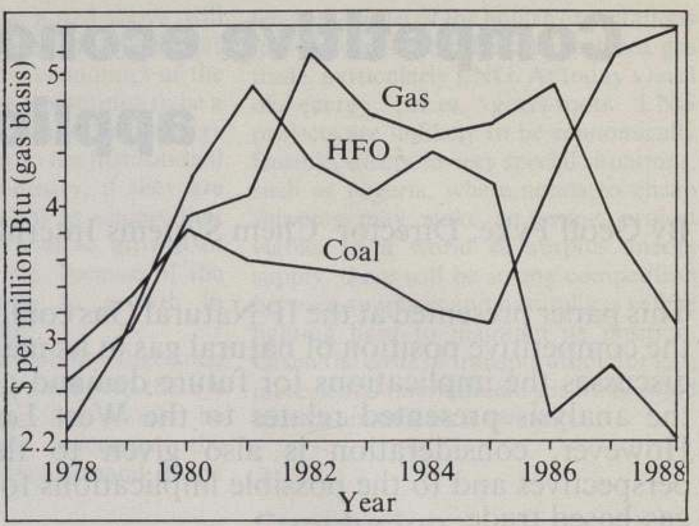


Figure 3: German industrial energy prices (excluding taxes)

In considering the future competitiveness of gas in its various applications one first needs to consider the costs of its supply. These vary enormously between locations and depend on whether or not the gas is produced in association with oil. In the Middle East, marginal production costs are to be measured in tens of cents per mmBtu. However, account then has to be taken of significant conversion and transportation costs. In the more developed regions production costs can be substantially higher and are to be generally counted in dollars per mmBtu. Suffice to say that significant further supplies of gas can be brought to market at costs (delivered) of \$2–3 per mmBtu. Certainly this is true in Europe of potential further supplies from the North Sea. This level of supply cost is compatible with the projected range of costs/prices for competing fuels (fuel oil, gas oil, LPG, coal). Consequently supply cost of additional gas is not seen to be a major constraint on future demand growth.

Power generation

Natural gas utilisation in power generation has good growth prospects. Particularly important in its favour are environmental considerations with gas posing much less environmental concern than coal, oil or nuclear power. In addition, modern combined-cycle (gas turbine/steam turbine) technology makes gas-based electricity generation very competitive. This is illustrated in **Figure 2**. It shows that in Europe gas at \$2.60 per GJ (\$2.75 per mmBtu) is competitive with nuclear power and that gas at around \$3.00 per GJ (\$3.15 per mmBtu) is competitive with coal-based electricity generation, assuming delivered cost of coal at around \$40 per metric ton.

Over the period 1977–87 there was little growth in gas consumption in this application in the major developed (OECD) economies. Indeed it fell in Western Europe reflecting government decisions that gas was too valuable a fuel to use for power generation. These policies are now being reversed, stimulated by environmental concerns, and many of the new generation of power stations will be gas based. Furthermore use of gas in existing facilities is expected to increase. According to our forecasts, gas consumption for power generation in Western Europe is expected to grow at around 7 percent per year.

Other energy sector use

Demand growth in this sector is largely derivative of that in the other sectors, being heavily dependent on the processing and transport of gas. Pipeline movements are projected to grow and further LNG projects are expected.

The costs of gas movement by pipeline are of course dependent on the distance covered but other parameters are also significant, notably throughput and load variation. The cost of moving gas on a large scale from Siberia into Western Europe, inclusive of capital charges, is estimated to be of the order of \$1.5 per mmBtu, extrapolating North American economics. It is interesting to note that British Gas will charge of the order of \$1 per mmBtu to move third-party gas from Scotland to southern England.

LNG projects are massive undertakings and require off-take commitments for some 20 years. Their viability is particularly dependent on whether or not the location will impose capital investment penalties such as the need for substantial infrastructure development. Assuming a relatively undeveloped site and a capital charge of 20 percent per annum, a rule-of-thumb equation is:

LNG cost (\$/mmBtu) =
1.10 × gas cost (\$/mmBtu) + 1.6

Hence a gas cost of \$0.50 per mmBtu would yield an LNG cost of \$2.15 per mmBtu. To this has to be added the cost of shipment. For a round-trip distance of 6,000 nautical miles the cost would be of the order of \$0.5 per mmBtu; for 12,000 nautical miles the figure would be around \$0.9 per mmBtu.

Industrial fuel

Gas competes with fuel oil, gas oil, LPG and coal in the industrial fuels market. The key applications are steam raising, process heating and space heating. The competitiveness of gas depends primarily on its pricing relative to the alternative fuels for the given application. In certain process applications the clean-burning charactristics of gas can be critical and this can support premium pricing.

Figure 3 shows a graph of industrial energy prices in West Germany over the 1978–88 period. This indicates that gas has generally been priced to be competitive with fuel oil (allowing for tax and combustion efficiency differences, both of which favour gas). This pattern is typical of Western Europe and will undoubtedly be maintained. As in power generation, environmental concerns are likely to favour increased gas consumption as an industrial fuel. Legislation (such as a 'carbon tax') is quite likely to be enacted to stimulate switching to gas. Chem Systems is projecting growth in industrial consumption of gas in Western Europe (inclusive of feedstock) at around 3 percent per year.

Feedstock

Feedstock use of natural gas is predominantly for the production of ammonia and methanol, although also significant is the use of NGLs abstracted from gas for the production of the olefins, ethylene and propylene. Natural gas is the dominant feedstock in both ammonia and methanol production and future projects will be very largely gas-based. Global demand growth in ammonia is projected at around 2.5 percent per year and around 4 percent per year in methanol. Most new investment in this sector will be based on the cheapest available gas. This is because margins in both products are highly volatile, with prices being strongly influenced by the relatively newly established low cost producers. Consequently there is little prospect of growth in Europe and indeed a risk of further decline.

New projects in these products will require gas costs of under $1 per mmBtu if they are to have a significant degree of export orientation. Otherwise they will require a high percentage of domestic demand and even then it will be difficult to support gas costs much in excess of $2 per mmBtu.

Residential, tertiary

In the residential/tertiary sector, gas is used for space heating, water heating and cooking and competes primarily with gas oil and electricity. **Figure 4** graphs West German historic costs for residential use (assuming 20,000 kWh/year space heating, 4,000 kWh/year water heating and 800 kWh/year cooking). (The graph shows gas price to have been most of the time below its breakeven cost relative to the alternative of a gas oil/electricity combination). This illustrates a similar pattern to that in industrial fuel, which is to say gas is being priced into the sector to be fully competitive with the alternatives. Again this pattern is similar to that in other West European countries and it will undoubtedly be maintained.

Given competitive pricing, gas consumption in this sector is set to increase further. This is particularly so in countries where heating requirements are significant (temperate/cold climates) and where gas penetration is currently low. In Europe, Scandinavia is a key area for such growth. This is supported by the intention to limit or even phase out nuclear power in Sweden. We are projecting growth in this sector in Europe at around 1.5 percent per year.

Growth prospects for gas consumption are generally good in all sectors with environmental concerns now particularly favouring the competitive position of gas. It is considered that sufficient additional supplies of gas can be made available at costs which will allow it to be competitive with alternative fuels and electricity.

Given the limited indigenous resources of a number of the major markets, the prospects for increased gas trade are consequently encouraging.

Our projections for European gas consumption are summarised in **Figures 5 and 6**. Overall demand growth is forecast at around 3 percent per year. Continuing penetration relative to oil is projected, as indicated by the forecasts of the ratio: gas/(oil + gas).

Future developments

Significant R & D effort is now being applied to establish new technologies to convert natural gas into transport fuels and chemicals. This effort is motivated by the fact that gas resources are of a similar magnitude to those of oil (and will undoubtedly increase with continuing exploration effort) and that oil resources are being depleted quite quickly.

Particular focus is being given to gas conversion into transport fuels (gasoline and middle distillates). Shell has developed its SMDS process for middle distillates and has just announced that it is about to proceed with its first project in Malaysia. It is believed that the project will be competitive at a crude oil price of the order of $25 per barrel. Mobil developed its gas to gasoline via methanol (MTG) process with the first, and to date only, plant being built in New Zealand. Unfortunately for New Zealand, this plant is not economic at current oil prices.

Other companies, such as BP, are very active in this area and obviously a significant breakthrough could have a major impact on the outlook for gas demand growth. However, this does not appear to be imminent.

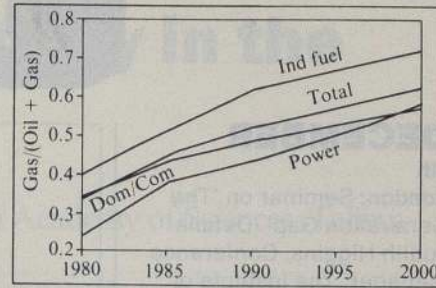


Figure 6: Natural gas penetration in W Europe

The Bush Administration has recently proposed that methanol use as an automotive fuel should be stimulated in the United States by requiring that a certain proportion of new cars be designed to run on high methanol content fuel and the oil companies required to retail methanol alongside their gasoline. It appears that this initiative is unlikely to be enacted in the near term. However, methanol use as an automotive fuel could, with rising crude oil prices, eventually take off. Again this would have a major impact on gas demand growth.

A final consideration is conversion of gas into chemicals. Here also major R & D effort is being applied with particular focus being given to producing olefins, for example Mobil's gas-to-methanol-to-olefins (MTO) process.

The economics of such processes are now beginning to look interesting. With the expectations of increasing crude price and improving process performance, the prospects in this area are consequently considered encouraging. Again the potential impact on gas demand is significant, although not of the same scale as that in fuels.

As in conversion to transport fuels, the key requirement for these new technologies is to develop catalysts and systems which can allow significant reductions in investment costs.

Thus, the development of new gas conversion technologies could, in the not too distant future, have a significant impact on the natural gas business.

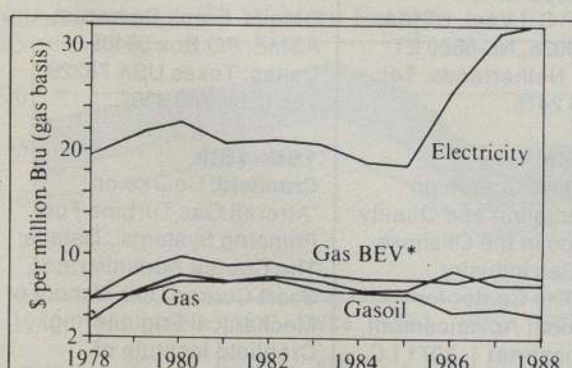


Figure 4: German residential energy prices (excluding taxes)

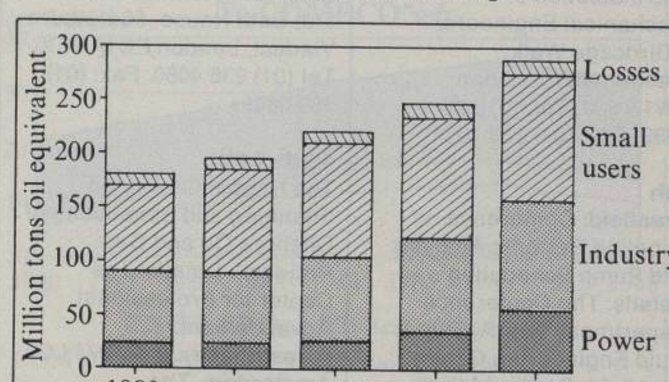


Figure 5: Natural gas demand projection — W Europe

FORTHCOMING EVENTS

DECEMBER

4th
London: Seminar on 'The Generation Gap'. Details: Judith Higgins, Conference Manager, The Institute of Energy, 18 Devonshire Street, London W1N 2AU. Tel: (01) 580 0008.

4th-5th
London: BIEE/IAEE/RIIA Conference on 'Environmental Challenges: The Energy Response'. Details: Energy Conference Organiser, The Royal Institute of International Affairs, 10 St James's Square, London SW1Y 4LE. Tel: (01) 930 2233. Fax: (01) 839 3593.

4th-7th
Cranfield: Course on 'Electromagnetic and Ultrasonic Flowmeters'. Details: The Short Course Office, School of Mechanical Engineering, Cranfield Institute of Technology, Bedford MK43 0AL.

5th-6th
London: Conference 'Subsea 89'. Details: Andrew McBarnet, Subsea 89 International Conference, PO Box 2, Chipping Norton, Oxon OX7 5QX. Tel: (0608) 84888. Fax: (0608) 84796.

6th
Aberdeen: Seminar on 'Pressure Control in Offshore Deep Gas Condensate Wells'. Details: The Institution of Mechanical Engineers, 1 Birdcage Walk, Westminster, London SW1H 9JJ. Tel: (01) 222 7899. Fax: (01) 233 1654.

7th
Cranfield: Conference on 'Pipeline Systems Analysis and Pump Scheduling'. Details: The Conference Department, BHRA, The Fluid Engineering Centre, Cranfield, Bedford MK43 0AJ. Tel: (0234) 750422. Fax: (0234) 750074.

CHANGE OF DATE

National Oil Corporation
(in collaboration with operating oil companies in Libya)

Technical Symposium on EOR in Libya: Today's Perspectives, Tomorrow's Direction
Tripoli, Libya, May 1–2 1990

Details: Symposium Organising Committee, Attn. A Misellati/E Egbogh, National Oil Corporation, PO Box 2655, Tripoli, Libya. Tel: (318 21) 46181. Telex: 20270 LINAFT LY.

8th
London: Course on 'Pipeline Systems – Economics, Design and Installation'. Details: Jean Pritchard, Conference Organiser, Society for Underwater Technology, 76 Mark Lane, London EC3R 7JN. Tel: (01) 481 0750. Fax: (01) 481 4001.

10th-15th
Moreton-in-Marsh: Course on 'Handling Emergencies in the Oil Industry'. Details: Fire Service College, Moreton-in-Marsh GL6 0RH. Tel: (0608) 50831.

11th-12th
London: Conference on Floating Production Systems. Details: Nadia Ellis, IBC Technical Services Ltd, Bath House, 56 Holburn Viaduct, London EC1A 2EX. Tel (01) 236 4080. Fax: (01) 489 0849.

11th-14th
The Hague: Course on 'Planning and Scheduling of Offshore Oil and Gas Projects'. Details: The Center for Professional Advancement, Palestrinastraat 1, 1071 LC Amsterdam, The Netherlands. Tel: (020) 6623050. Fax: (020) 797501.

12th-14th
London: Course on 'Valve Technology for Offshore Oil and Gas Applications'. Details: The Center for Professional Advancement, Palestrinastraat 1, 1071 LC Amsterdam, The Netherlands. Tel: (020) 6623050. Fax: (020) 797501.

14th-15th
Paris: DRI 'European Energy Conference — Energy Consumption for Transport'. Details: Dr Silvia Pariente-David, DRI, 13 Rue de 4 Septembre, 75002 Paris. Tel: (1) 42603700. Tx 216083 DRIPARI. Fax: (1) 42602505

12th-15th
Amsterdam: Course on 'Safety Assessment'. Details: P C J Vael, KEMA, PO Box 9035, NL-6800 ET Arnhem, Netherlands. Tel: (+31) 85 2476.

13th-15th
Amsterdam: Course on 'Documentation and Quality Assurance in the Offshore Oil and Gas Industry'. Details: The Center for Professional Advancement, Palestrinastraat 1, 1071 LC Amsterdam. The Netherlands. Tel: (020) 6623050. Fax: (020) 797501.

14th
London: Seminar on 'Mass Flowmetering' sponsored by the Institute of Petroleum. I.P. Members pay a reduced fee. Details: Conference Office, Sira Ltd, South Hill, Chislehurst, Kent BR7 5EH.

14th-16th
New Delhi: Conference 'Petroleum Pipeline Technology'. Details: MA Skaria, Indian Oil Corporation Limited, Refineries & Pipelines Division, 809 Kailash, 26 Kasturba Gandhi Marg, New Delhi, India-110 001.

18th-21st
Amsterdam: Course on 'Pollution Problems in Offshore Oil and Gas Operations'. Details: The Center for Professional Advancement, Palestrinastraat 1, 1071 LC Amsterdam, The Netherlands. Tel: (020) 6623050. Fax: (020) 797501.

JANUARY 1990

4th-6th
New Delhi: 12th International Conference – IAEE. Details: Dr R K Pachauri, Director, Tata Energy Research Institute, 7 Jor Bagh, New Delhi 110003. Tel: 619205, 618803.

14th-18th
New Orleans: 13th Energy-sources Technology Conference & Exhibition. Details: Frank Demarest, ASME, PO Box 59489, Dallas, Texas USA 75229. Tel: (214) 746 4901.

15th-18th
Cranfield: Course on 'Aircraft Gas Turbine Fuel Pumping Systems'. Details: The Course Administrator, Short Course Unit, School of Mechanical Engineering, Cranfield Institute of Technology, Bedford MK43 0AL. Tel: (0234) 752766. Fax: (0234) 750728.

The future of natural gas supply in the USSR

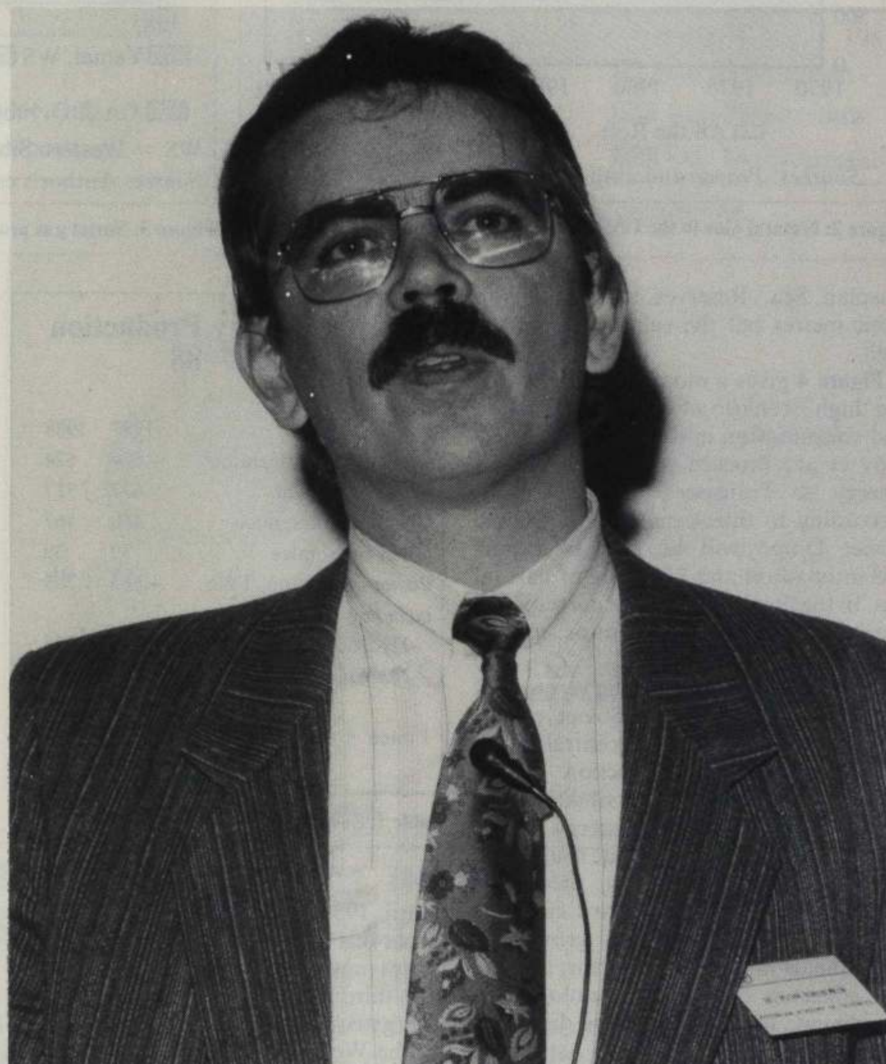
By Mikhail B Korchemkin, The Institute of Economics of the Estonian Academy of Sciences, Tallinn

The USSR's bountiful reserves of natural gas, which represent some 40 percent of the world total, are being increasingly exploited. In 1989, natural gas replaced oil as the principal source of primary energy in the USSR. It is now the main fuel responsible for the growth of energy production, since oil output this year is expected to be some 10–13 million tonnes less than in 1988 (see **Table 1**) and because the miners' strikes in July caused a decline in coal production — some 15 million tonnes less in the first nine months of 1989 compared with the same period in 1988.

Natural gas is also the second major item of Soviet exports for hard currencies (**Figure 1**). In 1988, the USSR exported over 80 normal billion cubic metres of natural gas, over half of which was sold to Western Europe and Yugoslavia. (Natural gas is measured in billions of normal cubic metres, at 0°C. Soviet statistics measure gas at +20°C. Soviet figures must, therefore, be multiplied by 0.9315 to equate with Western figures.)

Figure 2 shows that natural gas is the only primary energy source expected to show any growth in the future. At present, West Siberia produces some 70 percent of natural gas and, by the year 2000, this will have increased to 80 percent. Yamburg and the gas fields in the Yamal peninsula will account for most of the increase in production. However, the development of Yamal may have to be postponed from its scheduled date of 1990 because of environmental problems which are emerging in this area.

Recently gas has been found near the



Dr Mikhail B Korchemkin

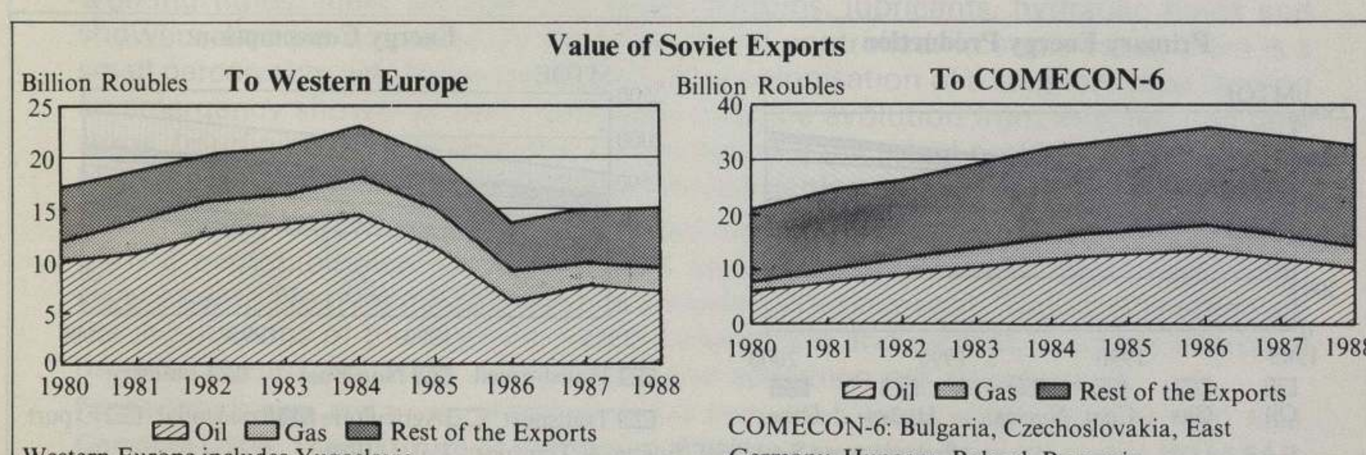


Figure 1a: Value of Soviet Exports to Western Europe

Figure 1b: Value of Soviet Exports to COMECON–6

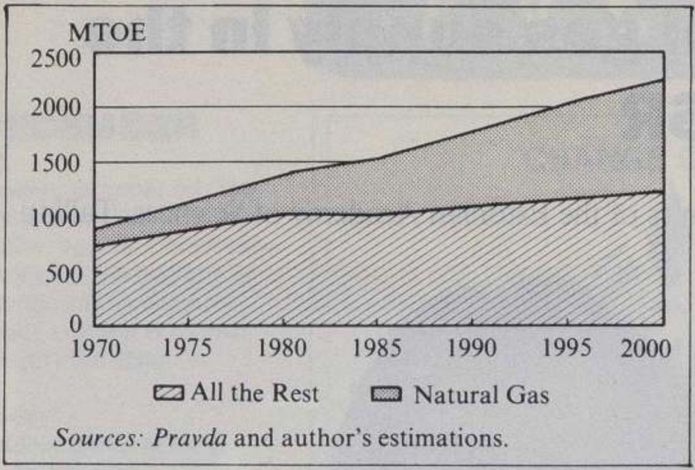


Figure 2: Natural Gas in the USSR's primary energy production.

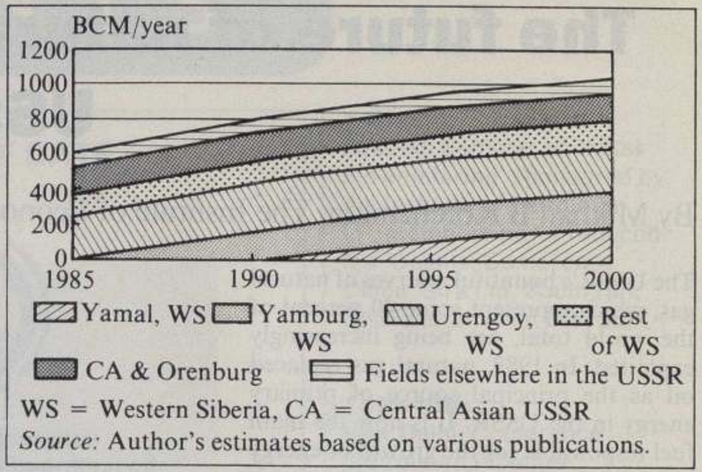


Figure 3: Soviet gas production forecast by major fields and regions.

Caspian Sea. Reserves total 5 trillion cubic metres but the sulphur content is high.

Figure 4 gives a more detailed view of the 'high' scenario of energy production and consumption in the USSR (A Makarov et al., Proceed Acad. Sci. USSR: Energy & Transport, Vol. 1, 1989). According to this scenario, in 2000 the Soviet Union will be able to export 158 mtoe of oil and 179 mtoe of natural gas. In the 'low' scenario, the corresponding figures are 144 and 91 mtoe, respectively.

New factors accompanying *perestroika* are now influencing the Soviet energy scene. These include the decentralisation of the economy; a reduction of the nuclear programme; possibilities for foreign investment in the energy sector; the planned devaluation of the rouble; the growing environmental protection movement; a decrease in hard currency earnings (Figure 1); sharp growth of investments in the energy sector; and the low efficiency of Soviet technology and equipment. These factors were discussed in the author's paper 'Energy Aspects of *Perestroika*', EURICES, Rotterdam, April 1989. It is also significant that, according to different estimates, energy losses and over-consumption represent one-third of total gas use. More efficient energy equipment, such as that available in the West, would lead to a 35 percent reduction in gas losses.

Soviet Energy Production 1987–88

	1987	1988
Oil & condensate, mtoe	624	624
Natural gas, bcm	677	717
Coal & lignites, mtce	460	467
Other fuels, mtce	39	39
Power generation, TWh	1,665	1,705
including		
—Hydroelectricity, TWh	218	225
—Nuclear electricity, TWh	187	220

1 mtce = 0.7 mtoe.

Table 1: Soviet Energy Production 1987–88

On the 1 January 1990, the official exchange rate of the rouble will be halved. A year later, it may be halved again. This means that in hard currency terms, the rouble could be four times cheaper than it is now. However, the exchange rate system and devaluation are complicated matters, since there are many varying 'coefficients' which are applied to different transactions.

A major problem is the deterioration of the natural gas grid which has started to cause more and more accidents in different parts of the country. Roughly one-quarter of the total pipeline system is over 15 years old and needs repair. Moreover, by the year 2000, all compressors will have to be replaced, as the fuel efficiency of those being used now averages only 25 percent. It is possible that future growth in gas production may be held back by the lack of effective pipeline capacity.

Among the most recent events in the Soviet energy field, the strength of public opposition to the joint petrochemical plant project between Combustion Engineering and the Ministry for Petrochemical Industry of the USSR has been somewhat unexpected and unusual. The

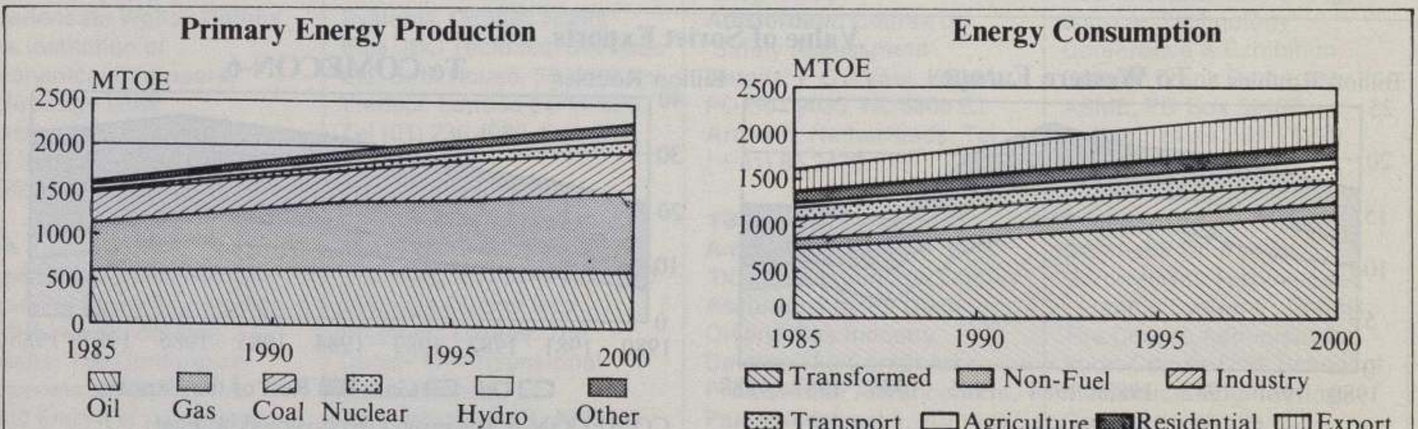


Figure 4: USSR energy production and consumption — high scenario.

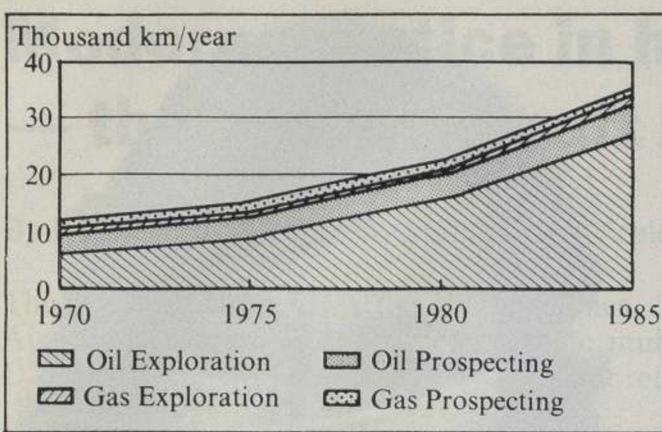


Figure 5: USSR drilling activities — oil and gas.

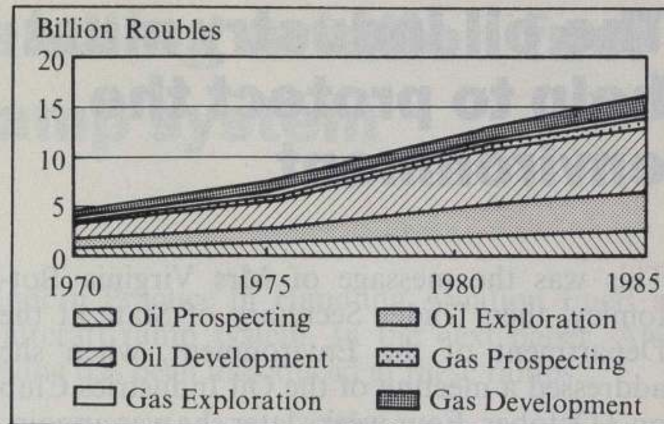


Figure 6: Capital investments in oil and gas industries.

project was criticised mainly for the lack of *glasnost* (and public discussions) during the negotiations. However, the criticism is expected to subside.

In late July, the Super-ministry for Oil and Gas was founded. This led to a very interesting move by the former gas minister, who then stepped out to create Gas Concern. The place of this body within the new ministry is still uncertain.

Such uncertainties do not aid Soviet oil and gas exports, whose future is dependent on a stable legislative environment. Another bottleneck is the shortage of capital investment despite the fact that already one-third of total Soviet investment is in the energy sector. The introduction of foreign capital is therefore another factor of great importance for the future of the Soviet energy sector.

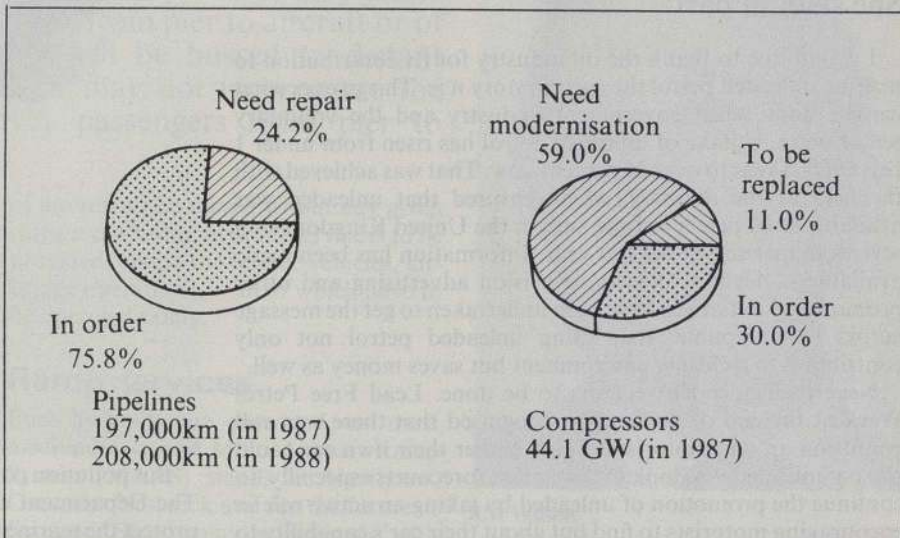


Figure 7: Soviet gas transmission system.

The oil industry must help to protect the environment

This was the message of Mrs Virginia Bottomley, then Under Secretary of State at the Department of the Environment, when she addressed a meeting of the Oil Industries Club on 3 October. Four weeks later she was appointed Minister of State for Health.
She said, in part:

I would like to thank the oil industry for its contribution to making unleaded petrol the success story it is. This proves what can be done when government, industry and the voluntary sector unite. Uptake of unleaded petrol has risen from under 1 percent last year to over 25 percent now. That was achieved with the help of the industry, which ensured that unleaded was available at 80 percent of the sites in the United Kingdom — a sevenfold increase in the last year. Information has been made available — leaflets, posters, television advertising and other promotional initiatives have been undertaken to get the message across to the public that using unleaded petrol not only contributes to a cleaner environment but saves money as well.

Nevertheless, much remains to be done. Lead Free Petrol Week at the end of September recognised that there was still confusion among motorists as to whether their own car could run on unleaded. We look to the staff at forecourts especially, to continue the promotion of unleaded by taking an active role in encouraging motorists to find out about their car's capability to use the fuel.

There are new challenges and threats to the planet. Most electricity is generated by burning coal or oil which emit carbon dioxide, a principal contributor to the 'greenhouse' effect. We know too that the average car produces nearly four times its own body weight in carbon dioxide each year. In addition, exhaust gases contain carbon monoxide, unburned hydrocarbons and nitrogen oxides. Reactions between the latter two and sunlight produce ozone. While this may be important to the upper atmosphere, it is a greenhouse gas in the lower atmosphere.

In water we have recognised for rather longer the impact that oil can have. It has certainly been brought home this year which has seen by one of the worst disasters suffered by the marine environment as a result of oil pollution. No one can ignore the widespread concern about the industry. The lessons must be learnt from events in Alaska: it is essential that we have an effective and rapid response capability to deal with accidents which have the capacity to cause this type of pollution.

In the United Kingdom, fortunately on a much smaller scale, we have also had recent illustrations of the problems caused by accidental spills.

We can take credit in this country for the effective arrangements built up over many years among the oil industry, the specialist firms dealing with oil recovery and pollution control equipment and the Marine Control Pollution Unit in the Department of Transport, who have the overall responsibility for planning, contingency arrangements and taking charge of operations to deal with pollution at sea. It is a tribute to UK expertise that a number of our firms have been contracted to play a major part in the action taken to clean up Alaskan waters after the *Exxon Valdez* incident.

But pollution control is not just about responses to accidents. The Department of Environment also co-ordinates policies to protect the marine environment which take account of all inputs to the sea — from rivers, the atmosphere, direct discharges from ships or offshore platforms. Policy is not developed in isolation. As many of you will know, the United Kingdom hosted the Second North Sea Conference in 1987. We are now preparing for the Third in the Hague in 1990.

Taking oil inputs generally, there is still strong concern among North Sea states about certain types of discharge. By common agreement, perhaps the greatest problem is that of illegal discharges from ships or platforms in contravention of existing regulations. Some countries are seeking to achieve higher standards for legal discharges. In our view this is to mistake the real nature of the problem. By increasing the resources available for inspection, for example of ships under the MARPOL Convention, we believe that it will be more effective to deter violation by the frequency and certainty of inspection than by seeking standards which impose excessive costs for very little environmental benefit.

Together with our European partners we have adopted tighter vehicle exhaust standards which should result in emission reductions of about 80 percent from new petrol-engined cars from 1991/93. All cars will require catalytic converters, which soak up noxious gases. This step can be expected to add about £1.5 billion annually to UK motoring costs. This is a price well worth paying to protect the environment. We have also successfully pressed the European Commission to bring forward proposals to reduce emissions of carbon dioxide.

I am confident that the oil industry can cope with these environmental demands. By publicising the benefits of environmentally benign products, industries can respond to the need to protect the environment. The oil industry must be at the head of that advance.

Modern practice in handling aviation fuel — the multi-aircraft ramp system

By RM Wilson, Operations Manager, BAA plc

This paper, presented at the IP conference, 'Modern Practice in Handling Aviation Fuels at Airports', introduced the concept of the multi-aircraft ramp system. In the next paper, Alec O'Beirne describes specifically how hydrant refuelling has been introduced at these ramps.

Aircraft ramps are designed and provided against forecast activities and where possible fleet mix. Ramp/stands may either be pier served, ie. passengers will walk from pier to aircraft or of the remote type where passengers will be bussed to distant parked aircraft. Pier service may or may not incorporate the provision of airbridges to convey passengers from pier to aircraft.

RM Wilson

The aircraft ramp/stand in either pier or remote layout will vary in size in order to serve a range of aircraft types. Typically the size will fall into one of five categories as in Table 1.

Stand Category	Typical Aircraft Size
1. Small	1 × BAC.1-11/B.737 or smaller
2. Medium	1 × B.757/B.727/A.320 or smaller
3. Large	1 × DC10/L1011/B.767 or smaller
4. MARS	B.747-400 or 2 × B.737-200
5. Super MARS	B.747-400 or 1 × B757 + 1 − B.737-300

During the planning of any scheme, consideration must be given to the range of aircraft to be served within any given category, whether hydrant service is to be provided, access for service vehicles, airbridge operations — all of which have to be operated safely.

Ramp services

Fuel hydrants are provided on most medium/large and Multi-Aircraft Ramp System (MARS) stands at Heathrow, Gatwick, Prestwick and for the future at Stansted. Stands may be equipped with Fixed Ground Power (FGP) providing a 400 Hz supply to aircraft on-board systems. This environmentally acceptable facility obviates the need for mobile power units or the running of high noise auxiliary power units.

Accurate stopping guidance for the aircraft is provided to ensure that hydrant service, FGP connections and airbridge service can safely be made. Stopping guidance will include Azimuth Guidance Nose-in Stand supplemented by either a Side Marker Board, Parallax Aircraft Parking Aid or Ground Stop Arrow.

It is a well-known fact that vehicle activity on ramp areas is at a very high

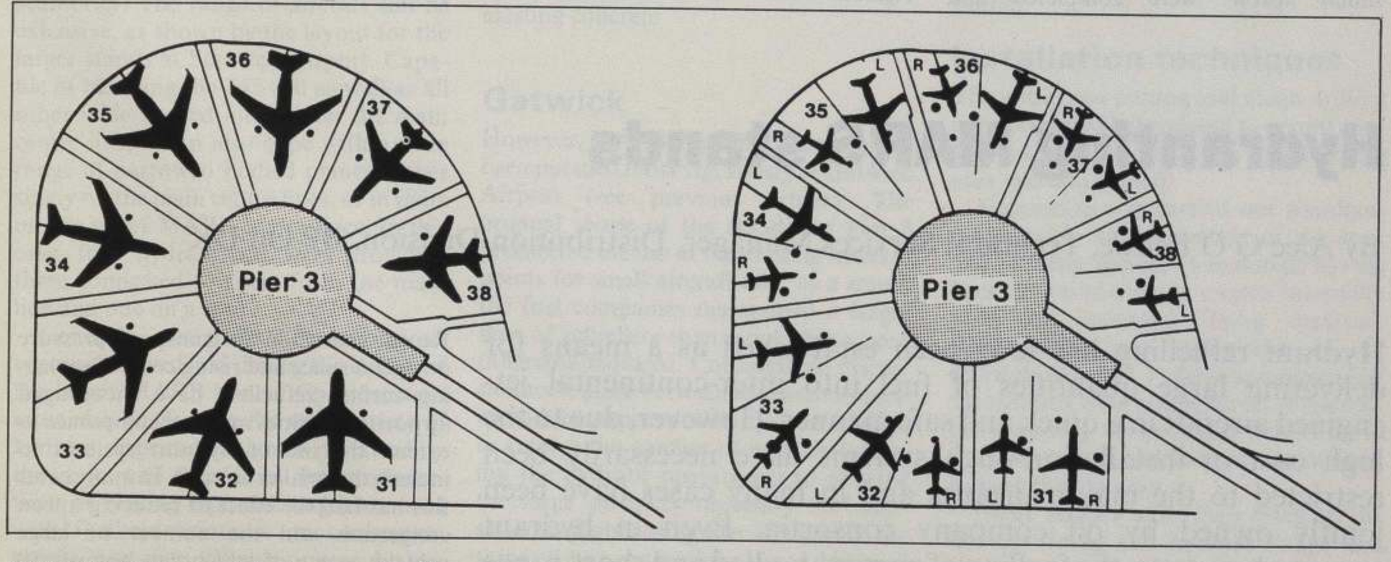


Figure 1: Gatwick airport showing the original layout (left) with six 747s and two DC10s and the present MARS layout with six 747s and two DC10s or 16 medium-sized aircraft.

level during aircraft turnround. Therefore the apron designer and operations manager welcome any system which will reduce the number or physical size of vehicles attending an aircraft. The provision of fuel hydrants, fixed ground power and airbridges has achieved this.

The MARS concept

The MARS came into being with the opening of Pier 3 (satellite) at Gatwick during 1983.

The initial design of the satellite layout provided hydrant served ramp space on 8 centrelines for six B747 and two DC10 aircraft **(Figure 1)**. From operational experience, it became evident that the demand for space to service 747/DC10 aircraft was typically limited to morning and early afternoon. Outside this, eight smaller aircraft (727-737), each using a wide-body centreline, tended to dominate the scene; clearly this arrangement did not maximise either airside or landside facilities and required change.

Discussions were held with the Gatwick Fuel Consortium and airlines with a view to modifying the ramp layout. A scheme was produced which sub-divided each of the eight single centreline stands into two, thus utilising the total space available to service a greater range of aircraft numbers and types. A further benefit of this layout was to assist in absorbing the ever-changing airline fleet mix and varying peak demand times. The 'two-on-one' which resulted would accommodate either the eight wide-bodies or 16 B737-sized aircraft or a mix of the two — a truly flexible stand arrangement **(Figure 2)**. Further refinement however was undertaken to improve airbridge interface operations early in 1987.

During 1987 the Gatwick North Terminal aprons were completed and introduced into operational service. As the concept of Pier 3 had proven to be a success, the North Terminal was to incorporate a MARS design. Of the seven new stands opened, four were in the MARS format. (747/2 × B737). By this time BAA, in conjunction with the Gatwick Fuel Consortium had agreed a scheme for additional hydrant outlets on Pier 3 (satellite) which, when spurred off the original ring main, would serve the 16 left/right MARS stands. A phased installation programme was undertaken and became operational during March.

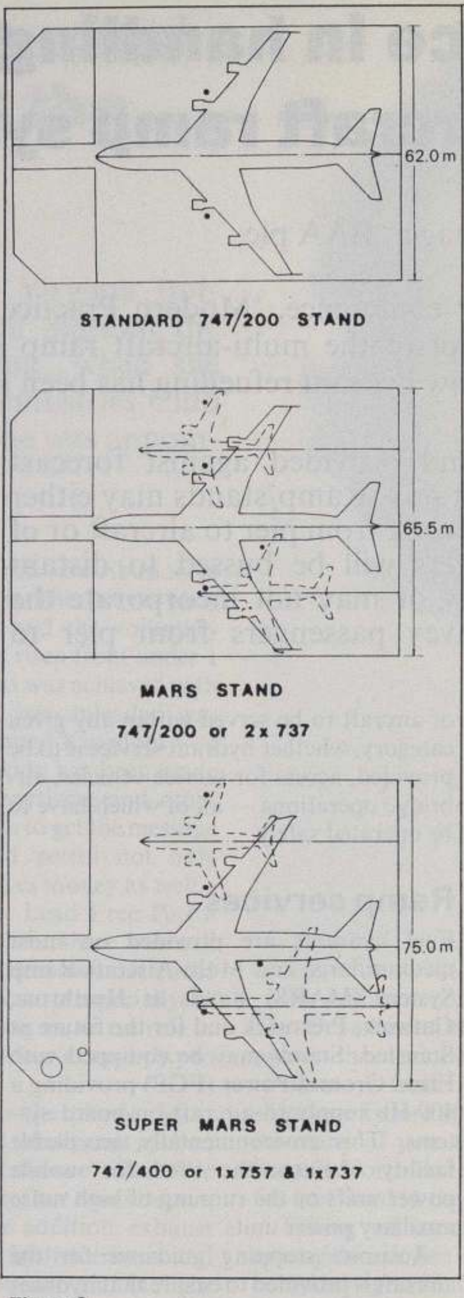


Figure 2

Future development

The latest and most recent development is Super MARS. This will be located on the new Gatwick Pier 4 and at Stansted. Widening the stand still further to 75.0 metres will allow main centreline operation of the B747-400 or a B757 + B737 MARS combination.

So what of the future? I share the view of my company that the next 747 derivative may well appear with a second deck nose to tail. This aircraft may use the present 400 series wing. A completely new long-range model may then be expected, with both new wing and body. This latter aircraft may have a span in the order of 75.0 metres. From a ramp planning viewpoint, the Super MARS stand would be large enough to accommodate either aircraft, with some refinement to the centreline position.

Finally, I would like to say that the hydranted MARS system offers a very comprehensive service level to all users/airlines across a wide range of aircraft. This operation when allied with ramp use flexibility can and will in my view be adopted by large airports both in the United Kingdom and Europe for many years to come.

Hydranting MARS stands

By Alec G O'Beirne, Technical Services Manager, Distribution Division, BP Oil UK

Hydrant refuelling has long been established as a means for delivering large quantities of fuel into inter-continental jet-engined aircraft in a quick and safe manner. However, due to the high cost of installation such systems have necessarily been restricted to the major airports and in many cases have been jointly owned by oil company consortia. Even in hydrant equipped airports, the fuelling of narrow-bodied and short-range aircraft was often carried out by surface refueller.

Recent growth in air transport, pressure on apron space and rising costs of replacing surface refuellers have encouraged airport authorities and fuel companies to extend the use of hydrant systems to include the smaller aircraft. In many cases this has had the effect of reducing apron congestion and the number of large vehicles, some of which can be over 50 feet long.

At Manchester International Airport in 1980 a hydrant system was developed for the new western apron. This apron was remote from the terminal building and was therefore not constrained by airbridge or other fixed equipment considerations. The main centre lines were laid out to cater for six wide-bodied aircraft, i.e. Boeing 747, DC-10 and Tri-Stars. The Boeing 737 was used as the typical 'small' aircraft and the subsequent design allowed for 10 such planes to be parked and hydrant fuelled. However, subsequent usage has shown that the lack of docking guidance systems and a lack of appreciation by the operators of the need for disciplined parking led to frustrated attempts at hydrant fuelling.

More successful was the hydrant extension provided on the International 'C' Pier extension at Manchester. In this case four wide-bodied aircraft or seven narrow-bodied could be accommodated. Due to the construction programme the hydrant design and installation was completed before the air-bridge information was available, giving rise to some hydrant pit positions which were less than ideal. As a result it is now realised that the interaction of all services to the aircraft and the resulting stand 'furniture' is most important and must be considered at the design stage.

Surprise is often expressed over the fact that stand layouts must often be redesigned for each contract, whether it be for a green-field site, or an extension in existing aprons. The factors affecting design are many, involving practical as well as financial considerations. Stands may be on-pier or off-pier, thus air bridge reach and internal gradients must be considered. Fixed ground power access must likewise be considered. Aircraft mix is critical and as with the other factors mentioned is determined by the Airport Authority. The range of aircraft can be extensive, as shown by the layout for the larger stands at Stansted Airport. Capable of handling the 747-400 as well as all other wide bodied aircraft on the main centre line, it can also cope with a wide range of narrowed bodied planes, either singly on the main centre lines, or in pairs on the offset MARS centre lines. In this case, four hydrant pits were provided, three connected to risers from the main line and one on a spur.

Generally around 20 different aircraft types are considered during the design of the larger MARS stands. Consideration must also be given to the wide variety of hydrant dispenser design as practised by the various oil companies. Input connections of varying type and length are used with further variations on connection points, near-side, off-side or rear, booms or hoses.

AG O'Beirne

The foregoing merely helps to establish the ideal position of the pit relative to the range of aircraft coupling points. Having agreed the ideal situation it is then necessary to consider the concrete bay layout, whether the apron is to be newly constructed in a green-field site or installed below existing paving.

If the civil engineers have already determined their bay-patterns it may be necessary to re-position the hydrant pit to avoid weakening the apron structure, or conflicting with expansion joints, drainage channels, lighting boxes etc. Occasionally bay patterns can be modified but if not, a compromise must be struck and the new positions agreed once more with operations. In existing aprons compromise is necessary from the outset and often pipe runs are routed to minimise the break-out and reinstatement of existing concrete.

Gatwick

However, MARS refuelling has probably been pursued most vigorously at Gatwick Airport (see previous article). The original shape of the stands on Pier 3 prohibited the use of the existing hydrant points for small aircraft and, as a result, the fuel companies maintained a larger fleet of refuellers than would have been otherwise required. Considerable discussion took place between the fuel companies and the airport authority in an attempt to resolve the conflict of both maintaining the hydrant operational to provide the large off-takes necessary for transatlantic flights using Pier 3, whilst at the same time connecting the additional spurs to the hydrant. As the same high standards of system integrity and fuel quality had to be maintained it was thought that the alterations would take two years, using previously proven techniques. As work could only be permitted during the winter months because of traffic demands, it was thought that only six stands would be converted for MARS fuelling.

Around this time apron works were nearing completion on the new North Terminal, which had been designed for wide-bodied hydrant fuelling. The decision was taken to re-align the stands to permit MARS operations, involving the re-positioning of several hydrant pits. As the hydrant had already been filled with fuel it was necessary to carry out the modifications as if the system were live, although the terminal and aprons were not yet in service. Previously used methods for modifying hydrant risers were not suitable for the offset spurs that were required and discussions with a specialist supplier produced a 'hot-tap' connection which permitted full-pressure testing of the installed spur prior to drilling of the main and a capping technique which reduced air pockets to an almost negligible level. Safety levels were also increased. The resulting conversion of Pier 5 to MARS configuration prior to its opening proved the new system and enabled supplier, contractor and oil company engineers to reach agreement with Gatwick Airport Operations that the conversion of Pier 3 should proceed. Pressure for apron space demanded that all eight stands be converted involving 16 additional pits, whilst only one winter season was available. Work commenced in late October 1988 with two stands at a time released for work. As stands were completed they were returned to service. The 16 new hydrant points were commissioned and in service before the end of March.

Installation techniques

The initial saw cutting and chain drilling was completed beforehand to permit continuous working once the construction area was established.

Excavation was carried out simultaneously with the fabrication of the spur and 'hot-tap' fitting, all materials having been delivered already treated internally with an approved lining material. Radiography was completed on all fabrication welds. Following exposure of the hydrant main and removal of the coal tar wrapping, the spur was welded on to the main, whilst fuel flow was maintained to keep the line cool.

Blank flanges were then fitted to the hot-tap fitting and hydrant flange and the spur was air tested. Back-filling and compaction round the spur was carried

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out prior to the hydraulic testing of the complete assembly.

After testing and removal of the fuel, the hydrant main was depressurised and the special drilling tool used to cut a hole in the main and the removal of the coupon and swarf was completed. As the break into the main and recommissioning of the system was completed during a one night shutdown, great care had to be taken to ensure that all swarf was removed from the main. Cleanliness at this stage cannot be over emphasised, swarf being removed by both magnetic or suction methods. The internal blanking plug could then be fitted to the hot tap fitting and the drill attachment flange removed by cold cutting. The blanking plate having been locked in place with grub screws, the end cap was fitted, welded and radiographed. Blanking plugs were installed, seal welded and MPI tested.

Following protective wrapping of the completed assembly the excavation was backfilled to the appropriate specification and the hydrant box fitted prior to final concrete laying.

Contract speed was achieved through close co-operation between all involved parties. Regular testing of concrete permitted early return to service of stands, while the use of motorway pre-cast concrete barriers to isolate working areas, dramatically reduced set-up times whilst improving apron cleanliness.

In the final analysis the results have benefited all parties. All aircraft using the pier may now be hydrant fuelled, enabling rapid turnaround and reduced congestion. The works were carried out with the minimum of airport disruption, within programme and under budget. This has resulted in additional stands being hydranted in the MARS configuration, the ultimate objective being to hydrant the airport fully and achieve maximum flexibility of operation.

Aviation fuelling hoses and couplings — safety issues

By Dr Harald Falckenberg, Elaflex

The safety aspects of the refuelling of airplanes are crucial. The reliability of the fuelling hose assembly therefore is of special importance. There have been accidents by electrostatic charging, bursting hoses and blown-off couplings. This paper considers what the manufacturer, the assembler and the user can and should do to avoid such accidents.

Hose construction

In order to evaluate the safety risks of a hose assembly one must have a clear understanding of the hose construction. The pressure bearing part of a hose, which keeps it from bursting at the high working pressure used for aviation refuelling, is the braided, woven or spirally wound textile carcass. The rubber lining protects this carcass against the fuel. The rubber cover of the hose protects against outer influences such as ozone, water and wear. The three layers of the hose are brought into a firm binding to each other by the vulcanization.

There is a safety risk if the lining or the cover are damaged so deeply that the carcass is exposed and may be weakened by the medium or outer influences. Also, the loss of the adhesion between the layers is critical because this indicates the beginning of a damaging process.

The carcass of modern aviation hoses is preferably braided. Woven or spirally wound reinforcements have to be wrapped around in several layers to achieve the required burst pressure. Such hoses have the tendency to form permanent kinks at the hub of the hose reel. They are heavier and stiffer than the braided type. From the safety point of view this is a disadvantage for the handling in the field, especially when connecting the hose to the underwing aircraft adapter. Braided hoses combine a maximum of burst pressure with easy handling.

The lining and the cover should be extruded seamlessly. Lapped constructions are only used for hoses with bigger inner diameters. If used, it should be made certain that the lapping is not wrapped axially but spirally. Axially lapped linings carry the risk of easily splitting up.

Since the famous accident in Copenhagen-Kastrup all into-plane and into-hydrant system-hoses are required to be without metallic elements and to have an electrical resistance between 1,000 and 1,000,000 Ohm. The minimum resistance of 1,000 Ohm protects the hose against external electrical currents, eg, from

Dr H Falckenberg

ground units. Above that the minimum resistance helps to avoid the formation of sparks when the hose assembly is attached between units of different electrical charge.

It should be stressed that the fear of using metallic elements in aviation hoses often goes too far. Hoses which are used within a dispensing system, for instance for the connection between truck and trailer or at dispensers for the connection to the upper platform, may have a steel helix as part of the system which is metallic anyway. Regarding the better kink resistance and the possibility of de-fuelling, hoses with steel helix offer good advantages.

Manufacturing faults

Absolute cleanliness has to be observed during the production of hoses. If the rubber compound contains dirt which is extruded onto the mandrel, the result may be little pinholes or other defects. Pinholes in the lining show up when the hose is pressure controlled after production, as every hose should be. The cover will blow up in such a case. More delicate is the control for little holes and irregularities of the cover. They can only be detected by visual control, which has to be incorporated into the guidelines of manufacturing as a separate procedure. The consistency of the wall thickness is a valid indication for good and bad quality in the production of hoses. Bad quality hoses have greatly varying wall diameters. This is a safety risk because it requires the assembler to choose the right coupling and to fit it correctly to the hose.

Quality frequency tests

These are very important points regarding quality and safety. The new BS 3158 : 1985 and the latest draft May 1989 of the API 1529 recommend certain minimum test frequencies. Without going into too much detail, we believe that the test frequencies recommended by these specifications are absolutely unrealistic.

We only see one reasonable solution. The user should carefully check what controls and tests are actually done by the manufacturer. He should look into the files and make sure that the data are accumulated regularly. This way he can compare the quality control and production test systems of the different suppliers and in the end agree with them on what has to be done.

Hose assembling

There are pinned, bolted and swaged-on types of couplings in the market. The swaged-on type is non-reusable and the bolted type is reusable. The pinned clamp can be supplied alternatively as reusable or non-reusable. In the latter case the pin is pushed into a blind hole.

The assembling has to be done by experienced and trained people. The pinned type seems to provide a fool-proof assembling but this is only true for hoses with the correct wall thickness and wall hardness.

In general it is recommended that hose and coupling are supplied by one company. One should order assembled hoses only. If the user prefers to do his own assembling, he must at least have the assurance from the supplier of the couplings that they are suitable for the hose.

Just to give one example — there are clamps of the bolted type with the same outer but different inner diameters for hoses with and without helix. If you are inexpert you can easily mix them up. This has already been done and caused an accident because of a blown-off coupling.

Storage and field tests

In the BS and the draft of the API there are a number of valid recommendations regarding hose storage and field tests. We need only mention some additional items.

For storing it has been proven to be advantageous to flush the hose beforehand with Jet A-1. The jet fuel forms a film on the lining and so hinders it from drying out.

Regarding field tests, the importance of the routine pressure tests is overrated and the importance of the visual checks underrated.

It is necessary to make hydrostatic tests with the hose, first after manufacturing and second after assembling. Usually the hose is tested a third time when it is taken into operation. As damage of the lining resulting in bubbles on the cover would show up during these first three tests, and as after assembling there is practically no way the lining could be damaged, the subsequent routine hydrostatic tests (in practice every three, six or 12 months) will very rarely indicate dangers. This could be the case if the reinforcement is weakened by an unnoticed damage of the cover. Modern aviation hoses have synthetic reinforcements which for a period of at least 15 years are not submitted to a relevant ageing process.

You are often asked whether routine hydrostatic tests should be done to 100 percent, 150 percent or even 200 percent of the 20 bar working pressure. Good hoses have a burst pressure of clearly over 100 bar. There are no objections to test to 200 percent of the working pressure. This does not harm the hose. 150 percent seems to be a good compromise. But there is a practical problem. In most cases it is impossible to increase to 150 percent of the working pressure in the field. The hose must be disassembled from the dispenser and cleaned before undergoing the hydrostatic test in the workshop. We propose that the users should discuss with the manufacturers of dispensers and refuellers to construct a joint by which a pump for increasing the pressure to 150 percent may be attached. Then the hydrostatic test could be done easily in the field without disassembling the hose.

Once being aware that the dangers for hoses in operation come from outside, the visual inspections gain special importance. Cuts, abrasion or permanent kinks have to be noticed from the very beginning and checked carefully. It is negligent to rely on hydrostatic tests and omit the chance to avoid dangers in their development. We recommend the establishment of the following guidelines (in accordance with the draft of the API 1529, appendix H):

(a) Visually inspect the hose daily, during fuelling.

(b) At least monthly, pull the hose out to the full length and pressurize to normal working pressure. Pay particular attention to sections at each hose/coupling interface.

Replacement

Hose assemblies should be replaced in the following cases:

(a) Soft spots and bubbles in the hose indicating that the adhesion between the layers is lost. Just thickening of the rubber compound which may happen during the extrusion is not dangerous. Test the cover with a finger to see whether there could be a separation of the layers. Also, permanent kinks should be checked regularly by this method. There is no indication for the general replacement of hoses with kinks.

(b) Abrasion, cuts or cracks which expose or even damage the carcass textile reinforcement.

(c) Coupling movement or slippage.

It has often been discussed whether the user should specify a maximum hose life from the date of manufacture. We are sceptical about that. Under good storage and service conditions the physical and chemical properties of the hose do not deteriorate significantly. Statistics show that hose assemblies may well be in service for 10 to 15 years. We think that the maximum storage period of two years according to the BS and the API together with the natural process of wear provide the necessary safety.

Product liability

In recent years the laws for product liability have been sharpened considerably. In view of this it is recommended that only complete hose assemblies should be purchased. If the hose and the couplings are supplied by different companies and the assembling is done by a third it will, in most cases, be impossible to establish the responsibility of one of these parties.

Finally, if you have chosen one company as supplier of complete hose assemblies, it is essential to check that this company has a sufficient product liability insurance.

Middle East Strategy to 2002

By Scheherazade Daneshkhu

Concern over the environment and problems connected with the greenhouse effect has spread to the Middle East. A mushrooming of the region's population in the next decade will lead to higher consumption of fossil fuels and a concomitant increase in environmental problems. This, with its implications, was the main issue to be examined at the annual Arab Press Service conference, entitled *Middle East Strategy to the Year 2002*, held in Nicosia, Cyprus in early October.

Dr David Everest, consultant to the Energy and Environment programme of the Royal Institute of International Affairs, spelt out some of the main difficulties that the region faces in the coming decades. One problem is the scientific uncertainties surrounding the greenhouse effect. It is still not known when and, indeed, whether global warming has taken place, nor what the effects will be. While rivers are likely to rise, when and by how much, are questions that still remain very much unanswered. Moreover, the global nature of the environment issue places the burden of responsibility on all nations and implies a co-ordinated set of responses to the challenge. This may appear an uncontentious observation but in a region still only recently free from colonial status, it was pointed out that the depletion of the ozone layer has not been the fault of the Middle East or the developing nations but a by-product of Western excesses.

The implication is that any form of global co-operation will have to take into account such politically sensitive issues, namely should the Middle East allow its industrial development to be held back because of environmental damage caused by another part of the world? This was pointed out by Dr Everest, too: 'The LDCs are likely to resist any limitations on their own use of fossil fuel, or even on their consumption and emission of other greenhouse gases such as the CFCs. which they regard as essential to their development'. Moreover, 'it is unreasonable to expect the LDCs to incur expenditure on pollution control when there is a greater need for them to spend the money expanding their economies'.

With world energy growth at an all-time high of some 8 billion tonnes annually and a growth rate of 2 percent, attempts to control atmospheric pollution can only continue to be a major headache. However, Middle Eastern governments could still study the issues in order to develop an environmental strategy tailored to their own advantage. The possibility of increased rainfall and steps to regulate a rise in the sea level are all important and could be turned to benefits for the region.

Technological advances

Another potentially important development for the region is improvements in technology. The benefits with regard to natural gas utilisation are outlined in Arne Fjeldstad's paper (see page 629). BP's research into membrane technology as a means of producing gas more cheaply is already known to *Petroleum Review* readers (see the July issue). Membranes are a non-porous polymer layer used to separate gases. It is a simple technology which can replace complex unit operations such as gas dehydration, acid and sour gas removal in one step. While originally developed as a means of reducing offshore gas development costs in the North Sea, the relevance of membrane technology to the Middle East was explored in the conference. Membrane technology would be relevant to high sulphur content gas fields, such as those in Libya's Gulf of Sirte. Iran would also benefit since its southern fields contain large amounts of carbon dioxide. Membranes can also increase plant capacity, improve product quality, improve feedstock utilisation and reduce the capital costs of new plant.

In the petrochemical sector, technological developments are likely to concentrate on the conversion of methane to high value-added liquids. After a poignant introduction on the rise and fall of industries and, in a reference to new molecular processes, Yoshio Tokuhisa, Managing Director of Mitsubishi Petrochemical Company, declared that petrochemicals had also become an outdated industry. While dyestuff, soda and fertilisers were unlikely to lose their importance, the days when these represented the forecourt of the petrochemical industry were over. Instead, Mr Tokuhisa emphasised research and development as the key to the future of the industry.

The Japanese connection

Japan's continuing and growing interest in the region was well represented at the conference with delegates from Chiyoda, Mitsui, Hitachi, Osaka Gas and the Japanese Ministry of International Trade and Industry, amongst many others. 'Japan cannot help but be dependent on Middle Eastern oil', said Mr Keiji Natori, Executive Director of the Japan Cooperation Centre for the Middle East. The JCCME was established in 1973 by the Japanese government and the private sector to promote ties with the Middle East. But despite the keen interest shown by many Middle East governments to involve Japan in industrial joint ventures, Japan's overall investment in the region is relatively low, particularly compared with the tremendous increase in Japanese investment in the United States and Europe.

For Japan, the most successful areas of investment have been in petrochemicals, especially in Saudi Arabia's Eastern Petrochemical Company (SHARQ) and Saudi Methanol (Ar-Razi). Few new investments have been forthcoming apart from in Turkey and the Jebel-Ali Free Zone in Dubai. However, Japan is happy to help in the reconstruction of Iran and Iraq, while increased trading activities have seen Japan opening up its own market, particularly to refined petrochemical products from the Middle East during the past three years.

Other possibilities that Japan is considering include technical cooperation upstream and downstream, investment in Middle Eastern exploration and development activities, as well as a re-examination of its own 'cautious' policy towards Middle East investment in Japan's downstream sector.

Upbeat tone

In general, the conference took an upbeat tone on the future of Middle Eastern oil both upstream and downstream, though emphasis was placed on the importance of planning by OPEC to cope with market fluctuations. Such fluctuations mean that OPEC could be producing anything between 18–35 million b/d. Paul Tempest, of Shell International, said that the company does not foresee non-OPEC suppliers continuing their growth. 'OPEC has turned the corner', he said. The six Gulf members of OPEC accounted for 43 percent of global oil exports last year and are in the best position to satisfy incremental demand for oil in the future.

But OPEC's powerful position as supplier would not mean that it would be able to drive the market, stressed Mr Tempest, a point also touched on by Tony Scanlan, former editor of *Petroleum Review* and now Deputy Director at the Global Centre for Energy Studies. 'The policy of the Middle East, if it wishes to maintain a comfortable midfield position in new energy developments, will be to keep prices at midfield levels, enough to encourage use of oil rather than alternatives, without overstimulating small oil province competition', he said.

The lessons of 1986 would indicate that OPEC's strategy for the 1990s might be best served by aiming to prevent a major price hike which would risk depressing oil and energy demand, causing a major fall in the price of oil.

If oil prices appeared uncertain, the news on the refining front looks promising. Energy consultant Gilbert Jenkins saw the opportunity for Middle East and African refiners to more than double their present market share of oil products in world markets. The consumption of high-octane lead-free gasoline, jet kerosine, low sulphur gasoil and low sulphur residual fuel oil are all set to rise in the OECD countries in the next decade, making Middle East 'investments in refineries with a high proportion of hydrocracking and sulphur removal facilities' more than justified, according to Mr Jenkins.

While the focus of the conference was on energy in the Middle East, the all-important backdrop to the region was not neglected. Comprehensive papers on the problems of population increase, electric power resources and water shortages were also given, as was a perspective on the recently-formed Arab Cooperation Council, the political and economic alliance forged between Egypt, Iraq, North Yemen and Jordan.

New technologies and natural gas in the Middle East

By Arne Fjeldstad, SAF Management, Norway

Natural gas has many benefits which can be used by the Middle East to good advantage. While oil production is 'fast and easy', giving rapid returns to its owners, the benefits of natural gas are not so immediately evident. Nevertheless, natural gas can be a positive development for industrialisation, technological advance and increased employment in the countries involved. The focus of this paper, however, is on the industrial uses of natural gas. Once technology is transferred, natural gas development will enable the country to obtain a far higher level of employment than that offered through oil production.

Technological development

Generally speaking, technological development is in many phases and years may elapse between each phase. Technology, such as a new basic chemical or a new plastic, is invented and sold on the market. This attracts competitors, which can lead to the product being standardised, further increasing the competition.

Production processes are then improved with larger plants built to make production more cost effective. It is at this stage that the introduction of new technology can have a dramatic effect. Resulting lower prices will then reduce the number of producers. New markets are opened and further development is in uncharted waters. Examples of such technologies are chemicals such as methanol, ethylene, PVC and other plastics. New technologies may change process development fundamentally.

'The world's first floating methanol plant is to be built in the Middle East'

Floating plants

Floating chemical plants are an example of this kind of new technology. They have now been in the market for many years but few of the project ideas have got off the ground. However, floating plants appear to be proving something of a breakthrough in the Middle East because of a number of advantages they offer.

They can be erected where the specialisation for technology and shipbuilding is available. They can be brought to the site of the resources, whether offshore or onshore, at a convenient harbour and have natural storage facilities. Their finance is also easier, since banks may be more willing to finance floating plants rather than fixed installations.

The world's first floating methanol plant is to be built in the Middle East. The Oman gas/methanol project involves gas production from offshore installations at the Bukha gas condensate field in the Arabian Sea off the Musandam peninsula. The $250 million plant will be built on a ship which can move from field to field and can also be moored off Sohar, north of Muscat, to supply gas to onshore projects.

In the Omani case, production is being undertaken for export. The aim is to produce some 2,200 metric tons a year of methanol to satisfy growing demand, particularly in the United States and Europe. Usually, however, such a process would lead to a methanol-based industry, for example, plastics or MTBE. Products other than methanol, such as ammonia, can be produced using floating systems though it might be preferable to localise these onshore. In the case of offshore oil production involving the offshore loading of crude, the gas content can become a problem. But the gas could be used for power generation in the local community. The oil can be produced onto the ship and stabilising by stripping off the gases and light components which can then be used for electricity generation. The financing of such a project can be met by allowing the project owner to sell off the rest of the oil. However, this type of project does not require a significant number of employees.

Cracking processes

Technological improvements are also taking place in the cracking process, particularly in the production of ethylene. Usually, ethylene is produced by cracking naphtha or LPG (see **Figure 1**) but these plants are expensive to run because of the high temperatures involved and the variety of basic products produced in the process. Treatment of the cracking products is also costly.

'Can the chemical cracking process be used for the production of ethylene?'

However, Saudi Arabia is to build a new type of cracking plant which will produce propylene by chemically cracking propane. The process uses less energy and, in the future, such plants will become much cheaper than the olefin plants of today. The plant is also an example of technology leadership in the Middle East. The next plant, due to be built in Belgium, will be based on Saudi technology and experience.

Can the chemical cracking process be used for the production of ethylene? Many companies are researching into this question, specifically into the type of catalysts and chemical processes that such plants would demand. There now looks like a possibility, in the shape of a methanol-production plant for the production of an intermediate which can then be chemically cracked by a dehydration process. There may be a breakthrough in this process in the near future. A plant of this type would initially be best placed where cheap natural gas is abundant. In a few years the price of ethylene may fall. If this were to happen, only those using new technology and with access to the raw material at the right price would be able to survive.

Prices and margins

The price of chemicals varies tremendously over time. **Figure 2** shows the price variation of methanol, where the price changes cyclically every three years. The situation is the same for a variety of different chemicals.

This obviously has an impact on production planning. The time lag between approving a production plan and seeing it realised is usually three to four years. This means that an investor cannot bank on prices for his product remaining the same once the plant is completed. In the intervening period, prices are bound to go up and down.

The decision to build has therefore to be taken on a different basis. Here marketing strategies, the strength of competition, raw material costs, expected growth patterns in the market and new production processes must all come to the fore. The decision has to be a strategic one based on changing circumstances and the business possibilities generated by the change.

Conclusion

Once the resources of natural gas are developed, new products, industrial development and increased employment all follow. Some of this development can, and in the future, will be made in the form of floating production plants, which can then be manufactured where the specialist knowledge is to be found. Such plants are easier to finance than ordinary local investments.

For the future, investment in chemical plants has to be based on market strategies and local advantages. With these two points in mind, we can expect to see a continuity of change in the gas industry.

This article is based on the paper presented to the Third APS conference, *Middle East Strategy to the Year 2002*, Nicosia, Cyprus, October 1989.

Figure 1: Cracking Technology

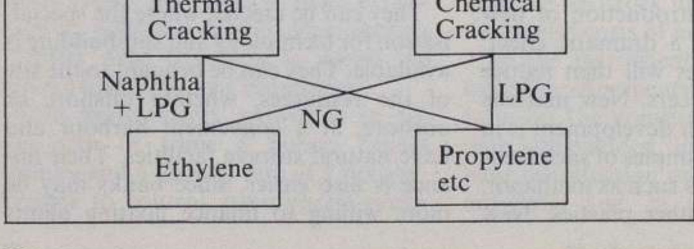
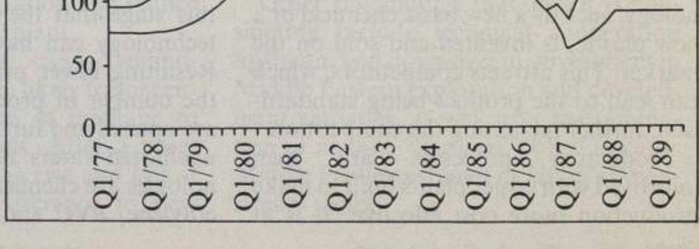


Figure 2: Methanol in North Europe



IFEG INFORMATION FOR ENERGY GROUP

OIL PRICE INFORMATION

20 February 1990

The Oil Price Information seminar has become a popular and regular feature during IP Week.

The programme of three papers on aspects of price information combined with an exhibition by suppliers of such information has proved to be a successful formula.

This year the seminar will present papers on electronic sourcing and analysis of oil price; the use of historical price data in future trading decisions; and the influence of OPEC on oil prices. The meeting will be of interest to traders, marketers, analysts, information providers and forecasters.

PROGRAMME

Chairman's Opening Remarks
Mr Silvan Robinson, CBE, Chairman, Energy and Environmental Programme, Royal Institute of International Affairs

Oil Price Information and Analysis — An Integrated Approach
Martin J Yates, Managing Director, Saladin Computer Systems Ltd.

Can Past Prices Predict Future Trends?
Meg Annesley, Oil Consultant

Sentiment as a Market Factor — Does OPEC Really Figure?
Peter Bild, European Representative, Oil Daily

Exhibits and Displays by Suppliers of Oil Price Information

Wine Reception

Exhibits will be provided by:
ICIS-LOR,
Saladin Computer Systems,
Telerate,
Petroleum Argus,
Reuters.

For a copy of the registration form, please contact **Mrs J Etherton**, The Institute of Petroleum, 61 New Cavendish Street, London W1M 8AR. Telephone: **01-636 1004**. Telex: **264380**. Fax: **01-255 1472**.

IP ENERGY ECONOMICS GROUP

The following meeting has been arranged:

Thursday, 18 January 1990

Refinery Upgrading — Past and Future

Speaker: **Dr DG Turpin,**
Independent Consultant

Venue and time: Institute of Petroleum
5.30 for 6.00 pm.

For further information please contact:
Mrs Jane Thompson,
Institute of Petroleum,
61 New Cavendish Street,
London W1M 8AR.
Tel. 01-636 1004.

New survey highlights training and recruitment issues

The University of Salford has recently completed a project on alternative tertiary education. The project was sponsored by British Petroleum, the Department of Trade and Industry and Ferranti plc.

The objectives were to outline the current provision of tertiary education, to investigate problems of training and recruitment in three major industrial sectors and to identify barriers to higher participation rates in education and training, especially for women.

Several major conclusions can be drawn from the research project:

1. Training
Training is becoming a major concern for many companies in a number of sectors as they experience severe recruitment problems. Problems exist not only in the graduate market but increasingly at all levels as the numbers of young people decline. However, companies have yet to recruit among mature people, women returners and people with non-standard qualifications, something which will become increasingly worthwhile in the 1990s.

2. Alternatives
Several companies and institutions of further and higher education are willing to explore alternative routes to enhance the skills and educational levels of the labour force. Credit accumulation and transfer schemes (both nationally and regionally), access courses to education, evaluations of experiential learning and in-house training are becoming commonplace not only among educational institutions. Industry has also begun to investigate such possibilities, linking up with higher education institutions.

3. Barriers
There are a number of barriers which must be overcome. First, individuals and industry must learn to recognise the benefits of continuing education and training, and institutions must be willing to provide learning opportunities suited to changing needs. The willingness to do so is there in principle, but there is a great diversity in practice; public sector institutions still remain the most accessible. Second, information is a critical factor because limited access, lack of public awareness about opportunities and the cost of maintaining information databases could severely limit participation. Third, lack of funding for training and education is hindering moves towards wider access; both the proposed loans scheme and the lack of tax incentives for adults act as deterrents. As competition sharpens after 1992, only firms with a well-planned strategy for training and education are likely to remain competitive.

Diary Date

Human Resource Development Week at the Barbican Exhibition Centre, London from 27 to 29 March 1990. Details from Blenheim Queensdale Ltd, 136 Blenheim Crescent, London W11 2EQ.

Allan Smith was the winner of an Institute of Petroleum Student Prize for his outstanding academic performance during a one-year MSc course in Petroleum Engineering at Imperial College in the 1988–89 academic year. Allan (second from the left) is here being presented with his IP prize by David Corkhill, Chairman of the Aberdeen Branch, at a recent Branch meeting. Also present were Ramsay Spence (left) and Haydn Barratt (right) who are Branch Committee members.

Earth science educational forum established

With the advent of the new National Curriculum in schools, Earth Sciences have finally achieved a statutory place in the science courses taught at all state schools to pupils between the ages of five and 16. The Earth Science Teachers Association (ESTA) has played a major role in amending many of the schools' science Attainment Targets so that they contain a significant Earth Science component, and ESTA has now been invited, through its President Dr RCL Wilson, to prepare guidance material for this part of the curriculum.

The collation and documentation of this material will require the help of a wide range of people, organisations and industries, and in June 1989 the Earth Science Educational Forum (ESEF) was set up to examine the ways in which assistance can be provided. The Forum's composition ranges from the Heads of the British Geological Survey and NERC, through university and polytechnic geology departments, to a number of Earth Science related sciences and institutions. The universities are one of the more obvious sources of assistance. For example, the Royal Holloway and Bedford New College (University of London), has set up an Earth Science Resource Centre, which provides advice, training and resources for schools in its area. Within the petroleum sector, the Petroleum Exploration Society of Great Britain (PESGB) has offered to compile a listing of the various videos, literature and Earth Science educational handouts, which are available from oil companies.

Any help which companies or individuals can give, bearing in mind that a wide regional spread is needed, will be greatly appreciated, and can be directed either to the PESGB or to Mr DJ Blundell, Chairman, Earth Science Educational Forum, c/o The Geological Society, Burlington House, Piccadilly, London, W1V 0JU.

New course in natural gas engineering and management

In most parts of the world today, the successful management of oil and gas resources involves interaction between government ministries, oil companies, service companies and financial institutions. As a result, the oil and gas industry in many countries needs managers with a wide knowledge of the technology, economics and operations of the industry, together with analytical and planning skills, to ensure that the greatest efficiency and economic benefit will accrue from oil and gas resources.

The College of Petroleum Studies, in conjunction with the University of Salford, is introducing a new one-year course in Natural Gas Engineering and Management in 1990. It is expected that the new course will meet an important need in the international gas industry as many countries seek to develop a viable domestic gas industry and market.

Further details are available from: The College of Petroleum Studies, Sun Alliance House, New Inn Hall Street, Oxford OX1 2QD.

Finola McCarthy received an Institute of Petroleum Student Prize at a recent meeting of the Institute's Finance Committee. Finola received her prize for outstanding performance on the Diploma in Petroleum Law course at Dundee University in the 1988–89 academic year. This is the first time that an IP prize has been awarded to a student from this particular course.

How to increase participation in higher education

It is widely accepted that there is a need to increase participation levels in higher education. In order to explore ways of achieving this, BP commissioned a study by Professor Alan Smithers and Dr Pamela Robinson at the School of Education at the University of Manchester.

The report puts forward five proposals that could lead to increased participation levels:

1. Reform of education for 16–18 year olds

Our current education and training arrangements for this age group are disjointed and fragmented. What is needed is a co-ordinated system of academic and vocational elements, interlocking to form a coherent whole — in fact, a national curriculum to follow on from that for the compulsory years of schooling. Like the national curriculum itself, it could be offered across a diversity of institutions. Such a system would benefit more young people aged 16 to 18 and provide a better basis for moving forward to further and higher education.

2. Incentives for staying-on

Given the constraints on public expenditure, it is unlikely that the government could be persuaded to introduce maintenance grants for students aged 16 to 18, but it is possible that any arrangements for loans to students in higher education could be extended downwards. It seems anomalous that there should be a gap between 16, when compulsory schooling ends, and 18, before financial support becomes available. Some financial support, if only in the forms of loans, could persuade more students to remain in education.

3. Admissions tutors

Admissions tutors could be informed of the changes taking place in education, and made fully aware of their institutions' policies.

4. Freedom in pricing courses

If institutions were given freedom to price their courses, the supply of places would beome much more sensitive — as it has done in the case of overseas students where full-cost fees are payable. But if institutions could price courses so as to make profits, they could invest in new facilities to meet student demand.

5. Reform of degree exams

There is a good case for trying to move towards a more criterion-referenced form of examining so that quality could be assured.

Future priorities

When education for 16 to 18 years old is reformed, as surely it must be soon, a more broadly-based clientele may be brought into higher education. The examination system could be an important lever for effecting change.

The report brings out how it is that the United Kingdom has such low participation levels in higher education. It should be doing much better. This does not mean lowering standards. It does mean recognising that everyone has a right to a good high level of education and training to fully develop their talents, whether they be in pipe-fitting (a very marketable skill), or physics.

Provided that education and training awards are clearly tied to external criteria there should be no fear about standards, and if these awards mean something, there should be no shortage of takers. But, getting people to raise their sights remains one of the most urgent problems facing the country.

The report, entitled *Increasing Participation in Higher Education*, is available from BP Educational Service, PO Box 5, Wetherby, West Yorkshire LS23 7EH.

Publications

Building Partnerships with Education. Comprises articles by leading policy-makers and practitioners concerned with industry/education relationships. Available from Hobsons Publishing plc, Bateman Street, Cambridge CB2 1LZ.

Education Year Book 1990. A comprehensive directory of individuals and organisations involved in education in the UK. Available from Longman Group UK Ltd, Westgate House, Harlow, Essex, CM20 1YQ.

HSE
Health & Safety Executive

MOTOR VEHICLE REPAIR — MOTOR VEHICLE MANUFACTURE
OPEN LETTER
PETROL FIRES — FUEL TANKS AND GAUGES

1 There have been a series of fatal accidents and serious injuries arising from uncontrolled release of petrol when removing the fuel gauge sender unit from vehicle tanks.

2 Modern vehicles do not have petrol tank drain plugs and are fitted with anti-spill/siphon systems which prevent the use of traditional fuel retrievers. Most incidents occur where the sender unit is located on the side of the petrol tank rather than on top. Unscrewing the unit may result in petrol running out in an unexpected way resulting in spillage and an associated vapour cloud or soaking the clothes of the person carrying out the operation. The petrol vapour is then ignited by items such as the vehicle electrical system, an unprotected hand lamp, the pilot light on heating systems or nearby welding.

3 Experience shows that it is no use relying on the owner to bring the vehicle into the garage with an empty tank. A safe system for draining the tank must be devised. The system of work should begin with estimating the contents of the tank where it is possible, otherwise assuming the tank is substantially full and providing a container large enough to hold the maximum amount of fuel which could drain out. The aim is to avoid spillage and the free fall of petrol to minimise the amount of vapour produced. It is, however, essential to assume the worst and remove any possible source of ignition from a substantial area around the vehicle. (Remember petrol vapour is heavier than air. It can spread over large areas and collect in pits or drains.)

4 The persons carrying out the draining must be aware that any spillage on clothing would cause it to catch light easily and contaminated garments should be removed and hung out in the open air before going near any possible sources of ignition. (After drying contaminated clothing should be laundered before re-use.)

5 Vehicles should never be drained over pits as petrol vapour, being heavier than air, will be retained in the pit. Draining should preferably be carried out in a safe area in the open air.

6 The risks from draining fuel tanks could be significantly reduced by re-design. For example locating the fuel gauge sender unit at the top of the tank so that it can be changed without difficulty and provides a safe access point for using a siphon or proprietary fuel retriever. It is also important that work shop manuals explain how to remove fuel safely where this is required for the particular job and emphasise the risks from petrol vapour.

7 The most effective way to reduce this risk from existing vehicles would be to use a fuel retriever capable of removing fuel by suction from a convenient part of the fuel line. Such devices are thought to be available on the continent and at least one is under development in the UK.

8 Dealing with this problem effectively will save lives. Please give this matter your urgent attention.

'Double skin' tanks

A breakthrough in underground storage of petroleum products, the 'Double Skin Steel Tank' (DSST) offers many of the advantages sought by the industry in one single system.

Manufactured in steel and protected by polyurethane lining, DSST's life expectancy will often outlast that of the forecourt lifecycle. It is manufactured to known British Standards (BS2594–BS5500) which is not the case for composite materials systems. So every aspect of DSST is fully quantified, qualified and certified.

Unlike alternative composite materials systems, the DSST will not fracture when unusual underground stresses occur and it can be installed without concrete casing or demanding installation constraints. Sand backfill is all that is necessary.

The DSST has been launched by Cookson and Zinn who say that its low installation costs mean that its working life costs are by far the lowest of any underground storage system.

The DSST is the only system now available in the UK which will prevent product escape into the environment or loss to the operator.

German move

In response to their greatly increased share of the German market for humidity measurement and calibration instrumentation, Michell are to open a Sales and Service Centre in Frankfurt, in January 1990.

The company is making this move in recognition that the German market is the strongest in Europe. Michell has already logged significant sales there, including the installation of a Calibration Dewpointmeter with the Physikalisch Technische Bundesanhalt (PTB) in Berlin.

Calibration systems have also been installed by the company with the Italian, Netherlands and Danish Standards Laboratories, to provide those countries with a positive reference against National Standards. Accordingly, the establishment of a stronger European presence in Europe as a whole, as represented by their Frankfurt office, is seen as a vital step in consolidating and coordinating Michell's European marketing, sales and support activities.

Machine debut

As the search continues throughout industry to contain maintenance costs and provide even more on-site flexibility, Hydra-Tight Limited of Walsall has announced a major new product addition to its equipment range.

For sale or hire, the new machine named 'Tay' is a fully transportable on site machining centre that is capable of flange facing from 6″–40″ and profiling to suit any gasket or seal requirement, as well as providing simultaneous pipe cutting and weld preparation.

Hydra-Tight claim that as a single machine its capability to machine flanges from 6″–40″ is unique in the market place and will produce a new dimension in cost effective and versatile on site *in situ* machining.

Tay's one man set-up.

Injection pump

The world's first injection pump in which the bearings are lubricated by the pumped liquid, in this case sea water, has successfully completed 1,753 running hours on site in the North Sea. It is currently injecting about 72,000 barrels of water a day.

The pump was developed, installed and commissioned by Sulzer (UK) Pumps of Leeds for the floating oil production platform in the Ivanhoe/Rob Roy field, operated by Amerada Hess Development.

The new pump is based on the Sulzer 'Twistlock' design. It is a high-pressure centrifugal type and features silicon carbon bearings which are product-lubricated. Consequently, no separate oil-lubrication system is necessary. This reduces the overall length required for the pumping system on the Amerada Hess Development by 26 percent from 9.7 to 7.2 m, and the weight by 21 percent from 21.5 to 17 tonnes. A further advantage is that the product-lubricated pump does not require mechanical seals.

Subsea trials

Commissioning of the Subsea Separator Pilot Unit (SSPU) on the Hamilton Bros Argyll field in the North Sea has been completed and the offshore trials programme is now under way using product from an Argyll well.

Designed and built by British Offshore Engineering Technology Limited (BOET), the SSPU is being used to assess the feasibility of separating wellhead fluids into oil, gas and water by a remotely operated unit on the seabed.

The successful completion of the SSPU trials programme should open up a way towards reduced costs and increased safety in the next phase of North Sea development. Such units are designed for use on smaller fields which cannot justify the heavy investment in major production facilities associated with larger fields.

Algerian seismic data

Halliburton Geophysical Services (HGS) is to reprocess up to 5,500 line-km of key Algerian seismic data. The contract follows the signing of a protocol and production sharing agreement between BHP Petroleum, of Australia, and the Algerian state oil company, Sonatrach.

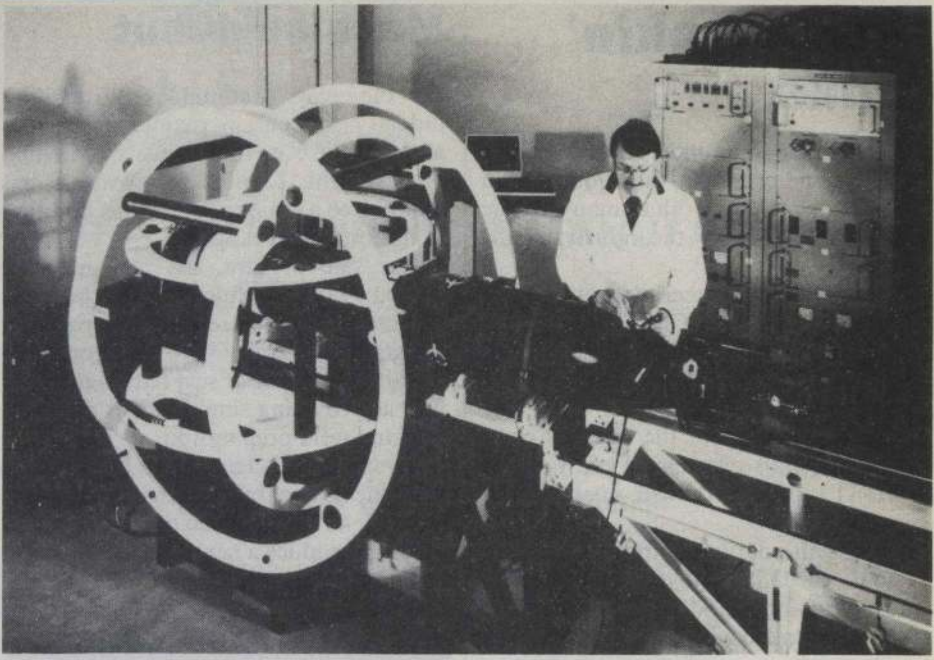
Reprocessing of existing seismic data has already started at the HGS European headquarters in Bedford, UK and BHP Petroleum is currently making plans for a major new seismic survey, to begin early next year.

BHP Petroleum is the first independent international oil company to acquire acreage in Algeria since the country introduced new petroleum legislation in 1986. Under the agreement, BHP Petroleum has won the right to undertake a major hydrocarbons exploration programme over two blocks, Rhourde El Louh and Sif Fatima, 900 km southeast of Algiers and close to the Tunisian border. The blocks cover an area of about 7,300 square kilometres.

Mr Fred Tietz, president of BHP Petroleum Ltd, said the signing of the contract was an important step forward for the London-based division, which had been established to administer and develop the company's interest in Europe, Africa and the Middle East.

The company's other interests in EAME include a 100 percent interest and operatorship of a block offshore Tunisia and interests in acreage in Egypt and the Congo.

Weapons testing and petrochemicals



SAC's integrated monitoring system for processing and testing live weapons.

To ensure that processing and testing of live weapons takes place only when all environmental conditions are in the safest possible state, an improved integrated monitoring system has been developed by the Bristol-based Technology Division of SAC International plc.

The system was developed under contract to the UK Ministry of Defence, and the first turnkey installations are now in operation at the Royal Naval Armament Depots at Beith and Ernesettle. SAC is the appointed design authority for all RNADs, and is committed to a programme of retrofit and new construction into the mid-1990s.

Any site, particularly high-risk or high-value environments, could benefit from a tailored version of the system, say the company, to provide a high level of protection and monitoring with a relatively low manning level. Typical examples are nuclear plants, petrochemical installations, and airports.

The difference between SAC's safety and monitoring system and others on the market is that, although it uses commercially available monitoring devices, they are built into one integrated system under common software control. The latest system uses an IBM-compatible supermicrocomputer for high performance at low cost.

St Fergus gas

As a result of the Bruce gas sales agreement concluded between the Bruce field partners and British Gas, up to 20 million cubic metres per day of Bruce gas will be transported and treated in the Frigg UK Transportation System operated by Total Oil Marine and owned 2/3 by Elf UK and 1/3 by Total Oil Marine.

The transport and treatment of this gas will necessitate substantial investments both offshore for the tie-in of the Bruce field to the UK line and onshore for the further development of the wet gas terminal at St Fergus. Bruce will be the tenth field to be linked to the Frigg system.

Colorado gas

Colorado Interstate Gas Company (CIG), a subsidiary of The Coastal Corporation, has filed an application with the Federal Energy Regulatory Commission requesting approval to expand the capacity of its mainline transmission system in Colorado.

The proposed project will enable CIG to move more than 100 million cubic feet of additional gas per day from the Rocky Mountain area, through interconnections with other pipelines, to markets in the MidWest, Northeast and elsewhere.

Construction of natural gas compression capacity and other facilities will cost an estimated \$18 million.

Wing dredger

A new company, Rapid Wing Dredging Co Ltd, has been formed to develop and manufacture towed dredges for rapid seabed clearance. The dredges, which take the form of a 9 m long 'aerofoil' type section, apply the normally shallow-water technique of propeller washing to deeper water sites.

Applications include seabed levelling, pipeline clearance or burial, deburial, salvage and the dredging of shipping routes at depths of 200 m or more.

Marine consultants, Robert Beaumont and Roger Ffooks, together with salvage diver Paul Burring, have set up the company financed by overseas investors through Capital Investment Agency.

Gas sensor

The KE-3 is a BASEEFA approved stainless steel flammable gas detector, incorporating the New Cosmos patented CH-series sensors for accurate detection of a wide range of flammable gases and vapours, at very low concentrations (PPM levels to 10 percent LEL) to provide a vital early warning of potentially explosive atmospheres.

The KE-3 is a 3 wire device and electrical connection is similar to that of catalytic sensors.

Sealless pump

Flux Pumps continues its programme of product innovation with the announcement of the F424, a sealless barrel or container pump which, it is claimed, is maintenance free.

Freedom from seals ensures less down time, traditionally caused by seal failures. The pump has a self-draining design which is provided by a novel helix device coiled round the drive shaft. Good flow rates are offered along with a range of construction materials and shaft lengths.

Jotun plant

Jotun-Henry Clark Ltd has commenced production from its new £5 million plant at Flixborough, South Humberside. The company is part of the worldwide Jotun group, and boasts an involvement in the manufacture of protective coatings since 1832. Built primarily to supply EEC markets, the plant will also export its marine and industrial coatings to Scandinavia, the Middle East, the Falklands, Costa Rica, Panama, Bermuda, Malta, Turkey and Caracao.

. . . people

George Band, above, retiring Director General of the United Kingdom Offshore Operators Association has been appointed Deputy Chairman of the Board of Premier Consolidated Oilfields plc, with effect from 1 February 1990.

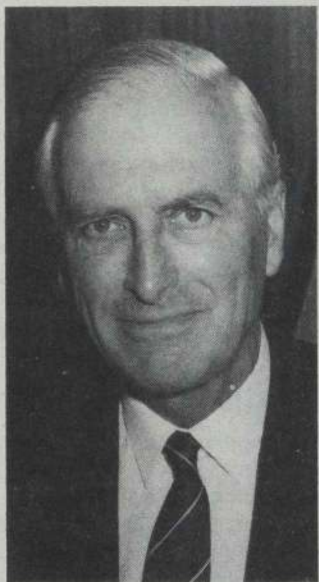
Mr Richard Johnstone, formerly General Manager, Supply, Trading and Participation in the Oil and Pipelines Agency, is now working as an independent consultant providing services to organisations and individuals involved in the oil and gas industry.

Mr Alan Hope, below, has been appointed General Manager — Oil responsible for Inspectorate Watson Gray, the supplier of sampling and analytical services to the oil and petrochemical industries and a subsidiary of the Swiss-based Inspectorate Group. His new responsibilities will involve extending the company's individually tailored reporting services into new business areas of loss control for the oil and related industries.

The FBT Group which consists of FloBin (UK) Limited and Bunting Titanium Ltd have appointed **Mr Chris Ruff** as Production Engineer and **Mr Mike Townley** as Quality Manager.

The Board of Administration of Société Horwell have approved the company's new structure — the Institut Français du Petrole, Geoservices and Forasol-Foramer are now associated within Horwell. This will allow Horwell to offer operators all services linked to the completion of drainage architecture, and in particular of horizontal wells.

SF Ltd have appointed **Mr James Milne** as managing director after two years as managing director of Alpha Fuels Ltd, one of the group's subsidiary companies.

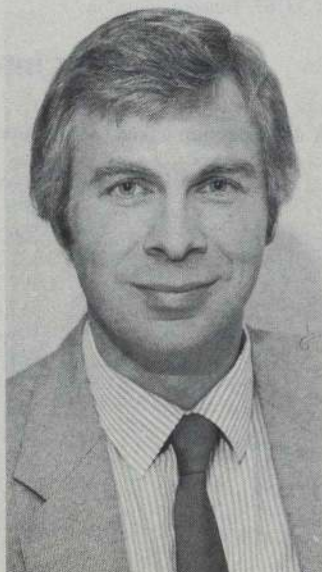


Avery Hardoll Limited, the fluid measurement company and subsidiary of GEC Electronic Metrology Systems, has formed a new company to strengthen its position in the specialist market of bulk fluid handling and metering. The new company 'Avery Hardoll Fluid Management Limited' will be headed by **Mr John Duncan**, above.

A new independent international energy consultancy has started operations in London. EMC — Energy Market Consultants Ltd — is headed by **Mark Lewis**, formerly joint managing director of Petroleum Economics Limited. Other directors of the company are **Michael Barry, Francis Osborne** and **Julie Clare** and will be joined by analysts **David Fyfe** and **Sarah Bond**.

Mr CE Willoughby, above, has been elected Senior Vice-President Administration of CBI Industries, Inc. CBI Industries, Inc, has interests in contracting services, industrial gases and investments.

Mr Ramsay Spence, right, previously managing director of Wood Group Drilling & Production Services has been appointed Group Director — Business Development and Marketing of the John Wood Group Plc. **Mr Alex Dron**, below right, managing director of Wood Group Drilling and Production Services and **Mr Roddy Matheson**, below, managing director of Wood Group Offshore, have been appointed as Executive Directors of the main board.



Mr Richard Parratt has been appointed as the Technical Director of QUBIT UK Limited. As a member of the QUBIT Group's research and development team, he will be concerned with the continuing development of its integrated navigation systems for defence applications.

Mobil North Sea have appointed **E le M Trafford** to the new position of Gas Manager, Marketing and Transportation. Mr Trafford was previously Manager of Mobil's European Gas Marketing Office.

Mr Fulvio Conti has been appointed Treasurer of Mobil Oil Company Limited, the marketing and refining affiliate of Mobil in the UK.

Around the Branches

Aberdeen
12 Dec: 'Policing the North Sea', by Chief Inspector Ian Gordon, Grampian Police.
Edinburgh & South-east Scotland
7 Dec: 'Water Losses — Detection, Control and Economic Consequences', by W Smith, Water Industry Training Association.
Midlands
13 Dec: Social Evening (details to be arranged).
Stanlow Branch
Dec: 'The Impact of Electricity Privatisation on Industry', speaker to be confirmed. Venue: Shell Refinery Training Centre.
Yorkshire
2 Dec: 'Bottom Loading', E Gillespie, Maidment Tanker Services Ltd.

New Members

Al-Salihi, Dr LBS, 66 Walter Road, Swansea, West Glamorgan SA1 4PT.
Aylard, RC, SG Warburg Securities, 1 Finsbury Avenue, London EC2M 2PA.
Bartlett, BD, 131 Lovibonds Avenue, Orpington, Kent BR6 8EN.
Berry, GS, Gulf Oil (GB) Ltd, 12 Grovepark, Misterton, Doncaster DN10 4HF.
Burek, CV, Earth Sciences Information, Newhaven House, Church Street, Holt, Wrexham, Clwyd LL13 9JP.
Burningham, DW, 14 Hillside Road, St Albans, Herts AL1 3QL.
Cook, NH, c/o Aramco, PO Box 553, Ras Tanura, Dhahran 31311, Saudi Arabia.
Dalmas, M, 28B St Philip Street, Birzebbugia, Malta.
Dameno, CA, Shell Cypus, PO Box 4569, Nicosia, Cyprus.
Deeming, P, GID International, 23 Chelsea Wharf, Lots Road, London SW10 0QH.
Folland, FP, 2 Newmills Grove, Balerno, Midlothian EH14 5SY.
Forster, JA, University of Aberdeen, Pickup Training Office, Regent Walk, Aberdeen AB9 1FX.
Green, D, 9 Addison Place, Arbroath, Angus, Scotland DD11 2BA.
Hare, OA, SG Warburg Securities, 1 Finsbury Avenue, London EC2M 2PA.
Hughesdon, RJ, Aberdeen Drilling School, 50 Union Glen, Aberdeen.
Kim, KS, Korea Petroleum Dev Corpn, Room 417, Victoria House, Southampton Row, London WC1B 4DB.
MacDonald, AK, SG Warburg Securities, 1 Finsbury Avenue, London EC2M 2PA.
McKerrow, J, 10 Northumberland Place, Petersham Road, Richmond, Surrey TW10 6TS.
Medani, Mrs CG, Flat 1, 17 Spenser Road, Herne Hill, London SE24 0NS.
Newbegin, C, 34 Tarnston Road, Hartlepool, Cleveland TS25 0PQ.
Njovu, JL, 21 Kabangwe Estates, Box 33767, Lusaka, Zambia.
Peace, DG, Craebreck, Holm, Orkney KW17 2RX.
Percival, IDR, c/o Petroleum Development Oman, Dep Pez PO Box 81, Muscat, Sultanate of Oman.
Philpott, RJ, 2 Berkeley Avenue, Shipham, Torquay, Devon TQ2 7LE.
Shammas, P, APS Group, PO Box 3896, Nicosia, Cyprus.
Smith, B, 23 Dinsdale Avenue, Acklam, Middlesbrough, Cleveland TS5 8NW.
Steen, CJ, Babcock Thorn, Sales & Marketing Dept, Rosyth Royal Dockyard, Rosyth, Fife KY11 2YD.
Taylor, RV, Milnthorpe, Upton, Aylesbury, Bucks HP17 8TZ.
Tierney, N, 21 Anglesea Avenue, Blackrock, Co Dublin.
Wadland, IC, TS Technical Services UK Ltd, 83 Wimborne Road, Bournemouth, Dorset BH3 7AN.

Eric Drummond

Lawrence Urquhart, Group Chief Executive of Burmah Oil, gave the Celebrity Lecture to the Institute of Petroleum West of Scotland Branch, in October.

Mr Urquhart also presented an Institute of Petroleum Award of Council to Eric Drummond for long and meritorious service to the Branch.

Obituary

We report with much regret the death of James Dougary in October. He was a member of the IP Council in 1961–62 and a member of the Institute for many years.

After obtaining a chemistry degree from London University, he joined Anglo Iranian in Abadan in 1935 and was involved in the vital wartime project of producing 100 octane Aviation Spirit, peak production being one million gallons a day.

In 1945, he moved to Kuwait Oil Company (50% AIOC) in Kuwait where oil had been discovered pre war. During the next 20 years, he was deeply involved with developments there which peaked at a production rate of 150 million tons a year. He retired as General Manager in 1967 and was awarded the OBE in 1968.

Deaths

We report with much regret the deaths of the following members:

	Born
TC Richards, Swansea, Wales	1902
JS Palmer, Ellesmere Port, Merseyside	1921
CJ Paysant, Great Baddow, Essex	1904
DA Simpson, NATO headquarters	1932
WJ Stiff, Swanage, Dorset	1900
AJ Williams, Colchester, Essex	1922
D Whiteley, Harrogate, N Yorks	1924

Deliveries into Consumption

UK deliveries into inland consumption of major petroleum products — Tonnes

Products	*Sep 1988*	*Sep 1989**	*Jan–Sep 1988†*	*Jan–Sep 1989**	*% change*
Naphtha/LDF	242,770	266,510	2,455,540	2,323,890	−5.4
ATF—Kerosine	602,380	632,510	4,710,320	5,020,450	+6.6
Motor Spirit	2,000,820	1,992,200	17,327,220	17,893,620	+3.3
of which unleaded	28,620	517,410	113,590	2,952,260	+2499.0
Burning Oil	157,740	141,440	1,356,290	1,303,470	−4.9
Derv Fuel	814,360	861,570	6,926,070	7,497,030	+8.2
Gas/Diesel Oil	687,890	611,450	6,164,220	6,129,550	−0.6
Fuel Oil	804,870	595,310	7,562,020	7,073,330	−6.5
Lubricating Oil	70,180	78,940	644,290	674,430	+4.7
Other Products	582,290	556,870	5,225,000	4,914,050	−6.0
Total above	5,963,300	5,736,800	52,370,970	52,829,820	+0.9
Refinery Consumption	451,420	475,370	4,089,760	4,358,740	+6.6
Total all products	6,414,720	6,212,170	56,460,730	57,188,560	+1.3

*Preliminary †Revised

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The ties are priced at £7.50 each, including postage and packing, and are available to Members only, from The Membership Department, Institute of Petroleum.

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Honorary Editor

PETER ELLIS JONES

Editors

TONY SCANLAN
CAROL READER

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