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Cover photo of Brent Bravo courtesy of Shell UK Exploration and Production, operating on behalf of Shell and Esso. Reproduced from UKOOA publication, *The North Sea Achievement.*

. . . news in brief

10 August

Test results from the UK's deepest ever well have confirmed commercial reserves in a new offshore field which has been named Franklin by its operator, Ultramar.

Arco has notified its Southern California dealers that it will dump its leaded regular gasoline effective 1 September and begin promoting a middle-octane, medium-priced unleaded petrol.

11 August

The North Sea's newest oilfields, Rob Roy and Ivanhoe, operated by Amerada Hess, have entered production, sending oil down a 120 mile pipeline to the Orkney Islands.

Elf Aquitaine has put all its Australian exploration and production assets — including the sizeable Tern and Petrel gas fields — up for sale.

Three Japanese oil exploration firms are planning to bid separately in tenders to explore for oil in Burma.

A group of French and Japanese companies have abandoned operations in the Beibu offshore oilfield, China, after three years of test drilling showed production would be uneconomical.

14 August

Singapore Refining Company plans to increase the capacity of its refinery by 20,000 b/d to cope with additional demand — as part of a US$51.3m investment plan.

15 August

British Petroleum Plc will participate in oil exploration off the southern coast of Cheju Island, South Korea together with Japanese and South Korean partners.

A joint venture developing the Waihapa oilfield in the Taranaki area off the North Island, New Zealand will spend about $64m on a two stage development of an onshore well according to Petrocorp Exploration Ltd.

Texaco has decided in principle to reverse the flow of its Wichita Falls, Kansas to Houston pipeline to permit transport to the Midwest of oil arriving at the Gulf Coast by tanker.

16 August

Japan's five largest oil companies have increased the amount of oil they buy from the Middle East under term contracts by 25 percent since the end of 1987.

17 August

Oil exploration companies are expected to spend $425m over the next five years to explore for oil in Malaysia.

Imported oil accounted for more than half of US petroleum supply in July for the first time in 12 years, according to the American Petroleum Institute.

18 August

Mobil Corp said the Chinook-1 wildcat discovery well off the north west coast of Australia flowed 6,412 barrels of 52 degree gravity oil per day and 4,300,000 cubic feet of gas per day.

Exxon Corp says it has scrapped an oil drilling project located amid Mayan ruins in Guatemalan rainforest after strident opposition from environmental and archaeological officials.

Turkey has agreed to resume oil purchases from Iran with a new 5m tonne 1 year contract.

21 August

Du Pont Co said it will invest over $4m to build a recycling facility in the Netherlands to minimise the amount of polymer-based plastic waste from several of its European operations.

New estimates from the US Department of Interior show that the US has less undiscovered oil and natural gas than was previously thought. The estimates mean that possible hydrocarbon resources are 60 percent larger than known US reserves of oil and 90 percent larger than known reserves of gas.

22 August

Shell UK may be prosecuted under the Control of Pollution Act for the pipeline leakage which spilled 150 tons of crude oil into the Mersey estuary.

Conoco is hoping to bring the Jolliet Field on stream by the end of the year following the recovery from deep water in the Gulf of Mexico of 4 tendons for the project's tension-leg wellhead platform.

23 August

The North of Scotland Hydro-Electric Board announced plans to build the biggest gas-fired, gas turbine power station in Britain.

Malaysia's Sabah Gas Industries Sdn Bhd signed a deal to supply 500,000 tonnes of methanol to Sunkyong Ltd over the next five years.

24 August

Texaco Canada Inc said it has changed its corporate, commercial trading name to McColl-Frontenac.

Bow Valley has secured a 15 percent stake in an onshore Indonesian oil prospect in South Sumatra, operated by Northwest Energy.

Nymex announced that its new residual fuel oil futures contract would begin trading on 2 October and also revealed modifications to its existing crude oil contract.

25 August

Ultramar has decided to dispose of its Western Canadian exploration and production assets on a piecemeal basis in a move designed to raise more than Can$ 80m.

29 August

Gulf Canada Resources is to sell its oil and gas subsidiary, Home Petroleum.

30 August

Finland is about to accept a substantial increase in gas imports from the Soviet Union as part of the country's switch from oil to gas.

Plans to produce speciality chemicals as by-products of the Motunui synthetic petrol plant in New Zealand have been shelved as uneconomical.

Trinidad will spend about $183m in the next four years exploring for oil in new areas off and onshore.

31 August

A feasibility study on a £500m power project on South Humberside is to be carried out jointly by Yorkshire Electricity and the owners of the Lindsey refinery.

Ecuador plans to replace the state oil corporation CEPE with a new state oil company which would be called Petroleos de Ecuador.

Recoverable reserves at the Norwegian Gullfaks oilfield may be uprated by as much as 30 percent by the end of 1989 because of the identification of a substantial new reservoir.

1 September

Shell Exploration BV signed a contract with Morocco to explore for oil on three offshore Atlantic permits covering about 6000 square kilometres.

Shell has awarded a Nor.Krl. 7 bn contract to Norwegian Contractors for the fabrication of the concrete gravity base structure for Draugen, the first field on the Haltenbank to be developed.

4 September

Ecopetrol has decided to suspend oil exploration efforts in the Northern regions of Bolivar and Cesar due to terrorist threats from the Popular Liberation Army.

West German imports of natural gas rose 13.1 percent to 27.42 bn cubic metres in the first seven months of 1989, from 24.25 bn in the same period in 1988.

5 September

Bariven will give technical support to CEPE to help it operate Ecuador's main pipeline.

The Indian Oil and Natural Gas Commission has again found oil in the Cauvery Basin in the state of Tamil Nadu.

New technology for converting natural gas to petrochemical products is to have its first large-scale application in a plant which Shell is to build at Bintulu, Malaysia. The catalyst used in the Shell middle distillate synthesis plant, developed at Shell's Amsterdam laboratories, converts 90 percent natural gas to useful products — a much higher yield than previous conversion processes.

6 September

Sales of unleaded petrol in the UK went on rising in August and now account for almost a quarter of the UK market.

Eight oil companies, including Norske Shell, with a stake in the Statfjord field have sued the Norwegian government over a royalty dispute. The companies want full compensation for an alleged loss of NKr 450m.

Mobil Corp announced a draft plan to drill a natural gas exploration well in federal waters off the coast of North Carolina.

7 September

A dispute between Enterprise Oil, British Gas and Amerada Hess was resolved on 6 September. The three agreed on a division of a £624m package of North Sea oil assets.

Elf Aquitaine is planning to rationalise its North Sea oil and gas assets during the next six months.

All grades of Esso petrol rose in price by 5p, taking the price of 4-star up to 187.8p and unleaded to 175.5p.

8 September

Sir Peter Walters will retire as Chairman of British Petroleum in March 1990, making way for deputy chairman Robert Horton.

BP Canada has put its 50 percent holding in the Wolf Lake heavy oil project in East Central Alberta up for sale as part of a restructuring of its energy business.

Total-CFP has been chosen to join PTT Exploration and Production Co Ltd in developing its offshore gas concession in the Gulf of Thailand.

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Texas Eastern settlement

Amerada Hess Limited and British Gas plc have announced that they have agreed the joint purchase of Texas Eastern North Sea Inc (TENSI) for the sum of $961 million plus interest. TENSI is presently a wholly owned subsidiary of Panhandle Eastern Corporation and is engaged in North Sea exploration and production. TENSI has interests in 76 North Sea blocks covering approximately 350,000 gross acres and interests in eight producing oil and gas fields.

Immediately prior to the acquisition by Amerada and British Gas, TENSI will close the sale of certain oil and gas properties to Enterprise Oil plc for the sum of $308 million, which funds will remain the property of TENSI and are therefore included in the acquisition by Amerada and British Gas, resulting in a net purchase price of $673 million plus interest.

Amerada and British Gas have agreed that their percentages of interest will be 37 percent and 63 percent respectively and have entered into a shareholders agreement which provides appropriate control procedures.

Both companies regard the agreement reached as a major step in developing their UK North Sea oil and gas businesses through the acquisition of high quality complementary assets with which both companies are very familiar by virtue of their existing licence interests.

Sovereign extends operations overseas

British independent oil company Sovereign Oil & Gas plc has signed agreements for licences which, subject to the final approval of the Italian licensing authorities, will take the company into international operations outside the North Sea for the first time.

The company has taken a 40 percent stake in five Italian onshore licence areas spread throughout the country covering an area of 2,328 sq km. One of them, Monte Caruso, is close to the Monte Alpi and recent significant oil discoveries in the Central Apennines.

The remaining licences, Fiume Era (north west), Monte Spigno (south east), Fregene (on the outskirts of Rome) and Fiume Sacco (central Italy) are all located in areas of high geological interest.

Sovereign Oil & Gas will be the technical operator, providing technical exploration and engineering management. Commencement of seismic work is scheduled for early 1990.

Sovereign has the major interest in all five licences, with a 40 percent stake; other companies with interests in various licences include Texaco Ltd, Anglo-Scandinavian Petroleum plc and Seafield Resources plc.

Under (1992) EC free-market agreements, the state-controlled Agip will come under pressure to relinquish its exclusive status in the prime Po Valley Basin, which is the largest hydrocarbon producing area in Italy, and Sovereign intends to be in a strategic position to participate in this opportunity.

Namibian offshore survey

As independence approaches for Namibia, Halliburton Geophysical Services (HGS) will be embarking on the largest offshore survey ever undertaken in Namibian territorial waters. The survey is regarded as the prelude to a post-independence oil licensing round next year.

As part of an agreement reached with UK-based Exploration Consultants Ltd (ECL) of Henley, HGS will be acquiring about 10,000 line-km of data.

Earlier this year ECL entered into a contract with Swakor (Proprietary) Ltd to conduct major seismic, gravity and magnetic surveys and an initial 820 line-km of experimental data was acquired.

Under the joint agreement the remainder of the data will be acquired by HGS using the seismic survey vessel, *Patrick Haggerty*, below, Halliburton will also process all the seismic data, including that obtained during the initial survey.

The survey programme has been designed to provide regional coverage of the entire offshore area of Namibia but concentrates on the zones of maximum oil industry interest, especially those in the south, adjacent to the Kudu discovery.

Soviet PVC plant

A $200 million joint venture agreement to construct and operate two polyvinyl chloride (PVC) plants at Kalush in the Soviet Ukraine was signed recently in Moscow. This follows completion of a feasibility study to determine its technical and economic benefits. Occidental Chemical Corporation will be the partner of the Soviet Ministry of Chemical and Petrochemical Industry in the 'Arnica' venture.

The plants will produce PVC films and resins using state-of-the-art technology and know-how provided by OxyChem, the largest producer of PVC in the United States. Seventy-five percent of the output will be sold in the Soviet Union and other Comecon countries, with the remaining 25 percent to be marketed by Occidental in western and other international markets. It is anticipated that project financing will be utilised.

The first phase will be a PVC resin facility which will be started in 1990, with completion in 1993. The resin plant will produce 40,000 metric tons per year of PVC dispersion resins via OxyChem's HYBRID technology.

Occidental has also announced that its wholly owned subsidiary, Occidental Eastern Inc, has signed a new production sharing contract with the China National Offshore Oil Corporation to explore for oil in the South China Sea.

Seismic exploration on the new area is expected to begin in mid-1990.

Bruce Gas sales

British Gas plc and BP Exploration have reached an agreement for the sale of gas from BP's Bruce Field in the Central North Sea.

The equity owners in the field are BP (operator), Elf, Hamilton, Total, Ultramar, and Renown.

First production from Bruce is expected in October 1993 and British Gas has agreed to purchase 90 percent of the sales gas ouput. The remaining 10 percent will be sold into the direct sales market in line with the recommendations of the Monopolies and Mergers Commission report published last year.

Bruce, which is located in blocks 9/8A, 9/9A, and 9/9B in water depths of 120 metres, has reserves of 2.6 trillion cubic feet of sales gas and some 210 million barrels of condensate and gas liquids.

When Bruce production peaks in 1994, BP expects it will be providing over 16 percent of the country's gas.

BP Exploration restructures

BP Exploration has announced plans to streamline and re-structure the company which will reduce overheads by more than $150 million a year. The re-organisation will mean the loss of 1,700 office jobs, a reduction of 17 percent in the company's worldwide staff. Offshore staff levels will not be affected. In London, a total of 470 jobs will disappear.

In Scotland, where BP Exploration numbers have risen by 1,130 since early last year, some 970 office job losses will occur, over a third in Glasgow and the remainder in Aberdeen. This will be partly offset, says BP, by the location in Glasgow of the international Information Technology centre, involving a move of 100 posts, many to be filled locally, and in Aberdeen by the creation of some 200 new jobs as the Miller field gears up for production.

In the US, 280 job losses are expected at the Houston office, in Texas.

The company said a substantial number of job reductions could be achieved through early retirement and voluntary severance but would not rule out compulsory redundancies. Compensation and associated charges are expected to exceed $100 million.

The re-structuring is part of a wider strategic review of BP Exploration's current and future activity worldwide. Apart from the reduction in overheads, the new commercial strategy will be to rationalise existing assets; focus the search for oil and gas in the higher-risk, higher-reward frontier areas; exploit assets in established areas, such as the North Sea, more intensively and cost-effectively; and streamline the organisation and simplify the management structure.

Q8 tour launch

In an initiative to encourage British motorists to use unleaded petrol, a special mobile unit known as the 'Q8 Conversion Crew', visited selected Q8 service stations throughout September offering motorists the chance to adapt their cars for free, courtesy of Kuwait Petroleum (GB) Ltd.

The 'Q8 Conversion Crew' — launched by Secretary of State for Transport, the Rt Hon Cecil Parkinson MP — advised people on whether or not their cars could take unleaded fuel and adapted as many vehicles as possible.

The crew's tour was part of the build-up to 'National Lead Free Week' which started on 25 September and was initiated by CLEAR — The Campaign for Lead Free Air. The tour also marked the official launch of Kuwait Petroleum (GB) Ltd in the United Kingdom. The company, which hopes to become a major new force in the petroleum market, has developed significantly since its arrival in the UK in 1986. It now aims to use its position as a new player, in an established market, to be different. The objective is to avoid the big, impersonal style of retailing and promises to 'put the service back into the service stations'.

Kuwait Petroleum GB now has some 1,000 Q8 service stations comprising five percent of the UK network. This service station growth is a result of the acquisition and development of five smaller companies under the Q8 banner.

To support its growth objectives, Kuwait Petroleum has invested heavily in the company, its infrastructure and new product development. The acquisition of Carless Lubricants Ltd in June, now Kuwait Petroleum Lubricants Ltd, gave the company four percent of the British market overnight. The company also has nine authorised distributors, which sell petroleum products to farms, homes and local industry.

Australian permits

Applications are being invited for the award of offshore petroleum exploration permits over 12 areas on the Australian continental shelf.

The new release of offshore permit areas is part of an ongoing programme which encourages petroleum exploration in Australia's offshore sedimentary basins by making more offshore petroleum exploration acreage available.

The areas being made available are 10 areas in the Perth Basin (Western Australia); one area in the Bass Basin (Tasmania); one area in the Carpentaria-Karumba Basin (Queensland).

All these areas have been the subject of some exploration in the past, but additional work is required to assess fully their petroleum potential. Applications for these areas can be lodged with the relevant State Mines Department before 16 February 1990.

BG in Iraq

The Oil Exploration Company of Iraq and British Gas have signed an agreement to conduct a co-operative study of oil fields in northern Iraq.

The 18 month project will determine the hydrocarbon reserve potential of a 1,200 sq km (296,000 acre) area containing four known oil fields.

Texaco expands

Texaco has announced that its wholly owned subsidiary, Texaco Petrolera Argentina SA, is entering nine new exploration contracts with Yacimientos Petroliferos Fiscales (YPF), the state oil company of Argentina, bringing Texaco's total exploration acreage interests in Argentina to more than 19 million acres.

Manchester pipeline

Manchester Jetline Limited have awarded a contract to Norwest Holst for the construction of a pipeline for the transportation of jet fuel from Plumley to Manchester Airport.

It is expected that the new pipeline will be able to satisfy jet fuel requirements well into the next century more safely and efficiently than through the current method of road transport. Manchester Airport will now be the third major UK airport, following Heathrow and Gatwick, to be supplied by pipeline.

Canadian backlash

Canadians might never know if Petro-Canada wasted money by buying Petrofina for C$1.7 billion, auditor general Ken Dye said after the Supreme Court of Canada ruled he may not see cabinet papers on the takeover. Seven high court judges upheld a Federal Court of Appeal ruling that the courts cannot force the government to show Dye cabinet documents on Petro-Canada's 1981 takeover of Belgian-owned Petrofina.

Dye, who has been fighting in the courts since 1984, said 'Unless Parliament helps me to get the access I need my guess is we will never know the story.' Dye told a news conference he suspected that the Crown oil company under the Trudeau government paid twice what it should have for Petrofina. He plans to release a report based on his incomplete information. The case has been considered an important test of the auditor general's range of power in monitoring the business of government. The government has argued cabinet documents are privileged, but Dye said he needs access to ensure taxpayers are getting value for their money.

Optimism at Offshore Europe 89

Scheherazade Daneshkhu, in Aberdeen, reports on the conference and the mood of the offshore industry in northeast Scotland

Pipelaying in the northern North Sea.

The hoteliers in Aberdeen are happy. The Offshore Europe 89 exhibition attracted 25,000 visitors to the city and hotel space for the next biennial event is already limited. The show, which took place in the purpose-built Aberdeen Exhibition and Conference Centre, this year expanded to 28,000 square metres of space to accommodate the 1,200 exhibitors.

The mood at the opening ceremony was certainly upbeat against a background of a revival in North Sea activity and a growing sense of confidence and optimism for future prospects. Malcolm Rifkind, the Secretary of State for Scotland, opened the exhibition calling it 'one of the great international events of the oil industry', while participants found themselves comparing the show favourably with the well-established Houston Offshore Technology Conference.

Two themes have emerged from the show. One is the need to reduce costs in order to make exploitations of the North Sea's marginal fields viable; the other is concern about the impending shortage of skilled labour to meet increased demand in Scotland.

Cost cutting vital

The cost theme was emphasised in particular by John Browne, Managing Director and Chief Executive Officer of BP Exploration. Basing his figures on the 3.5 percent annual increase in worldwide energy demand since 1986, Mr Browne laid out a scenario in which a 2 percent per annum growth in energy demand would mean an additional 30 million barrels of oil equivalent per day by the end of the century. Limitations in the nuclear, coal and gas sectors would make it likely that incremental oil demand would reach 10 to 12 million b/d, of which at least three-quarters would come from OPEC, given diminishing supplies in the rest of the world.

But, unlike many analysts, Mr Browne did not think that this would necessarily lead to a rise in oil prices. 'Greater reliance on OPEC might create some instability but it could be the instability of renewed over-production. Rising prices are not inevitable. It would certainly be wrong to anticipate or plan on a dramatic, sustained rise in the oil price', he said.

Instead, operators needed to realise that 25 years in the North Sea and the development of the larger fields would mean an inevitable rise in costs per unit of output for the future. With the decline in reserve additions to replace production, the need to come to terms with the cost disadvantages of the North Sea are imperative. 'The North Sea is reliant for its viability on OPEC continuing to take the economic rent over and above their real production costs. OPEC, I believe, will continue to do that but the North Sea will suffer and its potential will be lost if its cost disadvantage is allowed to erode

further', he said.

Cost cutting measures supported by Mr Browne included a call on the government to abolish royalties and to relate tax to profitability only. Tax grievances were also echoed by George Band, Director General of the UK Offshore Operators' Association (UKOOA), who called for a reduction in the 86 percent tax rate on marginal fields. He did, however, praise the government for its 'enlightened' 1983 tax changes.

At a press conference, Mr Rifkind would not be drawn out on the tax issue other than to say that the oil industry was in a healthy state and that it would be up to the Chancellor of the Exchequer, Mr Nigel Lawson, to decide whether further incentives were needed. At the opening ceremony, Mr Rifkind quoted a figure of £145 billion in total revenue generated from the UKCS, of which some £70 billion has gone to the Exchequer.

But the practical side of the cost cutting equation, as Mr Browne emphasised, was what was left in the hands of the companies themselves. Here, technology plays the biggest part. Horizontal drilling, unmanned or remote subsea production systems look set to increase in importance in efforts to reduce the costs per unit of output.

While substantial cost-cutting methods have already been introduced, such as those employed by Shell in the Kittiwake and Gannet fields and by BP itself, Mr Browne thought that more could be achieved. 'Esso Norway showed that for platforms performing the same basic functions, costs in the UKCS are 1.6 times costs in the Gulf of Mexico, and Norwegian costs are a staggering two times those in the Gulf. That has to change if the North Sea is to have a future', he said.

Cost cutting incentives have led Shell to consider moving its airport base from Sumburgh in the southern Shetland Islands to the northern town of Unst. Flying time would be cut by half if such a move were undertaken. However, the Shetland Oil Industries Group (SOIG) which is keen to maintain Sumburgh as the premier airport, points to capital costs of some £5 million for a new airport while Sumburgh, which has had £40 million invested in it, offers excellent facilities.

Once criticised for charging landing rights so high that it would be cheaper to set a jumbo jet down at Heathrow, the airport management says landing rights are now down from £26 per passenger to £12. Despite the upturn in traffic, there is certainly room for more business; the tower room and terminal are still only working at 40 percent and 50 percent capacity. Chairman of SOIG Arthur Laurenson said, 'We are encouraging the new generation of oilmen to come and see Shetland for themselves and there are signs of an increasing appreciation of the role the islands play and of their potential for the future'.

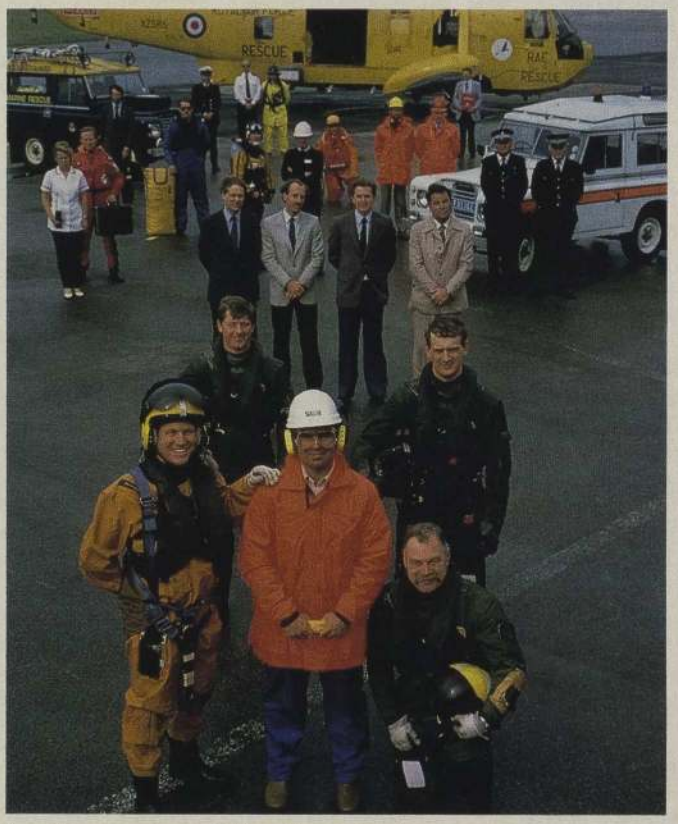
Gradual production decline

The future, and a buoyant one at that, was certainly on the agenda for the government, which took the opportunity on the opening day to announce three new North Sea developments. Making the announcements, Peter Morrison gave the go-ahead for the Shell/Esso Gannet field, Phillips Moira field and Mobil's Linnhe field. The three developments involved an investment of £750 million and Mr Morrison added that more than 10 Annex B projects were currently in the pipeline, though not all would necessarily be approved.

Mr Morrison also expressed pleasure at a set of technical projections released by UKOOA, again to coincide with the Aberdeen event. In its publication, *The Next 25 Years: Potential Oil and Gas Production from the UK Offshore*, UKOOA predicts that oil and gas from the UKCS will make a major contribution to UK energy investment and employment over the next 25 years. Peter Morrison said that the report confirmed the government's own projections that the future for the North Sea was longer than some would have forecast even a year ago.

Oil production from UKCS fields, which is currently just over 2 million b/d, will decline but far more gently than had been feared, according to UKOOA. UKCS production would be as high as

L to R: Dr Roy Wilkins, Assistant General Manager (Commercial), British Gas On Line Inspection Centre, explaining the advanced 'intelligent pig' to Peter Morrison, MP, Malcolm Rifkind, and George Band at Offshore Europe 89.



An offshore worker with his safety and back-up team.

1.3 million b/d in 2013, which means that though the United Kingdom would no longer be self-sufficient in oil, it would be far less import-dependent than originally expected.

The UKOOA study sees new oilfields contributing some 1 million b/d to future oil production by 2000, while gas from undeveloped fields has the potential to meet UK requirements for many years to come. Indigenous gas production, even without the contribution of gas condensate fields, could increase to about 5,000 million cubic feet per day (mcf/d) by the turn of the century. Adding gas condensates to the equation would boost total UKCS gas production up to levels as high as 8,000 mcf/d by 2000.

UKOOA identifies field development rates as one of the most important variables determining future production levels. Two new fields a year would see just over half a million b/d production from North Sea oil fields by the year 2000, compared with 1.25 million from five new fields. UKOOA has based its projections on three new platforms coming into production. 'We don't project a second oil peak', said George Band. 'There is a long, challenging period ahead but a bright future'.

Offshore expenditure

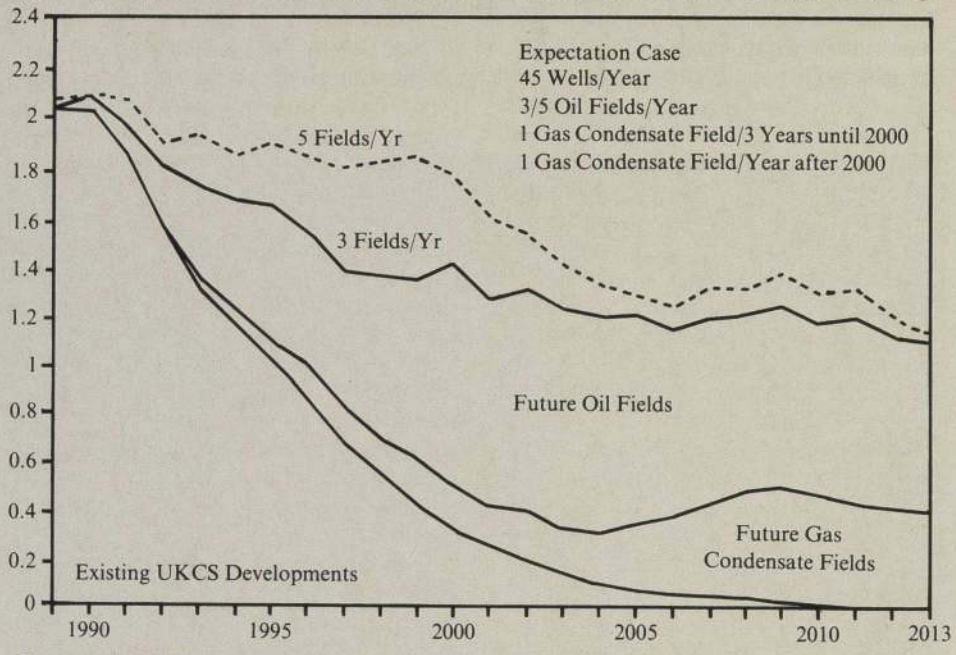
On the expenditure side, Mr Rifkind at the opening ceremony emphasised that, 'Over the next four years the resources spent by the industry will be over 10 times the cost of the Channel Tunnel'. The Scottish Development Agency (SDA) has published a five-year forecast of activity and expenditure for the industry which again foresees a bullish future.

UKCS total offshore expenditure dropped from £6.8 billion in 1984 to £4.6 billion in 1988. The SDA forecasts an increase of one-third in expenditure to a peak of £6.1 billion in 1991. The increase is based on a reflection of field development, pipeline and other exploration and development activity. The number of new fields in the UKCS, including gas condensates, to come onstream in the next five years is forecast to total 46 compared with 26 in the past five years.

Worldwide the picture is similar, though less dramatic. The SDA expects worldwide offshore expenditure to rise, in 1989 real money terms, from the 1988 value of $56.6 billion to $70.8 billion in 1993. Over the five year period, the total will be $338 billion, of which roughly half is expected to be on production facilities.

The increased space given to international developments in the report *Forecasts of Offshore Expenditure UKCS and Worldwide, 1989–1993*, reflects the SDA's planning towards the European

TOTAL OIL PRODUCTION POTENTIAL FROM UKCS FIELDS



Source: UKOOA

rather than solely the North Sea market. For Scottish-based companies to have a rosy future, it seems that they will have to spend time developing a more international outlook in order to become less reliant on the North Sea. The SDA is expected to provide assistance to Scottish companies to this end, in several ways. One is to provide facilities for developments in the technological field. The International Drilling and Downhole Technology Centre (see Technical News, page 516), in the Aberdeen Science and Technology Park, are both developments being promoted with the Grampian Regional Council.

The SDA says it can also help individual companies with their business development. In addition, assistance is being given to companies to penetrate export markets. £30,000 has so far been earmarked in grants. As worldwide markets open up, the SDA estimates that some $170 billion will be open to international competition. This is four times the amount spent on the UKCS. All areas, apart from the United States are expected to experience growth. Geographically, the largest markets are expected to be in Northwest Europe and also Southwest Asia where, for example, Japanese well heads are being used in Vietnam.

Trips have been undertaken, particularly to the Soviet Union, which the SDA regards as a particularly attractive market for Scottish companies, since there is a huge demand there for products and services as an alternative to those from the United States. Vietnam, Thailand, Malaysia and Indonesia are also being targeted.

1992 and all that

The main blot on the horizon, as far as Europe goes, is the draft directives under consideration regarding open procurement policy within the EEC. To date, the energy sector has been excluded from open public procurement policy but if the final decision results in a change, this will affect profoundly the offshore supplies industry. While most officials say they welcome 'full and fair competition', the implications are that the scramble for business will not be dignified.

'The official layer of tendering could lead to inefficiency and Scotland doesn't want this,' said Bob Downes, Director, North East of the SDA. 'EEC directives must not destroy the international competitive basis. We must move to consolidate our own markets'. The SDA is particularly anxious that companies understand their responsibility in being present in Europe in order to influence the standards currently under discussion and to ensure that these are formed to the advantage of UK offshore companies.

The fear is that British companies may find themselves competing with the large nationalised companies in Europe. 'It would be all right if the directives resulted in fair competition but in fact, it's a recipe for dirty play', said one senior executive. The resultant increase in the bureaucracy is another unattractive feature for most British companies.

Despite the push from the SDA, many companies appear to believe that 1992 will have less of an impact on their own sectors than the government expects. With the exception of individual countries such as Norway, many companies

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Tripoli, Libya, March 26 & 27, 1990

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EOR IN LIBYA: TODAY'S PERSPECTIVES, TOMORROW'S DIRECTION

Featuring

- ○ 5 Distinguished Keynote Speakers
- ○ 14 Technical Paper Presentations in 4 Sessions
- ○ A Panel Discussion by World EOR Experts, and
- ○ Exhibition by Service Companies & Consultants

For further information, please contact:

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seem to believe the opportunities within Europe are limited compared with markets overseas and the United States in particular. The Weir Group pump manufacturers, which already operate in Norway, the Netherlands and Denmark, say that 1992 is unlikely to make a big difference to their business.

Other suppliers such as the Sonsub Group, an engineering company committed to using diverless systems in exploration and construction programmes, also do not expect 1992 to make a difference to their fortunes. On the contrary, the company's record in Norway, where its head office is based, is more successful than in the United Kingdom. The main problem, according to James McLean, Marketing Director, is to persuade British operators that remotely-operated vehicles should be regarded as complete diver replacements. 'Our main competitors are divers rather than anyone else', he said.

The service sector

Although many suppliers are gradually recovering from the after-effects of the 1986 oil price shock, Ian Wood, chairman of the Wood Group plc, the Aberdeen-based services company with an annual turnover of £100 million and 2,000 employees worldwide, does not believe that the outlook for the service sector is necessarily bright. 'We are nowhere near where we should be in terms of North Sea activities, despite what the politicians say. Where are our exports?' he said. He called upon the government to undertake a study of overseas opportunities for the UK industry in order to increase the industry's 'woefully short' participation in the international market.

In a keynote address to the Offshore Conference, Mr Wood said that trading losses in North America and the crumbling North Sea market in 1986–87 have left their scars, with many contractors still fighting for survival. The drilling industry, for example, has lost an average of $1 billion per annum over the last three years. Mr Wood identified three medium-term implications of the free market approach:

- Increased diversification among the supply and service industries in an attempt to minimise risk;
- a poor survival rate for the small technological companies;
- an inability by the industry to achieve technological breakthroughs because of the lack of sufficient investment.

'The oil operators must therefore ask themselves, what number and quality of contractors do they require in the 1990s — what role do they wish them to play and what are they currently getting from them', he said. Mr Wood called for closer cooperation between oil operators and their suppliers/contractors — 'working together more like partners than adversaries' in technological development as well as risk sharing, in order to ensure greater stability for both sides.

Skills' shortages

Another problem for the future is the looming skills' shortage in the northeast. Company after company confirmed the problem, which was also brought up at the conference by Mr Wood. While acknowledging that the supply and service sector have a role to play in the necessary training, Mr Wood said, 'Current North Sea contracts do not begin to provide levels of return necessary to enable the service companies to make this kind of medium-term investment'.

Employment levels have climbed dramatically since 1986. The SDA says that the 10,000 jobs lost then, have since been replaced and that 60–70,000 people are now in jobs relating to the North Sea offshore industry. A staggering 5,000 of these were created in the Grampian region alone last year and the SDA predicts a couple of thousand extra jobs to come.

The main beneficiaries of the revival in the North Sea are the fabrication yards. Two of the largest yards nestle along the beautiful shores of the Cromarty Firth and the Moray Firth. Busy rig activity culminated in a record number of 17 rigs in the Cromarty Firth simultaneously at the beginning of the year. At Nigg, Highlands Fabricators was down to 39 men at the beginning of 1988 but now has 1,950 employees and has completed some 19,300 tonnage of work in the past year. Work has picked up more recently at the automated facilities of McDermott Scotland in Ardesier. Both companies highlight the increased demand for jackets and topdrive installation.

Moreover, the Module Constructors' Association (MCS) predicts an increase in manhours per annum, rising from its present level of 11.5 million to between 14–17 million next year and culminating in 21.7–26.4 million in 1991 right through to 1995. Can such demand be met domestically? The MCA believes it can, pitching maximum capacity in the United Kingdom at 28 million manhours per annum but there are sceptics who doubt that some 46 potential oil and gas developments in the next two to three years can be met through domestic labour.

The main skills shortages are for key technicians particularly in the manufacturing companies but recently signs are that such skills shortages are across the board, from large to small companies. This is despite the labour-saving techniques and greater efficiency developed over the years and accelerated by the 1986 collapse. A spokesman for the Weir Group said, 'We employ only half the number of people as 10 years ago, yet we are producing the same amount today'.

Halliburton, the huge, diversified services company, confirmed at its Aberdeen base that it is short of employees. The company, which is going through a period of flux at the moment due to internal reorganisation, says it has hired back all those who wished to return after 1986 — some 60 percent.

The government launched a new initiative, called Scottish Enterprise, on 31 August in an attempt to try to accelerate training. The aim is to invite business men to form consortia to bid for development funding in order to launch

The MSV Tharos approaching Invergordon, with the Trident X in the Queen's Dock.

local enterprise companies. Some £350,000 of funds is to be put in training but once again there is scepticism about the potential of the project which will see the phasing out of the Scottish Development Agency. There are doubts that the private sector will have the incentive to raise the investment needed for training, although the government is to pitch in with some funds.

Tom Clement, Managing Director of Highlands Fabricators and chairman of the recently restructured Cromarty Industries Group, sees skills shortages as the biggest limiting factor to the growth of the industry. 'I don't think Scottish Enterprise will really make a difference to the amount of training at the end of the day', he said.

The Highlands and Islands Development Board (shortly to be renamed Highlands and Islands Enterprise) is responsible for economic development in northern Scotland. While concentrating its activities on the oil sector, some initiatives have been made to build up smaller local enterprises not necessarily connected with the industry. One example is the Cromarty Centre situated in a converted brewery in the architecturally-important 18th century village of Cromarty. A Field Study Centre has been established there by the Aberdeen-based Richard Gordon's Institute of Technology (RGIT) with the aim of attracting students to the region to embark on specially designed RGIT courses.

Growth not boom

The upturn in the industry has been a godsend for all those involved but while predictions for the future are optimistic, the emphasis is on fostering a period of sustained growth rather than hopes for a boom. The 1986 collapse has caused companies to behave in a once-bitten, twice-shy manner with many reluctant to take on risk lest they be slapped down again.

The balance is hard to strike and many companies are still only at the recovery stage. But there is a general feeling of subdued pride at having overcome the trough. 'There has been a lot of introspection since 1986', said one company manager, 'but the market has now come back. The oil companies have got their act together so well that even if the price of oil fell to $15, they probably wouldn't be depressed about it.'

This view is confirmed by Johan Nic. Vold, Senior Executive Vice-President of Statoil, who told Offshore 89 that the uncertain oil price for the 1990s meant that companies had to be flexible. The silver lining is that 'Our organisations are leaner and our production teams more innovative'.

The lessons of the past, the success of the 11th licensing round and the strides taken in technological development do indeed seem to promise a more stable future for the offshore industry.

New technology delves subsea

By Steve Sasanow, Editor, Subsea Engineering News

Subsea is a new frontier which in times of adequate OPEC supplies at reasonable prices appears relatively expensive and unattractive. This issue of *Petroleum Review* attempts to balance this observation with the very long lead times inherent in the northern waters in the development of which subsea technology, especially under ice, is essential. Five years may be a long time in markets, but is a very short time in the world of offshore and northern waters, articles on which are also in this issue.

Steve Sasanow has been editor of the specialist offshore newsletter *Subsea Engineering News* since its inception five and a half years ago and has been covering the European oil and gas industry for more than eight years. He was previously North Sea correspondent for the American newspaper *The Oil Daily*, founding news editor of the geophysics magazine *First Break* and has contributed articles on offshore technology and policy and other energy issues to numerous publications including *The Times, The Independent, Offshore Engineer, The Oilman, Petroleum Management and New Scientist.*

Subsea research and development

If one looked for a single indicator that would highlight the growing importance of subsea technology, it would assuredly be the amount of subsea research and development (R&D) being carried out by the offshore industry.

The fact that the UK Department of Energy's Offshore Energy Technology Board (OETB) targeted subsea for special focus is significant. When one adds in the fact that half a dozen of the North Sea's biggest operators have been running large R&D projects for a number of years, this suggests that the industry perceives the need for expertise in subsea production and intervention, now and in the future.

What is interesting is that all of these projects — BP's DISPS (diverless subsea production system), Elf Norge's Skuld, Exxon's EDIPS (Esso diverless production system), Mobil/Kvaerner's SAS (Subsea Atmospheric System), Shell's DIMOS (diverless maintainable oil production system) and Statoil/Mobil's UPS (underwater production system) — began life before the oil price collapse of 1986 when operators were still talking enthusiastically about developing deepwater fields with big expensive subsea production systems.

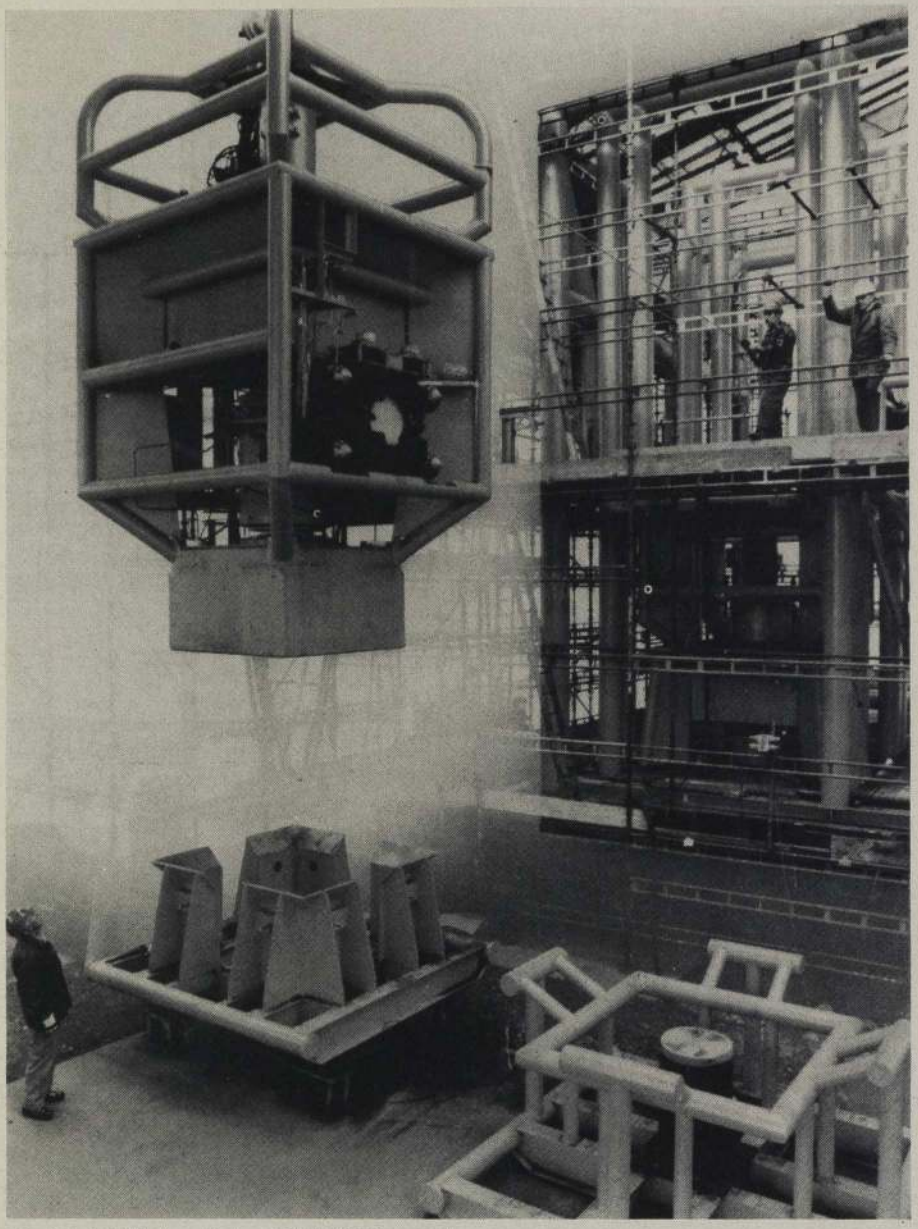
Changing scenarios

The crude price tumble did not, though, kill off these projects. On the contrary, it may have given some of them even more importance than before, except that the key words within the projects' scopes changed from 'new and emerging technology' to 'cost-effective solutions'.

The best example of this change was within UPS. When the project began in 1985 as a sole Statoil venture, its scope seemed to be to find a new and exciting solution for all the questions and challenges posed by deepwater subsea production, even if there were already suitable answers. Designers were using cad-cam systems to seemingly re-design every piece of existing hardware, even down to the simplest component level.

In just over a year, this had changed. Mobil Norway came in as a co-venturer and the new team focused on simplifying the concept and moving towards a more economic scheme. It seems likely now that UPS, in its refined form, will follow Skuld off the drawing board — Elf used its modular concept on the East Frigg gas development — and be the starting point for the Statfjord North and East satellite fields, due for formal startup in early 1990.

Just to prove that operators don't always get it right, the SAS concept, which is based on a one-atmosphere 'dry' chamber enclosing some of the more maintenance intensive equipment, is not likely to be used soon. Atmospheric chambers are definitely out of fashion compared with 'wet' (in-water) systems.



Module installation trial on BP DISPS project.

There also continues to be differing opinions on how best to configure, and thus maintain, subsea systems. There are those who favour insert technology, ie, remove and replace faulty equipment underwater, versus the modularists, meaning remove whole sections of systems and replace them with duplicates and do any equipment repair in the air. This debate will go on for some time.

Mainstream R&D

Besides the big 'system' there are three other key areas of subsea R&D. One is the development of production equipment that can be maintained diverless using remotely-operated vehicles (rovs) and tools (rots) to carry out basic installation and maintenance work on subsea xmas trees.

Within this area are the Comex Houlder-Vetco Subsea Intervention Systems (SISL) venture, the Mobil/Ferranti (with Cameron Iron Works and Sonsub as subcontractors) diverless xmas tree project and Agip's SAF design, with support from Tecnomare, Kongsberg Offshore and CIW, to be tried out on the Laura field.

The other two areas — subsea separation and multiphase pumping — seem to be intrinsically entwined and are often

seen as competing technologies, although this is not really the case. Both aim to solve the problem of trying to transport a multiphasic (oil/gas/water) wellstream — one by reducing it to its component parts and the other to try to overcome traditional pumping problems.

In the first area is BOET's prototype SSSU (subsea separation and storage unit), installed under Hamilton's *Deepsea Pioneer* floating production system and still waiting to come on-stream; Goodfellow Associates' GASP system, which is to begin testing on Teeside this year; VASPS (Vertical annular subsea separation system), originally a BP concept, but now being promoted by Baker Jardine and Mentor Engineering Consultants; and Aker Engineering's TSSTS (three-stroke separation and transportation system) development.

In multiphase pumping there is the Weir joint industry project; Multiphase System (nee Stothert & Pitt) work on marinising its topside pump; Total/Statoil/IFP's Poseidon project with its pump, developed by Insitut Francais du Petrole, due for testing in Tunisia this year; Shell's SMUBS booster station concept; Kvaerner's KSB-C compact booster system; the Italian SBS work by Snamprogetti, Nuovo Pignone and Agip; plus other pump developments by BHRA, Norway's Framo Engineering and Bornemann in West Germany.

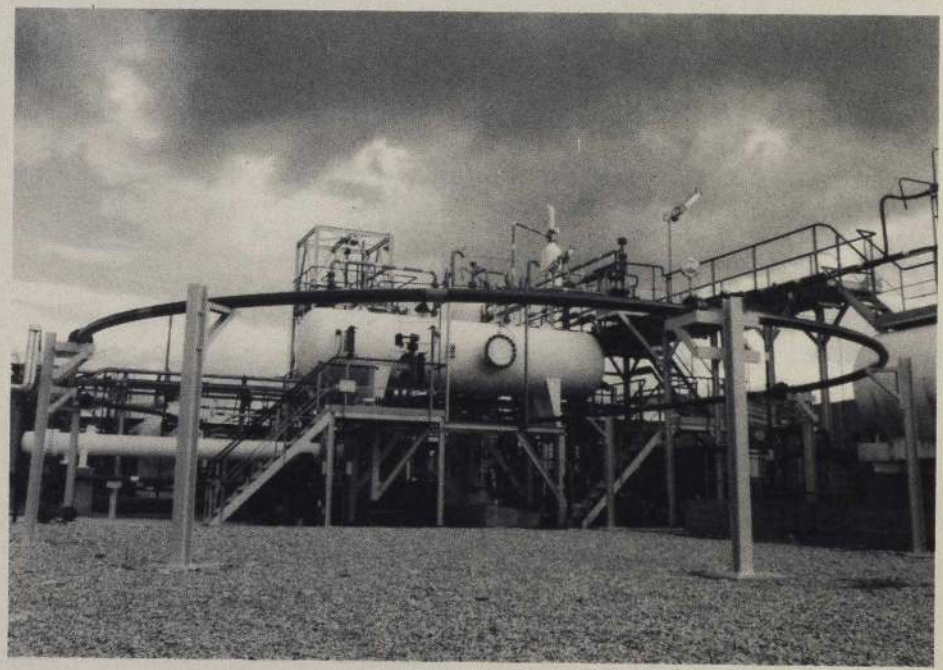
Also within multiphase technology is work on meters. The most advanced is Texaco's MPM metering station, already being tested at its Highlander subsea template, but rather a big beast and not the answer for all problems. Others, including Euromatic, Chr Michelsen's Institute, Petro-Canada, are looking for something more compact.

New interests

It would be impossible to catalogue all of the subsea R&D work going on at the moment. But other areas of interest include a subsea winch to be used for well maintenance (SWS with Amerada Hess); umbilical-less production systems (GEC SWAT, Conoco's tension leg wellhead control system and Agip Luna project); new subsea emergency shutdown valves (Liaaen and Grove Italia) and installation aids (BOET, Sheerwey Technology Group and BP with Royal Ordnance); subsea choke valves (AEA Technology and Introl); and so on.

There is no indication either, that the pace of R&D is due to slow down. There are likely to be fewer, if any, big umbrella projects, but probably more focus on small pieces of equipment which aim to reduce the cost and increase the reliability of subsea production.

There are satellite projects, too. Norsk Hydro is to run an extended well test of its 7/11 find with production to Phillips Norway's Cod platform, while Phillips continues thinking about South Eldfisk, also part of the Ekofisk complex, Saga's Midgard will follow as a gas satellite to Heidrun, but the biggest of the schemes will be carried out by Statoil with the Statfjord East and North satellite fields, due to begin formal development early in 1990. Statoil expects to use some of the technology developed in its Underwater Production Systems (UPS) research project on the Statfjord satellites.



Institut Francais du Petrole test loop at Solaize where Poseidon multiphase pump has been tested.

Current projects

Five years ago, the fingers on one hand exceeded the number of subsea projects on-going at any one time in the North Sea, as underwater production systems remained in the realm of new and advanced technology. Now, in 1989, subsea production has become a fully accepted part of many offshore development scenarios.

There remain few, if any, operators without at least a small subsea team and many projects, even those based on platforms, have elements of subsea within them. Subsea production can be broken down into three essential types: the satellite well or wells, either production or water injection, as part of large field development; the floater/subsea project; and the standalone subsea field. There are also several even more unusual configurations.

This is one of the aspects that makes subsea production such a useful technology. It can be made to work in a large number of configurations — single wells, clusters, template/manifolds, simple manifolds, combinations of producers and injectors, wells that begin life as producers and change to injectors later in the production life. A great deal of this flexibility has resulted from the development of the universal subsea xmas tree, which through the use of special wing valves, can be designed for either production or injection and changed from one to the other during its lifetime.

One of the first uses of such xmas trees was on Texaco's Highlander project in 1985. While subsea production had been used before Highlander (there were various satellites wells — BP's Buchan floating production system and Shell's Central Cormorant Underwater Manifold Centre, UMC) it was really the first project in which a subsea production system made the development of a marginally economic field possible. Thus it was a landmark project.

At the moment, there are 12–15 projects in the UK and Norwegian sectors of the North Sea with subsea elements that either have just come on-stream, are just due to come on-stream or are under development. Each one has one or two interesting facets that sets it apart from the others.

High technology

Subsea used to be thought of as 'new technology' and one project that has kept that image is Norsk Hydro's TOGI (Troll Oseberg Gas Injection) development. Gas from the western flank of Norway's

OIL SUPPLY AND PRICE

The Re-emergence of the Producers: OPEC and the Independents

The Annual IP Conference will be held on

TUESDAY 7 NOVEMBER 1989

Each November, a panel of distinguished experts come to London to discuss the latest outlook for world oil at The Institute of Petroleum. This year the speakers will come from New York, Moscow, Brussels, Calgary and Paris, as well as London. The Conference will be chaired by Silvan Robinson, Chairman of the Energy and Environmental Programme at the Royal Institute of International Affairs.

After the price collapse in 1986, world oil production remained relatively static in 1987. However, 1988 was a different story with world oil demand up by 4 percent and OPEC output over 20 million barrels per day for the first time since 1981.

Do these changes strengthen or weaken OPEC? What is the significance of the new developments in the Soviet Union? Will the spread of futures markets across the world and 24-hour trading improve or impair stability for producers? Are the 1990s going to see a different role for OPEC and the independents? How different will the new Single Market be for European energy? Where does the IEA see the demand curve for developing nations?

PROGRAMME

Morning Session

Keynote Address
Sir Peter Holmes, Chairman, Shell Transport and Trading Company plc

OPEC and the Middle East — An Energy Analyst's View
Mr Mehdi Varzi, Director, Kleinwort Grieveson Securities Ltd.

Spread of Futures Markets — Global Harmony or Regional Fragmentation?
Ms Rosemary McFadden, Former President, New York Mercantile Exchange

Problems for Consumer Nations in the 1990s
Mr Quincey Lumsden, Director of the Office of Oil Markets Development, International Energy Agency

Afternoon Session

European Energy Balances through and beyond 1992
Mr Clive Jones, Deputy Director General for Energy — European Commission

North America — An Oil Market Leader?
Mr Marcel Kramer, Senior Adviser for International Markets, Corporate Development, Petro-Canada Inc.

USSR — A Reappraisal of Energy and Export Values
Professor A A Arbatov, Vice-Chairman of the Committee for Productive Forces and Natural Resources, USSR Academy of Sciences

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

massive (1.3 tcm) Troll field is to be produced subsea, transported 48 km to Hydro's Oseberg field and then injected for pressure maintenance. The TOGI subsea station, just installed in Block 31/6, sits in 305 m, making it the North Sea's first deepwater (ie, greater than 1,000 ft or 300 m) facility. This, too, is a landmark project on many counts but probably its most notable feature, in addition to the water depth, is that it will increase by threefold the distance a remotely controlled subsea system has been placed from its mother platform. Production is due to begin in May 1991.

Continuing at the 'high tech' end of the subsea spectrum is Saga's Snorre project (34/4, 34/7). With a highly complex reservoir, the project features a tension leg platform (tlp) on one portion of the field and a huge UMC-style template manifold with 20 well slots on another.

Also in very deep (335 m) water, the Snorre subsea station is designed to operate any mix of 10 producing and/or injecting wells at a time with 10 spare slots to allow for the drilling of additional wells as the short-lived ones water out. The system combines through-flowline (tfl) capability for well maintenance and the use of a specially designed remotely operated maintenance vehicle (romv) for changing out insert valves and carrying out simple underwater tasks.

Norsk Hydro's TOGI subsea station loaded on a barge at Stavanger.

The smaller projects

At the other end of the spectrum are some smaller UK sector projects. They are often as highly engineered as the bigger, more complex ones, but tend to be solving simpler questions. A good example is the BP (nee Britoil) Don (211/18a) project.

It, too, has complex geology and production will begin from a single well through a simple manifold — one 3-D bend and three T's. This first phase of the project could end up as two producers and one water injector and if the early stages of production provide the right data, a second phase might see the first manifold moved to another part of the reservoir and a bigger manifold and seven more wells added to the phase one area. In order to accommodate all possible scenarios, GEC Avionics has supplied an electro-hydraulic control system that can grow with the number of wells.

Another project which has implications beyond its own development is Shell UK Expro's Osprey (211/23a) field. Shell, working with Cameron Offshore Engineering, spent several years developing a simple solid block manifold, a concept that it felt would be re-usable on other fields. Osprey is to get two such manifolds and Shell is to use the concept again (see the Future Projects section).

Amongst the novel features of other upcoming projects are:

- Marathon's Central Brae (16/7a): twin duplex stainless steel flowlines (reel-laid by *Apache*) with a unique double layer of insulation using polyurethane in both layers;
- Norske Shell's Draugen (6407/9): more subsea than platform wells with protective structures to be made composite (GRP) material;
- Arco's Welland (53/4a, 49/29b): first subsea wells in the North Sea controlled through an unmanned platform;
- Mobil's Linnhe/Ness II (9/13b): 'fast-track' projects making extensive use of individually laid pipelines.

Floating production

The floating production system (FPS) is finally coming into its own, particularly in the UK sector, with two projects on-stream this year and two more under development. There is also Sun Oil's Glamis (16/21a) project, which is essentially a three-well subsea satellite field, but is tied into Sun's Balmoral floating production system.

Hamilton Bros, with its long experience on the Argyll-Duncan-Innes complex, has brought Crawford (9/28a) on-stream. The most notable feature is that the company is using the upgraded *Transworld 58*, the original Argyll floater which produced the first UK sector oil 14 years ago, as the FPS.

The most recent addition to the list of FPS projects in production is Amerada Hess' Rob Roy/Ivanhoe development (15/21a). Amerada Hess is using a single FPS, the converted Sedco/Phillips support vessel, to produce from two small fields, each one using a manifold with cluster wells. The production manifolds are tied into a single riser base manifold.

There are no conventional FPS and Amerada Hess has done some interesting things on the floater, but most noteworthy is that the company was one of the first to react to the events at Piper Alpha last summer and spent an additional £15–20 million in safety features, including new blast and firewalls, and still brought the project in substantially under the original budget estimate.

On the floater development front are Sovereign's Emerald field (2/10a, 2/15a, 3/11b). The long-running saga about the project's development scheme, partners and financing far exceeds the technology here, although the production equipment will be maintained diverless and from the equipment side it will be the first large-scale use of Dunlop Armaline flexible risers.

Also coming up is BP's Cyrus (16/28), where the operator's single well oil production ships (SWOPS) will be used for the first time. It will also see the use of BP's universal subsea wellhead converted for subsea production.

The Institute of Petroleum

MODERN PRACTICE IN HANDLING AVIATION FUEL AT AIRPORTS

Wednesday 11 October 1989

to be held at

The Cavendish Conference Centre, London

During this one-day conference organised by the Institute's Aviation Liaison Committee an international group of speakers will explore some of the practices and problems related to the fuelling of aircraft throughout the world.

There will also be an exhibition by major equipment manufacturers which will be held at The Institute of Petroleum. Time is allowed in the following Programme for viewing of this exhibition.

PROGRAMME

TUESDAY 10 OCTOBER 1989

Viewing of the Exhibition at The Institute of Petroleum

WEDNESDAY 11 OCTOBER 1989

Morning Session:

Chairman: Mr SJ Shimmin, Shell International Trading Co., and Chairman, IP Aviation Liaison Committee

Opening Keynote Address
Sir Norman Payne, Chairman, BAA plc

TOPIC 1
'Multiple Aircraft Ramp System (MARS)'
Mr RM Wilson, BAA plc and Mr AG O'Beirne, Air BP

TOPIC 2
'Safety Equipment Issues'
Mr TA Sanderson, Shell International Trading Co., Mr CJ Williams, Avery Hardoll Ltd and Dr H Falckenberg, Elaflex Ltd

Afternoon Session:

TOPIC 3
'The Use of Filtration and Coalescence in Handling Aviation Fuel'
Mr Edward Matulevicius, Exxon Research and Engineering, New Jersey

TOPIC 4
'Hydrant System Integrity Monitoring'
to include:
'Introduction to the Problem' — Mr Albert Bates, Air BP
'The Hansa Consult Tightness Control System' — Mr G Schmidt and Mr P Schultz, Hansa Consult
'Underground Pipeline Leak Detection' — Mr Matulevicius

Chairman's Closing Remarks, and Viewing of the Exhibition at the IP

For a copy of the registration form, please contact

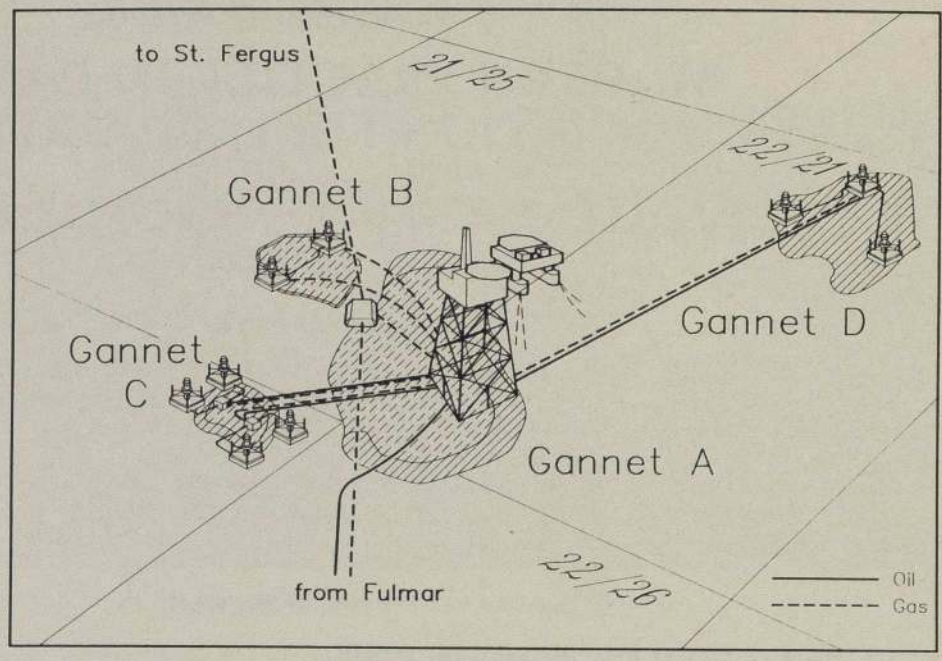
Caroline Little,
The Institute of Petroleum, 61 New Cavendish Street, London W1M 8AR.
Telephone: **01-636 1004.** Telex: **264380.** Fax: **01-255 1472.**

Future prospects and projects

Engineering consultancies, equipment suppliers and contractors in the subsea sector of the offshore industry, normally nervous sorts at the best of times, have been seen to be breathing a little more easily recently as the projections for the increased use of subsea production equipment and systems show a steadily rising curve.

This does not suggest that there is an excess of stability in the industry. Of the major producers of subsea production hardware, only FMC has not played musical chairs in the last few years. National Supply merged to become National Oilwell in order to increase its equilibrium. Cameron Iron Works swallowed McEvoy Willis and then recently found itself taken over by Cooper Industries, which only two years earlier had bought valve specialist W-K-M. Vetco and sister company Gray Tools were merged by parent Combustion Engineering, then sold to Hughes Tool, which merged Vetco with Hughes Offshore and then later sold it off to Bain Corp.

Despite this corporate insecurity, the future prospects for subsea are very good in both the UK and Norwegian sectors of the North Sea, but for different reasons, essentially reflecting the versatility and importance of underwater production systems.



The proposed field layout for Shell UK Expro's Gannet complex, showing a central platform (Gannet A) tied into three subsea developments (B-C-D).

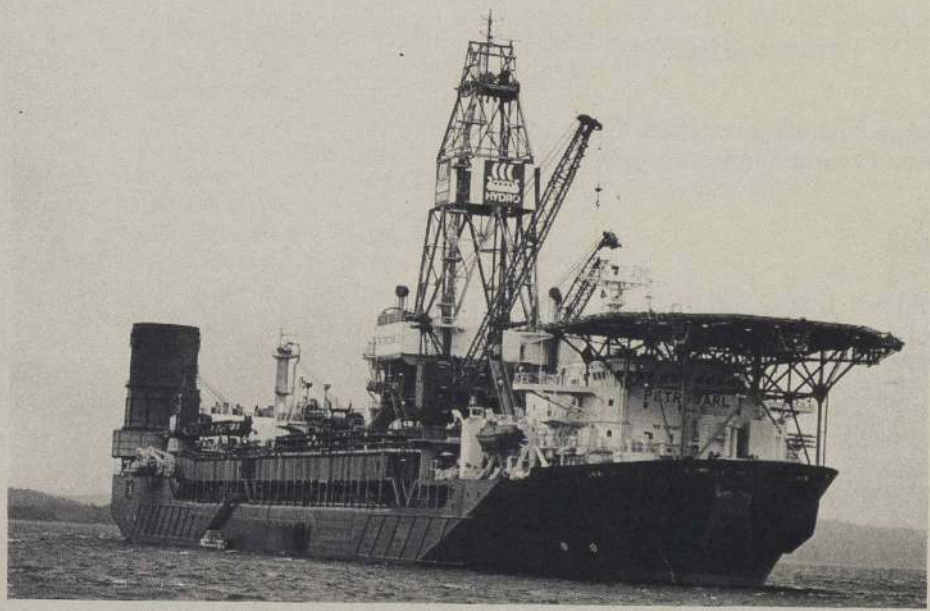
Satellite production

In the UK, with many fields past peak production and with excess processing capacity on a large number of platforms, operators will need to develop many of the smaller fields and want to find satellites nearby to keep process facilities in use and to push further into the future any thoughts of decommissioning platforms.

In Norway, while operators are for the first time beginning to think in terms of falling production profiles and developing satellite fields, the main trend is towards the development of its deepwater prospects, particularly oil. In many cases, deepwater fields, usually thought of as being in 1,000 ft or 300 m of water, will require subsea completions. In the case of bigger fields, tension leg platforms will certainly play a part, such as at Saga's Snorre field and possibly Conoco's Heidrun field on the Haltenbanken.

The future prospects for subsea in the United Kingdom were well presented in two reports out in the early spring, one which focused on general trends and one which addressed an important technical question facing the industry.

Oil sector watcher County NatWest WoodMac, formerly the Edinburgh stockbroker Wood Mackenzie, has presented its list of the expected next series of UK Continental Shelf developments. In the 42 projects mentioned, seven were gas and 35 oil, and of these latter, 27, or nearly 80 per cent, are projected to employ some subsea hardware.



The production testing ship *Petrojarl I* is to be used for an extended well test on Troll West.

The continental shelf

The range is from Chevron's heavy oil Alba project which is likely to have several water injectors on its flanks to increase reservoir pressure and Amerada Hess' Waverly/Brunel, which may have a handful of injectors and producers, to Conoco's Lyell field, expected to be a subsea or floater project, with up to 30 subsea wells, and Shell UK Expro's Gannet complex.

This last project is already on the drawing board and Shell plans to make extensive use of subsea in order to develop this four block, four-field complex. Shell will put a central platform (Gannet A) on this oil and gas development, which straddles Blocks 21/25 & 30

and 22/21 & 26, and tie-in three smaller accummulations.

Shell expects to employ its solid block manifolds as drilling centres, tie in a number of clustered wells to each manifold and link them to the Gannet A platform with flowline bundles. It is thought that Shell may use 15–20 subsea completions to fully develop Gannet. Not part of this scheme, but geographically linked, is the nearby Guillemot, which could add another 10 subsea wells to that total.

Another potentially big subsea project is Texaco's Strathspey (3/4a). At one time it was projected that this project, already in the conceptual engineering stage, would have twin production template/manifolds, making it one of the bigger subsea developments. But Texaco has put the project on ice for the moment, while it sorts out its oil and gas transportation problems, in an area with lots of options.

Other projects

Some of the other companies and projects mentioned in the WoodMac report are:

- Agip, with a big part of the T-block development going subsea;
- Mobil, which will continue to add satellities in the Beryl area with Katrina and Tay;
- Amerada Hess, already thinking in terms of an Annexe B for the small Hamish find, near Rob Roy/Ivanhoe;
- Sun, with Blair and Stirling to add to its Balmoral satellites;
- BP, with floater projects Ettrick and Machar in the back of its mind;

and others like Columba (Chevron), Ninian East (Lasmo), Piper redevelopment (Occidental); Gryphon (Kerr McGee); Nelson (Enterprise).

Another big boost in the United Kingdom for subsea, is expected to come from the development of high pressure gas/condensate (hpgc) fields, according to a report carried out for the Offshore Supplies Office and a number of operators by consultants Pell Frischmann GVA Engineering. It suggests that operators think subsea first when contemplating an hpgc development.

The study says that employing subsea completions would increase safety by reducing the impact of blowouts on these wells with high downhole pressures of 15–16,000 psi, or roughly 12,000 psi at the wellhead. It calls for the use of suitable wellheads that will allow for later conversion to production as the drilling of hpgc wells will be costly, up to £20 million each. Such developments will be dependent on new hardware capable of handling high pressures and temperature and complex casing programmes.

In Norway, the drive is for oil and much of it will be in deep water beyond 300 m. The big projects to come are Troll West where Norsk Hydro will operate and Conoco's Heidrun. An extended well test on the former, using the production testing ship *Petrojarl I*, is planned for later this year, while Conoco re-thinks its project and what to do with the large amount of associated gas, after its original early production scheme was shelved.

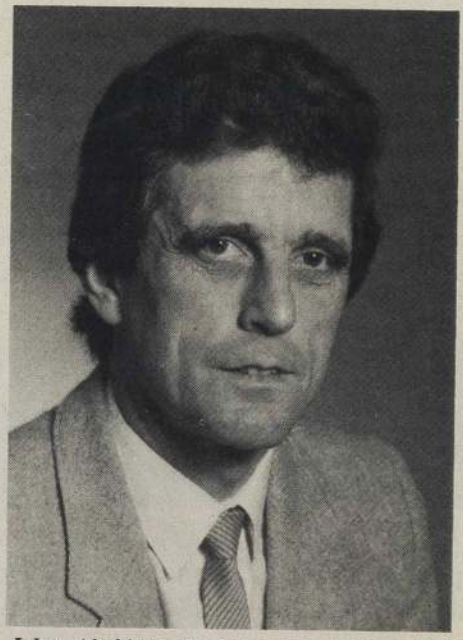
There are satellite projects, too. Norsk Hydro is to run an extended well test of its 7/11 find with production to Phillips Norway's Cod platform, while Phillips continues thinking about South Eldfisk, also part of the Ekofisk complex. Saga's Midgard will follow as a gas satellite to Heidrun, but the biggest of the schemes will be carried out by Statoil with the Statfjord East and North satellite fields, due to begin formal development early in 1990. Statoil expects to use some of the technology developed in its Underwater Production Systems (UPS) research project on the Statfjord satellites.

OPEC policy in a changing energy market

By David W Heal and John W Aitchison, Department of Geography, University College of Wales, Aberystwyth

In his analysis of the complexities of the world oil market at the end of the 1980s (*Petroleum Review*, October 1988), McCann drew attention to the 'pincer movement' which threatens to destroy even the vestigial coherence of OPEC. On the one hand, non-OPEC supplies of oil are increasing as governments everywhere encourage the search for new sources, which are preferably within the ambit of their control. On the other hand, the demand for oil has never quite regained the peak levels of 1979, even though the price has been falling since 1982, and by 1988 was lower, in real terms, than at any time since 1973. McCann suggested that a structural deterioration in world oil demand is underway and produced aggregate data in support of that hypothesis. If this is the case then the implications for all oil producers, OPEC and non-OPEC, as well as all producers of energy, are profound. The purpose of this article is to examine this hypothesis of structural change by an analysis of the variety in the pattern of energy consumption around the world, and the changes which occurred during the seven lean years of high real prices between 1979 and 1985.

David Heal, Lecturer in Geography, Institute of Earth Studies, University College of Wales, Aberystwyth. He has researched and published on the steel industry, industrial development in the Middle East and is, at present, finalising a study of the structure of demand for natural gas in the global energy economy.



John Aitchison is Gregynog Professor of Human Geography and Director of the Rural Surveys Research Unit at the Institute of Earth Studies, University College of Wales, Aberystwyth. His research activities and publications are wide-ranging but focus in the main, on problems of socio-economic development and cultural change in rural environments.

Variety between countries

We begin with an analysis of the pattern of energy demand in 1979. Using a simple least squares classificatory technique, countries can be categorised according to the significance of the fuels which they use.* The results of such an exercise upon data collated by the United Nations for *commercially* traded fuels, is presented in **Table 1**, which includes 107 countries each of which consumed at least one million tonnes of coal equivalent — the equivalent of one medium-sized coal-fired power station. Four different fuels are recognised — solid, liquid, gas and primary electricity. Each country is categorised according to the leading fuel which it employs — this determines the principal column in which it is found in Table 1 — but also according to the number of fuels used to a significant extent; this determines the row in which it is found.

No fewer than 85 countries are located in the liquid fuels column, and of these, 54 were so dependent on liquid fuels that no other fuel was statistically significant. This category is composed mostly of Third World countries in part a reflection of the data base which excludes the informally traded and used traditional fuels, whose energy consumption was small but it also includes large energy (oil) importers like Brazil. More importantly, it encompasses seven OECD countries including Japan, the fourth largest energy economy. Most other members of the OECD are located in the liquid column, but supplement their liquid fuel dependency with one or more other fuels.

Thus the USA, the largest energy economy, was a three-fuel economy as was the United Kingdom. New Zealand had the unique distinction of four-fuel status. Altogether there were 14 different permutations, which compares with the theoretical maximum of 64. The salient characteristic of the world energy economy, therefore, was its lack of variety. Inasmuch as the measure of variety is a measure of the ability to accommodate environmental change, the world energy market in 1979 was vulnerable to disruption. The economic recession and debt accumulation which followed the oil price increases of 1979–1982, were the fruits of that vulnerability.

The next stage in the analysis investigates the response which occurred between 1979 and 1985 after which oil prices declined as quickly as they had risen. The results of this analysis are summarised in **Tables 2 and 3,** which also include a glance backwards to 1973, the year before the first oil shock. The first point to emerge is that there was very

Table 1: Classification of economies by fuel-mix 1979

	SOLID	LIQUID			GAS	PRIMARY	
	Solid Alone Dominant	Liquid Alone Dominant			Gas Alone Dominant		
1-Fuel	S Africa, Zimbabwe, China, N. Korea, Vietnam, *E. Germany*, *Poland*	Algeria, Cameroons, Egypt, Ivory Coast, Kenya, Libya, Morocco, Nigeria, Senegal, Sudan, Tunisia, Bahamas, Costa Rica, Cuba, Dominican R, Guatemala, Jamaica, Neth. Antilles, Nicaragua, Panama, Puerto Rico, Virgin Isles, Bolivia, Brazil, Chile, Ecuador, Peru, Uruguay, Cyprus, S. Yemen, Hong Kong, Indonesia, Iraq, Israel, **Japan**, Jordan, Lebanon, Malaysia, Oman, Philippines, Saudi Arabia, Singapore, Sri Lanka, Syria, Thailand, U. Arab Emir, Yemen, **Ireland**, **Italy**, **Portugal**, **Spain**, **Sweden**, **Switzerland**, Papua N.G.			Bahrain, Qatar		63
	Solid/Liquid	Liquid/Solid	Liquid/Gas	Liquid/Primary	Gas/Liquid		
2-Fuel	India, Mongolia, *Bulgaria*, *Czeckoslovakia*, **Luxembourg**, **Australia**	Mozambique, S. Korea, **Turkey**, **Denmark**, **Finland**, **France**, **Greece**, **Yugoslavia**	Gabon, **Canada**, Mexico, Argentina, Venezuela, Afghanistan, Bangladesh, Burma, Iran	Ghana, Zaire, **Iceland**, **Norway**	Trinidad, Brunei, Kuwait, Pakistan, **Netherlands**		32
	Solid/Liquid/Gas	Liquid/Solid/Gas	Liquid/Gas/Solid	Liquid/Primary/Solid	Gas/Liquid/Solid		
3-Fuel	*USSR*	Colombia, *Albania*, **Belgium**, **W Germany**, *Hungary*, **U Kingdom**	**USA**, **Austria**	Zambia	*Romania*		11
4-Fuel			Liquid/Primary/Solid/Gas				
			New Zealand				1
Total	14		85		8	0	107

Note: Members of OECD in bold; of Comecon in italics; other countries in Roman.

little apparent change between 1973 and 1979, although the total number of single fuel economies declined marginally. The changes in the next six years however were very marked, partly because of policy decisions taken during the first period, for example in no less than 10 OECD countries oil consumption has never regained the level achieved in 1973. All three groups of countries contributed to change in the second period, but the largest contribution came from the OECD. By 1985, only Portugal was a single fuel economy (liquid). Japan had attained two-fuel status, and Canada and France had joined New Zealand in the four-fuel category. A three-fuel mix had become commonplace. Norway became the first country in which primary electricity is the leading source of fuel. The OECD still displays a liquid-fuel preference, but its share of world oil consumption declined from 63 percent to 56 percent, and has continued to decline. In Comecon the shift has been away from solid and liquid fuel dependency to natural gas. The USSR has a gas-solid-liquid fuel mix. In the Third World the trend towards liquid-fuel dependency has been definitely arrested, if not reversed, and the number of two-fuel economies has increased significantly. This category includes oil producers who are now making beneficial use of associated gas production, but also, from Latin America, Brazil, Cost Rica and Uruguay, where primary electricity has become a significant source of energy.

For the world overall, **Table 2** provides a measure of the liquid-fuel dependency which still obtains, but **Table 3** shows that more than half of the countries have left behind the one-fuel status, and that the trend towards diversity has been running strongly for at least 15 years. Equally important for the future is that the variety, as measured by the number of permutations existing, had increased from 14 to 20 by 1985. This is still far short of the theoretical maximum, but it suggests that the world energy economy by 1985 was less vulnerable to shock from whatever direction it might come.

Diversity within countries

The method used above provides a measure of the amount of change taking place by identifying those countries which moved from one category to another. It has been useful in measuring the extent of the flight from oil: the number of solely liquid fuel dependent countries declined from 54 to 38; the number in the liquid column from 85 to 79. It thereby provides one measure of structural change in the world energy market. The method does not, however, provide a simple measure of change which fails to cross the boundaries of a category. Such a measure is available in an index of diversification.† The lower limit of the index is 0. The upper limit, there being four types of fuel, is 1.386 (these limits are the natural logarithms of 1 and 4). Thus a country which used only one fuel would have an index of 0. A country which made equal use of four fuels would have an index of 1.386.

Indices of diversification were calculated for the 107 countries for 1979 and 1985. The **figure** presents a scattergram of the one set plotted against the other. The diagonal is a line of no change. The general trend is very clear; no less than 81 countries increased the level of diversification. The figure also identifies

Table 2: Classification of countries according to the leading fuel consumed

	OECD			COMECON			Others			Total		
	1973	1979	1985	1973	1979	1985	1973	1979	1985	1973	1979	1985
Solid	2	2	3	6	5	4	7	7	8	15	14	15
Liquid	22	22	20	1	2	1	59	61	58	82	85	79
Gas	1	1	1	1	1	3	8	6	8	10	8	12
Primary	0	0	1	0	0	0	0	0	0	0	0	1
Total	25	25	25	8	8	8	74	74	74	107	107	107

Table 3: Classification of countries according to the number of significant fuels consumed

	OECD			COMECON			Others			Total		
	1973	1979	1985	1973	1979	1985	1973	1979	1985	1973	1979	1985
One-fuel	10	7	1	3	2	2	55	54	42	68	63	45
Two-fuel	11	12	13	1	2	2	17	18	29	29	32	44
Three-fuel	4	5	8	4	4	4	2	2	3	10	11	15
Four-fuel	—	1	3	0	0	0	0	0	0	0	1	3
Total	25	25	25	8	8	8	74	74	74	107	107	107

the leading fuel with the following most interesting results. Of the 19 countries below the diagonal, nine were countries in which liquid fuels were not the leading sector. That is to say, these countries had less need than most to join the flight from oil, and were making maximum advantage of their local energy resource base. None of them were major energy importers. Four more, Afghanistan, Iran, Iraq and Lebanon were either at war or engaged in civil war, and were unlikely to have optimum patterns of energy consumption as a top priority.

The countries above the diagonal are divided into three groups. Firstly, those between the parallels are a very diverse group that achieved only limited absolute gains in diversification (the line has been arbitrarily fixed at +0·2). Secondly, there are 18 countries beyond the parallel. All of these are countries in which liquid fuels were the leading sector. Furthermore, with the exception of Ireland, they were all members of the group which the previous analysis had shown were heavily liquid fuel dependent. That is to say, the major achievers were all from the group that had the greatest inducement to respond to high oil prices after 1979. Liquid fuels remained the leading sector but 10 of them had escaped from the one-fuel category. These include Japan and Sweden from the OECD, and representatives from the three continents of the developing world, eg, Cameroons, Panama, and Malaysia.

The ability to increase diversity is, in part, a function of how much diversification remains to be achieved. The **figure** shows very clearly that there was an overall tendency for countries to respond to the size of the opportunity available to them, ie, the scatter of points above the diagonal is wedge-shaped, with the broad end of the wedge at the left-hand side. It is, however, reasonable to assess performance relative to the amount of diversification which remains possible. In order to identify the out-

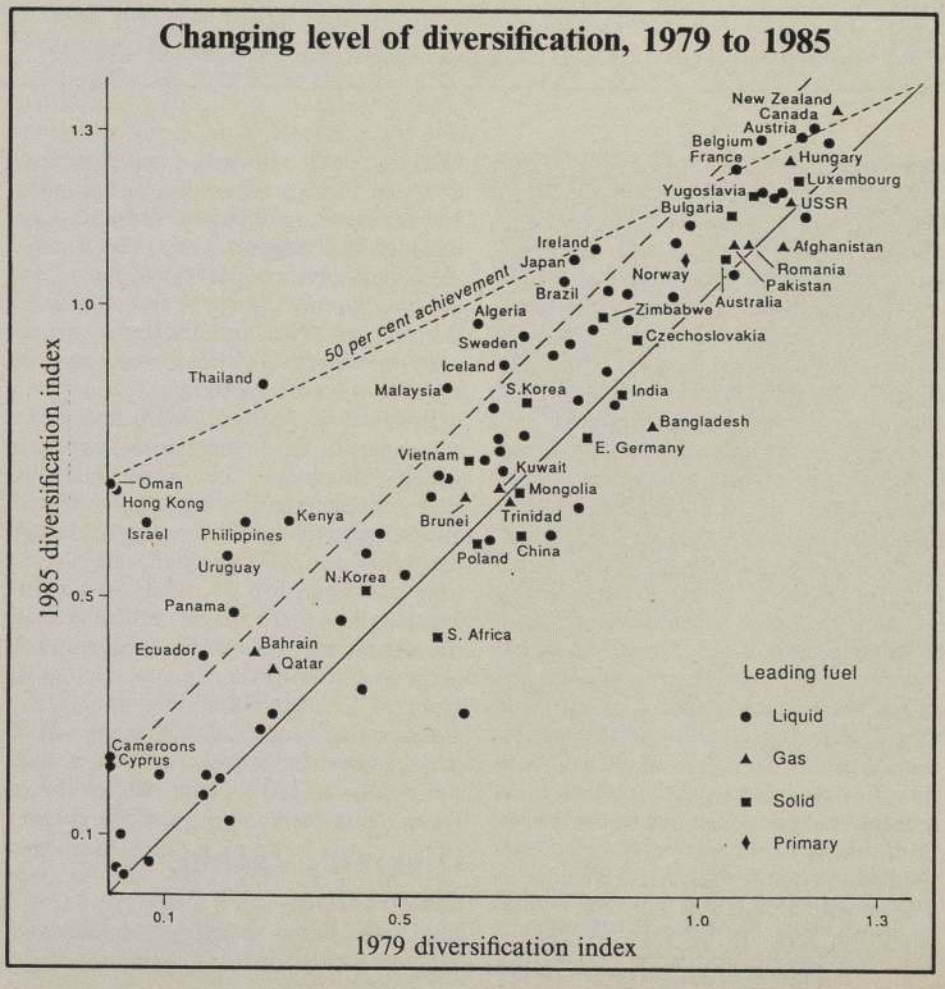


Table 4: Major diversifiers 1979–1985

	Index		% of possible	fuel combination 1985			
	1979	1985	improvement	Solid	Liquid	Gas	Primary
New Zealand	1.243	1.334	63.4	14	26	37	23
Belgium	1.114	1.282	61.4	30	38	24	9
Thailand	0.264	0.867	53.7	10	71	17	3
Canada	1.203	1.301	53.6	15	39	30	16
France	1.071	1.231	50.8	18	51	17	14
Austria	1.184	1.285	50.0	20	45	25	12
Oman	0.000	0.692	49.9	0	52	48	0
Hong Kong	0.012	0.680	48.6	42	58	0	0
Ireland	0.798	1.079	47.8	22	50	28	1
Japan	0.835	1.096	47.4	24	58	12	7
Algeria	0.631	0.971	45.0	9	50	40	0
Brazil	0.783	1.045	43.4	14	59	4	24
Israel	0.065	0.605	40.9	28	72	1	0

standing performers according to this criterion the **figure** includes a line above which are located six countries which achieved during these six years more than 50 per cent of the increased diversity which remained open to them in 1979. The details are presented in **Table 4** together with data for a further seven that achieved more than 40 percent of what was open to them. The table is of interest in terms of its contents and of the rank order. Five of the six outstanding performers are members of the OECD, who had already achieved a high level of diversity in 1979. The process seems to be a self-reinforcing one. This is without doubt of great significance for the argument of structural change in the energy market.

The single largest impact on the world economy is, however, likely to be that of Japan, the fourth largest energy economy, and Japan still has some way to go. Of the other countries, Oman and Ireland diversified into indigenous natural gas: Hong Kong and Israel into imported coal; Brazil into primary electricity. It should be noted that there are no representatives of Comecon in this table.

There is one country, Thailand, that obtained both a large absolute gain in diversity and a large relative gain. The data for Thailand are presented in **Table 5.** They show, for 1979, a typical Third World dependency on liquid fuels, and a low level of diversity (index 0·264). In the years that followed, by developing the newly discovered offshore gas fields, and by importing solid fuels, the level of diversity was increased (index 0·867) as total energy consumption grew by a third without any increase in the volume of imported oil. In the previous age, increased energy demand in a rapidly industrialising Third World country such as Thailand could have been expected to result in high oil imports. The significance of this new development to the oil producers is that, unless Thailand is a unique case, which it is not, they cannot rely upon capturing all the new demand in the Third World to off-set the increased energy efficiency of the developed world. Diversification and higher energy efficiencies are worldwide trends.

In his analysis, McCann drew attentional not only to the substitution effect of high oil prices, but also to the income effect and conservation effect. In the absence of adequate data these have not been examined in this paper, but in principle there would be no difficulty in so doing. If conservation was viewed as a 'fifth fuel' the indices would, of course, be different. The maximum value would be 1.609. The partial evidence that does exist shows clearly that the benefits from the effect are being gained by the high-technology societies, but these technologies are transferable, and are in the long term available to all societies. Energy consumption is increasingly a function of technology rather than geological resources.

Table 5: Energy consumption in Thailand (%)

	Solid	Liquid	Gas	Primary
1979	3	94	0	3
1985	10	71	17	3

Conclusion

The facts of the matter as outlined above are clear, the implications only marginally less so. Consumers do respond rationally to price increases. They also respond rationally to increases in insecurity of supply. An alternative to oil is a rational response to higher oil prices. Diversity of sourcing in any country reduces the risk of serious consequences from any major disturbance in supply. This is especially important to the world economy when diversity is achieved by the largest consumers. A reduced exposure to the consequence of disturbance should lead, in turn, to a calmer response to any such disturbance. Inasmuch as the very high prices of the early 1980s were the product of panic in the oil markets, anything that produces more calm should be welcomed.

But diversity is not the only universal rational response. Under some circumstances it makes more sense to capitalise on local advantages. This is easier for the small consumers, for example, Qatar and Norway but specialisation has also been adopted in some large markets, such as Poland, East Germany and South Africa. The trend away from single-fuel dependency is well defined worldwide, but what is more important is the increased number of permutations. It is highly unlikely that the theoretically possible 64 permutations will ever be achieved, but high variety is to be preferred to low variety as a stronger guarantor against panic. Thus the 20 permutations of 1985 are better than the 14 of 1979. The lesson to be drawn from **Table 1** is not that there is any single 'right' or 'best' permutation which all countries should aspire to, but that the 'best' solution for all is the greatest number of permutations achievable.

The world energy market in 1979 was vulnerable to a major disturbance because of the lack of variety. By 1985 significant steps had been taken to reduce that vulnerability. This was a process that had begun in 1974, and is not a process which is easily or quickly reversible. McCann argued that the short-term elasticity of supply from non-OPEC oil producers is low, and that the immediate consequences of an oil price collapse would fall most heavily on OPEC. This analysis of variety and diversity supports that argument and gives an indication of how slowly the world pattern of demand would respond to low prices. That there would be a response in time cannot be doubted, but in the immediate future it would seem that OPEC's preferred policy should be to defend the price of oil by controlling its level of production rather than to defend its share of an energy market which is continually finding alternative methods of satisfying aggregate demand through particular responses.

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*Aitchison JW, Heal DW. 'World patterns of fuel consumption: towards diversity and a low-cost energy future?' *Geography* (Vol 72, 1987), pp 235–239.

†Aitchison JW. 'Coefficients of specialisation and diversification.' *Area* (Vol 16, 1984), pp 121–129.

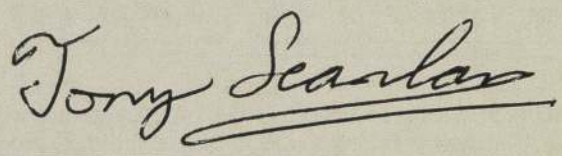
Letter from the Editor

This issue introduces a new design for *Petroleum Review*. Inside, the regular feature pages have been given a new style to differentiate them from main articles, not only for appeal but also for clarity. Forthcoming events is now a 'yellow pages' centre-fold pull-out. The regular placement of Contents on the first page, Events in the centre and Appointments (job recruitment) on the last page of each issue will also help readers to access information quickly. However, if occasionally major advertisers seek these positions, these features will appear on pages immediately adjacent. The Appointments page is also, of course, dependent upon advertisers — personnel managers please note. Jobs in the industry are on the increase and we look to you to advertise.

Forthcoming Events has expanded in the past year from one to four pages in response to demand. While entries remain without charge, editorial selection is final including the right to shorten entries. We try to select those events which we consider to have the greatest interest to our readers. The main IP meetings will continue to be included whether or not they appear elsewhere in the magazine, in order to keep this feature reliable as a stand-alone supplement. These may include some of the more important functions organised by branches of the IP —secretaries please note.

Finally, the new polythene wrappers are lighter than the envelopes they replaced, enabling us to use an improved quality of paper recently introduced in Britain, at no extra cost either in paper or at the post office. Over the rest of the year we expect to introduce further cost-effective design changes.

Tony Scanlan



Book Reviews

Blow Out by Robert Orrell

(London: Robert Hale, 192 pp; ISBN-0-7090-3944-5), £12.95

This is an unusual book which, according to the jacket gives 'a dramatic insight into the hard work, isolation, humour and danger of everyday life on a rig'. Bob Orrell is a writer and former BBC radio producer who apparently spends the time when he is not writing or with his family either on horseback or at sea. *Blow Out* gives an autobiographical account of his experiences as radio operator on the Hewitt A platform off Yarmouth in the southern North Sea, from the discovery of gas in late 1966 to the gas blow-out in November 1967; his accidental abandonment on the rig during the rescue and his return to the blowout with Red Adair and Vernon Andrews when the three men were dropped back onto the platform to inspect its raging column of gas and to diagnose how Adair would eventually control the well.

It is a hard hitting book, not one for those unable to accept the vernacular report of roughneck post-Tynan phraseology. The social habits of men trying to endure the stress of life offshore in those early days of North Sea oil and gas operations are shamelessly but sensitively recorded. The hardest hitting is reserved for the bureaucrats but there is warmth and praise for those from the companies, the rescue services, the townspeople and the churches who get to know the pressures on the men by actual participation in their problems instead of seeing the new industry as a bookkeeping item.

Orrell's style is engaging and immediate, something of Alastair Maclean perhaps, except that one has to remember that this is not fiction — the photographs prove that — nor, despite many advances in offshore conditions in the past 25 years, has the story lost its relevance or poignancy.

A Single European Market in Energy

(Joint report of Royal Institute of International Affairs and University of Sussex Science Policy Research Unit, available from 10 St James' Square, London SW1Y 4LE, UK at £10 including postage. ISBN-0-905031-28-8).

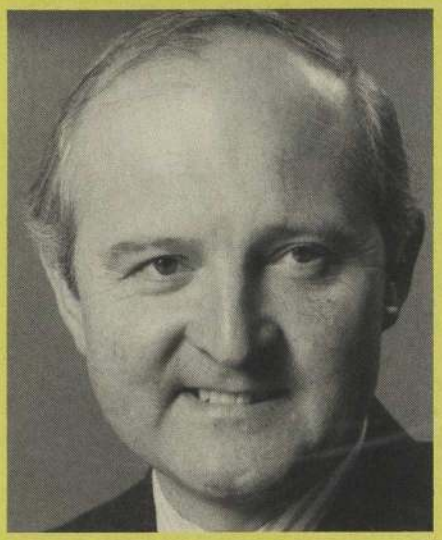
This is the first offspring of joint efforts from Chatham House and Sussex University — more especially SPRU whose European insight is enhanced by their active co-operation with Grenoble and Milan universities. The aim is to provide an analysis of the impact of the Single Europe Act on energy — originally an issue outside the 1992 debate but now seen as one of the main determinants of GNP accelerator if an internal energy market (IEM) can be achieved. The report notes that IEM proposals focus largely on basic supply — oil, gas, coal, electricity — but skip over demand efficiency or environmental impacts on the balance sheet such as conserving energy or emphasising renewables in the supply slate. The potential mismatch of excessive laissez-faire policies with security of supply issues is seen to be at the crossroads of Brussels' preoccupation with grid links beyond normal economic efficacy. Tangible benefits to consumers in a micro sense are perhaps more elusive than macro-economic attractions. External influences on IEM are also covered, as well as the tendencies of multi-nationals to think European rather than Thatcherite in the future free market. A stimulating look to the future for those who can live with the pace of the new Europe.

India Energy

Steve Sasanow who provides the subsea section of this issue has started a new bi-monthly newsletter focusing on the development of energy in India. India ranks in the top six economies in the world and its growth ambitions as well as its population rival those of China, but somehow have failed to attract the same attention. This new publication which may help to redress the balance is available from PO Box 213 Swindon SN6 8NT, UK. Telephone: 079371-303. Telex: 449703 telser g. Fax: 079371-433.

BP appointments

The Board of The British Petroleum Company plc has announced that, after 35 years' service with BP, Sir Peter Walters will be retiring on 10 March 1990. He has been a Managing Director of the Company for 17 years and its Chairman since 1981.

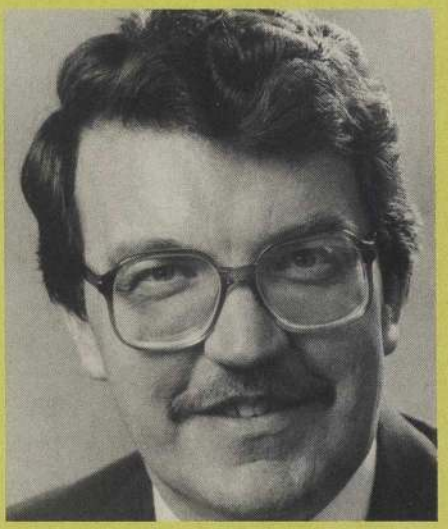


Robert Horton is Deputy Chairman of The British Petroleum Company plc and Chairman of BP Chemicals. His other responsibilities include the UK and Ireland, Government & Public Affairs, Human Resources, Pensions and Organisation Planning. He was formerly Chairman of Standard Oil and of BP America.

Sir Peter Walters

David Simon was appointed a Managing Director of The British Petroleum Company plc in January 1986. He is Chairman of BP Oil and BP Finance and is also on the Board of BP Nutrition. He has responsibility for the European Region, Finance, Accounts, Audit, Tax, Investments and Insurance.

Ray Knowland



Bryan Sanderson

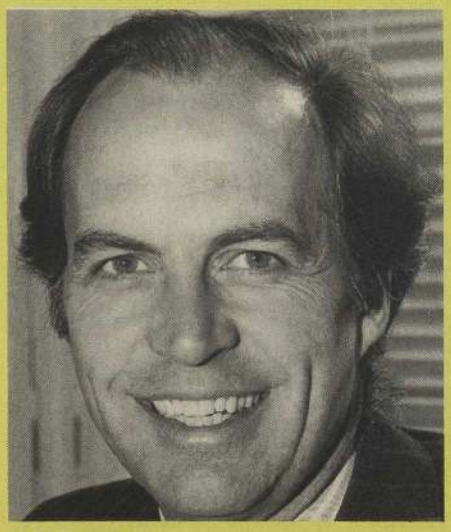
The Board intends to appoint Robert Horton, who at present is Deputy Chairman to be Chairman in succession to Sir Peter with effect from 11 March.

The Board also intends to appoint David Simon to be Deputy Chairman, and Ray Knowland as a Managing Director, both with effect from 11 March.

Bryan Sanderson will succeed Ray Knowland as Chief Executive Officer and Managing Director of BP Chemicals from 11 March 1990.

Robin Gourlay will succeed Mr Sanderson as Chief Executive and Managing Director of BP Nutrition, located in Antwerp, on 11 March.

Dr Charles Bowman will be appointed Managing Director of BP Australia Holdings, in succession to Mr Gourlay, on 14 February. Dr Bowman, from BP America, is currently a General Manager of BP Oil.



R M Gourlay

Charles Bowman

. . . people

Phillips Petroleum has made a number of new managerial appointments in its UK Exploration and Production Division. **Mr Kirby L Hedrick**, above, will be in charge of all UK exploration and production activities and will succeed **Mr Ted L Sandridge**, below, as Chairman and Managing Director of Phillips Petroleum Company United Kingdom Limited, based in Woking, Surrey. Mr Sandridge is elected corporate Vice President, International Exploration and Production, based in Bartlesville, Oklahoma. He will be responsible for all the company's exploration and production activities not assigned to the North America, Norway and United Kingdom Divisions.

Petrolite Corporation's oil field chemicals group has announced the appointment of **Marvin S Wade, Jr** to manager of speciality chemicals. In his new position, Mr Wade will supervise the group's well service, drilling fluids, transportation and corporate sales/oil field business units. Most recently he was operations manager for the company's European oil field operations.

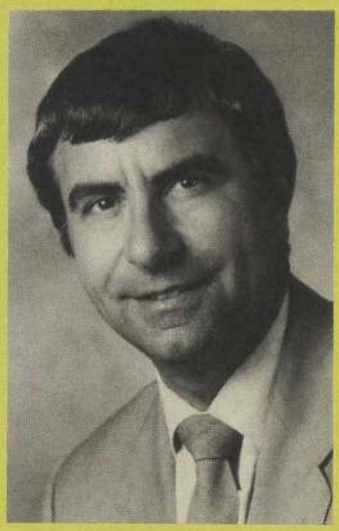
Mr Loïk Le Floch-Prigent has been appointed Chairman of Société Nationale Elf Aquitaine by the French Council of Ministers.

Dr Volker Mayweg has been appointed Manufacturing Director of Mobil Oil Company Ltd and Manager of the Company's refinery at Coryton in Essex. He succeeds **Mr Colin Murdoch** in an exchange of jobs which will take Mr Murdoch to Mobil's corporate headquarters at Fairfax, Virginia where he has been appointed European Manufacturing Coordinator.

The management buy-out of the Onstream Group has recently been completed and the consequent reorganisation has resulted in the setting up of a Dutch Holding Company, Onstream International Holding BV with its registered office in Rotterdam, and directed by group managing director, **Remti Maari,** below.

United Transport (UTE) has made a number of key appointments to strengthen its tanker team in the run up to 1992 and the Single European Market. **Mr Kevin Mellor** joins UTE as Chief Executive of the Tanker Division comprising all European road tanker and tank container operations. **Mr Philip Harrisson** becomes Chairman of the Tanker Division and will also be responsible for European acquisitions and development.

Dr Trevor Smith, below, has been appointed technical director of WASK-RMF, the pipeline fittings and ancillary equipment business which is part of the Parkfield Engineering Products Division.



A team from BP Oil took second place and a team from Conoco, third place, in their group in the regional final of the 1989 Reed National Management Game, held on August 31. The two-man BP team made profits of £8.1 million for its 'company' and was presented with a cheque for £700 and a certificate. The Conoco team, led by Mr Ian Wilson, made profits of £7.9 million and received a cheque for £500.

The BP Oil team — left to right: Mr Kevin Bell, Mr Michael Smithwick (Group Managing Director, Nicklin Advertising) and Mr Jonathan Wake.

Mr Donald Phillips, above, has been appointed to the newly created position of Operations Director at Wilcomatic Ltd, the UK's leading supplier of vehicle wash equipment. Mr Phillips was formerly a senior executive with BP where he spent the greater part of his 32 years in the UK retail sector.

Mr Kerry R Wark has been appointed marketing Director of Mobil Oil Company Limited. He takes over the Marketing responsibilities of **Mr Alan Britten**, Managing Director, Mobil Oil Company Limited who has been appointed Manager, Planning — Japan and Special Projects at Mobil Corporation's headquarters in Fairfax, Virginia.

In line with its reorganisation to a company with three major business units — Gas, Exploration and Production, and New Business Development, British Gas has announced seven top level appointments. The following four appointments have been made in the Gas business, all reporting to Group Executive member **Mr Ron Probert: Mr Simon Kirk** becomes responsible for marketing; **Mr Barry Reynolds** for finance; **Mr Max Tighe** for personnel; **Mr Russell Herbert** for engineering. The following two appointments have been made at Regional Chairman level in the Gas business: **Mr David Heslop** becomes Regional Chairman of British Gas Southern and **Mr Allan McKay** becomes Regional Chairman of British Gas North Eastern. In addition **Mr George Langshaw**, currently Regional Chairman of British Gas Wales, becomes Group Director of Personnel.

Microlec Group Plc, the USM quoted UK market leader in service station automation systems, announced the appointment of **Mr Ernest Potter** to the board as a non-Executive Director.

FORTHCOMING EVENTS

OCTOBER

3rd-5th
Nicosia: Third annual Arab Press Service conference on 'Middle East Strategy to the Year 2002'. Details: Arab Press Service, 37 Woodville Gardens, London W5 2LL. Tel: (01) 997 3707.

4th

London: Conference on 'Rapid Methods for Diagnosis of Microbial Problems in the Petroleum Industry'. Details: Caroline Little, The Institute of Petroleum, 61 New Cavendish Street, London W1M 8AR. Tel: (01) 636 1004. Fax: (01) 255 1472.

5th-6th
London: Conference on 'Exploring the Future: Trends and Discontinuities'. Details: The Strategic Planning Society, 17 Portland Place, London W1N 3AF. Tel: (01) 636 7737. Fax: (01) 323 1692.

8th-11th
San Antonio, Texas: Society of Petroleum Engineers Annual Technical Conference and Exhibition. Details: Fred Herbst, SPE, PO Box 833836, Richardson, TX 75083-3836, USA. Tel: (214) 669 3377. Fax: (214) 669 0135.

8th-20th
Oxford: Course on 'Management of Shipping Costs and Revenues with Computer Applications'. Details: Mrs J. Soper, Drewry Shipping Consultants Limited, 11 Heron Quay, London E14 9YP. Tel: (01) 538 0191. Fax: (01) 987 9396.

9th
London: Conference on 'Energy Policy and the Environment'. Details: UK-ISES, King's College London, Campden Hill Road, London W8 7AH. Tel: (01) 938 2919.

Call for Papers

The 13th Annual International Conference of the International Association of Energy Economics on 'Integrated Energy Markets and Energy Systems – Lessons and Perspectives' will be held in Denmark between 19 and 21 June 1990.
Papers are invited on such subjects as: demand, supply and interfuel substitution in integrated energy markets; energy system demand and supply balancing, capacity optimisation in integrated energy systems; pricing and regulation in integrated energy markets and energy systems. Prospective authors should send one or two page abstracts of papers, not later than 15 December 1989, to:
Petter Møller
General Secretary of the Conference
c/o SEAS Power Utility
Tingvej, DK-4690 Haslev
Denmark.

9th
London: Conference on 'Landward Oil & Gas'. Details: Nadia Ellis, IBC Technical Services Limited, Bath House (3rd Floor), 56 Holborn Viaduct, London EC1A 2EX. Tel: (01) 236 4080. Fax: (01) 489 0849.

9th-12th
Warwick: Course on 'Managing Major Emergencies'. Details: Petroleum Training Federation, Room 236, 162/168 Regent Street, London W1R 5TB. Tel: (01) 439 2632.

9th-13th
Mombasa, Kenya: Course on 'Land Tank Measurement, Shipboard Measurement and Flow Metering'. Details: The Course Manager, Redwood International Consultants Ltd, 29 Cambridge Park, Wanstead E11 2PU. Tel: (01) 989 5191. Fax: (01) 530 5547.

10th-11th
London: Seminar 'Diesel Fuel Injection Systems'. Details: Vanessa Whitehead, Institution of Mechanical Engineers, 1 Birdcage Walk, London SW1H 9JJ. Tel: (01) 222 7899. Fax: (01) 222 4557.

10th-13th
Florida: Meeting on 'Hazardous Substances and Oil Spill Response'. Details: Ray Sansone, ASTM, 1916 Race Street, Philadelphia, PA 19103, USA. Tel: (215) 299 5521.

11th

London: Conference on 'Modern Practice in Handling Aviation Fuel at Airports'. Details: Caroline Little, The Institute of Petroleum.

11th
London: Conference on 'Share Use of North Sea Assets – commercial, tax, legal & financial developments'. Details: Legal Studies & Services Ltd, IBC House, Canada Road, Byfleet, Surrey KT14 7LJ. Tel: (01) 489 0489. Fax: (01) 236 4080.

11th-12th
Bath: Symposium on 'Reliability on the Move – Safety and Reliability in Transportation'. Details: Ms A. Enderby, The Safety and Reliability Society, Clayton House, 59 Piccadilly, Manchester M1 2AQ. Tel (061) 228 7824.

12th
London: Conference on 'Standards: The Challenge of the Single European Market'. Details: Business Briefings Ltd, 565 Fulham Road, London SW6 1ES. Tel: (01) 381 1284. Fax: (01) 385 0974.

12th
Cranfield: One day seminar on 'Flow Measurement Update'. Details: Miss B. Baines, School of Mechanical Engineering, Cranfield Institute of Technology, Bedford, MK43 0AL. Tel: (0234) 752766. Fax: (0234) 750728.

16th-18th
London: Conference on 'World Coal – The 1990s'. Details: Conference Manager, CS Publications Ltd, McMillan House, 54 Cheam Common Road, Worcester Park, Surrey KT4 8RJ. Tel: (01) 330 3911. Fax: (01) 330 5112.

16th-18th
Los Angeles: 'Energy Markets in the 1990s and Beyond' sponsored by IAEE and UNIEE. Details: Joan Walsh Cassedy, IAEE, 1133 15th Street, NW Washington, DC 20005.

17th-19th
London: Course on 'Offshore Pipeline Engineering'. Details: Nadia Ellis, IBC Technical Services Ltd, IBC House, Canada Road, Byfleet, Surrey KT14 7JL. Tel: (01) 236 4080.

18th
London: Course on 'Drilling for Engineers'. Details: Society for Underwater Technology, 76 Mark Lane, London EC3R 7JN. Tel: (01) 481 0750. Fax: (01) 481 4001.

18th-20th
Stavanger: Conference on 'Structural and Tectonic Modelling and its

FORTHCOMING EVENTS

Application to Petroleum Geology'. Details: Norwegian Petroleum Society, PO Box 1897 – Vika, 0124 Oslo 1, Norway.

19th-20th
London: IHT/*Oil Daily* Conference on 'Oil and Money in the 1990s'. Details: Jennifer Bielenberg, International Herald Tribune, 63 Long Acre, London WC2E 9JH. Tel: (01) 379 4302. Fax: (01) 240 2254.

22nd-24th
Calgary: Conference on 'International Oil and Gas Markets'. Details: Conference Division, Canadian Energy Research Institute, 3512-33 Street NW, Calgary, Alberta, Canada T2L 2A6. Tel: (403) 282 1231. Fax: (403) 284 4181.

23rd
London: Talk on 'Energy Conservation'. Barry McNutt, DoE, USA. Details: Mary Scanlan BIEE. Tel: (01) 997 3707.

23rd
London: Conference on 'North Sea Gas Liquids – The Commercial Challenge'. Details: Overview Conferences, 19 Barlby Road, London, W10 6AN. Tel: (01) 969 1982. Fax: (01) 960 8850.

23rd-27th
Nigeria: Course on 'Land Tank Measurement, Shipboard Measurement and Flow Metering'. Details: The Course Manager, Redwood International Consultants Ltd, 29 Cambridge Park Road, Wanstead E11 2PU. Tel: (01) 989 5191. Fax: (01) 530 5547.

Call for Papers

The first (1990) Pacific/Asia Offshore Mechanics Symposium is being held in Seoul/Ulsan, Korea between 24 and 27 June 1990.
Papers are invited on subjects relating to offshore and marine technology and materials technology such as: offshore development, offshore structures and systems, codes and rules, pipeline and riser materials, pipeline materials/welding/inspection, pipeline design and engineering.
Prospective authors should send abstracts of around 300–400 words for review, by November 20 1989, to either:

Dr R Ramachandran, Director
Oil & Natural Gas Commission
9th Floor, Tower-II
Jeevan Bharati Building
124 Connaught Circus
New Delhi 11001, India

Prof Jin S. Chung
Organising Committee – PACOMS
c/o Colorado School of Mines
1500 Illinois Street
Golden, CO 80401
USA

24th
Solihull: Seminar on 'Fire Protection of LPG Storage Vessels'. Details: R. H. Shipman, Liquid Petroleum Gas Industry Technical Association, Alma House, Alma Road, Reigate, Surrey RH2 0AZ. Tel: (0737) 224700. Fax: (0737) 241116.

24th
Strathclyde: West of Scotland IP Branch Celebrity Lecture by L. M. Urquhart LLB, CA, Group Chief Executive, Burmah Oil Plc. Details: Mr A. Lowson, BP Exploration, 301 St Vincent Street, Glasgow G2 5DD. Tel: (041) 225 4937.

24th-26th
Florence, Italy: Conference on 'Internal and External Protection of Pipes'. Details: Lorraine Grove, Conference Organiser, 8th Pipe Protection, BHRA, The Fluid Engineering Centre, Cranfield, Bedford MK43 0AJ.

24th-26th
London: 'Sign International '89'. Details: Louise Levy, Batiste Exhibitions, Pembroke House, Campsbourne Road, Hornsey, London N8 7PE. Tel: (01) 340 3291.

25th
London: Conference on 'International Trade in Natural Gas'. Details: Caroline Little, The Institute of Petroleum.

25th-26th
London: Conference on 'UK Oil and Gas Accounting'. Details: Mrs E. Thomas, Centre for Petroleum and Mineral Law Studies, University of Dundee, Park Place, Dundee DD1 4HN. Tel: (0382) 23181. Fax: (0382) 201604.

26th
London: Conference on 'European Gas Markets: Regulatory and Environmental Developments'. Details: Ms Deborah Grad, WEFA Energy, 23 Lower Belgrave Street, London SW1W 0NW. Tel: (01) 730 8171. Fax: (01) 730 1400.

27th
London: Conference on 'Korean Science and Technology: Creating Competitive Capabilities'. Details: Korean Science Conference, The Royal Institute of International Affairs, Chatham House, 10 St James's Square, London SW1Y 4LE.

29th-3rd November
Moreton-in-Marsh: Course on 'Handling Emergencies in the Oil Industry'. Details: Fire Service College, Moreton-in-Marsh GL6 0RH. Tel: (0608) 50831.

30th
London: Seminar on 'Energy: Today's Decisions, Tomorrow's World'. Details: Geraldine Oliver, Information Officer, The Watt Committee on Energy, Savoy Hill, London WC2R 0BU. Tel: (01) 379 6875. Fax: (01) 240 7735.

30th
Kristiansand S, Norway: 'The Fourth Northern European Drilling Conference'. Details: Norwegian Petroleum Society, PO Box 1897 – Vika, 0124 Oslo 1, Norway. Tel: (47) 283 31 30. Fax: (47) 283 0547.

31st
London: Institute of Petroleum Cadman Memorial Lecture by Sir Peter Walters, the Chairman of British Petroleum Company plc. Details: Miss S. Ashton, The Institute of Petroleum.

FORTHCOMING EVENTS

31st–2nd November
Harrogate: Conference on 'Advances in Joining and Cutting Processes 89'. Details: The Meetings Department, The Welding Institute, Abington Hall, Abington, Cambridge CB1 6AL. Tel: (0223) 891162.

31st–3rd November
The Hague: Course on 'Corrosion in the Oil and Gas Industry'. Details: The Centre for Professional Advancement, Palestrinastraat 1, 1071 LC Amsterdam, The Netherlands. Tel: (020) 662 30 50. Fax: (020) 79 75 01.

NOVEMBER

1st
Zurich: Symposium on 'Solar Hydrogen'. Details: WCTC, Central Secretariat, Kellerweg 38, CH-8055 Zurich, Switzerland. Tel: (411) 463 02 26. Fax: (411) 463 02 52.

6th-7th
Madrid: Conference on 'Business with Spain – Strategies for 1992 and Beyond'. Details: Financial Times Conference Organisation, 126 Jermyn Street, London SW1Y 4UJ. Tel: (01) 925 2323. Fax: (01) 925 2125.

6th-8th
Amsterdam: Course on 'Cost/Planning/Economics for North Sea Projects'. Details: The Center for Professional Advancement, Palestrinastraat 1, 1071 LC Amsterdam, The Netherlands. Tel: (020) 6623050. Fax (020) 797501.

7th

London: Conference on 'Oil Supply and Price'. Details: Caroline Little, The Institute of Petroleum.

7th-8th
Maidstone: Conference on 'The Challenge of Fundamental Change in Europe's Gas Markets'. Details: Overview Conferences, 19 Barlby Road, London W10 6AN. Tel: (01) 969 1982. Fax: (01) 969 8850.

7th-9th
Aberdeen: Subtech '89 Workshop. Organised by Association of Offshore Diving Contractors and Society for Underwater Technology. Details: SUT, 1 Birdcage Walk, London SW1H 9JJ. Tel: (01) 222 8658.

8th-10th
Blackpool: 'UK Corrosion '89'. Details: PO Box 253, Leighton Buzzard, Beds LU7 7WB. Tel: (0525) 851967. Fax: (0525) 376690.

9th
London: Talk on 'Oil Supply'. Alexander Arbatov USSR Academy of Sciences. Details: Mary Scanlan, BIEE, 37 Woodville Gardens W5. Tel: (01) 997 3707.

9th
London: Lecture on 'Frigg Transportation System – a decade of Internal Inspection'. Details: The Pipeline Industries Guild, 17 Grosvenor Crescent, London SW1X 7ES. Tel: (01) 235 7938.

9th-10th
Madrid: International Conference 'Polypropylene – the way ahead'. Details: Diane Varley, Conference Manager, The Plastics and Rubber Institute, 11 Hobart Place, London SW1W HL. Tel: (01) 245 9555. Fax: (01) 823 1379.

12th-18th
Caracas: 'VII Venezuelan Geological Congress'. Details: Anibal R. Martinez, Pres. Organisation Committee, Centro Seguros La Paz, Petroleos de Venezuela, 3ro Av. Francisco de Miranda, Caracas 1070, Venezuela. Tel (+58 2) 239 1829-2084. Fax: (+58 2) 606 4963.

13th-15th
London: Conference on 'Power Generation and the Environment'. Details: Institution of Mechanical Engineers, 1 Birdcage Walk, Westminster, London SW1H 9JJ. Tel: (01) 222 7899.

14th-16th
Singapore: Conference and Exhibition 'The 4th ASEAN Council on Petroleum'. Details: Times Conferences Pte Ltd, 19 Tanglin Road, # 12-02, Tanglin Shopping Centre, Singapore 1024.

14th-17th
Milan: Conference on 'Engineering Solutions for Corrosion in Oil & Gas Applications'. Details: Prof R. N. Parkins, Department of Metallurgy and Engineering Materials, The University, Newcastle-upon-Tyne NE1 7RU. Tel (091) 222 7905. Fax: (091) 261 1182.

15th-16th
London: Conference on 'Risk Assessment for the Offshore Industry'. Details: Nadia Ellis, IBC Technical Services Limited, Bath House (3rd Floor), 56 Holborn Viaduct, London EC1A 2EX. Tel: (01) 236 4080. Fax: (01) 489 0849.

16th
London: Conference on 'World Electricity'. Details: The Financial Times Conference Organisation, 126 Jermyn Street, London SW1Y 4UJ. Tel: (01) 925 2323. Fax: (01) 925 2125.

16th

London: Conference on 'Cost Reduction Offshore – the Way Ahead'. Details: Caroline Little, The Institute of Petroleum.

16th-17th
Arlington, Va: Conference on 'LNG: How strong is the comeback?'. Details: Gas Daily, 2340 Texas Commerce Tower, Houston, TX 77002, USA. Tel: (713) 225 6035. Fax: (713) 225 6436.

16th-17th
Runnymede: Course on 'An Appreciation of Aviation Fuel & its Quality'. Details: Dr E. M. Goodger, RouteSouthWest Ltd, 78 Church Road, Woburn Sands, Milton Keynes MK17 8TA. Tel: (0908) 582120. Fax: (0784) 435383.

19th-24th
Moreton-in-Marsh: Course on 'Managing Major Emergencies'. Details: Fire Service College, Moreton-in-Marsh GL6 0RH. Tel: (0608) 50831.

20th
Oxford: Course on 'Maintaining Jet Fuel Quality in a Growth Market'. Details: The Registrar, The College of Petroleum Studies, Sun Alliance House, New Inn Hall Street, Oxford OX1 2QD. Tel: (0865) 250521. Fax: (0865) 791474.

20th-24th
Amsterdam: Course on 'Contracting and Contract Management 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.

FORTHCOMING EVENTS

21st
Oxford: Course on 'Diesel Fuel Quality Trends – The Growing Role of Additives'. Details: The Registrar, The College of Petroleum Studies, Sun Alliance House, New Inn Hall Street, Oxford OX1 2QD. Tel: (0865) 250521. Fax: (0865) 791474.

21st-22nd
London: Conference on 'Process Equipment for the Offshore Industry'. Details: Nadia Ellis, IBC Technical Services Ltd, Bath House, 56 Holborn Viaduct, London EC1A 2EX. Tel (01) 236 4080. Fax: (01) 489 0849.

21st-22nd
Stavanger: Conference on 'ONS-Advanced Petroleum Conference'. Details: Siv Aasland, PO Box 175, 4001 Stavanger, Norway. Tel: (+47) 4 55 81 00. Fax: (+47) 4 55 22 70.

22nd

London: Conference on 'Automotive and Industrial Fuel Combustion – Environmental and Health Implications'. Details: Caroline Little, The Institute of Petroleum.

22nd
London: Conference on 'Oil Pollution Claims & Liability'. Details: Legal Studies & Services Ltd, IBC House, Canada Road, Byfleet, Surrey KT14 7JL. Tel: (01) 236 4080. Fax: (01) 489 0849.

22nd-24th
Oxford: Course on 'Gasoline Technology and Economics – Specifications, Quality, Blending Components and Additives'. Details: The Registrar, The College of Petroleum Studies, Sun Alliance House, New Inn Hall Street, Oxford OX1 2QD. Tel: (0865) 250521. Fax: (0865) 791474.

23rd
London: Talk on 'Energy Modelling'. Jim Skea, SPRU (followed by AGM). Details: Mary Scanlan, BIEE, 37 Woodville Gardens W5. Tel: (01) 997 3707.

28th-30th
London: Course on 'Land Tank & Shipboard Measurement'. Details: The Course Manager, Redwood International Consultants Ltd, 29 Cambridge Park, Wanstead E11 2PU. Tel: (01) 989 5191. Fax: (01) 530 5547.

29th

London: Workshop on 'Standards of Competency'. Details: Mr Alan Lodge, The Institute of Petroleum.

29th-30th
London: Conference on Offshore Drilling Technology. Details: Nadia Ellis, IBC Technical Services Ltd, Bath House, 56 Holborn Viaduct, London EC1A 2EX. Tel (01) 236 4080. Fax: (01) 489 0849.

DECEMBER

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.

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
London: Talk on 'Outlook for Coal'. Mike Parker, British Coal. Details: Mary Scanlan, BIEE, 37 Woodville Gardens W5. Tel: (01) 997 3707.

11th-12th
London: Conference on Floating Production Systems. Details: Nadia Ellis, IBC Technical Services Ltd, Bath House, 56 Holborn 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'.
and
12th-14th
London: Course on 'Valve Technology for Offshore Oil and Gas Applications.
and
13th-15th
Amsterdam: Course on 'Documentation and Quality Assurance in the Offshore Oil and Gas Industry'.
and

18th-21st
Amsterdam: Course on 'Pollution Problems in Offshore Oil and Gas Operations'. Details: see 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. IP Members pay a reduced fee. Details: Conference Office, Sira Ltd, South Hill, Chislehurst, Kent BR7 5EH.

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

1990
IP Annual Dinner
21 February

Look out for your Ticket Application Form in the NOVEMBER copy of Petroleum Review

Overseas members should contact Caroline Little at the IP at 61 New Cavendish Street, London W1M 8AR as soon as possible. Tel: **01-636 1004**. Telex: **264380**. Fax: **01-255 1472**.

The closing date for receipt of ticket applications will be *Friday 24 November 1989*.

Mobil's new automated warehouse

Mobil has completed the second phase of its £30 million refurbishment programme to the company's Birkenhead Plant. Birkenhead is the centre of Mobil's lubricant blending, packaging and distribution operations in the UK. The plant manufactures and packages a range of over 650 lubricating oils, greases and wax emulsions, for distribution in the UK and abroad. Exports go to over 50 different countries and account for roughly 40 percent of the plant's throughput of 1 million barrels per year.

The first phase of the redevelopment project was the installation of a real-time computerised business system to control all Mobil's ordertaking using a new IBM AS400 computer. The recently-completed second stage was of the construction of an automated warehouse and associated automated materials handling facilities. The third and final phase, the automation of the manufacturing, blending and loading activities, is scheduled for the early 1990s.

The main contractor for the warehouse was a joint venture between Mowlem Engineering and BT Rolatruc. The warehouse is equipped with four 23 metre high automated stacking crates that deposit and remove pallets from the racking. 10 automated guided vehicles (AGVs) carry the pallets from the filling lines and from the warehouse to the lorry loading bays.

AGVs carrying pallets from the filling lines to the warehouse in Mobil's Birkenhead Plant.

The whole materials handling and storage operation is fully automated and the new warehouse is unheated and normally unlit.

Nixdorf computers

Nixdorf Computer Limited has announced a major £500,000 order from Taggarts (Motor Holdings) Limited, one of Scotland's largest motor groups, for four powerful Nixdorf Quattro minicomputer systems running Nixdorf's COMET Motor Plus motor dealer software.

Nixdorf's modular COMET Motor Plus is a sophisticated system designed for ease of use by non-computer personnel. It covers the five main activities of a motor dealer — Vehicle Sales, Parts, Servicing, Finance and Prospecting. All modules are completely integrated and interactive, and a dealer can start by computerising one or two activities and add others at a later stage.

Nixdorf Computer is Europe's leading minicomputer manufacturer. It operates through a network of sales and service centres throughout the United Kingdom, and in 47 other countries world-wide. In the UK, Nixdorf customers include major organisations such as the Midland Bank, Nationwide Anglia Building Society, the Alliance and Leicester Building Society, Tesco Stores, Dixons, Laura Ashley, Boots, British Airways Cargo, Saab, Twinings, and London Weekend Television.

CSPI buy Vortoil

Conoco Speciality Products Inc (CSPI) have purchased the world wide rights and distribution for the BWN Vortoil Hydrocyclone Separator. Control of UK operations will remain at the Gloucester Headquarters, under the direction of Conoco Speciality Products Limited (CSPL) and the regional office at Dyce, Aberdeen continuing its function as before.

Since its introduction in 1985, the Vortoil has proved to be the most efficient method of separating oil from produced water on offshore oil platforms. Such has been the success of the product, that today Vortoil Hydrocyclone Separators are in operation on 38 separate installations world wide, with the capacity to treat 2.5 million barrels per day. They weigh less than 10 percent of conventional systems, and require virtually no maintenance.

The technology incorporated within the Vortoil product is described by CSPL as complementing the company's existing product line, including the CDR Flow Improver for crude oil and refined product pipelines, GELSTOP pour point depressant and the HYDRAFLO emulsion technology.

Diving code

The Council of AODC (the International Association of Underwater Engineering Contractors) has given detailed consideration to adverse publicity over the past few months concerning safety aspects of commercial diving in the North Sea, in the air range, that is, down to a depth of 50metres (165feet). It was the unanimous view of members that most of the publicity had been misinformed and had not taken account of the considerable improvements in both the safety and cost effectiveness of commercial diving over the last 20 years.

The council fully acknowledged, however, that there is no room for complacency and means of improving the safety position even further, whilst still seeking improvements in the cost effectiveness of operations, must be sought. To this end, it was unanimously agreed that AODC should develop a comprehensive Guidance Note or Code of Practice to address all aspects of offshore diving in the air range including equipment, personnel, manning levels and operational aspects.

Whilst not having the force of law, the document would set down the basis of safe and cost effective air range diving from 1 January 1990.

Green light for £8.7 million Aberdeen drilling centre

Work is to start later this year on the International Drilling and Downhole Technology Centre in Aberdeen. The go-ahead results from Minister of State Ian Lang's announcement that the Scottish Development Agency (SDA) are to invest £2.4 million in the project. The Centre will be undertaking its first research and development contracts by the end of 1990.

The SDA's contribution represents the final part of the £8.7 million funding package necessary for the development of the Centre. The balance has been raised from major oil companies, service and supply companies and Grampian Regional Council who have contributed £500,000.

The Centre will be a major international facility – (unique in Europe) – where oil supply and service companies can develop, test and demonstrate new drilling and downhole techniques.

Located at the new Offshore Technology Park in the Bridge of Don area of the city, the Centre will house three wells and provide companies with the opportunity to test and develop equipment without having to interrupt production work being carried out offshore. It is expected to generate annual revenues in excess of £1 million.

The three wells will be of offshore design and configuration, while other facilities will include a full scale drilling rig of modern design. It will be placed on rails allowing it to be moved over either of the two proposed wells or used to drill additional wells for any future requirements or expansion of the Centre.

The wells and the rig will be supported by a range of service and operational equipment, including a blow-out preventor, mud mixing and storage facilities and electric power generation of approximately 2,500hp.

The Centre will be established as an independent company to ensure full commercial confidentiality to users of the Centre. Once established, the Centre will be operationally self financing. It will have a permanent staff, headed by a Director, Dr David Curry, who will run and maintain the Centre and, where appropriate, co-ordinate multi-client projects. This structure will ensure that the Centre's overheads are minimised and that the Centre can react quickly to changing requirements of the industry.

'Eyeball' ROV

OSEL, Offshore Systems Engineering Limited, have announced the sale of their first 'NUFO' Rov System to Tynebase Subsea Limited the Tyneside based offshore operations and engineering support company.

NUFO is believed by OSEL to be the most advanced 'eyeball' ROV ever produced, with massive onboard electrical power and an impressive electrical and electronic payload.

Developed from the pedigree of the UFO and Rigworker Rovs, both now industry standards, NUFO incorporates a full work Rov multiplexer and has some 15kva of electrical power available at the vehicle.

The vehicle is specifically designed to interface a full range of proprietary cameras, sonars and tools. It can be fitted with 5 or 7 brushless DC thrusters, designed exclusively for use with NUFO which afford the vehicle an all round performance in excess of 3 knots with a boost capability of 5 knots.

OSEL claims that the unique power control system of NUFO is the first real development in the ROV business for several years. Both OSEL and Tynebase are confident that the NUFO will fill the gap in the offshore industry for a high performance inspection and construction support ROV.

Steam plant

Cyanamid (UK) is a research based pharmaceutical, medical, agricultural, and chemical company. Its cogeneration (or CHP-Combined Heat and Power) plant is the first project in the UK to feature a dual fuel reciprocating engine with boost firing of exhaust gases to raise steam and consists of a NEI Crossley-Pielstick 10PC 2V dual fuel engine with an electrical power output of 3.5MWe.

Exhaust gases are ducted to an NEI Cochran boost fired exhaust gas boiler designed to meet an average base load steam demand of approximately 17,000lbs/hr with peaks of up to 30,000lbs/hr. The exhaust gases, emerging at a temperature of 450 degrees C, contain 10 percent oxygen. Boost firing consists of injecting into the stream of hot exhaust gases a supply of natural gas which combusts easily and efficiently by combining with the available oxygen.

Thermal efficiency is greatly enhanced because the oxygen is already at a high temperature. At maximum output, overall thermal efficiency approaches 76% (Gross CV).

Satellite control

Kongsberg Offshore in Norway has developed two modular systems, KOS 100 and KOS 500, for remote-control production from satellite reservoirs.

The systems have already been bought by Agip for installation in the Mediterranean and by Saga for installation in the North Sea.

The purpose of the KOS 100/500 is to enable offshore oil producers to exploit marginal and satellite reservoirs by remote-control techniques. The costs of the alternative, a separate production platform, are often too high for profitable operation.

The KOS 100 is a control module for installation on the seabed at depth of up to 1000 metres without the use of divers. In the KOS 500 system the control modules are installed and retrieved by a free-swimming ROV. They are interchangeable with the 100 module, sharing its basic technical features.

The systems provide full control of the production trees from land or from a platform and relay well parameters and data back to the operator.

Thai refinery complete

A major project at Thai Oil Company Limited's Sriracha Refinery was recently finished. The $230 million Stage I Project was successfully completed on time, within budget and is now on stream. It consisted of a major new process area block, the revamping of existing process units and supplementary utilities and offsites needed to support the new capacity such as extra tankage, additional effluent treatment plant and an extension to the jetty.

The processing capacity of the refinery has now been increased from 65,000 barrels per stream day to 115,800 BPSD. The crude capacity has been expanded from 65,000 BPSD to 83,500 BPSD as well as the ability to process 32,300 BPSD of imported long residue

The main new process units in the expansion include a hydrocracker complex consisting of a vacuum unit, a hydrogen manufacturing plant and a hydrocracker. The Managing Contractor throughout the project, on behalf of the Thaioil, has been Foster Wheeler Energy Limited of Reading, England.

Audi makes catalysts standard in UK

Audi has become the first manufacturer to offer British motorists top specification catalysts as standard equipment across its entire vehicle range, at no charge to customers.

Audi's no-compromise position means that all its cars will in future be fitted with electronically controlled three-way regulated catalysts that exceed the demands of the world's toughest legislation, and destroy at least 90 percent of all poisonous exhaust gases.

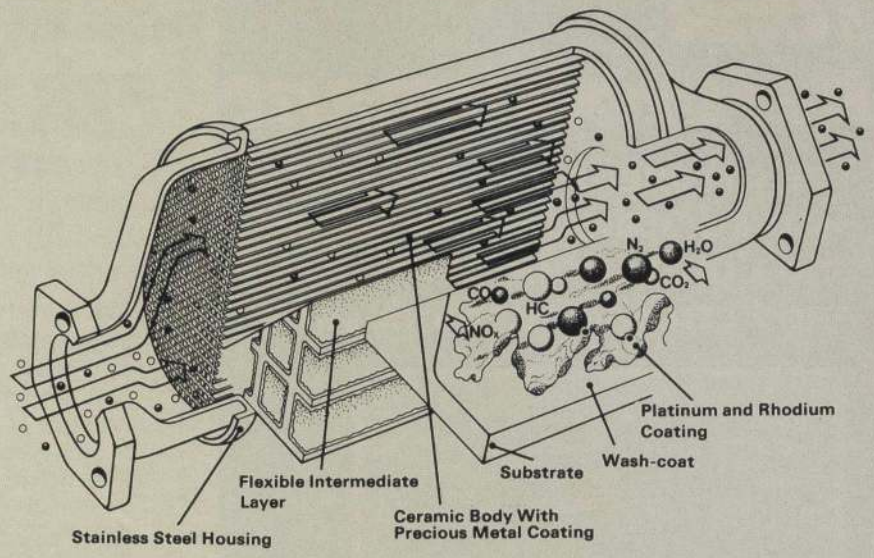
Moreover, according to the manufacturer, the new catalyst cars will cost no more to buy, no more to run, nor will they compromise on performance or economy.

At the same time the cars will be fully equipped to comply with impending 1992 exhaust emission legislation, when all cars will have to be similarly equipped.

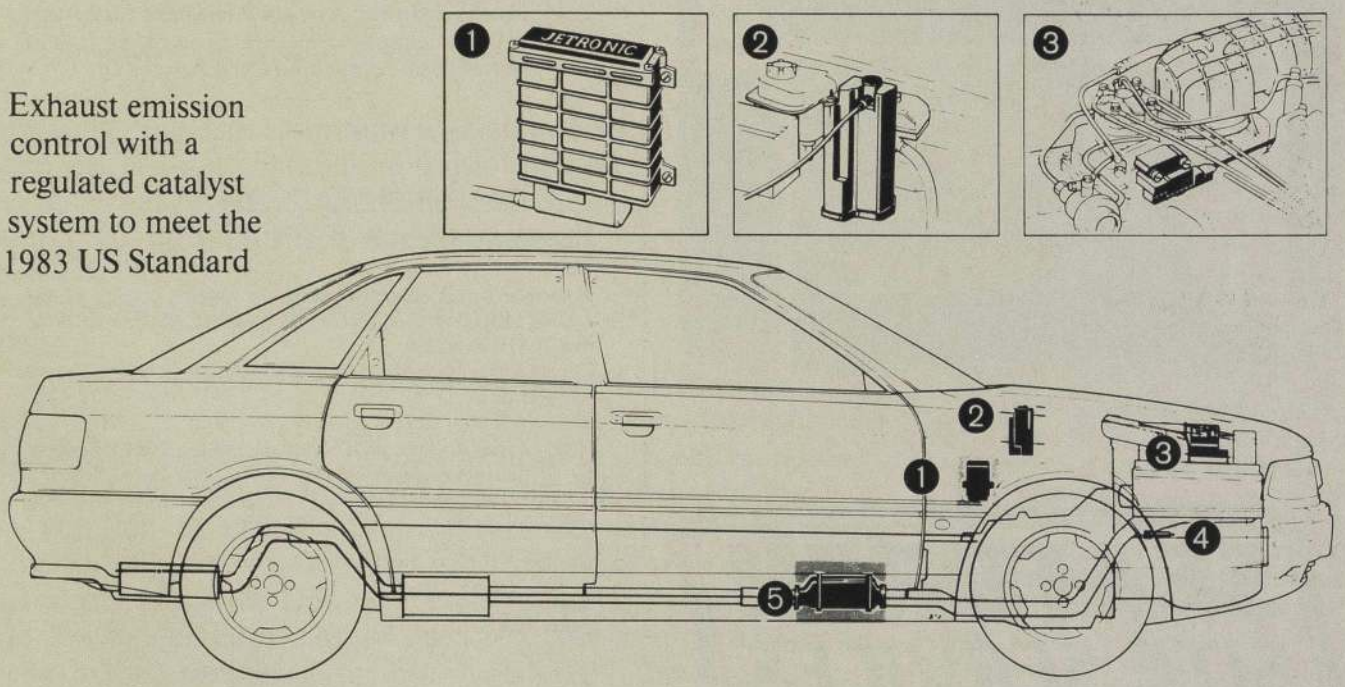
The company believes that its customers will enjoy an in-built hedge against inflation. Experience in West Germany has shown that cars fitted with catalysts are already enjoying stronger resale values, and this trend is expected to harden when emissions regulations become mandatory.

The company points out that an additional advantage of the move to a catalyst-only engine range is that the benefits of Audi's engine investment programme in recent years now becomes available to UK customers.

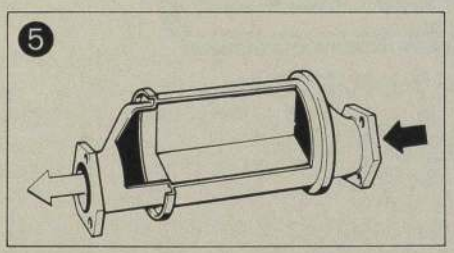
'The key to all of this has been the exceptionally rapid acceptance of unleaded fuel in Britain,' says Peter Cover, Sales and Marketing Director. 'Catalyst engines can only run on unleaded fuel, and even as recently as a year ago, our actions would have been unthinkable. But with unleaded fuel now widely available, we are absolutely certain of the direction in which the market will go.'

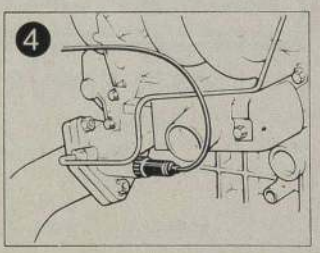


Exhaust emission control with a regulated catalyst system to meet the 1983 US Standard



1. Electronic control unit
2. Activated carbon container to trap fuel vapour
3. Warm-up mixture regulator
4. Lambda probe
5. Catalytic converter





Northern Waters and Arctic oil and gas

Recent discoveries offshore northern USSR have drawn attention once more to the geological expectancy that the Arctic may prove to be second only to the Middle East as a hydrocarbon province. The following paper from the USSR Academy of Sciences has been supplied especially to the Editor to coincide with the publication of the other four papers — from Canada, Norway, the Soviet Union and the UK on 'Northern Waters'.

These are published with acknowledgement to the British Institute of Energy Economics whose fourth annual conference on the North Sea included these papers in a session on this subject. The full conference proceedings will be available shortly.

Alexander Arbatov is Vice-Chairman of the Committee for Productive Forces and Natural Resources in the USSR Academy of Sciences. His doctoral thesis is in the economics of natural resource utilisation.

Andrei Konoplyanik graduated from the Moscow Institute of Economic Engineering, energy economics faculty, in 1975. He obtained his Doctorate in Economics in 1978 with a thesis on North Sea development. Since then he has worked as research fellow of the Moscow Institute of World Economy and International Relations (IMEMO), USSR Academy of Sciences, in the World Energy Analysis and Forecasting Group (GAPMER).

Peter Wadhams is director of the Scott Polar Research Institute at Cambridge. He heads the Sea Ice Group, involving field research in both polar regions. He currently holds the Walker — Ames Professorship of the University of Washington, and a Levin Scholarship of the University of California to cover a visit to the Scripps Institution of Oceanography.

Erik Solem is with the Operational Research and Analysis Establishment of the Department of National Defence, Canada. Educated at the Universities of Oslo, Manitoba, Leicester and Oxford. Dr Solem is presently seconded to the Directorate of Scientific Policy, Chief of R & D, National Defence Headquarters, Ottawa.

Arild Moe is a Research Fellow and Programme Director at the Fridtjof Nansen Institute, Norway. His degree, political science, Russian and public law, was granted by the University of Oslo in 1983.

Arctic shelf hydrocarbon resources development

By Alexander Arbatov and Yuri Shvemberger

Annually, the world output from Continental shelves in 45 countries is about 700 million tons of oil and 350 milliard cubic metres of gas, which is about one-third of the global output (not taking into account the socialist countries). According to some forecasts, the share of offshore oil in total oil production will increase up to 45 percent in 2000 and to 65 percent by the year 2020.

The great potential resources of Arctic shelf oil have long been hidden under the ice, away from human activity, but now, the increased progress in the development of the world economy is making Arctic resources one of the most important elements in the solution of the energy problem. That is why there was remarkably active exploitation of the Northern Territories and offshore areas of the US and Canadian Arctic shelf in the 1970s and 1980s. The beginning of the 1980s also saw the first ocean wells on the Continental shelf of the USSR, in the Barents Sea.

This can be explained by the fact that the areas of the Arctic shelf which are situated very close to the Eurasian border have very good prospects for oil and gas exploration extending over 10 out of 12 oil and gas regions of the USSR. There are large prospective sedimentary basins within its limits and there are grounds for the formation of large regions of oil and gas accumulation similar to North Sea, Mexico and even the Gulf.

The Arctic shelf is one of the last strategic world reserves for the forming of new large bases for the oil industry in the northern hemisphere. This is aided by the existence of equipment and technology recently developed for large-scale exploitation of oil resources in sub-sea Arctic conditions. A considerable volume of geological and geophysical data will enable us to carry out evaluations of deposits in different regions not only on the basis of geological analogs, but also on the basis of real results of exploration of oil and gas deposits on the Arctic shelf. Several scores of oil and gas deposits have already been discovered on the shelf and on the Arctic islands of North America and the first sea Arctic oil and gas deposit called Endicutt is already being exploited.

The drilling of offshore sea wells directly on the Barents Sea shelf in the USSR started in 1981 in the Dresviansky area, and in 1982 extended to the structures in the Murmansk region. The Murmansky and North-Kildinsky gas deposits, Pomorsky gas condensate deposit and the North-Guliyaevsky oil deposit have so far been discovered.

All this, generally speaking, can be described as the positive side of the picture. Negative sides of this development process, however, which require careful investigation, have already become obvious.

First of all, any involvement in turning

Arctic hydrocarbon resources into accessible new reserves creates a series of problems. The development of new oil and gas areas in this region makes it necessary to reassess from the beginning the socio-industrial infrastructure. In cases where the objective is in a sea area, the task becomes more complicated and expensive due to the emergence of quite new capital-intensive elements such as stationary exploitation bases (such as fixed platforms, artificial islands, floating bases, etc.) on which oil extraction equipment is placed. Development in sea areas with ice sheets makes this task even more complicated since the base must resist the pressure of ice field drift which reaches quite considerable proportions.

Generally speaking, today the ice sheet, as the most complicated and specific element of Arctic nature is not considered to be an unsurmountable obstacle for the industrial development of oil and gas resources of the shelf. Up to now more than 50 exploration projects for the development of Arctic deposits in regions with different types of natural conditions have been proposed. The development stage of the majority of these is of a technical proposal or project but only some of them have been accomplished. Up to now there is no one operating oil-producing construction on the foreign and Soviet Arctic ice shelf.

The development of oil and gas Arctic shelf resources requires the working out of new methods of work procedure and technical means as a variant of North Sea experience for all stages of work, beginning with exploration and search, then exploitation and ending with transportation of hydrocarbon raw materials. What is more, we are speaking about the creation and development of unique technical complexes and principally new technologies. All this will require considerable investments which are much bigger than those for development of similar projects on land.

The problem is so difficult, multifaceted and capital-intensive that in the estimation of a number of experts it can be compared with the problems of outer space development. The difficulty is to find the right combination of interdisciplinary groups to deal with interrelated questions. Many industrial and scientific organisations and different ministries and institutions must be involved to solve them.

Recently there has not only been a remarkable increase in expenditure on all stages in oil and gas resource development but also sizeable predominance (70–75 percent) of this capital investment is earmarked for the construction of exploratory bases in ice sea areas. For example, the cost of one well in the Beaufort Sea is 10–15 times more than in the Gulf of Mexico, and in the Chukotsky Sea (project) it is 25–30 times more. The most expensive reconnaissance borehole was drilled in 1983–1984 in the Beaufort Sea on Muckluk structure. It turned out to be 'dry' though it was previously supposed that an oil deposit like Prudhoe Bay would be discovered. The costs, with artificial islands, was $120 million while the price of reconnaissance boreholes in North Sea is $6–10 million. One more example. The cost for the construction of the third concrete oil production gravitational base of 'Kondip' type in the Norwegian sector of the North Sea on the Statfjord oil deposit designed for servicing 42 wells in 146 metres water depth was rated at $3 billion. From these examples, it can be seen that in order to take economically efficient decisions it is necessary to elaborate a long-term programme for oil and gas Arctic shelf resources development which would help to estimate the scale of hydrocarbon yield, the development lead time and extraction period for resources, the volumes of prospecting, reconnaissance and exploratory drilling and other necessary capital investments. The scale, complexity and prolongation of projects means that the solution to these problems, and quantitative estimates of their effect on the national economy is only now becoming clear. All these factors require us to reassess our previous decisions.

For the solution of general tasks of economic and social development of northern regions of the Soviet Union and other countries, both geological and economic aspects of Arctic shelf oil and gas resource development will play an important role and first of all the dynamic characteristics of this process can be obtained with the help of simulation model tests.

Such model calculations show that long-term programmes of prospecting and reconnaissance works for oil and gas in Barents and Pechorsky Seas are large-scale measures which will require capital investment on the level of 50–65 milliard roubles ($100 billion) during 50 years. Thus, to start getting Arctic oil, the state should allot large means and grant a delay in efficient returns out of its investment in such developments. What is more, *mean* specific expenditures for search and prospecting for oil and gas resources in these northern waters, are subject to wide areas of non-stable estimates, which require thorough ground work when taking decisions on the carrying out of work at different project stages. No two projects are identical.

Oil production long-term programmes in Barents and Pechorsky Seas are considered as very large-scale projects of very long duration (50–55 years), which will require remarkable capital (85–112 billion roubles) and exploratory expenditure (232–317 billion roubles) which will be treated as direct project investments, necessary for the construction of about 5,100 exploratory and pressure development wells and almost 100 stationary producing platforms.

Under joint exploitation of an estimated number of projects in the Barents and Pechorsky Seas the period of constant oil production can continue during 20–30 years on the level 87–98 million tons per year or 2 million barrels daily. Taking into account the dynamics of prospecting and reconnaissance processes, these may enable us to start development over 10–15 years after the start of the entire programme with the lead time then required to achieve stable extraction rates being a further 13–15 years. If these assumptions are accepted then the stage of stable constant oil production may take place between the years 2031–2051.

All in all, it will be possible to extract 4–5 times *less* oil from the Arctic shelf of these northern seas during the period of stable extraction than in Western Siberia during its corresponding peak period. Costs of net prospecting and reconnaissance drilling in Barents Sea are seven times more than in Western Siberia. Specific expenses for Arctic oil mining for example can be quite closely compared with the costs for extraction of synthetic oil out of Kansky-Achinsky basin coal (which is considered to be the most prospective in the USSR for this task). That confirms the necessity to investigate all other possible alternatives ('tertiary' oil, bitumen, combustible shale, etc.). That is why the main task for today is the working out of Arctic shelf development general scheme grounded on scientific research, based on many criterion, interdisciplinary and multi-variate analysis of alternative oil and gas resource development both in separate sea areas and in their totality in northern waters and elsewhere.

Undoubtedly, the main strategic direction under Arctic Sea conditions is first of all the search for giant and highly productive oil and oil-gas deposits.

That is why, on the current stage of research in the Barents Sea, the main task is the determination and preparation for drilling into large quantities of prospective localised structures and preliminary estimations of oil and gas presence (using one or two wells). After that the choice out of a representative majority of successful findings will be to decide on grounds of economic efficiency which ones will turn out to be profitable for

future development. But nobody should forget that the period from the starting of prospecting drilling up to full exploitation of the deposit on the Arctic shelf will take on average not less than 10 years (American expert forecast in the case of the Beaufort Sea is 14 years). Simulations show that real results out of Arctic Sea oil projects are expected to be obtained only in the first quarter of the next century.

In conclusion it is necessary to underline two more points. Firstly, the development of Arctic Sea oil is connected with technological risk — that is the necessity to use stationary bases which can resist ice drift, but there is no experience here or abroad of how to exploit them for a long period of time. Secondly, there is the 'ecological' risk — that is possible oil leakage; in this case, decomposition of oil is much harder by a factor of 20–50 times less than in southern latitudes and the ice sheet makes it much more difficult to eliminate oil leakage.

Future possible role of the Arctic and other severe seas in the USSR offshore petroleum development

By Dr Andrey Konoplyanik, Institute of World Economy and International Relations (IMEMO), World Energy Analysis and Forecasting Group (GAPMER), USSR

The USSR possesses the biggest continental shelf in the world. It is equal to some 22 percent of the world's ocean shelves and contains about one-fifth of the country's oil and gas initial potential resources. The largest part of the Soviet continental shelf lies under Arctic and Far Eastern regularly frozen seas with heavy-ice situation, severe environment and undeveloped or poorly developed onshore infrastructure. Those seas contain about 80 percent of the initial potential oil and gas resources of the USSR continental shelf. So, below the Arctic and Far Eastern seas lies one-sixth of Soviet resources.

During more than 40 years of Soviet continental shelf exploitation, the only offshore fields developed are those in the unfrozen part of the Caspian Sea at water depths of less than 130 metres. Up to now, less than 2 percent of the country's continental shelf prospective area has been covered by wildcat drilling. In 1987 offshore oil and NGL production, at 10.5 million tonnes was 1.7 percent of the total USSR petroleum production. Natural gas production reached 15 bcm or 2.1 percent of Soviet gross production. To compare: in the mid 80s, world offshore petroleum production outside centrally planned economies exceeded 750 million tonnes or 36 percent of the total. World offshore gas production exceeded 375 bcm or about 28 percent of the total. In comparison the role of Soviet offshore production is so far very small.

The geological structure of the Soviet continental shelf has been explored highly unevenly. About a half of the shelf's prospective area is almost totally unexplored in terms of geophysics. The offshore areas mostly explored by geophysics are the southern seas, Sakhalin Island's shelf, and southern parts of the Baltic, Barents and Kara Seas. In the 1980s geological exploration was concentrated in the southern part of the Caspian Sea. Less explored by geophysical prospecting are the eastern part of offshore Arctic basins and the Far Eastern seas.

According to some approximate calculations for an offshore petroleum field in the Arctic region to be exploitable, it must contain not less than 7.5–10 million tonnes of recoverable reserves per platform and must have a capacity of more than 100 tonnes/day per well. This is for a hypothetical field in the Pechora Sea region (the district with the most serious heavy-ice situation throughout the year). If a hypothetical field is located in the deepest waters of the unfrozen western part of the Barents Sea, it must contain not less than 20 million tonnes per platform with a capacity of more than 175–200 tonnes/per day per well (1,250–1,500 barrels per day).

	1990	*1995*	*2000*	*2005*
Oil and NGL million tonnes				
Caspian Sea	11.4	16.3	19.2	20.3
Sakhalin's Shelf	—	2.2	5.0	6.9
Arctic Seas	—	—	—	3.0
Total Offshore	11.4	18.6	24.2	30.3
Percent				
Caspian Sea	100	88	79	67
Sakhalin's Shelf	—	12	21	23
Arctic Seas	—	—	—	10
Natural Gas, bcm				
Caspian Sea	7.4	7.0	6.8	6.5
Sakhalin's Shelf	—	3.5	7.7	9.2
Arctic Seas	—	—	—	8.3
Total Offshore	8.7	11.9	15.9	25.5
Percent				
Caspian Sea	85	59	43	25
Sakhalin's Shelf	—	29	48	36
Arctic Seas	—	—	—	33

Table 1: The Possible Levels of the USSR Offshore Oil and Gas Production and its Forecast Geographical Distribution

It is estimated that more than 80 percent of offshore oil and gas resources could be contained below the Caspian, Okhosk, Barents and Kara Seas. In all except the Baltic Sea, gas resources are expected to predominate.

Future levels of offshore exploration activities are expected to increase. During the next 15 years the level of offshore geophysical prospecting may increase by some 30 percent, and seismic activities by more than one-third, with oil and NGL reserves additions increasing by more than 40 percent and natural gas resources additions by some three times. It is expected also that the geographical distribution of offshore geological prospecting may change greatly. The role of the Caspian Sea will probably decrease. The share of the Far Eastern Seas may stay near today's level. And we can expect a sharp increase of the Arctic Seas share in offshore geological prospecting.

During the next 15 years the yearly volume of offshore development drilling may be about 270–300,000 metres for oil and some 40–60,000 metres for gas. The rate of development drilling may reach 70–90 oil wells and 20–30 gas wells per annum. In this period the overall volume of development drilling for oil and gas on the continental shelf may decrease by some 7 percent and oil and gas well completions by about 20 percent. In contrast, the role of the Far Eastern and Arctic Seas will be steadily increasing.

All the offshore petroleum production in our country is located today at the Caspian, Black and Azov Seas. In perspective the Caspian Sea may provide up to one half of the oil plus NGL additional national offshore production. The other half may be provided by the shelf of Sakhalin Island and the Arctic Seas. These two regions may provide also the whole additional offshore gas production of the country because it is considered that gas production levels in the Caspian Sea will be steadily decreasing (**Table 1**).

In the next 15 year period all the Caspian Sea production would be probably located in the areas with water depths less than 350 metres, though right now there is no national technology for offshore petroleum development at 200–350 metres water depths range. The alternative scenario for Caspian Sea exploitation suggests development of its northern part with the shallower but periodically frozen waters. This would bring the problem of creating some largely new and ecologically clean technologies.

New technologies must be also created for offshore resources development in water depths in the range 350–500 metres. That means that these technologies if created may be several times more expensive than existing ones. Up to now this water depth range has been considered uneconomic (not commercially exploitable): discounted costs may reach 100–150 roubles per tonne (**Table 2**). For comparison oil wholesale prices at the end of the century are supposed to be some 70 roubles per tonne and replacement costs about 125–150 roubles per tonne. So we can suppose that in the next 15 years this range of water depths will probably not be developed.

Location, water depths	Total oil production per platform M ton/year	Discounted development costs, rouble/ton	Availability of national technology
Caspian Sea			
less than 200 m	6	up to 60	yes
200–350 m	6–8	80–100	no
350–500 m	..	100–150	no
Sakhalin's Shelf			
less than 50 m	8–10	up to 80	no
50–100 m	..	more than 150	no

Table 2: The Possible Range of Future Development Costs in the Soviet Continental Shelf

The priority regions for offshore petroleum development on the Sakhalin Island's shelf would be areas with water depths less than 50 metres. For these water areas special technologies must also be created, ice-breaking platforms being one of the principal items.

Special technologies for water depths of 50–100 metres in this region can be several times more complicated and expensive than for depths of less than 50 metres. We believe that we must solve our technical problems for shallower waters at first and only then work out the problem of deeper water depths' development.

Table 1 shows levels of possible production including some new offshore oil fields development such as Pieltun-Astokchskoye, Lunskoye, etc. Future gas production possible increase is based on supposed Lunskoye field development in the early 1990s.

In the Arctic Seas, resources evaluation and appraisal work would be continued to ensure future stable production in the Barents Sea, Tazov and Ob Gubas (Bays) and Yamal Peninsula's shelf.

For economic evaluation of the work held in the region it is considered that petroleum fields could possibly be discovered here with potential annual production of 3 million tonnes at the beginning of the next century (**Table 1**).

Arctic gas production would be probably located in two places. The first is in unfrozen parts of the Barents Sea. The gas field discovered at Murmanskoye may achieve some 3.3 billion cu metres p.a. production level at the beginning of the next century. The second is an offshore part of the gas field Semakovskoye-Antipoyutinskoye located at Tazov Guba. Gas production there may achieve some 5 billion cu metres p.a. at the beginning of the next century (**Table 1**).

Because of relatively effective exploration methods, the unit costs of reserves additions in this country are on average substantially lower on the shelf than on the land. It is supposed that these unit costs would on the whole be decreasing in the future (see **Table 3**). During the same period the units costs of gas reserves additions may decrease more sharply.

To realize such a programme of offshore petroleum development the coun-

	1991–95	*1996–00*	*2001–05*
Oil, total (1991–95 = 100)	100	95	90
Caspian Sea	105	100	95
Far Eastern Seas	120	140	145
Arctic Seas	80	70	65
Gas, total (1991–95 = 100)	100	50	40
Caspian Sea	160	150	140
Far Eastern Seas	70	80	90
Arctic Seas	90	40	40

Table 3: Indexes of Probable Unit Investments for Oil and Gas Future Reserves Additions on the Soviet Continental Shelf

	(Percent Shares)		
	1991–95	*1996–00*	*2001–05*
Geographical			
Caspian Sea	44	38	31
Far Eastern Seas	33	34	37
Arctic Seas	18	27	31
Functional			
Exploration Drilling	18	19	19
Development Drilling	9	8	7
Equipment Purchases	22	20	13
Construction	51	53	61

Table 4: Geographical and Functional Distribution of Possible Investments in Soviet Offshore Petroleum Development, %

try's total investments in that sphere must increase by some 10 percent every five years. The Caspian Sea's share in this total investment may decrease with corresponding increases in the shares of the Far Eastern and Arctic Seas (**Table 4**). To achieve this, considerable additional financing may be needed.

Table 4 also shows a changing pattern of expenditure for such development:

- exploration costs would be increasing and their share in total investments would stabilize,
- development drilling costs would stabilize in volume and their share in total investments would fall,
- the costs of equipment purchasing would be falling in volume and in share as the offshore areas become equipped,
- development costs other than drilling would also sharply increase (**Table 4**).

Technical reconstruction of the offshore petroleum industry and equipping it with new-type machinery (using where possible advanced Western achievements in this sphere) make it possible to develop offshore resources in unfrozen seas at depths of up to 200 metres and to explore periodically-frozen seas during their interfrozen periods.

But the volumes of new-type machinery production and their supplies to the petroleum industry are less than required. This equipment suffers too often from great shortcomings in technical level and in quality. It often lags behind corresponding Western equipment in its weight and size characteristics, energy intensities, levels of automation and mechanisation of main technological processes, etc.

As mentioned above, further offshore petroleum resources, development will inevitably be moved to water areas deeper than 200 metres and to the Far Eastern and Arctic Seas with conditions of severe climate, heavy ice, and maybe seismic activity.

For the development of these new regions principally new-type equipment must be created. As for existing machinery — its technical level and quality needs to be greatly increased.

From my point of view, to solve these problems in the most effective way, our country must develop strong economic relations with Western countries including scientific and technological co-operation with them.

The economic reform which is being carried out in the USSR creates favourable possibilities for expanding the sphere of East-West relations into the area of offshore petroleum development in severe environments where joint venturing is of special importance.

Possible co-operation with Western economies could be along the following lines:

- Organisation of mutually beneficial economic co-operation with leading Western petroleum companies for exploration of the USSR offshore petroleum resources on the basis of joint ventures. I consider that they can be an effective form of frontier petroleum development in the USSR, provided that they are based on production-sharing or risk-service contracts.
- Organisation of joint ventures with Western petroleum companies in order to extend exploration and exploitation activities on the shelves of socialist, developing and maybe developed countries.
- Rise of current technical level of national machinery and equipment for offshore petroleum development, using broadly advanced Western experience in this sphere through the programmes of scientific and technological co-operation.
- Purchases of licences, technologies and specimens of advanced Western machinery and equipment for organisation of their production at Soviet enterprises.
- Import of Western machinery and equipment which is unprofitable to develop at Soviet enterprises.

Among these directions I consider joint venture creation for the country's offshore petroleum development to be the priority. As for the economic problems to be solved through joint ventures, I should mention two points.

Firstly, the creation of joint ventures is impossible without preliminary unification among the partners of the methods of evaluating their economic activities. So the question arises whether there is compatability between Soviet and Western methods of profitability analysis of economic activities in general and of frontier petroleum development in particular and in what parameters they may differ.

The rules which are currently used in the USSR are based on the principle of cash flow discounting. However the particularities of its use and quantative parameters which are applied to profitability analysis of petroleum development in this country, may differ substantially from Western practice. I refer to discount rates, energy prices, costs of production, risk assessment, inflation rates, rates of interest, etc. This is especially the case for frontier petroleum development where the parameters of economic assessments should be correspondingly modified.

Secondly, in worldwide practice, a system of petroleum agreements between multinational corporations and host countries does exist. These agreements provide an economic order and legal rules for joint ventures in the industry. The history of petroleum agreements in Western countries covers some 90 years. In our country the modern history of joint ventures began in 1987 (if we exclude all the pre-revolutionary period and the post-revolutionary period of Lenin's 'new economic policy' in the 1920s). Thus institutional and financial principles of joint venture activities in this country are only now being formulated. So the question arises whether or not these principles affecting joint venture activities in Western practice and in the USSR are compatible, both in the economy as a whole, and in the petroleum industry.

I consider that both these problems are underestimated in current Soviet economics and in energy economics in particular. In my opinion they are not less significant than the technical problems of the country's continental shelf development. To escape future serious problems, we must pay attention not only to technical or economic · internal questions but also to these methodological, institutional and financial issues in the international sphere.

Environmental problems of Arctic oil and gas development

By Peter Wadhams, Director, Scott Polar Research Institute, University of Cambridge

The most important unsolved problems in Arctic oil and gas development concern the offshore. Onshore development has proceeded successfully both in the Soviet north and on the North Slope of Alaska, and the problems associated with drilling and pipeline construction in permaforest, and of operating in extremely cold conditions generally, have been solved. The single most important reason why offshore exploration has still not led to production anywhere in the Arctic is the extraordinary set of environmental and engineerng problems posed by the presence of sea ice and icebergs.

Ice and exploration

Sea ice dominates the Arctic. It is the central fact of life for Arctic peoples. Even in summer, the time of maximum retreat **(Figure 1)**, it fills the central basin of the Arctic Ocean, occupying an area of 8.4 million sq km (August) and making trans-Arctic shipping impossible. In winter it advances to cover the peripheral seas of the Arctic Ocean, together with the Bering Sea and Sea of Okhotsk in the west, the channels of the Canadian Arctic Archipelago, Baffin Bay, and a great area of the Greenland Sea. Its area in March reaches 15 million sq km.

The sedimentary basins of the Arctic which are known or thought to have hydrocarbon potential, correspond to the marginal seas and to the shelf areas of the Arctic Ocean, most of which are situated between the winter and summer ice limits. This region, known as the Seasonal Sea Ice Zone (SSIZ), is subject to enormous seasonal and regional variability in ice conditions and in the ice types that may be encountered, and herein lies the challenge to the oil industry. There are also regions with hydrocarbon potential where sea ice is seldom or never encountered but icebergs are a major hazard — such as the Hibernia field on the Grand Banks.

In exploration the easiest way to exploit the SSIZ is to work only in the summer ice-free season. In this case it is economically advantageous to use only a lightly ice-strengthened drilling rig or drillship, capable of rapid disconnection from a hole, and to depend on a reliable ice forecasting service to give warning of the approach of dangerous ice. 'Dangerous ice' is something that the rig cannot handle, such as an iceberg (very frequent in the Labrador Sea and Baffin Bay, fairly frequent in the Barents Sea and southern Greenland Sea, uncommon but not unknown in the northern Greenland Sea) or heavy multiyear ice (as in the Beaufort Sea, the seas north of the USSR, and even in the Barents Sea where multiyear ice sometimes breaks out southward in the East Spitsbergen Current). What is needed for such operations is reliable continuous ice imaging from satellites. This can only be achieved by the use of synthetic aperture radar (SAR) which will enter orbit in 1991 on ERS-1 and later on Radarsat. SAR alone has all-weather day-and-night capability combined with good resolution, and aircraft-mounted SAR is needed in the absence of satellites. This must be supplemented by systems mounted on the rig for close-range detection, using multi-frequency or multi-polarised radar or sonar to detect ice out to a range of a few kilometres.

Even if the ice which approaches the rig is of a type which can normally be resisted, its impact force may be enhanced by the effect of waves. The extreme edge of an ice pack is a region where waves from the open ocean break the ice up into floes a few tens of metres across, and then cause these floes to surge and heave. In a storm, a rig which is engulfed by an advancing ice edge will be subjected to the oscillatory buffeting of the discrete ice floes.

Another technique of exploratory drilling which actually makes use of the ice cover is it to drill in winter from the fast ice itself. This technique has been used for many years by Panarctic Oils in the channels of the Canadian Arctic Archipelago, where a fast ice cover grows to a thickness of about 2 metres and remains in place throughout the winter. The ice cover is artificially thickened by spraying water over it, then a portable rig is moved in. Drilling proceeds until a date which safely anticipates the climatological break-up date for ice in that location.

One useful consequence of the greenhouse effect is that the ice-free season in many parts of the SSIZ will be significantly extended during the next few decades. Models of global warming all agree that the temperature rise will be greatest at high latitudes — probably 3–5°C in the Arctic within 30 years. The growth of fast ice is influenced mainly by air temperature, and there is no doubt that the date of ice formation in autumn will be delayed (by about a month), the ultimate thickness of the ice will be reduced, and the date of breakup will be advanced (again by up to a month). Ice in the drifting pack is subject to wind and current stress and it is not so clear what changes will occur, but again some retreat of ice limits is likely.

Ice and production

The production platform must be capable of withstanding ice forces up to an extreme limit set by possible ice and environmental conditions in the area. Alternatively, some method must be used to keep ice away from the rig. In the case of icebergs, methods proposed include building huge submerged concrete dams to deflect bergs away from the rig, and towing icebergs which come too close.

The heaviest ice conditions of all are found in the coastal regions of the Beaufort Sea. This has been the site of exploratory drilling by Dome, Gulf and other operators since the mid-1970s, and many solutions have been attempted to the problem of establishing a firmly bottom-mounted structure which can resist the forces due to multi-year pressure ridges and rubble fields. Techniques include caisson-retained islands mounted on berms which reach to within a few metres of the surface (Tarsiut); mobile versions of the same concept involving use of a converted tanker hull as the 'island' (the SSDC); and single conical platforms. In water depths which are less than the maximum draught of ice keels (30–50 metres), a rubble field of increasing extent builds up on the upstream side of the platform during the winter, and

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David Trippier, MP, Minister of State for Environment and Countryside, Department of the Environment

General Review of Legislative Position and Public Attitudes
Nigel Haigh, Institute for European Environmental Policy

Health Effects of Exhaust Gases
Prof. Paul Grasso, Robens Institute of Industrial & Environmental Health and Safety, University of Surrey

Health Effects of Benzene (Refuelling)
Barry Simpson, CONCAWE

Hydrocarbon Emissions
Dr Jan Terning, CONCAWE

Afternoon Session

Chairman: Dr Anthony Fish, Shell Research Ltd

Impact on Gasoline and Diesel Engine Design
John May, The Society of Motor Manufacturers & Traders/Austin Rover

Combustion Plant Emissions
Martin Williams, Warren Spring Laboratory

Greenhouse Effect
Dr PM Kelly, University of East Anglia

Panel Discussion

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Institute of Petroleum Education and Training Committee

STANDARDS OF COMPETENCY

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Mr G Kendall, Director of Quality Standards and Methods, Training Agency.

Defining Standards and the Work of Industry Lead Bodies
Mr J Hillier, Chairman, User Group, Information Technology Lead Body.

Assessment of Competency in the Work Place
Mr B Marshall, Head of Curriculum Development, Testing and Research, CGLI.

Certification — The Role of the National Council for Vocational Qualifications
Professor P J Thompson, Chief Executive, NCVQ.

Certification — The Role of Examining and Validating Organisations
Mr T McCool, Chief Executive, SCOTVEC.

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since the deeper keels in this field are grounded, the ice pressure is partly transferred to the underlying sea bed.

Ice and transportation

The oil thus produced must be got ashore. The normal solution is a sea bed pipeline. However, in regions of heavy ice cover it is necessary to protect against ice scour. This occurs when deep pressure ridges in the pack are driven into shallow water and gouge out depressions up to 5 metres deep in the sediment. The solution has to be burial of the pipeline in the nearshore zone (less than 50 metres water depth). The burial depth must be sufficient not only to avoid direct disturbance by scouring but also to avoid dangerous overpressure due to a keel scouring the seabed overhead. A more radical solution might be to run the pipeline out to sea, to a bottom-mounted terminal for loading by icebreaking tankers or even submarines.

The idea of using icebreaking tankers to transport oil out of the Arctic dates back to the experiments with *Manhattan* in 1968–9. More recent proposals by Dome and Gulf have revived the idea, both for oil from the Beaufort Sea and liquified natural gas from Melville Island in the Canadian Archipelago. However, very large tankers are difficult to manoeuvre in ice, are difficult to design to withstand compressive ice forces, and have to have extremely powerful engines (200,000 HP for the proposed LNG tankers) whch makes them expensive to operate. Safety considerations — especially in the light of the *Exxon Valdez* incident — may make regulatory bodies wary of permitting passage through environmentally sensitive and poorly charted regions such as the Northwest Passage. Oil-carrying submarines have been proposed but the technology required lies so far beyond that of existing military submarines that we can expect a considerable time to elapse before practical developments occur in this area.

Oil spills and blowouts

In the early years of offshore drilling in the Canadian Beaufort Sea, the chief concern was the possibility of a sea bed blowout. Drilling regulations imposed by the Canadian government called for the summer drilling season to be ended early enough so that if a blowout occurred, there would be time to drill a relief well before the ice arrived. The fear was that an uncontrolled blowout would emit oil under the ice throughout the winter, and many experimental and theoretical studies were carried out on the consequences of such an emission. It was found that oil and gas will rise together as a plume. If fast ice overlies the site the plume will melt its way through the ice (using mainly the oceanic heat entrained in the plume) and so the oil will be largely confined to the melt hole where it can be burned.

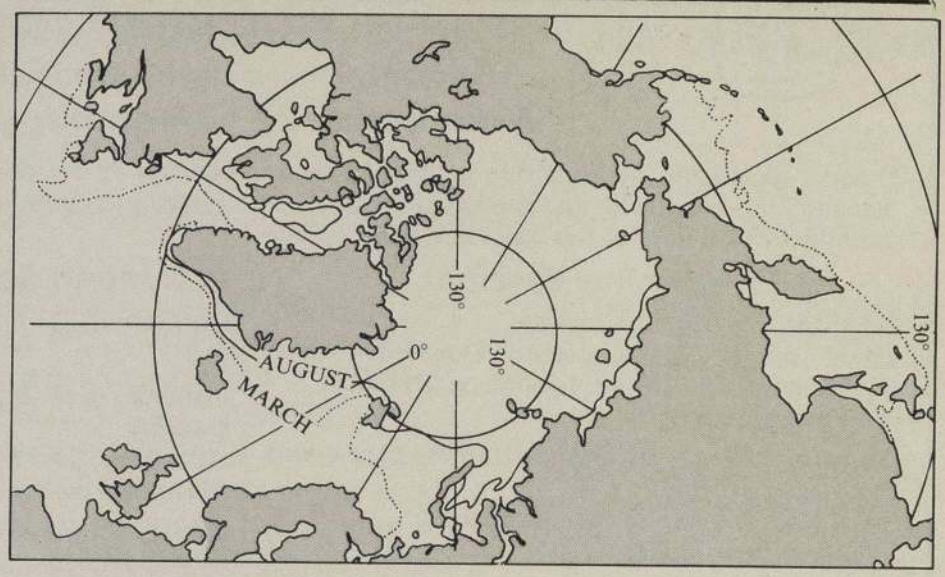

Figure 1: Summer and winter ice limits in the Arctic.

If the blowout occurs under moving pack ice there is no opportunity for a hole to develop, and instead the oil is deposited as a discontinuous layer over the underside of the ice. Under smooth ice the layer is less than a centimetre thick, but naturally the oil will tend to form pools in under-ice depressions. As winter progresses, new ice grows under the oil layer, forming an 'oil sandwich' in which the oil is preserved in its original state of freshness and toxicity whilst being transported around the arctic by the drifting pack. In first-year ice the network of brine drainage channels which permeates the ice opens up towards the ice surface in spring, and these provide channels for the buoyant oil to work its way up to the surface. The oil appears in a series of small puddles surrounding each drainage channel. These puddles will probably be too discontinuous to permit burning of the oil, and so the toxic oil may easily run off into the open leads of summer, where it can poison the entire food chain from plankton to seals and polar bears, with an especially adverse effect on the vast populations of sea birds which use Arctic leads in summer. In multi-year ice, the brine drainage channels do not reach the ice surface, so the oil may remain under the ice for a number of years before reaching the environment through eventual melt. The prospect is therefore a widely dispersed area of pollution, appearing after a considerable time and space increment, and at too low a level for clean-up methods to be effective.

Oil spills from tankers and offshore operations pose a similar set of problems, except that the pollution is more confined in space and time. Arctic coastal regions, where such incidents are most likely to occur, are areas of high biological productivity, especially in summer. If adequate clean-up facilities are not available the result can be disastrous, as has been shown by the *Exxon Valdez* incident. The first tanker accident to occur wholly in a pack ice zone was in fact the loss of the *Kurdistan* in the Gulf of St Lawrence in 1979. In this case the oil was deposited into an icefield composed of floes separated by brash ice (small ice fragments). The oil became mixed with the brash ice and found its way onto the raised edges of the floes.

A final and most important factor in Arctic oil development is the human factor. The Arctic has been home for thousands of years to native cultures which have gradually evolved means of living with its rigours. These cultures have already been radically transformed by the impact of the industrial world but the development of a major hydrocarbon industry in new parts of the Arctic is bound to cause further important changes in employment and settlement patterns. Care and understanding are needed so that, if possible, development is seen as a partnership between those who seek to extract resources and those for whom the Arctic will always be home. A tradition in the Arctic is the 'boom and bust' development (such as the fur trade, whaling, gold, and early-warning radar stations) where industrial man stays around long enough to violate the native way of life and then departs. The Arctic hydrocarbon industry has the opportunity to do better.

Arctic resources and their development

By Dr Erik Solem, Department of National Defence, Ottawa

Canada's Arctic hydrocarbon potential is found in the Mackenzie Delta, the Beaufort Sea, and the archipelago. Exploration activities and plans for production have been impressive in recent years. However, Arctic oil deposits tend to be smaller than those of, say, the Middle East and extraction is very much harder. Production costs are therefore considerably higher. In addition to yielding smaller deposits at higher production costs, Arctic oil deposits often contain greater quantities of gas than usual, making them — temporarily at least — less attractive to develop than southern deposits. Furthermore, the transportation costs for Arctic oil can also be formidable.

It is now nearly two decades since the first hydrocarbon discoveries were made in the Beaufort Sea and the Arctic Islands. Whereas drilling in the offshore Beaufort began in 1973, exploration in the Mackenzie Delta goes back to the early 1960s. From 1973 to mid-1985 a total of 59 wells had been drilled offshore in the Beaufort Sea — 31 of these were from islands built in shallow water and 28 from floating drillships in deeper water. This activity, which was largely undertaken by Dome Petroleum, Gulf Resources and Esso Resources had resulted in several oil and gas discoveries at such locations as Kopanoar, Issungnak and Tarsiut. Dome Petroleum's drilling has been operating 100–150 kilometres offshore in the July–October open-water season. During this period, which could be as short as 100 days, up to 1,000 workers have been employed.

By the mid-1960s the first exploration permits in the Beaufort Sea–Mackenzie Delta region had been issued by the Canadian Federal Government. Since then a very large amount of money has been spent by the petroleum industry on exploration in the region. By 1979 when Dome Petroleum struck oil, Canada's supply outlook had changed drastically. Domestic oil reserves had fallen for the 10th year in a row, world oil prices had more than quadrupled since the 1973-74 oil crisis and the international oil market was in turmoil following the revolution in Iran.

It is important to note that it was against this background that Dome predicted with confidence that it would start production by 1985. The development of Beaufort Sea oil seemed imminent.

However, as we now know, some of the early assumptions on which this planning had been based have now been challenged. One important challenge came from the discovery off oil at Hibernia on the Grand Banks off Newfoundland. If these oil reserves would prove large enough, their proximity to markets, the less severe climatic conditions (hence fewer technological obstacles to overcome), and the fewer environmental considerations to confront would give the Hibernia field an advantage over the Beaufort Sea finds.

In hindsight, and for reasons which will be discussed, it is interesting to reconsider some of the prevailing optimism about the hydrocarbon production capacity of the Beaufort Sea–Mackenzie Delta region, as it illustrates an important point about Arctic resources and their development. Seismic information and encouraging drilling results at Kopanoar, Tarsiut, Nektoralik, Ukalerk and Issungnak had led to the conclusion that the Beaufort Sea–Mackenzie Delta region could possess significant oil potential. Accordingly, the industry presented a series of oil and gas development scenarios for 1985, 1990 and 2000.

During the pre-production period (1981–1985), it was projected that some 30 offshore exploration and delineation wells could be drilled, five from artificial islands and the rest from conventional drill ships as well as year-round drilling systems. The islands were to be built in shallow water (less than 30 metres deep), each requiring the dredging of two to four million cubic metres of material. Fifteen development wells were to be drilled. During the early (1986–1990) and the long term (1991–2000) production periods, the number of exploration and delineation wells, artificial islands and off shore production wells would, it was claimed, increase dramatically; in the early period the production rate could reach 500,000 barrels per day, increasing to 1,250,000 barrels per day by 2000.

The scenarios for gas production rates were also optimistic, although not necessarily unrealistic. Over and above the six billion cubic feet said to already exist in the Taglu, Parsons and Nigliutgak onshore gasfields, production was projected to reach a level of 700 million cubic feet per day. By the year 2000, two to five offshore producing gasfields could be interconnected by an undersea pipeline gathering system. There would be a need for some 16 tankers to transport 45 million cubic metres per day in the form of liquified natural gas.

What is of interest is that all these projections rest on underlying assumptions which themselves are based on a series of complex calculations. Such factors as discovery rates, well productivity, reservoir geometry, economics, total reserves, market demands and lead time would all have to be taken into account. While the charge could be made that these projections, coming as they did from major oil companies were more likely to be on the optimistic side, they were also — at the time — perhaps the best projections available. They were based on first-class work by experts with a great deal of practical experience, who have much to lose if things go wrong, and a lot to gain if they go right.

Another important point illustrated here is the volatility of Beaufort Sea oil exploration. It has had an erratic history with a series of ups and downs. Since very little oil had been found by the mid-1970s, with many of the attractive onshore structures having been drilled, industry moved to the offshore thinking that this was where major oilpools were likely to be found. However, it was not until the beginning of this decade that a complete set of drilling systems became available to evaluate the offshore properly. These were Esso's island building capabilities and caisson, Gulf's conical drilling platforms and caisson, and Dome's drillships and single steel drilling caisson. During the period 1973–1986 these systems had drilled 80 wells and made 26 discoveries, with only one significant offshore oil success (Amauligak). A likely development scenario, therefore, could involve Gulf's Amauligak discovery as a cornerstone pool, with an earliest onstream time in the late 1990s.

In the Mackenzie Delta–Beaufort Sea region some 240 wells have been drilled,

leading to 49 significant gas and oil discoveries. The most important findings include the Taglu gas field – 3 trillion cubic feet (TCF) – and major gas at Parsons (both onshore), the (previously mentioned) large oilfield at Amauligak (some 500 million barrels), as well as a major accumulation at Adlartok. The importance of the first three discoveries lies in the fact that they have characteristics which could lead to early development. The 'but' in all of this is the question of world prices.

The regional resource endowment of the Mackenzie Delta–Beaufort Sea region has been estimated at 68 TCF of gas and 7 billion barrels of oil (average expectation) in recent studies. Some 11.7 TCF of gas and 1.7 billion barrels of oil have already been discovered with close to 75 percent of the total endowment of the region shown as undiscovered potential.

Needless to say, such estimates often found in statements of resource endowments can easily be oversimplified. Hence they are only of limited use for serious planning.

In the Arctic Islands, significant exploration started with Panarctic in 1968 and has been concentrated in the Sverdrup Basin. Large gas discoveries came quite early in the exploration history — e.g., Drake Point (1969) at 5.5 TCF and Heela (1972) at 3.5 TCF, leading to considerable emphasis and assessment numbers ranging up to 100 TCF.

Less than 200 wells have been drilled in the Arctic Island region, of which some 90 were exploration or wildcat wells. This relatively sparse drilling has resulted in 15 significant gas and oil discoveries — with assessments as indicated above.

In summary, northern Canada is richly endowed with oil and gas resources approximately equal to the more conventional oil and gas resources of western Canada. However, the resource endowment of northern Canada has to be discounted due to its remote location, high costs, concerns about the environment as well as a series of logistical difficulties associated with most of these resources.

Future trends

There are different definitions on what constitutes the Arctic. Canadian definitions include two territories, the Yukon and the Northwest Territories, as well as Northern Quebec. The southern boundary of this vast region is 60 degrees north, and it includes the archipelago north of the mainland. A region of some 4 million square kilometres, it constitutes 40 percent of the total size of Canada, a truly vast expanse. The distance from Frobisher Bay to the Yukon-Alaska border is approximately 4,500 kilometres, while the distance from 60 degrees north to the northern tip of Ellesmere Island is 4,000 kilometres. Individual islands in Canada's Arctic archipelago are the size of entire provinces in the southern part of the country.

Whereas Canada's population is around 27 million, the number of its Arctic inhabitants is only about 0.4 percent of that total. In the Northwest Territories, some 58–60 percent of the population is aboriginal (Indian, Dene, Inuit, Inuvialuit and Metis), whereas in the Yukon only about 15 percent of the population is native. In Northern Quebec the equivalent percentage is even smaller.

There are no large cities or even 'urban centres' of any distinction in the Canadian north. The Soviet Union, in contrast, is very much more developed and with a considerably larger population in its Northlands. By 1981 there were only two incorporated cities (Whitehorse and Yellowknife) in the Canadian north with more than 10,000 residents, and the larger (Whitehorse) had fewer than 15,000 inhabitants. In contrast, the USSR north had 10 cities with over 100,000, 17 cities over 50,000 and more than 100 cities over 10,000 residents.

Most of Canada's northern inhabitants — who live in small, widely scattered villages — earn their livelihood in a variety of ways, ranging from traditional subsistence (a minority), to non-recoverable resource industries, transportation and the service sector. It should be noted that a major employer in the Canadian Arctic is government service, at both the federal and territorial levels. An abrupt absence of (in particular federal) government activities in the Canadian Arctic would probably mean mass starvation, as the resource base for traditional hunting and fishing would be much too small to sustain the population.

Added to this 'constraint' it would be appropriate to refer to the frequently mentioned increased political consciousness of aboriginal as well as other northern inhabitants. Moreover, whereas the land claims all include demands for varying degrees of local political autonomy, this is unlikely to pose a major problem with regards to hydrocarbon development.

A more obvious and direct constraint has to do with climate. Extreme cold with air temperatures down to −50°C are not uncommon. In such conditions one's body burns energy at three times the normal rate. For at least eight months of the year, temperatures remain below freezing. Throughout February, the coldest month, routine temperatures are −35°C, with a wind-chill factor often down to −70°C. No daylight exists for upwards of four months of the year. During the autumn, sudden Arctic storms swoop in without warning, carrying rain and spray that freeze on contact. Everything is coated with ice. Even further south small ships may capsize from the weight of ice forming on them. Working conditions in this environment are such that drilling teams work 14 consecutive 12-hour days, followed by 14 days in the south. A quote from an employee handbook issued by one oil company working in the north:

> 'If you fall in the water, your body cannot produce enough energy to swim and keep the heart beating; therefore do not swim; conserve energy by moving as little as possible until rescue takes place.'

The final constraint, which is also in part an opportunity, is the question of market, especially oil and gas, prices. In the long run hydrocarbon resources are finite.

In Canada, as well as elsewhere, the debate on energy security has concentrated on availability and price of oil supplies. Oil is still the most important energy source in Canada, accounting for some 36 percent of our total energy consumption (down from 56 percent in 1973). Furthermore, oil represents Canada's major energy import. Security of supply is not only concerned with the physical availability of the commodity (oil) but also price shocks. Canada is in a highly favoured position among many industrialized countries in terms of its energy endowment but its greatest challenge, both in terms of constraints to be met and opportunities to be utilized has to do with the fact that much of our hydrocarbon potential's exploitation is overwhelmingly dependent upon world markets. In particular, the US market is the major factor for our gas potential, although other countries have also showed interest. But without stable prices and sufficient demand little will be done in the near future.

Climatic change

Finally, a few words about climatic change, environmental concern and their subsequent impact on Canada and in particular our north. Until now, climate is one of the main factors which has made the Arctic unique. It has helped to isolate the circumpolar world, preserving its wildlife and allowing its indigenous populations and their cultures to endure. Climatic change could very likely end this isolation and eliminate the Arctic's natural boundaries. Climatic change will

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also, in all likelihood, facilitate the development and extraction of non-renewable resources, whenever the demand will pick up and intensify. The Arctic has already demonstrated its importance as a source of raw materials. Some 20 percent of US oil production until recently came from the Alaska North Slope. Northwest Siberia contributed more than 50 percent of USSR gas production. There is agreement among many geologists that the one remaining area with favourable geological petroleum potential characteristics resembling the Middle East would likely be in the Arctic regions and near the USSR. International competition for resources and resource extraction is likely to increase. Climatic change could speed up this process. Renewable resources and their extraction modes will also likely be profoundly affected.

For Canada future international competition for resources could have important impacts.

- Climatic change could also have implications for our claims to sovereignty.
- Both superpowers may likely attach greater geostrategic and socio-economic importance to the north if climatic change is seen to make it more accessible.

Climatic change would likely have some important socio-economic and legal consequences as well. In balance, some socio-economic aspects for northerners could be positive. Cost of living could be reduced. A somewhat greater economic activity could make the north more 'independent' from the south. However, there are several potential problems as well, some of which are showing up already. Extraction requires a well-planned and balanced approach so as to avoid the double pitfalls of overdevelopment or underdevelopment (the 'boom-and-bust' syndrome). Arctic environmental issues impact directly upon Canada and will, therefore, increasingly form part of her 'natural' foreign policy posture. Expensive clean-ups of environmental disasters as well as proper planning and necessary precautionary measures will all be needed in the future. There clearly is an increasing need for the development of international law as a pro-active, rather than merely *ex post facto* (or reactive) instrument of policy.

Norwegian approaches to Arctic developments

By Arild Moe, Programme Director, Fridtjof Nansen Institute, Norway

The development of Arctic petroleum resources in Norway has several components. Energy policy is one, but only one of them. Other important components are regional policy, environmental concerns and foreign policy. It is the purpose of this paper to point out the driving forces and constraints in the present Norwegian policy regarding the development of Arctic oil and gas resources.

It was widely held in the oil industry that the Northern shelf constituted a potentially major petroleum region when exploration started in the early 1980s on Tromsøflaket. Seismic surveys indicated several interesting geological structures. In 1986 Statoil estimated the resources on the continental shelf outside middle and northern Norway to be between 4 and 20 billion tons oil equivalent of oil and gas (toe), most of which is on the northern shelf.

However, in 1988, the Norwegian Petroleum Directorate, which admittedly has been more cautious in its estimates came out with an estimate of total speculative resources of some 1.8 billion toe. This new figure reflects a growing concern over the resource potential on the Northern shelf. What is also of great importance is that the reserves are, to an increasing extent, believed to be dominated by gas.

The problem with gas on the northern shelf is twofold. Firstly the resource base on the North Sea shelf is already dominated by gas. Official estimates put total discovered resources there at some 4.4 billion toe. Of this 55 percent is gas. But of the new fields that have been declared commercial, and are not yet on stream, 83 percent of the resources is gas.

Judged in purely economic terms, Norway has already enough gas to sell for the foreseeable future. Additional discoveries of gas fields in the north are therefore not of great interest. The situation is quite different for oil. Here, the resources base needs to be replenished; if not, production will decline after the year 2000. Hence, the Norwegian petroleum strategy in the last couple of years has been summed up by the slogan 'Find more oil, sell more gas'.

Before 1985–86 the official Norwegian attitude was that the European gas market would always be ready to take more Norwegian gas. It was also held that Norwegian gas could command a 'premium price' because of reliability and security of supply. The Statfjord contract had assured many Norwegians of the truth in these arguments. The constraint on Norwegian gas exports was seen not primarily in the market, but in internal Norwegian decisions about field developments.

There was a drastic turnaround in Norwegian gas sales policy that took place at the time of the Troll negotiations in 1985–86. The Norwegian belief in its strength as a gas exporter was shaken by two events. First, by the British rejection to buy Sleipner gas in 1985 and then by the fall in oil prices in 1986. At the same time a re-evaluation of the outlook in the European gas markets took place. Gradually it became clear that it would become harder to get rid of the gas both in volume terms and on profitable conditions.

All this, naturally, had consequences for the northern shelf, although not as rapid as one perhaps should have expected. The reason is that activities in the north are partly steered by another logic — the regional dimension in Norwegian petroleum policy.

After petroleum production in the North Sea started in the early 1970s, exploration on the northern shelf was discussed, but put off several times. The physical distinctions between the northern and southern parts of the Continental shelf were seen as a reason for caution. (It has since been proved that the physical conditions in the north are no harsher than in some of the North Sea fields.) Even though environmental arguments had their own merit, they were reinforced by considerations for the fishing industry in the north.

In retrospect, it is striking to notice how rapidly the prevalent sceptic attitude towards oil exploration in the north was replaced by impatience. From the mid-1980s local and regional authorities as

well as business were anticipating large scale activities and preparing themselves for the moment it happened.

Regional pressure

Unfortunately, the regional momentum coincided with the new and more pessimistic outlook for Norwegian gas, as described above. But it was difficult to curb the regional pressure for increased petroleum activities. The authorities responded to the regional pressure by speeding up the exploration programme in the north and by encouraging development of an LNG-option.

Thus, exploration in blocks further to the east and to the north in the Barents Sea started in 1987. So far the results have been discouraging, perhaps with the exception of a find made by Shell last winter (north in Troms I). No serious assessment of this find has yet been published. Total recoverable resources in the Barents Sea are now estimated to be 245 million toe, almost all of it gas. Thus, towards the end of the 1980s, the expectations for oil finds in the north are far from fulfilled.

Regional pressures have also been put behind a call to develop the Snøhvit field. This field is the largest gasfield discovered in the north, with some 100 Sm^3 of natural gas. When Total and Statoil launched development plans in 1987, it was estimated to cost some 20 billion NOK. The market opportunities for Norwegian LNG were at the same time highly uncertain. Still, the more important aspect, in regional terms, was the prospect of 700 jobs with all the related activities in the province of Finnmark near the town of Hammerfest.

The central authorities are now trying to kill the LNG idea in the north that they once nurtured. With the uncertain demand outlook in the American market and the big risk exposure the Norwegian treasury already faces in the North Sea, it does not make much sense in commercial terms to develop a separate LNG project in the north. LNG to the US market can be produced at lower costs in the North Sea. The latest parliamentary report on these issues maintains that to get petroleum related development in the north, it seems necessary to make oil finds. Thus, the Ministry quietly endorsed Statoil's decision in 1988 to drop the Snøhvit project, and instead develop an LNG facility at Kårstø in the south.

Nevertheless the regional dimension continues to be an important factor in Norwegian petroleum policy. The ministry tries to play down the regional advantages of petroleum activities but the call for increased activity has not been silenced.

So far 40 exploration wells have been drilled, costing some 5 billion NOK, or some £500 million. The interest of the oil industry in exploration is still there but the oil companies realize they are in a better bargaining position with the authorities than before. They signal that they are no longer prepared to undertake development of an infrastructure that is not directly needed for the exploration effort.

The Norwegian Petroleum Ministry is squeezed between the political pressure to push the exploration programme and the growing reluctance among the oil companies. The Ministry argues in its latest report that if the exploration programme is forced, with more or less random drilling, the chance of finding oil will not increase proportionally. On the contrary, a number of dry wells could discourage the oil companies from further engagements in the area.

Foreign policy issues

To complicate the issue further, petroleum activities in the north also have a foreign policy component, due to the proximity of the border with the USSR, the unresolved boundary issue, as well as the general dominance of security interests in the area. Norway has negotiated with the Soviet Union over a delimitation line in the Barents Sea in nine rounds since the mid-1970s. The Norwegian position is that the boundary should be drawn according to the median line principle, whereas the USSR maintains the sector line principle. These two claims leave quite a big disputed area between the two countries, of some 155,000 km^2, or more than the Norwegian shelf in the North Sea. The Norwegian government has let it be known that it could accept a compromise between the two positions. It has also proposed that a 'unitization clause' be part of an agreement, i.e. should petroleum fields lie across the border between the two countries, exploitation would take place on a joint basis.

The Soviet side, however, has maintained that the sector line is the only possible solution. But when the Chairman of the Soviet Council of Ministers, Nikolai Ryzhkov, visited Norway in January 1988 he declared that the Soviets would favour the establishment of a cooperation zone for joint exploitation of resources in the disputed area, as well as joint jurisdiction. This proposal has been met with a cold shoulder in Norway, since bilateral 'special' arrangements with the USSR and joint jurisdiction produce exactly the kind of situation the Norwegian government seeks to avoid.

So far the boundary issue has not had a direct impact on Norwegian petroleum activities. But the exploration programme moves eastwards. According to the Petroleum Directorate, the Finnmark East area, which borders with the disputed area, is well mapped geologically and the time for giving exploration concessions is ripe. The Soviets have drilled several wells on the other side of the disputed area, some of them on the median line. They have found hydrocarbons but the size of the discoveries is unknown and probably small.

A new situation would arise if promising finds were made either west or east of the disputed area. The oil industry would probably be interested in entering the disputed area, particularly if promising finds have not been made in other parts of the Barents Sea. This would of course be in conflict with Norwegian foreign policy in the area, and the government has on some occasions signalled that companies that would try to make separate deals with the Soviets would face some sort of punishment.

Norwegian petroleum policy in the North is also facing challenges from another direction. Since 1920 Norway has held sovereignty over the archipelago Svalbard, or Spitsbergen. Sovereignty is regulated by an international treaty, the Svalbard Treaty, which gives parties to the treaty equal rights to certain business activities that are relevant on the islands, including excavation of minerals. Another important point in the treaty is that it limits the size of taxes Norway can impose.

Now, Norway maintains that the treaty rules are irrelevant for the shelf area within the geographical coordinates that define the islands. This shelf area is a mere continuation of the Norwegian mainland shelf, and consequently Norwegian sovereignty is unlimited. The Soviet Union has contested this view and holds that the treaty rules must be applied. Several other parties, including the United States, have reserved their position on the issue. However, any serious conflict over the legal status of the shelf around Svalbard is not likely to occur unless interesting finds appear probable.

It can thus be seen that the development of Norwegian arctic petroleum resources is affected by several political considerations. Many of them are uncertain, some of them may be volatile. But of course, in such a context one must not forget the obvious — the most important factor in the years ahead will be the resource base itself.

Preparing Hamble for its new role

Geoffrey Mayhew reports

In the spring of next year a new kind of petroleum storage terminal will be in operation in the UK.

The BP Hamble Terminal, on Southampton Water, will become the export outlet by ocean going tanker for crude oil it has received by pipeline from the Wytch Farm onshore oilfield.

BP Hamble Terminal will also continue to receive large volumes of petroleum products by coastal tanker for distribution inland.

In addition to the £40 million being spent on the installation of four crude oil storage tanks with a diameter of 150ft and a height of 60ft each to hold 22,000 tonnes, an upgrading of the distribution facilities for product distribution inland is also taking place. It is possible that a fifth crude oil tank may be built to give more flexibility in storage and export.

Two necessities

BP Hamble began operations as a products distribution centre 65 years ago. The new and different role has been formed by two recent events.

These were the unexpected discovery in Dorset of the largest onshore oilfield in Western Europe; and the laying of a 16 inches diameter pipeline 56 miles long from Wytch Farm through the perambulation of the New Forest, with great care to protect the environment, to reach and cross Southampton Water — where BP Hamble Terminal with its jetty and acres of storage is on the east bank.

David Rowlands, seconded from BP Engineering, and in charge of construction, said: 'The project is unique for the UK and requires interesting engineering solutions.'

The BP engineers, many from other major projects elsewhere in the world, faced two necessities:

- Space saving techniques were required to place the large storages in the limited area available.
- While parts of the jetty head were to be demolished, including existing dolphins, and new construction and strengthening was required for export to ocean going tankers, the regular importation of refined products by small vessels could not be held up.

Two types of distribution

'Crude oil operations are scheduled to begin next spring, when the first oil from Wytch Farm will be ready for export', said John Holleyoak, Project Engineer. 'The 110,000 dead weight tonnes tankers will be able to take up to 70,000 tonnes of oil each time. They will berth about every ten days.

'This means that the two types of distribution — crude oil storage and export of crude received by pipeline; and product import, storage and distribution — around which the new engineering work for Wytch Farm has been designed, will take effect and last for 25 years at least.'

By that time Wytch Farm's oil production will rise from 11,000 to 60,000 barrels a day.

The destination of the crude oil exported from Hamble in 70,000 tonnes cargoes will be the decision of BP and its Wytch Farm partners. Cargo schedules will be based on Wytch Farm production and the known volumes in storage at Hamble — which will be available on computer print-outs at any time.

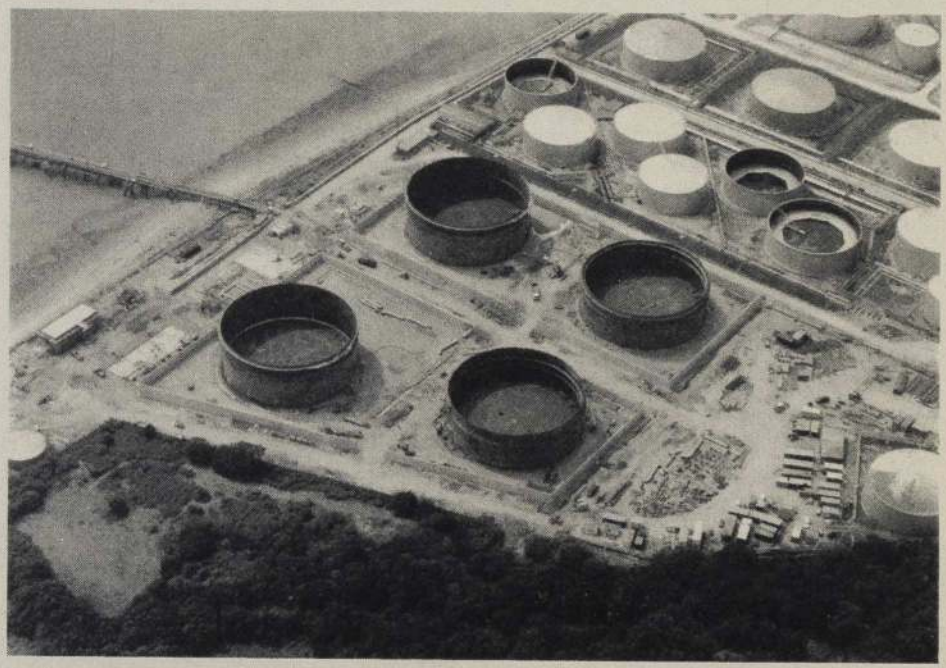
Saving space

Because of the collapse in the fuel oil market in recent years, 23 black oil storage tanks were no longer required at Hamble, and they were demolished. The four crude oil tanks for Wytch Farm oil now stand where these 23 tanks, and 14 other products tanks, once stood.

However, there was not enough space for conventional earth bunds around each tank. For this reason of limited space, 14ft high concrete bund walls were constructed to give each bund a containment greater than the volume of oil in one of the tanks.

Three of the tanks are founded on granular fill. The fourth is piled because of softer ground conditions. Around each tank for the entire floor of the bunded area, a special water-and-oil proof membrane has been laid. This is believed to be unique in the United Kingdom in petroleum bulk storage.

The membrane comprises a sandwich of dried Bentonite clay, similar to drilling mud, between two layers of fabric. When made wet, the clay layer swells and forms



The four storage tanks for Wytch Farm crude oil under construction at BP Hamble Terminal on Southampton Water. Each tank will take 22,000 tonnes of crude oil received by pipeline from Wytch Farm for export by ocean tanker.

a waterproof layer over the floor, preventing any passage of liquid into the ground beneath.

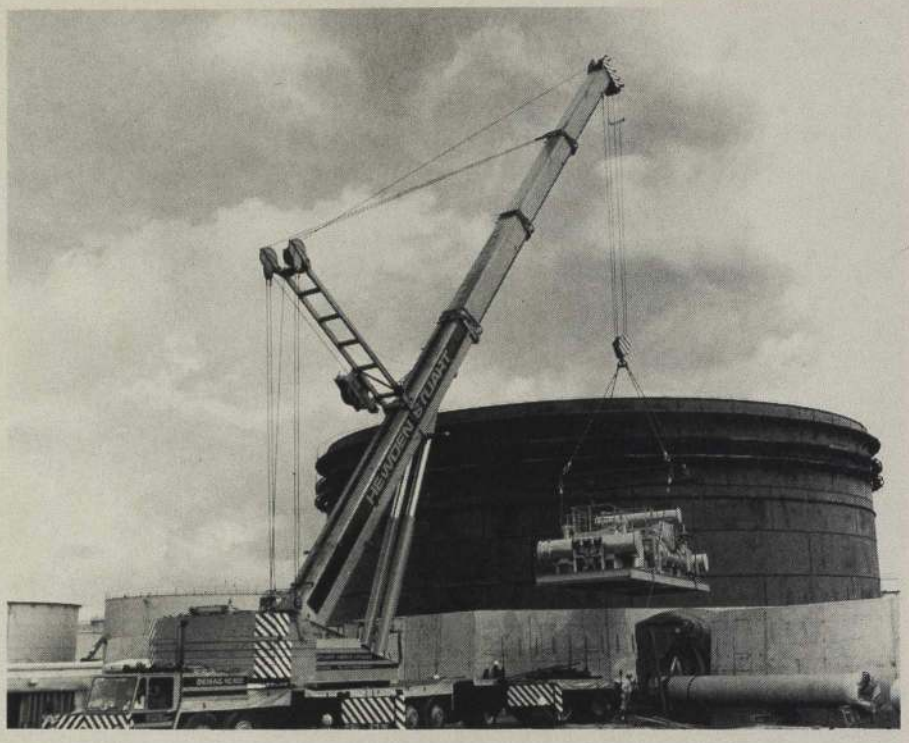
This has been used by the water industry, and was also used at the Humbly Grove oil development to line trenches.

These four storage tanks are the largest constructed on site for a decade. They have been fabricated and welded on site and are formed from 500 tonnes of steel. In preparing the ground, some 15,000 cubic metres of soil was moved.

Oil treatment advantage

The crude oil piped from Wytch Farm will arrive at Hamble stabilised. The natural gas will have been separated and delivered through a separate pipeline to the British Gas grid at Sopley, Hants. Liquefied petroleum gas will be delivered to Avonmouth by train from a new railhead currently under construction at Furzebrook.

As a result of the crude oil treatment, the amount of water remaining in the light crude oil from the Bridport and Sherwood reservoirs at Wytch Farm will be very low and no further separation will take place before export.



The biggest 'lift' seen at Hamble Terminal in Hampshire eased this 42 tonne export metre 'skid' gently into position close to Southampton Water. This, and associated units weighing a total of 142 tonnes, will be used to measure crude oil when it is pumped out to waiting oil tankers next year.

Jetty conversion

Large scale adaptation was required for the jetty because, although efficient for coastal tankers, it could not carry out the bigger role for the terminal as an exporter to large ships. As a start some 600,000 cubic metres of spoil were removed by dredging the seabed at the jetty head to allow for the deeper draught ships. At the same time sections of one jetty were removed by a 300 tonnes capacity floating crane, and the existing berthing dolphins were pulled out.

In their place, breasting and mooring dolphins with concrete heads were installed on steel piles capable of securing the larger vessels. Some 130 piles are being driven to depths of 50ft to 90ft into the seabed in the jetty improvement.

Another part of the conversion work on the 1,686ft reach of the jetty involved the removal of the now unused black oil pipelines and the strengthening of the structure to carry the heavier crude oil export line. This is on the downstream side of the jetty.

Metering

While the pipeline from Wytch Farm into Hamble is 16 inches in diameter, the outgoing line from the storage to ship is 30 inches in diameter. Five pumps onshore will be able to send crude oil down that line at the rate of 6,000 tonnes an hour. The crude oil tanks will be dipped daily on receipt of oil from Wytch Farm for stock taking, the figures being relayed to Wytch Farm. They will also be dipped before and after loading for export as a check against metering.

However, the focus is on the export metering skid which will provide a computer record of the volumes loaded into a ship for Wytch Farm partners as well as for Customs & Excise, for the Department of Energy and for input into the crude oil accounting system. This metering system is in four parts. The export meter skid was lowered into position near the jetty by crane.

On the jetty head two 16 inches diameter pipelines connect with the 30 inch line from the storage. These will lead to two new export loading arms. Each loading operation will be controlled from the jetty head, where it will be possible to open valves and start pumps to direct the crude oil to the meter skid and then to the loading arms.

Safety

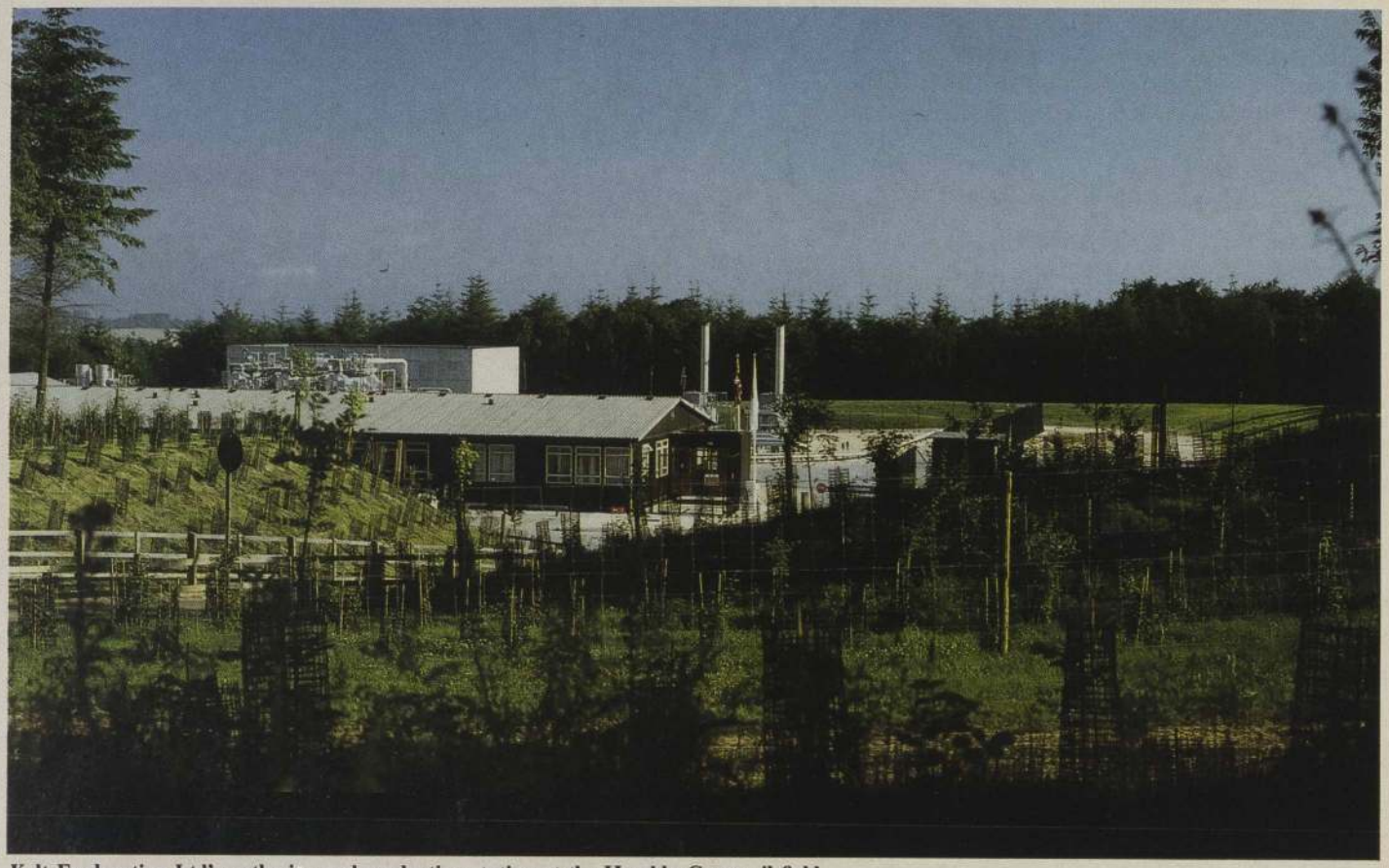
Among the safety features at Hamble is a new fire water main encompassing the area. Two large diesel pumps with a capacity of 27,000 litres an hour will pump water from Southampton Water into the main, which will be maintained full and under pressure. A new fire fighting foam package has been provided which will pump foam concentrate through a pipeline system to the place where needed.

One foam outlet is through foam pourers at the top of the large storage tanks, in order to protect the double seals round the floating roof. While the tanks are designed with a floating roof, which eliminates a potentially flammable air and gas mix, the availability of foam is typical of the extra precautions which is now a fact of life in oil industry construction.

As a precaution against marine pollution, the valves in the pipelines behind the two loading arms would close if there was a break in the line. Simultaneously the loading pumps would be tripped and this would bring the total flow to the ship to a halt.

A major oil pollution response base operated by BP, is located nearby at Southampton. When the terminal begins its crude oil export operations, there will be a fully trained oil pollution dispersal unit on duty.

The onshore oil industry is changing its structure as majors face time pressures



Kelt Exploration Ltd's gathering and production station at the Humbly Grove oil field.

Henry Boyd, Secretary of the United Kingdom Onshore Operators Group, suggests in an interview with *Petroleum Review* that it may be better to be a minor oil company than a major for onshore exploration and production. Indeed, some majors have recently sold out to minors. Problems include the large burden of overhead a major carries while waiting for a planning consent after making a discovery; for minors the burden is less. Moreover, offshore companies cannot offset onshore expenditure against Petroleum Revenue Tax, whereas small onshore companies, although not PRT payers, operate at lower cost. But there are factors helping the onshore industry. For example, planners are now more aware of the special care over the environment which is taken by onshore operators in drilling for and producing oil. Discussions initiated by UKOOG with planning authorities have led to national guidelines for seismic operations onshore which have been accepted by planners and exploration companies.

Geoffrey Mayhew: Is onshore oil and gas production in the United Kingdom a natural industry?

Henry Boyd: Yes. The oil companies now feel very much at home operating onshore UK, and it is interesting to see the way quite a number of small companies are now operating very efficiently. This is probably the way the industry will develop in the next few years, with the smaller, highly efficient companies operating very economically.

Has that state of affairs become established in the fairly recent past?

Until quite recently it was largely the major companies who had been making the running, but a number of them have found their overheads are such that, coupled with the delay between discovery and production which we find onshore UK, it is often difficult for them to operate economically.

How many operators belong to your Group?

We have some 30 members, and that comprises every substantial operator onshore UK.

Is the number growing?

I would say it is contracting slightly.

Why would that be?

Last year saw an enormous amount of flux in the industry. A lot of deals were done. A number of major companies left the industry, a number of non-oil operators left, and there have been consolidations and amalgamations.

Was that due to economic pressure or other reasons?

I think it was due largely to a low oil price.

It was not due to fears about lack of onshore oil and gas?

I think that must contribute to it as well. There has been disappointment that there have not been any major discoveries in the last few years. Hopefully, Wytch Farm is not unique, but so far there is only one Wytch Farm.

Are all the offshore operators also UK onshore operators?

There is a fair degree of overlap, but there are many offshore operators who are not onshore operators, and equally many onshore operators are not offshore operators.

Is there any special reason why that should be the case?

Some major offshore operators consider it inappropriate for them to operate onshore. A case in point is Conoco, which put a very great deal of effort into onshore exploration and eventually found it was not a place where it should be operating.

At the other end of the scale, there are a number of emerging oil companies which are now large enough to be onshore operators but are still far too small to be offshore operators.

Can it be an advantage onshore to be a minor company rather than a major one?

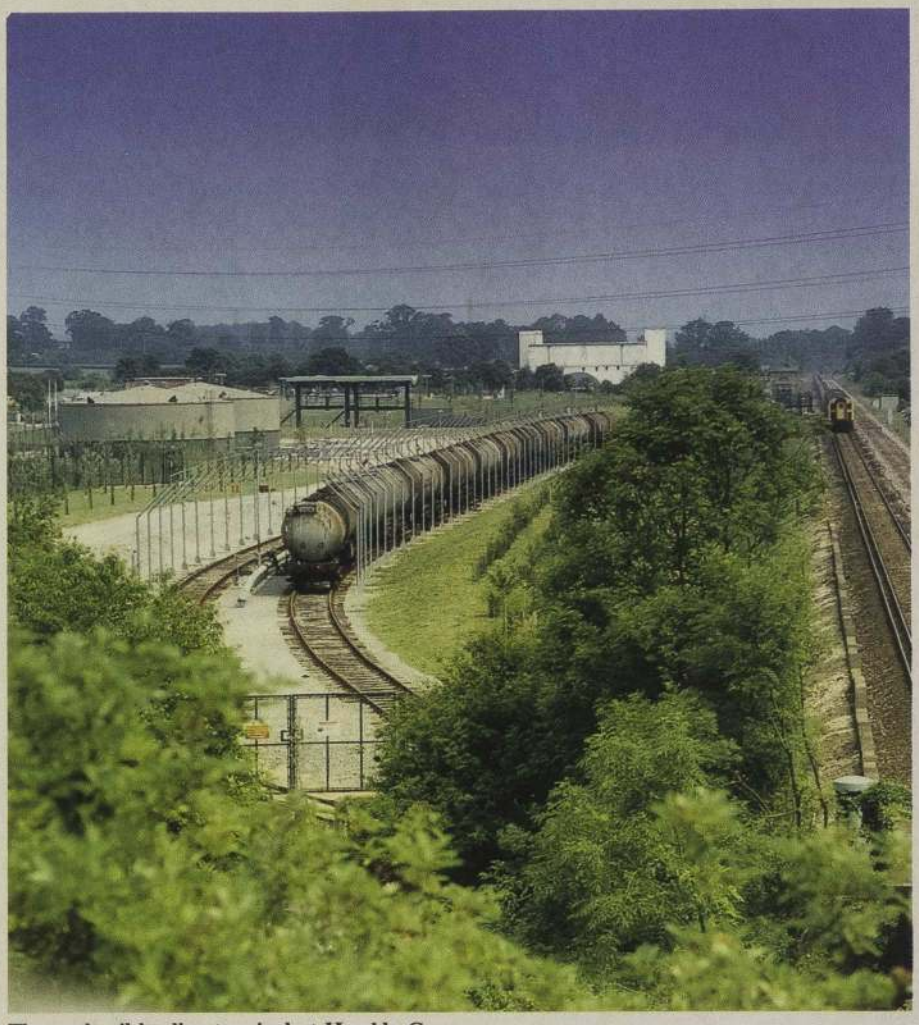
I think it can. It has a number of advantages, one being that you are not carrying a heavy burden of overhead. You can run a lean and mean operation, and a number of operators are presently demonstrating that that is the key to success onshore UK.

For example, Cairn are a fairly small operator showing a very dynamic approach to the development of discoveries which they acquired from Conoco. Another example must be Pentex which has taken over a number of small mature oil fields previously operated by BP. Another newcomer, Kelt, took over the Taylor Woodrow licences and, more recently, the Carless licences.

Do you believe that is a tendency which will continue?

Yes. I think operations onshore UK are likely to be similar to operations in marginal areas onshore the United States, and that is the province of the small, dynamic, efficient operator. That is not to say there is no place for large operators as well.

But don't small companies still need the same clever people?



The crude oil loading terminal at Humbly Grove.

Yes, and I think they have got the same clever people. Very often, people in management in the small companies are people who have come from major operators. They are highly qualified and highly professional people.

When a company has made a discovery it still has to get planning permission to proceed. Can that sometimes take a long while?

One of the biggest problems we have is the delay between discovery and production. A large operator may find it very difficult to carry his overhead burden over a long period of delay. I think the smaller operator may be able to reduce that delay, and that smaller operator also does not carry the same burden of overhead. I think he can reduce that delay because the large operator is likely to apply North Sea procedures and techniques to his evaluation of an onshore field.

It may be appropriate in the North Sea, before embarking on development, to carry out every test that the state of the art suggests, but onshore you cannot afford it and small fields do not justify that approach.

The important thing onshore is to get into production, not to get the design of the production facilities perfectly attuned to the geology of the field.

What about the tax situation? Does that affect onshore as opposed to offshore?

The big difference between onshore and offshore is that onshore a licensee's expenditure on exploration and appraisal cannot be offset against PRT, and that makes onshore exploration very much more expensive than offshore exploration—for a PRT payer. Not all onshore explorers are PRT payers, and so you find a division between those who pay PRT and those who do not.

PRT, for those who pay it, is in effect a penalty as far as onshore work is concerned?

For a PRT payer, what costs a dollar onshore costs 25 cents offshore.

Is that one of the reasons why a change has been taking place between big and small companies onshore?

It must contribute to it. A number of

larger companies who pay PRT are not at all happy at having to spend dollars onshore.

Are they seeking to get something done about that?

We did make a submission to the Treasury on PRT and royalties about two years ago and were successful in having royalties removed from onshore production, but we were unsuccessful in having PRT relief reintroduced. I think there were two reasons why we were unsuccessful. One is that some see an illogicality in having PRT relief for exploration which is unlikely to lead to the discovery of PRT-paying fields. The second reason is that we were unable to speak with a united voice, because some of the non-PRT-paying companies — not all — strongly resisted the reintroduction of PRT relief onshore.

Why?

Those companies who resisted the reintroduction of PRT for onshore did so because they saw the reintroduction as bringing in an element of unfair competition.

Because they are smaller?

Because they do not pay PRT, and therefore their PRT-paying competitors would be able to operate for one-quarter of the cost of the non PRT-paying companies. There is a counter argument — that the reintroduction of PRT relief would greatly increase the commercial value of onshore acreage — and that would benefit both small and large companies. Another argument in favour of PRT relief, from the point of view of the small company, is that it would encourage larger companies to farm in to the small company's acreage, and so a small company might be carried through a well it could scarcely afford itself.

Would that be a good thing?

I think so, but there are divided views.

Does 'farming-out' take place onshore?

In the sense of selling out of acreage, yes, it does. As I mentioned earlier, BP have recently sold eight small fields to Pentex; Conoco have also sold out. In the sense of farming out wells, yes, a number of wells have been farmed out, but the fact that PRT relief is not available, must discourage that happening.

In relation to local government, does UKOOG find planners are becoming more knowledgeable about the care that operators take in exploration and later, if a discovery is made and they get planning permission, in their production operations?

That is certainly true. Our experience is that planning authorities are now much more knowledgeable than they were, and as they grow more knowledgeable they become much easier to deal with.

Ignorance is a major problem for us. Once people have experienced oil company operations, objections usually subside. The major opposition seems to come from people who do not know what is involved.

Has the Wytch Farm development helped in this respect?

I think it has helped enormously. I do not think we should be ashamed to beat our own drum. The oil industry has done a first-class job wherever it has operated in taking care of the environment, and I think that is now more widely recognised.

The planners probably see this for themselves?

Yes, and of course planners do not live in isolation; they meet together and discuss onshore operations and learn from those discussions, and generally accept that the industry has a good record.

Does UKOOG encourage this?

Certainly. Recently, one of our members took a coach load of councillors to look over an exploration well site so that those deciding planning applications could speak from some knowledge and experience.

The Department of the Environment has issued guidelines for authorities which were based on the necessity to explore the nation's mineral resources?

I think you are referring to Circular 2/85 which was produced by the Department of the Environment. That Circular contains a very important section dealing with the need to explore and the need to develop, which are two separate things.

The section of Circular 2/85, dealing with national policy, has been referred to quite recently in two important planning appeals: one by Shell in respect of Shipbourne in Kent, and one by Amoco in Hastings. We are still awaiting the result of the Shell application, but the Amoco appeal was successful.

What does that mean as far as Amoco is concerned?

It means they have planning consent, subject to certain conditions, to drill their commitment well on the outskirts of Hastings.

As far as the need for exploration is concerned, successive governments have sought to encourage the full exploration of mineral resources, including hydrocarbons. It is government policy that it should continue.

Is UKOOG concerned in the development of technology, for example, to make onshore work quieter?

As an organisation we are not concerned at present, but certainly our members have been concerned. Almost invariably, any application for planning consent for an exploration site will address the question of noise, and the operator applicant will be concerned to minimise noise. We have made substantial progress in the last few years in reducing noise both at exploration and at production sites.

Is this widely appreciated?

I do not think it is, because often we drill so discretely that people do not appreciate we are there. Some time ago a group of protesters meeting in a pub were complaining about the proposed drilling of a well in their neighbourhood, and eventually one of the group turned to an oil man who was able to point out that in fact the well had just been completed, and none of the protesters had even noticed it.

Because of the absence of recognised noise?

Because of the absence of noise and general disturbance in the locality.

Is new legislation coming forward on onshore exploration and production?

We do not anticipate any radically new legislation. We are looking at the regulations to see whether they can be changed to make onshore operations simpler and more economic. One thing we are looking at, are the regulations relating to seismic acquisition.

At present, an operator is not allowed to shoot a seismic line outside licensed acreage, which often means that the seismic picture is not as complete as one would want. We hope to persuade the Department or government to introduce regulations which would permit shooting tails outside licensed acreage to produce a better seismic picture of the licensed acreage.

All the work we do is carried out by the staff of member companies, and I must say member companies are very generous in the staff time they make available for carrying out work on behalf of the Group.

Perhaps one example I can give, which has been most successful, is the technical work we have on the effect of seismic operations in relation to buildings. That led us to compile seismic guidelines, which we made available to the planning authorities.

This led on to discussions with the planning authorities and eventually to agreed national guidelines for seismic operations. That involved a lot of staff time by our members, but it has been successful, and it has made the work of both operators and planning authorities much easier.

It is sometimes said it is easier to explore in the north rather than in the congested south. Is that so?

That is certainly true. There may be many reasons for that. One is that in the East Midlands they are used to oil exploration and production; it has been going on there for a great many years, so we do not have a problem with ignorance.

Is the south showing any sign of becoming, in general terms, more amenable to onshore work?

Yes, I think it is. As people become more used to the idea of onshore exploration and production and realise it does not lead to something reminiscent of Texas in the 1920s, people do become more amenable.

Is it possible to estimate what is being spent on onshore exploration and production currently and to compare it perhaps with recent times?

I cannot give figures for earlier years, but in 1988 our members spent £123 million on goods and services for UK onshore activities.

Do you think this type of expenditure will continue?

Last year we had a great surge in development activity, but this was largely connected with Wytch Farm and also, to some extent, Welton. In 1988 a total of 46 wells was spudded onshore as opposed to 39 the year before, but of those 46 wells, 27 were development wells as opposed to one development well the year before. In terms of drilling activity, it is quite interesting that this year we have seen 21 wells spudded to date, as opposed to 13 by the same time last year.

The breakdown of that, is eight exploration wells so far this year as opposed to three the year before, one appraisal well this year as opposed to none the year before, and 13 development wells as opposed to nine by this time last year, so the picture shows that there is still a considerable amount of activity and little sign of it falling off. However, quite a lot of the exploration drilling may be to complete licence commitments.

Will Third Round onshore be popular?

The Second Round, announced in the autumn of 1987 and completed in March, 1988, was a very big one, some 60 exploration licences being granted to some 73 companies or groups of companies. I would not anticipate the Third Round being as large a round as the second one but it will give an opportunity for smaller enthusiastic companies to establish themselves with interesting acreage.

Europe is very interesting geologically, especially Northern France. The Paris basin is said to be similar in parts to southern England. Are some of the onshore operators in the UK interested, or involved in Europe?

Yes, definitely. It is an interesting pattern. UK onshore operators have been encouraged to branch out overseas and to operate particularly in France and Italy, and considerably more than half the members of the Chambre Syndicale — our opposite number in France — are also members of the UK Onshore Operators Group.

EXPLORATION AND PRODUCTION DISCUSSION GROUP

The next meeting of the E & P Discussion Group will be held at the Institute of Petroleum on Thursday, 12 October 1989 starting at **5.30 pm.** (Tea and biscuits available from 5.00 pm.)

The Ninian Field History

Speaker: **Mr D H Carmichael,** Platform Manager, Central/Southern Chevron UK Ltd.

If you would like to attend this meeting please contact

Mr Alan Lodge,
Institute of Petroleum,
61 New Cavendish Street,
London W1M 8AR.
Tel: **01-636 1004 Ext 236.**

New Members

Bray, DG, BOC Cryoplants Ltd, Engineering Centre, 30 Priestley Road, Guildford, Surrey GU2 5YH.
Cochrane, WJ, Chevron UK Ltd, Ninian House, Crawpeel Road, Altens, Aberdeen AB1 4LE.
Cook, AG, Petroil (Shore & Offshore) Ltd, 9 Cork Street, London W1X 1PD.
Cook, HG, Oxford Advertising & Technical Services Ltd (OATS), 701/702 Delta Business Park, Gt Western Way, Swindon, Wilts SN5 7YN.
Dawson, AD, Taylor Woodrow Construction Ltd, 345 Ruislip Road, Southall, Middx UB1 2QX.
Freeman, PJ, Warrior International Ltd, 100 Piccadilly, London W1V 9FN.
Khan, AA, House No 53 Nishtar Block, Allama Iqbal Town, Lahore, Pakistan.
Koenig, JWJ, Erdolbevorratungsverband, Jungfernstieg 38 IV, D2000 Hamburg 36, W Germany.
Krishnan, S, Bharat Petroleum Corpn Ltd, PB 33 Gandhidham, India 370 201.
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Powell, Mrs JA, NCNB Texas National Bank, 51 Gracechurch Street, London EC3V 0BD.
Ravey, P, Toplis International, 15/17 Christopher Street, London EC2A 2BS.
Rowett, AC, Barclays Bank plc, Natural Resources Dept Corp Divn, 33 Old Broad Street, London EC2P 2JE.
Tuvey, M, Flightflow Ltd, Weir Bank, Bray on Thames, Maidenhead, Berkshire SL6 2ED.
Ward, G, Yorkshire Pump & Tank Co Ltd, 30 Forest Lane Head, Harrogate, N Yorkshire HG2 7TF.
Zajdela, M, Enerfinance, 9 Boulevard Bonne Nouvelle, Paris 75002.

Have you moved?

If so, please don't forget to notify the Institute of your change of address.

Around the Branches

Aberdeen
10 Oct: 'Ivanhoe/Rob Roy Field Development'. by Paul Collins, Amerada Hess Limited.
14 Nov: 'Offshore Licensing — A Complex Issue!', by Ian Gray, Exploration Conoco (UK) Limited.

Edinburgh & South-east Scotland
12 Oct: 'Total Quality', by T Reilly, BP Chemicals. Venue: BP Oil Refinery Cinema.
2 Nov: 'Tunnelling' by RN Craig, Technical Director of the Channel Tunnel.

Essex
11 Oct: 'Quality Assurance and BS 5750', Dr ER Wright, Esso Petroleum Co Ltd.
8 Nov: Ladies Evening 'Garden Topics', Mr N Fisher, Tomlins Nurseries Ltd.

Humber
5 Oct: 'Major Hazard Assessment', Dr RP Pape, Head of HSE Major Hazard Assessment Unit.
27 Oct: Annual Dinner Dance. Venue: Beachcomer, Humberston.
23 Nov: 'Petrofina Pipeline Project', speaker to be announced.

London
19 Oct: 'Passenger Car Engine — Oil Development', M Wharton, Esso Research Centre Abingdon.
9 Nov: 'Small Field Developments of the Future', JP Shute, Enterprise Oil. Venue: Room 131, The Royal School of Mines, Prince Consort Road, London SW7.

Midlands
18 Oct: 'Synthetic Lubricants', A Robertson, ICI.
15 Nov: 'The Influence of Unleaded Petrol and of the Forthcoming Exhaust Emission Regulations on Engine Design', speaker to be announced.

Northern
17 Oct: 'Future Trends in the Oil Industry'. Speaker to be announced.
14 Nov: 'White Oils' by Dr Lees, Maff.
24 Nov: Annual Dinner Dance 7.00 for 7.30 p.m.

Shetland
10 Nov: Annual Dinner, Shetland Hotel.

South Wales
19 Oct: 'Weather Prediction', D Langley, Cardiff Weather Centre. Venue: Amoco Refinery, Milford.
23 Nov: 'The Beckingham Experiment and Application', K Floyd, BP Exploration.

Stanlow Branch
18 Oct: 'Channel Tunnel Transportation System', P Martens, Euro Tunnel Plc. Venue: Shell Thornton Research Centre.
17 Nov: Dinner and Dance, Queen Hotel, Chester.

West of Scotland
24 Oct: 'Celebrity Lecture', LM Urquhart LLB, CA, Group Chief Executive, Burmah Oil Plc. Venue: Strathclyde University.
23 Nov: Dinner and lecture.

Yorkshire
10 Oct: 'Compressor Lubricants', D Cassidy, CIBA-Geigy.
14 Nov: 'The Place of the Independent Distributor in Today's Market', P Kidd, Chairman, Fuel Distributor Holdings.

New Collective Member

Brasoil UK Limited is a wholly-owned subsidiary of Braspetro Oil Services Company (Brasoil) which, in its turn, is controlled by Petrobras International SA — Braspetro — the international arm of Petrobras, the Brazilian state oil company.

Brasoil UK Ltd holds a 2·5 percent share in the Magnus Field, entitling it to approximately 13MM barrels of proven reserves. It was awarded two blocks in the 11th Round and is actively seeking further exploration opportunities.

In addition to its close working relationship with its Magnus partners, Brasoil UK Ltd has access, through its membership of the Petrobras Group, to the international majors and the service sector. Also, and most particularly in deep water exploration and production, the company benefits directly from the expertise and offshore operations technology developed by its parent company.

Subscriptions

The new subscription rates to Petroleum Review are £40.00 (inland) and £50.00 (overseas). Individual issues will now cost £4.50, including postage.

MASS FLOWMETERING SEMINAR

14 December 1989

The Institute is co-sponsoring this conference on Coriolis mass flowmetering which will be held in London. Members of the Institute of Petroleum are entitled to reduced registration fees and should enquire about this when registering direct with the organisers — Conference Office, Sira Ltd, South Hill, Chislehurst, Kent BR7 5EH. Tel: 01-467 2636.

Deliveries into Consumption

UK deliveries into inland consumption of major petroleum products — Tonnes

Products	*July 1988*	**July 1989*	†*Jan–July 1988*	**Jan–July 1989*	*% change*
Naphtha/LDF	248,090	205,780	1,895,610	1,829,780	−3.5
ATF—Kerosine	627,460	675,600	3,494,510	3,715,670	+6.3
Motor Spirit	1,957,670	2,023,550	13,274,690	13,796,800	+3.9
of which unleaded	18,330	454,820	62,200	1,925,210	+2995.2
Burning Oil	99,440	68,510	1,092,000	1,058,330	−3.1
Derv Fuel	777,120	819,440	5,349,230	5,778,610	+8.0
Gas/Diesel Oil	537,740	558,540	4,869,580	4,930,210	+1.2
Fuel Oil	634,610	613,420	6,053,800	5,654,710	−6.6
Lubricating Oil	71,240	71,010	506,380	515,580	+1.8
Other Products	580,070	539,670	4,096,080	3,861,460	−5.7
Total above	5,533,440	5,575,520	40,631,880	41,141,150	+1.3
Refinery Consumption	459,810	478,400	3,216,860	3,376,510	+5.0
Total all products	5,993,250	6,053,920	43,848,740	44,517,660	+1.5

*Preliminary †Revised

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We are currently looking for an Account Manager to join the team responsible for servicing the various business needs of clients in the oil and petroleum business.

Developing good working relationships is a key part of the role, calling for exceptional interpersonal skills and the business efficiency to ensure that each client receives the very best in service. This will involve frequent "on-site" visits so although you will need to attend regular meetings at our Bristol Head Office, relocation will not be necessary.

The successful applicant is likely to be a graduate with considerable retailing, marketing or planning experience in the oil industry. Your responsibilities will cover all aspects of client service including planning, sales development, consultancy and product management, and you will be required to present completed projects to your assigned clients.

We are offering a highly competitive salary and benefits package, including company car, pension scheme and performance bonus, as well as the opportunity to establish yourself as a key part of our internationally successful and expanding organisation.

If you would like to know more about the position, please write in confidence with an up-to-date CV to Wayne Rees, our Advising Consultant, at B&B Selection, 2, St Augustine's Parade, Bristol, BS1 4XG, or contact him on (0272) 272983.

DRI/McGraw-Hill

a division of McGraw-Hill Financial Services Company, has several vacancies in the International Energy Services for

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Candidates should have an MSc or a PhD in energy economics or a related field. Besides broad quantitative skills, some familiarity with econometrics and modelling, involving the use of computer tools, is desirable. For one of the positions, some knowledge of oil markets and experience in the oil industry (preferably downstream) are an advantage.

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The positions are based in Paris and require complete fluency in English. Please apply in writing, with full CV, and, if possible, an indication of salary expectations to:

Director of International Energy Services
DRI/McGraw-Hill
13 Rue du 4 Septembre
75002 Paris, France