ENERGY WORLD

The magazine of The Institute of Energy

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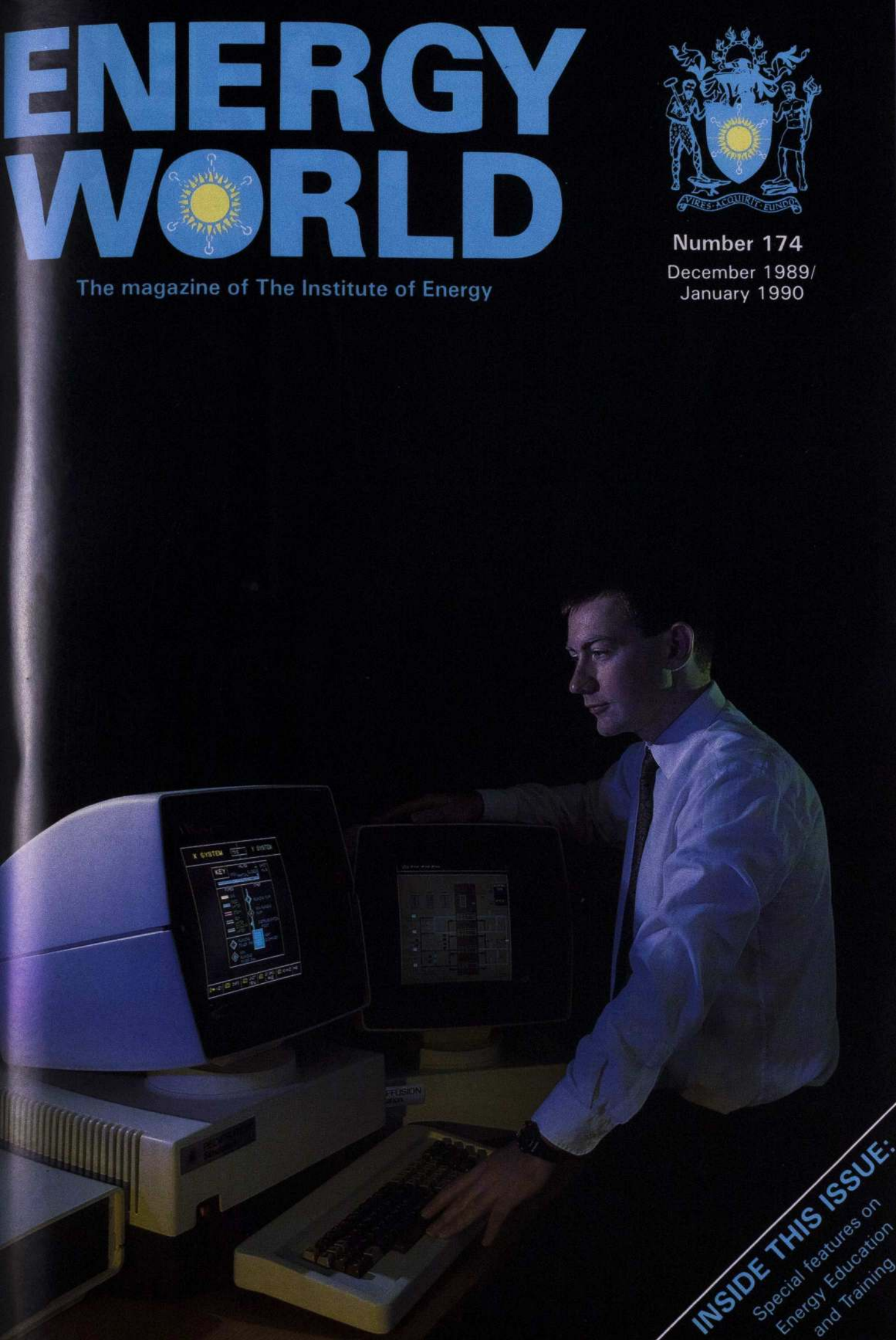

INSIDE THIS ISSUE:
Special features on Energy Education and Training

Fuel Officers

Energy to the nation

Fuel Branch, part of the Property Services Agency contract Directorate, is responsible for the provision of solid and liquid fuels and gas to Government and other public sector establishments. Fuel Officers are based in Central London, Bristol, Birmingham, Manchester and Edinburgh. A number of these posts are likely to become vacant shortly.

You will be responsible for dealing with the day-to-day supply of solid and liquid heating fuels, as well as motor transport fuels; this will include the preparation of contract details, the evaluation of tenders, and the award and supervision of contracts. You will also be involved in the formulation of fuel stocking policies and site inspections, as well as providing advice on the usage of fuel to officers throughout the Civil Service.

You will need considerable experience of the fuel industries, including trade practice concerning production, sales and distribution and should ideally hold an HND/HNC/C&G FTC or equivalent or higher qualification with an Engineering or Advanced Fuel Technology bias.

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Building for The Nation

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COVER STORY

Our cover photograph shows operations in progress on a computer-based training package (CBT) developed to assist operator training for AGR-type nuclear reactors. This particular simulator package has been designed to cover some aspects of operating procedures following reactor shutdown and has been developed by Rediffusion Ltd as part of an interactive training system.

The CBT will be used at the CEGB's Nuclear Power Training Centre at Oldbury, Gloucestershire, UK, and is intended to serve the needs of new operators for the Heysham 2 AGR station in Lancashire. It will provide practice in the post-trip sequencing which follows a reactor shutdown. It has been designed to function as a stand-alone training device but can also be used as an instructor tool during classroom training sessions.

The package has high resolution graphics utilising animation techniques and touch sensitive monitors to reproduce essential elements of the control system interface to a high degree. Completion of all training modules on the CBT ensures a smooth transition for trainees to the full control room simulator.

Photograph by courtesy of Rediffusion Simulation Ltd.

* See our series of feature articles on Energy Education and Training, beginning on page 10.

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TERMS OF CONTROL **Energy World is circulated free of charge to all paid up members of The Institute of Energy. To libraries, organisations and persons not in membership it is available on a single subscription of £70 for 11 issues. Energy World is also available with the Journal of The Institute of Energy (quarterly) at a combined yearly subscription of £130.**

Privatising electricity: Round 1

OVER the next two years we will see considerable activity in the energy field — with the onset of electricity privatisation, electricity pricing in the community and increasing attention being paid to the worldwide environmental aspects of energy production.

In the case of the electricity generating, transmission and distribution industry, the energy scene over the past few months has been consistent in only one respect, namely in the high degree of confusion that has been generated, with legislation and all that flows from it being produced to overcome the problems that emerged during the build up to privatisation. For the last nine months a game has been in progress between the generators and the distributors, with intervention by the Department of Energy as referee. The only winners to date have been the men from the City, the PR men and the advertising agencies making a fortune out of the wattless effort of new logos and adverts trying to tell us that National Power invented cornfields and windmills, and that PowerGen were responsible for the work of Ohm as well as tomorrow's independent weather. At a cost of over £1 million for the PR campaign alone, where does the basic objective of supplying cheaper electricity fit? And how is the electricity supply industry gearing itself to fight the serious competition of gas, rather than fighting in its own ranks? Would all this have happened if the UK Government had an energy policy?

The masssive reorientation of the electricity supply industry is taking place against the background of two other major interventions in the market. At the moment it is uncertain what substantial and long term changes they will bring with them, but at the very least they introduce another degree of uncertainty in long term planning which is essential to the industry. These are, of course, the single European market and the increasing concerns of all governments, not least our own, in the destruction of the environment.

The 31 December 1992 date, by which the programme for the single European market is to be completed, is not in reality three years away but is already with us. Many decisions have already been taken in Brussels and by those companies who believe their interests to be vitally affected. One thing is certain, the UK market will become a happy hunting ground for many more suppliers than there have been in the past. It is unfortunate we should consider the privatisation of our electricity industry *simultaneously* with 1992 as this does not give indigenous suppliers time to build working relationships with a whole range of customers operating under new rules and certainly thinking in different ways to the past.

The second issue is an increasing recognition worldwide of the need to take positive steps to converse the global environment and one can expect initiatives in this area at the national, community and international level. This issue too is fraught with difficulty. First, there is the difficulty of understanding the natural mechanisms and the extent to which they are affected by human activity. The second is how to put a value on the adverse changes to the environment in a way which is consistent with the way in which resources are customarily allocated, that is by price. The third is that even if one can solve the other two, there is the essentially political problem of the way in which those who impact on the environment should be charged for the privilege of so doing.

To recognise the complexities of this system — and the many important current issues which impact on it — is not to condone the delay in reaching a practical conclusion as to what should be done. The latest delay would be significant in itself, but it is more the severe coming as it does at the end of an extremely long process of discussion, negotiation and legislation. This has occupied the managerial talents of the majority of the industry for some two years. This has in turn diverted those management resources during that period from the longer term planning of the industry which is essential to ensure cheap and reliable supplies to consumers to the end of the century and beyond. Equally these delays have already led to a massive misuse of resources in engineering companies who have been trying to establish an intelligent and friendly rapport with potential customers, but who cannot offer them an open-ended consultancy service without firm prospects of business.

The announcement in early November of the withdrawal of the nuclear power stations from the privatisation portfolio together with the deferment of the programme to build further PWR stations (which were to provide the base load for the system during the first part of the 21st Century) is yet a further example of the confusion that has arisen in the industry.

There is an urgent need for clear decisions, which everyone must understand, and that will not be changed as a result of sectional pressures, however compelling the arguments may be. There will not be a perfect system no matter how long one tries, and there seems to be a danger of paying too high a price for the changes which are achievable in the present political climate. The achievement of clear definition *and* certainty is therefore important to all those involved in the industry. We are told the problems for ensuring global energy supply in the future are not technical but institutional. What better example of that could we have than the current UK scene. The confusion in the UK is leading to delays in the ordering and building of new plant, no matter what size and in whose hands, and unless we see some clear direction in the immediate future we could well be facing an energy shortage in five years, with all that that entails for the UK economy.

Dr Robert Hawley
Managing Director (Operations), NEI plc and President, Energy Industries Club

The author

Dr Robert Hawley is Managing Director (Operations), of Northern Engineering Industries plc, and a main board director of Rolls-Royce plc.

Born in England in 1936, he served an apprenticeship with BICC Ltd. After graduating with a First Class Honours Degree in 1959 from Kings College, University of Durham, he continued his studies receiving his PhD in 1962. In 1961 he joined C A Parsons & Co Limited to head a team studying vacuum, liquid and solid dielectrics. He became chief electrical engineer in 1970, a director in 1973, director of production and engineering in 1974 and managing director in 1976.

In 1984 Dr Hawley was appointed to the main board of Northern Engineering Industries plc and became Managing Director of the Power Engineering Group. In 1989 he was appointed Managing Director (Operations) responsible for all the trading activities of NEI plc with the sole exception of South Africa. In the same year and when NEI merged with Rolls-Royce plc he also became a main board director of Rolls-Royce plc.

He was awarded the 1989 IEE Achievement Medal for his outstanding contribution to power engineering, and in the same year became President of the Energy Industries Club.

He is an acknowledged international expert on the topics of power generation and energy and the author of several books and many papers on various aspects of power generation and dielectrics, for which work he was awarded a DSc from the University of Newcastle upon Tyne in 1976.

In 1979 he became a Fellow of Engineering. He is a Freeman of the City of London.

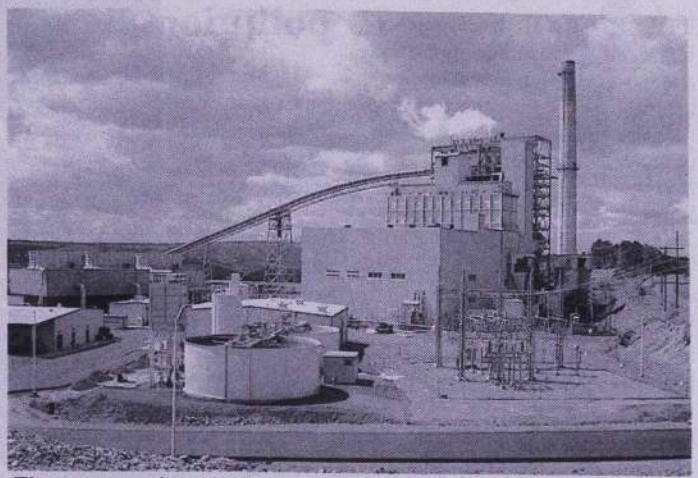
Cogeneration plant uses waste anthracite fuel

THE FIRST firing on waste anthracite fuel took place in October at Schuylkill Energy Resources' 80 MW (net) cogeneration plant near Shenandoah, Pennsylvania. The unit reached a maximum load of 68 MW before being shut down to correct an ash pluggage problem. Full load operation is expected soon.

Burns & McDonnell Engineers-Architects-Consultants provided design, start-up services and operator training for the plant under a subcontract with Blount Constructors, the plant's turnkey contractor.

The boiler, supplied by Combustion Engineering Company, is the world's largest single-unit circulating fluidized-bed boiler designed to burn unbeneficiated anthracite waste fuel with heat values lower than 3000 Btu/lb. The plant's fuel supply reserve consists of 37 million tons of culm, an anthracite coal mining waste product. Ash content of the fuel averages approximately 70 per cent.

The plant generates electricity for sale to Pennsylvania Power & Light Co, and process steam to dry high-Btu anthracite fines for commercial use.



The cogeneration plant near Shenandoah, Pennsylvania, owned by Schuylkill Energy Resources.

New steam generators

AT RINGHALS 2 nuclear power stations in Sweden, Siemens' KWU Group have replaced the original steam generators with new steam generators manufactured to KWU's proven quality standards by MAN Gutehoffnungshutte, FRG.

The work involved dismantling the old steam generators and installing the new plant — each generator weighed approximately 300 tons, within 72 days. The steam generators were rigged in and out of the containment through an opening in the containment wall for this purpose. Inside the reactor building, these heavy components were moved using special lifting gear and cranes. The replacement steam generators have been designed for an uprating of the plant's capacity for which the KWU Group have performed the requisite safety analysis.

The replacement of the steam generators at this nuclear power plant became necessary as a result of advancing wear of the steam tubes.

Indonesia refinery contract

THE Indonesian State Oil Company Pertamina has appointed a consortium led by Foster Wheeler, the Reading (UK) based engineering group, to build a new $1.8 billion 'grass roots' oil refinery at Balongan on the north eastern coast of West Java, some 250 kms east of Jakarta.

The refinery, known as 'EXOR-1', will process 125,000 BPD (barrels per day) of Indonesian crude oils comprising 100,000 BPD 'Duri' and 25,000 BPD 'Minas'. It will produce LPG, propylene, mogas, kerosene, gas oil, industrial diesel fuel and decant oil — mainly for the Indonsesian domestic market.

Detailed engineering, procurement and construction will be undertaken by Foster Wheeler and JGC Corporation of Tokyo working together as a joint venture. Initial refinery operation will commence during 1994.

The new refinery, supplying the domestic market, will enable the surplus capacity created at other Indonesian refineries to generate exports as a means of increasing earnings of vital foreign currency — hence the project name EXOR (Export Oriented Refinery). BP, acting as product offtaker through its Far East marketing organisation, will thus market the products of several Pertamina refineries. This income will be geared to pay for the cost of the new project with the balance being returned to Pertamina as owner.

The Foster Wheeler Consortium which brings together BP and Foster Wheeler from Great Britain and Mitsui and JGC from Japan, was created in 1986 in response to an invitation from the Indonesian Government to develop an export refinery. This plan, however, was modified a year ago when plans to expand the existing Duri were developed. The consortium was then asked to consider the notion of developing a refinery, located in Western Java and close to the market, to take 100,000 BPD.

In the pipeline

WINTERSHALL AG, Kassel, West Germany, a BASF Group company, plans to build a natural gas pipeline across western Germany. To be known as the MIDAL (Mitte Deutshland-Anbindungs-Linie or the Mid German Link), its route, some 560 km in length, will extend in a gentle curve from Rysum near Emden, where the Norpipe (North Sea natural gas pipe) reaches the coast, to Ludwigshafen.

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

At the present time natural gas accounts for about 16 per cent of the Federal Republic's energy supply. Consumption may be expected to increase due to the prevailing demand for generating energy without harm to the environment and burning fuels with low emission levels in combination with new, energy-saving technologies. Wintershall foresees rising natural gas demand particularly in central and southern Germany.

Offshore expenditure forecast

NEW FORECASTS from energy analysts Smith Rea predict the current £10 billion a year spent by the North Sea oil and gas industry will continue to rise, and will peak in 1992/3.

Smith Rea's latest volume in their Offshore Business series, entitled *European Industry Outlook*, includes data on 232 potential North Sea field developments. It concludes that in all sectors, at today's prices and with current technology, substantial reserves remain economic to develop.

Gas is in good supply with large reserves in Norway, Europe, the USSR and N Africa and is poised to take market share in the event of any significant oil price rise. European Community legislation is beginning to emerge and could open the European market to free competition, especially if a UK-Continental line is laid.

Smith Rea see individual government pressures to buy from national firms set to crumble in the new single market, unless compromises are reached whereby licence awards become more open in exchange for oil companies winning provisional exemption from the EC public procurement rules.

BP to sell SA coal assets

BP Southern Africa (Pty) Ltd (BPSA) and Anglo American Coal Corporation Ltd (Amcoal), have reached agreement for the Amcoal Group to acquire BPSA's 88.5 per cent holding in the Middelburg Mine Joint Venture and certain related coal interests, which include a shareholding in Richards Bay Coal Terminal Company Ltd.

The sale is subject to certain conditions including a 60 day pre-emption right in favour of Douglas Colliery Ltd, BPSA's partner in the Middelburg Mine.

In a separate sale BPSA has reached agreement to sell its West Waterberg coal reserves.

BPSA will receive approximately R590 million (US$225m) from these sales.

The sales follow the BP Group decision to invite bids for its worldwide coal assets earlier this year.

GE contracted to supply new c-c power plant

IN September GE (USA) announced the signing of a turnkey contract worth approximately $110 million with Virginia Power for the supply and installation of a second GE STAG® 107F combined-cycle plant at the utility's Chesterfield Power Station just south of Richmond.

Virginia Power, a major utility serving parts of Virginia and North Carolina, purchased the first STAG 107F plant in the autumn of 1987. GE is currently installing this system at Chesterfield for combined-cycle operation in June 1990.

Identical in design to the first plant, the second STAG 107F system also will be based on GE's advanced 150 MW MS7001F (7F) gas turbine, which was designed specifically for US utilities. The 7F meets stringent emissions standards operating on natural gas, light distillate oil, or medium Btu-gas made from coal.

Output of the new plant will be approximately 220 MW with a heat rate of less than 7550 Btu/kWh. Plant thermal efficiencies are expected to exceed 50 per cent.

GE will join forces with J A Jones, a major construction firm, to build the new STAG 107F plant, which is scheduled for combined-cycle operation in June 1992.

Fresh hope for reduction in global pollution

THE RECENT developments in Eastern Europe have not only opened up new political opportunities, but also opportunities for the reduction of global pollution, according to Peter Morrison, Minister of State for Energy.

Mr Morrison made his comments at an Energy and Environment conference in Cambridge in November.

He asserted that the scale of pollution from outdated heavy industries in Eastern Europe which is now coming to light, has exploded the 'myth' that environmental pollution is less likely to occur under a centralised state system than in a free market economy.

Mr Morrison attributed the momentum for political reform in the Eastern Block as being partly due to fears about the environment, adding that the rapidly changing situation offers new hope for solutions to the environmental problems the world is facing.

He suggested that the West could make a major contribution towards solving the problems by offering to provide technology to help reduce levels of pollution in Eastern Europe.

Joint venture

IT was announced in November by Phillips Petroleum that Hyundai Corporation had received the approval of the Korean Government to be part of a joint venture to explore for oil and gas in the United States.

An agreement was reached in April 1989 between Phillips, Opicoil and Hyundai to spend approximately US$100 million over a three-year period to explore prospects in the Rocky Mountains, Oklahoma, Texas, along the Gulf coast, in the Gulf of Mexico and in California.

Under the recently announced terms of the agreement, Opicoil will pay 45 per cent of the exploration costs; Hyundai, 35 per cent, with Phillips paying the remaining 20 per cent.

1989 was the first of the three-year programme, and during that year 15 wells have been drilled, of which three commercial discoveries were made, and one potential discovery.

The joint venture budget for 1990 will be approximately US$30 million.

BNFL wins Spanish order

BRITISH Nuclear Fuels is set to maintain its role at the heart of the Spanish nuclear power industry by winning business worth nearly £1 million a year over the next three years.

The Springfields fuel manufacture plant, near Preston in Lancashire, is to supply 100 tonnes of uranium dioxide powder a year to Empresa del Uranio SA (ENUSA), the company responsible for meeting the fuel needs of all Spain's nuclear reactors.

The work, an extension of an existing contract, will involve the conversion of uranium hexafluoride to uranium dioxide powder using BNFL's own pioneering technology, the integrated dry route (IDR) process. The contract means that BNFL will be supplying enough uranium dioxide powder to fuel all of Spain's pressurised water reactors (PWRs).

"Clearly, this new business is a measure of the confidence which our customers have in the quality of the product and in the IDR process itself," says Dr Gregg Butler, Springfields general manager and director of BNFL's fuel division. "We're pleased to be continuing what has been an enduring and successful commercial relationship with ENUSA." BNFL has been supplying a conversion to ENUSA since 1984.

Offshore oil/gas partnership

ENERGY Minister, Peter Morrison said in October that Britain and Norway can forge a partnership for the 1990s to succeed in world offshore oil and gas markets.

Speaking at a seminar in Stavanger, Norway, "Together into the 1990s," Mr Morrison said:

"This year the UK celebrates 25 years of offshore operations. To date in the UK sector some 4,000 exploration, appraisal and development wells have been drilled and over 1.2 billion tonnes of oil brought ashore from one of the world's most hostile environments.

"The focus of attention in oil and gas activity has now switched from North America to Europe, where two players dominate the scene — Britain and Norway.

"Our development of the North Sea has given both nations a unique experience in offshore oil and gas technology. Experience that will be of great benefit to the growing number of oil and gas developments throughout the world.

"In this anniversary year it is right that we should explore ways of collaborating to tackle world markets. Joint ventures are a particularly valuable way of combining our financial and technical muscle. But we must allow these ventures to establish themselves and develop in their own market place — the North Sea.

"I am sure that this forum will provide a springboard for our governments, and particularly our supplies and service companies, to find ways to work together."

Combined cycle contract

EWBANK Preece Ltd, the international engineering consultancy based in Brighton, UK has been awarded a major contract by the Electricity Generating Authority of Thailand (EGAT). The contract involves project management, engineering and detail design services for a 1 × 300 MW gas-fired combined cycle power station at Nam Phong in Khon Kaen Province, North Eastern Thailand.

Ewbank Preece had previously carried out a feasibility study into the power station development in 1983 following the discovery of gas deposits in the region. The project is now proceeding in order to support the recent, massive demand for power in Thailand caused by rapid economic growth.

The principal contractor for the power plant is Mitsubishi Heavy Industries of Japan who will supply all major equipment such as gas turbines, waste heat boilers and steam turbines. Initial civil work on the new station has already begun and it is planned that the gas turbines will be operational in open cycle by December '90 and in combined cycle by December '91.

Mitsubishi half-year results

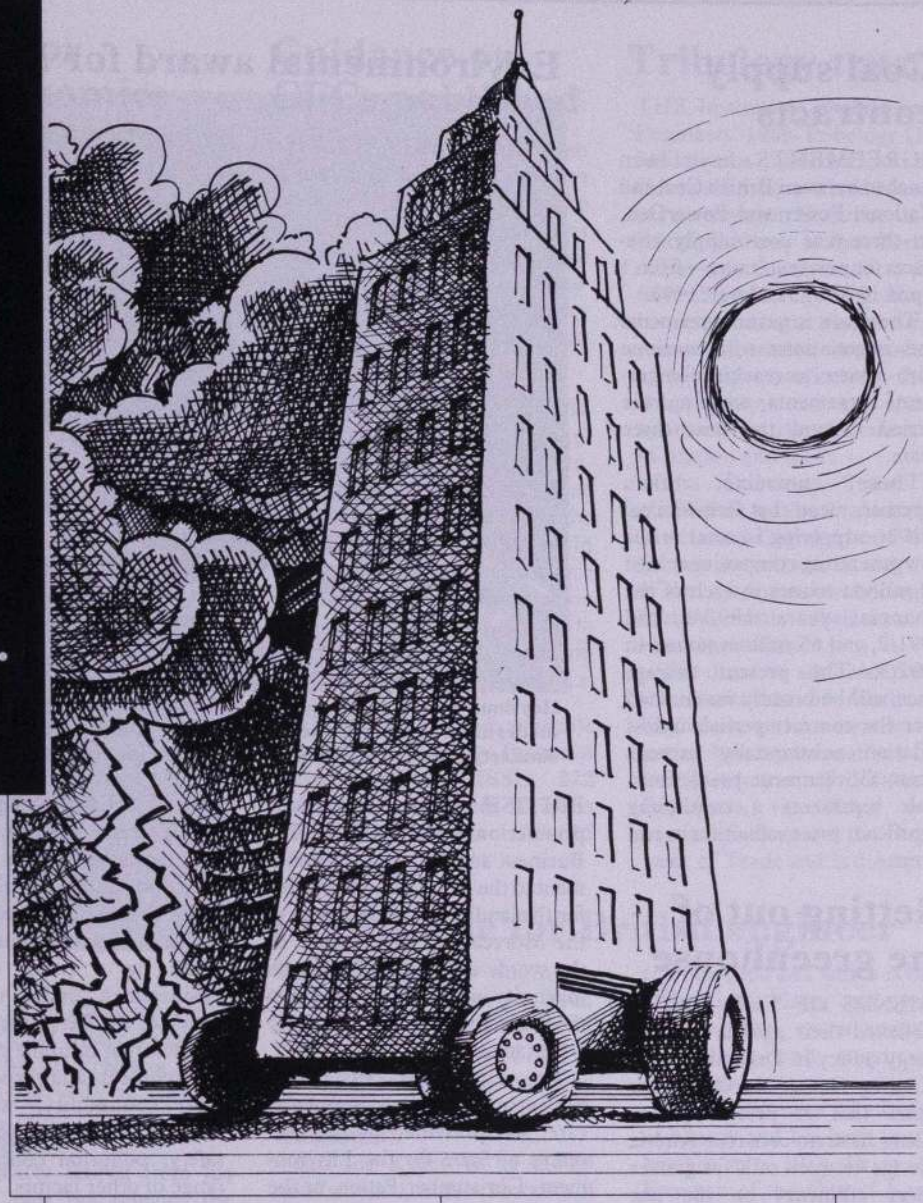
MITSUBISHI Electric Corporation announced its half-year financial results at the end of November.

Consolidated sales registered 1,414.4 billion yen, up 15 per cent from 1,229.1 billion yen reported a year earlier; and net profits showed an increase of 65 per cent to 35.7 billion yen from 21.5 billion yen of the same period in 1988.

Current profits before extraordinary items and taxes were 75.3 billion yen, up 61 per cent from 46.7 billion yen. Per share profits were 16.23 yen compared with the previous year's 10.16 yen.

THE TEST DRIVE FOR BUILDINGS.

THIS YEAR'S AWARD-WINNING IDEA.



The Royal Society Esso Energy Award for 1989 has been given to Professor T.W. Maver and Professor J.A. Clarke of the University of Strathclyde in Glasgow.

They receive a gold medal and a prize of £2,000 for their development of the CEC Reference Energy Model and the subsequent creation of an innovative energy design advisory service.

Professors Maver and Clarke realised that a major stumbling block to good building design or redesign was the absence of a reliable computer model.

A model that would enable architects and engineers to see how new designs or modifications to existing structures would react to the highly variable stimulus of the weather.

In response to this need, they developed the Environmental System Performance software.

The ability to simulate or test drive buildings before construction has already proved its practical worth.

In the last 18 months over 150 architectural firms and their clients have benefited from the advisory service's input on a variety of potential projects.

The Department of Energy has estimated that better building design and redesign could help reduce the UK energy bill by £2 billion a year.

So Professors Maver and Clarke are worthy winners of this year's award.

Now the Royal Society and Esso UK plc are looking for the next idea that will continue the drive to the more efficient use of energy.

Nominations are required by January 19th 1990.

For further details and nomination forms, please contact: The Executive Secretary (ref: JAN/EWD), The Royal Society, 6 Carlton House Terrace, London SW1Y 5AG. Telephone: 01-839 5561.

THE ROYAL SOCIETY ESSO ENERGY AWARD.

Esso

The Royal Society

Coal supply contracts

AGREEMENTS have been reached between British Coal and National Power and PowerGen, on three-year coal supply contracts for power stations — from 1 April 1990 to 31 March 1993.

These are interim agreements and negotiations will continue with a view to reaching longer-term agreements covering the period beyond the next three years.

These contracts, taken together, mean that British Coal will be supplying in total to the two generating companies at least 70 million tonnes in each of the financial years 1990/1 and 1991/2, and 65 million tonnes in 1992/3. The present average price will be broadly maintained over the contract period, unless inflation substantially exceeds recent Government predictions. This represents a continuing significant price reduction in real terms.

Getting out of the greenhouse

FRIENDS OF THE EARTH published their agenda for UK energy policy in December.

Getting Out of the Greenhouse argues that at present policy makers have no coherent criteria to judge between calls for greater energy efficiency on the one hand, and more nuclear power on the other.

Without such criteria, FoE feel that policy is likely to be dictated by the strength of corporate lobbying rather than by the need to reduce, cost-effectively, the UK's contribution to the greenhouse effect.

The report examines the costs and potentials of 18 different energy policy measures that would reduce CO_2 emissions by the year 2005. Without any of these measures being taken, the report estimates a 25 per cent increase in CO_2 emissions by 2005.

Nuclear power is seen as one of the most expensive options for reducing CO_2 emissions: energy efficiency, combined heat and power, renewables and gas-fired electricity generation are all cheaper per tonne of CO_2 saved.

The reports' authors, Dr Tim Jackson and Simon Roberts, have based their findings almost entirely on figures from government reports and studies.

Environmental award for Morecambe Bay project

Heysham operational base, where British Gas have improved and strengthened the harbour walls and modernised the site to encourage further development by local industry. The sea defences have been similarly repaired at Barrow Terminal to prevent coastal erosion and flooding.

BRITISH GAS has won a premier award in the 1989 Business and Industry Commitment to the Environment Awards for the landbased development of the Morecambe Bay Project. In the words of the judges, "much ingenuity and skill has gone into the project to ensure community acceptance."

The award, for outstanding achievement in environmental care, was presented by the Secretary of State for the Environment, Christopher Patten, at the Royal Society for the Arts in London in December to Mr James McHugh, managing director Western Regions, National Transmission System and Construction, and a member of the board of British Gas plc.

The prestigious annual awards, made by a panel of senior businessmen under the presidency of Sir Peter Parker, go to projects that combine care for the environment, and respect for the local community, with good working conditions, job creation, safety, pollution control and a range of other factors.

Launched in 1975, the awards are given to encourage companies to reconcile business activity and growth with measures to protect and enhance the rural and urban environment and to be good neighbours within communities.

This is the second major environmental award that British Gas has received this year for the same project. In April, the company was presented with the Environmental Management Award in the Better Environment Awards for Industry 1988. This was followed by a commendation in the Good Environmental Management category in the European Awards.

Nuclear company announced

THE NAME and designate board members of the new nuclear company, which will take forward the operation and development of nuclear power in England and Wales was announced at the end of November by UK Energy Secretary, John Wakeham.

The new company will be known as Nuclear Electrics plc. Its initial board will comprise John Collier as chairman and chief executive; Frank Ledger, deputy chairman; Mark Baker, director for corporate affairs and personnel, and Sam Goddard, director, construction and future programmes.

Further designate board appointments will be made in the near future.

Nuclear Electric will have the ability to construct new nuclear stations, but capital expenditure approval for stations beyond Sizewell B will not be considered by the Government until a review of the prospects for new nuclear stations in 1994.

Combined-cycle joint venture

THE FORMATION of NEI ABB Gas Turbines Ltd was announced in December by Asea Brown Boveri and Northern Engineering Industries.

The new company will be jointly owned on a 50-50 basis, and has been established to supply gas turbine, cogeneration and combined-cycle power plants for the UK and other selected markets.

Dr Robert Hawley becomes the new company's first chairman. Mr A D Dixon becomes the managing director.

MacRobert Award

BRITISH GAS has won Britain's premier engineering award — the 1989 MacRobert Award — for technological innovation in the development and exploitation of an on-line inspection system for operational pipelines. The company is only the second organisation to win this award twice since it was first established in 1968.

At a ceremony in November at Buckingham Palace, HRH The Duke of Edinburgh, Senior Fellow of The Fellowship of Engineering, presented the MacRobert Award Gold Medal to Mr Robert Evans, chairman and chief executive of British Gas.

The MacRobert Award is donated by the trustees of the MacRobert Trusts and is administered by The Fellowship of Engineering.

Companion wins award for distinction in energy economics

Professor Richard Eden OBE.

PROFESSOR Richard Eden OBE, a Companion of The Institute of Energy has been announced as the winner of the British Institute of Energy Economics' prestigious Open Award for Distinction in Energy Economics.

He has established an international reputation in high energy physics when, in 1972, he left the world of theoretical physics to found CERG, the Cambridge Energy Research Group, taking up the chair in energy studies at the Cavendish Laboratory. CERG rapidly established a reputation for independent analysis and comment on matters of energy policy as well as for its educational role, attracting PhD students from all over the world. Professor Eden has also served on several national and international committees.

He recently retired from his academic post but remains the non-executive chairman of Caminus Energy Ltd, a consultancy offshoot from the work he began at CERG, and is series editor for a forthcoming list of books under the general title of *Cambridge Energy Studies*.

At present, Professor Eden is at the Institute for Advanced Study Princeton, USA, but will return to England next year to continue his many interests in the field of energy economics.

Research fellowship

THE INSTITUTE of Energy, in association with Shell, are offering a research fellowship of £2,500 to promote study and research into all aspects of energy technology.

The fellowship covers a whole range of topics, including extraction, conversion, transmission, distribution and energy usage. However, particular emphasis will be given to new fundamental concepts, still some way off commercial application; or to underlying trends in energy economics or policies.

The fellowship is open to both academic and industrial applicants, who should apply to The Secretary, The Institute of Energy, 18 Devonshire Street, London W1N 2AU, enclosing a brief statement of their proposed area of study with the appropriate personal details.

The closing date for applications is 28 February 1990.

Guidance on CFCs published

THE CHARTERED Institution of Building Services Engineers has issued a guidance note on the use of CFCs in building services engineering. The guidance note includes an updated policy statement following a preliminary statement published in May 1989.

The guidance note was distributed to designers, manufacturers, contractors and building users at a conference organised by CIBSE and the Institute of Refrigeration in November. The conference examined the current situation with regard to alternatives to CFCs and advised delegates on how best to limit the use of CFCs.

The guidance note is available at a cost of £3 from the Technical Department at CIBSE, 222 Balham High Road, London SW12 9BS, telephone 01-675 5211.

Tribology trust

THE Institution of Mechanical Engineers' 1989 Tribology Gold Medal was awarded to East German Professor Gerd Fleisher at a ceremony in November at the British Embassy in East Berlin.

The award was made to Professor Fleischer in recognition of his outstanding achievements as researcher, teacher and promoter of tribology, particularly in the development of an energy approach for the determination of friction and wear.

The Tribology Trust was established by the Institution of Mechanical Engineers in 1969 to further the interest in and study of the science and technology of friction, wear, lubrication and associated subjects.

The fund is administered by the Institution of Mechanical Engineers, and its awards committee has representatives from the Institution of Production Engineers, the Royal Aeronautical Society and the Department of Trade and Industry.

FEANI title for British engineer

CONSULTANT engineer, William 'Bill' Ryder, has been awarded the prestigious title of European Engineer by FEANI — the Fédération Européene d'Associations Nationales d'Ingénieurs.

Eur Ing Ryder, as he should now be called, is also chairman of PRS — Partners in Recruitment and Selection Ltd which is based in Hatfield, Herts, and specialises in the recruitment of engineering and construction executives.

He is a Fellow of The Institute of Energy and has been in membership since 1973. He is also a Freeman of the City of London and lives at Sunningdale, Berks.

Bill Ryder — newly elected European Engineer.

Playing the zero sum game to make millions

Lewis Tozer, FInstE, reports on a London and Home Counties Branch lecture by Jeremy Elden, an energy analyst with stockbrokers Phillips and Drew.

IMAGINATION, a measure of intelligence, some understanding (but not too much) of the industry in which the analyst works, and the ability to identify and exploit commercial opportunities quickly was how Jeremy Elden summed up the qualities required of a successful analyst. Based on these criteria, it soon became apparent, listening to Jeremy Elden, that he was, very obviously, foreordained to become a successful energy analyst.

His qualifications confirmed the inevitable. After leaving Strathclyde University with an MSc degree in Petroleum Engineering, he was initially employed as a service engineer with Schlumberger, following which he saw service in the automotive industry as a secondhand car salesman.

The Zero Sum Game

Before becoming an insider in the business of stockbroking, Jeremy Elden shared a commonly held conviction that stockbroking was, by its very nature, a parasitic activity. After all, it could not be claimed that stockbrokers actually made anything. At best, they assisted new enterprises to raise capital by handling the issue of shares. In stockbrokers' jargon, floating share issues is referred to as a primary market activity. But most of the stockbroking action takes place in the so-called secondary market in which shares are traded rather than issued. Stockbrokers use a very apt expression to describe their involvement in share trading; they call it the *zero sum game*. It means that the net benefit, or the net gain from stock trading is zero. For every winner there's a loser.

On the other hand, share trading permits the efficient investment of one person's capital in another person's assets. Or, it might be said that one person is given the opportunity to save something, capital, while permitting another peson to use it until the first person wants his capital returned. Stockbrokers are part of the system which allows the efficient redeployment of capital. It is in striving to achieve the efficient use of capital that analysts, in particular, play an important part. They attempt to identify the investment opportunities which will give the maximum rate of return.

The most common way in which individuals release capital in the expectation of having it returned is through pension funds. The second most common way is through life assurance. 67% of the assets in the UK stockmarket are held by such organisations, collectively known as institutional investors. Pension funds, particularly, are currently getting in much more money each year than they are having to pay out and it is important that the residual capital assets are invested efficiently.

Institutional investors operate in both the primary and secondary markets. In the primary market, for example, a company J Bloggs plc, wishing to raise capital, will look to an institutional investor as a potential subscriber for shares. The institution in turn will ask stockbrokers for advice as to whether or not their funds should be committed to J Bloggs' enterprise. At this juncture it may not be entirely clear just how impartial the advice is likely to be because stockbrokers will, in any case, be receiving considerable payments in the form of fees from J Bloggs plc for services already, or in the process of being, rendered. Jeremy Elden conceded that the system was not yet quite perfect!

But questions of impartiality hardly arise if a company, like, for example, British Petroleum seeks advice in connection with a rights issue. In such a case, where the fees are so much bigger than in the case of J Bloggs, it is most unlikely that a dissenting broker would be found. Jeremy recalled however that, to the best of his knowledge, two brokers had advised their clients not to participate in the great BP bonanza, before the Black Monday stockmarket crash. Phillips and Drew was one of them.

The Man with the Dart

The secondary market, chasing money round a big circle, is not quite the zero sum game previously suggested. In reality it is a negative sum game because a typical institution with its high powered computer systems, in-house experts plus the very high cost of buying in outside advice, does a little bit worse on average than a man selecting his portfolio at random — for instance by throwing a dart blindfold at a dartboard of company names. Such a man will achieve, in the long term, an investment return in line with that of the market. Unfortunately for the professional, as most of the market is in the hands of his fellow pros — so will he. The man with the dart wins because he is not paying for advice. Because most of the market, 67%, is in the hands of the institutions, all taking the same expensive advice, the value of the advice is greatly diminished.

The important and useful feature of the secondary market is that it provides a means whereby an investor's capital can be repaid without the need for the person making use of the capital to pay it back. To enable the secondary market to work efficiently, it must possess liquidity and to achieve this it must be well researched if substantial sums of capital are to be repaid without destroying the market.

Back to the secondhand car lot?

Notwithstanding the importance of research to the operation of the stock market and the high individual rewards analysts can earn, demand for their services is declining. The number employed this year is less than it was a year ago and the reduction will continue. As Jeremy Elden put it, perhaps a quarter to a third of analysts will be selling secondhand cars again by the time the shake out is over.

The prime reason for the existence of analysts is to make money for their firm. They do this by advising clients on what shares to deal in. Advice is given directly to clients or through a sales force. The sales force normally does a hard sell of the researchers' findings over the telephone, or it might be said the sales force gives independent, impartial advice to clients who need to be spurred on to keep their portfolios moving and their returns high.

An analyst also adds value to his firm by advising the firm's market makers which stocks they should be long on and those on which they should be short. The market makers also receive guidance on how they should handle a story that might "break on the screen" — whether it might be thought to be good, bad or indifferent in stockbroking terms. At first sight it may seem there is a conflict because if the analyst tells market makers the good news first they will move prices up and this would be against the clients' interests. If he tells the clients first they will deal and his firm will lose money. The analyst tries to tell market makers and clients at the same time, so that both have the same knowledge when a bargain is made.

The Six Sisters

The expression, the six sisters, refers to the major international oil companies, namely, British Petroleum, Chevron, Exxon, Mobil, Shell and Texaco. Jeremy Elden outlined the features, facts and fantasies that have to be collected, researched, analysed and quantified as part of his day-to-day work, using the six sisters as an example.

If an oil company is to stay in business it must, at least, find as much oil as it produces. If it fails to do this it is liquidating. Identifying what proven reserve additions have accrued to an oil company is clearly strategically important information. Jeremy Elden showed that over the period 1982-87 BP's oil reserves had fallen more than any of the others in the group. Chevron had done best because it had purchased Gulf Oil. Only Shell had actually maintained discoveries to match production. The proven reserve figures include an item called "revisions". Revisions are quoted by oil companies but they pose a problem for analysts as revisions tend to be "discovered" for auspicious occasions rather than being released when the company first realised that recovery would be greater than first thought.

Another feature is the relationship of developed to undeveloped oil reserves. Undeveloped oil reserves represent future income and on this score BP had the most favourable position. On the other hand, Shell was the only company to have increased its

undeveloped reserves over the period. Chevron, because of its purchase of Gulf, had also increased its undeveloped reserves rating.

Jeremy Elden hastened to remind his audience that information published by the oil companies is, inevitably, couched in terms which present the companies in the most favourable light. In particular, BP, Exxon and Shell are all capable of showing figures which put them at the top of comparative rankings. The task of the analyst is to devise a level playing field and to detect biases which clearly affect the individual companies. For example, subtle changes like the margin per barrel in relation to sales volume are really significant in stockbroking terms and need to be identified. BP and Shell were the only companies to have improved their margins. Mobil's had gone steeply down, a fate shared by all the US oil companies. This European success story was much better received in London than New York.

The non-petroleum earnings of companies are also of interest to analysts. Studies showed that between 1982 and 1987 BP, Exxon and Shell added most value to shareholdings as a result of non-petroleum earnings. BP's success was achieved after losing money hand over fist in 1981 in chemicals and minerals. These loss makers were subsequently weeded out.

Cash generation

No analysis would be complete without a look at the loot and for the period 1982-87 a net was widely cast to catch all payments in, or out of, the companies which were not related to groups' operations. Companies have a penchant for hanging on to shareholders' money and building up immense bank reserves.

Shell, for example, was sitting on 9 billion dollars in the bank, with no net debt. Like Shell, BP and Exxon had generated enormous amounts of surplus cash — surplus that is to the capital needed in their businesses. In fact, all the big oil companies, the six sisters, had more money than they apparently knew what to do with. While individually, private shareholders would like to receive a more generous slice of the profits generated by their money, the overwhelming majority of the invested capital is owned by the institutions, and these, generally speaking, prefer to sit back and be satisfied with an adequate return matched to the actuarial requirements of their businesses. Naturally, they draw comfort from the bank reserves.

From an analyst's point of view, this situation indicates that the companies are short of investment opportunities and it is his job to get the money redeployed from the oil business into, say, pharmaceuticals, the defence industry or into electronics where it will be better employed. It was no good however suggesting to Exxon that it should go into pharmaceuticals or the electronics business because it had already tried it and made a complete hash of doing so. The only way to redeploy sleeping capital, according to Jeremy Elden, is to get these companies to give the money back to the capital providers who can then give it to another enterprise where it will be turned to good account. In reality, this means putting pressure on institutional investors by offering them equally attractive opportunities in new enterprises.

Analysts have computer models to help them research their markets. Apart from the data previously mentioned, models take into account the assset values of the different companies. Performance factors such as the price of each share compared to the earnings attributable to each ordinary share is determined, the ratio between price and cash flow is identified, and related accountancy yardsticks are evaluated to complete the analysis. The analyst then prepares a report of his findings which is presented to clients in an effort to persuade them to deal.

Jeremy Elden concluded that, notwithstanding his early scepticism about the ethical role of stockbroking, in reality it works for the common good. He hypothesised that there are far fewer people employed in the UK trying to allocate the country's capital resources effectively than there are, for example, in the Soviet Union and, no doubt, at much less cost. □

Meeting tomorrow's needs: are we doing enough?

*by Doug Willis, BSc, CEng, FInstE**

A rapidly-changing world in which new political and technological priorities and imperatives inevitably leads to a constant need to reappraise collective and individual training requirements. In the following article, President-elect, Doug Willis examines what The Institute of Energy is doing in the field of education, training and careers advice, and poses the question: what else should it be doing?

AT THE recent NEMEX conference Jonathon Porritt said: "I wonder if the energy efficiency industry has really woken up to the potential market it may enjoy over the coming years. If I were part of that industry I would be feeling pretty hopeful: the prospects of this sector over the next 20 years are second to none."

Energy is certainly in the news and scarcely a day goes by in which there is not some public statement involving energy or the impact of energy use upon the environment.

Against this background it is appropriate to examine what the Institute is doing about education, training and general careers advice. Is it doing enough? What else should it be doing?

The answer to the first question will clearly be 'not enough!' but before trying to answer the second question, it is appropriate to review what is being done.

Internal structure

The educational affairs of the Institute are in the hands of the Education Committee. The terms of reference of this committee are:

1) To exercise general oversight and responsibility for matters of education and training as required by the Institute and The Engineering Council.
2) To advise Council generally, as required, on matters relating to education and training.
3) The committee is responsible for promoting education and training in energy.

There are three sub-committees to the main committee:

a) The Degree Accreditation Sub-committee responsible for recommending which of the degree courses the Institute is asked to approve do satisfy the requirements of the Institute and The Engineering Council.
b) The Training Sub-committee which considers all matters relating to training and determines which of the courses the Institute is asked to approve do satisfy the requirements of the Institute and The Engineering Council.
c) The Incorporated Engineer Panel, which nurtures the education and training of Incorporated Engineers in the energy field, and determines which of the courses the Institute is asked to approve do satisfy the requirements of the Institute and The Engineering Council.

At this time there is no committee dealing with the training of engineering technicians and the Institute is not authorised to accredit training courses in this category, though it may well seek such authorisation in The Engineering Council review of the Institute, which will take place during the coming year.

Currently there are 20 establishments which are accredited primarily or secondarily by the Institute, and several of these have more than one course which fully meet the requirements of the Institute and The Engineering Council.

Corporate status

Full corporate status requires the equivalent of four years' practical involvement in an energy discipline after the initial qualification; and students; who may become Graduate Members on initial qualification, are encouraged to keep an official log, in a log book provided, of training subsequent to initial qualification. Presentation of the properly completed log book at the time of applying for Corporate membership will avoid the necessity of completing the 'Professional Review' form now required.

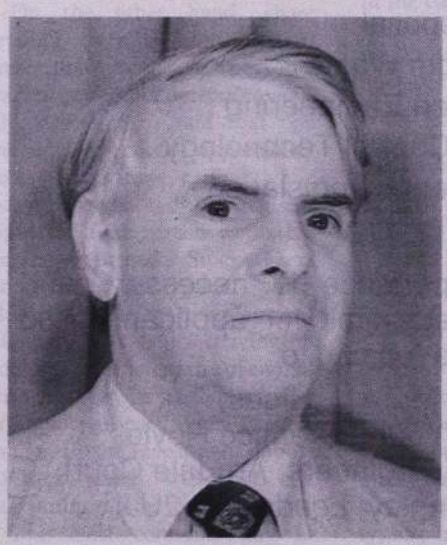
The 'Professional Review' document, which adds to the already very comprehensive application form was originally introduced as a requirement of The Engineering Council to ensure that there was good documentary evidence of appropriate practical experience in membership records before the granting of Chartered Engineer (CEng) status.

The Institute also has a number of Corporate Members who are not engineers, but who are welcome in the Institute, which has a broad spread of interest in the field of energy. These members will have a qualification in a non-engineering discipline, which may be as diverse as accounting enconomics or the pure sciences. The level of the qualification and the degree of practical involvement in energy has however to be equivalent to the CEng status, and consequently the applications are dealt with in precisely the same way.

Maintaining standards

The Engineering Council is also encouraging affiliated bodies to interview applicants for corporate grades of membership. It seems

The author



After serving in the RAF, Doug Willis graduated in Fuel Technology at University College, Cardiff. He went on to work for the National Coal Board in various technical and marketing roles in the West Midlands, East Midlands, at the Coal Research Establishment, and finally at headquarters.

He retired at the end of January 1989, when he was a manager of the Industrial Sales & Service Branch, dealing with the marketing of coal, and the provision of technical services to the industrial users of coal.

He has been a member of the Institute since 1954, and has been chairman of the Midlands and the East Midlands branches. He has served on Council and the Membership Committee for a number of years.

Mr Willis becomes President of the Institute in May.

**President-elect*

that the Council would prefer that all applicants were interviewed. The Institute believes that this is unnecessary as in many cases the qualifications and training requirements clearly have been fully met, but nevertheless the Institute does carry out an increasing number of interviews. Each interview is carried out by two senior members of the Institute with different backgrounds, either in one of the regions or in London. A standard assessment form is used by the assessors, who report back to the main membership committee.

It may appear to applicants that the Institute erects academic and training hurdles which make entry to the Institute an obstacle race rather than a smooth and welcoming path for new members. However, the Institute supports the desire of The Engineering Council to raise the status of corporate members of affiliated bodies, and corporate membership of the Institute is therefore prized.

The Engineering Council is also keen to ensure that the professional institutes take a lead in providing training throughout an engineer's career. Many older people will at times during their career have gone to evening classes at their local technical college to 'brush up' their knowledge in some particular aspect of their training, be it heat recovery, computers, or whatever.

These courses were organised on a local *ad hoc* basis, where a local technical college saw the opportunity of mounting a successful course and where a suitable lecturer, often employed by local industry, was available. Whilst such courses are still available in some places, pressures on educational establishments mean that such specialist courses can only be run where a regular attendance of 10 or 12 students can be guaranteed. At the same time the pace of change is increasing, and there is a need to ensure that professionally qualified Institute members maintain a broad perspective of the energy field and do not become too locked into a narrow specialisation.

A mid-career course held recently at the Institute's headquarters.

Effects of change

The other change which is having an impact in the energy field is the move away from large, sometimes state-owned, energy supply industries (often with their own substantial in-house training schemes), and a parallel change in emphasis from supply to efficient utilisation of energy sources in a way which protects the environment. This means that those involved in energy will have to be flexible in their future career. Thus they may find it necessary to change from *selling* a fossil fuel to *saving* it, or the nuclear physicist may find it necessary to become knowledgeable in the aerodynamic performance of a wind generator.

These changes are unlikely to be as dramatic as some would have us believe, but nevertheless it is clear that in a 40-year working life the successful energy practitioner is likely to have changed his or her career path, perhaps several times.

The change presents new challenges and new opportunities for professional Institutes; to identify changes and to try to ensure that the education and training system provides for such changes.

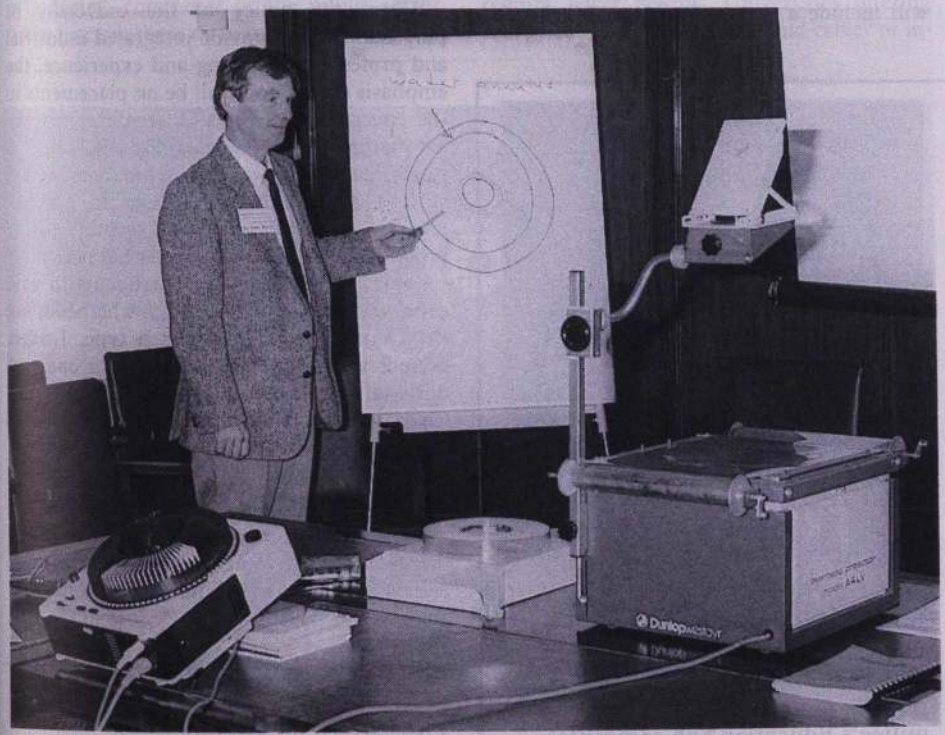
The Institute is taking its first steps along this new path by supporting the Mid Career College in a series of one day courses being held at the Institute headquarters. These have been advertised in *Energy World*, but the first series has attracted only moderate support. A second series is being planned, but the views of members are necessary to try and ensure that the plans do meet the requirements of members: so you vast, largely silent, majority out there, speak up!

Wider role

Whilst this article is concerned mainly with education, there are those activists at headquarters who believe that there is a wider role for the Institute in what might be described as 'career development' or perhaps more directly as 'job opportunity identification'.

In 1987/88 three issues of *Energy World* contained a section called 'Students' Forum'. These evoked little response, and they have not been continued. But it is felt that there is here an area where the Institute could have a useful and active role, but it should be broadened, not only to deal with those who are 'students' in the process of graduation, but with those who see a change in their prospects in 'mid career'.

During the next few months the Institute will be attempting to develop these proposals having regard to the resources available, and hopefully a useful programme will evolve. How useful it is will depend upon how far it goes towards meeting the requirements of you, the members of our Institute. It would be very helpful to the few activists at headquarters if we could hear from you! □



Dr Mike Purvis, one of the lecturers, in session with the MidCareer College.

Correction

In Table 4 which appeared on page 11 of the November 1989 edition of *Energy World* the ozone depletion potential of the R123 halocarbon (Dichlorotrifluoroethane) was misprinted as 0.5. This number should have read 0.05.

Opportunities for energy education and training

*by Alex Henham**

With the balance between environmental issues and energy efficiency swinging first one way, then the other, Alex Henham, Director of Energy Engineering at Surrey University, looks to future graduates to bring about a proper balance in our approach to energy and the environment. In this article he reviews the opportunities for aspiring energy engineers in tertiary education.

READERS of *Energy World* will mostly have completed a course of studies in some energy-related field or have embarked on one which they expect will lead eventully to the acquisition of corporate membership of The Institute of Energy. Education does not finish there, of course, and there are many opportunities for further education and continuing education available today.

Even those already well established in professional posts in the energy scene may like to know what types of courses are available from undergraduate level onwards, since they may be looking for future staff among the graduates from these courses.

Universities and polytechnics offer many possible routes to eventual professional qualification in subjects which may be appropriate for a career in energy. Not all of these are described in the title as being energy courses and, for these, the proportion of energy-related topics to those of more general science or engineering interest will vary.

In some cases there will be a final-year option in a mechanical engineering degree course which covers the utilisation of energy in industrial situations, energy conservation processes and power generation. The main part of the course will have included many more basic engineering science subjects of relevance and there will also be the broader-based study and practice of design alongside these.

Individual projects, which students undertake in the final year of undergraduate studies, may also be chosen from fields of value to a future energy engineer and these provide an opportunity to become involved in depth. Chemical and process engineering students will also cover many areas of energy utilisation and, perhaps, more detailed fuel technology topics.

Choices made by undergraduates within courses in other aspects of engineering often indicate an informed bias towards energy which has arisen as various subjects are studied early in the course. It is very difficult for those at school who contemplate a career in engineering to know exactly what each discipline offers before embarking upon the degree course.

Energy courses

There is, however, a limited number of first degree courses which contain the word 'energy' in the title, for example as Energy Engineering or Fuel and Energy. Such courses will include a range of subjects overlapping those in the traditional specifications of engineering — especially chemical and process engineering, electrical engineering and mechanical engineering. Some of these subjects, such as heat transfer, control engineering and electrical power, already appear in more than one of the single discipline engineering courses.

There may also be an option or core of subjects applicable to building services and topics like air conditioning will receive more attention than in mechanical engineering courses, where they are seen as examples of applied thermodynamics. They will also include the more general areas of mathematics, communication, management and design, using examples of energy applications.

Where the policy of the university or polytechnic is to provide integrated industrial and professional training and experience, the emphasis of this, too, will be on placements in the energy-related work. Placements may be for varying periods, possibly including a preliminary practical course in conjunction with a local technical college to give an effective understanding of manufacturing processes before the first industrial period.

Some institutions require students to gain experience in the long vacation, whether or not the course is of the sandwich type. Longer periods are usually of six months or one year duration and, increasingly, these are project-based rather than the old 'Cook's tour' of every department.

MEng courses

Some first degree courses are now offered for the Master of Engineering (MEng) an enhanced version of BEng courses, somewhat

*Director of Energy Engineering, University of Surrey

The author

Alex Henham is Director of Energy Engineering in the Faculty of Engineering at the University of Surrey, where he was responsible for the establishment of an MSc in energy engineering in 1978.

His involvement with industry includes many consultancies in energy management and engineering, running in-house and university-based short courses for industry and the public sector in the UK and abroad, and membership of the former National Energy Management Advisory Committee.

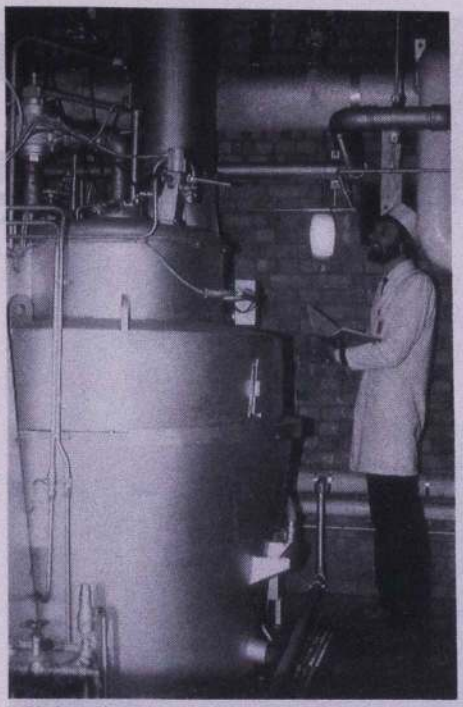
His research interests are mainly in the field of alternative fuels and this has involved working with universities in SE Asia, to which he has also acted as educational adviser through the British Council.

He is a member of the Watt Committee's Education Sub-committee.

longer in total of academic and industrial periods and usually covering a wider range of subjects. The senior industrial tutor of any of the departments providing integrated courses would be pleased to hear from companies and public sector establishments able to take part in the training of future engineers in this way.

Members of the constituent bodies of The Engineering Council (such as The Institute of Energy) are best placed to provide and supervise these periods of what is now called the *formation* of engineers. If we, as Chartered Engineers, feel that we know what skills and abilities the next generation of engineers should have this is our chance to have an input and make a real investment. It is a fruitful means of getting to know those studying in your field and to get ahead of the queue for their services when they graduate. Sponsorship for the remainder of their course is one way of helping to establish loyalty.

Postgraduate courses in energy cover an extremely wide range of subjects. These vary from the political and policy aspects of energy through the economic implications to the exploitation of energy resources and the engineering of their utilisation. The emphasis can be on one energy source from nuclear to renewables such as solar, wind and biomass. Engineering courses may be wide-ranging, covering all sectors of energy utilisation, or specialised dealing with the use of energy only, for example, in buildings or in processes.



University-based MSc student performing tests on a pharmaceutical plant's steam generator for his dissertation, which took the form of an energy survey.

CATS

Traditional masters' degree (MSc or MA) courses are of one calendar year duration comprising two to three terms of taught subjects, including continuous assessment and examinations, followed by an individual study, resulting in dissertation. Most start in October and finish at the end of September. Increasingly such courses are being made available part-time for those released by their employers in industry, commerce or the public sector. Attendance in these cases may be for one day a week for an extended period of at least two years. Blocks of one week — the so-called modular structure — are growing in popularity. They can be taken at the pace the student can accommodate within his or her overall work pattern, give choice of specialisation and sometimes allow incorporation of one or two modules from a related course in the home or another university or polytechnic. This latter is known as a transferable credit and there is a scheme, known as CATS, which regulates this arrangement.

The same courses are sometimes available for postgraduate certificates or diplomas which require fewer credits. Universities offering energy courses often provide mid-career or in-service education and training on short courses without linkage to any qualification. This can be either in-house for a particular employer's staff (eg, for local energy managers in a national group of companies or a multi-site operator), or bases at the university for an open clientele.

Post-graduate and post-experience courses in energy studies often attract mature students and this continuing education function is likely to prove a growth area in future. One of the great advantages of such a course is the sharing of such varied experience by the student peer group which typically includes people with backgrounds in industry, commerce and the public sector and from several countries as well as the UK. There are at least two courses which specialise in energy studies for developing countries including effects of local policy, economics and agriculture (as well as the engineering aspects) appropriate to the 'third world'.

Research students

Research students may register in departments which offer taught courses and are sometimes then asked to take some subjects alongside the course students. In any case each research student is allocated a supervisor from the academic staff who will direct the studies and advise on research methods, techniques, analysis and presentation of results. Many universities require those without a master's degree to register first for an MPhil. If satisfactory progress is made in the first year or so, transfer to PhD registration is confirmed.

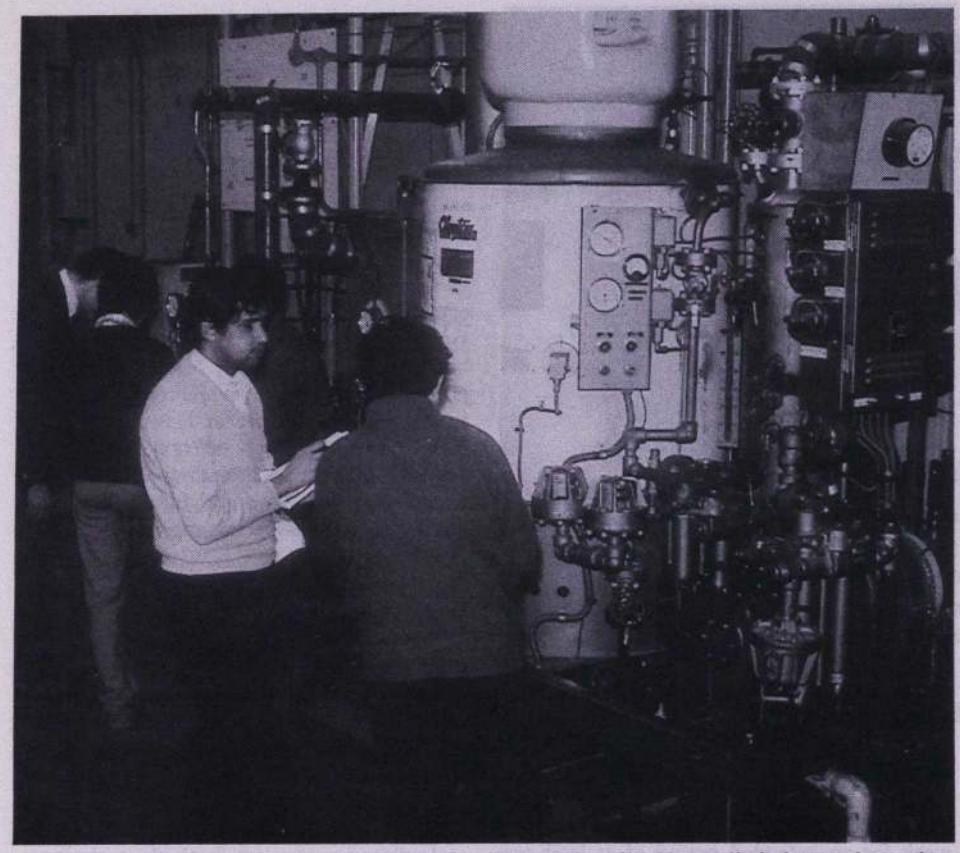
The regulations of institutions vary but broadly speaking an MPhil may be expected to take two years, or a PhD, three. Research degrees may also be pursued part-time or collaboratively where the student is undertaking research in his employment which can be jointly supervised by a senior member of staff there and by an academic. As each place is individual the only way for a potential research student to find out what is available is to contact those institutions which specialise in energy engineering and to give as many details as possible of background and main field of interest.

Funding for postgraduate studies can come from a number of sources. The research councils (for example the SERC) offer advanced course studentships on certain courses. As there is a quota for these awards early application is advised but those unable to obtain a quota place may compete for any remaining studentships in the appeal procedure.

Overseas students obtain grants from their home governments, trusts covering their home states and from such sources as the British Council and Commonwealth scholarships. For research the field is wide, as it includes the research councils, which also administer CASE awards jointly with industrial sponsors, companies sponsoring specific projects and the sources described above for overseas students. Within Europe there are increasing opportunities for exchanges, many of which are supported by EEC funding.

The demand for graduates with energy

MSc students on a case study visit to a micro CHP plant in a hotel.



MSc students carrying out a test on a steam generator in the applied thermodynamics laboratory at the University of Surrey.

specialisation has been increasing at a greater rate than that of graduating students. It seems very likely that the privatisation of electricity will create a demand in the areas for those who are capable of work formerly done only by the CEGB and Electricity Council. Other energy suppliers — British Coal, the oil companies, British Gas — employ graduates as do the major users of energy such as chemicals, steel, ceramics, food and textiles industries. Bodies in the public sector particularly the local authorities, health authorities and the Property Services Agency, all have energy management departments. The largest increase in recent years has been in the consultancy sector and in the contract energy management companies (specialising in third party financing of energy efficiency measures).

At the time of the oil price shocks of the early seventies there was a major change in the attitude to energy supply and use throughout the world. Environmental issues, which had been a priority until then, were put on one side for a while. Often an improvement in the environment is expensive in energy. Today, with cheap oil, we can afford the luxury of environmental benefit again, and energy efficiency often takes second place. Perhaps the achievement which scientifically trained energy specialists, whether economists or engineers, can bring about is a properly balanced approach to energy and the environment. □

The impact of new energy technologies on education

by Dr Alan Gray BSc, CEng, FInstE, FIGasE, Professor Geoffrey Sergeant BSc, PhD, CEng, FAIE, FInstE, and Professor Alan Williams BSc, PhD, CEng, FInstE, FIGasE, FRSC, FInstPet

The fluctuations in energy prices, various energy crises and the increasingly important environmental considerations cause problems, not only for those in energy management, but also for those responsible for the development of courses of study in energy engineering. In the following article, Professors Williams and Sergeant and Dr Gray discuss the approaches being adopted towards energy education in both the UK and Australia.

ENERGY technology is a subject in which considerable changes of direction have taken place in recent years. These changes have been caused by the various energy crises such as the oil shocks, the controversy over nuclear power plant accidents and nuclear waste disposal, and the impact of environmental pollution. The importance of energy conservation and good energy management is emphasised as energy prices rise and is then forgotten as energy prices fall again. This behaviour causes problems for those who develop schemes of study leading to professional qualifications in energy engineering.

In the UK particularly, another major factor in determining the content of these themes has been the considerable debate over the last two decades about the standard of engineering in the UK, in the context of a decline in the effectiveness of the manufacturing industries.[1-4]

This debate has embraced the energy industries, although the latter have, in general, continued to be very efficient and successful. Following this general debate, the whole of the education and training of the engineering profession was examined by the Finniston Committee which reached conclusions similar to those of the Dainton Committee a decade earlier.

However, because of the continued decline in the manufacturing industries, the climate was more favourable for change and the recommendations of the Finniston Committee[4] have had a significant impact on the content of undergraduate engineering courses and subsequent training of engineering graduates in industry. The changes stem from the formation of The Engineering Council, which

The authors

Professor Alan Williams has been the Livesey professor and head of the Department of Fuel and Energy at Leeds University since 1973.

His major interests are in the combustion of fossil fuels and environmental pollution control.

A past President of The Institute of Energy, he is currently the honorary secretary.

He has written a total of 140 papers on energy, combustion and pollution control.

Professor Geoffrey Sergeant is head of the Department of Fuel Technology in the School of Chemical Engineering and Industrial Chemistry at the University of New South Wales, Sydney, Australia, where he is also the director of the Energy Research Development and Information Centre.

He obtained a first class Honours degree and a doctorate from University College, Cardiff before moving to Australia in 1965.

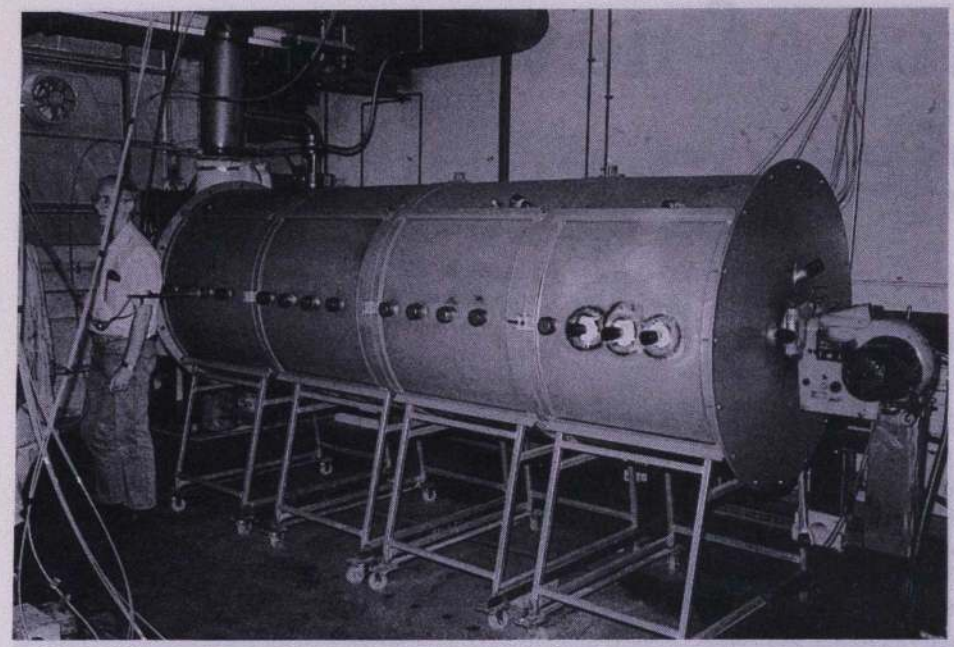
He was a foundation director of the Australian Institute of Energy, and became its President in 1980. He has served on many advisory committees to State and Commonwealth governments.

Dr Alan Gray is senior lecturer in the Department of Fuel and Energy at Leeds University.

He joined the Wales Gas Board in 1951 as a pupil gas engineer. In 1959 he obtained a first class Honours degree in Gas Engineering at Leeds University.

After working for Shell Research Ltd and then the Royal College of Advanced Technology (now Salford University), he went on to become a lecturer at Leeds University.

In addition to his post of senior lecturer at Leeds, he is also visiting professor at the University of New Brunswick, Canada.



Oil-fired furnace for teaching purposes at Leeds University.

replaced the Council of Engineering Institutions (CEI) and which implemented a number of the key recommendations.

The CEI has been the main guiding force in the last decade and had prescribed the standards required of a Chartered Engineer. Each applicant was assessed by an individual professional institution which generally established model degree schemes corresponding to their particular branch of engineering. Its successor, The Engineering Council, however, has greater power.

In essence, the objectives of The Engineering Council are threefold:

(i) to promote and develop the science and practice of engineering in the UK
(ii) to ensure the supply and best use of engineers
(iii) to co-ordinate the activities of the engineering profession

With regard to the training of professional engineers, the Council has inaugurated the Engineers Register which contains the names of 280,000 Chartered Engineers, Incorporated Engineers and Engineering Technicians, these being defined in specific ways given below. Elected engineers from 19 regions form an assembly which serves to advise the Council.

The engineering institutions, as bodies nominated by the Council, certify the attainments of individuals for registration and, as authorised bodies, accredit academic courses and training programmes.

Those engineers who are admitted to the register must qualify as a Chartered Engineer, an Incorporated Engineer or an Engineering Technician. The definitions of and the routes to these qualifications were given in an initial policy statement by The Engineering Council — called *Standards and Routes to Registration* (SARTOR which was published in 1984).[6] Although reference must be made to this document for a complete description of the three kinds of engineer, the following are simplified, working definitions:

"An 'engineer' uses scientific, technical and mathematical skills to build, operate and maintain efficient structures, machines and plant which are valuable, either practically or economically."

The Chartered Engineer must be able to apply scientific methods to the analysis of engineering problems, to supervise the work of others in the practical solution of the problems and to ensure that the whole operation is carried out with proper regard to ethics, economics and environmental consequences. The work of an Incorporated Engineer demands a practical approach and a detailed understanding of a particular technology. The practical implementation of engineering solutions must be carried out with due regard to the management, safety, social and economic aspects of the work. Engineering Technicians are required to apply proven techniques and procedures to the solution of practical problems usually under the guidance of Chartered or Incorporated Engineers.

A second document by The Engineering Council (SARTOR, Codes of Practice, 1986)[7] lists the three stages essential for progress to Chartered Engineer status, they are:

1 (a) an accredited degree in engineering or
  (b) a pass at an appropriate level in Part 2 of The Engineering Council examinations which contains energy-related papers
2 completion of an accredited training programme and
3 appropriate professional experience.

In summary, the syllabus for an undergraduate degree scheme in the UK, such as that described below, is a product of UK policy, the accepted methods of energy production and use in the UK and the prevailing opinions of appropriate engineering education.

In Australia a parallel activity has taken place with many similarities to the UK. The controlling body is The Institution of Engineers, Australia, which undertakes accreditation of engineering courses. Accreditation of a course ensures that graduates from that course can be admitted to graduate membership and then, subject to satisfactory practical training, this leads to corporate membership. For a course to be accredited it must meet criteria set out in the document *Basic Requirements for a Professional Engineering Course* which comprises the following essential components.

1 mathematics and other basic sciences
2 engineering science
3 engineering design and application
4 management and professional aspects of engineering
5 industrial experience for 12 weeks

There are, as might be expected because of the universality of the nature of engineering applications, many similarities between the UK and Australia. Other factors, specific to Australia, influence the content of undergraduate studies in fuel and energy. These are set out in Table 1 as statements of the factor and their impact.

Degree schemes

At Leeds University, we offer a degree scheme in Fuel and Energy Engineering which meets the requirements laid down by The Engineering Council and this is set out below, after a brief statement of those requirements, to illustrate the detailed content of such a course. The department is one of a number of departments accredited by The Institute of Energy, the accreditation sub-committee of which contains a representative from the Institution of Gas Engineers and one from the Institution of Nuclear Engineers.

Following the conclusions reached by the Finniston Committee, The Engineering Council has emphasised that all engineering degree schemes, which must be considered to be enhanced degree schemes and termed BEng must be based on four aspects.

1 the basic techniques used in the production of engineering components and structures
2 appropriate applicable mathematics
3 the theoretical or academic foundation for engineering practice with an emphasis on the specific engineering discipline involved
4 the principles of management, incorporating economics and communication amongst other topics

In addition, The Engineering Council advocated the setting up of extended engineering degree schemes of four years duration leading directly to a master's degree (MEng), but these would be restricted to the most able students only. Such a scheme is a departure from the traditional route of postgraduate study to the master's degree.

In our courses at Leeds the necessary subject matter is presented as formal lectures, tutorials and examples classes, laboratory work and computer-aided drawing and computer-aided design. The major components of the courses are discussed below.

The traditional way in which a mechanical engineering course, for example, deals with energy is via 'thermodynamics' or what used to be called 'heat engines'. Any specifically energy-orientated degree scheme, such as that

at Leeds or similar schemes elsewhere, must involve extra emphasis on at least two major areas. The first covers the production of fuels, their processing and combustion and the control of the emitted products. These topics require a greater knowledge of chemistry than is required for most engineering courses. The second is heat transfer which should cover conduction, convection and radiation in relation to high temperature and reacting systems. In this area, the need to survey materials of construction which will operate at high temperature in corrosive environments is essential.

Practical engineering applications

Two aspects are specified under this heading although their interpretation currently varies according to the individual engineering institution and is subject to some debate in university departments.

The first element, referred to as EA1, is concerned with the practical manipulation and use of ceramics, metals and plastics together with the measurement and control of plant. The precise content of EA1 is determined by individual institutions as set out in their model degree schemes, but it has caused considerable discussion not to say controversy particularly in energy and chemical engineering departments. Whilst it is clear that all engineering students need a knowledge of EA1, the level of hands-on experience is debatable. It is usually accepted that mechanical engineering students require reasonable familiarity with machine tools but this level does not seem appropriate for all engineering students. Consequently, different departments have met the requirements in slightly different ways.

The second element, called EA2, involves design. Engineering design within the BEng/MEng schemes of study in this department involves three aspects — drawing and computer-aided drawing, basic design, and design and computer-aided design.

Drawing is taught in the first year and is used subsequently in the design work. Basic design calculations are taught in the second year with relevant problems on individual plant components. The third year work involves analysis of major parts of the plant and the list in Appendix 2 gives examples of design projects examined in recent years.

Computer-aided design covers two aspects, the first incorporating programmes specially developed with the department for use on BBC computers and the second involves packages for use on IBM PC and Prime main-frame computers.

Table 1: Factors influencing the content of undergraduate studies

Factor	Impact
The Australian Commonwealth Government has a non-nuclear policy. Export of uranium oxide (yellow cake) is permitted from a limited number of approved mines and research is supported on radioactive waste containment, otherwise there is no involvement in the nuclear fuel cycle.	The one school of nuclear engineering that existed in Australia has now been disbanded. There is little incentive to formulate courses on nuclear energy in undergraduate courses. Students would perceive no future benefits with respect to employment. However, future governments may reverse this policy, if so, then there will be no trained nuclear engineers in the country.
The structure of industry is based to a large degree on subsidiary companies of major international or multinational organisations. Examples include the chemical industry, oil industry, aluminium industry, cement industry. Notable exceptions are the steel industry and gas industry. Many coal companies are at least part owned by the international oil companies or other overseas interests.	Reduced opportunities for original contributions in design, R & D etc. Graduates find themselves managing a process plant or part of it a relatively few years after graduation. They have less opportunity to use and develop engineering skills to their full extent.
There are few large industries and a large number of medium to small companies.	There is an expectation that graduates should be productive from day one. There is less time and capacity for in-house training and responsibility comes very quickly.
A predominantly coal based electricity system run by statutory authorities in each state. New boilers/power stations designed and built by major international companies in USA or Japan. Scale of units and the irregular timing of construction both mitigate against local design and construction or sustaining a large boiler making company in the country.	Only tried and proven overseas technology is implemented. Limited input to design. Where the particular properties of the coal are significant, ie, in Victoria with the brown coal deposits there has been the need to obtain a greater understanding of the coal and the deposits formed during its construction and also the need to improve burner design and heat flux distribution.
Australia is a net energy exporter, currently exporting coal, uranium, LPG, LNG, brown coal briquettes and crude oil.	Less resolve to be serious about implementing energy management practices and improved energy efficiency technologies. There is therefore a limit to employment opportunities associated with such developments.
Since the advent of natural gas, the gas companies have become marketers/distributors of gas and have moved away from manufacturing and R & D. There are some indications of a recovery in the technical R & D output of these organisations.	Reduced employment opportunities. Dependence on such things as overseas burner technology, etc.
A large country in area but small in population (16 million). The population is concentrated in major centres, especially the south-east coastal strip. The major cities are some 900 kms apart.	Employment opportunities restricted to particular areas. Fewer opportunities to move between 'like' companies to broaden experience.
The regional distribution of energy resources in Australia. For example, brown coal in the Latrobe Valley in Victoria, but no black coal; oil and natural gas offshore in Victoria but none in NSW, which is the largest manufacturing state (or largest energy consumer); black coal deposits in NSW and Queensland but none of significance in any of the other states; natural gas offshore in western Australia but thousands of kilometers from industry and population in south east Australia.	Tendency of universities to want to meet requirements of a local area, for example for many years brown coal technology was taught in Melbourne University and nowhere else. Tendency then to ignore brown coal technology in other centres. NB: Students in Australia (by a large majority) attend university in their own city. Several factors mitigate against moving to another state, including costs, distance and differences in the education systems at the secondary level.
Requirement for remote area power supply systems (ie, off the grid).	Some impetus for renewable technologies or hybrid systems, with diesel engines for example, but still a small and widespread market lacking focus for employment of skilled graduates: lends itself to R & D opportunities though.

In the scheme of study being described, there are two post A-level mathematics courses given by the mathematics department of the university. These courses provide the necessary methods to analyse the processes of combustion, heat transfer, fluid flow, mass transfer and measurement and control.

In addition, extra teaching of relevant mathematical and computational methods is provided by the staff of the fuel and energy department as the engineering and energy subjects are taught throughout the scheme of study.

Specialist energy engineering lectures

The detailed nature of energy courses varies with the particular engineering discipline. In the course at Leeds, for example, the first year provides a broad introduction to fuel and energy specifically and to engineering generally. In this year, as in every year, the student is presented with the practice of engineering in all its aspects: scientific basis, problem solving and computation, practical techniques in laboratory and workshop, communication, economics and the management and organisation of an industrial business. Courses in chemistry and mathematics, beyond A-level, provide the basis for engineering application in future years as do foundation courses in computing and materials science.

The second year is occupied with the major topics of fuel technology. These include burner and furnace design, heat transfer in furnaces and other equipment, measurement and control, fuel processing (including unit operations and plant design), storage and handling of fuels and other relevant materials, nature and use of materials in the fuel industries, power generation (conventional and nuclear) and laboratory work involving bench-top, engine and pilot-scale testing. In addition, the lectures in mathematics, referred to above and provided by the mathematics department, are taken. Essentially, the lectures cover a wide range of energy topics but they are concentrated on the distribution and utilisation of energy, particularly that from fossil fuels. Some aspects of fuel processing are undertaken but not to the detailed extent that would be expected from dedicated chemical engineering courses.

In the third year of the BEng course, some more detailed academic work is carried out but the emphasis is now more on application with major design and experimental projects. The experimental projects include the design and construction of equipment as appropriate are undertaken individually. Typical projects this year include:

(a) control of central heating boiler using a zirconia oxygen sensor
(b) combustion of residual fuel oils
(c) reduction of NO_X by methane injection (NO_X reburn)
(d) spectroscopic flame studies using optical probes
(e) microwave pretreatment of coal
(f) effects of surface emissivities on heat transfer in furnaces
(g) effects of additives on fuel economy in, and particulate emissions from, diesel engines

The four-year MEng course involves essentially all the three-year BEng scheme but with the addition, in the fourth year, of the following components:

(a) the experimental project undertaken in the third year is continued and expanded in conjunction with an industrial partner to form an integrated project covering technical, economic and managerial details
(b) the design of appropriate plant is continued from the third year with greater emphasis on computer-aided material
(c) additional lecture material on advanced instrumental, safety and risk analysis and computational techniques are given in order that they may be used within the experimental and design projects.

The accredited degree requires a foundation for the practice of engineering by dealing with the first principles of economics, organisation and communication (including the subject which is now known as information technology). This requirement is met in our BEng scheme in that, during both second and third years, lectures are given which provide the appropriate level in the subject 'Engineer in Society'. The third year lectures also draw substantially from lecturers from industry and commerce and are coupled with industrial visits and displays. Typically, British Gas make a substantial lecture contribution on management and lay on demonstrations and visits to illustrate pipe-line installation, control of corrosion and computer grid control. Other contributors are CEGB, UKAEA, British Coal, Shell UK, Department of Industry, YEB, Shell Exploration & Production and Energy Consultants.

Students are also requested to work for six weeks in industry in the summer vacations.

Exercises in communication skills are based on the tutorial system. Each member of staff meets a small group of students at least six times each session. Two essays are prepared each year and parts of these are presented by each student to the rest of the group and the lecturer for discussion.

Final-year students, as part of their research project, make verbal presentations to the supervisor and to their fellow students, the form of this varying from time to time.

University of New South Wales PhD student, Stephen Clough, inserting a probe to measure oxygen concentration and bubble size in an experimental fluidised bed combustion reactor.

Undergraduate education

The Department of Fuel Technology has been in existence at the University of New South Wales since 1958. Until 1972, it was possible to study for a BE (four-year full-time or equivalent) or a BSc(Tech) (three-year full-time or equivalent) degree in fuel engineering. That degree programme was the only one in Australia accredited by the (then) Institute of Fuel in the UK. The course was also accredited by the Institution of Engineers, Australia. In 1972, the course was discontinued in favour of a coherent elective strand of fuel engineering subjects in the BE chemical engineering programme.

In the period 1972-86, some 195 students (an average of 12 per year) have graduated having taken the fuel engineering strand. These graduates have found employment in a wide range of organisations including the steel, oil, gas, paper, aluminium, chemical industries, government departments of energy, some in the electricity commissions, some in small energy management companies, some in combustion or instrumentation equipment sales, and some in project evaluation with banks or finance companies.

Departments of chemical engineering in other universities in Australia, have offered technical electives, usually in the final year of the undergraduate programme, in one or more aspects of fuel engineering. For example, the University of Newcastle has long had

experience in pulverised coal combustion and radiation in thermal power stations and the University of Melbourne in brown coal utilisation.

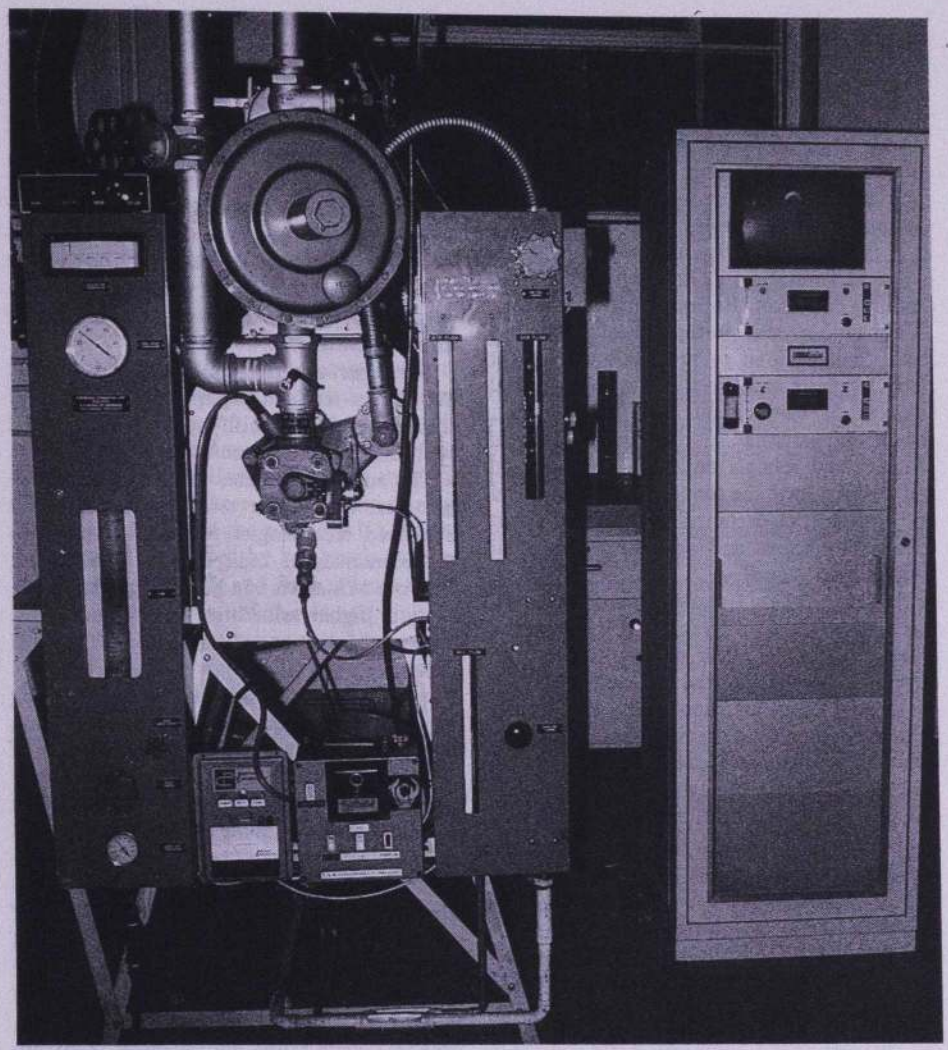
Graduates in mechanical or chemical engineering in particular have completed basic courses in such subjects as heat transfer, thermodynamics, fluid flow, etc and some move into fuel and energy related areas in their employment. In a recent survey conducted through the AIE it was found that, in the absence of a specific BE in fuel and energy, organisations employ graduates for fuel/energy related activities in the following ratio: mechanical engineers, 3; chemical engineers, 2.6; electrical engineers, 1.7; science graduates, 1.6; management economics, 1.

It would appear from these considerations that it is possible to have a substantial common core to a fuel/energy undergraduate programme that would be relevant on an international basis. A choice of specific technical electives would give the programme a local bias without impinging on educational relevance or viability. The core material would include physics, chemistry, mathematics, engineering and computing at first or first-second year university level. Courses in heat transfer, fluid flow, thermodynamics, materials, instrumentation, process control would build on the first year. Courses on properties of fuels, combustion, radiation heat transfer, thermal design of fuel using plant would integrate with the others. Technical electives would allow for more detailed studies in one or more of say — gas engineering, petroleum engineering, coal technology, nuclear engineering, air pollution formation and control, energy economics, energy management, alternative energy technologies, etc. The overall programme would have either built-in or separately organised studies on communication skills, industrial relations, personal responsibilities, etc.

The content of the fuel courses can be summarised as covering the sources and properties of fuels, fuel processing and interconversion of fuels, combustion, the thermal design of fuel using plant, furnaces, etc, and the efficient utilisation of fuels.

Throughout the period of its existence the department has conducted research and has produced a string of MSc, ME and PhD graduates. The very nature of a small department in an applied discipline presents difficulties in maintaining a graduate group at a constant level and we have had to cope with the cyclic nature of the enrolment. The department has been successful over recent years in obtaining research grants and training research students. We have maintained and in some cases updated our facilities. However the pressures within the university are such that it is essential to continue to attract funds from external sources to maintain a significant research programme. This effort must be an ongoing one and we look forward to increased support from industry with or without government incentives for R & D.

Current research activities in the department are centred on fluidised bed combustion, devolatilisation, coal volatiles combustion, gasification of biomass, coal and char reactivity, coal oxidation, energy efficiency in selected industries and shale oil characterisation.



Gas-fired furnace used for teaching purposes, Leeds University.

Conclusions

The study of energy technology in the universities is a product of the internationally accepted methods of energy production and utilisation and, to a significant extent in some aspects, of what is considered to be appropriate engineering education and government policy. Consequently, education in energy is broadly similar in the UK and Australia but specific factors related to government policies and the operations of fuel-producing and fuel-using industries lead to slightly different emphases.

The newer technologies in the international energy-producing industries embrace nuclear power technology, sophisticated technology used to obtain energy from renewable sources and the sophisticated methods now being employed in the traditional energy industries. The graduate from a scheme of study in energy engineering should be conversant with these technologies.

As well as the new technologies, new techniques used in the analysis of energy-related problems are constantly being introduced. These include new computational methods particularly for design, management techniques, application of new materials, etc. These aspects all demand a continuing change in the content and presentation of courses in energy engineering.

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A practical review

'Industrial Boilers'
by D Gunn and R Horton

I must admit to mixed feelings in reviewing this book. Having learnt what I know about industrial boilers while working under David Gunn, I thoroughly enjoyed the book, written as it is with the clarity and authority that I expected from David Gunn and anticipated from his co-author, Robert Horton.

The authors state in their preface that they have "endeavoured to provide guidance for both designers and users on the fundamental subjects of combustion and heat transfer, which are essential to the development of efficient and reliable boilers". This they do well, especially in the chapters on the chemical and physical aspects of combustion, heat transfer, fluid flow and water treatment — all good text-book stuff.

However, when I come to think about it, much of my pleasure in reading this book is the result of nostalgia. As an account of the developments in industrial boilers through the days when competition between manufacturers and fuel suppliers was keen, up to the point when new developments virtually ceased now more than a decade ago (with a few notable exceptions), it is an excellent review. Where I found the book lacking was in any consideration of the future of industrial boilers. There is little or no discussion of the economics of industrial energy production or of the sales over recent years. I suspect that, over much of the size range except maybe the largest sizes, the compact, packaged gas-fired boiler has dominated — a type of boiler that most owners hope that they can forget they have — and the installation of, in particular, new stoker-fired coal-fired boilers has been very rare. I admit I might be surprised at the number of chain-grate, underfeed and, even fixed-grate coal-fired units that are still operating up and down the country but I doubt if the operators of these will now get much benefit from a book like this. When coal firing does come back into fashion — as it must — or as the firing of solid wastes becomes more popular, I feel the firing appliances used will be pulverised coal burners or fluid bed units. Hence, the future belongs to topics such as low NO_x burners and circulating fluid beds, not dealt with in the volume under review.

Dr G G Thurlow

Published by Longman Group UK Limited, Harlow, England, 1989
362 pp. £45.00

New directions

'Catalysts for fuels from syngas'
by G Alex Mills

This report by Mr Mills is concerned with catalytic technology for indirect coal liquefaction, the two-step process in which coal is first converted to synthesis gas (syngas: a mixture of hydrogen and carbon oxides), which is then reacted catalytically to produce liquid fuels.

The focus of the report is on catalysis, both the science and application, for the conversion of syngas to hydrocarbon and/or oxygenate liquid fuels, particularly those suitable for transportation use. Coal gasification is not included in this study.

After a brief review of the background of catalysis in CO hydrogenation reactions, emphasis is placed on new scientific concepts and techniques and on experimental results of novel exploratory research to delineate possible new directions of research. As may be expected, these new directions are based on preliminary, exploratory results and indeed are often controversial.

The report evaluates the results of more than 300 recent research papers in the context of their potential to fulfil needs for improved synthesis gas conversion catalysts.

The author concludes that there are excellent near and longer term opportunities for improved technologies for improvements in the economics of indirect coal liquefaction. Improved catalysts can provide greater selectivity to higher value high-performance fuels, decreased plant costs and higher thermal efficiency.

It has been estimated that catalysts having improved capabilities for syngas conversion have the potential to improve the economies of synthetic liquid fuels manufacture by 10 per cent to about 30 per cent. Better catalysts can provide economic savings not only in the conversion reaction step, but they can also be advantageous through a combination of simplification of product upgrading, elimination of shift reaction requirements, and lessening of needs for syngas purification. Beyond these advantages, the selective synthesis of products which are of high performance value as fuels, notably octane rating enhancement, can contribute to economic benefits far beyond their value based on their heats of combustion.

Dr Andrew W Cox

Published by IEA Coal Research, London, 1988
62pp. £60.00 (to member countries of IEA Coal Research); £180.00 (to non-member countries)

Eternal vigilance

'The Application of Monitoring and Targeting to Energy Management'
Energy Efficiency Series No 8

Energy monitoring and targeting (M&T) is simple vigilance. It is about routinely measuring energy consumption against standards or targets (however you care to set them) so that you can first detect waste when it occurs, secondly estimate its significance in cost terms, thirdly diagnose the underlying cause, and finally take informed action.

Implementation of a scheme need not be difficult, and one of the things that I liked about this book was that it recognised and stated the need to reduce effort to a minimum. Particularly refreshing was the advice to tackle a small selection of major consumption streams first, and expand from there if it seems profitable to do so.

Many people see energy M&T as a means of shadowing the work of the accountant; their objectives thus become complex, and the scope and accuracy of the scheme they install is obliged to match accounting standards. Often they fail in the attempt as a result. This book concentrates on the detection and diagnosis of deteriorating performance as measured by units of consumption, an unambitious, practical, useful and achievable aim that everyone could aspire to.

The meat of the book is in section 4, and in annexe A and annexe B, which were well expressed and covered the right ground. There are only two criticisms, which are noted below. I was glad to see frequent reference to the cusum chart and regression analysis: the two foundation stones of successful M&T.

The first reservation concerns the parameter called "Specific Energy Requirement" (SER). This is the ratio of, for example, energy used to volume of product manufactured. The problem is that such a ratio changes with production volume — because there is normally a fixed "base load" component. A treatment based on the *marginal* SER would have been preferable, where standing loads are subtracted before the ratio is computed. The marginal SER is often a constant, and therefore a much more manageable and useful parameter. Marginal SERs also correspond to the individual coefficients in equations for standard and target consumption, and to the coefficients arrived at by multiple regression analysis.

At one point early in annexe A the author does describe SER in terms suggesting a marginal measure, but there is no acknowledgement of the distinction, which suggests that this apparent reference to the alternative definition was merely a slip.

The second reservation arises where the book refers to energy performance indicators (kWh per square metre per annum) used for assessment of individual buildings. I agree that for *aggregate* comparisons between *groups* of buildings such indicators may work after a fashion. But they cannot and should not be applied to the assessment of single buildings, because the characteristics of an individual building may differ very much from the group average, either hiding latent problems or causing investigative effort to be wasted where there is no significant soluble problem. People do use performance indicators in this way, but they are asking to be misled and I was sorry to see this book mention the method without any warnings about its limitations.

Subject to those criticisms, the book is worth a read. It is commendably brief, it succeeds in distilling the essence of the subject without being diverted by side issues and unwanted detail, and it stresses the value of starting with a small, simple system and expanding from there. If more people took that view, we would have more active M&T systems in operation today, and some of those that are in use would be earning their keep to a greater extent.

Vilnis Vesma

Published by HMSO Publications Centre, London, 1989
53 pp. £11.50

Sulphur in coal

'Reviews in Coal Science
The Problems of Sulphur'
by IEA Coal Research, London

This book, the first in a series of Reviews on Coal Science, is in three parts: chemical desulphurisation of coal; control of sulphur oxides from coal combustion; and sulphates in the atmosphere. The last part outweighs the first two put together. The end effects of the problems associated with the presence of sulphur in coal are not dealt with until chapter 26 in part 3 entitled 'The role of sulphates in the atmosphere'. The authors could have set the scene by dealing with this aspect in the beginning, which would have been in keeping with the title of the book.

The order in which the three parts have been chosen could have been improved if part 2 'Control of sulphur oxide from coal combustion' was dealt with in more detail. Although published in 1989, the processes in commercial use that have been chosen for review in part 2 do not appear to be up to date. Moreover, table 10.1 'Sulphur dioxide emission regulations and guidelines applicable to coal fired boilers' is based on two US publications of 1979 and 1981, which report that no emission regulations or guidelines are suggested for EEC! (A parallel publication by IEA Coal Research entitled 'Emission standards for coal fired plants' (report No IEA CR/11 p 49) grossly contradicts this entry in table 10.1).

The proof reading could also have been better. 'Pullutants' (pollutants), p 147 (which has not been numbered but immediately follows p 146), and 'phsilogical' (physiological) on p 279 (figure 26.1) are some examples.

It appears that acid pollutants, formed by atmospheric reactions of sulphur dioxide from coal combustion gases, were the primary topic of the book. If that were the case, this should have been reflected in the title of the book and not be treated in the last part. Readers will however, find valuable information on this topic. The means of abating or minimising the level of sulphur or its oxidised product by physical, chemical or biological means could have been better dealt with. Understandably this would have increased the bulk of the volume.

One looks forward to a revised edition of this book.

Dr A Sanyal

Published by Butterworth Scientific Ltd, Guildford (UK), 1989
354 pp. £75

A guide to the greenhouse effect

'The Heat Trap'
by J H W Karas and P M Kelly

This is a well-researched and highly readable review of all the main issues embraced by the popular expression 'greenhouse effect'. We are all aware that greenhouse gases occur naturally in the earth's atmosphere and that concentrations have been increasing significantly for many years. However, it is only in the past few years that there has been an emerging scientific consensus about the possible effects of many aspects of human activity, ranging from forestry and the management of nature reserves to food production and transport systems. The greatest change is thought to be in climate, although in coastal areas rising sea levels may be more significant.

The review is divided into eight chapters. Following a brief introduction, the second chapter gives an outline of the basic science of the greenhouse effect and the sources of the major greenhouse gases. Past effects on climate and future trends are also discussed. The third chapter examines the potential impact on society and includes a review of the work of the Department of the Environment up to 1988. The move to a drier semi-Mediterranean climate predicted for the southern UK would certainly be confirmed by last year's weather patterns during May and June. Planning for change is the theme of the fourth chapter, while the scope for reducing the actual rate of change in atmospheric composition is discussed in the fifth chapter.

The recommendations of the World Commission on Environment and Development and the call for action from the 1988 Toronto Conference are given in chapter six — 'A four-track strategy'. The seventh and eighth chapters are both written directly as policy statements by the Friends of the Earth. The seventh chapter points out the fallacies in the belief that a rapid expansion of nuclear power would solve the greenhouse problem, emphasising that carbon dioxide emissions from electricity generation contribute a relatively small proportion of total greenhouse gas emissions. The UK Government's approach comes in for scathing criticism in the final chapter as "... being similar to its initial but long held response to acid rain, ie, do little until the case is absolutely proved either way."

Two appendices give the recommendations and conclusions from workshops held in Villach and Bellagio (1987) and the statement from the participants at the 1988 Toronto Conference. The text is clearly presented with a wealth of relevant references and deserves to become the basic guide for the informed layperson as well as for the scientific and technical community.

Dr Cleland McVeigh

Published by Friends of the Earth, London, 1988
94 pp. £10

A realistic assessment

'Orimulsion:
The revolutionary new fuel for power and industry'
by Miri Zlatnar

We have grown used to treating claims of new energy innovations with a healthy dose of scepticism. Not only have the claims almost always proved hopelessly optimistic, but the status of world energy markets is scarcely attractive for such developments. The low price conditions of recent years effectively work against dramatic changes in the means of producing or consuming energy. If the 1970s were the decade of new energy technologies, the 1980s have seen a more realistic assessment of the potential of innovations.

It is then, all the more surprising to have seen in the last few years, the reaction of many in the energy sector to a mixture of rather dirty heavy crude oil and water. Orimulsion, as its developer Petroleos de Venezuela has named it, is being taken extremely seriously not only by its supporters but also by the existing suppliers of fossil fuels. Such interest is hardly surprising given that the fuel is intended for the increasingly competitive industrial and electricity generation markets. In just over five years, Orimulsion has gone from laboratory to power plant.

The initial claims for the fuel, and the hyperbole surrounding them have begun to die down and the first major assessment of the fuel has now appeared. Miri Zlatnar, a former Opec journalist and, until recently, deputy editor of the authoritative International Coal Report has published a detailed study of the fuel's progress. Her track record is well suited to the subject, since Orimulsion straddles the oil and coal markets (rooted in the former and targeted at the latter).

Zlatnar's study takes the reader from the chemistry and combustion characteristics of the fuel through its record in a number of pilot projects to the strategy for marketing the fuel into the next century (it seeks to compete with incremental demand for coal). With its detailed annexes and statistical and technical data, the report will be very useful to utility planners, boiler manufacturers and fuel purchasers (and it is they, given the report's price tag, that the report is aimed at).

Francis McGowan

Published by Financial Times Business Information, London, 1989
97 pp. £185 (UK); £195 (overseas)

Recently published

'1989 Who's Who in Electronics'
Harris Publishing Co, 1989. 800 pp. £105. Available from Elsevier Advanced Technology, Oxford, UK.

'International Electronics Directory '90'
Elsevier Advanced Technology, Oxford, UK, 1989. 1400 pp (two vol). £215.

'Who's Who in World Oil and Gas'
Longman Group UK, Harlow, UK, 1989. 336 pp. £85.

'The Offshore Technology Bibliography'
Edited by Lindsay Gale.
BHRA, Cranfield, UK, 1989. 648 pp. £84 (UK), £89 (elsewhere).

'Sub-Saharan Africa
From Crisis to Sustainable Growth'
The International Bank for Reconstruction and Development/The World Bank, Washington DC, USA, 1989. 300 pp.

Duke of Kent to be The Council's first President

THE ENGINEERING COUNCIL announced in November that His Royal Highness The Duke of Kent, KG, GCMG, GCVO, ADC, has accepted their invitation to be the first President of The Engineering Council.

The Duke of Kent said: "I greatly appreciated the Council's invitation to become their first President. I regard the appointment as a particular honour. I look forward to a close involvement in the Council's affairs which are very much in line with my own interests."

The Duke of Kent has strong links with industry. He is vice-chairman of the British Overseas Trade Board, and is a non-executive director of both BICC plc and Vickers plc.

His other appointments include: President of the Royal Institution, chairman of the National Electronics Council and patron of the British Computer Society. His Royal Highness is a past President of the British Association for the Advancement of Science and a past President of the former Institution of Electronic and Radio Engineers.

Sir William Barlow FEng, Chairman of The Engineering Council, said: "I am delighted that His Royal Highness has felt able to take on the Presidency of the Council. The Duke of Kent's presence will greatly strengthen the Council which is still at an early stage in its development."

Merger welcomed

SIR WILLIAM BARLOW FEng, Chairman of The Engineering Council, welcomed the merger of the Society of Civil Engineering Technicians with the Institution of Civil Engineers in November.

The merger increases the membership of the Institution of Civil Engineers to 75,000, enabling it to nominate Incorporate Engineers, Engineering Technicians and Chartered Engineers on The Engineering Council's register.

Sir William Barlow commented: "The Council welcomes this merger which is good for the profession. It demonstrates an acceptance that all three sections of our register have a significant part to play in the civil engineering profession. It will harmonise structured training at all levels and help to simplify for the public what the engineering profession stands for."

More young women needed in engineering

A WARNING that appalling consequences could follow if Britain fails to recruit more young women into professional engineering was given by Baroness Platt of Writtle in November.

Lady Platt, a member of The Engineering Council and former chairperson of the Equal Opportunities Commission, was speaking at a conference entitled *Women into Technology* in Bristol.

In 1981 there were 900,000 18-year-olds, by 1995 this figure will have dropped to 600,000, lending urgency to the need to attract more women into the profession.

Working together to integrate qualifications

THE ENGINEERING COUNCIL and the National Council for Vocational Qualifications have allocated responsibility to two executives in their respective organisations for liaison and joint development between the two bodies.

The Engineering Council has appointed Mr Peter Swindlehurst CEng, while the National Council for Vocational Qualifications (NCVQ) has appointed Mr Irvin Draycott.

The appointments were announced in a joint statement of intent, published in November.

The NCVQ's main duty is to develop competence-based national vocational qualifications (NVQs) at four levels across the entire occupational range, including engineering. The top two levels, NVQ IV and III have an educational and training affinity with the IEng and EngTech qualifications respectively. The Engineering Council's existing arrangements completely cover the Chartered Engineer level of qualification, but the appropriate NVQs will be taken into account when awarding the IEng and EngTech qualifications.

The Institute of Energy

Presidential officers and honorary officers 1990/91

The undermentioned have been elected by council to take office following the annual general meeting on 19 May 1990.

D M WILLIS to become president; **R EVANS** to become president-elect; **PROF A WILLIAMS** — honorary secretary; **P C WARNER** — honorary treasurer.

Election of council 1990/91

Following the AGM, the undermentioned will retire:

B A CHAMBERLAIN, P H J JOHNSON, J P MacCARTHY, M C ROBERTS, DR A SANYAL

The undermentioned has resigned from Council:

DR I BOUSTEAD

The undermentioned co-opted members will retire but are eligible for election:

A W T CLEAVER, W TIPLER

There are six vacancies and the undermentioned have been nominated by council:

J R AGG, A W T CLEAVER, W TIPLER

Any 10 Corporate Members may nominate in writing any duly qualified person to serve on council.

There are also two vacancies for Associate Members. Any three Corporate or Associate Members may nominate in writing an Incorporated Engineer to fill the vacancies. A vote for Associate Members would be by Associate Members only.

All nominations, together with the written consent of the nominee to serve, should reach the Secretary of the Institute not later than eight weeks before the AGM, but preferably earlier. (Members are not, however, permitted to join in the nomination of more than three persons in any one year.)

High speed recorder with 240 channel potential

Time related digital/logic signals regulating complex industrial and microprocessor operations can now be accurately measured with the SE560 high speed recorder from ABB Metrawatt, using an optional digital plug-in module.

The SE560 measures, stores and evaluates both transient and waveform signals, including many which are impossible to detect with conventional measuring instruments.

The digital plug-in module enables the potential 30 channel capacity of the SE560 to be enhanced to handle 240 channels, as each module has its own eight channel capacity.

The module can be supplied with a field probe with fibre optic linked 250V inputs designed for use in an industrial environment. Integral logic allows triggering by any combination of input signals, which can also be linked with AND or OR commands.

Analogue channels can also be included in the configuration to allow easy analysis of time-dependencies between analogue and digital signals.

The SE560 features two analogue floating input storage units provided as standard, with a 30 channel-maximum upgrade path. It has ten calibrated measuring ranges from 50mV to 50V with a 1 MHz bandwidth, and monitors signals up to 250 kHz.

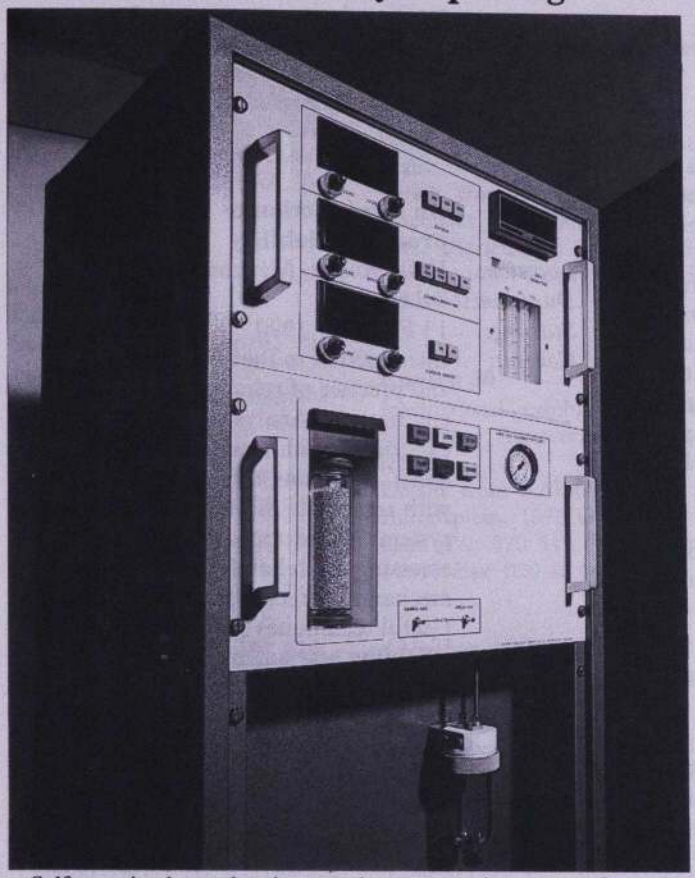
Signals can be digitally stored automatically when changes exceed pre-selected parameters, and data output can be fed to either the integral graphics printer, a recorder, or to other devices via RS232 and IEEE 488 interfaces.

Up to 16Kb memory can be installed in each storage unit, sufficient to record approximately 5000 periods of a sinusoidal signal.

ABB Metrawatt, based in Cheltenham, markets a comprehensive range of equipment including transducers, panel meters, recorders, controllers and plotters throughout the United Kingdom. It is a British subsidiary of ABB — Asea Brown Boveri.

For further information contact ABB Metrawatt, 4 Imperial Square, Cheltenham, Gloucestershire, GL50 1QR.

New combustion analysis package



Self-contained combustion products analysis system for gas appliance testing.

A NEW combustion products analysis package for monitoring levels of oxygen (O_2), carbon dioxide (CO_2) and carbon monoxide (CO) in combustion exhaust streams has been developed by the Analytical Development Company Ltd.

Incorporating an infrared dual CO/CO_2 analyser, a paramagnetic O_2 analyser and a CO/CO_2 ratio unit, the system is designed to monitor combustion gases emitted from domestic and industrial gas appliances, heating systems and boilers.

Enclosed in a transportable cubicle fitted with span and zero gas supplies, air filtration units and ancillary sampling equipment, the system also incorporates automatic protection against water entering the analysis line. Two hand calibrated meters provide a continuous readout of CO and CO_2 levels and a digital ratio unit displays CO/CO_2 ratios between 0.001 and 0.100.

Range selection is by self-illuminating, push-button switches. The system is calibrated to measure CO concentrations from 0-500ppm, 0-0.25 per cent, 0-2 per cent and 0-10 per cent and CO_2 from 0-3 per cent and 0-15 per cent. The preset ranges for O_2 concentrations are 0-10 per cent, 0-25 per cent and 0-100 per cent. Individual range requirements can also be specified.

For further information contact The Analytical Development Company Ltd, Pindar Road, Hoddesdon, Herts EN11 0AQ. Tel: 0992 469638. Fax: 0992 444567.

US standards catalogue

THE 1990 catalogue of American National Standards (ANSI) is now available free of charge from ILI.

The 84 page catalogue lists over 4,500 of the most important American standards from more than 50 standards authorities.

Standards are listed with sterling prices, by issuing authority and by subject matter. There are over 700 new or revised standards since the 1989 edition.

For a free American National Standards Catalogue or more information contact ILI, Index House, Ascot, Berks SL5 7EU. Tel: 0990 23377.

20 years of patience rewarded

SCIENTISTS at BNF Metals Technology Centre have just published the results of a series of long term experiments some of which lasted more than 100,000 hours to evaluate the properties of a range of silver-bearing tough pitch copper alloys containing from 0.01 per cent to 0.32 per cent silver.

Such silver bearing coppers are used for turbo alternators, transformers and other electrical equipment requiring the high electrical conductivity of pure copper but with enhanced strength and improved resistance to softening on heating.

In order to satisfy all the current uses, it is now possible to recommend only four alloys with minimum silver contents of 0.01 per cent, 0.03 per cent, 0.06 per cent and 0.14 per cent from the range of alloys currently available.

Pump upgraded

Sunflo have recently upgraded their single stage, high speed range of centrifugal pumps for a wide range of applications including reverse osmosis, ultrafiltration, paper showers and gas analysers.

The single stage design of the pump is compact and as there are fewer rotating parts maintenance is decreased and reliability is improved. Fewer spare parts are required for pump support.

The three ranges of pumps give flow from 7.5-140 m^3/hr and discharge heads to 1600m. The P2000 range has been upgraded to a 24 bladed impellor from an 8 bladed design. The 24 blade design gives 75mm clearance and eliminates the performance deterioration associated with multistage, turbine or positive displacement pumps.

The modular high speed shaft assembly which contains all the key rotating components can be replaced in minutes so minimising downtime and the units have a long service life due to low seal cavity pressures and low aerial thrust loading.

Long-coupled or close-coupled units are available as are a range of seal environmental control kits with single seal, double seal or tandem seals.

For further information contact Michael Smith Engineers Ltd, Oaks Road, Woking, Surrey GU21 1PH.

Title: **Applied hazard and operability study**
Location: Blackwell Grange Moat House.
Duration: 4 days.
Starting: 11 February 1990.
Content: Safe working practices, criteria of risk management and principles of systematic hazard identification. Property-related hazards of process materials. Principles and application of basic HAZOP technique with demonstration exercises. Study group leadership guidelines and HAZOP team management.
Contact: The Conference Department, Institution of Chemical Engineers on 0788 78214.

Title: **An introduction to air conditioning and refrigeration**
Location: Institute of Environmental Engineering, South Bank Polytechnic, London.
Duration: 5 days.
Starting: 12 February 1990.
Content: An introduction to the fundamentals of air conditioning and refrigeration. An overview of the different types of system employed in modern buildings in the UK, with a strong emphasis on energy conservation and efficient control.
Contact: Director of the Centre for CPE on 01-928 8989 × 2025/2112.

Title: **Monitoring and targeting for energy efficiency**
Location: Institute of Environmental Engineering, South Bank Polytechnic, London.
Duration: 1 day.
Starting: 13 February 1990.
Content: The principles of monitoring and the methods for monitoring heat and electricity. Analysis of consumption for targets from performance indicators to building analyses. The degree day method and adjustment factors. The yearly running total and cusum method of graphing results. Least squares regression analysis for graphical methods. Electricity consumption for tariff analysis.
Contact: Director of the Centre for CPE on 01-928 8989 × 2025/2112.

Title: **An introduction to process reliability**
Location: Holly Royde, Manchester.
Duration: 3 days.
Starting: 13 February 1990.
Content: Introduction to the concepts and practice of reliability engineering. Analysing experience with mechanical items. Analysing experience with repairable mechanical systems. Basic approach to assessing the reliability of mechanical process systems. Useful techniques for system reliability assessment. Demonstration and use of computerised techniques. Collecting reliability data.
Contact: The Conference Department, Institution of Chemical Engineers on 0788 78214.

Title: **Future North Sea Project Management**
Location: Institution of Chemical Engineers, London.
Duration: 3 days.
Starting: 20 February 1990.
Content: Project experience and future needs. Project team organisation. Authority and control. Types of control. Contract documents. Planning techniques and example. Use of risk analysis. Actions to improve project control.
Contact: Dr S Wearne, Project Management Group, UMIST on 061-200 4615.

Title: **Recent developments in aerodynamics**
Location: University of Nottingham.
Duration: 1 day.
Starting: 21 February 1990.
Content: Unsteady aerodynamics. The effect of rotation on stall. The design of spoilers. Flow visualisation.
Contact: Prof B Clayton, University of Nottingham on 0602 484848 × 2628.

Title: **Controlling the electrostatic hazard**
Location: Rubens Hotel, London.
Duration: 1 day.
Starting: 21 February 1990.
Content: Basic electrostatics. Electrostatic sparks and flammable atmospheres. Practical identification and assessment of the electrostatic hazard. Methods of controlling the electrostatic risk in powders. Methods of controlling the electrostatic risk in liquids.
Contact: Conference Section, Institution of Chemical Engineers on 0788 78214.

Title: **Preventing dust explosions**
Location: Rubens Hotel, London.
Duration: 1 day.
Starting: 22 February 1990.
Content: Understanding dust explosions. Industrial incidents. Preventing dust explosions — use of laboratory tests. Explosion protection of plant. Practical design of explosion protection.
Contact: Conference Section, Institution of Chemical Engineers on 0788 78214.

Title: **Project cost management**
Location: Institution of Chemical Engineers, London.
Duration: 1 day.
Starting: 1 March 1990.
Content: Project cost management – obtaining value for money. Completing project to time, budget and specification.
Contact: Conference Section, Institution of Chemical Engineers on 0788 78214.

Title: **Computer-aided chemical engineering**
Location: Beaminster, Dorset.
Duration: 4 days.
Starting: 5 March 1990.
Content: Data and data banks. Reactor development and design. Flowsheeting. Distillation and heat exchange.
Contact: Conference Section, Institution of Chemical Engineers on 0788 78214.

January 1990

Coal and the Environment
17 January, London.
Details from the Hon Sec, The Institute of Petroleum. Tel: 01-408 6257.

Circuit Protection for Industrial and Commercial Installations
Conference, 17 January, Heathrow, Middlesex.
Details from Susan Taylor, Conference Organiser, ERA Technology Ltd, Cleeve Road, Leatherhead, Surrey KT22 7SA. Tel: 0372 374151, Ext 2313 or 2488.

February 1990

Electrostatic forces in manufacturing process
Conference, 7 February, London.
Details from The Meetings Office, The Institute of Physics, 47 Belgrave Square, London SW1X 8QX. Tel: 01-235 6111, Tlx: 918453, Fax: 01-259 6002.

Process intensification
One day seminar, 15 February, Bedford.
Details from the Seminar Organiser, BHRA, The Fluid Engineering Centre, Cranfield, Bedford MK43 0AJ. Tel: 0234 750422, Tlx: 825059, Fax: 0234 750074.

Electrex '90
International exhibition, 26 February - 2 March, Birmingham.
Details from James Watts, General Manager, Electrex Ltd, Wix Hill House, West Horsley, Surrey KT24 6DZ. Tel: 0483 222888.

March 1990

Leipzig Trade Fair
11-17 March, Leipzig, GDR.
Details from Leipzig Fair Agency in GB, Suite 3, 1st floor, Queensgate Centre, Orsett Road, Grays, Essex RM17 5DJ. Tel: 0375 392222, Tlx: 995950, Fax: 0375 392929.

Energy innovation and the agro-food industry
International seminar, 21-23 March, Amiens, France.
Details from Mr Christian Fabry, Agence Francaise pour la Maîtrise de l'Energie, Délégation Régionale Picardie, 2 rue Delpech, F-80000 Amiens, France. Tel: (33) 22.45.18.90, Fax: (33) 22.45.19.47.

April 1990

Pumped Storage
International conference, 2-4 April, London.
Details from The Conference Office, Institution of Civil Engineers, 1-7 Great George Street, London SW1P 3AA. Tel: 01-222 7722.

Energy Law '90
Seminar, 22-27 April, the Netherlands.
Details from the International Bar Association, 2 Harewood Place, Hanover Square, London W1R 9HB. Tel: 01-629 1206, Tlx: 8812664, Fax: 01-409 0456.

May 1990

Fluid machinery: for the oil, petrochemical and related industries
4th European congress, 21-23 May, The Hague, Netherlands.
Details from Conference Department, Institution of Mechanical Engineers, 1 Birdcage Walk, London SW1H 9JJ. Tel: 01-222 7899, Tlx: 917944 IME LDN, Fax: 01-222 9881.

June 1990

Cities for the 21st Century
International exhibition and conference, 2-10 June, Glasgow, Scotland.
Details from World Trade Promotions, 19-21 High Street, Sutton, Surrey SM1 1NF. Tel: 01-642 7688 (exhibition); or CEP Consultants Ltd, 26-28 Albany Street, Edinburgh EH1 3QH. Tel: 031 557 2478 (conference).

IMEX 90 Maintenance & Engineering Conference
5-7 June, London.
Details from Rosemary Wood, CMC, Bankside, Hollybush Lane, Frensham, Farnham, Surrey GU10 3BN. Tel: 025 125 4702, Fax: 025 125 4808.

35th International Gas Turbine and Aeroengine Congress and Exposition
Conference, 11-14 June, Brussels, Belgium.
Details from the ASME Gas Turbine Institute. Tel: 404 847 0072.

September 1990

1990 European Community Wind Energy Conference and Exhibition
10-14 September, Madrid, Spain.
Details from H S Stephens & Associates, Conference Organisers, Agriculture House, 55 Goldington Road, Bedford MK40 3LS.

Enviro 90
International exhibition, 10-14 September, Amsterdam, Netherlands.
Details from RAI Gebouw bv, Europaplein, 1078 GZ Amsterdam. Tel: 020 549 12 12, Tlx: 10613, Fax: 020 46 44 69.

October 1990

Technology Licensing Fair
2-4 October, Brighton, England.
Details from Independent Exhibitions Ltd, Weybourne House, 2 London Street, Chertsey, Surrey KT16 8AA. Tel: 0932 564455, Fax: 0932 560009.

November 1990

Power Generation and the Environment
Conference, 13-15 November, London.
Details from Julie Brown, Institution of Mechanical Engineers, 1 Birdcage Walk, London SW1H 9JJ. Tel: 01-222 7899 Ext 237, Tlx: 917944 IMELDN, Fax: 01-222 4557.

IRM 90 incorporating ROV 90: The practical approach to safety
Conference and exhibition, 6-9 November, Abderdeen, Scotland.
Details from Offshore Conferences & Exhibitions Ltd, Rowe House, 55/59 Fife Road, Kingston upon Thames, Surrey KT1 1TA. Tel: 01-549 5831, Tlx: 928042, Fax: 01-541 5657.

Pumps for PWR
International conference, 6-7 November, London.
Details from the Conference Department, Institution of Mechanical Engineers, 1 Birdcage Walk, London SW1H 9JJ. Tel: 01-222 7899, Tlx: 917944 IME LDN, Fax: 01-222 9881.

New Developments in the Oil Industry
Three day conference, 12-15 November, Bahrain.
Details from the Conference Section, The Institution of Chemical Engineers, 165-171 Railway Terrace, Rugby CV21 3HQ.

February 1991

Powtech
Exhibition, 26-28 February, Manchester, England.
Details from Specialist Exhibitions Ltd, 183 Station Road East, Oxted, Surrey RH8 0QE. Tel: 0883 716244, Tlx: 957039, Fax: 0883 716901.

April 1991

Coal in the Environment
International conference and exhibition, 2-5 April, London.
Details from World Coal Institute, Conference & Exhibition Secretariat, 8 Cotswold Mews, Battersea High Street, London SW11 3JE. Tel: 44-1-228 8034, Tlx: 917712 POLYBS G, Fax: 44-1-924 1790.

June 1991

Power Supply Europe
International exhibition, 18-21 June, Birmingham, England.
Details from Swan House Special Events Ltd, Holly Road, Hampton Hill, Middlesex TW12 1PZ. Tel: 01-783 0055.

July 1991

The 9th International Conference of Women Engineers & Scientists: Communication
Conference and exhibition, 14-20 July, Warwick, England.
Details from Conference Services Ltd, Congress House, 55 New Cavendish Street, London W1M 7RE. Tel: 01-486 0531, Tlx: 934346 CONFAS G, Fax: 01-935 7559.

September 1991

Offshore Europe '91
Conference and exhibition, 3-6 September, Aberdeen, Scotland.
Offshore Conferences & Exhibitions Ltd, Rowe House, 55/59 Fife Road, Kingston upon Thames, Surrey KT1 1TA.

INSTITUTE OF ENERGY CONFERENCES

The following programme is currently being organised by The Institute of Energy, and its associated overseas societies, and other UK societies 'in association'.

For further details please contact Judith Higgins on 01-580 0008.

In 1990

29 March
The Role of Government in Energy
In association with the Parliamentary Group for Energy Studies
Venue: The Institution of Mechanical Engineers, London
Chairman: Prof I Fells (University of Newcastle)

Easter
Building Energy Management: Update & Analysis
Venue: to be announced
Chairman: Mr M C Roberts (PA Consulting Group)

9/11 April
Ceramics in Energy Applications — new opportunities
Venue: Sheffield City Polytechnic
Chairman: M L Hoggarth (British Gas)

April
Orimulsion: The Wonder Fuel?
In association with Financial Times Management Reports
Venue: to be arranged
Chairman: D M Willis (Institute of Energy)

17-20 May
Institute of Energy Annual Conference & Social Weekend
How Green is Our Energy?
Venue: Hotel St Nicholas, Scarborough
Chairman: M G Burbage-Atter (Institute of Energy)

19 September
'Costs of Flue Gas Desulphurisation'
Venue: to be arranged
Chairman: Dr A Sanyal (Babcock Energy)

Winter:
Electricity from Gas
Venue: to be arranged
Chairman: J Masters (British Gas)

In 1991

30 April-1 May
Fire & Explosion Prevention: Energy Utilisation
Venue: Fire Service College, Gloucestershire
Chairman: P G Redpath (British Steel)

Conferences with which the Institute is in association

In 1990

4-6 April
European Conference on Steam Plant for the 1990s
Contact: Conference Office, Institution of Mechanical Engineers on 01-222 7899

July:
Comadem 90 International
(Congress on Condition Monitoring and Diagnostic Engineering Management)
Venue: Brunel University, Uxbridge
Contact: Dr Raj Rao, Birmingham Polytechnic on 021-331 5441

September
'Piper Alpha - Lessons for Life-Cycle Safety Management'
Contact: Conference Office, Institution of Chemical Engineers on 0788-78214

15-18 October:
3rd International Conference on Circulating Fluidised Beds
Contact: Professor Hira Ahuja on (902) 439-8300 ext 2014 (Canada)