March 1988: No 156

ENERGY WORLD

Published monthly by the Institute of Energy
18 Devonshire Street, London W1N 2AU
Telephones: *Editorial:* 01-580 0008. *Administration:* 01-580 7124.
Membership, Education and Journal subscriptions: 01-580 0077.

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The Institute of Energy is in association with:
The American Society of Mechanical Engineers
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Advertisement representation
P Cottle Advertising Services Leatherhead (0372) 376884

Typeset by Trafford Typesetters and Printed by Trafford Print (Colour) Ltd,
Holly St, Doncaster Tel: (0302) 67509 and
108 Temple Chambers, Temple Avenue, London EC4.

Personal viewpoint

A dose of acid rain

The *Sunday Telegraph* of 26 July 1987 carried the headline: 'Europeans wake up to pollution', and a photograph showed 'trees defoliated by acid rain in South East England'. We are told that Britain emits 3.7 Mt of sulphur dioxide against Norway's mere 400 000 t. We will spend £780 M over a 10 year period cleaning up the gaseous emissions from power stations. This is barely a token compared with West Germany's £15 billion in five years. The *Daily Telegraph* of 9 May 1987 reported that 12 large power stations were to be fitted with special burners at a cost of £170 M to reduce NO_x emissions. This was in addition to the investment to reduce sulphur dioxide emissions. Commercial interests have got in on the act! I have seen advertisements for the Super Shield Acid Rain Car Wash to protect car enamel from insidious destruction.

I first became interested in air pollution when the then DSIR financed a three year survey of atmospheric pollution in Leicester; the work ended with the beginning of the Second World War. I was one of three young scientists who undertook this work, which appeared as an HMSO/CMD. The decay of smoke intensity and sulphur dioxide could be measured according to variables such as wind direction, wind velocity, time and distance from the centre. Sulphur dioxide was measured in parts per hundred million. With the means of measurement at the time it was not possible to prove conclusively that pollution was coming into Leicester from the industrial centres of the UK. Nor did rainwater show any measurable acidity beyond that due to the carbon dioxide in the atmosphere. The rapid disappearance of sulphur dioxide with distance from the centre of Leicester was a surprise to me; was this due to rapid dilution by the turbulent air, or removal by reaction with the earth's surface?

The issue of acid rain as a destroyer of plant life was raised in a Swedish paper at the Institute's Fuel and the Environment conference in 1973. No real evidence was produced, and I thought that was the last we should hear on this subject. How wrong I was.

The following points seem relevant to any discussion on the subject:

- What are the concentrations of sulphur dioxide in the atmosphere over the forests in Scandinavia, and what proportion comes from external sources?
- By how much is the acidity of rainwater increased by sulphur dioxide above the pH of 4.5 due to carbon dioxide?
- At the turn of the century the consumption of coal in the UK was about twice that at present. Furthermore most of the pollution was emitted at low levels. Why then did this problem only arise in 1970?
- I have seen no mention of salt and ammonia which are present in the atmosphere and will have some effect.
- Most of the sulphur dioxide is now emitted from power stations in the Trent Valley. I am familiar with the countryside between Gainsborough and Burton on Trent. There are many Forestry Commission plantings, and some preserved ancient woods, and none of these show any signs of blight.
- Has the body of tree specialists definitely proved that the trees are dying because of acid rain?
- The consumption of timber is now many times more than in past times. I estimate that one small sapling of unwanted paper drops through my letterbox every week. Unless the areas are fertilised when the trees are culled, then subsequent growth will be reduced.
- A large part of the earth's surface is either sea or ice which will absorb sulphur dioxide and acid gases. It should be possible, with our knowledge of air turbulence and the reaction rate of sulphur dioxide with water, to quantify the residues reaching Scandinavia in south west winds.
- Pollution in the London area, which at times has resulted in many deaths, does not appear to have harmed the trees in London squares and parks.

Finally, I am reminded of the Victorian GPPSs, (Green Peace Pseudo Scientists) who visited remote Bulgaria and there observed many centenarian shepherds whose main diet was a special cheese. The cheese was thought to be the reason for their lingering, and the active ingredient was identified as Baccillious Bulgaris. Ancient members, like myself, will remember buying St Ivel cheese which told one on the package when the life giving bacteria would be at a maximum. Alas, it was later shown that by carefully fudging birth certificates, the wily Bulgars could prove that they were too old for military service! Truly, as Anatole France remarks 'Le science est infallible, mais les savants se trompent toujours'. Dear readers, who has 'trompent'. Have I?

Dr N M Potter
Past President *(See also p 12)*

1987 Robens Coal Science Lecture: Part 2*

Gasification: a key to the clean use of coal

J A Lacey BSc PhD FEng MIChemE FIGasE AIChemE†

Last month Dr Lacey looked at gasification technology. This month he considers the application of gasification systems and their economic and environmental aspects

Application

For many decades electric power has been supplied reliably and efficiently by conventional plants in which coal is burnt in boilers to produce steam for a turbine driven generator. The efficiency is related to the temperature range of the working fluid and the efficiency of the heat engine used.

The lower working temperature is limited to about 33°C by the operation of the steam condenser and the upper temperature is limited to about 560°C by economic selection of materials for the boilers and turbines. The thermal efficiency of conventional power stations before consideration of any treatment of flue gases therefore lies in the range 36 to 39%.

The operating temperature range of the thermodynamic cycle can be extended if the high temperature combustion products, which are greatly in excess of the steam temperatures, are first passed to a gas turbine. Thus a gas turbine operating over the range 1200 to 560°C gives an efficiency of about 32% when used alone for power generation. If the hot exhaust gases from the gas turbine are used to raise steam to drive a steam turbine in a so called combined cycle the working temperature range extends from 1200°C to 33°C. This gives a potential efficiency of the order of 45%.

The main thrust of the developments in gas turbine technology is to increase the gas entry temperature and the unit size. The efficiency of a gas turbine is a function of the gas temperature leaving the combustor and the pressure ratio over the turbine. Currently, most industrial gas turbines work at temperatures of 1100°C and pressure ratios of up to 14, to give efficiencies of 30 to 32%. Mitsubishi now has gas turbines of 135 MWe capacity operating at 1154°C, using air cooled blades and vanes in the high temperature first and second stages. Six of these machines, together with two 190 MWe steam turbines, have been in operation since 1984 at an installation built by Tohoku Electric Power. Liquefied natural gas is the fuel and 1090 MWe of power is generated at an operating base load efficiency of 43.7%. In this installation low NO_x combustors are used in the turbine and there is a selective catalytic removal system to treat the flue gases from the steam generator. The emissions are reduced to 15 ppm NO_x. General Electric is about to introduce advanced gas turbines of 135 and 190 MW capacity with working temperatures of 1260°C and a pressure ratio of 15, for use in the 1990s. In Japan an advanced gas turbine cycle is being developed incorporating two stage air compression and a re-heat turbine stage with a TET of 1300°C and a pressure ratio of 56 to give a power output of 122 MW. Further developments, for example improved blade cooling, new materials – particularly ceramic blades – could, in the long term, increase the efficiency by several percentage points.

There are numerous combined cycle power generation plants abroad fired with natural gas or oil. It is envisaged that at some time beyond 1995 it could become economically attractive to replace the fuel used in such plants by a medium Btu fuel gas produced from coal. On the basis of an overall efficiency of 80% for gas production (allowing for both oxygen and steam raising) the overall efficiency of this plant concept would be more than 35%. If the gasification and power generation systems are fully integrated an overall efficiency, largely determined by the state of art of gas turbine technology, of 40% is feasible.

The concept of a fully integrated coal gasification combined cycle power plant has stimulated a worldwide interest. The first commercial demonstration unit of 100 MWe capacity has been in operation at Cool Water, Daggett, California, since 1984 and has successfully completed 15 000 hours of operation. A single Texaco gasifier with a nominal coal throughput of 1000 t/day is used. A direct quench heat recovery unit is now used in preference to the radiant cooler originally fitted. The complex comprises an oxygen plant, coal/water slurry preparation, gasifier, gas cleaning by the Selexol process with sulphur recovery by Claus and Scott units, and power generation by a single 65 MW gas turbine having a TET of 1050°C and a steam turbine of 55 MW output.

Satisfactory operation on both low and high sulphur bituminous coal has been achieved using slurry concentrations of 60/65% wt. Carbon conversions of about 98% have been reported. The purpose of the plant is to demonstrate the viability of the IGCC. Because of the small scale and the type of equipment installed the overall efficiency is only 30% and the plant is not economic. However the use of more advanced turbines, optimisation of the coal/water slurry system and construction of larger modules would give much higher efficiencies.

The environmental performance of the Cool Water plant has been very satisfactory being well below the stringent limits imposed in California for particulates SO_x, NO_x and CO, even when using Pittsburgh coal with more than 4% sulphur[1].

In West Germany an alternative approach to IGCC is being investigated. Since 1984 a 750 MWe plant has been in operation in which the exhaust gases from a natural gas fired turbine are used as the highly preheated air supply for the combustion of coal in a conventional boiler. The aim is eventually to replace the natural gas with gas derived from coal. A prototype 240 tpd partial gasification plant is being developed for this purpose[2] (Fig 1). Pulverised coal and air are supplied to an entrained flow reactor operating at pressure and about 1000°C. After separation of the char and dust the hot gases are cooled, purified, and then burnt in a turbine. The hot exhaust gases from the turbine pass to a boiler in which they are

* The 1987 Robens Coal Science Lecture was held at the Royal Institution, London on 5 October 1987

† Programme director SNG, British Gas Midlands Research Station

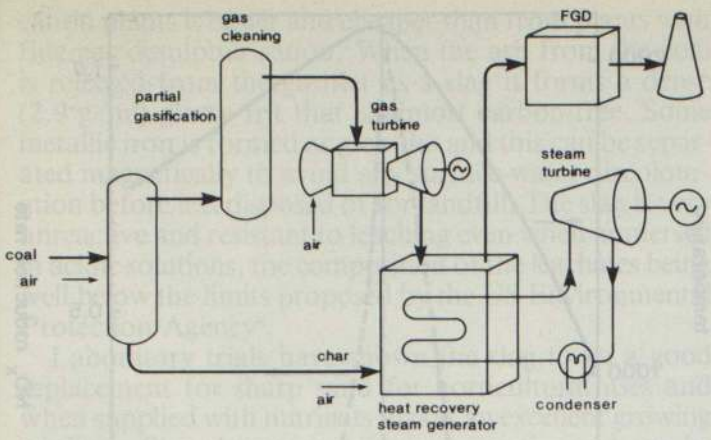

Fig 1: IGCC with partial coal gasification

used to burn the char from the first stage. Claimed advantages of this approach are that there are no tar or liquid by-products, no oxygen plant is required and the high nitrogen content of the gas keeps NO_x formation in the turbine to low levels. It is claimed that power generation efficiencies in excess of 40% are achievable.

The high efficiency of the British Gas/Lurgi slagging gasifier is a very good starting point for IGCC systems (Fig 2). Operability and performance of the present 500 tpd unit is good and there is confidence of its ability to use coals typical of the bulk production in the United Kingdom.

The general operability of the gasifier and the ability of the gasifier to follow load demand patterns, of crucial importance in power generation systems, have been investigated. Load changes from 30 to 100% design can be achieved at the rate of more than 5% per minute with less than 10% variation in the gas calorific value. Start up of the gasifier from cold to full output takes a matter of two hours and a return from hot standby to full output can be achieved within an hour.

The application of the slagging gasifier for power generation in a future power plant has been the subject of a detailed study sponsored by the UK Department of Energy, British Coal, British Gas and CEGB (Table 1). A power plant of 2000 MWe nominal capacity would have three units each of 700 MW. Each module would comprise seven working gasifiers with one spare, three 180 MWe advanced gas turbines and one heat recovery unit feeding a single 300 MW steam turbine. Compared with a conventional plant with flue gas desulphurisation, it is expected that the higher efficiency will offset larger capital costs.

Studies of the application of the slagging gasifier for power generation in units of 200 and 800 MW capacity have also been carried out in West Germany. Even with existing commercial types of gas turbines it is possible to achieve efficiencies of 39% and to meet the stringent environmental restrictions in West Germany.

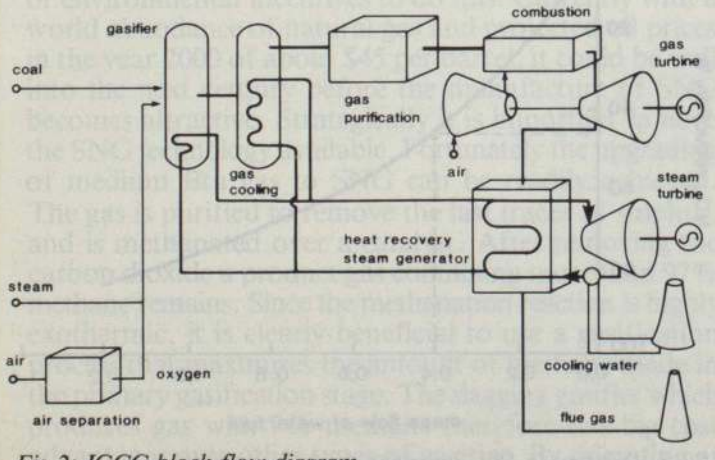

Fig 2: IGCC block flow diagram

Economic aspects

Numerous studies have been commissioned in the USA and Europe to assess the economics, performance and environmental acceptability of coal gasification in combined cycle power plants[3,4,5]. The general conclusions are that IGCC has considerable environmental advantages in that it can meet more easily the standards for NO_x and SO_x emissions than conventional power plants. There is also the expectation that IGCC plants can be constructed in smaller modules much more quickly than conventional power stations and their commissioning phased to match the predicted load growth. The Electric Power Research Institute (EPRI), which is funded by the electrical utilities in the United States, has devoted considerable effort to assessing the benefits of using IGCC technology. Substantial reductions in power production costs should be possible with the emerging generation of gas turbines. The main gasification technologies (Texaco, Shell, British Gas/Lurgi) evaluated by EPRI show the promise of providing economically competitive power when using these advanced turbines. There is the potential for saving up to 10% on power costs compared with a conventional plant. The costs shown in Table 2 are for a 500 MWe installation using Illinois coal[1]. They are specific to the United States and the efficiency of the base case power plant with flue gas desulphurisation used for comparison may well be below that of the larger power stations that will become operational in the United Kingdom.

Table 1: Performance of slagging gasifier IGCC

Net power output	2298 MWe
Nominal module size	700 MWe
Coal consumption	868 t/h
Oxygen consumption	442 t/h
Limestone flux consumption	92 t/h
Gas turbine power	9 × 187 MWe
Turbine entry temperature	1260°C
Steam turbine power	3 × 311 MWe
Flue gas temperature	160°C
Sulphur retention	90%
NO_x emissions (at 6% O_2)	960 mg/Nm³
Efficiency (HHV)	39%

Table 2: Comparative costs and efficiencies (500 MW units)

Process	Capital cost ($/kWh)	Efficiency at 100% load
Slagging gasifier	1204	39.4
Texaco	1296	34.4
KRW	1467	37.7
PFBC	1494	39.2
Advanced PF with FGD	1325	36.1

The air separation unit is a crucial plant item in IGCC plants since the oxygen consumption ranges from 50 to 120% of the coal supplied. Large scale tonnage oxygen plants with throughputs up to 2500 t/day using low pressure cryogenic distillation are well established in the chemical industry. Trials have shown that these plants are able to respond to load changes likely to occur when used for IGCC. Most modern air separation plants produce

high purity oxygen – 99.5%. By reducing the oxygen purity to 95%, which is quite adequate for IGCC, the plant can be simplified and the thermodynamic efficiency increased with cuts of around 10% in oxygen production costs[6].

Studies have shown that big savings can also be made by integrating the air separation unit with the IGCC plant[7]. Thus air at high pressure can be extracted from the gas turbine air compressor and supplied to the air separation plant, separation of oxygen occurs at pressure and high pressure nitrogen is returned to the gas turbines. Estimated capital cost savings on the air separation unit are of the order of 20%.

Environmental considerations

Air emissions

Reduction of the sulphur emissions by 90% or more in a gasification system presents no technical problems as this simply requires the removal of hydrogen sulphide. Higher levels of desulphurisation require the use of solvents capable of removing the organic sulphur, or the addition of a hydrolysis stage for converting the organic

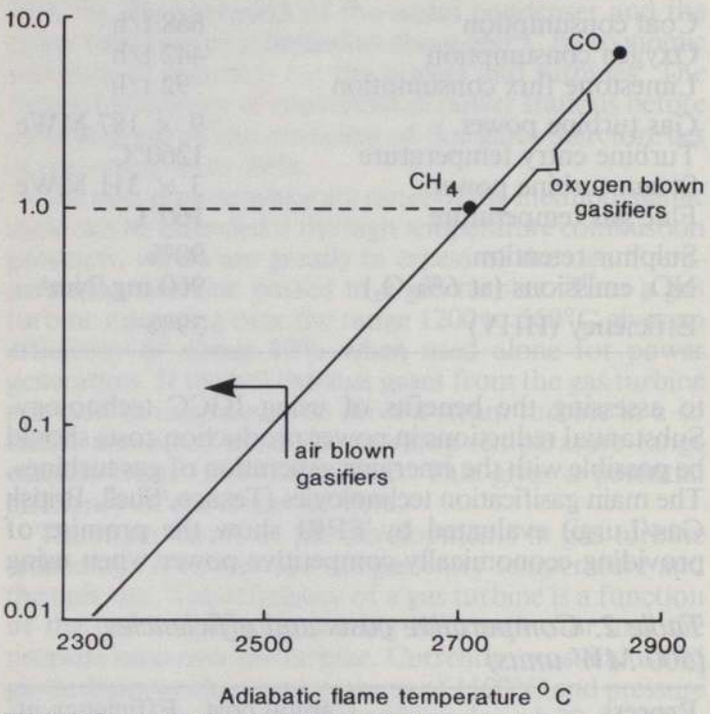

Fig 3: NO_x production by different fuel gases (relative to methane)

sulphur to hydrogen sulphide, both of which can be done at marginally higher costs. The technology exists to meet the most stringent restrictions envisaged.

The reduction of nitrogen oxides is not quite so straightforward. Most of the NO_x from an IGCC system is produced in the gas turbine by the reaction of atmospheric oxygen and nitrogen when the fuel is burnt. The amount of NO_x formed in the turbine combustor is determined by a number of factors; the air/fuel ratio, the gas composition, residence time, maximum temperatures and the degree of fuel/air mixing. It is particularly sensitive to flame temperature, an increase of 60°C almost doubling the amount of NO_x. The adiabatic flame temperatures of the medium Btu gases produced by coal gasification are much higher than that of natural gas so that the amount of NO_x formed may be several times greater (Fig 3). Special measures are required to keep the NO_x formation to an acceptable level and of course the problem becomes more acute as the working temperature of the turbine is raised.

Turbine combustors usually comprise two reaction zones; in the primary zone the fuel is burnt with about half the air; in the secondary zone the remaining air,

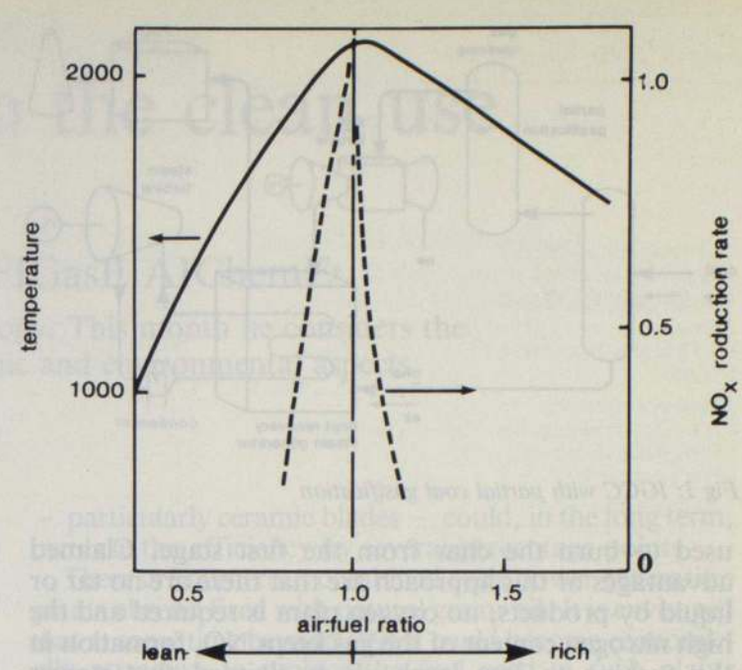

Fig 4: NO_x production vs Fuel ratio

which has been used to cool the walls and blades, is added to quench the flame. To achieve good flame stability in the primary zone most combustors work near the stoichiometric air/fuel ratio[8]. Unfortunately this is near the peak of the NO_x formation rate. By careful design of the combustors, with staged addition of the fuel or air, the NO_x levels can be substantially reduced (Fig 4). For example it has been possible to halve the NO_x formation when burning natural gas by using a pre-mix combustor.

The second method of reducing NO_x is by the addition of a diluent to reduce the flame temperature, for example nitrogen from the air separation plant, water or steam. It is very effective and the NO_x can be reduced by half by adding about 40 wt% water to the gas (Fig 5). Although the mass flow through the turbine is increased it is at the expense of an increased heat load, a reduced cycle efficiency and the need for boiler quality feed water.

To achieve the ultra low levels of NO_x emissions required in Japan it is necessary to pay attention both to the combustion of the fuel gas and to remove NO_x from the exhaust gas. The latter involves the addition of ammonia in controlled amounts so that there is reaction with the NO_x over a catalyst to form nitrogen. It is possible to achieve levels of 15 ppm in the exhaust gases by this method.

Liquid and solid wastes

The disposal of solid and liquid wastes from coal gasifi-

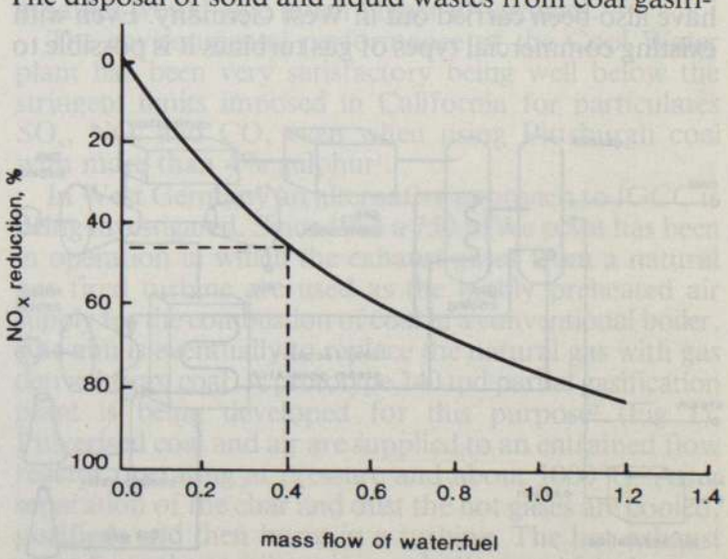

Fig 5: Decrease in NO_x emissions through water injection

cation plants is easier and cheaper than from plants with flue gas desulphurisation. When the ash from the coal is rejected from the gasifier as a slag it forms a dense (2.9 g/ml) glassy frit that is almost carbon-free. Some metallic iron is formed as globules and this can be separated magnetically to avoid any surface-water discolouration before it is disposed of for landfill. The slag is very unreactive and resistant to leaching even when immersed in acidic solutions, the composition of the leachates being well below the limits proposed by the US Environmental Protection Agency[9].

Laboratory trials have shown the slag to be a good replacement for sharp sand for horticultural uses and when supplied with nutrients makes an excellent growing medium. Slag shows pozzolanic properties and can be used as a partial replacement for cement in concrete.

The volume of waste water from an IGCC plant is less than that from an equivalent plant using flue gas desulphurisation and the treatment required is quite different. There is well established process technology for treating the waste waters from gasification plants. When high chloride coals are used additional treatment is needed before discharge: this may involve incineration of a side stream, or the use of reverse osmosis, to produce a highly concentrated salt solution or a solid residue for disposal.

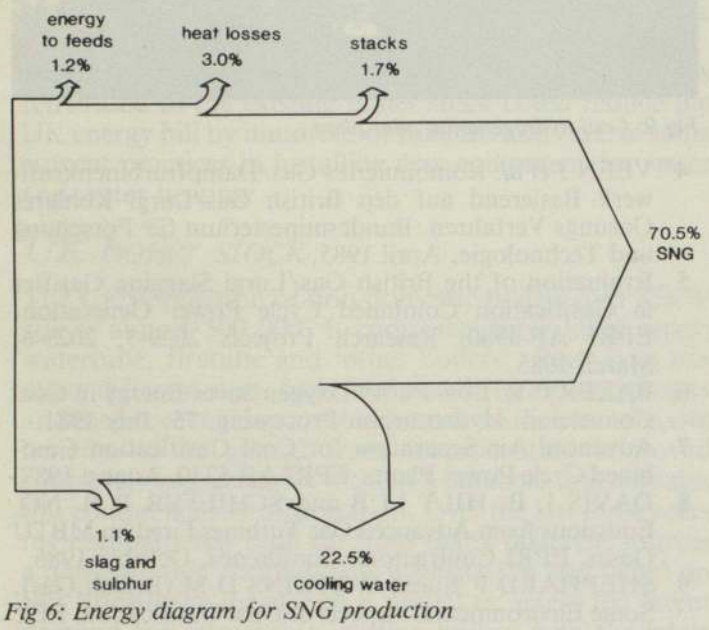

Fig 6: Energy diagram for SNG production

Substitute natural gas

The application of gasification to make a substitute for natural gas (SNG) to feed a high pressure transmission system has perhaps the least overall impact on the environment and is possibly the ultimate goal in the clean use of coal. However, there must be strong strategic, economic, or environmental incentives to do this. Currently with a world abundance of natural gas and projected oil prices in the year 2000 of about $45 per barrel, it could be well into the next century before the manufacture of SNG becomes attractive. Strategically it is important to have the SNG technology available. Fortunately the upgrading of medium Btu gas to SNG can be readily achieved. The gas is purified to remove the last traces of sulphur, and is methanated over a catalyst. After removing the carbon dioxide a product gas containing more than 97% methane remains. Since the methanation reaction is highly exothermic, it is clearly beneficial to use a gasification process that maximises the amount of methane made in the primary gasification stage. The slagging gasifier which produces gas with 7% methane therefore has big cost advantages over other types of gasifier. By operating at

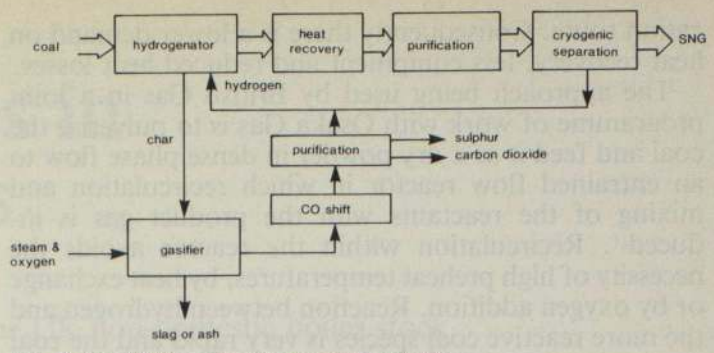

Fig 7: Coal hydrogenation process scheme

pressures above 35 bar the amount of methane produced in the gasifier can be increased by up to 50%. British Gas has developed the slagging gasifier for the purpose of making SNG and a plant to operate at 70 bar pressure will be commissioned at Westfield next year. A process (HICOM) for upgrading the high carbon monoxide content gas has been specifically developed to suit the slagging gasifier; it entails saturating the purified gas with hot water and methanating the gases in a series of catalytic reactors in which the reaction temperature is controlled, by recirculation of the product gas, to prevent damage to the catalyst and to enhance methane formation. Comprehensive engineering and process studies have shown that an overall coal to SNG efficiency of 70% can be achieved for a typical coal from the UK (Fig 6).

Capital costs are high and SNG will not be competitive with natural gas in the foreseeable future. The only major SNG plant operating in the world is in North Dakota and it consumes 14 000 tpd of lignite to make 125 MCFD. Since operation commenced in 1984 the plant has achieved notable production records. The plant was initiated at the time of the oil crisis in the early 1970s; the debt has been written off by the US Government and the plant now produces SNG at about $3.5/M Btu.

New methods for improving the efficiency and reducing the capital costs of SNG plants are being developed and the process concept of coal hydrogenation may have very good long term prospects. This was a topic for a previous Coal Science Lecture[10] and has been extensively studied in West Germany by Rheinbraun. The attraction is the high proportion of methane produced in the primary gasification stage. About half of the coal substance is gasified by reaction with an excess of hydrogen in the first reactor operating, at 70 bar pressure and 1000°C, to produce a highly active residual char (Fig 7). The latter is used as the feed to an entrained flow reactor in which it is gasified with steam and oxygen to make the hydrogen required for the first, hydrogenation, stage. The attractiveness of this route compared with the methanation route is apparent from the overall thermodynamics (Fig 8). In the steam-oxygen gasification route (path 1) a large amount of heat is absorbed in producing carbon monoxide and hydrogen and much of this heat is released during methanation. In the coal hydrogenation route (path 2) only half of the coal carbon is gasified and much less heat is consumed than in the steam-oxygen gasifi-

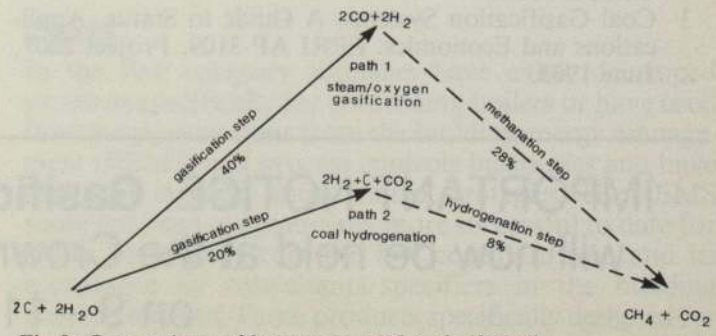

Fig 8: Comparison of heat consumed and released

cation route. Consequently there is a lower demand on heat recovery, less equipment and reduced heat losses.

The approach being used by British Gas in a joint programme of work with Osaka Gas is to pulverise the coal and feed it as a dry powder in dense phase flow to an entrained flow reactor in which recirculation and mixing of the reactants with the product gas is induced[11]. Recirculation within the reactor avoids the necessity of high preheat temperatures, by heat exchange or by oxygen addition. Reaction between hydrogen and the more reactive coal species is very rapid and the coal particles are converted to a highly porous char. Because of the high velocities and short residence times and the dispersed nature of the feed, it is possible to achieve very high throughputs even with caking coals. Development of this process concept is being carried out on a 200 kg/h plant that operates at 70 bar pressure (Fig 9). At temperatures of 1000°C methane is the main product. By reducing the temperature to 850°C about 10% of the coal is converted to an aromatic liquid. The co-production of liquids and methane could in the long term become an attractive proposition.

Conclusions

In the next decade the energy industries will face increasingly stringent limits to air emissions, and other environmental constraints. The CEGB has already taken firm and positive steps to reduce SO_x emissions by 30% before the end of the century by installing flue gas desulphurisation. This is a field in which there has been rapid development and many technical innovations. The direction of future developments and the rate of technical progress will depend on future legislation – the current view being that it will become more stringent.

Alternative technology that could have a major impact on the use of coal is expected to emerge in the 1990s. One of the technologies with big development potential is gasification combined cycle power generation. Major advances are to be expected in the engineering of gasification systems and in gas turbine development that will make this concept both economically and environmentally attractive. Already electric utilities abroad are turning to IGCC as offering the best cost solution to meeting progressive growth in demand. If these developments are pursued there are good prospects that gasification will offer an economically attractive key to the clean use of coal.

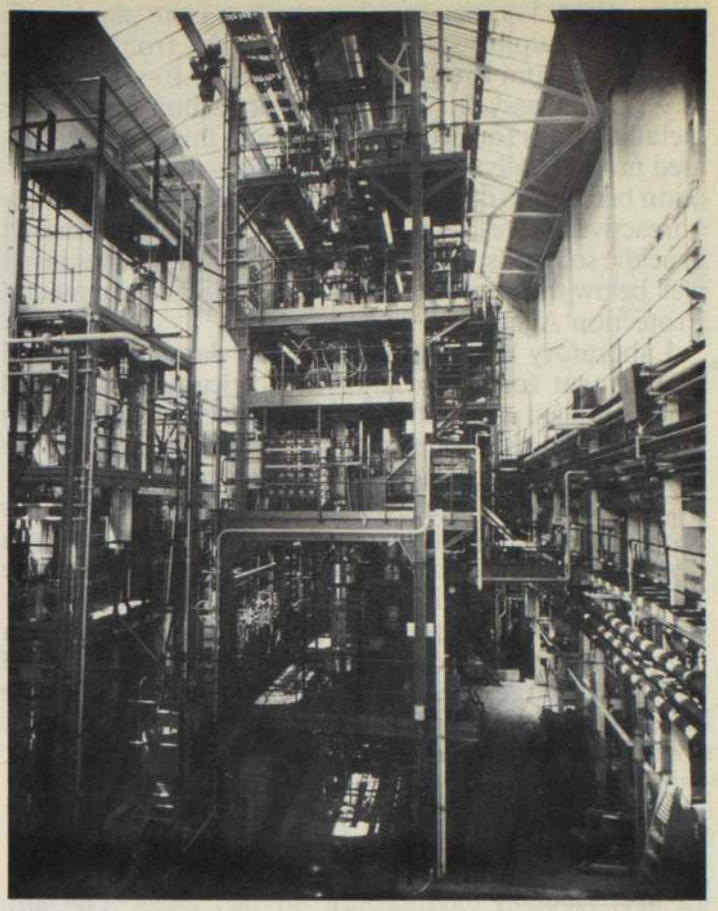

Fig 9: Coal hydrogenation pilot plant

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Acknowledgements

This paper is published with the permission of British Gas. The help is acknowledged of staff at the Midlands Research Station, particularly G W Rees, in the preparation of the paper.

□

Business opportunities in boiler control systems

Allan P McHale MInstE*

Each year some £4.5 billion is spent on fuel to fire the UK non-domestic boiler stock. The average age of the 500 000 population of boilers is more than 10 years and in that time great advances have been made in the capacity and capability of microprocessor controls. There is undoubtedly an enormous potential to retrofit existing boilers with the latest controls both to improve efficiency of production and utilisation

Since the oil crises of 1973 and 1979, energy costs and sometimes availability problems have created major changes in the types of power and heating equipment used, with energy efficiency being a major selection criteria. With time almost all practices of design and specification have been reviewed and set alongside new alternatives. Such changes have reduced the demand for certain types of boilers and there has been a general trend to separate hot water and space heating and decentralise its production in order to improve energy efficiency. However, microprocessor based energy efficient controls retrofitted to the existing boiler stock could reduce the UK energy bill by hundreds of millions and reverse some current practices in installing new equipment for space and water heating[1].

UK boiler stock

The UK population of non-domestic boilers over 45kW size is almost 500 000. It comprises three basic types; watertube, firetube and 'other boilers'. Each type has many different sizes, fuels fired and differing load factors and therefore making any judgement on the cost effective benefits to be gained from incorporating improved controls is impracticable without a database that contains this comprehensive information. Over the last three years my company has built up from many different sources a database that contains this information and based on this knowledge developed a model to assess the latent demand for retrofitting existing boilers with the latest energy efficient controls.

Fig 1 shows the size distribution of each of the three basic types of boilers; watertube, firetube and 'others'. This clearly demonstrates the importance of each type of boiler within different size bands, and the fact that 'other' boilers, then firetube boilers and then finally watertube boilers dominate as size of boiler increases.

Fig 2 shows the boiler stock by load factor. With 86% of all boilers operating below a 20% load factor it can be assumed that a high proportion of the boiler stock is oversized and would therefore greatly benefit from such control strategies as sequencing, optimum start and modulation of firing over a wide range coupled with oxygen trim.

Technology

It is the microprocessor that has made it possible for new energy efficient controls to be developed that provide significant improvements on conventional products. The microprocessor has made controls more flexible permitting strategies to be altered and to be adaptive to changing conditions. More accurate precise control has been possible through direct digital control and the capability to be networked to other microprocessor products has allowed more comprehensive strategies to be developed.

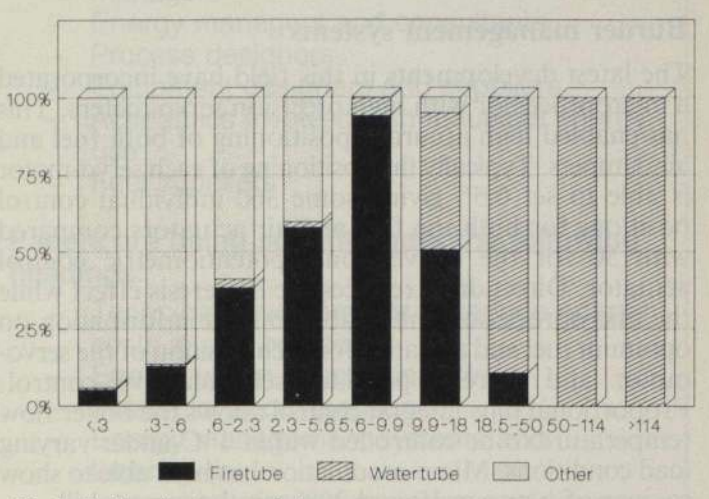

Fig 1: Boilers by type and size

In general, manufacturing costs are cheaper than electro-mechanical products and they are inherently more reliable and safe. While hardware costs will fall and more simple, easier to understand/operate products will be developed, no major changes will take place during the next few years that will provide an appreciable advancement in customer benefit. In the long term intelligent silicon sensors that contain a transducer, power supply, inbuilt processors and a communications interface for digital signals will revolutionise boiler control instrumentation but this technology will be imported from the automotive market.

There are three broad categories where the microprocessor has spawned new products; comprehensive boiler management systems (CBMS), burner management systems and discrete single function controls for, say, boiler sequencing and blowdown, and so on.

CBMS

In the first category suppliers have either developed products specifically for controlling boilers or have used functional outstations from the building energy management (BEMS) and process controls businesses and have then built in boiler house control strategies. The BEMS route has been commercially more successful to date for it has benefitted from the low cost hardware and its acceptance by consultants/specifiers in the building controls market. Those products specifically designed for the boiler house are generally more expensive but do

* Director of ProPlan

have some advantages in their programmes for reporting on energy consumption and performance.

CBMS has allowed strategies controlling efficient production of steam or hot water to be linked to those covering its utilisation. Through this adaptive control has been possible on boiler sequencing, optimum start and shut-down. Coupled with more precise control CBMS has been able to show savings of 15% on the energy bill. In addition other functional boiler microprocessor based sub-systems such as oxygen trim and burner management systems can be integrated through either RS 232 links or other direct standard interfacing techniques.

CBMS has at the same time automated the boiler house and reduced the need for manpower. In one particular case for an outlay of £100 000, labour costs were cut by £65 000/year and a fuel saving of £40 000 was achieved in the first year of operation.

Burner management systems

The latest developments in this field have incorporated a microprocessor with high precision servo meters. This has enabled high accuracy positioning of both fuel and air dampers. Typically the positioning of each servo-motor is able to set 0.5° giving some 360 individual control positions for both the fuel and air actuators compared with 50 for the conventional potentiometric control actuator. Direct drive reduces the hysteresis effect while the microprocessor unit is able to store information on optimum fuel and air ratios for each position of the servo-motor and thereby provides self adaptive control. Proportional plus integral control allows the boiler flow temperature to be controlled within 1°C under varying load conditions. Micro-modulation has been able to show savings of between 10 and 20% on the energy bill.

Exhaust gas analysis can also be incorporated and provide a final trim to the air damper position, whilst the microprocessor units of a number of boilers on a site can be linked together and programmed to provide an intelligent sequence control.

Other energy efficient controls

Although CBMS and burner management systems normally have a much greater impact on reducing fuel consumption, discrete single function controllers presently take the major share of sales in the retrofit market. The main reason for this is that having a much lower capital cost it is easier to get investment approval and in many cases although energy savings in overall terms is very small the investment can often be returned within a year. Oxygen trim, total dissolved solids control (TDS), boiler sequencing, optimum start/stop are amongst the more popular discrete microprocessor controllers. Quite recently one UK manufacturer has introduced an 'intelligent blow-down system' to overcome the problems of scaling on the conductivity probes and fouled modulating valves. In this system the TDS probe is placed in the make-up water line down stream of the water treatment plant. A micro-processor uses the signals from the feedwater TDS probe along with the signal from the feedwater flow transducer to calculate the blowdown required. One of the major advantages of such a system is that by metering the feedwater into the boiler and deducting the blowdown quantity an accurate measure of steam production can be obtained without a steam meter.

Boiler sequencing control offers possibly the greatest single energy conservation measure, particularly for steam boilers but bringing boilers on line to match demand is made complicated by the problem of starting steam boilers. Different control strategies are used but the most common one is to monitor the steam header pressure of each individual boiler. If demand is light one boiler operates while the others are maintained on a sliding scale of readiness. As steam demand increases the pressure on the first standby is raised and the next boiler is brought into a state of readiness. This is achieved by a micro-processor which calculates the error between demand and the header pressure and then adjusts the target pressure levels of the remaining boilers. These controllers can be interfaced without compromising existing safety systems and full manual override control is normally provided.

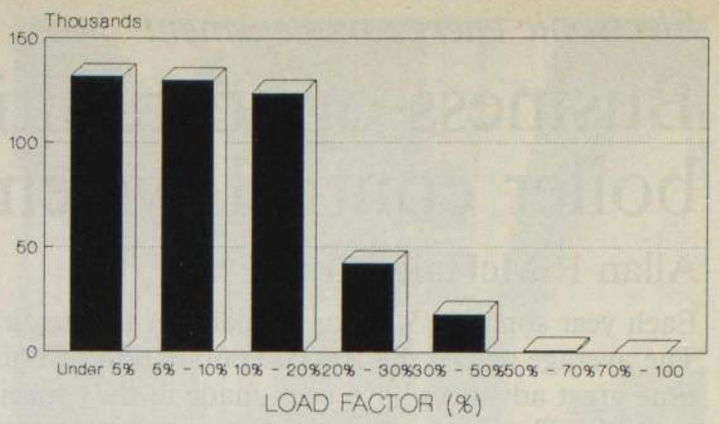

Fig 2: Boiler stock by load factor

Forces that will determine demand

There are two sets of forces that can work to both expand and contract demand, these are external forces on which the supplier has no control and internal forces which he can influence.

The major external forces are energy costs, fuel policy and investment in new construction and industry. Increases in energy prices means greater savings for the same degree of improved efficiency, a shorter payback period and therefore less risk in investing in energy conservation measures. Changes in fuel policy, for example, the move to coal in the early 1980s, provides the opportunity for supplying new controls as does the introduction of dual firing to ensure against availability problems. The most likely scenario to 1995 is very little change in real energy prices and adequate supplies, but it is quite possible that prices will fluctuate as oil pricing strategies and availability is unlikely to remain stable during this period. The net effect on demand will be broadly neutral during the next five years and additional business through fuel substitution is unlikely. New construction in the public, industrial and commercial building sector is forecast to increase to the end of this decade and consequently demand for space heating and hot water plant will produce some small growth for boiler controls.

If energy costs remain at today's levels then internal forces such as product and installation costs will become major factors in influencing demand. The last five years have seen a major reduction in the cost of electronic controls and this combined with a significant improvement in their effectiveness has provided more products that can achieve an acceptable return on their investment. Installation costs are a very significant part of the total installed price and this we believe is where further gains wait to be made, but integrated boiler control packages using BEMS functional outstations have already made some headway. Labour conservation through automation of the boiler house and improved management information will be powerful motivators for increasing demand and ones that the suppliers can influence.

For the biggest number of potential investors energy costs form a small part of overhead charges and a constant and unremitting campaign will be needed to make

all aware of the benefits to be accrued both in the short and long terms from employing the latest microprocessor boiler controls. The Energy Conservation Demonstration Project Scheme (ECDPS) has provided a very useful testing ground for some concepts of heating and boiler controls but it seems likely that we have now seen the major thrust of the Government's campaign. Suppliers will have to take up the initiative and ensure that their marketing budgets include adequate resources for spreading the message.

Despite the benefits to be gained by employing these latest controls the uptake of this technology has been slow. There are a number of reasons for this including the fragmented nature of the boiler stock and low priority for investment in the boiler house. However, the main reason why this £1.38 billion latent potential has not yet been adequately penetrated is because suppliers have not implemented appropriate marketing strategies. Those companies from the BEMS market are however bringing with them their marketing skills that have already developed a new business in building controls and we now expect the market in energy efficient boiler controls to grow quickly.

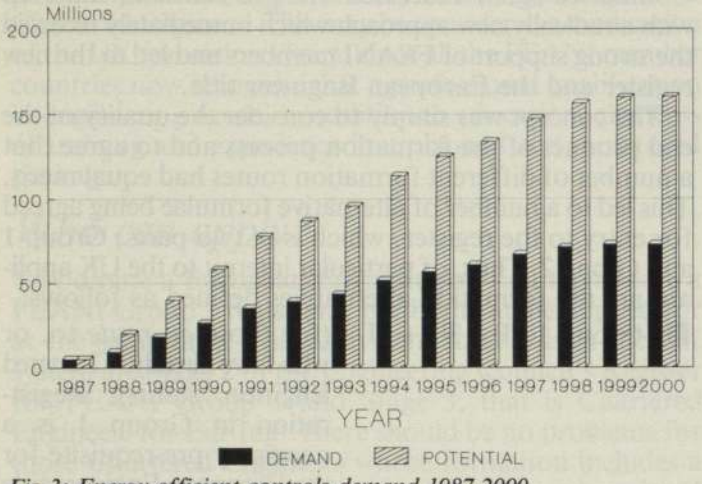

Fig 3: Energy efficient controls demand 1987-2000

Market potential

From our database of the UK non-domestic boiler stock it has been possible to develop a model on which we can test the economic validity of retrofitting boilers with different types of control systems. Fig 3 shows that the total economic market potential for retrofitting the boiler stock with the latest microprocessor based energy efficient controls to be some £1.38 billion (Curve A) but we estimate that market demand to the year 2000 will not exceed £627 M at 1987 installed prices (Curve B).

The economic market potential has been established on the basis that the investment costs would be recouped within three years from savings in energy costs alone. No attempt has been made to take account of savings on labour costs through automation.

Actual demand is based on the fact that not all owners of boilers would consider a three year payback to be sufficient to justify investment, not just on the basis of investment criteria but in some cases because the boiler and/or premises is close to the end of its useful life.

Nevertheless viewed from the present base of annual sales of £20 M a latent demand of £627 M is a dramatic prospect and with a boiler stock of 500 000 having an annual fuel bill of £4.5 M, this robustness makes it a particularly attractive market.

Reference

1 Boiler Controls and Instruments – Business Opportunities 1987 – 2000 by ProPlan.

The European engineer

G F W Adler OBE BSc(Eng) DIC FEng FIChemE FIMechE FBIM Eur Ing*

On 28 October 1987, an historic and impressive ceremony took place in the Luxembourg Palace in Paris, when the first 60 European Engineers received their titles from Alain Poher, President of the French Senate, himself an engineer and recipient of European Engineer certificate No 1. The largest national contingent was from the UK, 10 Chartered Engineers representing all sections of the profession and symbolic of the very many institution members who will now wish to use the title

The Paris ceremony was the culmination of four years' intensive negotiation and international collaboration within the European Federation of National Engineering Associations (FEANI), in which the UK delegates played a prominent role. It is important that all UK professional engineers understand the background and the significance of the new FEANI register and of the European Engineer title.

What is FEANI?

FEANI, founded in 1951, is the European Association of National Engineering Associations. It represents 1M professional engineers in its 20 member countries, which include all the countries of the European Community. Its headquarters are in Paris, where there is a permanent secretariat led by the secretary-general, Marcel Guerin. The current president is Anders Thor, from Sweden, and I am one of the six vice-presidents.

FEANI's main aims are *to secure the recognition of European engineering titles and to protect those titles, in order to facilitate the freedom of engineers to move and practise within and outside Europe;* and *to safeguard and promote the professional interests of engineers.*

How is the UK represented?

Each national member is represented by a committee (the National Committee for FEANI) having a named secretary-general and by delegates to the various FEANI boards and committees, which are chosen by the National Committee.

In the UK, the appropriate body is the British National Committee for International Engineering Affairs, of which I am currently chairman. This is administered by the Engineering Council and has representatives from all the nominated chartered engineering institutions, from the Fellowship of Engineering and from the Engineering Council. Its secretary-general is Prof Jack Levy, director, Engineering Profession at the Engineering Council.

Why is there a FEANI?

Since 1970 there has been a FEANI register of engineers, which sought to set and equate qualification standards in the member countries. Registrants were provided with a 'passport' intended to facilitate freedom of movement and the right to practise in Europe.

This earlier register was, however, beset by problems of comparability of the widely-differing engineering education systems in Europe. In particular, the validity of the UK system of formation, involving training and professional experience, as well as education, was disputed by European countries which relied entirely on a rather lengthier academic education process. This disagreement greatly reduced the effectiveness of the register and increased its complexity, so that only a few thousand of the one million engineers have registered (the biggest contingent being from the UK).

Four years ago, the newly-formed British National Committee again addressed this problem and came up with a radically new approach which immediately received the strong support of FEANI members and led to the new register and the European Engineer title.

The concept was simply to consider the quality of the end product of the formation process and to agree that a number of different formation routes had equal merit. This led to a number of alternative formulae being agreed for entry to the register, which is in two parts, Group 1 and Group 2. Thus, of particular interest to the UK appliant are the formation alternatives defined as follows:

- Group 1: B + 3U + 1T (for those *en route* to, or who have already, Chartered Engineer status). Registration in Group 1 is a necessary pre-requisite for the European Engineer title (see below).
- Group 2: A + 2ET + 1T (for those *en route* to, or who are already, Technician Engineers).

Where

A represents a good secondary education, validated by the award of a recognised certificate at about the age of 16 years.

B represents a high level of secondary education, validated by one or more official certificates awarded at about the age of 18 years.

U represents a year (full-time or equivalent) of approved engineering education, given by either a university or other recognised body at the university level.

T represents a year (full-time or equivalent) of technical engineering training, supervised and approved by either a university or other recognised educational institution, or by an official national body as part of engineering formation.

ET represents a year (full-time or equivalent) of approved engineering education, supervised and approved by either a technical school, college or similar body,

* Chairman of the British National Committee for International Engineering Affairs. He is a member of the Engineering Council and a past-president of the Institution of Mechanical Engineers

as part of a programme of engineering formation.

You will see that the above formulae (which I have chosen from the several FEANI alternatives provided) describe a minimum standard which is at or a little below that of Stage 2* of the appropriate parts of the UK Engineering Council's register. It is the intention of the British National Committee to establish Stage 2 as the level for entry to Group 1 (potential Chartered Engineers) and Group 2† (potential Technician Engineers) of the FEANI Register.

What is the European Engineer title?

FEANI recognises that the above minimum standards for entry to the register do not describe the fully qualified engineer in the professional sense. A higher standard has therefore been set, initially in Group 1 only, for the fully-qualified professional. Group 1 registrants who match this level will be able to apply for and use the title European Engineer (Eur Ing).

The minimum standard set for Eur Ing is a seven-year formation package of education, training and professional experience, similar to the current requirements for Chartered Engineer. This may be considered a vindication of the UK formation system since all the FEANI member countries now recognise that a professional qualification in engineering needs, in addition to education, elements of training and experience in a planned and monitored package.

Who can apply?

To become a European Engineer you first have to be a FEANI Group 1 registrant, but both can be applied for at the same time. The equivalent standards in the UK system are Stage 2 of the Engineering Council's Register for FEANI Group 1 and Stage 3, that is Chartered Engineer, for Eur Ing. There should be no problems for those Chartered Engineers whose formation includes a university degree. For those with other educational qualifications (eg HNC and endorsements), the British Committee for FEANI will seek to establish their equivalence on a case by case basis, with the target of eligibility for all Chartered Engineers.

How you can apply

Application may be made on a form available from the Institute of Energy (contact the Membership Department). Completed forms must be returned to the Institute with the fee (see below). The Institute will verify your qualifications and transmit the form to the British Committee for FEANI which is empowered to confirm your entry to the FEANI register. Your Eur Ing application, with the British Committee's recommendation, goes to FEANI's Register Commission for approval.

FEANI registrants are provided with the FEANI certificate or 'passport' and European Engineers receive, in addition, a certificate which is suitable for framing, signed by the president of FEANI.

When you are a European Engineer, you can use the Eur Ing title, which will be standard throughout Europe. The British National Committee has recommended that this title should be used as a prefix to your name, so as to distinguish it clearly from the national qualifications. However, it is understood that some European countries are intending to use it as a suffix and more consultation is taking place on this issue.

What next?

The FEANI Register Commission is now turning its attention to Group 2 of the register and expects to have this operational in the near future, using the same application mechanism as described above for Group 1. The Commission also wishes to provide a higher level qualification for Group 2 registrants (broadly corresponding to our Technician Engineers), of a similar character to the European Engineer title, but it may be some time before this is instituted and the title decided.

Of great importance are current negotiations in Brussels which we hope will lead to the incorporation of the Eur Ing concept into a European Community Directive for Engineers rather than engineering coming within the scope of a general directive. If we can bring this about, it will increase the legal and contractual significance of the title and, by implication, set the seal of European approval upon the UK system of engineering education and qualification. It will *not,* however, take the place of our own system of qualifications and titles, but be *additional* to it.

Some questions and answers

Q What if I am already on the old FEANI register?
A You may remain on it until your current period of 10 years expires. At any time during this period you may apply to transfer to the new Group 1 register, having paid the appropriate fee (see below).

Q Can I apply for Eur Ing without being on or transferring to the new Group 1 register?
A No. You need to be on the new Group 1 register first, but both applications can be made simultaneously.

Q Will all Chartered Engineers be *automatically* eligible for Eur Ing?
A Not initially. The British Committee will seek to establish, during the first year of operation, that all Chartered Engineers satisfy the FEANI requirement. They will start with those satisfying the current BER and previous CEI requirements and make case-by-case progress with applicants having a different educational basis. The aim is to establish the general case for all Chartered Engineers, on the merits of our own strict registration methods.

Q How much will it cost?
A An application for entry to the FEANI Group 1 register will cost £25, and will be renewable at the same cost every five years. An application for the European Engineer title will cost £60 once and for all, but subject to Group 1 registration being maintained.

Q Can I apply now?
A For Group 1 registration and Eur Ing: Yes.
For Group 2 registration: Not yet, but it is hoped during 1988.

Q Will I have to give up my UK qualifications and titles?
A Certainly not! Not now, nor after the Single European Act of 1992. But the Eur Ing title will be increasingly important and useful in the future.

Q Must I maintain my Institute membership and Engineering Council registration in order to retain registration as a European Engineer?
A You must be on the Engineering Council's Stage 3 register and this means that you should maintain your Institute membership as a Chartered Engineer.

□

* The Engineering Council's register is organised in three stages; Stage 1 denotes that a person has an appropriate academic qualification. Stage 2 denotes that the appropriate training has been gained. Stage 3 denotes that appropriate experience, including some of a responsible nature, has been gained. It is only at Stage 3 that the titles Chartered Engineer or Technician Engineer can be used

† Group 2 of the FEANI Register is not yet open

Greenhouse effect

The cost of pollution*

Andrew Stobart BSc CEng

Upsetting the world's environmental balance costs money to do it, and will cost a lot more money to undo it. Two courses are open to mankind: either to insure against trouble, and possible disaster, or to invest in means of containing or even reversing the trend towards ecological calamity. Is mankind prepared to pay the price? Do our rulers even know what price may have to be paid, and for what? Have governments, besotted by the supposed enmity of their neighbours, considered that their expenditure on arms may have to be replaced by expenditure on protection from another peril, a rise in sea levels? Or do we just sit idly by and, like King Canute, tell the tide to retreat. It didn't for him and it won't for us. A 'Canute' approach could cost less in the short run, but more in the long run

Since the Industrial Revolution started some 200 years ago, mankind has increasingly used fuel and power sources which involve burning carbon compounds. Before then wind, tides, flowing water, oxen, men, horses and elephants provided most of the power. In general these sources of power and energy had little effect on the atmosphere, as the 'pollution' either did not exist, or was recycled. The lower numbers of the world's population also helped. Coal was used to boil kettles. It still is: a power station is a large kettle, with additions; the fuel may be coal, oil, gas or nuclear, but the principle is the same, one boils water.

One view of technology can be the number of uses to which it can be put. Nuclear power has two: to make a loud noise or boil water. Renewable energy has three or more: to boil water, to create mechanical power, or to create electricity. So ecological considerations apart, there are advantages with renewable energy sources over fossil fuels.

All the industrial development has meant an increasing demand for fuel and resources, and some of these are starting to become depleted. In general, resources per head of the world's population are declining fast.[1] The more easily won sources get used up first, leaving the more costly until later. This again will mean that actions to counteract problems will be more expensive in the future.

All this great, and increasing, burning of carbon compounds has two results: carbon dioxide and heat. The heat is useful but eventually goes to join the heat in the atmosphere; the carbon dioxide is rarely used, except in one chemical works which uses boilerhouse gases to make aspirin. But the world's ability to re-absorb more carbon dioxide than that generated by life forms is limited, so the amount remaining in the atmosphere increases, and has been increasing steadily over the last century. More carbon dioxide makes the atmosphere able to retain more of the sun's heat, as well as restricting the heat loss of that generated from the fuels. So the atmosphere warms up. This is known as the 'greenhouse effect'. Other gases also contribute to this effect[2-4]. Even nuclear heat is considered by some to be contributing to the atmospheric warm-up.[5] Some also cause other problems, like the destruction of the ozone layer in the Antarctic which may have dire, but different, consequences for the ecosphere.[6]

All this sounds complicated, so let's hear what a pastor in the Deep South once told his congregation when telling them about Hell. 'Brethren,' he said, 'Ah'm going to tell you about Hell. Now de Lord set dis earth revolving round an axis. An' to keep dat axis runnin' nice an' sweet an' cool, de Lord poured lots of oil an' grease roun' dat axis. But dere's folks in Oklahoma, folks in Arkansas, an' folks in Texas as is diggin' holes and stealin' de Lord's oil an' grease. An' one day dat oil an' grease is goin' to run out an' dat axis is goin' to run dry, an' dat axis is goin' to run hot ... an' dat, Brethren, is goin' to be Hell!'

So, if the world's atmosphere gets hotter, what then? We will use less heating, you say? Possibly, but we might then use more air conditioning. Just as big a power consumer. The scientists tell us of several probabilities[2-4,7-9]. One is that the sea will warm up, and thus expand. (Warm water is less dense than cold, run the cold water into the bath gently after the hot, and you will find that it stays on the bottom.) The sea level will start rising. This, plus the general heat-up, will start faster melting of the polar ice caps, and glaciers in general.

According to Dr Maynard Miller, an American scientist, this is already happening.[10] The rapid movements of the Mount Hubbard Glacier in Alaska are one sign. Rapid melting of other glaciers is also being reported. This will further raise sea levels, and accelerate the process generally. A report some while back also mentioned a possible very rapid melt, once warmer seas get over rock shallows in the Arctic and get under the ice cap. The Russians have had an Antarctic research station vanish on a huge breakaway iceberg recently. This sea level rise is the subject of investigation by such bodies as the Institute of Oceanographic Studies in Birkenhead[7]. The time scale has been set at anything from 30 to 70 years ahead for a one metre rise. Some set it much higher, much faster.[8]

Official sources in the UK have in the main turned a blind eye to the invisible pollution and its possible effects, although a recent conversion to considering sulphur dioxide is perhaps a sign of some changes. Using *Nelson's eye* is now no longer viable. If officialdom persists in this, the eventual result will be to sink Nelson with the stinks.

Some official comments are as follows: **Royal Commission on Environmental Pollution:** 'We have done no studies on the problem to date'.

Royal Institute of Chartered Surveyors: 'We have no information on the subject'.

Department of Transport: 'The effect (of the rise) on port operations must be highly speculative'.

* This article first appeared in the Summer 1987 edition of *The Scorpion* which is available from: BCM 5766, London WC1N 3XX at a cost of £2

Southern Water Authority: 'I have no idea of the effect of the changes (in sea level) that might occur'.

Building Societies' Association (referring to the Thames Barrage): 'The problem was identified, precautions taken, and contingency plans drawn up'. (A positive approach at last.) 'A house under one-and-a-half metres of water is neither mortgageable nor insurable'. (Quite.)

Ministry of Agriculture: 'A great deal of money has and is being spent on sea defences, but the rises in sea levels so far have been small. We will continue to devote funds to monitoring the situation closely'.

***Financial Times* Legal Queries Service:** 'You could not sue anyone for the sea level rise; it would be treated as an act of God'. (Caused by man?) 'The land newly covered at high tide would revert to the Crown'. (At least someone gains?)

The Treasury: They referred to the remarks made by the Ministry of Agriculture, to which they had nothing to add.

Political parties: Only two of the four main political parties replied. They have 'a concern about the environment and are studying the problem'.

The Anglian Water Authority: 'We need a major investment programme'.

The Dutch have taken a different view. First, they have spent a very large amount in new sea defences, to counter the problems caused by the 1953 flooding, but it has taken 33 years to complete the work. Second, a recent conference studied the cost of raising the bridges over the canals, and other expected costs of a rise in sea levels; this seems a practical approach and further conferences are proposed.[11] If the UK Government continues to dither, as it usually does, it will be safer to move to Holland than to stay in the South East.

The Department of Transport comments do not hold up. Replies from 64 ports to a questionnaire on what effect certain sea level rises would have produced the following: **Four** welcomed it: they were short of water depth. **Eight** said that there would be no problem. **Four** navy establishments had no comment (covered by the Official Secrets Act). **Eight** said that the questions were too technical. **Two** said that the problem would be tidal changes silting up the port. **Thirty-eight** (over 50%) said that there would be expensive problems at a rise of one metre; 25% of the ports would have to shut down, and the remainder spend large sums; **16** did not know how much, **two** quoted 'multi-million pounds', and the rest added up to some £43 M among small ports.

All the work needed to insure against trouble, or to prevent it, will cost money – vast sums of money. The Government, judged by its attitude to farmers' compensation over Chernobyl, will not help much. You cannot insure against a rise in sea levels: two Lloyds brokers and the Association of British Insurers tell me that. This is also a good pointer to the rise being likely to happen. If there was even a slight chance of it not happening, I cannot see the money boys missing that opportunity. But they say they will not bet on the sea level rise not happening. And Lloyds of London make a lot of money by accurate forecasting of the chances.

So who will have to pay? We all will – and perhaps, therefore, we should view prestige, energy-using projects, such as the Channel Tunnel, with less favour and turn our attention to major public works projects, to safeguard the low-lying lands in the UK, its port facilities, and the drainage system. Sewage backing up can be very nasty. This is the cost of insuring against trouble.[12]

Sea walls, and so on, are the insurance against the problems which may come from the 'greenhouse effect', alternative energy sources are the investment to counteract it. The Department of Energy is half-hearted about this; major energy producers don't want to know. Out of some 42 venture capital concerns approached for possible investment in wind energy: **17** said that it was outside their field. **Nine** said 'not interested'. **Nine** said that they could not help now, possibly later. **Three** said that they could not help at the moment. **Four** are still looking into it (having given an interim reply of 'possibly interested'.)

So we are not going to get much help, quickly, from the money men – in spite of the the fact that renewable energy is one of the very few investments that actually creates wealth, along with agriculture and mineral extraction. It could, in some forms, be economic now[13], and it could provide the basis for an expansion of the UK engineering industry, thus creating jobs.

One final thought on the insurance approach as opposed to the investment-to-counter-the-problem approach on the subject of increasing carbon dioxide levels in the atmosphere. This gas is used as a stimulant in resuscitation apparatus. In very high concentrations (4% plus), one dies of an apoplexy. We are all breathing increased percentages, compared to our forebears. When (if ever) will the concentration start to affect our metabolism, and especially our mental processes? We are all part of a universal chemical system: alter one part of that system and you alter the whole.

Mankind is rapidly outgrowing his environment, and possibly poisoning himself in the process. Prevention is better than cure. Insurance is just an expense, investment can bring a return if properly done. The cost will be enormous – are we prepared to pay for it?[14] We have to face the problem and face it now.

William Rees Mogg in a recent article said that he welcomed the 'ecological pessimists as the alarm bell'.[15] I am pressing the bell push – **now.**

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Greenhouse effect and the energy industries, a meeting organised by the Watt Committee on Energy and the Institute of Energy is to be held in London on 14 April 1988. (See Special Announcements on p21)

Combustion, flames and explosions of gases (third edition)

B Lewis and G von Elbe
Academic Press, 1987
739pp. $69

When the first version of Lewis and von Elbe appeared in 1938 the only other major textbook on combustion and flame propagation was that by Bone and Townend entitled *Flame and combustion in gases* which had been published in 1927. The contrast was remarkable because although Bone and Townend gave an excellent account of flame phenomena the interpretation of flame chemistry was based on the hydroxylation theory; furthermore little emphasis was placed on turbulent combustion. Lewis and von Elbe's book was an important contribution to the understanding of combustion because it was based on the free radical theory of oxidation. The book was completely rewritten and republished as the first edition in 1951. It immediately became the classical textbook in this field and gave excellent accounts of not only combustion mechanisms but also ignition, and especially turbulent combustion. Much of this work had resulted from the development of rockets and gas turbine during the Second World War, but also from the need to achieve greater safety standards in coal mines and the chemical industry. The second edition was published in 1961 and again was greatly welcomed. We now come to the third edition but published in a world where there are at least 10 major textbooks on combustion and flame, and probably 100 books on specialist aspects of combustion and many more review articles.

How does this third edition of Lewis and von Elbe fare in such a world? The book consists of four parts dealing firstly with chemistry and kinetics, then flame propagation, the state of the burned gas, and technical combustion processes. The first part gives a good account of the theory of free radical reactions and of the mechanism of the H_2/O_2 reaction, the CO/O_2 reaction and an outline of the hydrocarbon/O_2 reaction including cool flames and engine knock. The second part deals with flame propagation and detonation. The coverage of laminar flames is extensive and deals with the adiabatic plane combustion wave, stabilisation and quenching, flammability limits, and ignition. Turbulent flames are dealt with by an approach which combines nicely the mathematics of turbulence and the experimental aspects. Also dealt with in part two are jet flames, detonation, flame spectra, electrical effects and flame photography. Part three deals with the state of the burned gas and covers flame temperature, radiation and flame emissivity; it is backed by some useful appendices. The fourth part deals with technical combustion and is the shortest section; it deals with industrial heating and internal combustion engines in a very superficial way. The title of the book of course limits the topics dealt with to only gases.

The book as a whole gives a good overall coverage of combustion and flame including both theory and experimental techniques. It contains an admirable amount of data in the text and the appendices. It is not the most up-to-date book on the market nor the most advanced, but it gives an excellent overview of the subject.

Prof A Williams

Understanding nuclear power

H A Cole
Gower Publishing, 1988
410pp. £30.00

Information is provided on many aspects of the nuclear industry. The supply of facts is generous enough to make the book useful for reference on a lay person's bookshelf. That is praise, not a sneer: the author's aim is avowedly to explain 'in a way which can be readily understood by anyone': he is not writing for professional engineers or scientists.

The coverage is broad and the intention is to guide lay people to a technical understanding of the industry's workings. In the process the author touches on broader energy questions as well as the history of nuclear power. Thereafter he proceeds from general expositions of radioactivity and the nuclear fuel cycle to more particular accounts.

He devotes two chapters to uranium exploration, mining and enrichment. The composition of nuclear fuels and their manufacture also get two chapters. So do the various types of power reactor. Spent fuel storage, transport and reprocessing have a couple of chapters too. Radioactive waste gets a chapter to itself, as does decommissioning. Moderators and neutron absorbers share a chapter. Coolants rate their own chapter. Radiation instruments do likewise. And radiological protection gets the last chapter before the author moves on to a discussion of plant safety, accidents and safeguards against the spread of nuclear weapons. An appendix lists organisations in, or connected with, the British nuclear industry and a bibliography offers further reading.

The bibliography is one example of the author's effort to be even-handed, for he includes titles from the nuclear opposition. The author is a Harwell man, an electronics engineer, obviously pronuclear but earnestly essaying objectivity. His declared intention is 'not to put the case for or against nuclear power but simply to say "like it or not, this is nuclear power and this is how it works".' To which he adds: 'Having read the book you may or may not be more in favour of nuclear power but it is hoped you will be much better informed about it and therefore in a better position to participate in a meaningful debate with other rational people about the pros and cons'.

The ambition is worthy but the means adopted for its achievement are not uniformly good. The volume is hardback, well printed and copiously illustrated in line and half-tone, and it looks more like a college textbook than a popularisation. The author resorts to mathematics despite a dustjacket blurb claiming that nuclear science and technology are explained 'in everyday language'. On the other hand he does seek strenuously for the common touch (and sometimes too strenuously, as when he over-indulges in italic passages and exclamation marks). Inevitably there are simplifications that may strike some critics as excessive. For instance, he writes that Niels Bohr 'perfected the atomic theory' and when he first uses the term *thermal efficiency* he defines it as

$$\frac{\text{amount of electricity generated}}{\text{corresponding amount of heat generated}} \times 100\%$$

which may beg a question or two for some readers. All this is nitpicking, however. The work is to be commended.

Arthur Conway

Optimisation of radiation protection

IAEA, Vienna, 1987
605pp. 1240 Austrian Schillings

In 1977, the International Commission on Radiological Protection (ICRP) issued new guidelines on radiation protection with a revised system of dose limits. From these guidelines grew the requirement that all exposures be kept as low as is reasonably achievable, commonly known as ALARA. Optimisation of radiation protection is a similar expression.

The papers brought together in this book therefore, span the decade from 1977 and review the extensively vast experience gained over the period. The purpose of such a collection of papers on the subject allows those in the field of study to see whether the optimisation principles are being successfully applied and are working. It allows the reader the opportunity to evaluate the methodologies that are illustrated and to appraise radiation protection principles, identifying new potentials and limitations.

The book contains some 40 papers from authors around the world. The majority are in English, although sadly the two papers from the USSR are in Russian and an English abstract serves only to frustrate the reader further.

The book appears to cover the subject matter very widely and in great depth. There are three sections. The first

(Continued on p18)

Electricity privatisation
CEGB makes three

The Government has told Lord Marshall, chairman of the Central Electricity Generating Board, that the £27 billion enterprise will be broken into three parts when it is privatised in two to three years' time, reports the *Financial Times*.

The board, which owns all power stations and the transmission grid South of Scotland, will be allowed to retain only about 70% of power plant including all the nuclear stations. It will be given the right and obligation to develop a nuclear power programme based on a family of four to five pressurised water reactors to be ordered in the next 12 years.

The remaining plant will be hived off as a separate private company, intended to compete in the generation of electricity and the building of new power stations. This new company may have a generating capacity of about 12 GW, equivalent to 12 large generating plants with a replacement cost of around £10 billion.

The CEGB will also lose ownership of the national high voltage transmission grid, which will be split off into a separate non-profit making company jointly owned by 12 area distribution companies.

The privately-owned distribution companies will be the successors of the 12 area boards, which at present buy electricity from the CEGB at a standard bulk-supply tariff and sell it on to consumers.

The new distribution companies will be given a major increase in power and responsibility. This will include:

- The statutory duty to keep the lights burning and to meet all reasonable demands from electricity customers. This obligation will be transferred from the CEGB.
- The ability to build their own power stations or to form consortia to finance the building of power plant by an independent company.
- The ability to buy electricity from whoever they wish.
- Ultimate control over the transmission grid through joint ownership of the grid company. The successor to the CEGB may be given a seat on the board and might run the grid under a management contract but it will be denied control.

The two Scottish boards, the South of Scotland Electricity Board and the North of Scotland Hydro-Electric Board, will be sold separately as going concerns. The SSEB will be encouraged to compete vigorously with the remains of the CEGB by exports from its surplus nuclear and coal-fired generating capacity.

Source: Financial Times

Opencast coal
A new report

Current and projected levels of opencast coal mining in the UK are not justified by market or mining technology needs and therefore misuse valuable long-term resources, according to a new report from a working party of the Coalfield Communities Campaign (CCC). The report throws doubt on official claims that opencast coal mining subsidises deep mining activity and questions the effectiveness of current environmental criteria in regulating opencast site approvals.

The report compares British Coal's (BC) claims that, for quality reasons, up to three-quarters of present opencast output could not be replaced by deep-mining with two other findings. The first from the National Union of Mineworkers (NUM) says only half (5 Mt) the opencast output proposed by BC (10 Mt) is necessary, because modern coal preparation plants and cutting equipment overcome most of deep-mined coal's former disadvantages. The second is the Council for the Preservation of Rural England's finding that only 2-4 Mt of opencast coal are essential. The report also finds no reason to support BC's optimistic projections for the coal market and therefore points to the urgent need for a strategic choice between closing more deep-mined capacity or restricting opencast.

The report sees any inclusion of already incurred fixed costs in deep-mining calculations as irrelevant and also of far less future significance than the environmental and social consequences of new opencast work.

It points out that the coal industry's losses are due to interest charges and social costs and therefore opencast profitability which is said to subsidise deep-mining can only be seen as a contribution to the cost of past, not present, deep mining.

The CCC report calls for a national plan for opencast production based on consultations with the coal industry and local authority associations. This should aim to avoid increased opencast output at a time of falling demand and prevent indiscriminate exploitation of valuable high-quality coal reserves for short term profit which would in turn trigger premature closures of existing collieries.

Source: Coalfield Communities Campaign

Energy manager
National award winner

The winner of the Powrmatic/NIFES National Energy Management Award for 1987 is Norman Sockett, for the past two years energy manager for Inco Alloys International, manufacturers of high-grade nickel alloys in Hereford, reports *Energy Management*.

Mr Sockett received his trophy and cheque for £1000 from Peter Morrison, Minister of State for Energy, at the Energy Manager of the Year lunch.

His energy management programme yielded a reduction in energy consumption at 8.1%, netting cost savings over £300000 for the company. Capital expenditure on energy efficiency over the same period was £400 000.

Among the measures taken was the decentralisation of heating and steam supplies, and the replacement of factory and office heating equipment. Only one boiler is now needed for process steam, making it possible to de-man the central boiler house. The elimination of the cost of maintaining a steam distribution system is saving an estimated £100 000 a year.

Source: Energy Management

Transport fuel
Record demand

According to statistics issued by the Institute of Petroleum, demand for petroleum products in the United Kingdom fell by almost 2.4Mt during the first nine months of 1987 compared with that of 1986. A total of 53 562 864t was recorded in contrast to the 55 929 589t of the previous year.

There were record deliveries for the transport fuels, which accounted for over 50% of total product demand. Derv Fuel showed a rise of 7.4%, Avtur (aviation turbine fuel) 6.7% and motor spirit (petrol) 3.2%. Gains were also shown in demand for bitumen, ethane, and lubricating oils and greases.

Demand for fuel oil, naphtha/LDF, and burning oil, fell by 25.7%, 18.9%, and 6.2% respectively.

Source: Institute of Petroleum

Acid rain
Plant lining project

The four leading rubber-lining companies in the UK have formed a consortium to provide the large-scale plant lining facilities required to meet the CEGB's flue gas desulphurisation (FGD) programme. The consortium, known as the British Plant Lining Group (BPLG), has been formed under the auspices of the British Rubber Manufacturers Association.

There are four members of BPLG and they have specific experience of the requirements of FGD, having supplied staff for projects in Germany. The individual companies are approved to various recognised certification standards, including MoD 05-24 and are experienced in working to the latest British Standard 6374 part 5.

In addition to many years of specialist

experience, the consortium will pool its resources to offer comprehensive facilities within easy reach of most UK power stations. These facilities include autoclaves up to 16ft by 30ft, large-scale manufacturing and storage, design consultancy, materials supply and technology.

An adequate supply of trained liners for work on site or in the factory will also be crucial to the programme. Consequently, the consortium plans to establish its own training programme in conjunction with the rubber industry training body, BRITO.

The CEGB has announced that it will inaugurate its programme by installing £600 M of equipment at two of its largest power stations, Drax in Yorkshire and Fiddlers Ferry in Yorkshire. Drax will also have a limestone gypsum flue scrubber, while Fiddlers Ferry will have a regenerative plant producing sulphuric acid for commercial use.

It is estimated that the equipment will reduce by 360000t the amount of sulphur dioxide that British power stations emit, or 15% of the total. The Drax installation will be complete in 1995 and Fiddlers Ferry in 1997.
Source: British Plant Lining Group

Batteries
To keep lights burning

The lights of London, Bonn and Paris will never go out, at least, not completely, reports a new study, for more than $1 billion a year is being spent on batteries that sit quietly awaiting their turn to take power.

*Industrial batteries and fuel cells in Europe** is a 325-page report that says 'by far the most important industrial battery application is in the field of standby power systems, where the greatest growth is likely to occur'. Such back-ups account for 36% of the spending in the field, or what was $357 M in 1986 and is expected to be $459 M by 1992. The total market, the study says, should climb past $1.2 billion by then, in constant 1986 dollars.

The back-up electricity is a particular requisite now that computers are so widespread. In the UK, for instance, 'the high quality of the domestic main supply gave little cause to install UPS (uninterruptable power supply) systems in the past. Now the extensive use of data processing, especially in the financial services industry, renders such installations imperative'. Furthermore, particularly in London, the profusion of various switching equipment has made the main power supply waveform so variable that UPS is most desirable to maintain power consistency, even without the threat of a blackout.

In West Germany, a different condition exists. Rather than a few large concerns, there are nearly 650 firms providing power, mostly mixed public/private companies. There are on average two breaks of supply a year that are longer than a minute long, and about 1000 reductions to 70% of the supply voltage. In France, the relative frequency of main supply interruption has led to a healthy demand for UPS equipment, the report says. The major French applications for battery systems for alternative power are in conjunction with computers.

Technologically, primary batteries (those with one cycle of operation, discarded when spent) account for 42% of the market and secondary batteries (rechargeable) 58%. Far and away the most popular primary batteries are zinc-carbon Leclanche types, on which European industry spent $215 M in 1986. The fastest growth, however, due to their great longevity, will come in the lithium primary batteries, forecast to rise by more than 18% a year in sales.

Among secondary batteries, lead-acid types predominate, and were the best-selling of any battery type, $363 M in 1986. The high cost of lithium units will inhibit their growth as secondary batteries. Fuel cells (which generate electricity rather than storing it) are unlikely to see significant sales volume before 1992, due to cheaper alternatives for most applications.
Source: Frost and Sullivan

British technology
Goes to China

Over 1000 homes and businesses in Beijing, China, are to be connected to natural gas in an unusual joint marketing project by British Gas and 10 member companies of the Society of British Gas Industries. The society is the trade association for contractors and gas equipment manufacturers.

A pilot distribution system is to serve as a showcase for UK gas industry technology in China, not only for Beijing but for representatives from the many other Chinese cities who are expected to visit the site. The installation of polyethylene pipes, pressure regulators, meters, and associated equipment will be carried out by the Beijing Gas Company and should be completed by the summer.

The extensive demonstration project will serve 1120 premises, including schools, restaurants and a hotel, as well as homes. The opportunity exists to extend the project on a commercial basis. Harding Bassett, HQ director of the International Consultancy Service of British Gas, said: 'China plans to double its energy output by the year 2000. This project is a major opportunity for British firms to demonstrate their expertise in gas distribution to one of the largest potential markets in the world. We are particularly happy to have been able to organise this marketing initiative with other British companies, many of whom we already work closely with at home and overseas.'
Source: British Gas

Stop the brain drain
Support SCIENCE

At the end of 1987 some 3000 research workers were involved in intra-Community cooperation schemes thanks to a programme originally launched in 1983 as an experiment. The programme known as the 'stimulation plan' has made it possible to lay the foundations of the vital European research area, by ensuring mobility for European research workers and giving them the opportunity to become involved in advanced research programmes in other member states.

The programme was set up in response to the 'brain drain' to the United States when nearly 7000 research workers emigrated between 1982 and 1985. Nine per cent of the scientists employed in US industry are now of Community origin and the development of the Strategic Defence Initiative, the so-called Star Wars Programme, is now tempting many others. To combat that the Commission is now asking the 12 to agree to a major initiative for the period 1988-92 to provide a climate in which intra-Community cooperation will be encouraged.

The Commission's plan, which is known as SCIENCE, would provide financial support of almost £117 M and involve up to 8000 research workers by 1992. It will provide bursaries, research grants and advanced training courses in the fields of mathematics, physics, chemistry, life sciences, earth and ocean sciences, scientific instrumentation and engineering science, particularly in the areas of fluid and solid mechanics.
Source: Community News (Wales)

Engineers
More flexibility needed

Fresh proposals for engineering training, aimed at reflecting the greater employer demand for craft flexibility, are being developed by the Engineering Industry Training Board, reports the *Financial Times.*

The proposals, known as the Coherence Project, take the form of a new system of competence specifications which will allow the accumulation of training credits. If implemented, the proposals will facilitate greater movement across traditional occupational boundaries.

The EITB is examining the possibility of sub-dividing its present modular training programme, which replaced the old apprenticeship scheme some years ago, into a range of discrete elements, for which specific statements of required competence could be made.

Trainees would have their achievements formally recorded and so accumulate credits towards chosen qualifications. This would help flexibility by allowing the formal recognition of relatively small portions of training.

In a new study on the employment and training of craft workers, the EITB says that the project represents a likely way forward to increase progression from lower to higher levels of engineering training and to reduce the rigidities im-

* Frost and Sullivan

posed by structuring training according to traditional occupational boundaries.

Its report urges engineering employers to think beyond immediate company requirements to the collective needs of the industry.

The EITB suggests that the blurring of occupational boundaries, resulting from employer pressures for greater workforce flexibility, has hit craft workers.

When new high-level skills are required craft workers may either be displaced by technicians, or when de-skilling takes place craft workers may be displaced by semi-skilled machine operators or else end up performing routine work for which they are over-qualified.

The EITB is warning that, on present recruitment trends, craft skill shortages could worsen for the rest of the decade even though total craft employment in engineering is expected to continue to fall.

Of the 2 M people employed in the industry, the EITB says that about 327 000 are classified in craft occupations dominated by four sectors – machinery, metal goods, motor vehicles and aerospace.

Since 1978 craft employment has fallen both in absolute terms, from 530 000, and as a proportion of the total engineering workforce, from 18.1% to 17.1%.

Some 1800 women, or 0.5%, were employed in skilled craft occupations and the EITB says that despite its own and others' efforts the number of craftswomen in the industry is likely to remain very small for the foreseeable future.
Source: Financial Times

Energy Park
Becoming more efficient

The Milton Keynes Development Corporation (MKDC) has announced the widening of its innovative energy efficiency measures which will make all future housing in the city as energy efficient as houses in Denmark and Norway.

During a visit to Milton Keynes, the Minister of State for Energy, the Rt Hon Peter Morrison MP, welcomed the announcement under which the Milton Keynes Energy Cost Index (MKECI), first developed for housing in the unique Milton Keynes Energy Park, will now be applied to all new housing built throughout the city.

This continuing development of effective energy efficiency initiatives, such as those typified by the Energy Park Project, means that the application of the MKECI to all new housing in the designated area will widen the benefits of improved energy efficiency for all housebuyers, and provide a valuable step towards improving energy efficiency nationally.

The introduction of the index means that all new houses should be built to an energy efficiency standard at least 30% better than that required by current building regulations.

This latest move by the Corporation to actively integrate energy efficiency in all aspects of development has won full support from energy conservation bodies and housing developers in Milton Keynes. A standard house built to current building regulations would have an Energy Cost Index of 170, and new houses in Milton Keynes will now have to achieve an index rating of 120 or lower. Milton Keynes has a strategic new housing target of over 2000 units annually (around 1% of Britain's total new housing starts each year).

The MKDC has also announced proposals for increasing still further the energy efficiency standard of new housing located within the Energy Park. In the first phase of housing development in the park, 600 houses (now built or under construction) were required to have an MKECI of 120. The latest proposals will require an index rating of 100 for new houses in phase two in which another 600 houses will be started on site in the summer.

Stephen Fuller, manager of the Energy Park project, explained that developers in phase one had had an open brief to achieve the 120 Index by using whatever tried-and-tested efficiency measures suited them best. 'Developers in phase two, however, will be asked to demonstrate specific approaches, techniques and technologies,' he said. 'Following extensive discussions with the Department of Energy, the EEC, energy utilities, and a range of consultants, a number of potential demonstration projects have been identified, ranging from the use of micro-CHP systems, innovative solar systems, super insulation, orientation and house design, advanced glazing systems, and use of heat recovery and controlled ventilation systems. These projects will require a greater degree of international cooperation and collaboration and will reinforce the Energy Park's position as an international energy efficiency demonstration project.'
Source: Milton Keynes Development Corporation

Health and safety
New rules proposed

Proposals for new regulations on informing employees about health and safety law at the workplace have been published by the Health and Safety Commission (HSC). Employers would be obliged to display an eye-catching poster or distribute leaflets informing their workers in general terms about the requirements of health and safety law.

The new poster and leaflet would replace the existing prescribed abstracts of the Factories Act 1961 and the Offices, Shops and Railway Premises Act 1963, which employers at factories, offices and many other premises are required to display.

These abstracts have long been a feature of many workplaces in Great Britain, but they are hard to understand and their information is out of date, for example, they do not cover the 1974 Health and Safety at Work Act or regulations made under it.

The new poster and leaflet would be less detailed than existing abstracts, but more wide-ranging. Their presentation would be simpler and they would be less likely to become outdated. The poster and leaflet would also refer to further sources of information, including health and safety inspectors and HSE publications.
Source: Health and Safety Commission

Indonesian nuclear power
With German help

Indonesia's third nuclear reactor, a 30MW multipurpose research facility built in cooperation with West Germany, has begun operating in Serpong, 25 miles west of Jakarta.

The new reactor ranks as the third largest neutron-producing facility in the world, after Grenoble in France and Brookhaven in the United States.

The West German company supplied the materials used in the construction of the reactor. The fuel was supplied by another West German firm. The total cost of the facility, on which construction began in 1983, was DM171M, with DM30M being contributed by the West German Government.

Dr B J Habibie, Minister of Research and Technology, said the research reactor would be available to foreign scientists wishing to undertake joint projects with Indonesian scientists. He said expressions of interest have already been received from scientists in West Germany and Australia.

Next to the reactor is a fuel-element plant capable of producing 70 pieces of fuel element a year if operated for eight hours daily. Using dissolved nitrate uranium as its raw material, its initial production is designed to meet the needs of the reactor. It is anticipated that the plant will be able to produce fuel for export at a later date.

In addition to the reactor and its fuel production plant, the Serpong nuclear centre is to include other supporting facilities: a separate radioactive waste processing installation, a radioisotope production plant, an experimental fuel production unit, a radiometallurgy centre, and a nuclear electronics centre.

Some 750 research workers, including about 50 nuclear engineers trained in West Germany, are employed at the reactor. Another 100 people work at the fuel production facility. When completed in 1991, the nuclear centre is expected to employ some 1500 people.
Source: Indonesia Development News

Indonesia
Taxis on natural gas

A major programme to use Indonesia's abundant supplies of compressed natural

gas (CNG) to power automobiles and trucks is under way in Jakarta.

Presiding at the opening of the first of six CNG stations in the capital, Mines and Energy Minister Subroto said the project would reduce air pollution, help diversify the nation's energy resources, and provide a considerably cheaper energy choice for consumers.

Each of the stations will be able to accommodate 400 cars a day. Leading the way towards the replacement of gasoline by CNG is a Jakarta taxi company that has converted 100 of its 500 cabs for the use of natural gas at a cost of about $100 for each vehicle. The conversion kits are imported from the United States.

A spokesman for PT Bluebird, a private cab company, estimated that the cost of conversion would be recouped in one year because of the lower cost of CNG – $.11 per litre, compared with $.23 per litre for gasoline.

CNG stations are also being constructed in Cirebon and Bandung, West Java; Surabaya, East Java; Palembang, South Sumatra; and Medan, North Sumatra.

Indonesia, the world's largest exporter of natural gas, has reserves estimated at more than 250 trillion ft^3, of which only about 1.3 trillion ft^3 annually are either used for domestic purposes or exported as liquid natural gas.

Source: Indonesia Development News

Thailand
Increasing oil demand

Foreign and local operators of Thailand's oil refineries are gearing up for an increase in demand as the country's industrialisation proceeds apace. All four existing refineries plan to expand, and newcomers are manoeuvring to set up at least one additional refinery in the near future. For foreign firms, this will mean consultancy and construction deals and opportunities downstream. It also reaffirms Thailand's liberal attitude towards foreign investment and promising growth prospects.

Thai Oil will expand its refinery to raise capacity to 115 800 bpd by mid-1989. The contractors involved are all Japanese: Chiyoda Chemical Engineering and Construction, Marubeni, Mitsubishi, and Nichimen, but the project supervisor is Foster Wheeler of the UK. Thai Oil then wants to undertake a second-stage expansion to boost capacity to 148 500 bpd by 1992.

Bangchak Petroleum has begun rehabilitating its recently acquired refinery, which was in poor shape after years of neglect. The overhaul, now in the first phase, is due for completion in 1992. The consultant for this initial phase is UOP of the US, with Chiyoda as contractor. Bangchak is evaluating proposals submitted late last month for technology and design of the second and third stage distillation units. It will select the technical consultant in February and issue construction tenders in October. The output target for 1992 is 85 000 bpd.

In 1986, Thailand's four refineries' average utilised capacity was 186 393 bpd *vs* actual capacity of 194 000 bpd. Domestic demand for refined products is running around 240 000 bpd, thus requiring average imports of 54 000 bpd. By 1990, demand will reach 280 000-300 000 bpd. If the Thai Oil and Bangchak projects are completed on schedule, refined capacity should be sufficient (though there may still be a product imbalance), and growing demand in the early 1990s is unlikely to justify more than one new refinery. Another consideration influencing the Government's final decision will be the fate of the proposed National Petrochemical Corp Project II, the aromatics stream, which will require integration with a large oil-refining complex.

Source: SEAISI News

Oil/water
Flowing through Canada

Trials to demonstrate the feasibility of pipelining heavy oil-in-water emulsions have been been successfully concluded. TRANSOIL technology* was discovered in 1983 by scientists working in the United Kingdom as part of a fully collaborative research and development programme with INTEVEP of Venezuela. It is the subject of several patent applications. The TRANSOIL process uses controlled mixing of heavy oil with low concentrations of commercially-available surfactants to produce heavy oil-in-water emulsions. These emulsions contain oil droplets with a narrow and well-defined size range. This results in greater stability during long distance pipeline transportation, since there are no very large droplets which could settle out. As there are also no very small droplets, this unique technology allows easier separation of the oil from the water by the customer.

The process has been used during the second half of 1987 to produce emulsions at the Wolf Lake heavy oil field in Alberta. These emulsions have then been moved through a pipeline to a truck terminal at La Corey, near Bonnyville. Bonnyville.

Notable targets achieved during the testing programme included: 575 bpd of 65% heavy oil/35% water have been produced continuously for more than six days; 5900 barrels of emulsion have been transported along a 27 km pipeline without any changes to the emulsion; pipeline operation was restarted after the emulsion had been shut in the line for over 56 hours; A 1000 barrel batch of emulsion was transported along the pipelines between batches of sales-specification heavy oil/condensate blend; 6700 barrels of emulsion were stored in tanks without encountering any problems of emulsion stability or stratification.

Presently, the very viscous heavy oil can be shipped by pipeline, only if it is mixed with natural gas condensate to make it flow. With increasing demands on the supply of gas condensate, the technology is being developed to offer a cost effective alternative.

Source: BP

* By the TRANSOIL group – BP Canada, AEC Pipelines and BP Canadian Holdings

BOOKS *(continued)*

examines the present role of ALARA. The second and longest section covers Application and Implementation in nearly all aspects of the nuclear energy topic. Finally, updated methods and techniques are observed by a number of authors, including new criteria for cost-benefit analysis.

It does appear that judged by this book, optimisation is achieving a great deal in both the protection of the public and the environment, although no way has yet been found to allay the fears of the general public. It is so very often scientific terms which inhibit understanding.

An interesting book and to quote a phrase in its conclusion 'in science, truth never wins, never gets established; what happens is that all its opposition gradually fades away'. I, personally hope that in nuclear energy that is found to be so.

F John L Bindon

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LETTER

A diverse future

Lady Anglesea, in *Energy World* for January, considered that her role in ACTRAM and RWMAC (Advisory Committee on the Transport of Radioactive Materials and the Radioactive Waste Management Advisory Committee) is to ask or encourage the asking of the 'idiot questions'.

One idiot question not asked is why the insurance companies will not underwrite nuclear risks. Another is why Cecil Parkinson has to force nuclear power stations on to unwilling buyers.

Could not the answers be that the cost of compensation following a nuclear accident might be impossibly high and that the commercial return on investment in nuclear power is unreasonably low?

As Lady Anglesea says, our future energy policy should be based on a diversity of sources. Nuclear power, by absorbing nearly all the available research, development and support money, is seriously limiting that diversity.

HAZEL DUMPLETON

The Engineering Council *Plans to keep engineers & technicians up to date*

Qualified engineers of the 1990s will have their own personal record book to help ensure that they are keeping up to date with modern technology. This is one of the key features in a consultative document issued in January by the Engineering Council for its 300 000 Chartered Engineers, Technician Engineers and Engineering Technicians, industry, the professional engineering institutions and academia. The document *Continuing education and training: a national system for engineering** is jointly issued by the Engineering Council and the Department of Education and Science PICKUP† updating skills programme. The engineering institutions have been involved in its preparation through the Council's five executive group committees.

Its objective is to improve industrial competitiveness through a system in which individual engineers and technicians would be encouraged to draw up for themselves Career Action Plans. Those plans would set out how they would improve their current performance, anticipate future changes of role and generally enhance their professional development.

Career Action Plans would be undertaken with the help of their employers and their own professional institutions. Continuing education and training would be planned for a year or more ahead. They would use a variety of learning methods including open learning, in-house training, work experience, professional institutions' learned society activities and courses, and often involve further and higher education institutions.

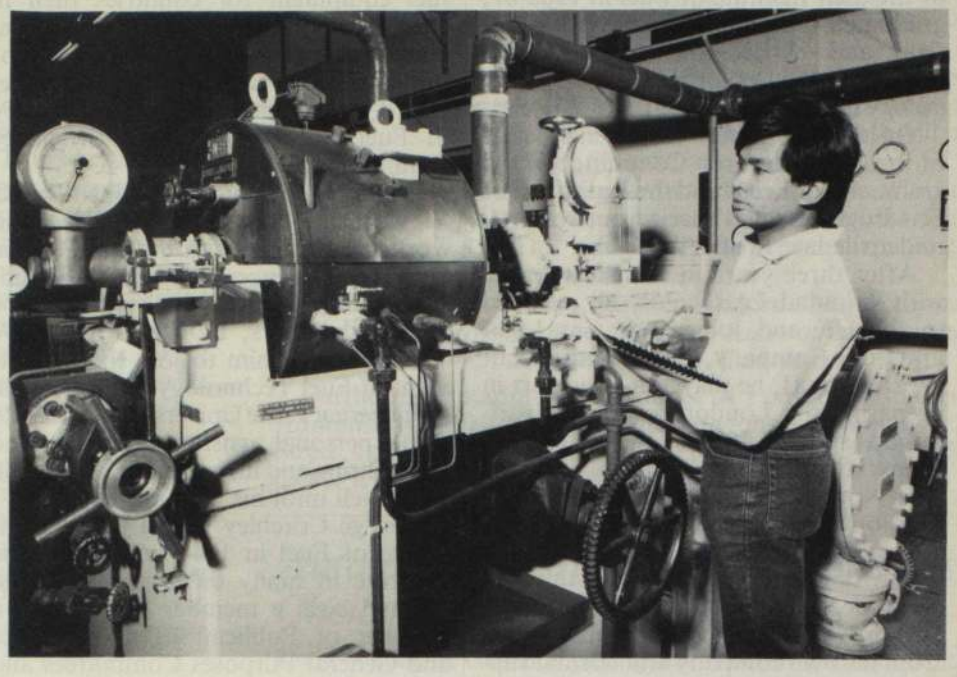
A series of pilot schemes, to test the ideas in the national system proposals, will start this year. Leading firms such as ICI, BP, Ferranti Defence Systems, Ove Arup and the Building Design Partnership have already expressed an interest in taking part. They will test the use of personal records by individuals and the monitoring and evaluating of continuing education and training. They will also explore ways in which this could become self-funding.

The far-reaching pilot schemes, to be funded initially by £170 000 over the next two and a half years from the Department of Education and Science PICKUP programme, will need support from a wide range of employers, trade unions, individual engineers and technicians, providers of education and training and professional engineering institutions. The aim will be that they should lead towards a comprehensive approach to continuing education and training for engineers and technicians on a voluntary basis. This is expected to become normal practice in the early 1990s.

The Engineering Council sees the potential benefits to individual engineers as: increased job satisfaction, career advancement and more earning power. And for employers: their workforce will be more capable both technically and managerially. Education providers will benefit by greater demand for their services and professional engineering institutions by an increased and better qualified membership.

* *Continuing education and training: a national system for engineering* available free from the Engineering Council, 10 Maltravers Street, London WC2R 3ER (tel 01-240 7891)

† PICKUP stands for Professional, Industrial and Commercial Updating Programme. It is helping Britain's colleges, polytechnics and universities to increase substantially the amount of training they provide to employers and their workforces, particularly in new skill areas and updating



J Sainsbury plc sponsors prize for MSc energy engineering course

The Institute of Energy's Annual Prize for the best overall performance in the MSc energy engineering course is now sponsored by J Sainsbury plc. This company is well known for its efforts in providing energy efficient buildings for its chain of supermarkets. The winner of this award is Manuel Soriano and the presentation is being arranged by the British Council representative in Manila. He is the senior industrial engineer in the Bureau of Energy Utilisation of the Office of the President of the Philippines. Projects for which he is currently responsible include the development of guidelines and policies for energy conservation in new buildings, building energy modelling, energy audits of industrial plant and lecturing on energy management seminars. Manuel is one of many former students from 25 countries in Africa, Asia, Central and South America and Europe who hold responsible positions in government departments, research centres, industry and universities. The photograph shows Manuel Soriano in the Energy and Thermodynamics Laboratory at the University of Surrey

Careers in engineering for girls

A handy booklet which lists details of national awards, courses, talks and visits designed to encourage girls to consider careers in engineering and technology has been published by the Engineering Council.

The booklet**, which covers opportunities from a year's course on technology to a half-day event on electronics, is part of the Women Into Science and Engineering (WISE) campaign run by the Engineering Council and the Equal Opportunities Commission. The four-year-

** The booklet *Women into science and engineering – awards, courses and visits* can be obtained from the Engineering Council, 10 Maltravers Street, London WC2R 3ER (tel 01-240 7891)

Obituary

G N CRITCHLEY

G N Critchley (Senior Fellow), president of the then Institute of Fuel in 1966-67, graduated from the University of Sheffield and carried out post-graduate research in the Department of Fuel Technology under the late Prof R V Wheeler.

On leaving Sheffield he joined the staff of the Joint Research Committee of the University of Leeds and the Institution of Gas Engineers and carried out research under the late Prof J W Cobb.

After three years in the West Indies with Trinidad Leaseholds, he returned to the UK and joined the Gas Light and Coke Company. On the outbreak of World War II, he played a large part in preparing the London town gas distribution system against the effects of enemy air attack.

In November 1940, after the heavy air raid on Coventry, Mr Critchley was seconded to that city to restore some kind of town gas supply. He achieved this with great success in a remarkably short time. He borrowed 120 experienced mainlayers from his own company and normal supplies were quickly restored. In Coventry official tribute was paid for his work *'in overcoming what seemed insuperable difficulties'*.

In August 1941 he was again seconded by the Gas Light and Coke Company, at Government invitation, to the Ministry of Supply to organise and direct a department responsible for fuel and fuel equipment in the wide range of factories working for that Ministry. Other Government work included the chairmanship of the Inter-Allied Committee which planned fuel equipment for countries then in enemy occupation, on their liberation. He was also head of the Gas Division of the Combined Production and Resources Board and a member of the Ministry of Fuel and Power's Fuel Efficiency Committee.

On completing his Government work, he went into consulting practice and worked for a time with the late Captain Gregson at Spencer-Bonecourt, the subsidiary of Babcock's making fire-tube packaged boilers. In 1962 Prof M W Thring invited him to join the Department of Fuel Technology and Chemical Engineering at the University of Sheffield as his personal assistant and he served Prof Thring and his successor, Prof John Beér, well until his own retirement.

George Critchley joined the then Institute of Fuel in 1944 and served the Institute in many different capacities. He had been a member of Council, a member of Publications and Finance and General Purposes Committees and chaired Publications Committee from 1960 to 1966. He was elected a vice-president in 1964 and was president in 1966-67. He also served on the Fuel Abstracts Panel for two years and was chairman of the organising committees for six of the Institute conferences between 1945 and 1965.

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old campaign has already resulted in more women studying engineering and technology at universities and polytechnics. Now one in 10 engineering students are women.

Dr Kenneth Miller, director general of the Engineering Council, said: *'WISE has brought home to girls, their parents and teachers that engineering offers a worthwhile, satisfying career. It offers excellent prospects for employment and job satisfaction. Our new booklet provides some stepping stones in the way of courses, awards and visits towards learning more about engineering careers'.*

The Fellowship of Engineering

MacRobert Award

The MacRobert Award consists of a Gold Medal and a prize of £25 000. It is given for an outstanding contribution by way of innovation in engineering or the physical technologies or in the application of the physical sciences, which has enhanced, or will enhance, UK prestige and prosperity.

The Award was instituted by the MacRobert Trusts in 1968 with the aim of honouring individuals or small teams of individuals. The MacRobert Trusts were founded by Lady MacRobert of Douneside and Cromar, wife of Sir Alexander MacRobert Bt, head of the British India Corporation.

The Award is administered and bestowed annually on behalf of the MacRobert Trusts by the Fellowship of Engineering. *Submissions are invited by 1 May for the 1988 Award.* Rules and conditions from the MacRobert Award Office, Fellowship of Engineering, 2 Little Smith Street, London SW1P 3DL (tel 01-222 2688).

New members

Fellow

Laurence George Britton, Union Carbide Corporation, USA *(transfer)*
Charles Edward Pugh, *(transfer)*

Member

Andrew Neill Brooks, Ove Arup & Partners, London
Stephen Anthony Cooke, T Dunwoody & Partners, Harrow, Middlesex
Kassiap Deepchand, University of Mauritius
Robin Tudor Griffiths, Cambridge Engineering Consultants, Cambs
Greatrex St John Hawkes, Barker Hawkes Partnership, London *(transfer)*
Andrew Peter Hill, Babcock Energy, London
Martyn Christopher Ingham, South Wales Electricity, Cardiff
Kam Bor Lam, China Light & Power, Hong Kong
Peter Alexander Lachlan Macleod, Marks & Spencer, London *(transfer)*
Nicholas Adrian Purdon, BP Energy, Uxbridge, Middlesex
Michael John Shilston, Cornwall County Council
Abdul Samad Tariq, Marconi Underwater Systems, Waterlooville, Hants

Associate Member

Glyn Clifford Kemzura, British Gas, North Thames, Brentwood *(transfer)*

Associate

Anthony Colin Wild, Emstar, Altrincham, Cheshire

Graduate

Katherine Finikopoulos, University of Birmingham
Tony Eric Grainger, Robb & Associates, Newcastle upon Tyne.
Ania Maria Wanda Grobicki, Imperial College, London
John Edward Kingsland, Ocean Energy Services, Birmingham
John Maxwell, Dyer Warner Partnership, Leicester
Tania Moore, Industrial Sales & Marketing, British Coal, Warrington
Simon Charles Peskett, BNSC Division, Rutherford Appleton Laboratory, Didcot *(transfer)*
Michael Round, NIFES, Birmingham *(transfer)*
Henry Dumsani Shongwe, Bolton Institute of Higher Education
Fraser Wigley, Dept of Materials, Imperial College, London

Collective

Northern Engineering Industries, Regent Centre, Newcastle upon Tyne.

Institute of Energy

1988 Branch conferences

North-Western

23 and 24 Mar (W and Th). Conference: *Energy for the future,* Royal Insurance Building, Liverpool.

South Coast

8 Sept (Th). One-day symposium: *NO_x generation and control in boiler and furnace plant.* The Crest Hotel, Southsea. In association with the Combustion Institute (UK section).

1988 April meetings

Midland

7 Apr (Th). Cogeneration on a multi-fuel site, by S Hope (The Boots Co). University of Aston in Birmingham, Senior Common Room at 1900 h.

Merseyside

13 Apr (W). AGM, Feathers Hotel, Mount Pleasant, Liverpool 3 at 1830 h.

Yorkshire

13 Apr (W). AGM. AHED House, Ossett at 1430 h.

(Continued on p22)

The greenhouse effect and the energy industries: London, 14 April 1988

The Watt Committee on Energy and the Institute of Energy are holding a small one-day symposium at the Institute of Energy, 18 Devonshire Street, London on Thursday 14 April to discuss informally what interest the energy industries should be taking in the present debate as to the possible effects of the build-up of carbon dioxide and other gases in the atmosphere. Present expert opinion on the build-up of these gases and their possible effect on climate and environment will be summarised and it is intended that this will lead to a discussion as to the possibilities for limiting these emissions and the likely economic and other 'end-on' consequences that will result. The possible role that the Watt Committee could take in the subsequent debate will be considered.

There will be a charge of £6 per delegate to cover the cost of a sandwich and wine lunch. Space limitations will mean that attendance will be strictly restricted to those with a direct interest in the subject and will be by invitation only.

If anyone feels he/she should be at this meeting and has not been invited already, he/she should write to: Dr G G Thurlow, Eastcott House, 24 Alexandra Road, Malvern, Worcestershire WR14 1HQ. Cheques payable to Institute of Energy.

Annual luncheon

The annual luncheon of the Institute of Energy will be held at the Inn on the Park, Hamilton Place, Park Lane, London W1 on Tuesday 26 April 1988 at 1230 h for 1300 h. The principal guest and speaker will be the *Rt Hon Cecil Parkinson* MP, Secretary of State for Energy.

An application form for company tables and individual tickets was enclosed, as a loose insertion, in the January issue of Energy World.

ASME: Steam generators and related auxiliaries

The *1988 Joint Power Generation Conference* will be held in Philadelphia from 25-29 September 1988.

Papers are invited on the following topics:

- ☐ *Life extension.*
- ☐ *Fluidised bed combustion.*
- ☐ *Municipal solids waste.*
- ☐ *Cogeneration.*
- ☐ *Steam generator design for smaller modular power plants.*

People who are interested should write to Colin R Coleman, 7 Rowlls Road, Kingston-upon-Thames, Surrey KT1 3ET (daytime tel 01-211 3542).

Anyone who is interested in *Lignite* is also invited to contact Colin Coleman with a view to submitting papers for the *1989 Joint Power Generation Conference.*

College of Petroleum Studies courses: Oxford, April/May 1988

The College of Petroleum Studies, Oxford include the following courses in their spring calendar.

18-22 April	A five-day course in Oxford. *Petrochemical markets and economics – the impact of feedstocks and costs on competitiveness and business strategy.* Course code CH1. This course will be repeated on 23-26 October 1988.
25-29 April	A five-day course in Oxford. *Creative international trading in crude oil and petroleum products.* Course code TR1. This course will be repeated on 17-21 October 1988.
3-6 May	A four-day course in Oxford. *A foundation course in petrochemical technology and economics.* Course code CH0. This course will be repeated on 23-26 October 1988.
9-13 May	A five-day course in Oxford. *Trends, developments and economics in retail petroleum markets.* Course code RM1. This course will be repeated on 5-9 September 1988.
15-18 May	A four-day course in Oxford. *The creative use of oil futures in physical trading.* Course code TR3. This course will be repeated on 20-23 November 1988.
23-27 May	A five-day course in Oxford. *Major capital projects in oil and gas – development, evaluation and management.* Course code PL1.

Further information from College of Petroleum Studies, Administrative Offices, Sun Alliance House, New Inn Hall Street, Oxford OX1 2QD (tel Oxford (0865) 250521; tlx 838950 COLPET-G *or* 83147 VIAOR Ref COLPET).

Automated methods for coal analyses: Cheltenham, 19 May 1988

Users of coal are currently paying more attention to the quality of their feedstock and consequently the number and complexity of coal analyses required are increasing. There is concurrently a general move in industry to reduce service staff. These are the classical conditions that promote the consideration of automation. Much automatic equipment for coal analysis is already installed but there have been many problems in reliability and acceptance of results in lieu of BS tests. This meeting by the IChemE Coal Utilisation Subject Group has been called to review the situation and provide a forum for discussion between users and manufacturers of automatic coal analysers.

Programme	
0900 – 1000	Registration
1000 – 1020	Introduction: *The case for automatic coal analysis.* Dennis Page (BCC).
1020 – 1040	*What is available today – the state of the art.* Dr John Graham (CEGB).
1040 – 1100	Discussion on opening talks.
1100 – 1115	*Coffee.*
User forum	
1115 – 1135	*Gas industry.* Alan White (BG, Solihull).
1135 – 1155	*Electricity.* John Brown (CEGB).
1155 – 1215	*Iron and steel.* A Cunningham.
1215 – 1235	*British Coal.* N Finch.
1235 – 1315	User/manufacturer discussion.
1315 – 1430	*Lunch.*
1430 – 1450	*Application of nuclear techniques in coal analysis.* M Wormald (Harwell).
1450 – 1510	*New analytical requirements.* J Gyllenspetz (CEGB).
1510 – 1540	Final discussion and need for future meetings in coal analysis.
1540 – 1600	CUSG business.
Fee:	£25 for CUSG Members; £30 for non-CUSG Members.
Registration:	J Tayler, Conference Section, IChemE, 165-171 Railway Terrace, Rugby CV21 3HQ.

Institute of Petroleum: Information for Energy Group

The Information for Energy Group of the Institute of Petroleum provides a forum for those interested in information and the energy industries. It arranges meetings and

(Continued on p22)

Special announcements *(continued)*

seminars for the exchange of views and information and for making contacts.

Meetings for 1988 include:

Visits to: *British Geological Survey,* Keyworth, Nottingham, 25 May.
Atomic Energy Research Establishment, Harwell, 12 July.

Evening meeting: *Californian wind power,* talk and video, 14 April.

One-day conference: *Documentation control in the energy industries,* 18 October.

IFEG welcomes new members – a £5 subscription fee is all that is required to join. Those interested in joining the group are invited to contact: Jean Etherton, Institute of Petroleum, 61 New Cavendish Street, London W1M 8AR (tel 01-636 1004).

Call for papers:

1. CIMAC 1989, China, 5-8 June 1989

CIMAC is a world-wide technical association which promotes and facilitates the development of expertise in all aspects of the design, construction and use of diesel engines and gas turbines. The 18th congress will be held in Tianjin, China, between 5 and 8 June 1989.

Main themes

As usual, the congress papers will relate to both internal combustion engines and gas turbines.

(a) Diesel engines

- ☐ Reliability, availability and maintainability.
- ☐ Engine management and monitoring systems.
- ☐ Pollution with particular reference to emissions.
- ☐ Noise and vibrations.

(b) Gas turbines

- ☐ Development of new, high-efficiency gas turbines.
- ☐ Gas turbines in combined cycles and cogeneration-development and experience.
- ☐ The role of gas turbines in an integrated energy system.
- ☐ Computational analysis applied to gas turbine technology.

However, papers on significant developments which do not fall within these themes will also be considered. Papers proposed by manufacturers of engines, components and auxiliary systems; by engineers; and by researchers may also report, in a clear and concise way, important new discoveries resulting from a high level of research and development.

Synopses from UK-based authors must be received by *22 April 1988* by British National Committee of CIMAC, Forbes House, Halkin Street, London SW1X 7DS (tel 01-235 7000; fax 01-235 7112).

2. Multi-phase flow, London, 19-21 June 1989

BHRA, the Fluid Engineering Centre, will hold their fourth international conference on *Multiphase flow* in London from 19-21 June 1989. Offers of papers are invited on all aspects of multiphase flow including: operational experience; flow prediction and modelling; measurement, instrumentation and control of multiphase flows; separation systems; pigging; prediction and treatment of hydrates, wax and emulsions; and future needs and developments. Titles and synopses should be submitted as soon as possible to the conference organiser (MPF), BHRA, Fluid Engineering Centre, Cranfield, Bedford MK43 0AJ (tel (0234) 750422; tlx 825059).

Sponsorship for MIDEST 88: Lyons, 24-28 October 1988

The British Overseas Trade Board has granted joint venture terms, with the Engineering Industries Association as co-sponsor, for a British group at *MIDEST 88,* in Lyons, France, 24-28 October 1988.

Regarded as Europe's principal subcontracting event, *MIDEST LYONS,* the international market for subcontracting, is held on alternate years with *MIDEST PARIS.* The exhibition has grown with successive years and includes metal processing, plastics and rubber, electrical/electronic equipment and semi-finished products. For the third time *MIDEST* will incorporate *EURODESIGN* which is an industrial design exhibition stressing the importance of design in the subcontracting industry.

Space and stand costs at *MIDEST* are subsidised by the British Overseas Trade Board by up to 60%. At *MIDEST 87,* the all-in cost to joint venture exhibitors was £52 per square metre.

Applications to exhibit in the joint venture should be made before *6 May 1988.* Further information from Anna Small, Engineering Industries Association, 16 Dartmouth Street, Westminster, London SW1H 9BL (tel 01-222 2367).

☐

Scottish

13 Apr (W). *1815 h:* AGM; *1930 h:* annual dinner. Royal Scottish Automobile Club, Blythswood Square, Glasgow.

East Midlands

15 Apr (F). Annual dinner. George Hotel, Nottingham.

National

26 Apr (Tu). Annual luncheon. Inn on the Park, Hamilton Place, Park Lane, London W1 (nearest underground, Hyde Park Corner) at 1230 for 1300 h. Principal guest and speaker: Cecil Parkinson MP (Secretary of State for Energy).

East Midlands

27 Apr (W). Works visit to John Player, Nottingham followed by AGM.

Personal

D G Hugh (Member) has been appointed a director of Foster Wheeler Power Products with responsibility for the company's sales and marketing activities.

He joined Foster Wheeler Power Products in the Design Department in 1967. In 1968 Mr Hugh joined the Sales Department and in 1974 was appointed to the Board of Quality Inspection Services – an independent subsidiary company of Foster Wheeler Power Products.

He was appointed export sales and marketing director in 1979 and, in 1980, was elected a vice-president of Foster Wheeler International Corporation. He was appointed director of Sales and Marketing (Industrial) last year and retains these responsibilities with his present appointment

He is also a Member of the Institution of Mechanical Engineers, Institution of Civil Engineers and of the Institution of Marine Engineers.

Lord Caithness, Environment Minister, has appointed **David Pounder** as the Environmental Protection Technology (EPT) adviser. Mr Pounder will be responsible for managing the EPT scheme which will promote new methods of abating pollution, including the use of clean technologies. The appointment will be for two years. Mr Pounder is on secondment from ICI Chemicals and Polymers, where he has been new business leader (Environmental).

Mr Pounder will be responsible for the operation of the EPT Unit in the Department and will oversee the work of the EPT Group at Warren Spring Laboratory, who are supporting DOE in the scheme.

Sir Denis Rooke CBE FRS FEng (Honorary Fellow) and **Dr A Kelly** FRS FEng attended the annual meeting of the National Academy of Engineering in Washington DC in October when they were inducted as foreign associates of the NAE. Sir Denis is president of the Fellowship of Engineering.

Vilnis Vesma (Member) has been appointed as a retained consultant to Oak-

(Continued on p23)

REGISTER OF ENERGY COURSES

Course No 00-385

Title: Coal technology and utilisation.
Duration: 5 days.
Location: University of Sheffield.
Starting: 17 April 1988.
Content: Nature and classification of coal. Coal preparation. Visit to coal preparation plant. Coal combustion. Pollution – origins and control. Coal pulverisation. Pf boiler design. Visit to Ferrybridge power station. Industrial usage of coal. Coal storage and handling. Carbonisation. Visit to Avenue coking plant. Fluidised bed technology. Gasification and liquefaction. Visit to fluidised bed installation. Coal economics. International coal trade.

Course No 00-386

Title: Chemical engineering for scientists.
Duration: 5 days.
Location: University of Bradford.
Starting: 18 April 1988.
Content: Introduction. Material balances. Energy balances. Mass and energy balances. Basic concepts of fluid flow. Simple fluid transfer systems. Liquid mixing. Safety and loss analysis. Process heat transfer. Heat loss calculations. Heat transfer equipment. Basic mass transfer. Gas absorption. Basic heat transfer, mass transfer and pressure drop calculations. Solvent extraction. Binary distillation. Liquid-solid systems. Solid liquid separation. Reactor design. Powder technology. Process economics. Instrumentation and control.

Course No 00-388

Title: Water treatment for air conditioning and heating engineers.
Duration: 3 days.
Location: Polytechnic of the South Bank, London.

Course No 00-388 (continued)

Starting: 18 April 1988.
Content: Basic instruction on the harmful impurities present in water supplies. Guidance on spotting likely problem areas. Scale, corrosion and organic fouling in heating and air conditioning systems.

Course No 00-389

Title: Fundamentals of lighting design.
Duration: 3 days.
Location: Polytechnic of the South Bank, London.
Starting: 19 April 1988.
Content: Vision, units, basic calculations. Light sources and luminaires. Design of electric lighting installations.

Course No 00-387

Title: Conditions of contract for process plant.
Duration: 1 day.
Location: Institution of Chemical Engineers, London.
Starting: 19 April 1988.
Content: General conditions of contract. Model conditions of contract. Variations. Delay. Guarantees. Safety.

Course No 00-390

Title: Computerised drafting for building services.
Duration: 1 day.
Location: Polytechnic of the South Bank, London.
Starting: 21 April 1988.
Content: The course is designed to give practising building services engineers experience in the use of computerised drafting systems as a part of the design process.

Course No 00-381

Title: Arbitration, practical procedures.
Duration: 1 day.
Location: CIBSE, London.
Starting: 22 April 1988.
Content: A guide through the arbitration process from the decision to go to arbitration to the award.

Course No 00-391

Title: Advanced air conditioning system design.
Duration: 3 days.
Location: Polytechnic of the South Bank, London.
Starting: 25 April 1988.
Content: Advanced psychrometry. Part-load operation of air conditioning systems and the prediction of annual running costs. The interpretation of building heat loads, and simulation of systems performance. Predicting the steady-state and dynamic performance of air conditioning plant and systems. New applications and trends. Future trends in air conditioning.

Course No 00-382

Title: Boiler selection control and performance.
Duration: 1 day.
Location: Heriot-Watt University, Edinburgh.
Starting: 28 April 1988.
Content: Boiler construction and characteristics: firing methods – oil, gas, coal and dual fuel. Combustion air provision and control. Chimneys and flues. Factors affecting performance. Boiler control.

Course No 00-392

Title: Refrigeration for maintenance engineers.
Duration: 2 days.
Location: Polytechnic of the South Bank, London.
Starting: 28 April 1988.
Content: Basic principles of vapour-compression refrigeration, refrigerant characteristics, types of plant components and associated maintenance problems. Testing, dehydrating, leak detection and refrigerant charging procedures.

□

Institute news *(continued)*

wood Associates, the Cheltenham-based Mechanical and Electrical Building Services Consulting Engineers. Under their agreement Mr Vesma will advise the Oakwood Board on matters of general, technical and business policy, as well as participating in the engineering of specific projects.

Vilnis Vesma, an Oxford graduate Chartered Engineer, has previously led energy conservation teams for the London Borough of Lambeth and Gloucestershire County Council, and is a former Council Member and staff member of the Institute of Energy. He has written and lectured on energy efficiency, and is an acknowledged expert on microcomputer applications. His book *Managing energy with a desk-top computer* is shortly to be published by Energy Publications (Cambridge).

Sir Frederick Warner FRS FEng (Melchett Medallist) is one of the first recipients of the new pan-European title 'European Engineer', conferred by the European Federation of National Engineering Associations (FEANI).* He was presented with his certificate on 28 October 1987 in Paris by M. Alain Poher, President of the French Senate.

* See page 10, this issue

CONFERENCES

The following conferences, courses and meetings are organised by bodies other than the Institute of Energy. For Institute conferences please see inside back cover

April 1988

Energy and the future

Exhibition, symposium and conferences. Jönköping, Sweden, 11-16 April 1988.
Details from Westrade Fairs, 28 Church Street, Rickmansworth, Herts WD3 1DD (tel 0923 778311).

Microclimate and the environmental performance of buildings

BRE seminar, Garston, 19 April 1988.
Details from Mrs Patricia Rowley, Building Research Establishment, Garston, Watford WD2 7JR (tel Garston (0923) 674040).

Steam compression in the process industries

Seminar and exhibition, Aberdeen, 19-20 April 1988.
Details from British National Committee for Electroheat, 30 Millbank, London SW1P 4RD (tel 01-834 2333 ext 6339; tlx 23385 and 261130).

May 1988

Combustion fundamentals and applications

Spring technical meeting, Indianapolis (IN, USA), 2-3 May 1988.
Details from Dr S M Shanhed, Mailcode 50182, Cummins Engine Company, PO Box 3005, Columbus, IN 47202, USA.

Measurement of toxic and related air pollutants

Symposium, Raleigh (NC, USA), 2-4 May 1988.
Details from APCA, PO Box 2861, Pittsburgh, PA 15230, USA (tel (412) 232-3444).

Atmospheric ozone research and its policy implications

Third US-Dutch international symposium, Nijmegen (The Netherlands), 9-13 May 1988.
Details from Mrs O van Steenis, RIVM, PO Box 1, 3720 BA Bilthoven, The Netherlands (tel (0) 30-742970; tlx 47215 rivm nl; fax (0) 30-742971.

The remote sensing of oil slicks

Symposium, London (Institute of Petroleum), 17-18 May 1988.
Details from Caroline Little, conference officer, Institute of Petroleum, 61 New Cavendish Street, London W1M 8AR (tel 01-636 1004; tlx 264380; fax 01-255 1472).

The future role for oil in the energy spectrum

RSA Cadman Memorial Lecture, by B Reid (chairman and chief executive, Shell UK). London (Royal Society of Arts), 18 May 1988 at 1800 h. *Admission free but please apply in advance to the RSA.*

May 1988 (continued)

Details from, and applications to, office of: Penny Egan, Lectures, Royal Society of Arts, 8 John Adam Street, London WC2N 6EZ (tel 01-930 5115).

The Mersey barrage project

Lecture by representative from Mersey Barrage Company. Ladbroke Hotel, Chester, 20 May 1988.
Details from Institution of Electrical Engineers, Savoy Place, London WC2R 0BL (tel 01-240 1871; tlx 261176; fax 01-240 7735).

Condition monitoring

Second international conference, London, 25-27 May 1988.
Details from Conference Department, BHRA, Fluid Engineering Centre, Cranfield, Bedford MK43 0AJ, UK (tel (0234) 750422; tlx 825059 BHRA G).

June 1988

Flash reaction processes

Fourth annual conference, Salt Lake City (UT, USA), 9-10 June 1988.
Details from Dr D G C Robertson, Centre for Pyrometallurgy, Fulton Hall, University of Missouri-Rolla, Rolla, MO 65401-0249, USA.

International trade fair

Poznan, Poland, 12-19 June 1988.
Details from Sarah Nightingale, Exhibitions Department, 69 Cannon Street, London EC4N 5AB (tel 01-248 4444; tlx 888941).

Waste & recycling 88

Exhibition and conference, Jönköping (Sweden), 13-17 June 1988.
Details from *ELMIA Waste & recycling 88,* Westrade Fairs, 28 Church Street, Rickmansworth, Herts WD3 1DD (tel 0923 778311; tlx 296689; fax 0923 776820).

July 1988

Cremation Society of Great Britain

61st annual conference, Eastbourne (Grand Hotel), 13 and 14 July 1988.
Details from Cremation Society of Great Britain, 2nd floor, Brecon House, Albion Place, Maidstone, Kent ME14 5DZ (tel Maidstone (0622) 688292/3).

August 1988

Liquid atomisation and spray systems

Fourth international conference, Sendai (Japan), 22-24 August 1988.
Details from Steering Committee, ICLASS-88, c/o Fuel Society of Japan, 5-4 Sotokanda 6-chrome, Chiyoda-ku, Tokyo 101, Japan (tel (03) 8346456).

Gas cleaning

CSIRO conference, Sydney (Australia), 22-26 August 1988.

August 1988 (continued)

Details from C A J Paulson, CSIRO Division of Fossil Fuels, PO Box 136, North Ryde, NSW 2113, Australia (tel (02) 887 8666; tlx AA 25817; fax (02) 887 8909).

August/September 1988

COGEN – TURBO

ASME international symposium and exhibition on turbomachinery, combined-cycle technologies and cogeneration. Montreux (Switzerland), 30 Aug-1 Sept 1988.
Details from International Gas Turbine Institute, 4250 Perimeter Park South, suite 108, Atlanta, GA 30341, USA (tel (404) 451-1905; tlx 707340).

September 1988

Uranium

Uranium Institute thirteenth annual symposium, London, 7-9 September 1988.
Details from secretary general, Uranium Institute, 12th floor, Bowater House, 68 Knightsbridge, London SW1X 7LT (tel 01-225 0303; tlx 917611 URINST G).

Condition monitoring and diagnostic engineering management

Informal seminar, City of Birmingham Polytechnic, 19-21 September 1988.
Details from Dr Raj B K N Rao, Department of Mechanical and Production Engineering, City of Birmingham Polytechnic, Perry Barr, Birmingham B42 2SU (tel 021 331 5000).

Petroleum

Asia-Pacific petroleum conference and exhibition, Singapore, 19-21 September 1988.
Details from conference manager (APPEC), Times Conferences plc, 19 Tanglin Road, No 12-02, Tanglin Shopping Centre, Singapore 1024 (tel 7349385/2355222; tlx RS 40113 ATT; fax 7379027).

September 1989

Energy for tomorrow

14th WEC congress, Montreal (Canada), 17-22 September 1989.
Details from British National Committee, World Energy Conference, 34 St James's Street, London SW1A 1HD (tel 01-930 3966; tlx 264707 WECIHQ G; fax 925 0452).

Course (overseas)

Closed feedwater heaters. Amsterdam (The Netherlands), 2-5 May 1988.
Details from Centre for Professional Advancement, Department NR, Palestrinastraat 1, 1071 LC Amsterdam, The Netherlands (tel 020/62.30.50; tlx 10662 (cfpa nl).