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The president

Continuing the good work

Being president certainly means a busy time and during the last few months a lot seems to have happened. In September I attended a symposium in Portsmouth organised by the South Coast Branch on *NO_x generation and control in boiler and furnace plant*. Clearly, after the Prime Minister's recent statement on the environment, the subject was very topical and I felt that the meeting, run in collaboration with the Combustion Institute (British Section) hit the right note and contained much high quality information both on NO_x generation during combustion and subsequent control.

During October I chaired the first one-day conference and exhibition on *Energy efficiency in buildings*. This was held in Newcastle and was organised by the North East branch of the Institute of Energy together with the Chartered Institute of Building Services Engineers. The conference proved to be excellent and continues the good record of the Institute of Energy in the region in proposing the wise use of energy. The papers reviewed the key points that designers must keep in mind when designing buildings and also reviewed some of the problems which have emerged and offered some possible solutions. Many projects were reviewed and evaluated together with the financial benefits that result. Modern methods of control using the electricity mains as the carrier system were discussed.

The Council of the Institute of Energy and the Executive Committee have given careful thought to the Benevolent Fund and in July decided on a new approach to the problem. The fund has good reserves and a steady income from donations and investments but virtually no requests for assistance have been received. In the past appeals have been made for information about deserving cases through branch officials, in the pages of *Energy World* and elsewhere but without success. It was therefore

Continued overleaf

decided to send a letter to retired members enclosing a cheque for £10 drawn on the Benevolent Fund Account. Retired members were also asked to decide for themselves whether to cash the cheque or not, and to inform us if they felt that the money could be used for younger members, especially research students.

The response was overwhelming, in fact I have read just over 200 replies. Many of them were constructive and a great deal of natural humour emerged. Many members returned the cheques, some made donations and some cases of need were identified and are now being followed up. There was general support for helping students providing that it was carefully controlled and did not deprive older members of the benefits of the fund. Many felt that the Retired Member subscription rate was too high, that the fund should seek out those members who had allowed their subscription to lapse through possible hardship and dependants of deceased members.

I would draw your attention to the fact that CREATE has been in operation and established at

Devonshire Street for several months. CREATE is the Centre for Research, Education and Training in Energy and is charged by the Department of Energy and the Institute of Energy with encouraging education in all aspects of energy from production through to use. This is an exciting new departure for the Institute and is an extension of our activities. (See page 11 — CREATE — a new role for the Institute of Energy.)

As president I have represented the Institute at many functions and have taken the opportunity of discussing with other Institutions the future of Chartered and Incorporated Engineers as we approach 1992. This is a subject that all the Institutions need to address, and one that all members must consider, especially now as we move into the New Year, another year closer to 1992. On that note may I take this opportunity to wish all members of the Institute of Energy and their families a happy Christmas and a prosperous New Year.

C E Pugh CBE

President of the Institute of Energy

Are you missing out on the Journal?

The *Journal* of the Institute of Energy is published quarterly and is optionally available to members of the Institute of Energy wishing to receive it. (To those outside of membership it is available on subscription jointly with *Energy World*: price £102.00.)

December issue:

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CHP/DH: the Belfast case

Prof B Crossland CBE FEng FRS and D Watmuff

Combined heat and power (CHP) could provide a competitive, convenient and clean source of heat for Belfast. It could save the consumption of the equivalent of 150 000 t of coal a year and lead to a significant reduction in harmful emissions. It could also be a convenient way of utilising the Northern Ireland lignite resource while other sources of waste heat, for example from industry, could be utilised. Environmental problems posed by dumping of waste could also be reduced through the use of domestic refuse as a fuel

The basic principles of CHP are well established and practised in the process industries in the UK. But, unlike some countries, the application to provide district heating for our cities, CHP/DH, has not been exploited in the UK.

Fig 1 shows the separate generation of electricity and heat, as at present practised, for a situation where the heat load is 50% greater than the electrical load. It has been assumed that the overall efficiency of electrical generation including transmission losses is 32%, while the thermal efficiency of heat generation is taken as 65%. This results in an overall conversion of the heat content of the fuel used in the generation of electrical and thermal power of 46%, whereas for the CHP/DH scheme, depicted in Fig 2, the overall efficiency is 64.7%, having allowed for some reduction of

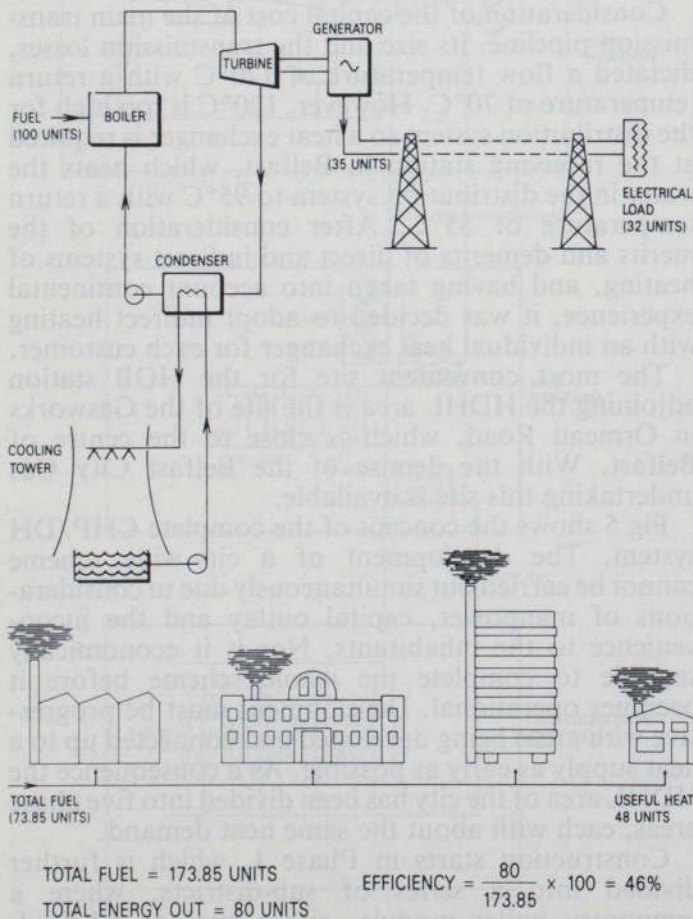


Fig 1: Separate power and heat generation systems.

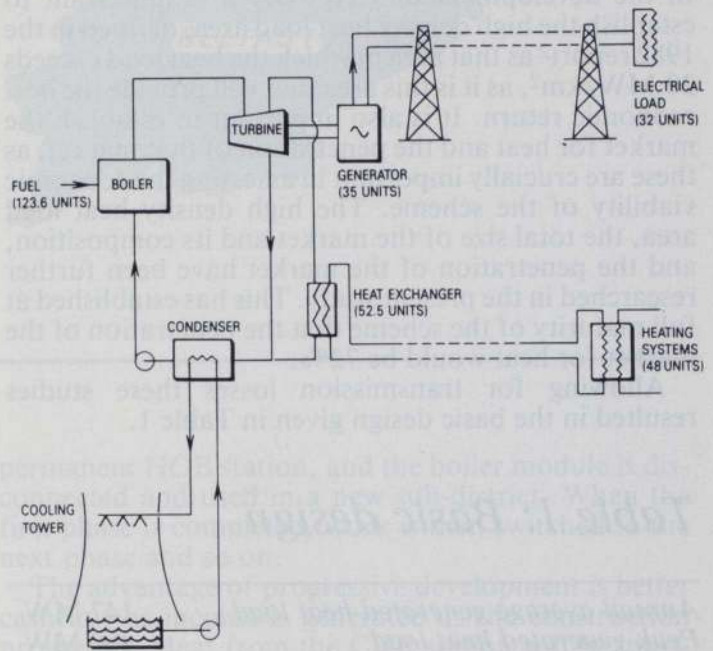


Fig 2: Combined heat and power system.

electrical output as a consequence of extracting some steam from the turbine before it is fully expanded.

From these figures it is important to note that even on full load the overall efficiency is raised not from 32% to 64.7%, but from 46% to 64.7%. This would lead to a 28.9% reduction of fuel consumption. However, taking into account the variation of heat demand throughout the year, the average gain in efficiency will be less.

The potential advantages of CHP/DH for inner cities has been studied by the Marshall Committee¹, which reported in 1979. As a result of this report the Department of Energy commissioned a study of nine cities by W S Atkins & Partners, who reported in 1982². One of the conclusions was that Belfast potentially offered the highest rate of return of the cities studied, mainly because of the absence of natural gas.

On April 1984 the Government announced that they would provide support of up to £250 000 on a 50/50 basis for up to three UK cities, which would be chan-

nelled through consortia of private and public bodies. On 25 January 1985 it was announced that grants would be provided to three consortia in Belfast, Edinburgh and Leicester.

The Belfast Joint Venture had the following membership: Associated Heat Services, Fairclough Scotland, Harland and Wolff, Mainmet, Northern Engineering Industries, Northern Ireland Electricity, Press Construction, and the Ulster Investment Bank. Though the Belfast City Council could not be a member for constitutional reasons, it provided a substantial financial contribution. The Joint Venture had an independent chairman, Prof B Crossland, and the project manager was D Watmuff of Harland and Wolff.

The market for heat

In the development of CHP/DH it is important to establish the high density heat load area, defined in the 1982 report² as that area in which the heat load exceeds 20 MW/km², as it is this area that will provide the best economic return. It is also important to establish the market for heat and the penetration of that market, as these are crucially important in assessing the economic viability of the scheme. The high density heat load area, the total size of the market and its composition, and the penetration of the market have been further researched in the present study. This has established at full maturity of the scheme that the penetration of the market for heat would be 72%.

Allowing for transmission losses these studies resulted in the basic design given in Table 1.

Table 1: Basic design

Annual average generated heat load	147 MW
Peak generated heat load	460 MW
Annual heat generated	1290 GWh

Design of the CHP/DH scheme

The variation of heat load during the year is considerable, as shown in Fig 3, as there is no major process industry in the vicinity of Belfast that would provide a significant base load. It would be uneconomic to install CHP heat capacity for the short duration peak loads, and these will be provided by CHP heat supplemented by heat alone boilers (HOBs) and some heat storage capacity.

Various options for the siting of the CHP station were considered, including a reconstructed Belfast West power station, but it was concluded that it was best to fit in with the future power station building programme envisaged by Northern Ireland Electricity. It was assumed that the next power station to be built would be Kilroot II with the commissioning of the first unit in the early to mid-1990s, which has recently been confirmed in a Government statement. On current forecasts a further power station will be required by the year 2000. It is assumed that this will be a 3×150 MW lignite fired power station at Crumlin, adjoining the large lignite deposit on the eastern shore of Lough Neagh. As can be seen from Fig 4, the Crumlin option requires a very long transmission main of some 34 km to the receiving station in Belfast. A

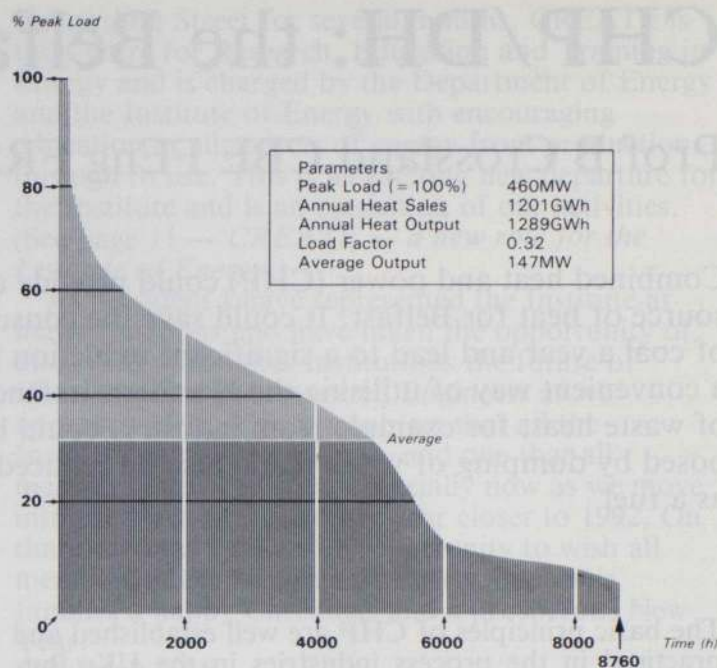


Fig 3: Load duration at maturity of scheme.

more direct route is prevented by the high hills between Crumlin and Belfast.

In the proposed scheme all three turbines in the station would be built as pass-out units, in which steam is extracted from the turbines to provide the heat output. Each turbine develops a maximum output of 150 MW electricity and 120 MW heat, but with an output of 120 MW heat the electrical output is reduced to about 130 MW. The heat transmission line has a capacity of 300 MW, which means that in the event of a turbine set being out of service 240 MW of heat is available from the two remaining turbine sets, thus providing reasonable security of supply.

Consideration of the capital cost of the main transmission pipeline, its size and the transmission losses, dictated a flow temperature of 120°C with a return temperature of 70°C. However, 120°C is too high for the distribution system so a heat exchanger is required at the receiving station in Belfast, which heats the water in the distribution system to 95°C with a return temperature of 55°C. After consideration of the merits and demerits of direct and indirect systems of heating, and having taken into account continental experience, it was decided to adopt indirect heating with an individual heat exchanger for each customer.

The most convenient site for the HOB station adjoining the HDHL area is the site of the Gasworks in Ormeau Road, which is close to the centre of Belfast. With the demise of the Belfast City Gas undertaking this site is available.

Fig 5 shows the concept of the complete CHP/DH system. The development of a city-wide scheme cannot be carried out simultaneously due to considerations of manpower, capital outlay and the inconvenience to the inhabitants. Nor is it economically sensible to complete the whole scheme before it becomes operational. Development must be progressive with areas being developed and connected up to a heat supply as early as possible. As a consequence the HDHL area of the city has been divided into five phase areas, each with about the same heat demand.

Construction starts in Phase 1, which is further divided into a series of sub-districts, where a temporary boiler module, either coal or oil-fired, provides heat as the distribution system is developed. When a sub-district is completed it is connected to the

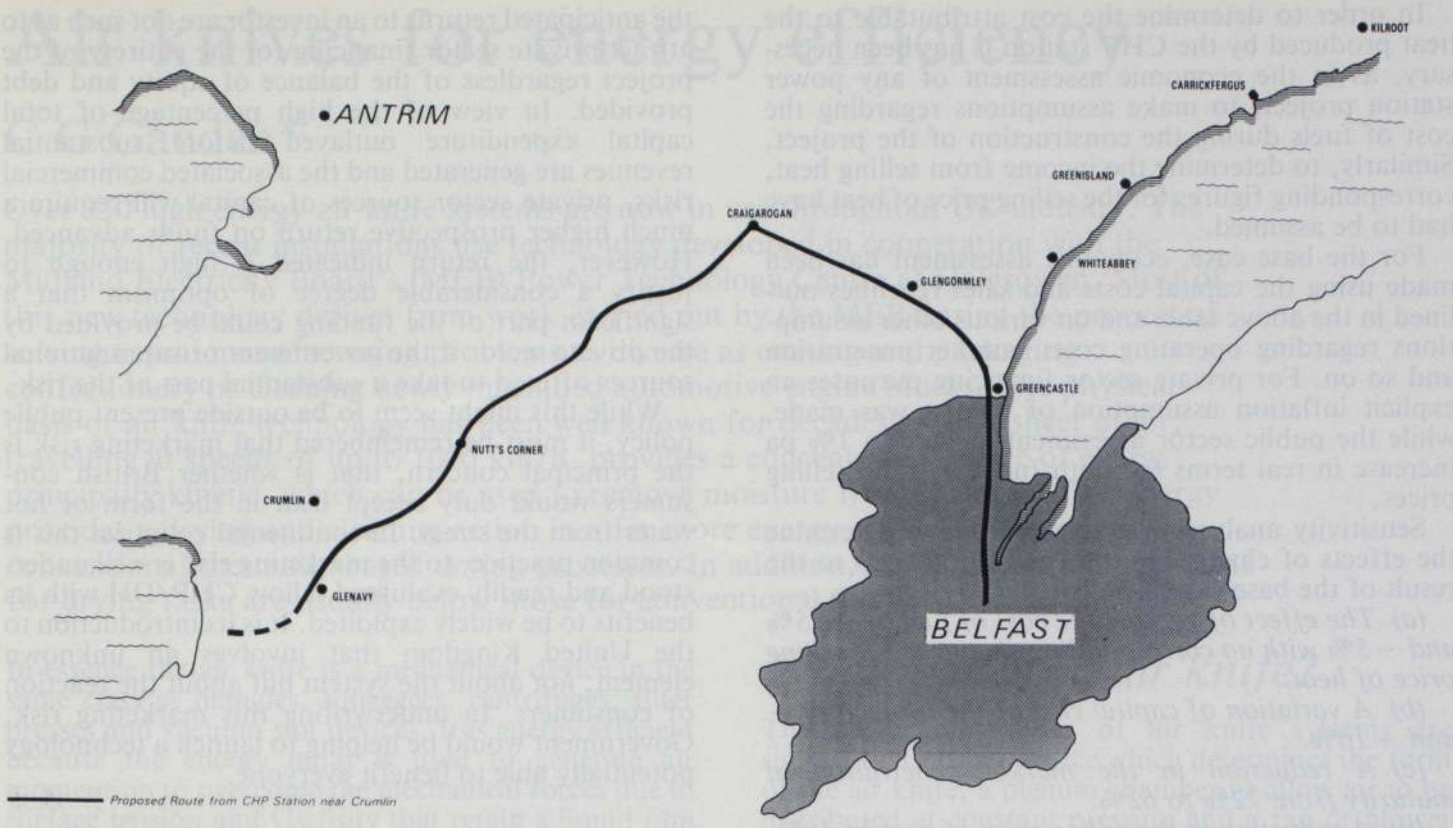


Fig 4: Route of transmission main.

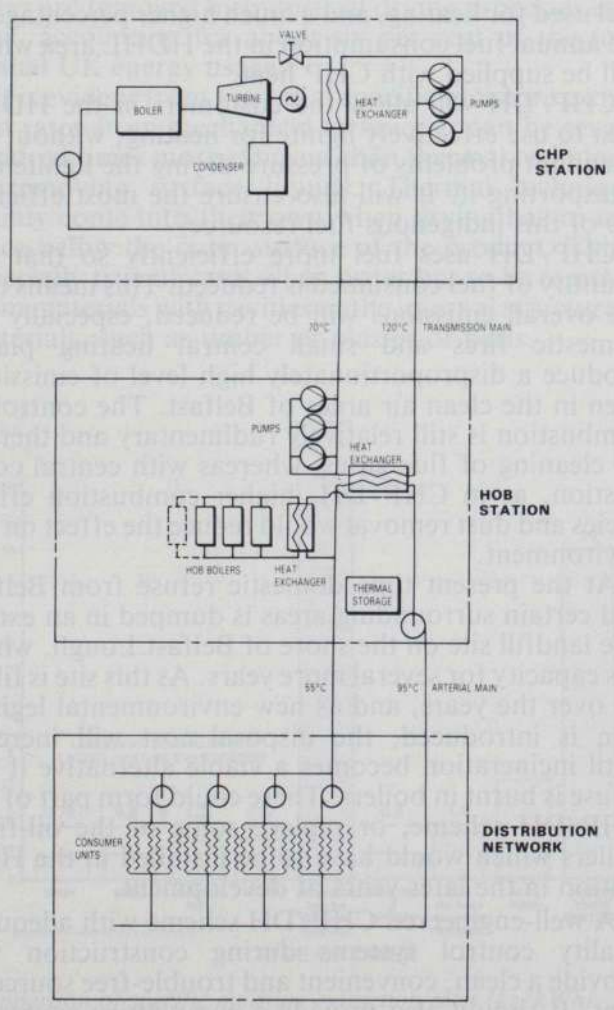


Fig 5: Schematic arrangement of CHP/DH scheme.

permanent HOB station, and the boiler module is disconnected and used in a new sub-district. When the first phase is completed, work is then switched to the next phase and so on.

The advantage of progressive development is better cashflow as income is generated as the construction progresses. Heat from the CHP station will be introduced during the construction of Phase 2.

By the time the entire HDHL area is connected, through an arterial mains network, into a single unified DH scheme, the HOB station will have been fully commissioned. It will incorporate permanent HOBs, thermal storage, reception point for heat from the CHP station, and pumping equipment. The main construction period totals 17 years, and full maturity is reached in 22 years.

Economics and finance

To establish the economics of the proposed CHP/DH proposals the capital expenditure and annual income from the sale of heat has been determined for the market penetration programme established by market research. These figures in £M are given in Table 2.

Continued overleaf

Table 2: Cost

	Capital expenditure	Cumulative capital expenditure	Heat sales	Year
Phase 1	107	107	6.7	4
Phase 2	61	168	16.3	8
Phase 3	36	204	24.2	11
Phase 4	32	236	30.6	14
Phase 5	45	281	39.1	22

In order to determine the cost attributable to the heat produced by the CHP station it has been necessary, as in the economic assessment of any power station project, to make assumptions regarding the cost of fuels during the construction of the project. Similarly, to determine the income from selling heat, corresponding figures for the selling price of heat have had to be assumed.

For the base case, economic assessment has been made using the capital costs and sales revenues outlined in the above table and on various other assumptions regarding operating costs, market penetration and so on. For private sector financing purposes an explicit inflation assumption of 6% pa was made, while the public sector assessment includes a 1% pa increase in real terms for both fuel costs and selling prices.

Sensitivity analyses were carried out to determine the effects of changes in the key assumptions to the result of the base case. These include:

(a) *The effect of varying the cost of fuel by +15% and -5% with no corresponding change in the selling price of heat.*

(b) *A variation of capital cost of the project by + and -10%.*

(c) *A reduction in the market penetration at maturity from 72% to 62%.*

(d) *A reduction in the selling price of heat by 10%.*

The economic appraisal is based on the internal rate of return (IRR) of the project assuming a life of 35 years. It should, however, be noted that with corrosion protection measures and quality assurance during construction the pipe system should exceed this life. The net present value (NPV) of the cash flows at a test discount rate of 5% has also been calculated. The IRR and NPV results, including the major sensitivities, are given in Table 3.

Table 3: Economic appraisal

	IRR at 35 years (%)	NPV at 35 years (£M)
<i>Base case</i>	6.9	49
<i>Inflated base case (that is, with 6% inflation pa)</i>	13.4	505
<i>Public sector base case</i>	8.7	107
<i>Fuel costs + 15%</i>	6.5	36
<i>Fuel costs - 5%</i>	7.1	53
<i>Capital costs + 10%</i>	6.1	29
<i>Capital costs - 10%</i>	7.9	68
<i>Market penetration at 62%</i>	5.9	21
<i>Selling price - 10%</i>	5.5	11

The results of the base case, while unlikely to form the basis for a wholly private sector project, appear to be sufficiently robust to withstand a variety of adverse scenarios, although it clearly is very sensitive to adverse movements in selling price and market capture, which are the two most critical assumptions. A 1% ramp in energy prices significantly enhances the prospective return, and this may be an important factor as regards public sector participation in any financing of the scheme. The most attractive feature is the very favourable long term cash inflow, which is especially significant in the inflated case.

Taking the project as a whole, the IRR suggests that

the anticipated returns to an investor are not such as to attract private sector financing for the entirety of the project regardless of the balance of equity and debt provided. In view of the high percentage of total capital expenditure outlaid before substantial revenues are generated and the associated commercial risks, private sector sources of capital will require a much higher prospective return on funds advanced. However, the return indicated is high enough to justify a considerable degree of optimism that a significant part of the funding could be provided by the private sector if the government or supranational sources offered to take a substantial part of the risk.

While this might seem to be outside present public policy, it must be remembered that marketing risk is the principal concern, that is whether British consumers would duly accept heat in the form of hot water from the street. In continental countries this is common practice, so the marketing risk is well understood and readily evaluated, allow CHP/DH with its benefits to be widely exploited. It is its introduction to the United Kingdom that involves an unknown element, not about the system but about the reaction of consumers. In underwriting this marketing risk, Government would be helping to launch a technology potentially able to benefit everyone.

Advantages of CHP/DH

It is estimated that at maturity the CHP/DH will provide a saving of fuel amounting to the equivalent of 150 000 t of coal pa. This represents 3% of the total Northern Ireland consumption of fuel excluding that used by transport, or 7% of the total fuel used for heating, and a much higher percentage of the annual fuel consumption in the HDHL area which will be supplied with CHP heat.

CHP/DH will allow the customers in the HDHL area to use effectively lignite for heating, without the attendant problems of pressure-drying the lignite and transporting it. It will also ensure the most efficient use of this indigenous fuel resource.

CHP/DH uses fuel more efficiently so that the quantity of fuel consumed is reduced. This means that the overall emissions will be reduced, especially as domestic fires and small central heating plants produce a disproportionately high level of emissions even in the clean air areas of Belfast. The control of combustion is still relatively rudimentary and there is no cleaning of flue gases, whereas with central combustion, as in CHP/DH, higher combustion efficiencies and dust removal would reduce the effect on the environment.

At the present time domestic refuse from Belfast and certain surrounding areas is dumped in an extensive landfill site on the shore of Belfast Lough, which has capacity for several more years. As this site is filled up over the years, and as new environmental legislation is introduced, the disposal cost will increase until incineration becomes a viable alternative if the refuse is burnt in boilers. These could form part of the CHP/DH scheme, or replace some of the oil-fired boilers which would have to be installed in the HOB station in the later years of development.

A well-engineered CHP/DH scheme with adequate quality control systems during construction will provide a clean, convenient and trouble-free source of heat. It should also provide a competitive source of

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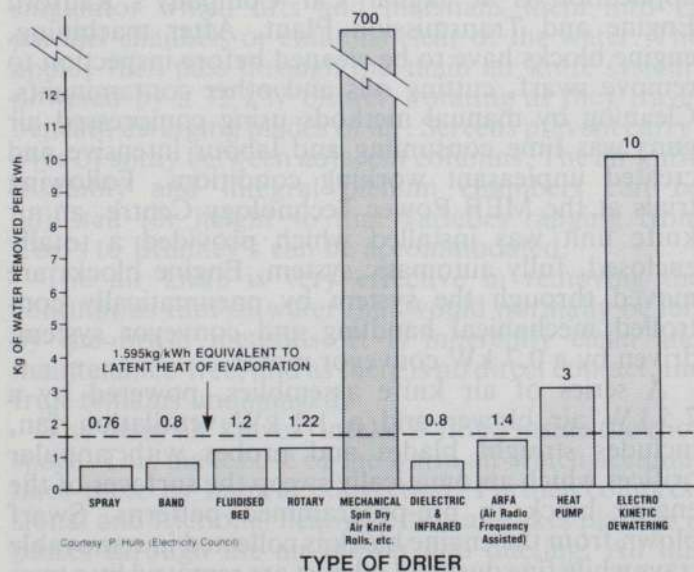
Air knives for energy efficiency

C G Gauden*

Over 350 high energy air knife systems are now in use throughout UK industry. The majority of recent installations use technology developed in cooperation with the Midland Electricity Board's (MEB) Power Technology Centre at Halesowen. Most of this new technology derives from work carried out by the MEB during the process of solving actual manufacturing problems as diverse as coating and packaging confectionery or cleaning newly machined automotive engine blocks. The physical basis of air knife technology has been well known for decades. A thin sheet of air, travelling at speeds of up to 1000 km/h, provides a concentrated source of energy, principally kinetic, which can be used to remove moisture from surfaces. This energy provides a drying and cleaning action in a far more energy efficient form than conventional thermally-based drying processes. In addition, the capital equipment costs for drying tasks are usually below those for conventional thermal drying systems

In essence the air knife is a mechanical device in the same class as mangles, squeegees, centrifuges, filter presses and vacuum slot devices. It is energy efficient because the energy input is used to generate air momentum to overcome the mechanical forces due to surface tension and viscosity that retain a liquid film on the surface. This is in contrast to evaporative drying which requires a high input of thermal energy to produce the sensible and latent heat required for efficient evaporation. For some processes the air knife is by far the most energy efficient method for removal of surface liquids at production line speeds. This is most important for UK industry. Around 30 Mt of water are removed by industrial drying processes each year, accounting for about six per cent of the total annual UK energy usage.

It is evident from Fig 1 that specific moisture extraction rates from mechanical techniques can be several hundred times more efficient than thermal techniques in removing surface liquids. Thermal techniques mainly come into their own when drying has to take place below the outer surface of the product. This is especially true of cases when water has to be removed from materials with cavities or the internal structure of materials, such as timber or plaster of paris.



Comparison of specific moisture extraction rates (kg/kWh).

*MEB Power Technology Centre

What makes an air knife?

The basic components of air knife systems are simplicity itself: an orifice which determines the form of the air knife, a plenum chamber to allow air to be distributed at constant pressure and a fan or blower system which supplies pressurised air to the system. Low loss ducting links the fan with the plenum chamber and orifice so that as much as possible of the pressure is converted to kinetic energy. This high speed stream of air can then be used for the work of removing liquid films. The efficiency of this work depends on the interaction of the air knife with the work surface. To be effective the air must have enough momentum to shear through the liquid film, roll it back and vaporise or atomise the liquid. Much of the detail of air knife technology is devoted to designing efficient knife forms which effectively carry out the process.

An efficient air knife system achieves its drying action in a two-stage process. The horizontal component of the high velocity air stream rolls the liquid film back, creating a standing wave at the point of shear and leaving a thin residual layer. As the point of impact of the impinging air flow passes over the residual layer, this layer is shattered or atomised to form minute liquid droplets which are then carried away by the air stream to leave a clean dry surface. Of course, part of the liquid surface may be removed by accelerated evaporation and this additional effect, which may be beneficial, can be enhanced by increasing air temperatures.

At the MEB Power Technology Centre the most efficient air knife design has been found to require a rigid, precisely formed, unobstructed, high aspect ratio orifice which provides an air knife with parallel edges. This air knife is normally used in conjunction with air blowing pressures of between five and 70 kPa (0.5 to 10 psi). Development teams at the Power Technology Centre have evolved a number of different test rigs to demonstrate different systems and carry out trials for potential customers.

Naturally, the pressures can vary widely depending on the application; very low pressures are required to remove water from delicate fruit and vegetables, while pressures of the order of 50 kPa (5 psi) are required for cleaning relatively viscous liquids, such as cutting oil, and solid particles, such as swarf, from complex metal surfaces.

(Continued overleaf)

Of course, the basic form of the system has to suit the application. In some cases, the air knife can be in the form of a thin regular sheet, but for complex workpieces, multiple passes with simple air knives may be required or the form of the air knife must be contoured to suit the process.

Any air knife system must also be designed to be a practical production line machine; robust, easily dismantled for routine maintenance and capable of minor adjustment to fit the production process. While the physical basis of air knives is now fairly well understood, the evolution of a strong theoretical basis requires much more study.

Design considerations

The development of any new and practical drying technology is necessarily a complex process. Some 32 specific parameters may have to be carefully considered for any new air knife application. These variables extend from the technical data affecting the workpiece surface, whether it is a sprout, a carpet tile or an engine block, to air pressure and volume. Other factors, such as acoustics and air filtration, must be taken into account so that the system can comply with the Health & Safety at Work Act and all relevant safety regulations.

No drying process can be effective without considering the nature of the liquid to be removed, whether it is aqueous or hydrocarbon, high or low viscosity or whether solid particles are entrained within the liquid. The solution adopted may vary considerably. Another significant set of variables relates to the workpiece, especially form and surface texture. A smooth metal ceiling tile, a complete engine block with, perhaps, a multiplicity of oil ways and tapped holes and a synthetic fabric mat must all require totally different designs of air knife to be efficiently processed.

Once the characteristics of the workpiece and the surface film have been evaluated, the final design must depend on the management objectives, production rates, space, control and so on.

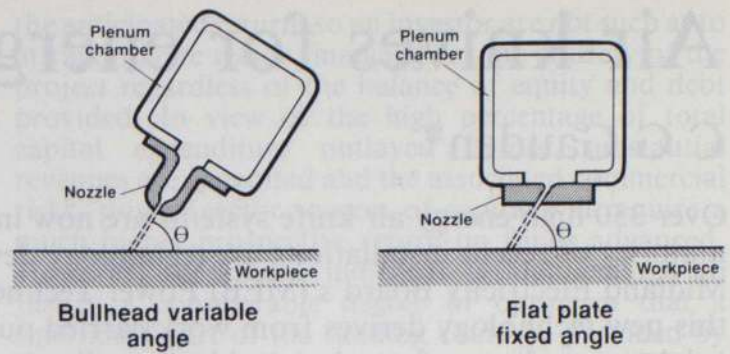
Most of the system design parameters are easily evaluated using a test rig. The test rigs installed at the MEB Power Technology Centre provide one of Europe's most comprehensive resources for air knife technology. They include rigs which cater for a variety of product transportation systems. The rigs can be fitted with varying designs of blowing heads.

Depending on the requirement, tests can be carried out on products moving at speeds of up to 1000 ft/min (305 m/min) at pressures up to 120 psi (8.2 bar) and temperatures of 350°C.

Detail design of the critical component, the orifice, depends on applications, but there are two principal types; the *bull-nose* which has a variable aperture and angle of incidence and the *flat plate* which has a slot cut into flat metal plates. In this latter case the aperture only can be varied.

In many cases the main operating constraint in design of the total system is to present the component to the air knife in the most effective way and to stabilise or restrain the workpiece to withstand the thrust generated by the action of the air knife. In some cases the air knife component may cost around £3000 while the associated mechanical handling may be around £20 000.

In the applications for continuous web or strip textiles or steel strip, the mechanical handling requirements of the air knife system are easily incorporated in



Types of air knife.

the normal system of tensioned rollers. In other applications where workpieces have complex shapes, have large areas and low weight, or are loose or jig mounted, the conveyor system may form a substantial proportion of the costs.

Applications

So far, the principal applications of air knives have been in the mechanical engineering industry, food processing and textile manufacture. By far the most common application in both the engineering industry and other industries is drying, but the air knife is also used for wiping, material removal and controlling film thickness.

The drying applications extend to metal strip, aluminium and rubber extrusions, circuit board laminates, battery cases, crankshafts and roof tiles. Cleaning and wiping operations extend from removal of peat from power station crane gantry rails to cleaning machine oil and swarf particles off uranium fuel rods and engine blocks.

Perhaps the simplest, most efficient air knife application is drying or wiping a taut, smooth metal strip. A pair of flat plate knives can remove heavy water burdens at strip speeds of up to 50 m/min with blower powers varying between one and four kilowatts per foot run. With multiple systems total throughput can be increased by a factor of 10.

One successful and far more complex air knife application is at Jaguar Car Company's Radford Engine and Transmission Plant. After machining, engine blocks have to be cleaned before inspection to remove swarf, cutting oils and other contaminants. Cleaning by manual methods using compressed air guns was time consuming and labour intensive and created unpleasant working conditions. Following trials at the MEB Power Technology Centre, an air knife unit was installed which provided a totally enclosed, fully automatic system. Engine blocks are moved through the system by pneumatically controlled mechanical handling and conveyor system, driven by a 0.7 kW conveyor motor.

A series of air knife assemblies, powered by a 7.5 kW air blower and a 1.1 kW ventilation fan, includes straight blades and probes with annular orifices which automatically sweep the surfaces of the engine block in pre-programmed patterns. Swarf blown from the engine block is collected in removable trays while fine dust and oil mist are removed by a two-stage filter system.

This system achieved a 60% speed increase in the engine decontamination process, cutting cleaning time per engine block from four to two and a half minutes.

Substantial energy savings were generated by reducing the consumption of compressed air.

The food industry

The food industry is an increasingly enthusiastic specifier of air knife systems. The ability to use precisely controlled low pressure air for the drying process offers major advantages in comparison to many relatively primitive mechanical processes which include sponging and towelling, rotating brushes, dragging chamois leather sheets, vibrating conveyors and manual mopping.

The air knife can often overcome the 'overheating' results of otherwise efficient hot air recirculation and infrared systems by reducing water load and power requirement for evaporation.

Other applications of air knives in the food industry have included control of batter thickness of fish fingers, wiping excess cream off jam/cream sandwich biscuits; where the air knife replaced a gloved finger, controlling the flow of chocolate eggs to the wrapping machine and forming the ripple pattern on chocolate biscuits.

The drying applications are legion; they include drying of sausage extrusions and potato chips and drying canned goods at rates between 600 and 1300/h. Primary food processing industries are now making considerable use of air knives for cleaning and drying crops such as onions, leeks, beetroot and celery.

Wye Fruit of Ledbury have used air knife technology in a new high speed electronic weighing and sorting line; the largest one of its type in Europe. The new line, with a capacity of nine tonnes of apples per hour needed high speed drying with gentle handling, a requirement which was met by twin air knife installations with a total electrical input of 97 kW.

Water is used to float apples out of their bulk storage bins and carry them along the line. The apples are lifted from the water trough by an inclined conveyor and then pass through a water curtain which removes leaves and other debris. They are then dried by the first air knife, powered by a 22 kW blower. Dryness at this stage is important because it eases the grading operators' task of checking for blemishes and colour and removing any sub-standard apples.

Another water conveyor takes the apples to the singulator which lifts and marshalls them into 12 parallel channels or columns clear of the water. The apples then pass through the main air knife system, powered by a 75 kW blower, rotating as they travel beneath diverging blades of air. Screens prevent carry-over of spray between adjacent columns. The air knife assembly and integral plenum chambers can be adjusted for height so that varieties ranging from Cox's to Bramley's can be accommodated.

The air knife is very effective in removing the continuous film of water that would normally be left by the brush methods. It is inherently clean and maintenance-free, and as there is no direct contact, the fruit remains undamaged.

The main air knives' intake is fitted inside the roof space. This makes use of the warm air which accumulates there by natural convection. Further compressional and frictional heating of the air takes place as it passes through the air blower and ducting. All this helps the drying process and, as warm air is being recirculated to the packing hall at the operator level, it provides a 'spin-off' benefit by reducing space heating costs as well.

The energy cost for old and new systems is roughly

the same. But the new packaging line speed has increased output by 50% so that overall there is a saving of a third in energy cost for drying an apple.

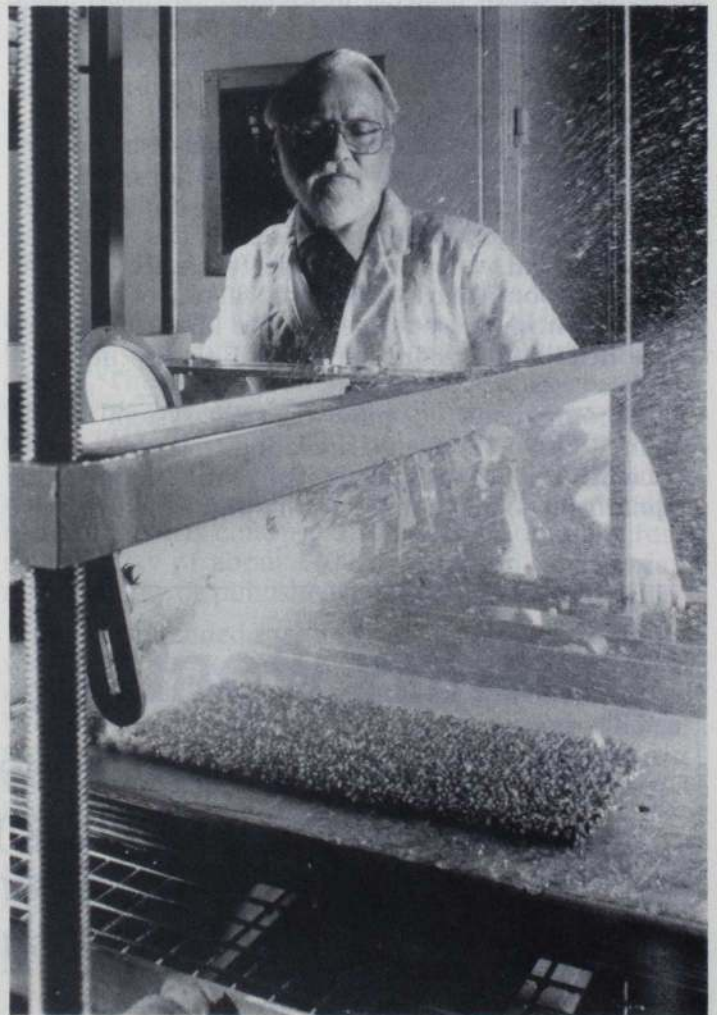
A area of energy savings is where air knives replace the use of hot washes to raise metal baking cases to high enough temperatures to encourage flash-off to remove residual moisture.

The increasing use of herbicides and biocides leads to risk of chemical transmission down the manufacturing chain. Efficient washing and drying of products such as apples, potatoes and other products that are, initially, soil covered or directly sprayed is becoming more important. The only practicable method is water wash and without the rapid and efficient removal of water, chemical residues can still be left on the surface. Air knives, with their gentle, positive and efficient action, will make a major contribution in this area.

Another area of great potential is container cleaning, baking trays, bottles, plastic vessels and carrying trays. Both warm air recirculation and hot flash-off systems are costly and relatively inefficient. In addition, residues from disinfectant chemicals can be left after uncontrolled evaporation. The adoption of air knife technology may overcome many of these problems while generating substantial energy savings.

The textile industry

Applications in the textile industry have been slower to develop than in other areas partly because the action of the air knife is much more complex and may be damaging when interacting with webbed and fibrous surfaces. The air knife produces an effect similar to a deeply penetrating flexible comb which removes



MEB air knife testing removing water from a carpet sample.

liquids surrounding the filament's pile and backing.

The drying mechanism is much more complex; liquid can be pushed deeper into thick fabrics and, where opposing air knives are used, liquids tend to migrate forwards and backwards in diminishing quantities through the body of the fabric.

This complexity means that, in many cases, multiple systems are required, sometimes supported by heated air or other thermal techniques for final drying. In addition, the pile structure can be affected and unfixed liquid dyes or dressings may be removed. These constraints may lead to the specification of relatively low blowing pressures which may reduce the efficiency of drying. Nevertheless, over 90% of the liquid can be removed using air knife techniques which still give rise to substantial energy benefits, especially when used with other techniques such as rolls and vacuum slots.

While successful applications have already been pioneered in the textile industry, it is evident that the more complex fabrics require a great deal of development to evolve an effective technology.

In many cases so far investigated, substantial benefits have been demonstrated. The chief operating restraint is the effect of the air knife on the pile. Much of the development work lies in this area and the evaluation of the most cost-effective combination of techniques. It may be that the air knife system gives most benefits to the textile industry as a major component of the drying process rather than as a stand alone device. So far, the most effective total system design is to use a single squeegee roller followed by one, two or three passes with air knives.

One of the many applications being investigated in the textile industry is the drying of rubber-backed tack carpet, typically used as household entrance mats. Using the Power Technology Centre's test rig, sample nylon mats were mounted on a metal mesh carrier and moved on a horizontal path below bull-nosed air knives.

As the air knives passed over the mat at a speed of 15 ft/min and a blowing pressure of 3.6 psi, 88% of the initial water load was removed. Two more passes removed an additional eight per cent of the water load to give a total water removal performance of 96%. This corresponded to a water removal rate of 870 kg/h from a continuous one metre wide line using an air knife installation requiring a total energy input of 80 kW.

By comparison, a pure thermal system would require 1400 kW even if evaporation was 100% efficient. Use of a squeeze roll could reduce this requirement to 560 kW. If a still optimistic, but more

realistic, efficiency figure of 50% was taken into account, total power requirements would still be 1100 kW.

This prototype system, while not yet confirmed on production line applications, gives some idea of the energy saving potential of the air knife in textile drying applications, but it is also important to note the peripheral benefits of the technology. In addition to energy savings of well over 80%, there are space savings because the complete system would occupy only two or three metres of line run.

The development of air knife technology in both textiles and other industries is at an exciting stage. The technology gives major operational benefits in a number of industries which are heavy energy users.

Total energy savings of 70 to 90% can be demonstrated and a compact air knife unit can dry products at very high production line speeds, in some cases 10 times the rate of conventional drying methods.

The relatively simple concept of the total system, mostly employing well proven technologies of air movement, control, utilisation and handling, leads to low capital costs and rugged, dependable machinery with minimal maintenance and supervision requirements.

In many processes, the elimination of high temperatures and the possible gentle nature of air contact has led to product quality gains as well as energy cost reductions.

Like any other new technology, air knives have to be correctly assessed and applied. This applies especially to workpiece handling and design must ensure that small and lightweight components can be restrained against the blowing forces exerted by the air knives.

This increased mechanical handling requirement is usually more than compensated for by the efficiency obtained from the great reduction in energy input and quality gains from the inherently clean nature of the process.

The high air velocities and rapid liquid or solid removal rates generally require an enclosure for maximum economy and operator safety, but the ability to introduce fully automatic non-thermal processes given by the technology more than offsets these relatively minor disadvantages.

The air knife is a proven technology, giving many users of energy intensive processes an opportunity to reduce costs, increase quality and improve working conditions. The major areas of development in mechanical engineering, food processing and textiles have already seen great progress and development of this relatively new technology will give substantial gains to industry in the next decade. □

ENERGY WORLD – NO JANUARY ISSUE

Members are reminded that there will not be a January issue of *Energy World*. Instead there will be a combined January/February issue to be published in February.

CREATE — a new role for the Institute of Energy

A J Williams*

Energy has a unique and important place in education. A fact that members of the Institute of Energy have always known. The pivotal place of energy as a cohesive force in education and training is now being fully recognised and this recognition represents a major development in the Institute's affairs

As a result of considerable effort within the Education and Training Committee of the Institute of Energy and in conjunction with the Department of Energy, a new body has been set up under the auspices of the Institute to look after education and training. It will look after the needs of energy and energy management education and training below undergraduate level and will work closely with the Institute's Education and Training Committee. Collaboration is enhanced by the fact that the new body is housed at 18 Devonshire Street and its chairman and director are both members of the Education and Training Committee of the Institute.

The new body, called CREATE (Centre for Research, Education and Training in Energy) will initially take over the role of the education group within the Energy Efficiency Office. It is sponsored mainly by the Department of Energy supported by the Institute of Energy. The directorate and administration is funded initially for two years at the end of which it is hoped CREATE will be self financing.

Objectives

The ultimate aim of CREATE is to establish a climate in which energy education and training (including energy management) can be developed to its logical extent within the changing national environment. This will be achieved in a number of ways:

■ Contact will be maintained with examining boards to ensure energy is not only properly represented in syllabus reforms but that it is taught in a balanced and accurate fashion.

■ Regular surveys will be carried out to determine what is happening in energy education, where the deficiencies lie and how these may be overcome by the provision of new teaching materials, of in-service training, and of professional experts to assess and monitor the materials and training carried out.

■ Information, ideas and teaching material will be disseminated through a regular newsletter to schools, via the NERIS database and by using a suitable exhibition programme.

The management of CREATE

A major aspect of importance to the Institute of Energy is the role of branch membership in CREATE. The branch network plays a major part in the strategy of CREATE. It can achieve many of its objectives using central organisation of both CREATE and the Institute of Energy. However, the local dimension is vital to the successful development of energy education and training. Real success depends on what happens at the 'chalk face'.

The work at local level must be done through the branches and through individual members of the Institute of Energy and in conjunction with other bodies at regional level, such as the SATROs, the SILOs and the ECROs. Local initiatives can take many forms and those envisaged at present will have strong industrial links locally and nationally. Initial ideas include the following:

■ It is hoped that teaching material will be produced by small firms who are interested in meeting a local need but with much wider publicity. This can be done for very little expense. Gone are the days when thousands of pounds were required to produce glossy materials for schools.

The idea is to match a company with a local teacher to produce material which is relevant to the company's business. All companies have material with links to energy. The only cost to the company will be payment to the teacher plus a small editorial fee to enable CREATE to make the material appropriate for transfer to the NERIS database. This material can then be made available nationally and with full acknowledgement to the firm concerned. This can be obtained for a small outlay of about £100. In addition, appropriate material may be published in the CREATE newsletter.

■ It is intended that a list of lecturers be compiled who are able to talk to students and teachers at regional level. The hope is that these will be sponsored by industry. Each lecture or series of lectures will bear the name of the sponsoring firm, for example, the Pilkington Lecture. These may be given by industrialists or teachers sponsored by industry.

However, the most important task with which local branches will be charged is to seek out local initiatives whether by a local teacher or group of teachers as part of the curriculum, as project work or as extra curricular activity. This material must be the bread and butter

*Chairman of the Institute of Energy Education and Training Committee

Institute of Energy Conference **Industrial Energy Management**

on
16-18 May 1989
at
National Exhibition Centre,
Birmingham

The conference is being held in conjunction with **ENERGY '89**, a major exhibition being organised by EMAP Maclaren Exhibitions.

For more information contact:

**Mrs I. Hutchings on
01-660 8008**

Process technology for the clean use of fossil fuels*

A one day conference organised by the Society of Chemical Industry and the Royal Society of Chemistry in association with the Institute of Petroleum and the Institute of Energy was held at the Society of Chemical Industry on 13 May 1988. The aim of the conference was to provide a review of current technology and to give an indication of future developments.

The key to the material was provided by M F Tunnicliffe from the Department of the Environment during the final discussion. He said that EEC legislation for large plant was likely this year during the German presidency of the EEC. The framework document (84/360) covers plant of 50 to 700 MW(th). For new larger plant, continuous monitoring achieving 90% sulphur dioxide reduction as a rolling average over a period of one month will be required. It has since been reported in the press that Britain has asked for the lower limit of MW(th) to be raised to 100 MW(th).

The first topic covered in the formal presentation was how the polluting constituents were held in coal, the methods available for beneficiation at the pits and their performance and desulphurisation of oil. Coal is a very variable material both in rank (lignite to anthracite) and inert content, water and minerals. In spite of employing mining machines designed to select coal rather than rock there can be mineral levels as high as 50%. Dust suppression spraying can also produce additional dirt.

Coal cleaning uses the differences in coal's physical and surface properties. The sulphur will either be in the form of pyrites or marcasite or integrated into the coal lattice (20-40%). There will also be nitrogen linked into the lattice. Chlorine too is bound into the coal structure and in British coals is usually in the range 0.3-0.7% by weight.

To remove pyritic sulphur the coal must be crushed before cleaning; this can reduce the efficiency of the cleaning process and will remove perhaps 30% of the sulphur content. Chlorine removal can be achieved by leaching but the contact time is long — 30% reduction in 12 hours compared with a few seconds or minutes in washing processes.

The cost of coal cleaning to reduce sulphur levels by 30% will be 7-8% of the coal prices including safe disposal of the residue. With fines the figure can be three times more with an added cost of drying the fuel.

Oil and its problems

On the oil front the main problem is heavy fuel oil. Oils vary considerably in sulphur content from the low levels in the North Sea light oils to high levels in the Arabian crude. However, the use of fuel oil is reducing, particularly the heavy oil component.

Because of this the sulphur emissions in Europe from fuel oil are likely to reduce from six million tonnes a year in 1980 to two and a half million tonnes in 2000.

Residual oil desulphurisation plant is available and in use in Japan and the USA because oil fired stations there need low sulphur fuels for use when smog warnings are issued. Desulphurisation adds greatly to the fuel cost so its use continuously for power generation is uneconomic.

There are no fuel oil desulphurisation plants in Europe. The process requires high pressures and temperatures and the catalyst can become poisoned quickly. As refinery plant that is more than adequate for oil industry needs for the rest of the century is already installed, there are no plans for desulphurisation at refineries. Desulphurisation after combustion costs 40% less than sulphur removal at the refinery.

The next option is sulphur and nitrogen oxide emission control during combustion or in the furnace. Here fluidised combustion absorption processes are the most advanced. Limestone injection into the bed will absorb sulphur; the extent of absorption depends on particle size, pore size and chemical composition. 60-90% removal can be obtained in circulating beds with one and a half to three times the stoichiometric proportion of calcium to sulphur. Calcium sulphate is stable up to 1200°C. However, there is little operating experience. Moreover there are few experimental data for shallow beds or stokers.

With nitrogen oxides, bed temperatures are not high enough for oxygen and nitrogen in the combustion air to combine significantly.

With pulverised fuel burner and furnace developments nitrogen oxide reduction is the main target. Of the nitrogen combined in the coal molecule some will form nitrogen oxides in the three gases while about 30% will remain in the char. There are a range of techniques which can contribute to nitrogen oxide emission reduction:

	<i>Reduction</i>
<i>Low NO_x burners</i>	20-30%
<i>Staged combustion</i>	20-40%
<i>Flue gas recirculation</i>	15%
<i>Reburning</i>	30-50%

Combinations of these can reduce emissions by 30-80% depending on the fuel, plant and burner designs and operational techniques. Limestone injection, it was noted, can increase NO_x levels in fluidised beds.

To reduce sulphur oxide emissions limestone injected in the burner can produce 50% reductions, upper furnace injections would be less effective. The limestone injection can be combined with low NO_x burners. It was reported that there were no significant problems with slagging or deposition although calcium compound additions would be expected to change the mineral and deposition chemical composition.

*Papers presented at the conference will be published by the Society of Chemical Industry in *Chemistry and Industry*

Flue gas treatment

The next area of emission control was associated with flue gas treatment. There are catalytic and injection processes being developed, for lower levels of NO_x emission but these did not feature in the presentations. Desulphurisation plants are employed widely. Table 1 shows data for four countries.

Table 1: Desulphurisation plant (GWe)

	Existing	Planned	Total
West Germany	31	12	43
Japan	12	19	31
USA	60	16	76
United Kingdom	0	11	11

There is a family of technologies available that react the sulphur gases in a liquid sorbent. The system may be non-regenerable where the product is either dumped or sold as a by-product. These processes generally involve wet scrubbers with limestone or slaked lime as sorbent. In some systems the sprayed sorbent evaporates to produce a powder. In regenerable systems there is a subsequent process which gives the sulphur in a usable form and reforms the sorbent for recycling. About 500 plants exist and the wet waste processes dominate although the processes generating usable gypsum are increasingly used and specified. Only a few spray regenerable plants are in operation or planned.

For industry and small plants problems start with particulate emission control with a move from cyclones, with limited and often inadequate efficiency, to bag filters or electrostatic precipitators. Cyclones have poor performance at low loads and increased separation efficiency is expensive both in capital and fan power. Bag filters can be highly efficient but bags have to be replaced after about two years service. Electrostatic precipitators are efficient and have low maintenance costs. Their gas resistance is low with a small fan power penalty and their performance is good at low loads. They tend to be bulky.

Nitrogen oxide emissions are best dealt with by combustion process techniques. For medium sized plants sulphur oxide removal is probably best dealt with by spray-dry absorption processes rather than wet scrubbing as the capital investment is lower. In the spray-dry process the droplets absorb the sulphurous gases and the acid solution then reacts with the absorbant to form a dry dust. The dust would be removed in a bag filter or electrostatic precipitator. The ceiling performance is over 90% removal of sulphur dioxide but reagent use is poor at over 70% removal. Most of the hydrogen chloride in the gases would also be removed.

There was a detailed presentation on the General Electric flue gas desulphurisation system. A spray tower with fluid recirculation provides both absorption of the sulphur dioxide and the oxidation of the resulting calcium sulphite to calcium sulphate in the same vessel instead of in a separate vessel which is an alternative. Long life sprays using silicon carbide or more recently stellite coating are employed. Precipitation of calcium sulphate is under controlled conditions at the base of the spray tower. Hydrogen chloride and

dust are removed in a pre-scrubber which also cools the flue gases from about 120°C. The flue gases can be heated to about 80°C in a regenerative heater before discharge to the stack. The General Electric design is one of those being considered for British power stations. Developments under investigation would allow a variety of saleable by-products to be produced such as gypsum, ammonium sulphate or sulphuric acid to meet market demand.

All of the techniques described apply to current, widely used combustion systems. There are a number of advanced generating plant concepts which have inherently good emission characteristics. Some of these have been the subject of joint studies by CEGB, British Coal, British Gas and the Department of Energy for a three-unit station of 2000 MW(e). The results of the studies and their details have not yet been published. The target emission performance was 90% sulphur dioxide removal and at least reducing nitrogen oxides to 400 ppm while aiming at 150 ppm.

Among the schemes reviewed were pressurised fluidised bed, circulating fluid bed, gasifier and a hybrid fluidised bed/gasifier. Overall, thermal cycle efficiencies ranged from 38 to 42% or above. High gas turbine inlet temperatures for the gasified scheme would be possible with gas turbine developments expected to be available in 1990.

N G Worley (Fellow)

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Low head hydroelectricity

There is no such thing as a free lunch: right? Wrong: and you may claim your lunch upon purchasing Water Shares and cashing in the accompanying Abstraction Charge tokens. Yes, customers! Some authorities still levy a charge on water 'abstracted' to power a turbine with no refund when the same water is dis-abstracted, as new, five yards downstream.

Now for something equally absurd, but much more sensible: did you know that, for fiscal purposes, renewable energy sources are to be classed as honorary nuclear fuels? After privatisation of electricity, non-fossil fuels (by which must have been meant the nuclear industry) will continue to be sheltered against fossil fuel competition, with the surely unintended result that renewables will be commercially viable if they can but compete with nuclear generation.

These and other economic anomalies formed the introduction by Peter Rost, the local MP and vice-chairman of the Parliamentary Alternative Energy Group, to the UK-ISES conference on *Low head hydroelectricity* held at Borrowash, Derbyshire on 9 June. Much of the conference was, in fact, devoted to economic and legislative factors, with relatively little discussion of technical problems.

The venue for the conference was a large marquee in the grounds of Riverside House, by kind permission of the owner, Mr Heppal-Mooney. This is the site of an EEC funded prototype device described below.

I M Smith of Salford University Civil Engineering described the first year's results of a survey commissioned by the Department of Energy to fill gaps in existing knowledge on small scale hydroelectric generator potential in the UK. The study comprised site identification, site survey, detailed hydrological analysis, calculation of scheme capacity and energy yield, scheme costing, and calculation of scheme charges and environmental factors. About 2000 viable sites have been identified in England alone, with a combined output of tens of megawatts. The lack of investors willing to participate in development was attributed to a low rate of return on investment due to abstraction charges and anomalous local authority rating policies.

Paul Craddock, principal engineer, EMEB, talked of the interface between private generation and the main supply system. Advantages and disadvantages of synchronous and asynchronous generators (both mains-excited and self-excited) were described. Mr Craddock went into considerable detail concerning system protection against various irregularities, such as voltage fluctuations and harmonics. He was, however, unable to assure persistent questioners that small producers would ever be awarded long-term contacts by the area boards.

The honorary secretary of the National Association of Water Users, Cdr G C Chapman, reviewed legislative factors affecting UK hydro-power. The situation

is rich in irony and paradox. 'It is no wonder that in the political field where opinions, and who holds them, count for more than facts, there are so few engineers to legislate for sensible engineering solutions to our energy problems.'

Dr N D Mortimer of Sheffield Polytechnic described a current study of renewable energy in the North East of England, conducted by a team from Sunderland and Sheffield Polytechnics, and co-ordinated by NIFES. An inexpensive method of preliminary evaluation of low head hydro schemes was outlined, which is particularly suited for semi-automatic measuring using digitised maps and computer profiling packages.

Dr John Burton of Reading University Dept of Engineering recounted some micro-hydro experiences in Columbia. He described turbines of the low head Pelton, submerged free current and open flue axial varieties, generating usually less than 300 W. Apart from electricity generation, these devices have been used, for example, to drive flocculators in water treatment plant, and to lift useful amounts of water up the steep valley slopes for irrigation during the dry season.

The conference was greatly enriched by practical demonstrations of two devices. The first, developed by Prof Norman Bellamy and the Energy Systems Group at Lanchester Polytechnic working together with Hydro Energy Associates, derives from early experience in the wave energy research programme. Power for synchronous generation is derived from speed rather than torque: water flow is used to force low pressure air backwards and forwards in cycles through a self-rectifying Wells air turbine. The demonstration system, installed on the River Derwent at Borrowash, uses a flexible membrane separating water above it from two air bags below in an inclined duct set across the available water head. The system is set up so as to be bistable, with bi-directional air flow through a Wells turbine housed in a smaller air duct joining the two air bags. The unit at Borrowash is one of only three large Wells turbines in the world, the others being in Norway and Japan. The device, using a head of about 2.8 m and a mean flow rate of 8-9 m³/s, is rated at 150 kW. A teething problem with the kevlar bag resulted in an underground hydroelectric explosion and a mighty geyser, electrifying all present.

An old style undershot water wheel on the adjoining river Amber, that has been adapted to produce 10 kW electricity for Mr C Sutton's small farmhouse at Ambergate, was visited in the afternoon. The system was designed, fabricated and commissioned by Nicholls Engineering of Nether Heage, Derbyshire, in, of all years, 1977, with a pay-back period of about three years.

Ivan Vince
Fellow

Acid rain a perspective

Edited by
**John Ward and
David Browning**



This set of papers, initially presented at a one-day symposium organised by the Open University in association with Institute of Energy, presents a balanced and up-to-date appraisal of the acid rain problem.

Copies are available from the Institute of Energy at a cost of £25.00 (inc p&p).



Orders with remittance should be sent to the

**Publications Department,
Institute of Energy,
18 Devonshire Street,
London
W1N 2AU.**

CO₂ and climatic change

Irene M Smith

IEA Coal Research, London, 1988
52pp. £120 (non-member countries),
£60 (member countries)

The issue of CO₂ and the greenhouse effect on climate was reviewed at IEA Coal Research by Irene Smith as a summary in 1978 and in greater depth in 1982. When the fossil energy growth rate slackened off to around 2% in the 1980s, the issue appeared to decline in urgency. Interest has renewed in the past two years because of the recognition of an equal importance of the other trace greenhouse gases such as chlorofluorocarbons (CFCs) and methane, and a possible expansion of coal use following the Chernobyl disaster. This should shorten the time span before potential climatic effects.

In view of increasing concern about the issue among scientists, policy makers and the public, this new report summarises recent developments in this area for the coal/energy industries.

The CO₂ issue today has become part of an overall greenhouse gas issue that needs to be looked at in its entirety. It is an established fact that the concentrations of the greenhouse gases — carbon dioxide, methane, nitrous oxide, chlorofluorocarbons and ozone in the atmosphere are increasing. This is due to human activities, including the use of fossil energy, chemical and agricultural industries. The greenhouse gases, including water vapour, control the radiative heat balance of the earth. These simple facts are complicated by the complexities of the climatic system (atmosphere-ocean-ice-earth). Because of this, it is not yet possible to make definite predictions about the response of the global climate to increased concentrations of the greenhouse gases. Although the results of climatic model experiments broadly agree that there will be an unprecedented global warming next century, there is as yet no conclusive evidence that increasing concentrations of the greenhouse gases are resulting or will result in a climate warming and no agreement about the regional effects of a warming.

This review examines recent developments in the issue of a greenhouse warming due to increased concentrations of CO₂ and other trace gases in the atmosphere. Past, current and possible future trends in the emissions of the gases are summarised.

The limitations and results of models to study possible climatic changes are discussed and evidence from empirical studies appraised as a means of detecting such changes. Precautionary measures concerned with abatement and control of CO₂ emissions are out-

lined. These include improved energy use efficiency, substitution of energy sources as well as recycling, removal, utilisation and disposal of CO₂.

The author concludes that future emissions of the greenhouse gases form one of the greatest sources of uncertainty. Climatic model results suggest that there will be a noticeable global warming in one or two decades with more uncertain regional changes. Observations are consistent with these results. An improved understanding of such climatic changes is required to provide a firmer basis for policy decisions. The report excludes the potentially detrimental or beneficial effects of a climatic warming on human welfare and hence also policies of adaptation to such changes.

Andrew W Cox

Social costs of energy consumption

Olav Hohmeyer
Springer-Verlag, 1988
126pp. DM49

This is a report prepared under contract for the Commission of the European Communities by a group under the direction of Olav Hohmeyer at the Fraunhofer-Institut, Karlsruhe. They began from the premise that the overall environmental attractiveness of the renewable energy sources is not adequately treated by the traditional market pricing mechanism and showed how some, at least, of the external effects of energy systems can be adequately quantified.

Three principal areas where these external effects should be considered were identified:

- Environmental effects, including effects on human health.
- General economic effects, such as changes in employment.
- Public subsidies, direct or indirect.

The production of electricity based on fossil fuels and nuclear energy was compared with electricity production based on wind energy and photovoltaic systems.

When the quantified external effects were summed up and standardised for the production of 1 kWh of electricity, additional gross external costs for conventional electricity ranged from DM0.05 to DM0.12/kWh (at 1982 prices). On the other hand the quantifiable benefits for wind energy and photovoltaic electricity had mean values of DM0.089 and DM0.119/kWh respectively. Several other major factors, including the environmental effects of all stages of the fuel cycles and the psycho-social costs of serious illnesses or deaths and the costs to the

healthcare system, could not be quantified or included in the study.

The net effect of not taking these social costs into account was shown to discriminate against the renewable energy sources and favour conventionally generated electricity, thus perpetuating major errors in energy resource investment decisions. The introduction of renewable energy sources was being delayed by over 10 years, resulting in considerable losses to society.

This is a particularly timely report, especially for readers in the UK, where concern about environmental issues is attracting considerable government interest. The techniques used by the team are clearly described and well referenced and there are a number of well displayed diagrams. It can be thoroughly recommended for all energy professionals and academic courses.

Dr Cleland McVeigh

Renewable energy sources for the 21st century

Edited by R Hill, P O'Keefe and N M Pearsall
Adam Hilger, 1988
170pp. £25.00

This book contains the collected papers from an international conference, (E-EYE plus Fifty), held in Tynemouth as part of the European Year of the Environment in November 1987. In their preface the authors point out that the title reflects the fact that energy technologies require a period of the order of 50 years to move from a research phase to full commercial deployment and that similar periods of time are required to make significant changes in the mix of energy technologies used in society. Three major themes; — energy efficiency, biomass and other renewable energies — dominated the conference as the new technologies were considered to be the most likely to have a significant impact on energy in society and which are relatively environmentally benign.

In the first paper Michael Davis from the European Commission posed the question 'Renewable energies: are they alternatives?' and concluded that while they begin to be real alternatives they should be regarded more as a valuable indigenous component of our energy supply, for which their characteristics enable them to take their place alongside, rather than replacing our other energy sources. The second paper, from O'Keefe, Kirkby and Hill of Newcastle Polytechnic, explored existing projections for future energy

demand at a global scale. An interesting feature to emerge from their studies was that current world energy consumption projections to the year 2080 differed by a factor of 120. They had three main suggestions for the way forward; improving energy efficiency, recognising the exceptional importance of biomass as an energy source, especially in the Third World, and a recognition that the renewable resources do not simply produce energy but allow new development opportunities and new social relations to emerge. The remaining papers could be broadly divided into review papers, for example biomass, the development of the renewables, the significance of energy efficiency, and the special energy and programme of the Federal Republic of Germany, and papers which dealt quite deeply with a narrow topic, for example, practical experience of operating small engines with alcohol fuels, cogeneration from biogas, and the assessment of renewable energy sources for national supply, a case study of the Severn Tidal Barrage. This latter paper was by Dr M J Grubb, who described how the Cambridge Energy Research Group's linear programming model of the CEBG grid was adapted in his analysis. Grubb's final conclusions are that powerful analytical techniques are available and '... it is striking that when analysed thoroughly, even the straightforward economic benefits from investing in renewable energy developments appear to be substantial', a view which echoes the findings of Hohmeyer, reviewed above.

This collection of papers contains many thoughtful contributions from authors who are already recognised authorities in their fields, and the book deserves a place in all serious energy libraries. Students at undergraduate level will find it valuable in several disciplines.

Dr Cleland McVeigh

Information sources in energy technology

**Edited by L J Anthony
Butterworth Scientific, 1988
324pp. £35.00**

This book is one of a large series published by Butterworths on information sources from management and business, engineering to mathematical literature.

The book is divided into three parts; the first is energy in general which details the major organisations and agencies in Britain and worldwide, learned bodies, statistics, patents and so on. It would have been useful to provide contact names and addresses for these organisations. It is gratifying to note that the Institute of Energy's publications and conferences are given prominence here.

The second part covers fuel technology which rather surprisingly includes

energy conservation. The other sections cover combustion, steam and space heating, electrical energy and the environment. The third part is on energy sources — solid, liquid and gaseous fuels, nuclear, solar geothermal and alternative energy.

To illustrate the general method employed, the chapter on energy and the environment starts with a short scene-setting introduction which in many sections also involves an historical outline. General textbooks are recommended with a list of environmental journals, mainly British or American. The next section covers specific problems — air, marine, land, radiation and probability in much the same way — an introduction to the subject, textbooks and regular publications.

The first comment is that the lists of reference books and journals in each section provide a remarkably comprehensive and useful set of sources. The book is therefore a source which will be a valuable addition to energy libraries. The text too provides an interesting and brief introduction to each technology that sets the scene for those not fully immersed in all of the subjects. The area covered is comprehensive, there is a full index which makes using the book straightforward.

Even so, it is arguable whether some of the information about sources is best presented in this way. It is unlikely that an engineer searching for sources would expect to read several paragraphs with numbered references that are now always at the end of the section. It is suggested that some consideration should be given to collecting all of the references to one place preferably at the end of the book. With this reservation the source book is recommended as a way to short cut the normally tedious searching for background and detailed references on topics in energy engineering.

NG Worley

Coal preparation technology — vols 1 & 2

**David G Osborne
Graham and Trotman, London, 1988**

These two weighty books fill a substantial void in the coal preparation engineering literature by being texts for students, source books for other engineers wishing to learn about coal preparation in depth, plus good research and reference books for operating personnel, design engineers, supervisors and administrators.

The standard books of the past quarter of a century have typically had a much narrower audience in mind, and the available books fill only some of the needs. The two volumes described here have the advantage over most of their predecessors of being written by only

one author, so providing a greater degree of cohesiveness.

The text is efficiently organised, with the introduction to each chapter clearly delineating the importance of the topic being discussed, the problems to be solved and how the subject at hand forms a part of the whole.

The first 12 chapters (in volume one) cover the elements of coal use, properties, size reduction, sizing, concentration, dewatering and process-evaluation techniques. This part will be invaluable as a basic text for students and for non-specialists, as well as being an excellent reference source.

Volume 2 introduces a variety of specialised topics that will be particularly useful to advanced students, design engineers and, most especially, operating personnel.

Notably significant is the rise in importance of the role of pollutants in modern coal preparation technology. This is acknowledged by specific chapters that describe the current status of each of these important topics.

This is a welcome addition to the available literature on this subject. The two volumes should be on the book shelf of every coal preparation engineer.

Andrew W Cox

Catalysis in coal liquefaction: new directions for research

**Frank J Derbyshire
IEA Coal Research, London, 1988
69pp. £180 (non-member countries),
£60 (member countries)**

This report concerns the application of catalysis to the production of liquids by the direct liquefaction of coal. Direct liquefaction is understood here to concern the conversion of coals to liquid and gaseous products by any route that does not require the intermediate production of synthesis gas. This includes liquefaction both in the presence and absence of a solvent medium and, where a solvent is required, it will not necessarily be coal derived. In other words, co-processing and pyrolysis will be considered as well as more 'conventional' liquefaction.

The purpose of the report is to assess the current state of knowledge, to evaluate strengths and weaknesses and to identify new directions and strategies for research. Recommendations are made that are intended to provide a basis for the formulation of future R & D programmes.

The processes of primary coal dissolution and coal liquids upgrading are distinguished. Concerning the former, the discussion has centred on two broad groups of catalysts: hydrogenation catalysts and acid catalysts. In both cases, effective control of the dissolu-

tion process requires intimate coal-catalyst contact.

Hydrogenation catalysts, such as certain metal sulphides, may function by providing a source of hydrogen atoms through the dissociation of molecular hydrogen. The hydrogen atoms can promote bond cleavage reactions and assist in stabilising the products of these reactions. The partial pressure of H_2S is important to the catalyst mechanism. Acid catalysts, such as metal halides, promote bond cleavage by an ionic mechanism. In general, they are not particularly active hydrogenation catalysts, this creates the potential for the stabilisation of cracked products through the formation of high molecular weight adducts. Mr Derbyshire gives consideration to the limitations of these catalysts and to approaches that could lead to improvements in their performance and utilisation.

Multi-component systems appear to offer excellent prospects for the development of more active and selective catalysts.

Existing supported catalysts are quite adequate to the task of hydroprocessing distillate coal liquids. In the presence of high boiling and non-distillable coal-derived liquids they are rapidly deactivated by the deposition of carbonaceous materials and metals. The author believes that one prospective solution to this problem is to generate feeds that are most amenable to upgrading by enhanced catalytic control of the dissolution process.

There is also a need for the development of supported catalysts that are resistant to deactivation. This will require exploratory research into non-conventional catalyst phases and novel supports.

Other topics that are addressed in this study include the effects of low-temperature and consecutively staged reactions, conversion in $CO-H_2O$ and $CO-H_2O-H_2$ atmosphere and coal degradation by biological action.

The text is concluded by an extensive bibliography. The references reflect the seminal work in the principle subject areas, providing a useful source of review material.

Andrew W Cox

Purchasing oil and gas

Terry Robinson

Energy Publications, Newmarket, 1988

The subtitle to this small book is *The new opportunities from a competitive market*. The author, who has spent his career in industrial purchasing, has focussed his attention on a subject dealing with the procurement of energy sources, a topic which he admits he finds fascinating.

Oil supplies by tradition, have nearly always been available to the industrial and commercial user through multi-national integrated companies,

that, in the main, are in the private sector. This has meant of course, that buyers of fuel oil have been free to seek alternative suppliers and differing quotation for price. Such commercial freedom has not been available to other energy sources, gas, electricity, coal or water in Britain. Gas is now privatised and other energy sources are due to follow in a series of flotations by 1992 or soon after. By the mid 1990s all of Britain's energy sources are expected to have been de-nationalised.

Privatisation is presenting the fuels buyer with greater opportunity for negotiation of price and supply. The buyer is advantaged by buying in a market which is in surplus.

In an early chapter Terry Robinson stresses the importance of undertaking performance audits. This is to identify movements away from the factors established by the business to ensure the best economic return. Flexibility in purchasing arrangements is important for maintaining a competitive edge.

The author sets out a purchasing profile outlining 10 questions for the fuels buyer and he gives some suggested answers. In another chapter, he discusses the fuel supplier's objectives and these are important for the buyer to understand. Buying on contract or spot price is covered in the book. The buyer again has to appreciate the fact that spot purchasing can mean less security of supply. On the other hand, a contract price will not have a competitive aspect to it. The subject seems to have been well covered by the author.

F J L Bindon

Before the oil runs out

Economist Intelligence Unit, 1988

This Special Report from the Economist Intelligence Unit has as its main aim 'to set limits to the uncertainties now facing the suppliers of equipment and services for the offshore industry of oil and gas'. Exploration and development of the hydrocarbon resources of the North Sea has entered a new phase. After the oil price escalation in 1973, those industrialised countries outside OPEC, spent huge sums of money on oil exploration that was rewarded when the second oil price rise occurred in 1979. With the collapse of oil prices generally in 1986, the further spending of huge sums of money on oil discovery lost its point.

The last two years has seen a period of retrenchment and cost cutting. To make matters worse, the UK's North Sea oil development programme has been especially hard hit, given that its production is thought to have peaked. Today, some recovery of economic nerve is to be observed, but the future prospects for the North Sea industry remains highly uncertain.

The EIU Special Report reviewed here divides into two parts: Part I sets

out the context in terms of national, economic, fiscal and regulatory matters, the policy in the UK, Denmark, The Netherlands and the Republic of Ireland.

Part II gives a number of standardised profiles of each oil and gas field, country by country. It gives a brief history of development and shows the estimates of future capital expenditure.

The report is aimed primarily at the suppliers of exploration and development equipment and services in the countries mentioned above, but the book is an extremely informative and useful piece of literature for all those engaged or interested in energy topics.

There are over 240 platforms installed in the North Sea, all of which have to be maintained and operated. The annual operating and maintenance costs of these platforms is running at around \$5000 M, giving an operating cost for oil production of about \$4 per barrel. The growth in the number of platforms is likely to continue until the mid-1990s, before the economic cost of production becomes too excessive. The report makes the point that when such a period is reached, a whole new industry will develop. This will be for the provision of services and equipment to dismantle obsolete platforms. Only one platform has yet been dismantled. This was a small one installed, circa 1967, the cost of dismantling being £1.5 M.

An interesting point, bearing in mind the tragedy of Piper Alpha, concerns the legal framework. Under the 1958 Geneva Convention on the Continental Shelf, all such installations abandoned or disused, must be entirely removed. The report contains many interesting passages of a similar nature for the reader.

From a UK viewpoint, our production now appears to be decreasing. Oil output now runs at about 2.5 M barrels/day compared to 2.6 M in 1986. This stark fact will regretfully affect our future balance of payments. The question: when the UK will again become a net importer of crude oil, is posed. This is difficult to answer, as new discovery rates must be balanced against market demand and the economy of the production processes.

Of more immediate interest perhaps, are the UK's remaining gas reserves. The main Frigg field is thought to have reserves sufficient to last to a time between 1990 and 1992. The chief concern for British Gas is, of course, to cover its winter peak commitments. Much of the increase in the potential UK gas supplies, lies outside the Southern Basin province of the North Sea. At present, a big percentage of British Gas supplies are provided from its own Morecambe gas field. The report makes the point that British Gas will need to keep imports as an option, if it is to avoid being caught short in mid-winter when the UK gas demand can soar to twice its annual average value.

The report contains a series of maps of the North Sea and Irish Sea, that can

be read in conjunction with Part II which details the present situation at a number of the more interesting plants in operation or to be developed.
F J L Bindon

Source term evaluation for accident conditions

IAEA, Vienna
775pp. 1580 Austrian Schillings

The book is a collection of some 60 separate papers that contain a vast amount of information on the subject of source terms. The use of the phrase 'source term' is fairly new and, even to many people in the nuclear field, rather undefined.

Since the early days of nuclear generation, extended research work has been undertaken to try to define the potential consequences of a nuclear accident which involves the release of radioactivity to the environment.

As public concern and controversy has increased, so has the effect been concentrated into new analysis techniques to examine the possible hazards. Source terms have now become indispensable to the adequate understanding of severe accidents.

The majority of the papers published in this book are in English. They have been brought together as the result of an International Symposium organised by the IAEA which was held in the United States in November 1985, some six months before Chernobyl.

The book contains five major sections; in-vessel release, retention in the primary circuit, ex-vessel release, containment retention and release from the plant.

Each section contains papers from a wide variety of experts in their particular field of study, but unfortunately the

discussions are excluded. On the credit side, it is pleasing to find that the publishers have included the papers presented in the poster sessions.

Whether the basic and generic findings expressed in the many papers should be used for the practical aspects of source term application is open to question. Source terms are mainly equated to plant-specific details. The individual nuclear power plant must be identified clearly in order to ascertain the most effective way of preventing radioactivity releases. In addition, increasing attention must be given to accident prevention and control management as an overall policy for the whole of the nuclear industry.

The book emphasises that existing emergency plans should be reassessed in view of present knowledge. This is certainly so after the event in the USSR. It further sees existing engineered safety features and operational procedures needful of re-examination and that source term and containment behaviour will have a beneficial impact on evaluation of radioactivity releases and their consequences.

Although each paper has references to other works on the topic, the book does not have an index other than its contents list. This is not in itself a major drawback because it is possible to select particular aspects of the work from the contents. It is however very much a book for the specialist.

F J L Bindon

Recently published

Energy and environmental terms: a glossary

Peter Brackley
Gower Publishing, Aldershot, 1988.
Price: £21.45

Business directory of Hong Kong

Available from: Current Publications,

GPO Box 9849, Hong Kong. Price: US\$70.00

HEVAC yearbook and product directory

Available from: HEVAC Association, Sterling House, 6 Furlong Road, Bourne End, Bucks SL8 5DG. Tel: (06285) 31886

World energy directory

Longmans, 1988. Price: £160.00

Network energy — energy directory
British Gas, 1988

Readers may be interested to know that **Emigration of German-speaking engineers to Palestine 1933-1945** by Yoav Gelber and Walter Goldstern (Senior Fellow) has been published by VDI-Verlag GmbH. The book is written in German and is available from VDI-Verlag, Düsseldorf (ISBN 3-18-400 833-9).

In the preface Dr-Ing Peter Gerber (director, VDI) and Prof Dr-Phil Wolfgang König (Technical University of Berlin) write: 'Walter Goldstern... had effectively sponsored the investigations as initiator, collector, reminder and as a person who suffered under Nazi persecution. Now, however, at the age of over 80, he decided to add to his numerous activities and tasks throughout his life as a professional engineer, the new profession of a historian. The present book is mainly his work, even though he was advised by VDI-Committee and has found in Prof Yoav Gelber of the University of Haifa a co-author who contributed the chapters dealing with general aspects of the emigration to Palestine. The mixture of historical analysis and reflection, documentation of the material collected with the personal experiences of the author, who lived through this period, is at the same time the strength and the weakness of the book. For the science of history it will be a widening of material and problems, for the expelled engineers it will be a mark of honour, for the younger generation a warning.'

(Continued from p. 11)

of CREATE. All such activity will be recorded in the newsletter or through NERIS or through the many links being formed with educational journals. In this way current teaching material can be disseminated widely and hopefully save teachers much work in 'reinventing the wheel'.

Energy management

An important aspect of energy education and training must be that of energy management whether it be in the home, school or in industry and commerce.

In schools the influence of local financial management (LFM) will be significant and training courses for head teachers and indeed all teachers will be essential during the coming months. CREATE will be active in providing this training.

Energy management in industry is essential and the need to train energy managers and provide a suitable vehicle for exchange of ideas and information is a continuing priority. CREATE is investigating ways of

helping to achieve this. The many local and national efforts in this area are currently disparate.

International cooperation

It is the intention that CREATE will make contact with many energy agencies abroad and with overseas education and training organisations in the EEC and beyond. In this way, a larger reservoir of information and ideas will become available for exchange on an international basis.

The Institute has taken an important and timely initiative. This brief outline of CREATE's aims shows that the programme is ambitious. It can be done and Institute of Energy members at all levels can help to ensure that it will be done.

If you have any comments upon CREATE and if you can help in any way, please contact Peter Reynolds the CREATE administration officer on 01-436 3981. CREATE officers are available to offer further explanation or to address local meetings — please ask. □

Big G and Little G New names announced

National Power is the name to be given to the larger of the successor generating companies to be formed from the Central Electricity Generating Board under the Government's electricity privatisation proposals.

The new company will own 70% of the CEGB's generating capacity in England and Wales. It will have almost 30 900 MW of conventional capacity and some 9000 MW of nuclear capacity.

The Power Generation Company (PowerGen) will inherit 38% of the current fossil-fired generating capacity of the Central Electricity Generating Board.

Source: CEGB

Freeze on coal prices For CEGB deal

Power station coal prices are likely to be frozen as the electricity industry enters its final year before being broken

up for sale to the private sector reports the *Financial Times*.

A deal between the Central Electricity Generating Board and British Coal will further enhance the CEGB's commercial prospects while making it harder for the coal industry to realise its cherished aim of breaking even in the current financial year.

In the long run, however, it strengthens British Coal's case for keeping the bulk of its power station business, once the privatised electricity industry is freer to purchase imported coal.

Although inflation is currently running at about 6%, the new deal will leave the price of most power station deliveries unchanged. That could cut British Coal's income over the next 12 months by nearly £100 M.

With British Coal's financial year ending on March 31, that might cut its operating profits in 1988-89 by nearly £50 M, almost as much as the margin by which it had been hoping to break even for the first time for more than a decade.

However, corporation officials have not completely given up hope of breaking even this year, thanks to the industry's higher than expected productivity levels throughout the summer.

Source: *Financial Times*

Offshore supplies Newsletter

The Offshore Supplies Office at the Department of Energy has recently published the third edition of their *Export Newsletter*. The newsletter highlights some of the markets that continue to feature prominently in OSO's export work and could offer particular opportunities for UK suppliers of oil and gas equipment and services.

Copies of the newsletter are available from Robert Kipps, Department of Energy, Offshore Supplies Office, Room 1482, Thames House South, Millbank, London SW1P 4QJ. Tel: 01-211 6616.

Source: *Offshore Supplies Office*

PEP Awards National winners announced

A company producing horticultural giftware in Chedburgh, Suffolk, and a manufacturer of hand cut lead crystal glass in Stourbridge, West Midlands, have won the electricity supply industry's national PEP (Power for Efficiency and Productivity) Awards for 1988.

Sir Philip Jones, chairman of the Electricity Council, presented the awards to SimpleGrow and Stuart Crystal who were judged the winning entries from those submitted by 355 companies throughout Britain.

The PEP Award scheme is organised by the electricity supply industry to reward companies who have significantly improved their business performance by adopting an electrical process or service. Regional competitions were held by the Electricity Boards in England and Wales and in the North of Scotland for companies with up to 100 employees and for those with over 100. The regional winners, who went forward to the national competition, between them achieved aggregated benefits of nearly £8 M in the first year, which meant that the average payback on capital invested was about 17 months.

SimpleGrow won first place in the category for companies with up to 100 employees for the extensive production benefits gained from the installation of electric powder coating and in infrared oven to produce a high quality finish on pottery for the horticultural giftware market.

Replacing a fuel-fired kiln with the electric equipment has eliminated the need for a second firing. The product is

British Gas Monopoly complaint upheld

British Gas was condemned by the Monopolies and Mergers Commission for charging high and discriminatory prices to industrial customers reports the *Financial Times*.

The commission's report, endorsed by the Government, says British Gas's pricing policies represented an abuse of its monopoly position and acted against the public interest.

It proposed that the corporation's licence under the Gas Act (1986) should be changed to bring it under closer control by the Office of Gas Supply (Ofgas) in the industrial market. It also said the company must publish a schedule of industrial prices and that its position as sole purchaser of North Sea gas must be ended.

The commission rejected British Gas's complaint that such changes would contravene the Gas Act under which the corporation was privatised nearly two years ago. The report said that changes should be made even though relatively little time had elapsed

since privatisation.

The report was unsympathetic to a claim that the measures would cut British Gas's £290 M profit from the industrial market to almost zero.

The commission found British Gas varied its prices by up to 10p per therm from a maximum of 34.4p depending on the ability of the customer to turn to alternative fuels and the use to which the gas was put.

It added: 'Despite the difficulties in making price comparisons, and various factors which may affect relative prices, we believe that high UK gas prices are cause for real concern.' Its recommendations were intended to bring UK industrial gas prices down relative to those in other EC countries, the report said.

The commission also recommended that British Gas should publish much more detailed information about the prices it would charge to potential competitors for the use of its pipelines.

It said the company should be allowed to purchase only 90% of the output of any new North Sea Gas field in the UK sector, but if the remainder was unsold two years later, British Gas should have the option, though not an obligation to buy it.

Source: *Financial Times*

now heated and then sprayed — the heat in the product curing the powder to a quality finish. This has increased throughput by 200% while reducing the reject rate from 12 to one per cent. Energy costs have also been halved, which has contributed to the recovery within one year of investment in the new technology for this traditional craft.

Winner of the category for companies with more than 100 employees was Stuart Crystal, one of the leading producers of hand cut lead crystal glassware, which made a major investment in electric melting to increase competitiveness in world markets.

An electric continuous cold top tank furnace has replaced fuel-fired pot furnaces and produced an eight per cent increase in 'first quality' yield of the company's 30% lead crystal glass. The new furnace has more than halved energy costs per tonne of glass melted. The installation has also given potential for further improvement. In addition, there has been a considerable improvement in working conditions.

Sir Philip stressed that a privatised electricity supply industry would be just as keen to promote efficiency and profitability. This could serve only to enhance the opportunities for its customers to achieve greater cost effectiveness and enterprise.

In conclusion, Sir Philip said that the winners of this year's national PEP Awards, together with the winners in the next two years, if they agreed, would form the UK short list from which would be selected the entries to the new international 'eta' awards launched by UNIPEDA, the International Union of Producers and Distributors of Electrical Energy.

Source: *Electricity Council*

British Standards BS 799

BS 799 Part 7: Specification for dimensions for atomising oil burner pumps with rotating shaft and external drive is now available from BSI. Copies are available from BSI Sales, Linford Wood, Milton Keynes MK14 6LE. Tel: (0908) 220022.

Source: *BSI*

Nuclear safety research

To go to DOE

Responsibility for most of the nuclear safety research programmes currently funded by the Department of Energy with the United Kingdom Atomic Energy Authority (UKAEA) will move to the Health and Safety Commission (HSC) in 1990. In addition legislation

will be introduced to enable the HSC to recover the cost of this research from nuclear site licensees and applicants for licences.

Energy Minister Michael Spicer announced the proposed transfer in a Parliamentary answer to Andrew Mitchell (Gedling). He said: 'Following discussions with interested parties, it has been decided that the Health and Safety Commission (HSC) will take over the Department of Energy's responsibility for contracting research programmes related to the safety of established thermal nuclear power systems. The transfer covers the existing programmes funded by my department and carried out by UKAEA on pressurised water reactor (PWR) safety and advanced gas cooled reactor (AGR) safety, together with relevant parts of the General Nuclear Safety programme. The transfer to the HSC will take place on 1 April 1990 and the HSC's responsibilities will be managed on its behalf by the Health and Safety Executive (HSE).'

Source: *Department of Energy*

Fuel cells Effects of contamination

To enhance the efficiency and operation of molten carbonate fuel cells (MCFCs), the US Department of Energy has awarded a new research contract to Energy Research Corporation (ERC) of Danbury, Connecticut. Under the contract, the company will assess the combined effect on MCFC performance of trace elements and other compounds that are found in coal-derived fuel gas streams. In addition it will conduct analyses to understand the chemical interactions that occur between the MCFC components and the gaseous trace elements and other compounds.

MCFCs continuously transform the chemical energy of a gaseous fuel and oxidant to electrical energy. Unlike a battery, a fuel cell does not require recharging; as long as fuel and oxidant are supplied to the electrodes, it will operate for an extended period of time. This electrochemical transformation is isothermal, that is the fuel cell directly uses the available free energy in the fuel at its operating temperature, which provides high energy conversion efficiencies.

Operating MCFCs with coal-derived fuel gas requires careful consideration of the effect of contaminants on their performance. A great many elements and their compounds are present in coal and, therefore, the coal-derived fuel gas. Many of these elements and compounds can decrease the power output or cause mechanical failure of the MCFCs through contamination or fouling. The primary contaminants

that are being considered are sulphur compounds, halogen compounds, nitrogen compounds, trace elements, hydrocarbon compounds, and particles.

Under the \$460 000 contract, the effect of at least three trace elements on MCFC performance will be investigated individually before the combined effect of trace elements as well as other compounds is assessed. Researchers at ERC will conduct the necessary tests to ascertain the MCFC tolerance level for each of these trace elements. Subsequently, researchers will determine the MCFC tolerance levels for a combination of at least eight contaminants, including trace elements and other compounds. They will accomplish this by conducting thermogravimetric, half-cell, and bench-scale experiments that use a simulated fuel gas from a coal gasifier. The effect of the combined trace elements and compounds will be mathematically modelled, and the model predictions will be compared with the experimental results.

Both the MCFC combined tolerance levels and the model will be used to develop cost analyses for future work. The combined tolerance levels will also be used to determine if advanced, hot gas clean-up control technologies need to be developed to integrate the coal gasifier/MCFC system. Successful integration could lead to commercialisation of the technology.

Source: *US Department of Energy*

Hot gas sulphur US research into sorbents

In an effort to develop hot gas desulphurisation sorbents, the US Department of Energy recently awarded two contracts. These sorbents can be used to clean fuel gas from a coal gasifier before it is used to produce electricity. The contracts were awarded to the Research Triangle Institute (RTI) and the GE Corporate Research & Development (GE-CRD) Centre.

Both contracts further the development of an integrated gasification combined-cycle system. A key element of this system, one of the most promising advanced power generation systems, is desulphurisation of coal gases at high temperature and pressure.

Both contracts will seek to identify and demonstrate methods to enhance the use of desulphurisation sorbents for removing sulphur from hot, coal-derived gases.

The sorbent specified for study is zinc ferrite (a combination of zinc and iron oxides). A number of zinc ferrite based sorbents will be formulated, tested and screened in the laboratory. From these results, several formulations will be selected for bench-scale testing.

RTI will concentrate on developing sorbents for use in a fluidised-bed reactor. An existing bench-scale reactor will be modified for use in the tests. This portion of the contract is expected to last two years.

GE-CRD's contract work concentrates on moving-bed reactors. The sorbents in a fluidised-bed reactor are smaller and move faster than sorbents in a moving-bed reactor where the sorbent moves slowly down through the reactor bed. The GE-CRD contract also includes options which would last 38 months. These options are for improving other types of desulphurisation sorbents such as zinc titanate (a combination of zinc and titanium oxide) for use in hot, packed-bed processes. If these options are exercised the contract value would increase approximately \$227 285.

Research at Morgantown Energy Technology Centre had identified zinc ferrite as a leading candidate sorbent for high-temperature desulphurisation of coal gases. The zinc ferrite sorbent was shown to reduce sulphur dioxide emissions to levels far below that required by the New Source Performance Standards for coal-fired power plants.

Source: US Department of Energy

Oil and gas More than first thought

The UK's oil and gas reserves are greater than was thought six months ago and the cost of recovering them is decreasing, says County NatWest WoodMac in its latest North Sea Report reports the *Financial Times*.

Estimates of total reserves in oilfields already developed or committed have risen by 560 M barrels since the last survey in March. This is twice the size of the estimated oil reserves in the BP's Miller field, which was recently approved for development by the Government and is the largest field to be developed for six years.

The increase in estimated reserves reflects oil companies' improving recovery techniques and greater optimism about the effectiveness of extending projects.

The increase represents a rise of 3.8% on previous estimates of total reserves in the UK sector of the North Sea and increases by 8.5% the estimate of reserves remaining to be produced.

Source: *Financial Times*

Coal port For foreign coal

Harbour authorities on the River Tees, in north-eastern England, may build one of Europe's biggest coal ports if

sufficient demand for foreign coal materialises when power stations are privatised reports the *Financial Times*.

The port, on the 300-acre site of a former Shell refinery, would unload 160 000 t vessels of the type hauling coal to Europe from low-cost producers in Australia, Colombia and South Africa.

It would have 600 000 t of stocking space and be able to handle 6 M t of cargo a year.

About two thirds of the coal would be offered to private power stations; the rest could be shipped on smaller vessels to coastal power stations and factories elsewhere in Britain and Scandinavia.

The port is one of several schemes under consideration for expanding the capacity of British ports to land coal for the private power industry and for other customers.

Source: *Financial Times*

Minipower stations British Coal seeks partners

British Coal are seeking partners for the joint construction and operation of mini power stations for the independent generation of electricity for the public supply, industrial and commercial use said the Corporation's commercial director, Malcolm Edwards, in London recently.

He explained how it is feasible for about 1500 MW of small coal-fired capacity, involving a total investment of more than £1 billion, to be started in the UK in the next five years.

Mr Edwards told a seminar organised by British Coal for companies likely to be interested in private power generation that the Corporation's primary objective was to secure long-term coal supply contracts with the large privatised generating companies. However, the great changes now in prospect for electricity generation in Britain heralded developments parallel to the multiplicity of small local independent power generation or combined heat and power schemes commonplace in Europe and the United States.

Source: *British Coal*

Nuclear insurance Likely to continue after privatisation

The Government is likely to continue to provide a large part of insurance cover for nuclear power stations under proposals to privatise the electricity supply industry reports the *Financial Times*.

This was made clear by Mr Christopher Wilcock, a Department of Energy official, during three days of cross-examination last week at the

public inquiry into plans to build Britain's second pressurised water reactor nuclear plant at Hinkley Point, Somerset.

Under current legislation the Central Electricity Generating Board has public compensation liability of up to £20 M for each nuclear site and a further £210 M is available via the International Monetary Fund.

Mr Wilcock said that under present arrangements the Government would decide whether it wanted to draw on the fund, but it would have to ask for parliamentary approval.

He said that he understood there would be no change in the position under privatisation.

Source: *Financial Times*

Heat with rent New scheme for local authorities

In conjunction with British Gas, a gas appliance manufacturer,* has developed a low cost central heating system called Heat with Rent. The system is said to provide a cost effective alternative to electricity for local authority landlords.

Based on the manufacturer's Warmplan XX gas wall heaters, Heat with Rent should provide benefits for both landlord and tenant. A centrally controlled time switch controls the whole heating system and minimum and maximum temperatures are guaranteed to each individual dwelling.

For the tenant, the specially adapted wall heater gives a choice of maximum and minimum heat settings between 15°C-20°C. A thermostatic control ensures even heat and tamper proof controls mean the heater cannot be turned off. These all add up to controllable economic warmth, with nominal heating costs that can be added to rental payments.

Source: *Robinson Willey*

East/West collaboration On nuclear power

A general agreement for industrial cooperation in the planning and construction of small high-temperature reactors (HTR) has been concluded in the Soviet Union by Asea Brown Boveri AG (ABB), Mannheim, and the KWU Division of Siemens AG Berlin and Munich. On the Soviet side, the contracting party was the Central Administration for Nuclear Power (Glawatomenergo) of the State Committee for the Exploitation of Nuclear Energy (GKAE). The contract was signed in Moscow in the presence of Mikhail

*Robinson Willey

Gorbachev and Chancellor Helmut Kohl.

The initial phase of this general agreement covers the joint planning and construction of a large-scale experimental plant comprising a modular high-temperature reactor with a thermal capacity of 200 MW for the NIIAR research centre in Dimitrovgrad, some 800 km east of Moscow. In addition, the joint implementation of follow-up systems for generating electrical power, process steam and/or process heat are planned in the USSR and possibly for other countries.

The large-scale experimental plant to be built in Dimitrovgrad will during the first few years be operated at temperatures up to 700 to 750°C; the plant will subsequently be converted for elevated operating temperatures up to 950°C in order to demonstrate the capability of generating high-temperature process heat for the chemical industry and the gasification of coal. For this purpose, both partners will in the future conduct joint project-oriented research and development work.

Source: ASEA Brown Boveri

Isle of Man Extends power station

The £13.7 M turnkey contract to extend the Isle of Man's main power station at Pulrose was completed in October. The new power station extension will provide the island with an additional 19 MW of generating capacity.

The power station represents the conclusion of the first phase of a massive expansion programme being undertaken on the Pulrose site for the Manx Electricity Authority*. The second phase of the programme is currently underway, with a further three Mirrlees Blackstone diesel powered generating sets being supplied under an additional £8 M turnkey contract. Awarded by the authority in March this year, this latest contract will more than double the power station extension's output, boosting its capacity to nearly 50 MW.

Source: Hawker Siddeley Power Engineering

PWR Vital, says CEBG

A pressurised water reactor (PWR) at Hinkley Point, Somerset would be the best option to help meet the requirement for extra capacity by the turn of the century, the Central Electricity Generating Board has said. The station

would represent the earliest means of providing a substantial contribution to the non fossil fuel quota, said Sam Goddard, the Board's corporate director of System Planning.

Under the Government's privatisation proposals distribution companies would be required to contract for a minimum proportion from non fossil sources by 2000. This quota was intended to be not less than the present level of existing and committed nuclear and renewable generating capacity.

Presenting evidence on the comparison between other non fossil options and Hinkley Point C to the Public Inquiry at Cannington, Mr Goddard said the station was the right choice on economic and environmental grounds to follow Sizewell B, the Board's first PWR now under construction in Suffolk, and was sufficiently well advanced to be commissioned in 1998 when the additional 1175 MW capacity was needed.

The contribution of renewable energy sources was uncertain, said Mr Goddard, but by the year 2000 it would be unlikely to exceed about half the equivalent plant capacity of Hinkley Point C. Wind energy was now regarded as one of the most promising of the renewable energy sources. Until more practical experience of its reliability, economic viability and environmental impact in this country had been gained as the result of three new wind parks, each planned to have 25 wind generators, it could not be considered for large-scale development.

To further the technology, the Board had embarked on an expanded wind power programme which, if successful, could lead to a modest contribution to electricity supplies from the wind by the year 2000. Although a useful contribution, this could not replace the need for Hinkley Point C.

Turning to the potential contribution from tidal power, Mr Goddard said that although it was a well-established technology, only two schemes, the Severn and Mersey, offered prospects of substantial power generation. Analysis by the Board of the figures in the 1986 report of the Severn Tidal Power Group (STPG) demonstrated that the Severn Barrage would be uneconomic in comparative generation costs with Hinkley Point C.

Even on the programme presented in the 1986 report, which now looked optimistic, the barrage would be unlikely to be available in time to help meet the non fossil fuel quota by 2000.

Of the other renewable technologies considered, hydropower and electricity generation from refuse were established technologies, but the Board anticipated only a limited additional contribution from these.

Additional imports from non fossil fuel sources could not be assumed to be available as a contribution to the shortfall of about 3120 MW in the non fossil fuel quota which was expected to arise during the 1990s.

It was likely that export of surplus

electricity from Scotland in the future would be from fossil sources. More experience was needed of the existing link with France before any decisions could be taken on a new one.

Moving on to an assessment of the comparative merits of other potential PWR sites at Druridge, Northumberland; Dungeness, Kent; Sizewell, Suffolk; Winfrith, Dorset; Trawsfynydd and Wylfa, North Wales, Mr Goddard said that, taking economic, system and environmental considerations into account, Hinkley C represented the best option for the next PWR.

Source: CEBG

Ivory Coast oil Espoir Field to shut down

Phillips Petroleum Company Ivory Coast will cease oil production later this month from the Espoir Field, located offshore Cote d'Ivoire. According to Wayne Allen, vice president, International Exploration and Production, the field has become uneconomic due to declining production and weak oil prices. Recently, the company's share of production has been averaging about 5500 barrels of oil a day.

Production facilities, consisting of a converted jack-up drilling rig and a storage tanker, will be removed by the end of this year. The subsea wells will be plugged in early 1989.

The company began exploration activity in the Cote d'Ivoire in 1975 and discovered the Espoir Field in 1980. The field began production in 1982 and has produced approximately 30 M barrels of oil.

Source: Phillips Petroleum

US nuclear plant Dogged by leaks

The US Department of Energy has come under bitter attack from politicians and residents of the Cincinnati, Ohio, region following an alarming admission that it secretly released thousands of tons of radioactive uranium waste from its 37-year-old Fernald plant into the atmosphere and water supplies reports *The Guardian*.

In testimony before Congress, government officials acknowledged that they knew 'that the normal operation of the Fernald plant would result in emissions of uranium and other substances' into the Great Miami River (which runs close to the plant) and the atmosphere.

The Fernald plant near the city of Cincinnati processes uranium for nuclear weapons production, including the Department of Energy's military

*Hawker Siddeley Power Engineering

reactors in South Carolina — on the Savannah River — which also are under scrutiny for years of safety violations.

The government's admission of awareness of the problem, together with details of how much radioactive material had been emitted into the atmosphere, has been forced into the open by a lawsuit conducted by 14 000 Ohio residents against National Lead of Ohio, the contractors for the government.

Evidence collected by Ohio's own Environmental Protection Agency provides a picture of the potential damage to the population from the Fernald plant. Dr Richard Shank told the committee, in written evidence, that some 12.7 million lbs of uranium has been disposed of in pits since the plant opened in 1951. An additional 167 000 lbs had been discharged into the waters of the Great Miami river.

Source: *The Guardian*

UK/Japan cooperation A new report

A report published by the Science and Engineering Policy Studies Unit (SEPSU) of the Royal Society and the Fellowship of Engineering shows that collaboration between the UK and Japan in science and technology and in related industrial and academic research is an increasingly important feature of relations between the two countries. The report was commissioned from SEPSU jointly by the Cabinet Office and the UK-Japan 2000 Group. It presents a detailed review of the nature of research collaboration between the UK and Japan. It analyses the motives for collaboration; discusses what is being shared or exchanged between partners; considers how collaborations are initiated, structured and financed; addresses specific management issues such as intellectual property and methods of communication; and looks at the overall benefits accruing to the partners.

The report says:

■ Basic and applied scientific and technical knowledge flows in both

directions, but on balance it flows most often from the UK to the Japanese partner (particularly at the basic end of the R & D spectrum) with the UK partner obtaining other sorts of benefit from the collaboration;

■ Japanese companies appear to find it easier to collaborate with UK academics than do UK companies with Japanese academics;

■ intellectual property rights generally cause few problems, either because detailed arrangements are agreed at the outset or because in some collaborations (typically those involving academic partners) the partners do not regard them as important;

■ long-term commitment is essential for successful collaboration with Japan;

■ Japanese students in UK universities are typically studying economics, politics or law rather than science or engineering;

■ collaboration is a complex process with a wide variety of objectives, structures and benefits.

Copies of *Collaboration in science and technology between the UK and Japan* are available from SEPSU, 6 Carlton House Terrace, London SW1Y 5AG. Tel: 01-839 5561. Price: £16.00 (inc P&P).

**FOR ADVERTISING RATES
CONTACT
SARAH CARPENTER
(0233 43712)**

CHP/DH: the Belfast case (continued)

heat for residential, commercial, institutional and industrial use. With new technology pre-payment meters will overcome the frequent complaints from private sector customers regarding the unsatisfactory metering of heat consumption, and the bad debt problem which has been a disadvantage in the existing DH schemes. A more competitive source of heat and the provision of a potential market for waste heat might attract industries to Belfast.

The construction and operation of the CHP/DH system will provide significant employment opportunities within Northern Ireland. Most of the labour involved in installing the transmission main and distribution system, in the construction of the HOB station and local pumping stations, will be locally recruited. It may be possible to set-up a small factory in Northern Ireland to produce insulated pipe under licence to one of the insulated pipe producers, as with progressive construction of the system the delivery of insulated pipe will extend over many years. The consumer units should be suitable for local design and manufacture. Once the CHP/DH system begins to be installed and brought into service there will be a need for management, accounting, cash-collecting, operational and maintenance staff. The estimated work content of the Belfast scheme over the 35 years from the start of construction is 36 400 man years.

Conclusions

A CHP/DH system has been proposed for the HDHL area of Belfast fed from a lignite fired CHP station. The economic examination shows a rate of return on

capital of 6.9% which exceeds the 5% against which public sector projects are tested. If a future fuel price rise of 1% pa is postulated with a corresponding increase in selling price, then the internal rate of return over 35 years is 8.7%.

In the private sector, where it is usual to make an allowance for inflation, the internal rate of return increases to 13.4% for an assumed inflation of 6% pa. Long term cash flow is very good. However, in view of the high percentage of the total capital expenditure outlaid before substantial resources are generated, and the associated commercial risk such as achieving the market predicted by market research, the private sector sources of capital would require a much higher prospective return. The rate of return is nevertheless sufficient to justify optimism that a significant part of the funding would be available from the private sector, if there was support from the Government or supranational source to take a substantial part of the risk.

There are other advantages of CHP/DH not quantifiable in terms of the economic case, such as energy conservation and reduced pollution.

References

1. Combined heat and electrical power generation in the United Kingdom. Energy Paper No 35, July 1979.
2. CHP/DH feasibility programme: stage 1. Summary report and recommendation for the Department of Energy, W S Atkins & Partners, Energy Paper No 53, HMSO, 1980. □

1989 January/ February meetings

Midland

5 Jan (Th). *Gasification: a key to the clean use of coal*, a review of gasification technology, its applications, economics and environmental considerations by Dr J A Lacey (British Gas Midlands Research Station). Senior Common Room, University of Aston at 1900 h.

2 Feb (Th). *Heat treatment in the glass industry* a review of processes and equipment, by H Holt (Stein Atkinson Stordy). Senior Common Room, University of Aston at 1900 h.

East Midlands

9 Jan (M). *Quality integrity within the automotive industry*. Joint meeting with Lincs Iron & Steel Institute at BSC Scunthorpe at 1930 h.

9 Feb (Th). Process control development at Dawes Lane coke ovens by R C Mills (BSC General Steels) Joint Meeting with COMA at Orgrave, 1930 h.

North Eastern

10 Jan (Tu). *The engineer and society* by Dr L Mercer (director, Engineering Research Station, Killingworth). Joint meeting with the Institution of Gas Engineers in the lecture theatre, British Gas School of Engineering, Killingworth at 1730 h. Tea and biscuits will be served before the meeting.

8 Feb (W). *Energy efficiency in the glass industry* by K Hamilton and other speakers from Corning. Joint meeting with the North East Energy Management Groups and the North East Section for the Society of Glass Technology. 1400 h at Corning, Wear Glassworks, Sunderland. Tea and biscuits will be available following a tour of the works.

28 Feb (Tu). *Opencast coal mining vs The environment* by R Proctor managing director, British Coal Opencast Executive) and M Brocklesby (Council for the Protection of Rural England). Curtis Auditorium, Physics Building, University of Newcastle upon Tyne at 1800 h.

Scottish

10 Jan (Tu). *The John Reyner Shield*, presentations of short papers by young engineers competing for the John Reyner Shield. Napier College, Colinton Road, Edinburgh. For more information contact the honorary secretary, John McColl, on 041-332 2453.

7 Feb (Tu). Presentation on offshore oil and gas by Prof T Patten. Contact John McColl (above) for further details.

South Wales and West of England

11 Jan (W). *Landfill gas — harnessing the spectre* by Keith Wake (Coal Processing Consultants). Polytechnic of Wales, Pontypridd at 1800 h, refreshments at 1730 h.

22 Feb (W). Young Persons' Papers Evening. University of Bath at 1800 h for 1830 h.

Yorkshire

18 Jan (W). *Nuclear energy — critical for Britain's future* by C E Pugh CBE (president, Institute of Energy). Leeds University at 1400 for 1430 h.

15 Feb (W). Visit to Yorkshire mining museum, Caphouse Colliery, New Road, Wakefield at 1830 for 1900 h.

New members Fellow

Raymond Philip Dickson, CEGB, Nr Bridgwater, Somerset (*transfer*)

Fred Nash, McLellan & Partners, West Byfleet, Surrey (*transfer*)

Peter Hamish Athey Roebuck, Kanthal, Perth, Scotland (*transfer*)

Member

Adel Karim Ahmed, Portsmouth Polytechnic, Hants, (*transfer*)

Michael John Baker, British Gas, Midlands Research Station, Solihull

Jeffrey Paul Blaevoet, Ove Arup & Partners, California USA (*transfer*)

Paul Michael Bradley, Troup Bywaters, Essex (*transfer*)

Alberto Bustani, Instituto Tecnológico de Monterrey, Mexico

Alan John Edward Carter, Dewest Services Consultants, South Croydon

Jonathan Peter Cox, Hoare Lea & Partners, Birmingham

Michael Down

Christopher George Easy, R S W Associates, Westcliff-on-Sea, Essex

Andrew Stephen Fox, British Gas Northern, Tyne and Wear (*transfer*)

Tai Ming Steven Lee, Environmental Protection Dept, Hong Kong

Simon John Mitchell, Eastwood & Partners, Sheffield (*transfer*)

Derek Kam Fat Man, Foster Wheeler Power Products, London

Tadevsz Oreszczyn, Polytechnic of Central London

Dennis Timmins, British Gas, Midlands Research Station, Solihull

Sai Wah Wong, Environmental Protection Dept, Hong Kong

Professional Associate

Kenneth Bruce Harrison, The Engineering Council, London

Associate Member

Philip Gardner, Baxter Healthcare, Thetford, Norfolk



L to R: Prof Derek Bradley, Dr C J Lawn (CEGB and the honorary secretary of the Combustion Institute), C E Pugh CBE (president, the Institute of Energy) and Dr J Gibson (chairman of the British Flame Research Committee and a past president of the Institute of Energy). The photograph was taken at the 'NO_x generation and control in boiler and furnace plant' symposium, organised by the South Coast branch of the Institute of Energy in conjunction with the Combustion Institute. The symposium, held on 8 September 1988 at the Crest Hotel, Portsmouth, attracted over 100 delegates.

Roger Galbraith Gerrish, British Gas, Cardiff

Peter Reynolds Lewis, R W Gregory & Partners, Cardiff

David John Moore, Stordy Combustion Engineering, Wolverhampton

Steven Donald Thomas, British Gas North Western, Manchester

Associate

Charles William Kibirango

Keith Alexander Weir Simpson, Saudi Consulting House, Saudi Arabia

Ting Rui Wei, Yunnan Chemical Research Institute, China

Graduate

Jamil Ahmad

Michael Joseph Ashe, University of Surrey

Stephen Michael Cornwell, University of Surrey

Minas Iatridis

Alastair James Nicol, Rendel Hancox, Glasgow

Olinga Ta'eed, Fairey Filtration Development, Hampshire (*transfer*)

Nicholas David Witney, British Gas, Brentwood, Essex

Joseph Owvor Lalah, Ministry of Energy, Nairobi, Kenya (*transfer*)

Student

Shahid Raza Malik, University of Leeds

Andrew John Wing, University of Newcastle upon Tyne

Personal

Malcolm Wesley (Member) has been appointed general manager, Canada for British Gas. He will have a key role in relation to British Gas's current and future business interests in Canada.

Mr Wesley joined the Gas Industry in 1957 and spent his early career in gas manufacturing and transmission. In 1974 he joined British Gas Headquarters and occupied a number of positions in the Production and Supply, Economic Planning, Research and Development, Finance and Resources and New Business Divisions.

P J Waite (Member) has been promoted to director, London Operations of Cremer & Warner.

The Engineering Council

Britain needs more engineers

Recommendations for improving the image of engineering among young people and for increasing the access to engineering university courses have been made by the Engineering Council and the Standing Conference on University Entrance (SCUE).

In a joint report *Admissions to Universities: action to increase the supply of engineers* the two organisations say that to eradicate the United Kingdom's balance of payments deficit it will be necessary to accelerate the country's acknowledged recovery. To accomplish this there must be a good supply of properly educated and trained people. At a time when the labour pool is set to diminish, at least equal numbers of higher technicians and graduates will be required now as in the recent past.

'The gap at the higher national level is extremely serious and is already reflected in reported shortages,' the report warns. The nation's weakness is most seriously exposed at the Incorporated Engineer level.

The Engineering Council and SCUE say that they and other organisations should continue to promote the widening of access to universities with particular reference to Business and Technician Education Council (BTEC), Scottish Vocational Education Council (SCOTVEC), International Baccalaureate (IB), Access courses.

SCUE and the Engineering Council in collaboration with other bodies should ask Government to review the funding arrangements for mature students on engineering Access and similar courses and to make grants available.

The Engineering Professors' Conference, the Committee for Engineering in Polytechnics and professional bodies should consider and recommend modifications to existing degree syllabuses to ensure that they are more suitable for students from a wider technical and scientific background.

It is also proposed that the image of engineering should be improved, by a co-ordinated initiative to illustrate the school syllabus in science, technology and mathematics, with practical examples drawn from industry, manufacturing, consumer products or from those providing public services. The initiative should cover primary and secondary education to the age of 18 or 19.

Copies of the report *Admissions to universities: action to increase the supply of engineers* are available from the Engineering Council, 10 Maltravers Street, London WC2R 3ER.

Be a college governor

A campaign to encourage its 300 000 Chartered Engineers and Incorporated Engineers to become school governors, has now turned the spotlight on Britain's universities, polytechnics and colleges of higher and further education.

In a leaflet called *Opportunities as a college governor*, the Engineering Council says that the Education Reform Act will lead to new and greater responsibilities for governors throughout higher and further education. The Council says that colleges will benefit from having more engineers as governors because engineers will:

- Improve industrial links
- Give a better understanding of the real needs of engineers
- Provide management skills
- Ensure that the academic programme is related to the needs of local employment.

Denis Filer director general of the Engineering Council, said that the new campaign to encourage engineers to become involved in running colleges followed the Council's successful campaign in the schools. 'The industrial and engineering background of an engineer can be beneficial to a college of further or higher education or to a polytechnic or university. An engineer can also help close the gap of understanding that exists between industry and education.'

Copies of the booklet *Opportunities as a college governor* can be obtained free from the Engineering Council.

Integrated engineering degree

Polytechnics and colleges have been invited to take part in pilot schemes for the new Integrated Engineering Degree Programme (IEDP) proposed by the Engineering Council. The National Advisory Body for Public Sector Higher Education (NAB) has written to directors and principals asking for outline proposals for selective funding for the IEDP courses in 1989/90. After evaluation of the outline proposals, up to six of the institutions that meet criteria prescribed by NAB will be invited to provide detailed proposals from which two or three will be recommended to the Polytechnics and Colleges Funding Council for the funding of the courses.

Annual dinner and dance — Sheffield University

The Annual Dinner and Dance of the Sheffield University Chemical Engineering and Fuel Technology Society will be held on Saturday, 11 March 1989. The venue is the Hallam Tower Hotel. For further details contact Mrs Lynne Williams, Department of Mechanical & Process Engineering, University of Sheffield, Mappin Street, Sheffield S1 3JD. Tel: (0742) 768555, ext 5252.

Joint meeting of the British and French Sections of the Combustion Institute

The joint meeting will take place in Rouen, France on 18-21 April 1989. It will deal with a wide range of combustion topics, but with a particular emphasis on oxides of nitrogen. It will allow presentation and discussion of current issues and work in progress. The meeting will be informal with plenty of time for discussion.

If you wish to present a paper at the meeting, let the organisers know as soon as possible. At this stage, you need to send just a title plus author(s) and affiliation(s). The organisers have already received an interesting range of submissions but more are welcome.

Regarding the meeting itself, it will be held in the Hotel des Societes Savantes inside the medieval city of Rouen. There are a good number of hotels available, offering accommodation at a range of prices.

For further information contact: David Smith, British Gas, London Research Station, Michael Road, London SW6 2AD. Tel: 01-736 3344 ext 4183 or Denis Stepowski, Faculté des Sciences de Rouen-CORIA, BP118 76134 Mont-Saint-Aignan Cedex, France. Tel: Int + 35 14 6577 or 35 14 6585.

Expert planning systems — 27-29 June 1990 — call for papers

The conference will take place at the Metropole Hotel, Brighton and is organised by the Computing and Control Division of the Institution of Electrical Engineers.

The conference is intended to be a forum for the dissemination of knowledge and experience among a broad range of people with an interest in or responsibility for planning in business, engineering, finance, or other environments in which complexity is present.

The Organising Committee is arranging a programme containing some invited contributions for consideration, but in addition, would welcome offers of contributions for inclusion in the programme. Papers are invited that will explore recent developments in methods of planning with

particular reference to automated aids and the impact of knowledge-based systems. There will be three main themes to the conference in which papers will be grouped by three different dimensions:

■ Level of planning (strategic, technical or operational);

■ Techniques involved (mainly expert systems, and systems involving knowledge-based techniques, although others such as economic modelling, computer-automated software engineering, may be appropriate);

■ Application area (manufacturing, finance, retailing, medicine, third world, national economy etc.).

Those intending to offer contributions should submit a synopsis (approximately 1000 words) to the Conference Secretariat before 5 May 1989. The synopsis should include the main points of the paper and where possible, indicate where the emphasis will be placed in relation to issues of levels, techniques, and application area.

Contributions should be sent to: EPS90 Secretariat, Conference Services, IEE, Savoy Place, London WC2R 0BL.

Computer training for energy managers

Vilnis Vesma (Member) will be running three courses for energy managers:

Spreadsheet technique for energy managers (26 January 1989) The one day course is suitable for new users of Lotus 1-2-3.

Energy spreadsheet master class (23 February 1989), for experienced 1-2-3 users.

Build your own M&T system with Lotus 1-2-3 (30 March 1989), for all users of Lotus 1-2-3 and compatibles.

The courses will take place in Tewkesbury, Gloucestershire and will cost £155 + VAT. For more information contact Vilnis Vesma on (0531) 821350.

Royal Society Esso Energy Award 1989

Nominations for the 1989 Royal Society Esso Energy Award should be sent to the Executive Secretary (ref: ASB), The Royal Society, 6 Carlton House Terrace, London SW1Y 5AG by the closing date of Friday 20 January 1989.

The award, instituted in 1974, is normally given annually for outstanding contributions to the advancement of science or engineering or technology, demonstrably leading to the more efficient mobilisation, use or conservation of energy resources, and consists of a gold medal and a prize of £2000. The intention of the award is to promote a more efficient use of all existing energy sources and to stimulate the development of new sources. The selection is made by the Council of the Royal Society on the advice of its Esso Energy Award Committee.

Italgas prize for research and innovation

Turin was the first Italian town to use gas for public lighting. In 1837 Compagnia di Illuminazione a Gas per la Città di Torino (later Società Italiana per il Gas) was established. Italgas has passed through processes of industrial reconversion tied to the technologies and the market of energy sources. In a century and a half it has built gas distribution networks for civil use throughout Italy.

On the occasion of its 150th anniversary, Italgas has decided to establish three prizes for research and innovation with the intent of offering recognition and stimulus to all those working on research for civil and social development in Italy and the other EEC countries.

Prizes will be awarded to researchers who have distinguished themselves in pure and applied research in the following fields: a) Physics and chemistry; b) Energy sciences; environmental sciences; c) Materials technologies and science; information systems; communications. For each category an annual cash prize of 100 M Italian Lire will be awarded.

Application forms are available from the Prizes Secretariat, Italgas, Via XX Settembre 41, 10121, Turin, Italy.

Prince of Wales Award

The 1989 Prince of Wales Award for Innovation and Production was launched in October. The award is organised by the Engineering Council with the aim of encouraging the creation and growth of new business based on British inventions and new technology.

Entry is open to a wide range of people and organisations, including private inventors, small firms and new businesses, other companies of all sizes, academic researchers in universities and polytechnics and research bodies. Entries should be new products or processes that incorporate an original British idea that leads to the

marketing of a new product. The closing date for entries is the end of January 1989. Because it takes some time to determine if a product is likely to be a success in the marketplace, the award is divided into two stages. The first, the *innovation stage*, will be completed by March 1989, when The Prince of Wales will present certificates to the finalists. The second stage is the *production stage*. The outright winner will be presented with a trophy by The Prince of Wales on the BBC TV programme *Tomorrow's World* in 1991.

Entry forms and further details can be obtained from: The Prince of Wales Award for Innovation and Production, The Engineering Council, 10 Maltravers Street, London WC2R 3ER. Tel: 01-240 7891.

Engineers — the chance to work abroad

The Fellowship of Engineering operates a scheme that is open to professional engineers who are British nationals and employed in industry, academia, local government or a research organisation. It is designed to support them on secondments of between six and 12 months to engineering organisations in developed countries overseas. The engineer remains an employee of his/her parent company or organisation and continues to receive salary and other benefits as normal, but half of the total cost of the secondment is met by the Fellowship and paid directly to the employer. Past candidates have visited countries such as France, Sweden, Germany and the USA. Applications for visits to all developed countries are welcomed, but we particularly wish to encourage applicants to visit member states of the European Economic Community and the newly industrialised Pacific rim countries including Korea. The preferred age range for applicants is 25-35.

For further details of the scheme and the application procedure please contact Jose Spring, Manager, Engineering Support, The Fellowship of Engineering, 2 Little Smith Street, London SW1P 3DL. Tel: 01-222 2688 ext 39.

ENERGY WORLD YEARBOOK 1989

The fifth edition of the Energy World Yearbook will be published soon. Members should receive their free copies together with the List of Members in January.

Extra copies may be ordered from the Institute of Energy (Dept PT), 18 Devonshire St, London W1N 2AU at a cost of £49.00.

Remittance with orders please.

REGISTER OF ENERGY COURSES

Course No 00-456

Title: VAV control
Duration: 3 days.
Location: South Bank Polytechnic, London.
Starting: 7 February 1989.
Content: The theory and practical aspects of industry standard electronic controllers — both analogue and digital.

Course No 00-458

Title: Energy management controls and systems — basic control theory.
Duration: 1 day.
Location: South Bank Polytechnic, London.
Starting: 14 February 1989.
Content: An introduction to control theory and application.

Course No 00-424

Title: Fluid sealing technology.
Duration: 3 days.
Location: Cranfield Institute.
Starting: 14 February 1989.

Course No 00-459

Title: Energy management controls and systems — microprocessors and control.
Duration: 1 day.
Location: South Bank Polytechnic, London.
Starting: 15 February 1989.
Content: An introduction to microprocessor control, interfacing and compatibility.

Course No 00-460

Title: Energy management controls and systems — specification, experience and the future.
Duration: 1 day.
Location: South Bank Polytechnic, London.
Starting: 16 February 1989.

Course No 00-425

Title: Slurry pumping rheology.
Duration: 1 day.
Location: Cranfield Institute.
Starting: 21 February 1989.

Course No 00-461

Title: Energy management workshop and targeting.
Duration: 1 day.
Location: South Bank Polytechnic, London.
Starting: 27 February 1989.
Content: Introductory talks followed by opportunity to tackle examples under supervision.

Course No 00-426

Title: Mixing of powders.
Duration: 1 day.
Location: POWTECH '89, Manchester.
Starting: 27 February 1989.
Content: The course establishes the principles of powder mixing and highlights the most attractive manufacturing process for complex, high quality, powder mixtures.

Course No 00-462

Title: Efficient use of electricity and lighting.
Duration: 1 day.
Location: South Bank Polytechnic, London.
Starting: 28 February 1989.
Content: Efficient lighting design. Efficient light sources. Light switching and motor control. Electrical tariffs and monitoring.

Course No 00-427

Title: Bulk powder testing.
Duration: 1 day.
Location: POWTECH '89, Manchester.
Starting: 28 February 1989.
Content: Bulk of 'technological' properties of powders such as the failure properties, handling angles, bulk densities, cohesiveness or aerated properties. Primary properties like particle size, shape and distribution, specific surface and particle density.

Course No 00-428

Title: Classification of powders.
Duration: 1 day.
Location: POWTECH '89, Manchester.
Starting: 1 March 1989.
Content: Processing of particle size distributions, review of the classification methods, assessment of classifier performance, air classifiers, hydroseparators.

Course No 00-463

Title: Basic refrigeration.
Duration: 3 days.
Location: South Bank Polytechnic, London.
Starting: 1 March 1989.
Content: Basic thermodynamics of the vapour compression cycle. Description of refrigeration equipment, its operation and control. Aspects of installation and

copper piping, pressure testing, leak detection, evacuating and charging of systems.

Course No 00-429

Title: Particle degradation in industrial processing.
Duration: 1 day.
Location: POWTECH '89, Manchester.
Starting: 2 March 1989.
Content: Basic particle properties. Assessment of attrition. Breakage mechanisms. Tests for friability. Attrition in various of industrial processes and operations.

Course No 00-430

Title: Circulating fluidised beds.
Duration: 1 day.
Location: POWTECH '89, Manchester.
Starting: 3 March 1989.
Content: A review of development of the circulating fluidised bed to date. Hydrodynamics. Gas and solids mixing. Heat transfer. Reactor modelling. Applications. Scale-up.

Course No 00-464

Title: Refrigeration systems and fault analysis.
Duration: 2 days.
Location: South Bank Polytechnic, London.
Starting: 9 March 1989.
Content: Fault analysis, to cover symptoms, diagnosis and rectification of system faults in refrigeration systems.

Course No 00-465

Title: Advanced refrigeration design.
Duration: 2 days.
Location: South Bank Polytechnic, London.
Starting: 14 March 1989.
Content: Refrigeration system calculations. Compressor performance characteristics. Design aspects of plant selection such as evaporators, condensers, control valves. Capacity control or refrigeration components and systems. Oil return, recovery and circulation. Refrigeration pipe design and sizing.

CONFERENCES

January 1989

Air-cooled heat exchangers

Workshop, Surrey (Chequers Thistle Hotel), 10-11 January 1989.

Details from Tom Ralston or Muriel Watt, National Engineering Laboratory, East Kilbride, Glasgow G75 0QU. Tel: (03552) 20222, fax: (03552) 36930.

International environmental and safety news

Conference, London (Connaught Rooms), 17-18 January 1989.

Details from Christine Smith, Thames Events (COSHH), Richmond Bridge House, 417-421 Richmond Road, Twickenham, Middlesex TW1 2EX. Tel: 01-892 3637, fax: 01-744 2142.

Energy sources technology

12th conference and exhibition, Houston, Texas, 22-25 January 1989.

Details from ETCE Co-ordinator, American Society of Mechanical Engineers, PO Box 59489, Dallas, TX75229, USA. Tel: Int + (214) 437 0094.

January/February 1989

Fuel alcohols and chemicals from biomass

Conference, Guadalajara, Mexico (Hyatt Regency Hotel), 30 January 1989-1 February 1989.

Details from W H Kampden, K-Engineering Inc, 447 Blue Rock Drive, Charlotte, NC 28213 USA. Tel: Int + (704) 598 0890.

Reliability of mechanical systems

Course, Watford (Spiders Webb Hotel), 31 January 1989-2 February 1989.

Details from the Conference Section, Institution of Chemical Engineers, 165-171 Railway Terrace, Rugby CV21 3HQ. Tel: (0788) 78214, tlx: 311780, fax: (0788) 60833.

February 1989

Commercial and contractual aspects of project management

Course, London (St Ermin's Hotel), 13-14 February 1989.

Details from the Conference Section, Institution of Chemical Engineers, 165-171 Railway Terrace, Rugby CV21 3HQ. Tel: (0788) 78214, tlx: 311780, fax: (0788) 60833.

Coal utilisation

Conference, Beijing, China, 20-23 February 1989.

Details from Dr Arnold H Pelofsky, AER Enterprises, PO Box 454, East Brunswick, NJ 08816, USA. Tel: Int + (201) 254 6930, fax: Int + (201) 254 6812.

Radioactive waste management

Conference, London (Gloucester Hotel), 22-23 February 1989.

Details from Katie Lye, IBC Technical Services, Bath House (3rd Floor), 56 Holborn Viaduct, London EC1A 2EX. Tel: 01-236 4080, tlx: 888870, fax: 01-489 0849.

February/March 1989

Fossil power plant rehabilitation

Conference, Cincinnati, Ohio, 27 February 1989-1 March 1989.

Details from: Technical Department Marketing, ASM International, Metals Park, OH 44073, USA.

March 1989

The new technology and wind energy

Conference, St Andrews, Scotland, 29-30 March 1989.

Details from the Scottish Branch of the BWEA, c/o Energy Studies Unit, University of Strathclyde, Glasgow G1 1XQ. Tel: 041-552 4400 ext 3307, fax: 041-552 0775.

Energy utilisation

Symposium, San Francisco, USA, 7-9 March 1989.

Details from David Rigney, EPRI, Energy Utilisation, PO Box 104 12, Palo Alto, CA 94303, USA. Tel: Int + (415) 855 2419, tlx: 910-373-1163.

Low temperature waste heat from power stations

Seminar, Gembloux, Belgium, 13-15 March 1989.

Details from Prof J Dettour, Faculté des Sciences Agronomiques et de l'Etat, 8 Avenue de la Faculté, B-5800 Gembloux, Belgium.

Mathematical modelling of processes in energy systems

International forum, Sarajevo, Yugoslavia, 20-24 March 1989.

Details from Dr M Ivanovic, Mechanical Engineering Faculty, University of Sarajevo, Omladinsko Setaliste bb, YU-71000, Sarajevo, Yugoslavia.

April 1989

Combined heat and power

Symposium, London (Heathrow Penta Hotel), 11-14 April 1989.

Details from Crest Communications, Bank Street, Lutterworth, Leicestershire LE17 4AG. Tel: 045 55 56418, fax: 045 55 3432.

Building services

CIBSE national conference, Warwick, 16-18 April 1989.

Details from the Conference Office, CIBSE, Delta House, 222 Balham High Road, London SW12 9BS. Tel: 01-675 5211.

May 1989

Design and manufacturing standards for the international nuclear industry

Seminar, London (Institution of Mechanical Engineers), 18 May 1989.

Details from The Secretary, Institution of Nuclear Engineers, Allan House, 1 Penderley Road, London SE6 2LQ. Tel: 01-698 1500.

June 1989

Heat production in Europe and North America

Symposium, Karlovy-Vary, Czechoslovakia, 4-9 June 1989.

Details from ECE Secretariat (Energy/SEM 7/INF 1), CH-1211, Geneva 10, Switzerland.

LP Gas '89

Exhibition, NEC, Birmingham, 6-8 June 1989.

Details from Gary Swinford, Industrial and Trade Fairs, Radcliffe House, Blenheim Court, Solihull, West Midlands B91 2BG. Tel: 021-705 6707, tlx: 337073.

Plant engineering and maintenance

Conference, Harrogate, Yorkshire, 8-9 June 1989.

Details from Rosemary Wood, Institution of Plant Engineers, Bankside, Hollybush Lane, Frensham, Farnham, Surrey GU10 3BN. Tel: 025 125 4702, fax: 025 125 4808.

Heat exchangers for Sizewell 'B'

A £150 000 heat exchanger contract for the Sizewell B nuclear power station reactor cooling system test facility has been awarded to **Graham Manufacturing** of Cheltenham.

The eight units to be supplied are the company's Heliflow heat exchangers. They were selected for their wide temperature-range capabilities, rapid response in on/off situations and their ability to operate efficiently with big variations in flow rates. Delivery is scheduled for early 1989.

The Alloa-based facility is designed to test the reactor cooling pumps in all operating modes and possible fail conditions (30% to 110% cooling capacity). Temperatures will be up to 305°C, to be cooled to 70°C with pressures to 184 bar. Four Heliflows in the cooling loop at peak loading will be dissipating more than 7850 kW.

The units' efficiency results from a design that eliminates 'dead' spaces and ensures an accurate, consistent flow velocity. It also defines the two fluid paths and permits 100% counterflow with high velocities for both hot and cold media. The Heliflow has no sharp turns or baffles to promote pressure drop. Instead, pressure drop energy is utilised for generating turbulence to promote efficient heat transfer.

Thermal stability results from the spring-like coils that absorb thermal expansion without putting strain on joints. Such stresses can shorten tube life and cause leaks in other types of heat exchangers.

Reader enquiry no 12/1

New pipe to pipe manifold

A **Whitey** pipe to pipe two-valve manifold that allows easy block, bleed and calibration of static pressure transmitters and gauges, is now available. The 316 stainless steel unit resists corrosion, and incorporates a high strength, one-piece body for safety. Connections are 1/2" female NPT and BSP in all three ports.

Valves are available with non-rotating ball tip stems, metal vee tip stems or metal vee tip stems with replaceable soft seat inserts. Other valve features include bonnet lock plates that prevent accidental dis-



Whitey pipe to pipe two-valve manifold

assembly, and metal body-to-bonnet seals (no O-rings). Valves are 100% pressure tested for shut off, and at all seals.

Standard service ratings range to 6000 psi (41 300 kPa) and from -54°C to 232°C. A high temperature version is available. Also available is a sour gas service option, with materials conforming to NACE standard MR-01-75.

Reader enquiry no 12/2

Low resistance terminals

Red Bank, the terra cotta manufacturer has redeveloped its low resistance terminal. Suitable for use on duo-pitch roofing with angled or half round ridges, the low resistance terminal recently redeveloped to meet requirements outlined in BS 1289: Part 2. It has also been approved by British Gas.

The terminal is manufactured in 450 mm lengths in most standard ridge tile profiles and decorative patterns. It is available in red terra cotta, buff fireclay, slate bodymix and a variety of sandfaced colours. Terminal design is such that maximum cross sectional outlets are provided, reducing the resistance to the flow of combustion gases.

Reader enquiry no 12/3

On line oxygen analyser

Teledyne's Model 316R trace oxygen analyser monitors O₂ contamination in nitrogen, argon, helium and many other pure gases and gas mixtures. The Model 316R monitors oxygen from parts per million (ppm) to parts per billion (ppb) levels.

The heart of the Model 316R is a micro-fuel cell O₂ sensor. This maintenance-free electrochemical device features an absolute zero and an output that is linear with respect to oxygen concentration which means no zero gases are required and atmospheric air (209, 500 ppm O₂) can be conveniently used for calibration.

The Model 316R features four full-scale switch-selectable ranges: 0-10, 0-100, 0-1000 and 0-10 000 ppm O₂. Also available are optional ranges as low as 0-1 ppm O₂! Other features include: A special span range of calibration; signal output; integral meter read-out; and optional alarms.

Reader enquiry no 12/4

New range of industrial temperature sensors

Portec Instrumentation have a new range of thermocouple and resistance thermometer sensors for the industrial and process control industries.

The sensors include all the thermocouple combinations from small light duty assemblies with fast response, as used in the food industries, up to heavy duty units with Inconel sheaths utilised in heat

treatment applications. These thermocouples are complimented by mineral insulated units ranging from 1 mm up to 6 mm diameter in many configurations.

The resistance thermometer assemblies follow a similar pattern with various styles available to meet the requirements of accurate temperature measurement and control in the process industries.

Reader enquiry no 12/5

New boilers in Manchester

Three Type 315 Raypak, rated at 74 kW (252 000 Btu/h) have been installed at Manchester airport's police headquarters. Tests carried out by the Airport Engineering Department have shown that during winter the new boilers have produced savings in running costs of between 40 and 45%. The boilers were supplied by **Acoustics and Environmetrics**.

The boilers are lightweight and compact in construction, and have low water content. They are designed to go through a standard doorway, and can be broken down and re-assembled quite easily. The advantage of the low water content in the boilers is an instantaneous response to demand for heating or hot water. For example, the water content of the boiler having 1 000 000 Btu/h output is only 1.25 gallons. By contrast a traditional cast-iron or steel boiler with the same output could have a water content as high as 125 gallons.

Reader enquiry no 12/6

Compact loop controllers

A network of 24 Protronic PS compact loop controllers, manufactured by **Hartmann and Braun UK**, has recently been installed at the CEGB power station at Blyth in Northumberland. Designed to control the superheat and re-heat burner tilt and spraywater systems on each of the four boilers.

Used to regulate the exact temperature of the superheated steam, which is fed to the turbines from the steam generator, the spray and tilt control system comprises a series of burners and low temperature water sprays, designed to maintain the output steam temperature within close limits at

465°C. Each boiler is coal-fired with an attenuator device used immediately before the final superheater chamber, to prevent damage to the Boiler 8 turbine from too high a steam temperature. The Protronic units are used to control this temperature by positioning and operating the burner tilt and water sprays; in addition, pressure is monitored to determine the steam temperature saturation curve which, in turn, is used to regulate the degree of cooling required.

Fully programmable, the controllers enable process conditions to be monitored from a greater number of locations and are able to respond faster and more effectively to changes in generator load. Each controller is designed to be programmed using one of nine supplied hand-held configurators, with each controller having a front panel keypad and an LCD for local operator monitoring, plus an RS422 serial interface to allow it to be connected to a higher level system for both remote control and recording of trend and historical data.

Reader enquiry no 12/7

Trade publications

The Thermal Division of Alfa-Laval have released a 14 page, full colour publication that examines the uses of heat exchangers in conventional and nuclear powered stations, plus an illustration of a comparatively new duty, utilising heat from geothermal sources, whether in the form of water or steam. Typical subjects covered include central cooling, generator cooling, emergency diesel cooling and more vital duties such as emergency core cooling.

Reader enquiry no 12/8

A four-page brochure dealing with the use of infrared thermometers in electrical maintenance is available from **Calex Instrumentation**.

Finding 'hotspots', preventing arcing; fires; power outages, and insulation damage are all covered. Locating 'grounds' in circuits; and the pinpointing of nuisance tripping is dealt with; as is the protection of electric motors and transformers.

Reader enquiry no 12/9

ENERGY WORLD — COMMERCIAL

(Photocopy acceptable)

Please send me further information against the reader enquiry no(s) listed below (please tick)

12/1 12/2 12/3 12/4 12/5 12/6 12/7 12/8 12/9

Name

Address

Organisation