November 1988: No 164

ENERGY WORLD

Published monthly by the Institute of Energy
18 Devonshire Street, London W1N 2AU
Telephones: *Editorial:* 01-580 0008. *Administration:* 01-580 7124.
Telex: 265871 Monref G quote ref: MNU142.
Fax: 01-580 4420.
Membership, Education and Journal subscriptions: 01-580 0077.

Editor Sharon Dorrell BSc

The Institute of Energy is in association with:
The American Society of Mechanical Engineers
The Canadian Institute of Energy
L'Institut Francais de l'Energie (Paris)
The Fuel Society of Japan (Tokyo)
Verein Deutscher Ingenieure (VDI-Gesellschaft Energietechnik)
The Australian Institute of Energy

Printed by Headley Brothers Ltd, The Invicta Press, Ashford, Kent

Contents

Personal viewpoint

Changing ideas into actions

There are many definitions of the purpose of a professional body such as the Institute of Energy. Many of these relate to the advancement of knowledge, the setting of standards and the regulation of the profession. These are very relevant and important but I believe that the Institute of Energy is, above all, about people. All the best technology and scientific knowledge are useless unless applied effectively by people. In the same vein, the Institute would not exist if people did not take part in its activities. The membership of the Institute is comparatively small and it is always complained that a large proportion of the membership takes little interest in its activities.

During the short time in which I have been secretary I have been impressed by the contribution of so many members, through the various committees, in the branches and at headquarters. I hope that we can use the considerable network of people that exists on a national and international basis to develop the work and interests of the Institute. There is only a small staff based at 18 Devonshire Street but the effectiveness of this group can be increased considerably by help from the members.

It is obvious that there is a fund of goodwill among members. A recent example was the president's letter to retired members about the benevolent fund. This produced over 200 replies, most of them expressing gratitude at receiving a letter and making very helpful suggestions about the fund. The magnitude of the replies did present one problem; it has been impossible to acknowledge such a large volume of correspondence. I hope that the members who wrote will accept this acknowledgement, their comments were received and will be used in consideration of the work of the fund.

The world has always been changing and the pace of change always is said to be increasing. In the political scene we can compare the speed with which

the United Kingdom was brought together from Saxon and other kingdoms into the United Kingdom to the speed with which a much more complex united Europe is being developed. 1992 will be crucial for everyone, but are you prepared for all the changes that will be brought about by the removal of barriers on trade and employment that will have taken place by the end of that year?

Professional bodies are also in the process of change. Readers of *Energy World* will know that the Strategy Working Group has thrown up many ideas. The problem has been translating those ideas into practical objectives that can be implemented within the resources of the Institute. However, much is going on; the Centre for Research into Education and Training in Energy (CREATE) is now well established at Devonshire Street and taking the message of the importance of energy to school teachers and hence to the new generation of school children; a new brochure publicising the Institute will be available in the next few months; advisory panels have been established for the *Journal* and for *Energy World* to act as sources of ideas for the editors. We would very much like to develop our conference activities, perhaps with more popular one day events of various types and also to develop courses of continuing education and training. With our limited staff it is not possible to do everything, so we must establish priorities. It is obvious that professional bodies need to provide services for their members and I would welcome your views on what we should be doing to help you in your professional work.

I have said that the Institute is about people and that we are living in a world of change. One aspect of the Institute that has seen considerable change in the last few months has been the staffing of the Publications and Conferences Department. In the space of a few weeks we lost Phyllis Tegg, Joan Deakin and Christopher Payne. It was their very strong desire to leave quietly and not be embarrassed by formalities, presentations and speeches. However, I consider that a few words are necessary to attempt to acknowledge their contribution to the Institute over many years.

The first to leave was Phyllis Tegg. She left a few days after my arrival, pure coincidence, I assure you. Obviously I did not get to know her well but I know that she made her mark on the Institute. She will be particularly missed by the branches who she visited often to sell publications at conferences.

Christopher Payne and Joan Deakin left at the end of July. It is almost impossible to imagine, never mind describe, the service that they gave to the Institute. In Christopher's case this was for some 16 years and for Joan it was 34 years. Christopher came to edit the *Journal* and early in his time he developed it into two publications and *Energy World* was born. He also developed conferences from a minor activity to a very large operation. In his work he had a meticulous attention for detail and a self-effacing charm that hid the hard work that he was doing to make the publications and conferences such a success.

Joan would have seen a number of changes during her time at the Institute. Presidents and secretaries have come and gone, but it was not until Joan left that many members realised just how much she contributed to the Institute.

It was perhaps typical of Joan and Christopher that they did not want the Institute to arrange a party for them. Instead they arranged a magnificent luncehon for the staff, to thank us for working with them! Although we did not canvass contributions for a leaving present there was a spontaneous response from many members. Christopher was given a painting of Salisbury Cathedral that he had had commissioned and Joan was given items of jewellery that she had selected and, in addition, there were cheques for both of them. Phyllis Tegg received a cheque that was used towards the purchase of video equipment that she intended to use at the race track.

Colin Rigg
Secretary, the Institute of Energy

Energy from waste: current progress in Sweden

R G Loram*

Considerable effort worldwide has been put into trying to find the best way to utilise the large amount of energy that we put into our dustbins every day. One of the problems encountered is that the waste collection systems tend to gather together in one place between 400 and 1000 t of the stuff everyday and since it is possible to extract rather more than 2 MW from each tonne, that is a lot of energy for which to find a market. In continental European cities, especially Germany, and Sweden with most of the population living in apartment blocks, and with colder winters than the UK, district heating provides a suitable market. With its milder winters, more diverse housing and cheap gas the UK is not such a fertile ground for district heating. But since the passing of the Energy Act in 1984, there is a steady market in electricity generation with the advantage that the purchase tariffs are published so that income can be accurately calculated

Now considerable quantities of electricity are generated around the world by burning municipal waste in mass-burning incinerators, including that at Edmonton, London. The trouble with mass-burning incinerators is that it is not practical to shut them down at night and start them up again in the morning; electricity boards pay very little for power generated at night. So what is needed is a boiler that can burn a low grade but very reactive fuel and does not mind being turned on and off; a fluidised bed boiler in other words.

It is known that the Japanese have some 22 *Superburn* revolving fluidised bed furnaces burning municipal wastes many of which are fitted with boilers to recover the energy. The Swedes were also believed to have half a dozen fluidised bed boilers burning waste, including one or more circulating beds. Details of the Superburn furnaces are not available despite their being originally a British design and patent. Some details of the Swedish plants were published in the Harwell report *Municipal solid waste conversion to energy: a summary of current research and development activity in Sweden* (see *Energy World* July for review). My appetite whetted by that report I resolved to go and see for myself and, with some financial help from the Warmer Campaign and my employers, Merseyside Waste Disposal Authority, I duly went there in April this year. There was another, two-fold reason for going to Sweden which was that not only had the Swedes recently introduced stringent new emission limits, that were similar to but somewhat stricter than the new regulations for waste burning plant in the European Community, but they had also developed flue gas treatment plants to comply with the new rules. Furthermore some of those treatment plant designs entailed condensing the flue gas and recovering a major part of the large amount of latent heat of evaporation due to the high moisture and relatively high hydrogen content of the fuel present in the flue gas.

*Merseyside Waste Disposal Authority. Mr Loram (Associate Member) is leader of the Special Interest Group on *Waste derived fuel*

Swedish practice on emission standards is to licence each plant individually in this respect against a set of national guidelines. The standards for new plant are given in Table 1 together with the equivalent new EC standards.

Table 1

Substance	Flue gas emissions Sweden (1)	EC (2)
Particulates	20(3)	50
Mercury Hg	0.08	0.1
Cadmium, Cd	0.02	0.1
Nickel, Ni	0.001	1.0
Copper, Cu	0.06	5.0
Lead, Pb	0.50	5.0
Hydrogen Chloride, HCl	100(3)	50
Hydrogen Fluoride, HF	1.0	2.0
Sulphur Oxides, SO_x	200	300
Nitrogen Oxides, NO_x	400	—
Polyaromatic Hydrocarbons, PAH	0.1	—
Dioxins, TCDD equiv.	0.1(4)	—

(1) given in mg/nm^3 (dry gas 10% CO_2)
(2) given in mg/nm^3 (dry gas 9% CO_2)
(3) As a monthly average
(4) Ng/nm^3

In Sweden

After initial discussions at the Environmental Authority, Statens Naturvardsverk, I visited four plants, all district heating stations. One plant was an incinerator serving a wide geographical area and the other three had fluidised bed boilers and were operated by smaller municipalities. There was one feature common to all the heat stations, they all used refuse preferentially for their base load so that all of it burnt all year round, it is their cheapest fuel and generally they cannot get enough of it. The fluidised bed plants run by the municipal authorities, who were also responsible for the waste collection and disposal and

although the heat stations were run as independent entities, there were considerable variations as to how the costs and savings split between the two functions. District heating itself has to remain competitive with oil-fired central heating and low oil prices were exerting pressure on the DH companies' profits.

Uppsala

The first plant I saw was the incinerator operated by Uppsala Energi. This was a conventional grate incinerator designed and built by Widmer and Ernst of Switzerland, that handles 250 000 t of waste a year. It has two streams, one with a double grate of 15 t/h design capacity and the other with a double grate of 10 t/h. The incinerator is part of a DH complex that also includes a 100 MWt solid fuel fired boiler purely for DH, a CHP boiler that produces 200 MWe of electricity and 315 MWt of DH when oil fired (60% of that when burning solid fuel), an electric boiler able to use cheap electricity for top up purposes and a heat pump that recovers heat from the sewage flowing into the treatment works complete the installation. In 1980 92% of the 1750 GWh of energy put out by the plant was supplied by oil and 8% by waste. By 1987 the scene had changed dramatically, energy conservation had more than held in check the expected expansion of energy use and now 40% of the 1700 GWh was supplied by waste, 40% by solid fuel coal initially to be replaced by peat 13% by heat pumps extracting the heat from the sewage, 1% by electricity at off peak rates and only 6% by oil. The plant pays about £2/t for municipal waste all year round, this allows rural communitites from as far away as 75 miles to send their waste to Uppsala without incurring unduly high disposal costs.

The interesting feature of the Uppsala incinerator was the flue gas treatment plant installed by Fagersta Energetics AB, now part of Götaverken Energy Systems. In this plant the flue gas is cooled from 140°C to 35°C in a two-stage cooler system where it is also washed to remove dust, acids and other contaminants such as mercury. The heat from the cooling circuit is concentrated in two lithium bromide, steam driven absorption heat pumps and used to raise the incoming return water from the DH scheme from about 60°C to 75°C. After demisting the flue gas is reheated to 60°C before being discharged to the stack. The scrubbing liquor receives the appropriate neutralising and chemical treatments to produce a stable sludge and pure water; the sludge is mixed with fly ash for disposal by landfill. This plant cost £6.5 M to install and costs £0.3 M a year to run but it increases the incinerators 70 MWt capacity by 20 MWt and bring in an extra £0.94 M of income, so paying for itself in about 12 years. This means that flue gas cleaning to a higher standard than that required by the regulations is achieved at virtually no cost.

Sundsvall

The second installation I visited was at Sundsvall, a modest sized port and industrial town about 300 miles north of Stockholm where the temperature in winter can drop to −30°C, and the whole town is heated by district heating. The heat station was built in phases as the DH network was expanded, first supply came from two 80 MWt oil fired boilers, then a CHP plant was added with a capacity of 110 MWt for the DH and 55 MWe for the local grid, fired currently by oil but designed to be converted to solid fuels in the future. The waste burning boiler was the last to be added, it became operational in 1984 and is a 20 MWt circulating fluidised bed boiler designed and built by Götaverken Energy System AB. The station also has a 50 MWt electric boiler, one of Sweden's largest, to take advantage of very cheap off peak electricity.

For historical reasons the waste fuel is in the form of refuse-derived fuel (RDF) prepared at a landfill site six miles away from the heat station. The refuse is shredded and screened to produce a paper and plastic light fraction which passes through a secondary shredder before being transported to the heat station. The net calorific value is quoted as being 13 MJ/kg which squares with the operator's statement that they extract 3 MWt from each tonne. This is near enough the same CV as for peat and wood chips allowing these fuels to be mixed before burning, in common with other fluidised bed boiler plants visited, there is not enough waste to run the boiler full time so these other fuels are also used. The boiler has however been run with complete success on 100% MSW.

Although the management at the Sundsvall plant felt they could meet the proposed new and stricter emission requirements with the lime injection and electrostatic precipitator, with which the plant was originally equipped, the Environmental Agency and the boiler manufacturers were keen to try a bag-house filter on a circulating fluidised bed boiler. One was installed with the aid of a Government subsidy. It worked so well that it was concluded it should have been fitted from the start with a cyclone in place of the ESP; as it is the flue gases still pass through the ESP which is not energised and merely acts as a drop out box for the coarser particulates, total emissions are now comfortably inside the new regulations. The plant pays the surprisingly high price of £15/t for the RDF but that is less than half the cost of peat and wood chips. The management said that the circulating fluidised bed boiler was not profitable at present oil prices because there was not enough waste available, on the other hand the municipality has very cheap waste disposal.

Eksjö

The plant at Eksjö is the oldest fluidised installation burning waste in Sweden, it started up in 1979. The first boiler, built by Generator AB, now part of Götaverken Energy Systems, was a modest sized one with a design rating of 5 MWt; after a few years a second boiler of 10 MWt capacity was added, in practice the boilers have been found to have capacities of 7 MWt and 14 MWt respectively, a tribute to the generator design. The boilers burn woodchips or refuse, there is landfill capacity available near Eksjö so the heat station pays about £13/t for the refuse; that is still 45% cheaper than woodchips.

Until fairly recently the boilers were supplied with waste that had only been shredded by a Tollemache shredder, the original screw feeder caused feed problems due to textiles and other oversize items passing through the shredder and was replaced by belt conveyors. They recently installed a PLM ballistic separator to refine the fuel by removing metals and glass that had been giving trouble by bed sintering. The separator has fine, 10 mm screening holes and, with 60% of the input reporting to the fuel fraction, recovers a high proportion of the combustible waste. They did not fit a secondary shredder but devised a de-

ragging device at the PLM light fraction discharge point. Boiler efficiency was given as 82% when burning refuse with excess air at 30%.

A feature of the Eksjö plant is the recently added condensation flue gas cleaning equipment designed and built by a company called Andeze which is also now part of Götaverken Energy Systems. Working on the same basis as the much larger Fagersta plant at Uppsala, it differs significantly in detail but does the same job of producing an extremely clean flue gas (HCI for instance down to less than 5 mg/nm^3 and no dioxins detected) and at the same time enhancing the heat production by more than 25%. Lime is fed into the bed at a ratio of 20 kg to a tonne of waste fuel, this captures some of the acid gases and makes the job of the flue gas cleaner that much easier.

The plant manager at Eksjö had designed a new style of nozzle for the fluidising air in which the air jets were horizontal so that the initial bed movement was sideways, this helped to move the incombustible fraction of the fuel towards the bed drain. This nozzle has been adopted by the other waste burning fluidised bed boilers.

Lidköping

The newest heat station I went to was at Lidköping a small town and port in the southern shore of Lake Vanern. Everything was smaller and simpler than at Sundsvall, the DH load was about a third and the wastes arising were also about one third. The heat station consisted of two bubbling fluidised bed boilers, whose design rating was 12 MWt each but which actually produced 14 MWt; they were backed up by two 20 MWt oil fired boilers which were only used in the winter months to top up the production from the solid fuel boilers.

Since there is only enough waste for less than half the summer load, wood chips and peat are also used. In contrast to Sundsvall and Eksjö the preparation of the wastes is very simple only being shredded in a Swedala horizontal shaft grided shredder and passed under a magnetic separator and burned. The shredded waste, wood chips and peat are stored in separate bunkers but fed to the boiler surge hoppers by a single transfer conveyor: the fuels are not mixed at Lidköping but are burned individually. The transfer conveyor feeds surge hoppers for each boiler via a reversing conveyor, from the surge hoppers a combination of slow running and variable speed fast running conveyors is used to control the feed into a rotary valve on the fuel chute into the bed.

The fuel feed is automatically controlled by a computer in the control room which is fed with data from various sensors monitoring bed temperature, O_2, CO_2 and CO. The control room is very impressive, fully computerised and capable of displaying a vast array of statistics and of printing out records of the boiler control parameters to convince the regulatory authorities that the plant has been operating to the required standards.

The boilers were supposed to be an improvement on the Eksjö design, which is shown in Fig 1, having only one water wall baffle instead of the three in the Eksjö boiler. This turned out to be less efficient and liable to more slagging problems than they had at Eksjö. Even so it works well enough to produce 17% more output than its design rating.

Emission control is also simple, finely divided lime is sprayed into the flue gas after the cyclones and particulate emissions are dealt with by a bag house

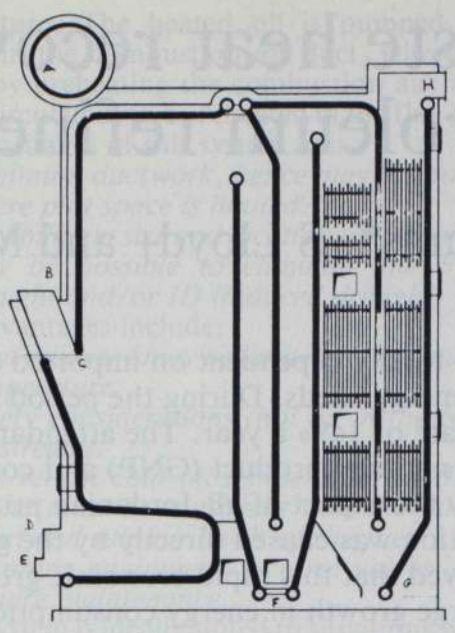

Fig 1: Refuse fluid hot water boiler with fluidised bed combustor. Output 5 MW. Key: A Outgoing water 170°C; B Fuel intake; C Secondary air nozzles; D Starting burner; E Air intake; F Ash removal; G Incoming water 150°C; H Flue gases 170°C

filter. It was found to be very difficult to get the lime balance just right but once the optimum amount had been established it works well and the plant stays well within its specified limits.

At Lidköping the DH network is still building up so it is in direct competition with oil; since the municipality has no landfill the heat station is paid about £14/t to receive the waste and this helps it to be competitive.

None of these three fluidised bed plants had much trouble with aluminium in the waste though Lidköping burning coarse RDF did have a bit. A bubbling bed boiler at Bollnas reported having trouble with aluminium build up on the water tubes.

Lessons learned

So what are the lessons for the UK from the Swedish experience? One conclusion is that it helps to have a government with a positive policy; the Swedish environmental and energy agencies have worked together closely to promote research and development and to get their policy implemented at municipal level. The present UK Government's refusal to contemplate having an energy policy and failure to formulate a waste disposal policy look pretty silly beside the Swedish performance.

The Swedes have an easy market in heat for the district heating schemes that can utilise the very small amounts of waste available in small towns. In the UK we are unlikely to ever have a significant district heating market so we must look elsewhere and that realistically means electricity generation. The Swedes have shown us that both types of fluidised bed boilers can burn peat, wood waste and refuse with equal facility but ideally much larger boilers are needed for the UK scene and these are available from Finland where Ahlstom have built many circulating fluidised bed boilers to burn wood wastes and peat while Lurgi of Germany, with whom NEI International Combustion at Derby have an agreement for the UK market, consider that their big circulating fluidised bed boilers are suitable for burning wastes.

Apart from the fluidised bed boilers, capability of being shut down at night that allows a given supply of

(Continued on p 12)

Waste heat recovery in Jordan petroleum refinery

R Aburas*, S Lloyd† and M Webster†

Jordan is totally dependent on imported crude oil and some petroleum products to meet its energy needs. During the period 1974–1984, energy consumption grew at an average rate of 14% a year. The attendant energy bill equalled approximately 13% of the gross national product (GNP) and consumed the majority of foreign exchange earned by the export of all Jordanian products. This high growth in energy consumption was caused directly by the growth in the national economy. However, it was believed that this rapid economic growth could have still been achieved without such a large growth in energy consumption if a more efficient energy use programme had been implemented. Unfortunately, at that time, the country lacked a national energy policy caused, among other things, by the abundance of agencies operating in the energy sector with different goals and objectives. To address this shortcoming, the Government of Jordan set up in 1984, the Ministry of Energy and Mineral Resources (MEMR) whose goals included planning, formulation of general strategies and research work related to the energy sector

Since its establishment, MEMR has adopted a policy aimed at securing adequate energy resources at minimum cost to the economy. MEMR has focused on two major programmes.

- *Development of indigenous energy resources through exploration for fossil fuels and the exploitation of natural resources, including renewable ones such as wind energy, passive solar energy.*
- *Encouragement of the conservation and the optimal use of energy.*

So far, comprehensive audits have been made in the electric power, transportation and industrial sectors and tangible results have been achieved. Publicity campaigns have also heightened public awareness of the need for and importance of energy conservation.

As part of this programme, MEMR and Bechtel studied energy conservation in the industrial sector. Over 20% of Jordan's energy is consumed here with the bulk accounted for by six key industries. These are: petroleum refining, power generation, fertilizer production, cement production, phosphate mining and potash extraction. The main objective behind the study was to identify practicable, economically sound energy conservation measures and to develop them to the point where the individual industries could implement them directly. Emphasis was originally placed on techniques involving operational improvements which required little or no capital expenditure.

Of the ideas generated by the study, between 50 and 60 have proved to be worth implementing and, in total, are predicted to save over 12 000 MWh of electricity and 80–100 000 t of fuel oil each year. The actual numbers eventually achieved will depend on many factors, but this equates to approximately 3% of Jordan's total national oil consumption in 1986.

The measures requiring capital expenditure may be conceptually distributed among the following categories:

(i) Modifications and improvements to the process itself.
(ii) Improvements to the utilisation of heat within the process, for example by product/feed heat exchange.
(iii) Improvements to the utilisation of electrical power.
(iv) Increased insulation to conserve energy.
(v) Improvementsd in control and monitoring techniques to ensure that the plant is operating as close as practicable to ideal conditions.
(vi) Waste heat recovery specifically from combustion devices, for example refinergy fired heaters, kilns, and so on.

The last item was studied in some depth as a separate item, rather than a sub-group of *(ii)*, due to the large number of these installations where the potential for heat recovery exists. This paper considers the various techniques available for the recovery of heat from refinery fired heaters and presents the results of two projects in the Zerqa refinery of the Jordan Petroleum Refining Company.

Flue gas waste heat recovery

The energy available in the flue gases from refinery heaters is substantial. In the older style of refineries, the heat released in the fired heaters can be equivalent to 7.5% of the refinery throughput. Only part of this energy is usefully absorbed in the process, the rest is lost. In a modern refinery, this figure can be reduced by one to two percentage points by minimising energy losses from the flue gases alone.

The energy available in the flue gases is a function of the mass flow of the products of combustion and their available temperature above ambient conditions. The simplest and cheapest method for reducing this wasted energy from existing equipment is to minimise the

*Ministry of Energy, Jordan
†Bechtel

excess air consistent with good combustion conditions. This can be achieved in the first instance by simple monitoring and control of the heater draught. Further refinements include the introduction of forced draught low excess air design burners. Fig 1 shows the relationship between energy loss, stack temperature and excess air.

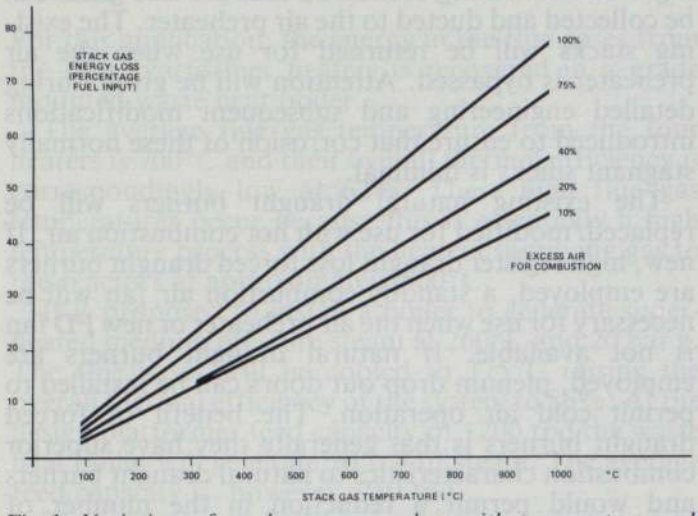

Fig 1: Variation of stack gas energy loss with temperature and excess air

The second approach for energy recovery is to exchange the heat from the flue gas to another stream. Suitable acceptor streams include:

(i) Other feedstock or raw material heating
(ii) Steam and power generation
(iii) Combustion air preheating
(iv) Fuel heating

The preferred choice from the above is *(i)* or *(ii)* as the heat recovered is that expensively (energywise) transferred elsewhere. For example, steam generated in a waste heat boiler will save that generated in a package boiler which has its own inherent thermal efficiency.

Although *(i)* is very attractive, its application is severely limited by the ability of the process to conveniently use this heat. In addition, the capital cost of other equipment is not necessarily saved, only the operating cost: for example, a steam boiler may be necessary to supply steam when the generator of the waste heat is down.

For these and other reasons, preheating of the combustion air is frequently employed as a fuel saving measure, as both the source and the sink for the recovery of waste heat are integrated into a single component.

Types of air preheater employed

For the scoping studies undertaken for this exercise, three types of airpreheat system were examined. These were:

(i) Hot oil belt system
(ii) Rotary regenerative system
(iii) Static gas-to-gas tubular exchangers

Other types of air preheat systems exist, for example, process slipstream, heat pipe, plate type exchangers and their use could be relevant, especially to the smaller heaters, but for this initial study, only large energy users were considered.

Hot oil belt system

In this system, an intermediate heat transfer fluid is used. The hot flue gases pass through an oil coil and by giving up their heat are cooled to the required stack temperature. The heated oil is pumped to a coil located in the combustion air duct, where the oil is cooled by preheating the combustion air: the cooled oil is recirculated, to be reheated in the flue gas cooler. The advantages of this system are:

(i) Minimum ductwork, hence may be more suitable where plot space is limited.
(ii) Flexibility in size and location of the coils, hence it may be possible to eliminate the FD (forced draught and/or ID (induced draught) fans.

Disadvantages include:

(i) Heat recovery may be limited by the maximum oil temperature.
(ii) Safety considerations (hot oil in the combustion air stream).
(iii) The return cold oil temperature to the flue gas cooler must be consistent with the flue gas dewpoint and sulphur levels of the fuel.
(iv) Pumping equipment, control valves and so on, require maintenance.

The system is ideally suited to situations where there is a large quantity of heat to be transferred at comparatively low temperatures: (the complexity of this scheme, pumps, expansion vessels and so on, often is unjustified for small size units).

Rotary regenerative exchanger

In this scheme, a rotating metal matrix passes continually through the hot flue gas and cold air streams. The matrix is alternatively heated and cooled by the flue gas and the air.

The advantages are:

(i) Compact, low cost design in common usage.
(ii) Dewpoint corrosion problems can be minimised by enamel or other coating of the cold end of the metal matrix.
(iii) Small mechanical size implies that the replacement of parts when required is usually simple.
(iv) Fouling on surfaces is comparatively easy to remove with soot blowing.

The disadvantages include:

(i) Mechanical drive is required: (typically power requirements are low, 0.5–5.0 kW on refinery size units but this system does require switchgear, maintenance and so on).
(ii) Maintenance of seals.
(iii) Air to flue gas leakage across rotating matrix affects power achieved by the fans, and final allowable cold end temperatures. This is especially true in the smaller units where fixed seals are employed.

Tubular, cast iron, gas-to-gas exchangers

These are simple gas-to-gas heat exchangers. If the walls of the exchanger are above the dewpoint of the flue gases, then a rugged cast iron construction can be employed. If there is any prospect of the walls being below the flue gas dewpoint, then it is possible to use glass tubes for that section of the exchanger.

The advantages are:

(i) No moving parts
(ii) No air-flue gas leakage path
(iii) Dewpoint problems can be designed out
(iv) Maintenace requirements are minimal

The disadvantages are:

(i) The units are very large, heavy and expensive
(ii) The units require a large plot area
(iii) Performance falls off dramatically with fouling and the cleaning process can be cumbersome (for example, water washing).

Example: CDU 3 crude charge heater

CDU 3 charge heater is the largest fired heater on the refinery with an absorbed duty of 55.5 MW for a nominal unit feed rate of 11 000 tpd. The heater was originally operating with a stack temperature of approximately 500°C which corresponds to a thermal efficiency of 76%. By installing an air preheater to heat the combustion air, it is planned to cool the stack gasses to 175°C and raise the overall thermal efficiency to 88%.

The capital cost of this retrofit is estimated to be $1.5–2.0 M. For present refinery throughputs, fuel oil consumption is predicted to be reduced by 6000 tpa giving an annual saving of $600 000.

A conceptual general arrangement of the system is shown in Fig 2. Combustion air from a new forced draft fan is taken via a rotary regenerative heater to

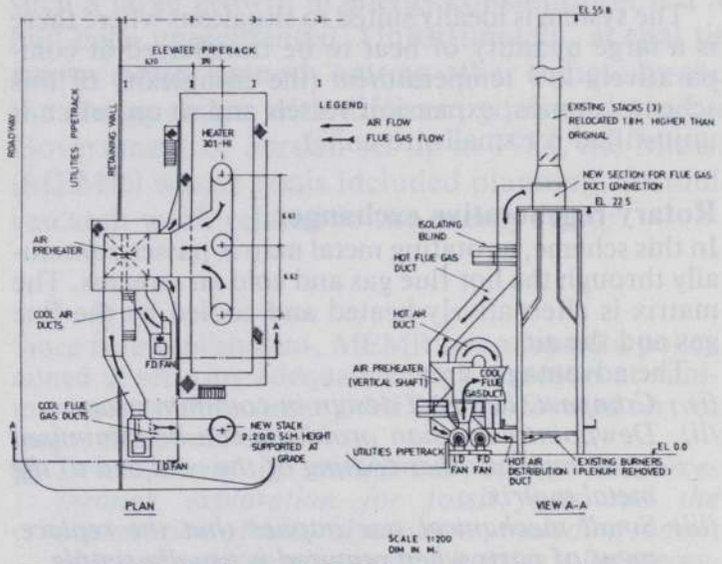

Fig 2: CDU 3 fired heater 301 HI layout for air preheater

the burners. Hot products of combustion will be taken to the air preheater, via a new breeching, cooled and directed via a new induced draught fan to a new stack.

The plot space available for the new equipment is extremely limited, and this dictated the selection and layout of all equipment, even if it was not the ideal one from combustion/heat transfer aspects.

It is proposed to employ a rotary, regenerative type of air preheater as it is of compact design and, of lower capital cost than the larger static air preheaters. At the detailed design, a tubular, gas-to-gas exchanger, may be considered if space considerations allow. Though air leakage from the air to the flue gas side across the air preheater face lowers the maximum air preheat achievable for a given stack temperature (determined from dewpoint and plume dispersal requirements), the benefits from the compact nature of this design outweighed for this application any performance penalty.

The air preheater rotor itself is sufficiently large so that baffles and seals can be employed to reduce any leakage across the rotating elements. In addition, these metallic elements will be treated to resist corrosion, as these elements will at times be below the dewpoint temperature of the flue gases.

As part of this project, the following new items will be required:

- forced draught (FD) fan
- induced draught (ID) fan
- air preheater
- grade mounted stack
- air and flue gas ducting

The following modifications to or replacment of existing equipment will be required:

- modifications to the existing stacks
- modifications/new burners
- sootblowers to the existing convection section

It is necessary to modify the existing stack by installing a new breeching section so that the flue gases can be collected and ducted to the air preheater. The existing stacks will be returned for use when the air preheater is bypassed. Attention will be given during detailed engineering and subsequent modifications introduced to ensure that corrosion of these normally stagnant stacks is minimal.

The existing natural draught burners will be replaced/modified for use with hot combustion air. If new, high register draught loss forced draught burners are employed, a standby combustion air fan will be necessary for use when the air preheater or new FD fan is not available. If natural draught burners are employed, plenum drop out doors can be installed to permit cold air operation. The benefit of forced draught burners is that generally they have superior combustion characteristics to natural draught burners and would permit a reduction in the number of burners from the 19 presently installed. However, they require additional space for themselves under the heater and space for the standby FD fan. The decision on which design to adopt has still to be made.

Ash deposition and fouling of the existing heater convection bank already takes place. Changing the flue gas temperature profile due to the addition of air preheat may increase the tendency for this to occur. Sootblowers will be installed as part of this project.

In addition to the previously mentioned hardware changes, the following instrument loops will exist.

(i) The fuel flow will be set by the heater outlet temperature.

(ii) The FD fan flow will be pre-set by measuring the air flow in either an inlet (preferably) or discharge venturi. This flow will be reset by oxygen trim as measured at the heater exit. An allowance must be made for any air infiltration into the heater so that combustion requirements are satisfied by the air passing through the burner registers. To this end, it may be decided during detailed engineering to relocate the oxygen analyser to the furnace combustion chamber.

(iii) The FD fan flow will be controlled to maintain a constant, slightly negative, pressure in the firebox.

(iv) An air aide bypass around the air preheater will be employed to prevent overcooling of the flue gases. This can be either manually or automatically controlled based on the stack gas temperature.

It is presently proposed to control the fans using variable inlet guide vanes for the FD fan and inlet louvre dampers for the ID fan. Inlet louvre dampers are proposed for the ID fan to ensure that no bearings are located within the flue gas stream. During detailed engineering, the use of variable speed fan drives will be considered. These offer operational and economic benefits, involve additional capital cost.

The following emergency features will be required:

(i) In the event of ID fan failure or high furnace arch pressure, the dampers in the existing stacks will open to permit natural draught performance to take place.

(ii) In the event of FD fan failure, with natural draught burners, supplementary air doors will

open. With forced draught burners, a standby fan will be required.

However, fan reliability is generally high, especially if fans specified to API 673 are employed.

An example: platformer charge and interheaters

For this application, the energy in the flue gases from the four platformer heaters is recovered in a grade mounted waste heat boiler.

The average flue gas temperature from the four heaters is 700°C and their overall thermal efficiency is correspondingly low at 62%. These high flue gas temperatures occur because this is essentially a high temperature process with the heaters supplying gas to the reactors at approximately 500°C.

It is proposed to install a boiler to generate superheated medium pressure steam at 260°C and 20 bar g. The flue gases will be cooled to 175°C raising the overall thermal efficiency of the system to 86%. At the design platformer feed capacity of 1200 tpd the waste heat boiler will generate 20 t/h of steam. The average feed capacity is, however, 750 tpd.

The capital cost for this retrofit is estimated to be $2.5 M generating an annual saving of $800 000 at design throughputs.

An airpreheater installation was considered for this application, but the concept was rejected, due to the proposed installation's complexity and the available plot space limitations.

The conceptual schematic and plot plan of the waste heat boiler installation is given in Figs 3 and 4. In normal operations, hot flue gases from the four heaters will flow through the waste heat boiler, induced draught fan and stack. On loss of the ID fan or in the event that the waste heat boiler is out of operation, the flue gases will go via a bypass directly to

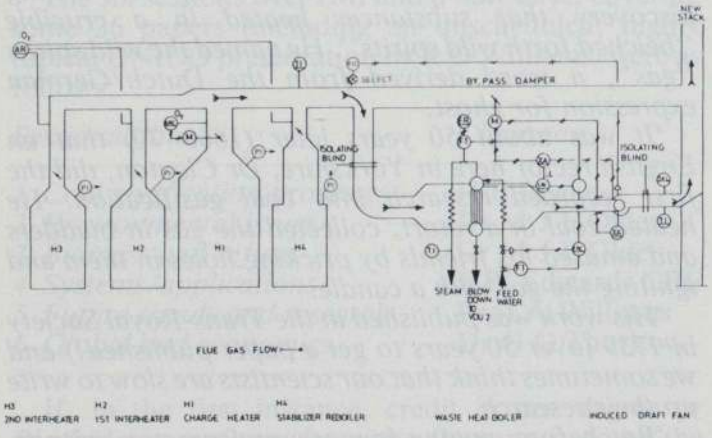

Fig 3: Platformer—waste heat boiler flow scheme

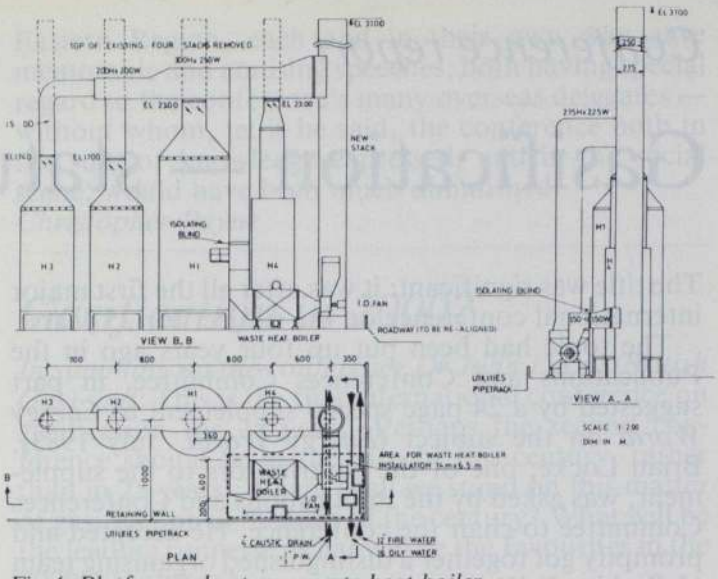

Fig 4: Platformer heaters—waste heat boiler

the new stack. Isolation blinds will be located either side of the waste heat boiler to permit maintenance of the boiler whilst the platformer unit is on line.

The following major new items will be installed:

(i) Waste heat boiler
(ii) Induced draught fan
(iii) Flue gas ducting, including supports
(iv) Free-standing stack

The waste heat boiler will be a free-standing two drum natural circulation design with a superheater and economiser. A steam feed preheater may be introduced during detailed design depending on the final feedwater temperature available and the sulphur level of the fuels.

The induced draught fan will have an electric motor drive. Variable speed will be employed to control the fan's performance: the set point will be the required furnace arch draught for one of the four platformer heaters. The motor size will be approximately 40 kW. In the event of the loss of the ID fan, the boiler bypass damper will open automatically.

The draught in the other three heaters will be adjusted manually using stack dampers.

Implementation

Both of these projects are being implemented by Jordan Petroleum Refinery Company and are now progressing through the detailed engineering phase. This represents part of the implementation of MEMR's goals and objectives. Progess is continuing in these and other projects arising from the MEMR/Bechtel study.

In general, MEMR is continuing in an advisory role to support the various industries who are themselves implementing the projects outlined in this study. □

Gasification — status and prospects*

The title was significant: it was after all the first major international conference on the subject for 25 years.

The topic had been put up four years ago in the Publications and Conferences Committee, in part suggested by a 24 page special supplement to *Energy World* on the subject (*Energy World*, July 1983). Brian Locke, one of the contributors to the supplement, was asked by the Publications and Conferences Committee to chair the conference. He accepted and promptly got together a distinguished organising team (J Boddy, F W Edwards CBE, J Foxcroft, Dr A B Hedley, H R Hoy OBE, Dr W A Simmonds, N G Worley, Dr B Thompson and Dr G G Thurlow.)

The first meeting was in 1985, and the conference was at that time projected for the latter half of 1987. Conflicting dates with other events, and the quest for a venue that would match up to the requirements of a major international meeting, and exhibition, were reasons for subsequently moving the event into 1988. It should be said that the Watt Committee on Energy consultative meeting on the subject in December 1986 far from being in conflict, was always perceived to be a valuable preliminary platform; and this was abundantly plain from the response to the Organising Committee's call for papers, the better part of which came from overseas, as indeed had been anticipated.

The organisation began in earnest and, on the principle of making the best collective use of organising 'minds', the team was split into a logistics and business panel, under the chairmanship of Frank Edwards CBE, and a programme panel, chaired by John Boddy. Both panels were under the overall chairmanship of Brian Locke.

The venue chosen initially, and for perfectly valid reasons at the time, was the Birmingham Metropole: the response to the call for papers indicated a three-day event with scope for a not inconsiderable exhibition. Some 35 000 copies of an elaborate conference brochure were distributed worldwide.

Firm response, however, was slow. It became uncertain, even improbable, that forward financial commitments on the venue, would be covered by the initial response. There were three options open to the Organising Committee. However, we need only record that the most positive course of action was immediately adopted: a new venue, less immediately onerous financially, had to be proceeded with in all good faith.

The choice of new venue was less problematic than it might have been, the Crown Hotel at Harrogate, which had done so well for the Institute's First European Dry Fine Coal Conference in the previous year, was selected.

The original dates, alas, could not hold good (nor indeed had they been possible at any of the alternative venues looked at). Inevitably, several authors indicated that the new dates were no longer possible for them, but the major impact of the dates change was on the exhibitors, and the number of stands was reduced from 18 to 12 because of manufacturer commitments elsewhere. Inevitably, too, new arrangements put additional strain on the administration side, and not least the need for revised publicity; but the additional work was of much less importance than the gradually perceived build-up of registrations to a number (if still well short of earliest expectations some three or four years back) that was acceptable in the present 'less robust' climate of conference attendance.

On the first morning of the conference, 9 May 1988, Dr Guy Masdin, then president of the Institute of Energy, welcomed just over 100 delegates, more than half of whom represented some 16 countries; and he recalled the Institute's first conference on the subject at Eastbourne in 1963.

The president said: *'This attendance truly* validates *the Organising Committee's claim about it being an "international" conference;* illustrates *the widespread interest in the subject; and* demonstrates *that companies and organisations worldwide are continuing to invest in this strategic area of technology.*

'Gas, gasification and the transfer of technology have of course been of international interest for centuries. I am sure all of you can point to significant innovations arising in your own country which are now applied worldwide.

'However, the transfer of ideas and technology on gasification were quite slow at first and the business did not really take off until scientists, engineers and entrepeneurs got their act together.

'It was in 1609 in Brussels that Jean Baptiste van Helmont gave gas its name. He made the startling discovery that substances heated in a crucible "belched forth wild spirits". He named the wild spirits "gas", a word derived from the Dutch/German expression for ghost.

'It was about 50 years later (1660–70) that an English rector here in Yorkshire, Dr Clayton, did the first recorded research into coal gasification. He heated coal in a retort, collected the gas in bladders and amused his friends by pricking holes in them and igniting the gas with a candle.

'His work was published in the Trans-Royal Society in 1739 (over 50 years to get a paper published!) and we sometimes think that our scientists are slow to write up their research.

'But before anyone saw any real practical significance in his research and built the first pilot plant took another 50 years. Then in 1792 William Murdoch (who is credited as the father of gasification technology) distilled coal in a retort, fed the gas 70' through tinned iron and copper pipes and lit up his house in Redruth, Cornwall. Lebon in Paris developed the technology and did a similar test. In about 1801 Murdoch began to exploit his technology but other businessmen took an interest — especially as Murdoch estimated that the cost of lighting by gas was about one-third of that of the competing technology — candles.

'It was a German businessman (Frederik Albert Winsor) using this English invention, developed further by a French technologist to light the streets of London who set up the first gas business (1807) against the opposition of the establishment of time. Napoleon described his plans as "une grande folie" *and Sir*

*9–11 May 1988 at the Crown Hotel, Harrogate

Walter Scott wrote "Some madman is proposing to light up the streets of London — with what? — With smoke".

'Fortunately the technology and economics won, so over the next 50 years gasification technology spread throughout the world.

'There are still lessons to be learnt from these early experiences. I feel confident that many of the technologies we will learn about this week will also spread throughout the world, but I hope we can shorten the time span a bit with the aid of modern communications and conferences like this.

'As an institute which has just celebrated its Diamond Jubilee we are reviewing our strategy, hopefully as a basis for another 60 years of constructive activity.

'Two of the key issues arising relevant to the conference are:

- *Promotion of stronger cooperation between learned societies nationally and internationally. (We welcome the participation of the Institution of Gas Engineers whose president is also with us, the Institution of Chemical Engineers and the support of our affiliated societies overseas in organising this conference.)*
- *Support to developing countries in resolving their future energy problems. In this respect I am delighted to see papers on biomass at the conference. I feel sure that for those countries without indigenous fossil and fuels without the foreign currency to import adequate oil and gas, biomass utilisation and conversion can make the significant contribution.'*

The president's opening remarks were followed by conference chairman, Brian Locke's introduction to the subject generally, and the aims and objectives of the conference in particular, and then the first session under his chairmanship, got under way.

The six sessions over two and a half days, covering some 36 papers (including an unscheduled, highly topical UNIDO presentation by R O Williams) were as follows:

Sessional title	*Chairman*
1 Coal gasification processes	H B Locke
2 Environmental issues	Dr M J F Olden
3 Biomass and refuse	Dr M J F Olden
4 Systems/applications	F W Edwards CBE
5 Future trends and research	Prof A Williams
6 Global and economics	Dr G G Thurlow

If, in the first instance, credit in one degree or another for response from the floor must go to the author, the overall achievement of the conference may be perceived in the extent and depth of delegate-interaction. Of that there was no doubt, and the Institute's international standing was surely enhanced by so rewarding a meeting in technical terms, whose earlier vision was realised in the sum of the presentations — as succinctly summed up in the conclusion by Dr John Lacey (British Gas Midlands Research Station).

But one would not wish to conclude this general review without reference to the lighter moments of the social side: the relaxed and in every way delightful reception on the first evening, under the kind auspices of British Gas, Eastern Region: and indeed the conference dinner, at which the president was in the chair, and when the principal guests, the Mayor of Harrogate and Mr Parsons, deputy chairman, British Gas, Eastern Region, each and in their own way gave memorable and amusing speeches; both having special regard to the conference's many overseas delegates — without whom, let it be said, the conference both in the sum of knowledge expressed, and in the social scene, would have been much diminished.

Christopher Payne

Gasification in 2000?

In summing up the conference Dr John Lacey (British Gas) said: This is the first international conference on gasification for 25 years. Perhaps the second conference should be at the turn of this century, rather than in 25 years. Where shall we stand on this matter of gasification at the turn of the century? What will be the leading runners? What will be the favourites in the 2000 AD stakes?

We have seen during this conference, the leading current contenders paraded before us in the Crown enclosure. At the top end of the range, the large sized range, we have seen the hot favourite, the slagging gasifiers. We have seen with a very long pedigree, and a good track record, some recent successes for syn-gas production and for IGCC (integrated gasification combined cycle). We have had the Texaco process wearing almost the same colours and the Prenflow and Shell processes all with similar technical features. From the Anglo-German stable we have a formidable contender in the British Gas Lurgi slagging gasifier. Almost 20% of the energy value of the gas which is produced from such a gasifier is in the form of methane. The original purpose of the design is for SNG, but that is still a long way off. IGCC must come first.

For lignite, brown coal and peat, we have seen the Rhine brown coal, Winkler process and a very impressive process it is too. I managed to visit the installation at Cologne last year and have observed the plant operating. It was very impressive.

At the lower end of the size range, we have the fluidised bed and the air blown systems that have been developed by British Coal. We have heard described the work that is being done in India by BHEL. What we have not heard about at this conference are the real outsiders in the race, the Dow process and from East Germany, the so called GSP process. This is really a dry Texaco process. How will these developments affect the gasification process by the turn of the century?

Environmental problems

The second session of the conference dealt with the environmental aspects of gasification. We have indeed heard that sulphur really presents no problem in the gasification processes. The sulphur is converted to hydrogen sulphide. It is at very high pressure and the process is cheap and effective. As far as the environment is concerned, achieving 90% reductions in emissions is fairly straightforward. If you want to go up to 99%, as indicated in this conference that indeed can also be achieved.

What may well emerge is that NO_x is a real problem. Much will depend upon what happens after 1992 and the legislation that is introduced into Europe and into this country. This is likely to provide the driving force and the incentive to move towards IGCC. It may

(Continued overleaf)

perhaps present a problem to the turbine manufacturer. Will they be able to use phased combustion with steam and water injection into the turbines, to get down to the levels of NO_x that are required.

Thinking back on some of the numbers that I have actually seen in the papers, 75 ppm has been quoted. In Japan, in the combined cycle plants that are in operation there they are actually getting down to 15 ppm of NO_x with catalytic conversion. I do believe that with IGCC we do stand a good chance of being able to comply with the environmental restrictions at a cost that is competitive with conventional stations with flue gas desulphurisation. They have many problems in reducing emissions to the required NO_x levels.

Session 3 dealt with the question of biomass and refuse collection. It is quite clear from the papers that there are many dedicated enthusiasts in this field. I think it is a topic we have covered widely during the course of this conference. We had a very good example of what could be done, in the work carried out at the Liverpool Festival Garden Centre. That was very impressive.

In Australia biomass provides a supplementary fuel and solves an environmental problem. The small down draught gasifier, operating and producing something like 27kVA, showed the simplicity and the elegance of such a device. It really does show what can be done in this type of gasifier.

In the penultimate session, we had some insight into the activities going on in the universities and the research establishments covering the basic work of gasification. Indeed this is very crucial and it is important for us to obtain a good understanding of what is going on inside gasifiers. We have been working with this problem for a very long time and all the process developers have models that they believe give results that are representative and reliable for their systems.

If I could just sum up the conference. Firstly, I found over the week, that the event has provided an excellent opportunity of meeting and talking with people and reviewing the general status of gasification.

Secondly, we see that oil and gas prices are such that the only likely application for coal gasification in the foreseeable future is in fact for power generation. The main driving force for this, is going to be the legislation on environmental emissions that we shall be presented with in the 1990s. It should be possible for the IGCC to meet the legislated limits, but what we require is a demonstration of an IGCC system with an advanced turbine to show that, not only does the technology work, but that it meets the environmental requirements. Perhaps the most important, is that it produces power at the right cost.

Finally, the work on biomass and refuse gasification is never going to have a major impact on the energy science, but it is tremendously important to communities in certain areas. It is something that I think needs to be pursued and supported as strongly as we possibly can. □

Energy from waste: current progress in Sweden — *continued*

cheap waste fuel to be concentrated on the more lucrative daytime generation, they can also burn other wastes such as fragmentiser waste and coal slurries. This enables greater amounts of power to be generated by one unit with beneficial effects on the economics of the operation. In the case of a refuse collection strike, coal can be burned to ensure the continuity of power supply which is necessary to achieve the best purchase tariffs, it is not possible to do that with a grate type of incinerator.

On the question of flue gas cleaning it can be done simply by lime spray and baghouse or super-efficiently by flue gas condensation, but the key to the economics of the latter, which is an expensive process, is to be able to use the relatively low grade heat recovered. That is easy with district heating, how else can it be used?

I have tried comparing the income that can be obtained from generating electricity with that obtained generally in Sweden from DH sales, setting against the former the cost of generation. It can only be an approximate exercise but it does indicate that this route could provide some pretty competitive waste disposal costs, which could conceivably challenge landfill as the lowest disposal cost and is certainly on target to be the next cheapest.

Since the power generation is likely to be at a rate of between 30 MW and 60 MW these projects will be capital intensive and the Waste Disposal Authorities will not be in a position to fund them but they represent a good business opportunity for entrepreneurially orientated companies in the energy sector. □

The opinions expressed by the author are not necessarily those of his employers.

The problems of acid emissions — an opportunity for British industry

Institution of Chemical Engineers, Rugby, 1988
215pp. £19.50 + 60p p&p (£1.00 if overseas)

The conference, organised by the Institution of Chemical Engineers, was held in September 1986 at the University of Birmingham. Developments have taken place since that date so that some of the papers were updated to the end of 1987. Eleven papers are included in the report. They are mainly concerned with the introduction of pollution control technology for sulphur dioxide and NO_x emissions in the UK.

The introduction is by N Haigh of the Institute of European Environmental Policy on *Legislative aspects of acid emissions: EEC and UK*. He says that 'Britain has established a well tried system of air pollution control but the danger of something long established is that it may well have become old fashioned. Major pressures for change are now coming from abroad and forcing the British to reassess their leglislation'. Dealing with acid rain he says that Britain's refusal to reduce its emissions is seriously impeding Britain's ability to influence international and EEC policy. He details how Britain is falling behind other countries in Europe relating to air pollution legislation but appears to ignore the different weather conditions in the British Isles compared with some other parts of Europe.

The other papers are concerned either with the need or otherwise for reducing emissions or with methods for reducing emissions. Papers from the oil industry and the steel industry emphasise that they produce less than 4% and 2% respectively of total acid emissions and that installation of very expensive desulphurisation plant is difficult to justify.

The methods for reducing emissions are mainly concerned with power station applications.

Four practical papers, based on developments abroad, give details of:

(a) De NO_x experience in a 200 MW plant in West Germany using a Japanese catalytic process.

(b) The Lodge-Cottrell spray dry desulphurisation system.

(c) The Wellman-Lord process developments with its world wide applications.

(d) developments of the Norton flue gas treatment system for NO_x removal.

ing emission control techniques from the CEGB and Warren Spring Laboratory that in the UK conventional lime/limestone scrubbing is likely to be the preferred option in many applications. This would incorporate an oxidation step to convert the waste product to gypsum. A detailed description of this type of plant is not included.

Consideration is given to the instruments required to monitor the operation of emission control plant and to assess whether corrosion problems are being encountered.

Perhaps the title of the conference should have been modified to read 'An opportunity for British industry to use pollution control techniques developed abroad which will be paid for by an increase in the price of electricity'.

Byrom Lees

The world nuclear handbook

Alicia Freundlich and Don Hedley
Euromonitor Publications, London 1988
228pp.

'There is far more to the nuclear industry than bombs and power stations'. Perhaps more than any other single phrase in the book this sentence from the foreword describes the content of this very comprehensive guide to all the major nuclear applications. There are seven main chapters contributed by experienced specialist authors. Six chapters include detailed notes on their text. One third of the book consists of a detailed series of annexes and appendices, which in themselves form a substantial nuclear reference section.

The book begins with an introduction that places the nuclear industry in its historical applications. The first main chapter describes the extraction and processing of nuclear fuel and, in common with the rest of the book, includes numerous tables based on NEA, OECD data.

The transportation, reprocessing and waste disposal issues are covered in the second chapter, again with tables from the major national organisations such as the IAEA and NIREX, and quotations from reports that highlight differing views on these issues; for example, the IAEA's statement that 'technologies to perform the required waste processing and isolation are available' and the International Council of Scientific Unions response that 'technology for final disposal... is not established'. The development of nuclear power generation is clearly described in the third chapter and is followed by an interesting overview of the medical applications. The fifth chapter, on nuclear applications in food and agriculture, includes details of insect pest control and applications in plant and animal science. The sixth chapter covers nuclear weapons and the final main chapter, written by an author from Harwell, gives a careful outline of many other applications, including non-destructive testing, environmental monitoring and radiocarbon dating. The wide ranging group of annexes and appendices include a glossary, acronyms, national bodies, international organisations and projects and there are lists of tables and figures as well as a detailed index.

The publishers have aimed the book at a very wide readership, including specialists in the industry, government, the media, college and university libraries and the interested lay person. It can be argued that they have succeeded in this task as the breadth and depth of the balanced text will appeal to each group in a different manner. The editorial team deserve considerable credit for maintaining a consistently high quality throughout the text and the book should become a standard reference throughout the world.

Dr Cleland McVeigh

Financing waste management, decommissioning and site rehabilitation in the nuclear industry

Uranium Institute, London
63pp. £30.00

The Uranium Institute is an association of industrial enterprises engaged in the production or use of uranium for civil purposes and in related nuclear fuel market activities. The Institute promotes the use of uranium for peaceful purposes and provides a platform for the exchange of information concerning the use of uranium. Its membership is drawn from 68 organisations in 18 countries and the EEC.

In publishing this excellent booklet the Uranium Institute illustrates how waste management and decommissioning expenses have to be taken into account in the costing and financial operation of today's fuel cycle activities and nuclear power station operation.

In common with many industrial activities, electricity generation by nuclear energy leads to some waste and thus efficient management and decommissioning is important especially if the income producing stage of the operations is to be optimised. It is important that wastes are dealt with in a way that protects human health and the environ-

ment. Obviously adequate financial provision is needed for this.

In a survey of these considerations provision is seen to be made for most of these potential problems; adequate means of control within a legal and sound financial framework is provided. The procedures and arrangements that are operating, or are shortly to be implemented, give a sound basis for confidence that sufficient finance will be available when and where it is needed in the future.

The conclusion is that the future of all such nuclear installations will be in a safe and environmentally sound state. This fact is highly important if we are to protect the health of our present and future citizens, as well as the world in which we live.

The agreed policy outlook is that today's society should ensure that it deals with the disadvantages and adverse effects of its activities from which it derives its benefit, rather than leaving its future generations to carry the burden.

Of the 17 countries surveyed, only 10 have nuclear power reactors. Those 10 countries appear to have substantial governmental legislation covering the industry, supported by a whole range of legal regulations on operators of nuclear installations.

In the three countries that do not possess nuclear plants (Australia, Gabon and Namibia) no laws deal explicitly or directly with financing mine decommissioning and clean-up, but a number of legal requirements are imposed that can be seen to deal effectively with the nuclear activities.

The book is perhaps too highly priced for the individual, but to those interested in today's nuclear debate it is well worthwhile attempting to secure a copy.

F John L Bindon

Coal-fired MHD

G F Morrison
IEA Coal Research, London, 1988
32pp.

This report reviews the status and prospects of coal-fired magnetohydrodynamics (MHD). It begins with a brief description of the MHD process and its advantages, followed by a review of national research programmes.

The development status of the individual components (the combustor, generator, magnet, power conditioning, heat recovery/seed recovery and gas cleaning) which make up an MHD system is presented prior to an assessment of the economics.

The technology is usually considered in terms of electric power generation for utilities. It may also have military and space applications. For military purposes the process is particularly suitable for providing large bursts of power for short durations from relatively lightweight equipment at low capital cost. However, almost all available information on MHD is related to producing electric power for utility applications, and it is this application that the study deals with.

Early commercial coal-fired MHD/steam generator plants are predicted to cost about 10% more than conventional steam plant. However, with efficiencies of approximately 45% compared with 36–37% for conventional plants, the cost of electricity may be up to 10% lower. This cost reduction is less than that projected for other advanced coal-fired generation systems and, in isolation, may not therefore be sufficient to justify the considerable R & D effort required to bring coal-fired MHD technology to commercialisation.

The author concludes that MHD may also have inherently low emissions of SO_2. Modifications to the process may also reduce concentrations of NO_x to within current required limits. However, advanced coal-fired MHD plants, using high-temperature directly-fired air heaters have potential efficiencies greater than 50% and perhaps as high as 60%. Based on the limited number of studies, the cost of electricity from these plants is predicted to be lower than that of electricity from other advanced coal-based technologies such as pressurised fluidised beds, coal gasification combined cycles and molten carbonate fuel cells.

Despite these potential advantages the author considers that MHD remains very much a long-term technology. Significant component development, particularly with regard to materials, is required, and much of the R & D work is about an order of magnitude lower in scale than for a full scale commercial plant. Current R & D programmes are mainly on a small scale with the MHD plants fuelled by oil and gas rather than by coal. The restricted finance allocated to this technology and the nature of the problems yet to be solved means commercialisation of the technology, if it does occur, is a long-term prospect.

The text also contains nearly 80 references making this report useful for further reading and research.

Andrew W Cox

Electricity in Europe — opening the market

Andrew Holmes
Financial Times Business Information, London, 1988
131pp. £155.00

Andrew Holmes has produced an updated review of Europe's biggest and most complex industry.

The European electricity industry is currently undergoing a period of change in ownership and structure. Privatisation in Austria, Spain and the UK aims to transfer ownership from the public to the private sector. Elsewhere there is a perceived need to open up the power market to 'new entrants' that can bring the spirit of the entrepreneur, lacking in the big utilities. Elsewhere, notably in West Germany, the Netherlands and Norway, there is pressure for structural change to create a more flexible and responsive industry.

A parallel move has appeared in the EEC's attempt to include electricity in the 'single internal market', breaking down protectionism in electricity supply across national borders and in power station equipment procurement. Whether the EEC will succeed in the creation of a free market in power is considered an open question. The breaking down of national barriers could create an unfair system in which certain utilities, burdened with political and environmental duties that cannot be shed or influenced, have to face the full rigour of competition from other utilities which face no such burdens.

However, Mr Holmes believes that political rhetoric about 'opening' the electricity market needs to be treated with caution. Electricity is the most highly regulated of the energy industries, and there is little indication that the regulatory network is being loosened; rather the opposite, in fact. The danger for the electricity industry is that the preoccupation with structural change will divert attention from the real problems facing the industry, chief

(Continued on p 18)

Recently published

Electrical equipment for use in hazardous areas
Available free from the Institution of Plant Engineers, 138 Buckingham Palace Road, London SW1W 9SG. Tel: 01-730 0469.

Industrial and commercial certificated equipment list
British Gas, Service Engineering, 326 High Holborn, London WC1V 7PT.

Energy and environmental terms: a glossary
Peter Brackley
Gower Publishing. Price £21.45.

Coal research projects 1988
IEA Coal Research. Price: 100.00.

American national standards catalogue 1988/9
Available from ILI, Index House, Ascot, Berks SL5 7EU. Tel: (0990) 23377.

Sutherland's comparative domestic heating cost tables.
The tables are published twice a year at a cost of £30.00 + VAT for two issues. For more information contact Sutherland Associates, Ridge House, Park Road, Banstead, Surrey SM7 3EJ. Tel: (0737) 350414.

Energy education Institute calls for more effort

In a letter to *The Times*, in October, the president of the Institute of Energy, C E Pugh CBE, wrote: 'The Prime Minister's speech on the need to protect the environment is great news and I hope it prompts many people to understand that the continuing and increasing demand for energy throughout the world brings with it scientific, social and political problems of enormous magnitude.

'At the present time the world consumes 10 billion toe every year and in the last 100 years we have probably used as much energy as in the previous 2000 years. The early use of energy was in the form of food, cooking, and simple heating, whereas today's industrial world releases carbon that has been fixed over millions of years. Fifty-eight per cent of the energy we use is in the form of oil and gas, both short-lived and finite fuels with no easy replacement.

Protecting the environment is vital, but it is equally important to ensure that everyone is educated in the use of supply of energy. Many of us now have a growing concern that at a time when we need more effort put into education and research, the privatisation of the energy industries will have the opposite effect.

Source: The Times

Piper Alpha Hearing set for this month

Lord Cullen, appointed to conduct a public enquiry into the Piper Alpha oil production platform disaster, has written to people who have expressed an interest in the inquiry giving details of the preliminary hearing which is intended to be held in Aberdeen this month.

Lord Cullen has decided that the interim report of the technical investigation into the disaster should be made public. It was produced by James Petrie, head of the Department of Energy's Petroleum Engineering Safety Directorate. The foreword to the report emphasises that the findings are necessarily tentative, and may require to be revised in the light of the continuing technical investigation.

The report describes the Piper Alpha installation, the events leading up to the accident and subsequent actions. It also sets out Mr Petrie's preliminary findings on the most likely cause of the accident and outlines further areas of work necessary to verify and evaluate more thoroughly the information obtained so far.

Source: Piper Alpha Enquiry Service

USSR/UK Something in common

Soviet anxiety about this trend emerged during a week-long tour of Soviet education and research institutions by Mr Kenneth Baker, Education Secretary, reports the *Financial Times*.

Prof Juri Vasiliev, rector of Leningrad Polytechnic Institute, an elite Soviet higher education institute specialising in engineering and science, told Mr Baker: 'This is our sore spot.'

He said the ratio of applicants to places at the Leningrad Institute had fallen to 2:1 from about 6:1 in the 1970s. 'Even to get two applicants for each place, we have to work a lot with schools,' he added.

Mr Viktor Zubaryev, Deputy Soviet Education Minister, confirmed that this was a nationwide problem. He said it had emerged as a significant trend about five years ago.

Mr Zubaryev blamed the dwindling interest in technical subjects on the increasingly negative image among young people of industry, which was being held responsible for serious ecological problems.

He added that the trend was less pronounced in mathematics and physics, but was still noticeable. Young people preferred to study for professions such as law and medicine.

This comes at a time when the British Government has announced that it will cooperate with the engineering industry in an investigation into the shortage of engineers in Britain. The investigation will be funded jointly by the Engineering Employers' Federation, the Engineering Industry Training Board and the Department of Education and Science and will take place over the next six months.

Source: Financial Times

Chernobyl fears Nuclear plant abandoned

The Soviet Union has abandoned construction of a nuclear power station near the western city of Minsk, in the face of the public outcry since the Chernobyl disaster in 1986, reports the *Financial Times*.

The first 1000 MW reactor at the plant had been due to come on stream next year. Instead of the nuclear station, a gas-fired station is to be built but it will not be commissioned until 1993.

The decision comes in spite of repeated government assurances about new safety systems at Soviet nuclear plants.

These were tested only two days ago in a fire at the country's 3000 MW Ignalina plant in Lithuania, where the first post-Chernobyl control system was installed.

The power station was to be located about 25 miles from the centre of Minsk and was intended to supply both heat and power to the city.

In January, it was disclosed that the building of a nuclear plant in Krasnodar, in the northern Caucasus, had been halted in the face of public concern after expenditure of 25 M roubles (£22.7 M). The Minsk station, however, appears to have been much nearer completion.

The Ignalina plant in Lithuania, where a fire broke out in electricity cables on 5 September, is only half the 6000 MW size originally planned.

In its case, the decision to build a smaller plant was taken in April, 1987, and was attributed to the fact that it was using 'obsolete technology.'

Source: Financial Times.

Powrmatic/NIFES Award Finalists announced

Four finalists in the 1988 Powrmatic/NIFES National Energy Management Award competition have been announced and are now candidates for this prestigious award, which is in its tenth year.

The winners are M Jobson (Ind Cooper Burton Breweries, Burton on Trent), K Platt (London Borough of Lewisham), P Lye (The Littlewoods Organisation, Liverpool) and from the University of East Anglia, B Deakin (Member).

This year a number of changes were made to the competition, which for the first time was organised on a national basis, with the finalists representing energy management programmes selected as the most effective throughout the country, irrespective of region.

Each finalist will receive a certificate and a cheque for £50 as recognition of their achievement.

The overall winner will be announced at NEMEX '88 on December 6 at the Hotel Metropole in Birmingham. The Powrmatic/NIFES Award winner will collect a trophy and a cheque for £1000. The Institute of Energy is one of the sponsoring organisations of NEMEX '88.

Source: Garnett Keeler

ESI privatisation
Head of common services announced

Mr Roger Farrance, currently a full-time member of the Electricity Council, is to head the organisation that will provide common services required by the electricity industry after privatisation.

During his career, Roger Farrance CBE (54) has been an HM Inspector of Factories, and a company industrial relations and personnel manager. He has also spent a considerable time as deputy director of a major engineering employers association. He joined the electricity supply industry in 1975 and was appointed a full-time member of the Electricity Council with special responsibility for industrial relations in 1979. He is a part-time member of the Council of the Advisory Conciliation and Arbitration Service.

Source: Department of Energy

Manufacturer...
... introduces CHP

Industry could be generating its own electricity and making energy savings to the value of over £30 M within the next 10 years. That is the claim of a Gosport, Hampshire based pharmaceutical company.*

At a cost of £2.2 M the company has installed a new combined heat and power (CHP) plant producing the electricity and steam that it needs for its many manufacturing processes, and surplus electricity that it can sell to the grid. The annual savings of £500 000 are equal to an impressive payback of just over four years.

The Energy Efficiency Office put up a grant of £300 000 towards the project which it believes, other companies could copy.

Source: Cyanamid (UK)

Opencast coal
'Low cost energy'

'Opencast coal plays a vital role in improving the quality of deep mined coal and secures the future of many collieries such as Lea Hall', Energy Minister, Michael Spicer said on a visit to the Lea hall Colliery, Rugeley, Staffordshire.

Mr Spicer said: 'Opencast coal is an important source of low cost energy. The Government would like to see a significant increase in the production of opencast coal provided it can be achieved in a way that is environmentally acceptable.

'I am anxious that the industry should put back into the community what it takes out and am delighted that the policy of British Coal is to restore sites to a high standard.

'This should mean that low grade farmland can be given good drainage and fields brought up to modern standards. Derelict sites, which are often dangerous as well as being eyesores can be turned into either productive farmland, leisure parks, golf courses, industrial developments or land for housing. The Government is certainly determined that this policy should be put fully into effect'.

Source: Department of Energy

*Cyanamid (UK)

Investment in coal
£16 M for Nottingham pit

British Coal have announced a £16 M investment scheme for Welbeck Colliery in Nottingham. This will give access to new reserves of coal and enable output to be maintained at 1.25 Mtpa.

The money will be spent on driving new underground roadways or tunnels for a total distance of 3.6 km to open up the Parkgate seam.

Source: British Coal

IEE/IERE
Merger announced

The Institution of Electrical Engineers (IEE) and the Institution of Electronic and Radio Engineers (IERE) have merged. The new body will be called the Institution of Electrical Engineers; it is now the largest of the British chartered engineering institutions with a membership of over 105 000.

Speaking of the merger, Dr Bryce McCrirrick, who became president of the IEE on the day of the merger, said: 'There has always been considerable collaboration between the IEE and the IERE and it was felt that a merger would benefit the members of both Institutions and lead to a strengthening of the electrical and electronic engineering profession.'

The decision to merge came after nearly three years of negotiations between the two engineering institutions and was warmly approved by members of both bodies.

Source: Institution of Electrical Engineers

Merger talks begin

Following discussions between the Society of Electronic and Radio Technicians (SERT) and the Institution of Electrical and Electronics Incorporated Engineers (IEEIE), the report of a Joint Amalgamation Committee has been prepared and the councils of the two bodies are holding meetings with their members to discuss a merger.

The proposal is to form a new, non-chartered, institution — one that with some 27 000 members would be far better placed to cater for the needs of the combined memberships and the industries they serve. The new body would have the title Institution of Electronics and Electrical Incorporated Engineers and bear the heraldic arms of SERT. It would continue to nominate its members in the IEng and EngTech sections of the Engineering Council register.

Source: Society of Electronic and Radio Technicians

Generator sets
For the Third World

An imaginative scheme for resettling a quarter of a million Ethiopians threatened by hunger is underway in the valley of the River Beles. The key to the success of the project is a reliable power supply, and a British company has been chosen to provide the engines.* Four constant speed engines will drive four generator sets working in automatically controlled parallel for general power.

Two more engines will go on duty in the general hospital, part of a major scheme for creating a small town surrounded by 100 villages scattered along the 60 km Beles Valley stretching down to Lake Tana.

Money for the Tana Beles project comes from the Italian Aid Fund and more than 250 000 people (with a potential of up to one million people) will be resettled in an area which a year previously was uninhabited territory. More than 350 km of roads are being built to connect the villages which will also be served by an all weather airport.

A second phase involving dam building, water pumping tunnels for hydro-electric and irrigation purposes with a power house will follow. The aim is to ensure that the people become self-sufficient for food almost immediately and that they become economically independent soon after the project is completed.

Source: Perkins Engines

Engineering...
... and the past

In September the American Society of Mechanical Engineers (ASME) designated the world's first industrial gas turbine a 'milestone in the international history of mechanical engineering'. The turbine was supplied by Brown Boveri in 1939 to 'Service industriel de la ville de Neuchâtel'. The distinction was awarded by ASME as part of its History and Heritage programme for technical achievements in mechanical engineering.

The purpose of the programme is to preserve cultural heritage in the field of

*Perkins Engines

mechanical engineering. The award, presented 26 times since 1971, is intended to encourage the owner of the facility or equipment associated with the particular engineering achievement, to preserve it for future generations.

Today, 50 years after its installation, the unit is still supplying standby power.

Source: ASEA Brown Boveri

Energy efficiency
At home and at work

The Building Services Research and Information Association (BSRIA) has developed a simulation technique for a wet domestic heating and hot water system that can be used to facilitate the following:

- Measurement and comparison of boiler seasonal efficiency.
- Evaluation of component performance, eg boiler/pump controllers, thermostats, control valves, hot water cylinders.
- Assistance in the development of domestic heating appliances and controls.

A combination of physical hardware and software modelling is used to achieve a realistic simulation of a domestic heating system. The hardware consists of: boiler, pump, control valve, hot water cylinder, pipework and radiator simulation circuit in the form of a second hot water cylinder. The real-time software mimics a house to give internal building temperature for a set of daily external conditions, representative of a typical heating season.

The software interacts with the hardware simulating a timeclock and room thermostat as well as controlling output from the radiator simulation circuit and providing a hot water draw-off schedule.

BSRIA has also identified potential energy savings averaging 16% at 44 commercial sites. Heating control faults were identified using a computer based analysis program, developed for the Energy Efficiency Office, to interpret recordings of internal building temperature.

About half of the energy was wasted because of incorrect scheduling of the heating plant, that is, continuous, weekend and holiday heating. Such faults are, apparently, not uncommon, and are easily put right. Energy was also wasted because of overheating, where the temperature level was too high. This, and the associated problem of poor temperature control, are more difficult to correct.

The effect of late stop times, which increased energy usage, was counteracted by the effect of late start times, which reduced energy usage but also reduced morning comfort conditions.

Source: BSRIA

All nuclear sites
Under same rules

Nuclear sites operated by the United Kingdom Atomic Energy Authority (UKAEA) are to be made subject to licensing by the Health and Safety Executive (HSE).

The change means that all civil nuclear sites in the UK will be subject to the same system of regulation. Currently, ministerial directives require the authority to secure the highest standards of safety in line, as far as practicable, with current safety requirements imposed on licensed commercial operators. Licensing will be administered by the HSE's Nuclear Installations Inspectorate (NII).

Source: Department of Energy

New appointments. . .
. . in gas research

British Gas has announced changes in its research and marketing activities with the creation of three director posts under the director of Technology, Gerald Clerehugh.

Dr Les Mercer has been appointed director, Gas Research; Dr Ernest Shannon director, Engineering Research; and Don Wilson director, Technology Transfer.

Dr Mercer will be responsiible for the proposed new research centre in the Midlands, replacing three existing research stations, two in London and one in Solihull, West Midlands. Dr Ernest Shannon will have responsibility for the Engineering Research Station, Northumberland, and for transmission, distribution and offshore research. Mr Wilson will be responsible for technology marketing, including the International Consultancy Service, pipeline inspection technology, technology applications and patents and licensing.

Source: British Gas

Gas
For electricity production

Investigations into the suitability of four sites for possible gas turbine power stations are to be carried out by the Central Electricity Generating Board (CEGB).

The studies will cover the potential of the sites for the development of two types of plant: open cycle gas turbines, similar to those presently used by the CEGB to help meet peak demand for electricity, and combined cycle gas turbines. Both types of plant can use either distillate oil, natural gas or a combination of the two as a fuel that is burnt in a gas turbine to drive a generator producing electricity.

The investigations will be centred on units of around 300 MW at each site. They are aimed at providing the Board's successor companies under privatisation with options to develop gas turbine stations together with coal and nuclear plant.

The four sites which are all owned by the Board are: Didcot, in Oxfordshire, Little Barford, on the border of Bedfordshire and Cambridgeshire, Rye House in Hertfordshire, and Killingholme on South Humberside.

Source: CEGB

UK oil demand
Up by 2.5 Mt

Figures issued by the Institute of Petroleum show that inland demand for petroleum products in the United Kingdom increased by 7.2% during the first half of 1988 compared with that of 1987. A total of 37 820 493 t was recorded in contrast to the 35 270 801 t of the previous year.

There were increased deliveries in the transport fuels, derv fuel showed a rise of 11.2% avtur (aviation turbune fuel) 6.8%, and motor spirit (petrol) 5.9%. Fuel oil demand increased by 20.5% from 4 498 039 t in 1987 to 5 419 194 t in 1988.

Source: Institute of Petroleum

Young Engineer for Britain
Alarm design wins

A 17 year-old schoolboy from Cheltenham College won the title of Young Engineer for Britain 1988. Paul Dagley-Morris carried off the coveted trophy, and £1250 for his school, for inventing Rapidcall, a sophisticated radio transmitter alarm system.

This high technology transmitter system can be attached to a belt and can be used, for example, by old people and security service staff. It activates a receiver plugged into existing alarm systems and works up to a distance of 350 feet away.

Paul was one of 59 of Britain's budding engineers, aged from 11-19, who competed in the national final of the Young Engineers for Britain contest, organised by The Engineering Council.

The Engineering Council's Women Into Science and Engineering (WISE) award of £200 for the best project by a girl was won by Beverley Waugh (18), of South Park Sixth Form College, Normanby, Middlesborough. Beverley invented Chuck Change, a device to make the removal of heavy jaw chucks used on a centre lathe easier.

Source: Engineering Council

(Continued overleaf)

Radiation monitoring CEGB get the OK

Following a rigorous examination, a Watt Committee on Energy Working Group says that it is 'impressed' by the Central Electricity Generating Board's (CEGB) system for monitoring radiation levels around its nuclear power stations. But its communication of the results to the public is currently inadequate.

Monitoring is carried out so that the CEGB can ensure that radiation levels are kept within the statutory limits for public safety. The Board tests a range of different substances such as milk, soil and fish within a wide radius of each of its nuclear power stations. In the committee's report, Prof Keith Boddy, a medical physicist at Newcastle General Hospital and chairman of the Working Group, says of the CEGB, 'We were fully satisfied that the documented programme was being fulfilled with respect to the distribution and number of monitoring sites as well as the nature, frequency and type of analysis of sampling'. Despite this, over 30 recommendations were made in the report for improvements to the system of monitoring radiation levels in England and Wales.

The working group maintains that people living in communities around nuclear power stations deserve full reassurance and should have access to accurate and well presented information on radiation levels in their home environment. Local Community Liaison Councils (LCLCs). The group recommends that local health authorities, which serve on the LCLCs, 'should be represented by a senior medical physicist with considerable experience of, and expertise in, radiation protection' to provide independent expert guidance to other council members, some of whom have little or no technical experience. Not only, it believes, would this allow correctly interpreted data to reach the local populace, but it would help to inspire confidence in the Board's monitoring programme by facilitating technical questions.

The Watt Committee's Working Group also criticises the Department of the Environment concerning a particular summary report of CEGB and Ministry of Agriculture Fisheries and Food (MAFF) data produced for LCLCs. This summary report, it says, contains 'careless presentation' of the facts which could lead to 'potentially alarming inaccuracies'.

Prof Boddy and his team also call for greater comparison to be made with data supplied by the MAFF, which, as a regulator for the nuclear industry, carries out its own monitoring of radiation levels around CEGB stations.

Although not in the Watt Committee's official remit, the working group's report includes a note of reassurance for people living in the vicinity of nuclear power stations. It explains that for the majority of the population living more than a few kilometres from a nuclear site, any additional dose is virtually indistinguishable from that due to natural background radiation. Of people living closer to a station, most would be unlikely to receive an attributable additional dose of radiation exceeding about 10 micro-sieverts per annum. This is equivalent to spending about five hours in an area of Britain with above average natural radiation levels.

The report, entitled *Radiation monitoring around CEGB nuclear power stations* costs £15.00 (plus £2.00 for postage and packing) from the Information Officer, The Watt Committee on Energy, Savoy Hill House, Savoy Hill, London WC2R 0BU. Tel: 01-379 6875.

Source: Watt Committee on Energy

BOOKS — *continued*

among which is the increasing difficulty in siting new power stations.

The author also believes that the theories of competition in electricity supply also need to be treated with some scepticism; electricity supply has never given an important place to open competition, and is never likely to. Forcing competition, in an artificial way, will probably offer few long-term benefits.

On a more positive note, the author thinks that the industry faces a wider choice of fuels, at reasonable prices, than seemed possible in the 1970s, with natural gas making a significant, if limited, return to the power station market and world steam coal prices remaining depressed. Renewable energy, however, is still considered a distant prospect.

The report also concludes that nuclear power will face, at best, stagnation in the 1990s and beyond. The damage done to nuclear's reputation by the Chernobyl accident has since been compounded by the Nukem scandal in West Germany. Nuclear expansion is off the agenda in most of Europe, leaving France and Belgium out on a limb as far as nuclear dependence is concerned.

Several countries are selected for detailed examination by the author — United Kingdom, West Germany, Austria and Spain. The electricity supply industries of the remaining European countries are dealt with in an extended section of the second half of the text.

The report is completed by an 11 page appendix containing useful addresses for electricity utilities and associated energy agencies for all European countries.

Andrew W Cox

CORRECTION

In BOOKS, *Energy World,* April 1988 we mistakenly gave the author of *Application of optimal control theory to enhanced oil recovery* as W Fred Ramsey. The author's name should have read W F Ramirez. We apologise both to the author and to the reader for any confusion this may have caused.

1988 December meetings

Midland

Hon sec: A W T Cleaver (Tel: (0902) 753806)

1 Dec (Th). *Steam compression in the whisky industry* by Dr D L Hodge (Electricity Council Research Centre). Senior Common Room, University of Aston in Birmingham at 1900 h.

Scottish

Hon sec: J McColl (Tel: 041-332 2453)

6 Dec (Tu). Presentation by Scottish Development Agency including the work of the agency in furthering prosperity in Scotland. Royal Scottish Automobile Club, Blythswood Square, Glasgow at 1800 for 1830 h.

Yorkshire

Hon sec: A Mallalieu (Tel: (0532) 711 888 ext 230)

7 Dec (W). *Role of building management systems in facilities management and energy efficiency* by Stuart Rose (FHP Management Services). Royal Victoria Hotel. Victoria Station Road, Sheffield at 1900 for 1930 h.

North Eastern

Hon sec: A W Cox (Tel: 091-261 5274)

12 Dec (M). *Fast moving wind energy* by Dr D T Swift-Hook. Lecture theatre L101, Merz Court, University of Newcastle upon Tyne at 1815. Refreshments will be served before the meeting. Joint meeting with the Institution of Electrical Engineers.

East-Midlands

Hon sec: J R Agg (Tel: (0533) 549414 ext 2037)

13 Dec (Tu). Development in non-domestic utilisation of natural gas. British Gas East-Midlands, Longeaton, Nottingham at 1400 h.

The Engineering Council *Neighbourhood engineers*

Recently, The Engineering Council reported to Eric Forth, Parliamentary Under Secretary of State for Industry and Consumer Affairs, on the progress of a new initiative being funded by the Department of Trade and Industry in Merseyside and Cheshire. Called *Neighbourhood engineers,* the scheme, supported by six local education authorities, involves linking three or four local engineers with each local secondary school in the area. The scheme will help schools with curriculum development, careers advice and community involvement. Eventually it is hoped to expand the scheme nationwide.

CET

Denis E Filer, director general of the Engineering Council has announced that pilot schemes for the continuing education and training of engineers have been launched in several large firms throughout the United Kingdom.

The schemes were introduced as a result of a consultative document published by the Council on continuing education and training that suggested a national system for engineering based on career action plans. They had been started with the help of the Department of Education and Science Professional, Industrial and Commercial Updating PICKUP programme.

NI office

The Secretary of State for Northern Ireland, Tom King, opened the first office in Northern Ireland of the Engineering Council Regional Organisation last month.

The office, named Engineering House, will be the focal point for the 3000 professional engineers belonging to the Engineering Council in the region. It will also provide the necessary links between industry, education and the engineering profession, thus helping to strengthen the industrial economy of Northern Ireland.

Personal

James S Harrison (Fellow) has been appointed director of British Coal's Coal Research Establishment at Cheltenham, Gloucestershire. He was formerly Deputy Director of the Establishment and succeeds **Dr A D Dainton** (Fellow) who retired on 31 October 1988.

Born in Lancashire and educated in Guildford, Mr Harrison gained first class honours in chemical technology at Loughborough College and in chemistry at the University of London. He is a Fellow of the Royal Society of Chemistry, for which he was chairman of the Process Technology Committee. He is a past member of the Council of the Institute of Energy and was chairman of the Publications and Conferences Committee. At the Institute's Annual Luncheon he was presented with the Institute's Special Award in recognition of his services to Institute.

He is chairman of IEA Coal Research which is responsible for the international coal project established under the auspices of the International Energy Agency and is chairman of Combustion Systems, a company jointly owned by BP and British Coal that markets the fluidised bed technology developed by the two companies.

John Mulholland Member has been appointed national training manager for NIFES Consulting Group. Based at the group's Nottingham office, he will be responsible for expanding the current range of NIFES' energy-related courses and for developing new management training services.

REGISTER OF ENERGY COURSES

Course No 00-451

Title: VAV air conditioning design.
Duration: 1 day.
Location: University of Liverpool.
Starting: 13 December 1988.
Content: Variable air distribution. Terminal geometry. Heating methods. System types. Fan capacity control. Noise. Space occupied. Energy consumption. Running costs.

Course No 00-438

Title: The control of substances hazardous to health.
Duration: 2 days.
Location: University of Sheffield.
Starting: 13 December 1988.
Content: Details of the new COSHH regulations, with practical implications for the requirements of each section within them. Including: toxicity risk assessment methods, monitoring strategies, health surveillance requirements, record keeping, communication and training requirements.

Course No 00-443

Title: Effective project management.
Duration: 4 days.
Location: Amsterdam.
Starting: 13 December 1988.
Content: Introduction to project management. The project life cycle. Functions of the project manager. Organisation. Communicating the job. Planning. Working with vendors/contractors. Negotiating for success. Effective presentations. Coping with change. Project control. Summary. The computer as a tool. Determining your needs. Using project management software. Building an effective system.

Course No 00-452

Title: Quality assurance in practice.
Duration: 1 day.
Location: University of Liverpool.
Starting: 14 December 1988.
Content: BS 5750. Experience from a quality assured practice. Role of QA in design, installation, commissioning and maintenance of building services. Planning the introduction of QA. Preparing system documentation. Implementation. Procedure for certification. Monitoring and QA system maintenance.

Course No 00-444

Title: Applied combustion technology.
Duration: 4 days.
Location: Amsterdam.
Starting: 19 December 1988.
Content: Combustion calculations. Flame temperature and equilibria. Fuel composition and the combustion process — gas, oil, coal. Flame stability. Combustion chemistry. Flame aerodynamics. Combustion generated air pollution. Pollutant control by combustion. Heat transfer from combustion. Substitute fuels. Fuel/air proportioning. Furnace pressure. Fuel conservation through heat recovery. Burner management. Refractories, maintenance, noise.

Course No 00-445

Title: Distillation: design, operations and control.
Duration: 4 days.
Location: Amsterdam.
Starting: 19 December 1988.
Content: Introduction to distillation operations. Vapour-liquid equilibria. Distillation operating variables. Contacting requirements. Batch distillation. Multicomponent distillation. Objectives of distillation column control. Distillation column control. Advanced control techniques. Commerical contacting devices. Distillation control design. Distillation economics. Distillation optimisation. Troubleshooting.

Course No 00-446

Title: Metallurgy for non-metallurgists.
Duration: 5 days.
Location: Amsterdam.
Starting: 19 December 1988.
Content: Survey of metallurgy. The nature and properties of pure metals. Principles of alloying and casting. Strength and deformation. Strengthening by work hardening. Mechanical forming. Heat treatment — age-hardening alloys and strengthening of steel. Understanding commercial allowys. Thoughness, fracture and afailure analysis. Non-destructive testing and evaluation of metals. Other fabrication methods. Long-term service under load. Corrosion control. Selection and treatment of materials. Materials treatment, selection, evaluation and design. Heat treatment and mechanical treatment. Prevention and analysis of mechanical failure. Corrosion prevention. Materials selection and failure analysis workshop.

Course No 00-450

Title: CAD in building services.
Duration: 1 day.
Location: CIBSE, London.
Starting: 31 January 1989.
Content: Low cost computer aided design and draughting. Software functions. Hardware, software — selection and purchasing. CAD in building services design. Database links. Drawing and data exchange.

Calling all UMIST & Tech former students

Any former students or academic staff who have not yet received details of the UMIST Association (which replaced the Manchester Technology Association) are invited to write to the association at the address shown below. The association includes all former members of UMIST and Tech, and aims to keep them in touch with UMIST and with each other. Membership is free.

UMIST is currently establishing a register of prospective members, and would be pleased if ex-UMIST and Tech students and academic staff would write, enclosing their current address and details of their year and subject of graduation to: Helen M Cane, Alumni Officer, UMIST, PO Box 88, Manchester M60 1QD.

Global forces in the energy scene — lecture 26 January 1989

The lecture, *A view of global forces in the energy scene* will be given by R Malpas CBE FEng, British Petroleum, at the Royal Institution of Chartered Surveyors at 5.30 pm. Those who wish to attend are asked to inform the Fellowship of Engineering, 2 Little Smith Street, London SW1P 3DL. Tel: 01-222 2688.

Environmental degradation of materials in water reactors for nuclear power systems — call for papers

Papers are being solicited for the fourth international symposium on *Environmental degradation of materials in nuclear power systems* to be held 6-10 August 1989, at Jekyll Island, USA. The symposium will be sponsored by the National Association of Corrosion Engineers (NACE) and co-sponsored by the Materials Science and Technology Division of the American Nuclear Society and the Nuclear Materials Committee of the Metallurgical Society of the AIME.

Symposium topics will range from irradiation effects on mechanical properties, water chemistry, corrosion fatique, erosion, remedial measures to prevent problems, monitoring methods, and plant life extension. Systems to be covered include reactor vessels, steam generators, turbines, piping, fuel cladding and irradiated components, condensers, valves, bolts, pumps, heat exchangers, reactor internals, balance of plant, and service water systems.

The purpose of the conference is to provide an exchange of ideas about the materials problems and their remedies in nuclear plants using water coolants. Almost 90% of the operating nuclear plants and over 90% of plants planned for or under construction are water-cooled reactors. However, the current availability of these plants is only about 65%; the outage time is due largely to materials related problems. Scientists and engineers concerned with corrosion mechanical and radiation effects on materials will exchange their views and experiences and present the latest results of their work and research.

Abstracts of 50-100 words should be sent to Dan Cubicciotti, Nuclear Power Division, Electric Power Research Institute, 3412 Hillview Avenue, PO Box 10412, Palo Alto, CA 94303, USA.

Minerals, materials and industry, 2-6 July 1990 — call for papers

Minerals, materials and industry is the theme of the 14th Congress of the Council of Mining and Metallurgical Institutions. Mineral resources, including oil and fossil fuels, are fundamental to the needs of society and, at the technical sessions, attention will be focused on the expanding range of materials that are required by contemporary industry. Four particular areas are:

- Identification of industry's needs
- Exploration and assessment of resources
- Production and recovery of minerals
- Preparation and marketing of mineral products

will be examined in a technological context and, within those broad areas, such traditionally associated factors as safety, legislation and fiscal philosophy, operations management and energy employment will be reviewed.

The organising committee invites the submission of abstracts (200-400 words) of papers for its consideration; selected authors will then be required to submit the manuscripts of their papers. Those papers which are accepted for presentation at the technical sessions will be published. Abstracts should be sent to the Secretary, Institution of Mining and Metallurgy, 44 Portland Place, London W1N 4BR.

The Rolex Awards for Enterprise

The Rolex Awards for Enterprise have been granted on four occasions: in 1978, 1981, 1984 and 1987. In 1990, they are to be granted again for the fifth time.

As before, there will be five awards, each consisting of a sum of 50 000 Swiss Francs and a gold Rolex chronometer specially engraved for each winner. The awards are intended to provide financial assistance to people with the spirit of enterprise in order to allow them to carry out unconventional projects in one of the following three broad fields of human endeavour:

- applied sciences and invention
- exploration and discovery
- the environment

Projects must display the 'spirit of enterprise' plus qualities of innovation, originality, inventiveness, interest and impact. In addition, they must be feasible, and there must be a good likelihood that they can be put into action.

Prospective applicants should write for an official application form to: The Secretariat, The Rolex Awards for Enterprise, PO Box 178, CH 1211 Geneva 26, Switzerland. Projects must be presented in English and should reach the secretariat not later than 31 March 1989.

Fellowships in Japanese government laboratories

The Japanese Science and Technology Agency (STA), in association with the Royal Society, is offering six post-doctoral fellowships of between six months and two years tenable in laboratories of Japanese government ministries and public research corporations. The successful candidates will take up their fellowships before the end of March 1989.

The fellowships are open to suitably qualified British scientists and engineers under the age of 35, from universities, research councils, government research establishments or industry, working in any science or engineering discipline except military R & D. Fellowships include a return air fare, a monthly stipend, family allowance where necessary and health insurance.

There are no closing dates but candidates are encouraged to submit their applications as early as possible. Further details and application forms are available from: The Executive Secretary (Ref: KK), The Royal Society, 6 Carlton House Terrace, London SW1Y 5AG. Tel: 01-839 5561 ext 309.

Senior research fellowships

In 1986 the Fellowship of Engineering instigated jointly with industry a series of collaborative senior research fellowships tenable at higher education institutions aimed at fostering industrial/academic cooperation. The area of research and level of appointment are selected by the industrial partner.

The scheme is designed to provide additional funds for a senior research fellow, working in a higher education institute, on a research project of direct relevance to the sponsoring industrial company. The researcher's salary together with national insurance and superannuation are paid by the industrial sponsor. The Fellowship of Engineering contributes additional funds of up to one third of salary plus national insurance and superannuation. This can be used for the purchase of equipment and travel related to research. Further capital funds for the purchase of equipment may be bid for by the research fellow and may be available from the Fellowship of Engineering. Research Fellows may also apply for an International Travel Grant from the Fellowship of Engineering for overseas travel directly related to their research project with a maximum of one grant per annum.

A proposal for a senior research fellowship should be submitted through the Fellowship of Engineering Secretariat. The proposal should be submitted by the head of department of the higher education institute outlining the area, aims and objectives of the research programme which has been agreed with the industrial sponsor. The level of salary and length of the fellowship should be stated, together with the proposed starting date. Any additional support provided by the industrial sponsor should be specified. A letter of support including the level of financial contribution from the industrial sponsor should accompany the application.

The proposal should be submitted in triplicate to: Manager, Engineering Support, The Fellowship of Engineering, 2 Little Smith Street, London SW1P 3DL. Tel: 01-222 2688, tlx: 918358 FOENG G.

1989 Beilby Medal and prize

Awards from the Sir George Beilby Memorial Fund are made by the administrators of the fund, representing the Royal Society of Chemistry, the Society of Chemical Industry and the Institute of Metals, and consist of a medal and a prize of £500.

The awards are made to British investigators in science in recognition of original work of exceptional merit that has led to advances of practical significance. This work should have been carried out continuously over a period of years and should have involved the development and application of scientific principles in any field related to the special interests of Sir George Beilby that is, in chemical engineering, fuel technology or metallurgy, in their modern interpretations. The awards are intended as an encouragement to young men and women, normally under the age of 40.

Consideration will be given to the making of an award from the fund in 1989. Outstanding work of the nature indicated may be brought to the notice of the administrators, either by persons who desire to recommend candidates or by the candidates themselves, not later than 31 December 1988, by letter addressed to the Convener of the Administrators, Sir George Beilby Memorial Fund, The Royal Society of Chemistry, Burlington House, London W1V 0BN. All applications or nominations should include the names of two referees. The letter should be accompanied by five copies of a short statement on the candidate's career (date of birth, education and experience, degrees and other qualifications, special awards and so on, with dates) and a brief summary (not more than 200 words) of past research. Candidates must also provide a list of titles, with references, of papers or other works published by the candidate independently or jointly, and are advised to forward one reprint of each published paper of which copies are available.

The Energy Industries Club

The Energy Industries Club is a private luncheon club at which addresses are given by prominent members in the energy and associated industries.

Members of the Institute of Energy who are not members of the Energy Industries Club are entitled to attend one luncheon meeting at the luncheon price only, with the option of joining the Club for subsequent meetings, at the membership rate. For more information contact Dr G G Thurlow on 06 845 4481.

Forthcoming meetings:

13 December 1988	*The first estate* Canon J R Smith, Vicar of Bury
21 February 1989	*The European estate* Clive Jones, Deputy Director General for Energy, European Commission

CONFERENCES

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

December 1988

Power generation and the environment

Colloquium, Institution of Electrical Engineers, London, 5 December 1988.
Details from: The Secretary, Institution of Electrical Engineers, Savoy Place, London WC2R 0BL. Tel: 01-240 1871, tlx: 261176 IEE LDNG, fax: 01-240 7735.

Energy '88

Third international conference, Royal Institute for International Affairs, London, 5-6 December 1988.
Details from: Terry Lockhart, RIIA, Chatham House, 10 St James's Square, London SW1Y 4LE. Tel: 01-930 2233, fax: 01-839 3593.

Gas, oil and coal biotechnology

First international symposium, New Orleans, USA, 5-7 December 1988.
Details from: David Akin, Institute of Gas Technology, 3424 South State Street, Chicago, IL60616, USA. Tel: Int +(312) 567 3724, tlx: 25-6189.

Electricity privatisation — implications for private generators and the coal industry

Conference, Whitbread Conference Centre, London, 14 December 1988.
Details from: D C Gardner, 5-9 New Street, London EC2M 4TP. Tel: 01-283 7962.

February 1989

The effects of small doses of radiation

Conference, London Marriott Hotel, 7-8 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.

Coal and Steel

Fourth coloquium, Berlin, 21-22 February 1989.
Details from: Prof Dr Oeters, Technische Universitat Berlin, Institut fur Metallurgie, Sekr Bh14, Strasse des 17 Juni 135, D-1000 Berlin 12, FRG. Tlx: 184262 TUBLN D.

February/March 1989

Coal handling plant

Course: Durgapur, India, 27 February-3 March 1989.
Details from: Deputy Director (Technical), Power Engineers Training Society, 207-212A Chiranjiv Tower, 43 Nehru Place, New Delhi 110019, India. Tel: Int +(11) 6417430, tlx: 031-5227 PETSIN.

March 1989

Circulating fluidised bed technology

Meeting, Manchester, 3 March 1989.
Details from: Institution of Chemical Engineers, Conference Section, 165-171 Railway Terrace, Rugby CV21 3HQ. Tel: (0788) 78214, tlx: 311780, fax: (0788) 60833.

Stationary combustion NO_x control

Symposium, San Francisco, USA, 6-9 March 1989.
Details from: Ms Claudia Runge, Symposium Coordinator, Electric Power Research Institute, 3412 Hillview Avenue, Palo Alto, CA94303, USA. Tel: Int +(415) 855 2149.

The membrane alternative — energy implication for industry

Conference, University of Bath, 29-30 March 1989.
Details from: Watt Committee on Energy, Savoy Hill House, Savoy Hill, London WC2R 0BU. Tel: 01-379 6875, tlx: 261176, fax: 01-240 7735.

April 1989

Industrial CHP

Symposium, Heathrow Penta Hotel, London, 11-14 April 1989.
Details from: Crest Communications, Aspect Business Centre, Bank Street, Lutterworth, Leicestershire LE17 4AG. Tel: (04555) 56418, fax: (04555) 3432.

Combustion

Joint meeting of the British and French sections of the Combustion Institute, Rouen, France, 18-21 April 1989.
Details from: David Smith, British Gas, Michael Road, London SW6 2AD. Tel: 01-736 3344 ext 4183.

US-European coal

Conference, Hotel Ritz, Lisbon, Portugal, 18-20 April 1989.
Details from: National Coal Association, 1130 Seventeenth Street NW, Washington DC 20036-4677, USA or telephone the Coal Exporters Association on Int +(202) 463 2639.

Decommissioning and removal of North Sea structures

Conference, London Press Centre, 19-20 April 1989.
Details from: Liz Hide, IBC Technical Services, Bath House (3rd floor), 56 Holborn Viaduct, London EC1A 2EX. Tel: 01-236 4080, tlx: 888870, fax: 01-489 0849.

Manpower 2000

Conference, University of Southampton, 19-21 April 1989.
Details from: John Bladon, Conference Director, SSTF, University of Southampton, Southampton SO9 5NH. Tel: (0703) 553404.

May 1989

Clean combustion in flames

Ninth International Flame Research Foundation members' conference, Leeuwenhorst Conference Centre, The Netherlands, 24-26 May 1989.
Details from: IFRF, PO Box 10.000, 1970 CA IJmuiden, The Netherlands. Tel: Int +(2510) 93064, tlx: 35211 hovs nl, fax: Int +(2510) 26318.

June 1989

Power supply '89

Exhibition, Frankfurt Fairground, West Germany, 21-23 June 1989.
Details from: Messe Frankfurt Dept 1002, PO Box 970126, D-6000 Frankfurt 1, West Germany. Tel: Int +(69) 7575 6951.

Petroleum and computers

Conference, San Antonio, USA, 26-28 June 1988.
Details from: Society of Petroleum Engineers, Meetings Dept, PO Box 833836, Richardson, Texas 75083-3836, USA. Tel: Int +(214) 6693377, tlx: 730989, fax: Int +(24) 669 0135.

Energy saving chillers

Flowcool Systems have introduced five new packaged water chillers suitable for a wide range of manufacturing and processing applications as well as for commercial air conditioning.

The models offer heat extraction capabilities from 50 kW to 108 kW and feature multiple independent refrigeration circuits. They are based on hermetic refrigeration compressors and air or water cooled condensers, with a choice of coil in tank evaporators, plate evaporators or shell and tube evaporators.

All five models incorporate a number of safety and energy saving features with the multi circuit systems, including the facility to shut down part of the system during reduced load conditions, or for routine maintenance, whilst leaving the remainder of the system fully and independently operational.

Separate timers can be fitted to stagger start the compressors thus keeping starting currents to a minimum. Integral water tanks and circulating pumps can also be included to create a closed circuit cooling system that obviates the need for additional expensive ancilliary equipment.

Reader enquiry no 11/1

Chimneys and heaters

System 500 is a new range of commercial and industrial chimneys with diameters up to 500 mm from **Powrmatic.** System 500 is an extension to the existing systems 1, 90, 125 and 250 range and is a stainless steel chimney with a 50 mm insulated double skin wall.

The company has also expanded its range of suspended gas fired unit heaters to include a semi-condensing model. The range is rated at 44 to 59 kW (150 000–200 000 Btu/h) the unit has an operating efficiency in excess of 95% on net CV. This is achieved by incorporating a secondary heat exchanger. The PGUH H/E is fitted with automatic ignition and ducted combustion air inlet as standard features.

Reader enquiry no 11/2

New insulation board

A new ceramic fibre insulation board has been developed by **Ceramic Fibreforms** specifically for use as the target surface in certain high-temperature process applications.

The board has been named Stellaboard R. It is a normal-density board of ceramic fibres, with a post-rigidised hardened face capable of withstanding the direct flame impingement from gas or oil burners. The affect of this ability to withstand localised heating, is that additional strength and hardness is imparted to the surface without changing the physical or thermal properties of the board as a whole.

The material is available in a variety of individual grades for use at temperatures up to 1600°C and is produced in standard sheet sizes of 1.0×0.5 m, with thicknesses from 3 to 100 mm. It is a hard, robust homogenous product, which is capable of being tailored or machined to meet the needs of individual applications.

Reader enquiry no 11/3

First UK condensing boiler

The Ideal Concord CX-C condensing boiler (pictured) is produced by **Stelrad Ideal**. The boiler comes complete with aluminium secondary heat exchanger and, the manufacturer claims, is 91% efficient in the condensing mode and 86% efficient when operating conventionally.

The Ideal Concord CX-C commercial condensing boiler.

Developed from the Concord CX series there are four models in the CX-C range: 44 kW, 66 kW, 88 kW and 110 kW.

Reader enquiry no 11/4

Building management

Serck Controls is launching a new building management system as part of its plans to expand activities for the single European market in 1992.

The Proteus 2000 building management system incorporates technology based on computer network architecture and is designed for new installations and the retro-fit sector.

The manufacturers claim that benefits of the new Proteus 2000 system include energy savings, improved maintenance procedures, rapid response to environmental problems together with the integration of other services including fire and security.

It uses industry standard Ethernet communication links and Decnet software which allows the system to be expanded to cover multi-user situations.

Reader enquiry no 11/5

The intelligent outstation

The Station Master from **Rapaway Energy** is an energy/factory management system consisting of an accommodating and intelligent outstation with versions to suit almost any need; the configuration can be chosen to suit the application. Standard programmes provide control for heating, lighting, chillers, boilers and so on, or, in order to meet a particular need, programme modules may be used in conjunction with special programmes. This enables unique requirements, often found on boiler and process control, to be satisfied quickly and efficiently without having to write the complete programme from scratch.

Reader enquiry no 11/6

Flue gas O_2 analysis

Teledyne claim that their model 320P portable flue gas oxygen analyser can improve process efficiency, lower fuel costs and reduce explosive hazards in such applications as power plants, refineries, chemical/petrochemical plants and steelmaking.

Used to monitor boilers, fireboxes and process streams, the analyser can safeguard combustion processes from too much or too little oxygen. The instrument is powered by rechargeable batteries, it includes a large easy read meter display, and incorporates a built-in sampling system with integral push button-operated pump to bring out sample gas without positive pressure.

The sensing element is a maintenance-free, sealed electrochemical cell which is specific to oxygen, insensitive to flow rate, and has 90% response in less than 7 seconds.

Reader enquiry no 11/7

Trade publications

Potterton Commercial Products Division have issued *Technical Bulletin No 3.* This 12 page document carries general information on systems with condensing boilers. There is also further information and diagrams on condensing boiler flues and multiple condensing boilers.

Reader enquiry no 11/8

The Boiler and Nuclear Engineering Division of Sulzer, Winterthur, recently issued a new four page brochure entitled *Helix and helium up to 950°C.* The brochure describes equipment delivered to high temperature power stations and testing facilities. The description of a helium/helium heat exchanger includes a comparison between design and operating data. It concludes with a list of the division's activities.

Reader enquiry no 11/9

The refrigeration and air conditioning waste heat recovery system manufacturers Vesco Zelos International have produced *Made to save energy to save you money,* a brochure to introduce their range of energy converters.

Reader enquiry no 11/10

ENERGY WORLD — COMMERCIAL
(Photocopy acceptable)

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

11/1 11/2 11/3 11/4 11/5 11/6 11/7 11/8 11/9 11/10

Name .....

Address.....

.....

Organisation .....