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## Personal viewpoint

### The role of professional institutions – in need of an overhaul

Could I comment on Mr Tipler's Personal viewpoint (*Energy World*, August/September 1987), please? It is difficult to disagree with his overall view and it is far from reassuring to know that we are not the only learned society to suffer these circumstances. In no especial order, I offer:

The whole of the engineering and scientific profession, the former notably, suffers from public ignorance.

It's not the public's fault – it is ours. We do not always present an attractive, coherent, professional face to the world.

The role of the institutions is in need of a proper overhaul. Once upon a time, they offered qualifications which were available by no other route. Now these qualifications are little more than extra feathers in our degree or diploma caps. So what is the value of such qualification? How many jobs actually demand an engineering institute qualification? Where this does happen, is that demand listed before or after the degree or diploma?

Until professional qualifications are a licence to practise, nothing will change. The engineer will be perceived as those most laudable people, the plumbers and the car mechanics. What then is the 21st century role of the institutions? Up to yet, much the same as it's always been but gathering dust on top of the apathy.

Referring specifically to the Institute of Energy, we are small compared to, say, the Mechanicals or the Civils.

Is that such a huge drawback? That will not change. The student population, if nothing else, will ensure that. So what can we do? If you have a market stall, you succeed either by having goods that are specialised and which everyone needs, or by shouting your wares the loudest. We should fit the former and we certainly don't do the latter.

Mention is made in Mr Tipler's article and in *Energy for the future*. At the time of the so-called energy crisis, other bodies from the Institution of Mechanical Engineers to the Royal Institute of British Architects (RIBA) were making their presence felt. This Institute did little, as if waiting for the world to beat a path to our door.

We can and do, to an extent, offer the specialised goods. We should do more and we must certainly shout louder.

Is Council addressing itself properly and positively to these problems?

In this vein, the Institute is missing – probably has missed – an excellent opportunity. I understand that much has been said about the position of energy managers in the Institute. Has anything been done, though? Has pride or prejudice got in the way? The energy management movement exists and must be a source of enhanced membership on some logical, reasonable, acceptable footing. There are several thousand people in the UK responding to the title of energy manager. I know full well that the title is applied inconsistently but that does not change the basic argument. I know that meetings have been held and notes exchanged but the Institute is doing nothing positive.

Why not? Don't we want such people as energy managers? If not, why does the Institute offer its Energy Management Diploma through several UK Colleges? Can I make a plea for consistency?

It is very easy to offer criticism and leave someone else to pick up the pieces, so I hope I will not fall into that racket. What can the Institute do? Can I suggest:

Make our voice heard, more often in more places. There are plenty of radio and TV opportunities and many programmes are pleased to receive offers. There is plenty of mileage in comment on government policy and privatisation, for instance.

Generate a proper niche for energy managers, whatever the qualifications of the individual. Make them welcome, offer them a professional forum and a service.

Make an even greater attempt to attract revenue. I have mentioned one modest area. There must be others. Above all, decide what is the proper role of the Institute in these changing times, then get on with a vigorous promotion.

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Note: see also Letters, p14

# Looking ahead

Graham Newbert

INSTITUTE  
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**60**  
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*The business of energy can change a great deal over 60 years, and in this final article of our series celebrating the Institute's 60th anniversary Graham Newbert, a member of the Publications and Conferences Committee, looks forward over this period in which we can only be uncertain about what will happen and what steps are needed now to make the most of future conditions. Sixty years ago in Britain, heat and power were taken from coal, imported oil and running water. Domestic heating was usually by open coal fires. The electricity grid had only recently covered the country and the benefits of cheaper electricity, efficient lighting and reliable motors were just spreading to give us many of the things that we now take for granted. Developments of the time included low voltage neon lights, batteries and internal combustion engines worked by coal dust. The benefits of North Sea oil and gas and nuclear power were not yet expected. It is clear that discoveries and inventions may make a great change in any number of conditions. But some things stay the same, physical limits remain and to look forward over the next half century can give some food for thought. This forecast is not as scientific as present day weather forecasts where instruments make exact measurements but more like an observation of the weather vane to say which direction the wind is blowing.*

Between now and 2040 the world might consume the equivalent of between 650 to 900 billion tonnes of oil. This could be up to five times its consumption over the past 50 years. To put a scale to these numbers, at current rates of consumption the United Kingdom would consume the equivalent of 10 billion tonnes of oil over the next 50 years. The future picture is one of steadily increasing annual world energy consumption, doubling or tripling between now and the year 2040.<sup>1</sup> Although the increases appear extravagant the forecast is very modest. It assumes a slowing growth rate in the northern hemispheres per capita consumption but an increasing world population and an increased share of the world's energy by the developing countries. So even if the increases look reasonable, will the remaining energy stocks be able to supply the estimated demand?

In the next few decades we will not come to the last lump of coal, drop of oil or speck of uranium. At present, the world's total of proven non-renewable energy amounts to the equivalent of about 1100 billion tonnes of oil, with perhaps three times this amount in non proven reserves. But the similarity in size of the forecast consumption and the proven energy reserves indicates that strong pressures will be placed on all resources over the period.

Of the total non-renewable reserves about 80% is coal. By virtue of its quantity it must become the dominant energy supplier in 50 years' time. Virtually all the remaining reserves are oil and gas. Inevitably oil, with all its attractions, will not meet the increasing demands placed on it without becoming more expensive and finally exhausted. This may happen sooner rather than later. Then it can be substituted for by other forms of energy. Uranium only provides 1 to 2% of the reserves as it is used now by thermal nuclear reactors. But if used in a breeder reactor its power is increased 60 fold and uranium becomes equal in size to coal as an energy reserve.

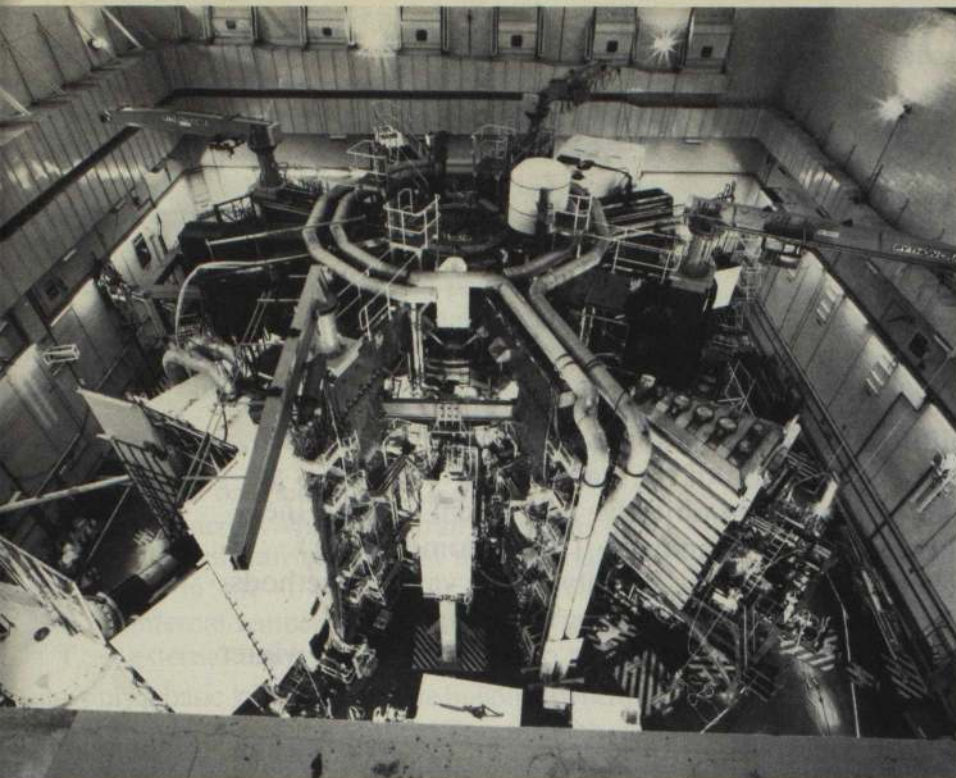
With all the technologies available at present there are many ways open to getting what we want from our remaining energy sources. Looking from the point of view of best use with least waste of the natural power giving materials we could set about things conservatively. A talk with a gas engineer of 60 years ago would have given many suggestions about the best use to be made of coal, in place of burning it in grates and under boilers. In addition to making gas and coke would be petrol, plastics, chemicals and fertilisers which presumably will still be needed. Oil now provides many of these high grade products and as it becomes unable to cope coal can substitute for it, and water power and nuclear power can substitute for coal in providing the electricity.

The Severn Barrage has been talked about since 1849. Sixty years ago it might have cost £28 M. Today it might cost £7 billion and provide 13 TWh a year. At present it appears to be cost effective compared with a fossil fuelled steam plant but would be more expensive than a pressurised water nuclear reactor. Major obstacles to building it are the initial cost (although a less expensive version is also proposed) and the 10 years construction time. With no major technical risks foreseen the cost of the power produced would be dependent on the rate of interest. We must wait and see when the financial risk can be taken.

Nuclear power will only give a vast additional energy source if we have breeder reactors. This will raise nuclear power from being, at best, a short term cost effective supplement to our energy supplies to a level where the energy reserves are doubled and the lifetime of coal is extended by many years. Breeder reactors cannot immediately take the place of thermal reactors as they need a stock of plutonium. This has to be built up and would require a long period during which an increasing number of breeder reactors are built. This is not the same path as the *ad hoc* adoption of non breeder reactors with shorter term economic advantages.

Plutonium is extremely toxic. It is argued that the best thing to do with it is to use it in all breeder reactors but another view is not to allow any to be created in the first place and risk its dispersal in a catastrophic accident. The safety record of the UK nuclear industry is good and its handling of dangerous materials is first rate. Nevertheless the debate and argument will go on as the potential benefits and disbenefits of a breeder reactor programme cannot be unreasonably ignored. This debate seems to have been determined in Russia where a programme of construction of fast breeder reactors was recently announced.

The dilemma might be put aside if the JET experiment is a success. JET stands for the Joint European Torus and is one step towards building a fusion reactor. The engineering of fusion reactors will be difficult as it will involve many new areas, such as high temperature plasma physics and magnetic confinement on a scale not tackled before. The ultimate reward is a type of power station that can use a limitless source of energy taking its fuel from water and other common materials. It is unlikely to supply a significant amount of energy on a world scale during the next half century but a successful demonstration



*The JET experiment, inside the Torus Hall (By courtesy of JET)*

An economic fusion power plant is to be hoped for. Again we must wait and see.

The sun gives the earth energy that is equivalent to 1000 000 000 power stations. This should save something out with anything that uses free energy it is worth asking for the cost of the machine that does it. In the UK, hydropower and passive solar are now economically attractive.<sup>2</sup> But there are only limited opportunities for these two. Wind energy, tidal power and wood forestry are promising but uncertain. The long shots are wave power, active solar water heating, photovoltaics and energy crops other than wood. Although the picture might change in other countries, solar sources appear to be able to contribute only a fraction of demand.

Nevertheless it is still possible to meet the world's needs without taking so casually the projected bite out of remaining energy resources. To make this saving improved efficiency should be firmly applied throughout the chain of supply and demand. At the supply end we could stop accepting 30% as being about the top limit of efficiency of electricity generation and 70% as being about the top limit of efficiency of heat generation. Combined heat and power and binary cycles significantly improve efficiencies of combustion power plant. Condensing boilers and heat pumps improve the efficiency of providing heat from fuel. At the user end insulation, controls, efficient lighting and motors and a variety of methods of heat recovery can greatly reduce energy demand. Each technique has a practical limit but the number of different techniques is very large and the total savings if they are applied at every link in the chain could be substantial. But as well as technical potential the question of cost effectiveness should be asked.

Money is the common factor that compares one thing against another. Through it we judge the machine needed to do a job and the lifetime over which it will pay the customer back. The economic lifetime is governed not only by development time, load factors and reliability but also by when it will be replaced by something better. It will be no surprise that paying customers prefer the cheaper ideas that payback quickly to development

programmes, that promise security in 50 years.

Over past years the energy business has been a success for the engineers and organisations who were involved with it. Power, heating and lighting has been taken to where it was needed. There may have been unfairness and lateness but shortages and shortfalls were overcome. New sources have been exploited and innovative equipment has been applied. During all this environment has not suffered too drastically. On this basis the past system may be a good recipe for the future.

However a longer view is justified. The bigger projects on fusion and fast breeder reactors have gained some support under national, European and international umbrellas. Smaller projects need help too. Small experiments without any guarantees of profit will help identify the future successful energy saving profits. Frequently large amounts of money will be spent before the product is ready for the market. Money-makers can easily come to the decision that it is better to leave it alone. The energy supply industries and governments have an admirable record in supporting some fledgling ideas up to their take up by manufacturing industry. A role that ought to be kept up in this country after privatisation.

Solid fuel, natural gas, nuclear power, renewable energy source, oil and hydropower may become the major suppliers, (perhaps in that order) within half a century, competing against each other and against improvements in efficiency in energy supply and use. Each of the different ways will have their good points, their bad points and some will be cheaper than others. The variety and complexity of the different ways of doing things highlight the need for commercial and professional decisions helped by information and argument on policy, technology, economics and environment. This may be the business of the Institute of Energy in future years.

### References

- 1 FRISCH, J R. Future Stresses for Energy Resources.
- 2 Prospects for the Exploitation of Renewable Energy Technologies in the United Kingdom, HMSO.

# An appraisal of the techniques used in the assessment of building energy requirements

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An overview of some of the numerous techniques applied to the problem of predicting the pattern of energy consumption in commercial and domestic premises is presented. This is accomplished by undertaking a comparison of the standard methodologies as applied to a model structure in order to provide an objective assessment of both the feasibility and accuracy of thermal performance techniques. The outcome of the comparison is used as the basis for a discussion on the validity of the various methods and to highlight the discrepancies that can exist when applying differing design calculation methods to the same problem. The main emphasis of the study is on winter heating considerations

The desire to achieve a comfortable environment in our homes and at work whilst simultaneously minimising the energy consumed for this purpose is of concern to all. A fundamental necessity for achieving this is the ability to accurately predict heating and ventilation requirements. Without such knowledge, the correct sizing and selection of heating plant as well as decisions regarding, for example, the provision for air conditioning or insulation, cannot be made with any confidence. The existence of a variety of thermal calculation techniques inevitably leads to discrepancies in the final results, the magnitude of which are often significant enough to create problems in the sizing of the plant. Both the undersizing and oversizing of plant are, for obvious reasons, disadvantageous with regard to achieving desired comfort levels without incurring unnecessary capital investment.

The evaluation of energy consumption of a building is strongly reliant upon the accurate interpretation and definition of:

(i) 'Fixed' parameters including materials used and method of construction together with their thermophysical characteristics, required design temperatures and ventilation rates, type of building, internal and external configuration, type of heating system, and so on.

(ii) 'Variable' parameters such as the vagaries of the weather and inhabitation profile, uncontrolled ventilation, porosity and moisture absorption, wind and solar exposure, occupancy behaviour and internal building processes giving rise to casual gains. It can be appreciated that the sheer volume of data and detail that can be incorporated when specifying a system is phenomenal, and a line must be drawn at the point where the desire for accuracy transcends from practicality to obscurity, becoming unrealistic in the design situation.

With such a large number of factors to be accounted for it often proves necessary to generalise, lump together, simplify or even omit altogether certain parameters in order to develop computer models or manual quantitative analysis techniques describing thermal behaviour.

Differences in predicted energy consumption will therefore inevitably arise as a consequence of not only differing system definitions but also, for the same technique used by different analysts, inconsistent interpretations of and assumptions (guesses?) made concerning input requirements.

The wide range of existing thermal calculation methods encompasses various degrees of complexity and hence ease of use and speed of solution. Some can be handled manually whilst others are only available as large computer packages. The staggering increase in computer power relative to cost in recent years has also resulted in the development of more sophisticated models and a crop of personal computer based software designed around standard methodologies. The latter can have the effect of considerably enhancing our overall perception and the value of such techniques by making them quicker to use and 'user-friendly'. A problem arises if the slickness of the software presentation or its features, such as graphical output, are incorrectly translated into the notion that the answer is more accurate since it was generated by computer.

Having set the stage by making the above points, the question that arises must still be: which technique is the most accurate? Quite simply, this cannot be answered merely by validation of predicted results for, say, a single building design using experimental data for comparison. An unambiguous frame of reference is required that can be proven to be accurate in all situations. In this context it is more pertinent to assess the effects of a parametric study and to note the relative variations in the range of predicted results obtained by manipulation of the variables used in each method than the absolute value of the results. A consistent database for use in the calculations is also essential. A study of this kind would be more objective if it were applied, space permitting, to more than one building type, each representing a particular generic group.

The primary objective of the present paper is to provide the reader with an insight into thermal performance calculations. The choice of structure to be used as the subject building is purely representative and is somewhat simplified to enable each technique to be applied without

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roducing irrelevant complexities. The techniques covered are limited to those which lend themselves more readily to manual computation. An inter-model comparison of the larger dynamic computer based simulations in use in the UK can be found elsewhere<sup>1-4</sup>.

### Assessment techniques

Probably the most familiar and frequently adopted design technique used to assess the thermal performance of a building is the 'U-value' or Thermal Transmittance technique. This is based upon the one-dimensional steady-state conduction heat loss equation.

$$Q_F = \Sigma(AU)(T - T_o) \quad (1)$$

where  $Q_F$  = fabric or conduction loss (W).

$A$  = area across which heat transfer occurs ( $m^2$ ).

$U$  = thermal transmittance of the material ( $W m^{-2} K^{-1}$ ).

$T$  = internal temperature ( $^{\circ}C$  or  $K$ ).

$T_o$  = external temperature ( $^{\circ}C$  or  $K$ ).

Using only a basic knowledge of the building structure, and armed with U-value data, the heat flow through each component unit (walls, windows, roof, floor, etc) can usually be calculated separately and then summed to obtain the overall fabric heat loss.

Since the rate of heat loss is proportional to the temperature difference ( $T - T_o$ ), it is evident that the choice of values for these parameters will crucially influence the final result. For  $T_o$  recommended winter design temperatures for various building geographical locations in the UK can be obtained from published data<sup>5</sup>. The selection of an appropriate value for the internal temperature is based on the requirements for occupancy comfort and, in certain situations, the demands of the process/manufacturing function of the building. Furthermore, unless the location satisfies the criteria of a well insulated area with little air movement, the wall temperatures will rarely be the same as the corresponding internal air space temperature. A more realistic approach to calculating the fabric loss involves the concept of specifying an inside environmental temperature,  $T_E$ , which better describes the exchange of heat between a surface and an enclosed space, and should be used for the value of internal temperature,  $T$ , in equation (1). Its precise value depends on the room configuration but, in general for the UK,  $T_E$  can be defined by the relationship.

$$T_E = \frac{1}{3} T_i + \frac{2}{3} T_M \quad (2)$$

where  $T_i$  = the internal air space temperature and  $T_M$  = the mean surface temperature obtained by summing the products of the internal areas bounding a room and their respective surface temperatures and dividing this total by the sum of the areas.

The effect of heat loss by ventilation is also a highly significant parameter in design calculations, its magnitude often being comparable, in many cases, to the fabric loss. Ventilation loss occurs when warm internal air is replaced by fresh external air, the difference between internal and external space temperature being the controlling parameter. Assuming constant pressure and humidity, the heat loss associated with ventilation,  $Q_v$ , can be written as

$$Q_v = M c_p (T_i - T_o) \quad (3)$$

where  $M$  = the mass flow rate of air egress ( $kg s^{-1}$ ).

$c_p$  = the specific heat of air ( $J kg^{-1} K^{-1}$ ).

Use of the above equation assumes that the mass flow rate is explicitly quantifiable with all mechanisms leading to both controlled and uncontrolled infiltration of air being accounted for. Design criteria exist<sup>5-6</sup> for predicting air movements based on a knowledge of the position and characteristics of all openings through which flow can occur. In practice, this is usually difficult and a more viable approach is to express ventilation rates in terms of a number of air changes (room volumes) per hour,  $N$ . On this basis, the ventilation heat loss becomes

$$Q_v = \frac{\rho c_p NV}{3600} (T_i - T_o) \simeq 0.33 NV (T_i - T_o) \quad (4)$$

where  $\rho$  = density of air ( $kg m^{-3}$ )

$V$  = volume of ventilated space ( $m^3$ )

Note that the ventilation loss is based on the internal air space temperature,  $T_i$ . If environmental temperatures are to be used, the ventilation loss must be modified to allow for the fact that the internal air temperatures will be different from the environmental temperature. In general, for mainly convective heating it may be shown that

$$Q_v = C(T_E - T_o) \quad (5)$$

where  $C = 0.33 NV (1 + \frac{\Sigma(UA)}{4.8 \Sigma A}) (W K^{-1})$

In assessing the overall rate of heat loss,  $Q_T$ , the ventilation loss is simply summed with the fabric loss,

$$Q_T = Q_F + Q_v \quad (6)$$

The question of specifying the optimal ventilation rates commensurate with the requirements of health, safety and comfort in the working environment has been extensively studied and various recommended air change rates have been stipulated for certain situations and degrees of occupancy<sup>5, 7-10</sup>.

A relatively recent development in thermal performance calculations has been to consider the influence of the type of heating system, whether radiative or convective, on the perceived comfort of the building occupants. Personal comfort will be affected by factors such as air temperature, humidity and velocity, degree of radiant heat, individual metabolic rate, activity and clothing level<sup>10-12</sup>. The suggested index employed in specifying thermal comfort levels is the dry resultant temperature,  $T_c$ . This is defined as

$$T_c = \frac{T_r + T_i \sqrt{10v}}{1 + \sqrt{10v}} \quad (7)$$

where  $T_r$  = mean radiant temperature  $\simeq T_M$  at the centre of a room.

$v$  = air velocity.

In situations where air movement is relatively low, an acceptable index for  $T_c$  is given by the average of the air space and mean surface temperatures.

$$T_c \simeq \frac{1}{2} T_i + \frac{1}{2} T_M \quad (8)$$

The current recommended approach in the UK is based on a modification of the basic U-value technique to further consider the relationships between the inside environmental air and dry resultant temperatures

depending on the type of heating system to be installed. This is accomplished in practice, by introducing the CIBSE<sup>5</sup> factors  $F_1$  and  $F_2$  defined as

$$F_1 = \frac{T_E - T_O}{T_C - T_O}, \quad F_2 = \frac{T_I - T_O}{T_C - T_O} \quad (9)$$

These factors,  $F_1$  for fabric loss, and  $F_2$  for ventilation loss, are incorporated into the calculation of the total heat loss as follows:

$$Q_T = F_1 \sum (AU) (T_C - T_O) + F_2 0.33NV (T_C - T_O) \quad (W) \quad (10)$$

In effect, they compensate for the relationships between  $T_I$ ,  $T_M$ ,  $T_E$ , etc, and allow the use of a single design temperature,  $T_C$ , for estimating heating plant capacity. The method assumes some importance when maximum plant capacity is being assessed for various types of heating systems, particularly in situations subject to high rates of ventilation<sup>13</sup>. For the model building presented, the two extreme cases of 100% convective and 10% convective/90% radiative heating will be examined.

A well known technique which can be used to provide an estimate of the likely seasonal energy consumption and hence heating costs throughout the heating season is based on the concept of 'degree-days'<sup>14-15</sup>. A degree-day is accumulated for each degree centigrade that the mean 24-hour dry-bulb outside temperature falls below a base temperature. The heating season is usually based on the period between September to May inclusive.

The degree-day total for the heating season can then be used in conjunction with U-value data to estimate the seasonal heating load.

$$Q'_T = 24 HD \quad (Wh) \quad (11)$$

H = building design heat loss per unit internal/external temperature difference ( $W K^{-1}$ ).

D = seasonal degree-day total.

Monthly and seasonal degree-day data, available on a regional basis, are normally collated and used on the basis of a 20 year average figure to account for periodic fluctuations<sup>16</sup>. The technique can incorporate a simple compensation for the effect of solar and other incidental heat gains since the base temperature usually chosen ( $15.5^\circ C$ ) is  $2.8^\circ C$  below that which historically is considered to be the critical minimum internal comfort temperature of  $18.3^\circ C$  ( $65^\circ F$ ). The missing  $2.8^\circ C$ , known as the base offset, is assumed to be a realistic expectation of the temperature rise in a typical building arising from the contribution of solar and other casual gains.

Another frequently used and established steady-rate technique based on U-values and used for the prediction of seasonal energy consumption is the Building Research Establishment (BRE) technique<sup>17-18</sup>. The principles encompassing the methodology are aimed primarily at domestic dwellings which constitute the main area of applicability for this method. It essentially stipulates that nominal U-values are used except for roofs and windows where these may be reduced to account for factors such as curtaining and intermittent operation. More significantly, allowance is also made for internal heat gains due to building orientation, lighting, cooking, number of occupants, etc. Temperature variations over the heating

season (usually assumed as 33 weeks) are represented by adopting an average representative value of the internal/external temperature difference.

A method that can be used to predict thermal performance under dynamic conditions is the Admittance technique<sup>19</sup>. Originally developed for the prediction of peak internal summertime temperatures (and hence air conditioning loads) resulting from diurnal changes. The technique has also proved useful in investigating the performance of an intermittently heated building. The treatment allows for both incidental and intentional heat together with the effect of the thermal capacity of the building structure.

The admittance of a building or room, that is the rate at which heat is assumed to penetrate into, and is absorbed by, its structure, is determined by the admittance or Y-value of the surface constituting each of the enclosing fabric elements. The Y-value is a function of both the thermophysical properties of the fabric, namely density, specific heat capacity, thermal conductivity and thickness and the nature of the transient thermal input. For a composite element, the Y-value is primarily determined by the characteristics of the internal surface material layers. If an element is thin, such as a single glazed window, the Y-value becomes equal to the U-value, since a steady-state temperature gradient between the internal and external surfaces, which governs the rate of heat flow, is likely to be rapidly established.

The full admittance procedure usually calculates the 24-hour mean values of the heat gains from all sources followed by the calculation of a periodic component of half amplitude which expresses the mean to peak swing. Thus, for example, the peak value in internal environmental temperature,  $T_E$ , over the calculation period may be written as

$$T_E = \bar{T}_E + \bar{T}_E \quad (12)$$

where  $\bar{T}_E$  is the mean internal environment temperature and  $\bar{T}_E$  is the mean to peak deviation.

Solar gains are assumed to result both as a result of component acting directly through glazing, and of component acting through the opaque fabric. The fabric gain component can, however, be negligible, particularly for well insulated structures or when a room is surrounded on all sides by others as in an office block and may be ignored for such situations without significant loss of accuracy. For lightweight constructions, the heat gain through external opaque surfaces can be more significant.

If it is assumed that the heat gains can be equated to the heat losses, then the average net heat flow into (or out of) the structure,  $\bar{Q}_T$ , can be written as:

$$\bar{Q}_T = \bar{Q}_V + \bar{Q}_G + \bar{Q}_W - \bar{Q}_S - \bar{Q}_C \quad (W) \quad (13)$$

where  $\bar{Q}_V$  = the mean ventilation heat flow rate =  $C(\bar{T}_E - \bar{T}_O)$ .

$\bar{Q}_G$  = the mean heat flow by conduction through glazing =  $\sum A_G U_G (\bar{T}_E - \bar{T}_O)$ .

$\bar{Q}_W$  = the mean heat flow through the exposed fabric surface =  $\sum AU (\bar{T}_E - \bar{T}_{SO})$ .

$\bar{Q}_S$  = the mean solar heat gain =  $A_G \bar{I}_S$ .

$\bar{Q}_c$  = the mean casual heat gains from occupants, lighting, etc.

and  $\bar{I}$  = mean daily incident solar radiation ( $Wm^{-2}$ ).

$\bar{S}$  = mean solar gain factor.

$A_G$  = glass area ( $m^2$ ).

$\bar{T}_{so}$  = sol-air temperature defined as the hypothetical external temperature which, in the absence of solar radiation, would result in an equivalent energy input.

If the heat gain through the opaque fabric is ignored, and it is assumed that conditions are steady-state then, from an energy balance, the mean internal environmental temperature may be written as

$$\bar{T}_E = \frac{\bar{T}_O + A_G \bar{I} \bar{S} + \bar{Q}_c}{A_G U_G + C} \quad (14)$$

The total peak to mean swing in the net heat gain is similarly given by

$$\bar{Q}_T = \bar{Q}_v + \bar{Q}_g + \bar{Q}_w + \bar{Q}_s + \bar{Q}_c$$

where  $\bar{Q}_v + \bar{Q}_g = (\sum A_G V_G + C) \bar{T}_O$

$$\bar{Q}_s = A_G \bar{I} \bar{S} \quad (15)$$

where  $\bar{S}$  = the alternating solar gain factor, dependent on the building and window type.

and  $\bar{Q}_w = f AU \bar{T}_{so}$ . The decrement factor,  $f$ , is associated with the time lag in the penetration of the solar radiation through the structure due to its thermal capacity.

The magnitude of the mean to peak swing in internal environmental temperature may be determined by

$$\bar{T}_E = \frac{\sum (AY) + 0.33NV}{\bar{Q}_T} \quad (16)$$

The term  $\sum AY$  represents the sum of the product of all surfaces, internal and external, of area  $A$  and admittance  $Y$ .

Appropriate value for  $\bar{I}$ ,  $\bar{I}$ ,  $\bar{S}$ ,  $\bar{S}$ ,  $\bar{T}_{so}$ ,  $f$ , and a more detailed description of the calculation method may be found in the CIBSE Guide: sections A8 and A3<sup>5</sup>. The admittance procedure of the BRE for evaluating peak summertime temperatures is similar<sup>18</sup>.

The time of the peak internal temperature is not usually known although the time of peak solar intensity may be. If the construction is heavy, then the peak temperature will be out of phase with the peak intensity.

From the foregoing it can be seen that the admittance value can be thought of as the rate of heat entry into a unit area of constructional elements from the surrounding space for each unit temperature deviation in the environmental temperature from the mean environmental temperature. It is the periodic equivalent of the U-value and in effect represents the heat gain required by unit area of internal constructional element to affect a unit rise in the environmental temperature from its mean value. The location of thermally insulating materials on the inside or outside of the constructing envelope will have the effect of reducing the Y value and thus isolating the thermal mass comprising the outer fabric elements. Consequently, the

energy provided by the heating system to the insulated space will be more effectively utilised in raising the internal air temperature as opposed to being lost through the fabric. In contrast, the positioning of insulation between or outside the enclosing fabric elements it will have little effect on the admittance value resulting in less of a change in the internal temperature for the same heat input. An appraisal using only U-values is unable to distinguish between the above two modes of insulation.

Another approach to the problem of estimating plant capacity for transient systems relies on the calculation of the thermal response factor,  $f_r$ , defined as

$$f_r = \frac{\sum (AY) + 0.33NV}{\sum (AU) + 0.33NV} \quad (17)$$

where  $\sum (AY)$  = sum of the products of all surface areas and their admittance.

$\sum (AU)$  = sum of the products of all exposed surfaces and their thermal transmittance.

Structures with a high response factor, say  $>6$ , are termed 'heavyweight' whilst those with a lower value in the region 2-3 are known as 'lightweight'. As a guide, the former require around 1.5-2 hours of preheat time whilst the latter, one hour or less may be sufficient.

Equation 17 shows that  $f_r$  depends upon both the materials of construction and the ventilation rate. The actual calculation of the time dependent heat flow through the walls of structure in terms of its composition and surface temperature history is usually best accomplished using digital computing techniques since the solution of the heat balance equations usually require a time series iteration technique. Complex dynamic thermal prediction models are now common and it is only a matter of time before advances in computing make them more readily available as well as cheaper and easier to use.

A more practical approach to estimating the optimal capacity of heating plant to cope with variable heating times is currently based around the use of an intermittent heating factor,  $F_3$ , given by

$$F_3 = 1.2 \left[ \frac{(24 - N_T)(f_r - 1)}{(24 + N_T)(f_r - 1)} \right] + 1 \quad (18)$$

where  $N_T$  = total hours of operation of the heating plant.

The inclusion of the factor, 1.2, ensures that the building reaches the desired temperature rapidly prior to the start of the occupancy period<sup>20</sup>. The factor  $F_3$  is a measure of the additional boost heating capacity required to achieve this aim over and above that which is needed to simply maintain steady-state conditions. Thus,

$$\text{'Boost' heating plant capacity} = F_3 Q_T \text{ (W)} \quad (19)$$

### Model building description

In deciding on the type of model to assess it was considered relevant to select a small factory unit with adjacent offices as shown in Fig 1 allowing the factors pertinent to both commercial and industrial premises to be highlighted. The internal design temperature conditions, expressed as dry resultant values, and ventilation rates for the various building zones (see Tables

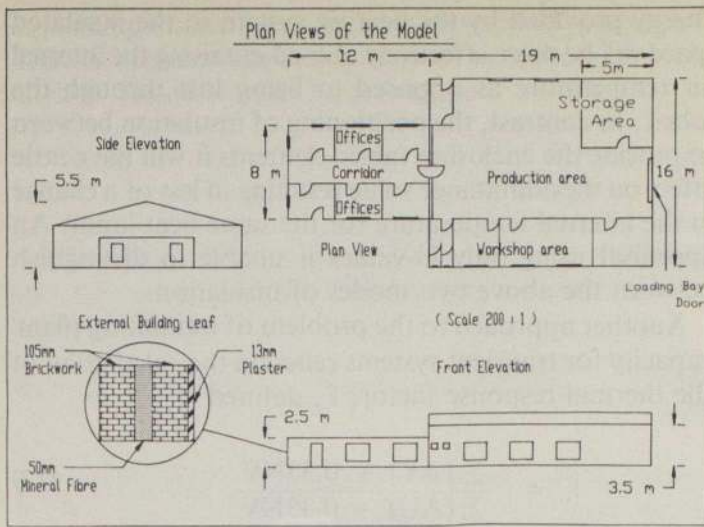


Fig 1 General layout and dimensions of model structure

2 and 3) were determined from the recommended values in the CIBSE guide<sup>5</sup> (tables A1.3 and A4.12 respectively). Representative data for Y and U-values for the building structure, shown in Table 1, are based on values from the literature<sup>5,21</sup> or calculated from the thermal resistances of the various construction materials including, where applicable, surface resistances for normal exposure conditions.

### Calculations summary

To help form a basis for comparison, the overall heating requirements evaluated by each method are expressed wherever possible as a design heat loss per unit temperature difference, and as an overall figure in GJ over the heating season taken as September to May inclusive (approximately 39 weeks) and assuming continuous operation. Note that some methods eg BRE, employ 33 weeks to denote the length of the heating season.

#### (a) U-Value winter heat loss calculation using CIBSE $F_1, F_2$ method

The evaluated design loss, based on equation 10, for each of the building zones is shown in Table 2 for a 100% convective type heating system and, for comparison, a 90% radiant heating system. An assessment is also made in Table 3 of the total steady state energy loss using a representative winter external design temperature of  $-3^\circ\text{C}$  to form the basis of an estimate of heating plant capacity. Recommended winter design temperature values for various building locations and types can be found in the CIBSE<sup>5</sup> Guide: section A2. From the tabulated values of  $F_1$  and  $F_2$ , it is of interest to derive various temperature relationships, based on equation 9, as shown in Table 4. In particular, the range of values for the inside

Table 2:  $F_1, F_2$  design loss calculations

	$\Sigma(A)$ m <sup>2</sup>	$\Sigma(AU)$ WK <sup>-1</sup>	$\frac{\Sigma(AU)}{\Sigma(A)}$	N	V m <sup>3</sup>	$\frac{0.33NV}{3\Sigma(A)}$	$F_1$		$F_2$		$Q_T/(T_c - T_o)$ WK <sup>-1</sup>	
							$F_1$ 100% conv	$F_2$ 100% conv	$F_1$ 10% conv	$F_2$ 10% conv	100%	10%
Office	219	230.3	1.0	1.0	180	0.3	0.95	1.16	1.04	0.88	288	292
Corridor	53	53.2	1.0	1.5	60	0.6	0.95	1.16	1.06	0.83	85	81
Workshop	246.5	184.6	0.7	2.0	266	0.7	0.97	1.12	1.05	0.83	376	340
Production	501.5	3.8	0.9	1.5	710	0.7	0.95	1.15	1.06	0.81	854	787
Store	85	94.7	1.1	0.25	88	0.1	0.94	1.17	1.03	0.92	97	104
Total design loss											1700	1604

\* From CIBSE Guide: Section A9.

air space temperature,  $T_i$ , as they relate to the type of heating system are worthy of note. In this context care must be taken to ensure that room temperature controllers, which respond predominantly to air temperature, are set at the appropriate value.

#### (b) Degree-day estimation of seasonal heating requirement

For the example calculation shown in Table 5, a degree day total of 2272 was chosen, representing the 20 year national average figure to 1979 for the period September to May. The choice of internal temperature and base offset,  $d$ , is critical to the calculation since it influences the base temperature,  $(T_i - d)$ , on which is based the number of degree-days used in the calculation. Selected values for the base offset, to account for internal gains and degree-day correction factors for base temperature other than  $15.5^\circ\text{C}$  were based on the recommendation given in the CIBSE Guide:<sup>10</sup> Section B18. There are no current recommendations regarding the use of design environmental or dry resultant temperatures to represent the indoor temperatures and the calculation was performed using the values of  $T_i$  equivalent to the indoor dry-bulb temperature, from Table 4 for the 100% convective heating case. It should be remembered that the degree-day value is purely a climatic factor which is not dependent on the type of building but on the base temperature selected.

Table 1: Thermal transmittance and admittance values

Element	U-value ( $\text{Wm}^{-2}\text{K}^{-1}$ )	Y-value ( $\text{Wm}^{-2}\text{K}^{-1}$ )
External walls	0.37	3.7
Internal walls	0.89	2.45
Windows (double glazing, wood frame)	3.0	3.0
Floor	Office	1.36
	Production/Store	5.9
	Workshop	1.7
Roof*	Office	1.4
	Factory	1.76
Access doors	2.9	2.8
Loading bay door	5.0	6.7

\* Plan area used for calculations.

#### (c) BRE modification of U-value technique

An illustration of this procedure as it might be applied to the model building is shown in Table 6. The estimation of the seasonal heat loss (taken as 33 weeks) is centred on the adoption of an average internal/external temperature difference of  $10^\circ\text{C}$  for dwellings with full heating. Internal gains due to solar radiation through windows, occupants, electrical appliances, etc, can also

Table 3: U-value heat loss calculation for  $T_o = -3^\circ\text{C}$

	$T_c/^\circ\text{C}$	$(T_c - T_o)/^\circ\text{C}$	$Q_r/\text{kW}$	
			100% conv.	10% conv.
Office	20	23	6.62	6.72
Corridor	18	21	1.78	1.70
Workshop	19	22	8.27	7.48
Production	16	19	16.23	14.95
Store	13	16	1.55	1.66
		Total	34.45	32.51

estimated by the method using the criteria and factors shown in Table 6 which have been applied to some representative example data.

(d) Mean monthly heating requirement

Although the main use of the Admittance procedure is calculating peak summer time temperatures and cooling loads, the concepts which form its basis will be applied here to evaluate the average monthly heat input required from the heating plant on the basis of an energy balance

Table 4: Temperature relationships

	$T_c/^\circ\text{C}$	$T_e/^\circ\text{C}$		$T_i/^\circ\text{C}$	
		100% conv	10% conv	100% conv	10% conv
Office	20	18.9	20.9	23.7	17.2
Corridor	18	17.0	19.3	21.4	14.4
Workshop	19	18.4	20.1	21.6	15.3
Production	16	15.1	17.1	19.0	12.4
Store	13	12.0	13.5	15.7	11.7

ing equation 13 with  $(Q_G + Q_W)$  replaced by  $Q_F$ . Solar gain through the fabric was not considered for the sake of simplicity on the basis of the assumption that the indoor air temperature can be equated to the outside air temperature for winter design calculations. Monthly weather data for mean solar irradiance and external temperatures were obtained from the CIBSE Guide<sup>5</sup> Tables A8.1 and A2.7. The ventilation rates and representative casual heat gain data as used in (a) and (c) above were re-employed together with environmental temperatures from Table 4 corresponding to a fully convective heating system. An example calculation for January is shown in Table 7. It should be evident that the calculation could have been performed equally well using the dry resultant design temperatures from Table 4, together with the corresponding  $F_1, F_2$  factors for a 100% convective system to yield the same result. The calculation was repeated for the remaining eight months to construct an energy profile as illustrated in Fig 2. Casual gains were assessed according to section A7 of the CIBSE Guide<sup>5</sup>. It was assumed that heat gains from lighting, occupants,

Table 5: Typical degree-day calculation

	$H = \Sigma(AU) + 0.33NV$ $\text{Wk}^{-1}$	Base offset, d $^\circ\text{C}$	Base temp $(T_1 - d)$ $^\circ\text{C}$	Degree-day factor $D/D_{15.5}$	Corrected degree-days $D'$	Loss $\text{kWh} \times 10^{-3}$
Office	289.7	5	18.7	1.38	3135	21.80
Corridor	82.9	3	18.4	1.35	3067	6.10
Workshop	360.2	5	16.6	1.13	2567	22.19
Production	825.2	4	15.0	0.94	2135	42.28
Store	102.0	2	13.7	0.78	1772	4.34
	1660			Total $Q'_T$		96.71
						348.2 GJ*

\*  $\text{kWh} = 0.0036 \text{ GJ}$

Table 6: BRE method – calculation of seasonal heat gains and losses

	Orientation	Area/ $\text{m}^2$	Solar gain	Factor/ $\text{GJ m}^{-2} \text{ GJ}$
Windows	S	3	0.68	2.0
	E & W	29	0.41	11.9
	N	0	0.25	0
People	1 GJ per person $\times$ 15			15
Electricity	Based on average wattage consumption over season of 33 weeks:			
	Lighting: rating 3.25 kW; 50 hrs per week			19.3
	Machinery: office 1kW; workshop 3kW – 50 hrs per week			23.8
	<b>Total gain</b>			<b>72.0 GJ</b>
Ventilation	(0.33NV) $\Delta T$ , $\Delta T = 10\text{K}$			124.7
Fabric	Roof U-value multiplied by 0.75			174.3
<b>Net heat requirement =</b>				<b>227 GJ</b>

etc remained constant throughout the period under examination. The net monthly heating requirement, indicated by the continuous line in Fig 2, is the sum of the fabric and ventilation loss minus the sum of all the heat gains for any particular month. Note that consideration of heat gains during the warmer months can negate the requirement for heating. The total seasonal energy consumption is taken as the sum of the net positive (ie when heating is required) energy requirements for the period September to May inclusive. For the peak summer months, the mean external temperatures can exceed the internal design environmental temperatures which will,

Table 7: Calculation of average monthly net heat flows for building (data for January)

	Orientation	$A_G/\text{m}^2$	$\bar{I}/\text{Wm}^{-2}$	$\bar{S}$
Mean solar Gain $Q_s$	S	3	130	0.64
	E & W	29	14	0.64
	N	0	15	0.64
Mean casual Gain $Q_c$	Lighting and machinery, 7.25 kW; 50 hours/week People: Office $\times$ 140W Factory: 14 $\times$ 235W			$50(7.25 + 0.84 + 3.29)$ $(7 \times 24)$ $= 3.39 \text{ kW}$
	Ventilation $\bar{T}_o = 4^\circ\text{C}$ , $\bar{T}_e$ values from Table 4 and Fabric loss: Design loss			
$Q_F + Q_V$		$\Sigma(AU + C)/\text{WK}^{-1} (\bar{T}_e - \bar{T}_o)/^\circ\text{C}$		
Office	302.7	14.9	$\Sigma(AU+C)\bar{T}_e - \bar{T}_o = 22.06$	
Corridor	89.1	13.0		
Workshop	387.5	14.4		
Production	894.9	11.1		
Store	110.4	8.0		
Net Heating Requirement		$22.06 - 3.39 - 0.51 = 18.16 \text{ kW}$ * = 47.03 GJ		

\* 1 kW/month = 2.59 GJ/month.

coupled with the higher levels of solar irradiance, result in a net cooling requirement. Supplement A9/1 of the CIBSE Guide shows how cooling loads may be assessed<sup>20</sup>.

(e) Response factor and 'boost' plant capacity

The calculation of the response factor and intermittent heating factor according to equations 17 and 18 respectively are shown in Table 8. The heating plant is assumed to operate for 9.5 hours per day, including one

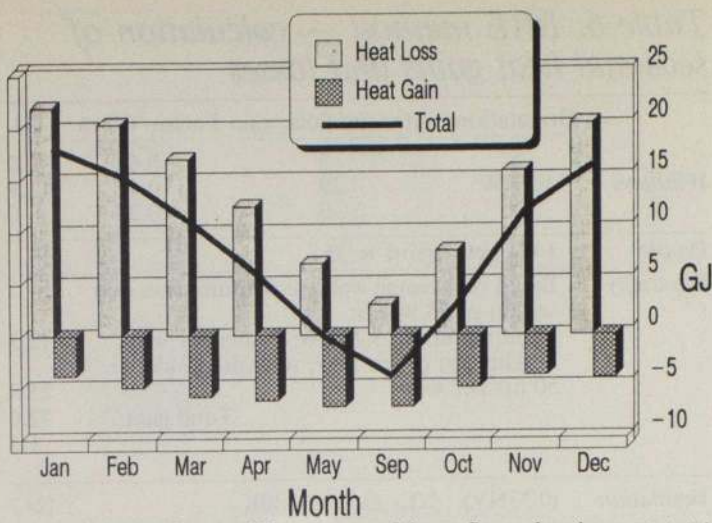


Fig 2 Calculated monthly pattern of heat flow, showing net total heating requirement (solid line), based on  $F_1F_2$  method

hour of preheat as recommended for a 'lightweight' structure.

### Discussion and analysis

The assessment of the thermal performance of a building can broadly be split according to two requirements. The first is for the sizing of the heating plant capacity to cope with the worst of the expected average winter conditions based on long term weather data. The second is to predict seasonal energy consumptions, perhaps with the aim of evaluating the economic viability of an energy conservation measure or estimating annual energy costs.

Figure 3 compares the seasonal energy consumption derived from the various methodologies covered above. Also shown are the predicted seasonal energy requirements from:

- (i) The degree day method, but assuming a standard base temperature of  $15.5^{\circ}\text{C}$ .
- (ii) The basic U-value method assuming an average  $6.7^{\circ}\text{C}$  internal/external temperature difference.

Other similar simplified procedures also exist for calculating the seasonal heating consumption based on a knowledge of the mean outdoor temperature averaged over the heating season<sup>22</sup>. The validation of one particular technique over another purely by comparison is flawed and Fig 3 only serves to highlight the differences that can result from alternative initial assumptions. The main parameters responsible for the differences shown are the chosen design temperatures and the extent of gains

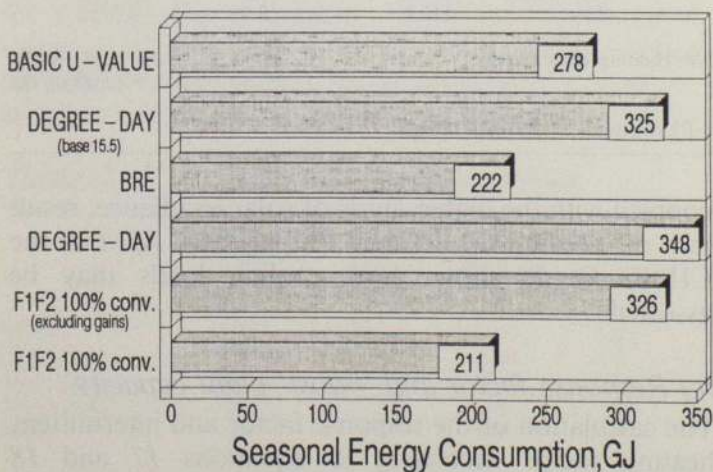


Fig 3 Comparison of predicted seasonal energy consumption for the techniques shown

attributable to sources not derived from the heating system.

A more useful comparison might be to consider the design heat loss values derived from each technique, shown in Fig 4. It should be remembered that each method is linked to a specific definition of design temperature (see Table 4) as required by the final calculation.

The assumption of steady-state heat transfer using known or assumed temperature difference forms the basis of all the methods considered. This is an idealistic representation of the real situation, but it does have the advantage of simplifying the task of calculating heat loss

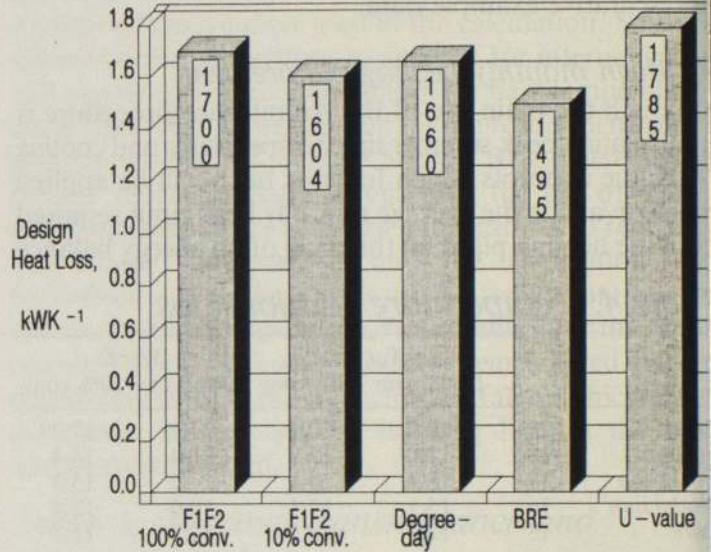


Fig 4 Comparison of predicted design heat loss per unit internal external temperature difference

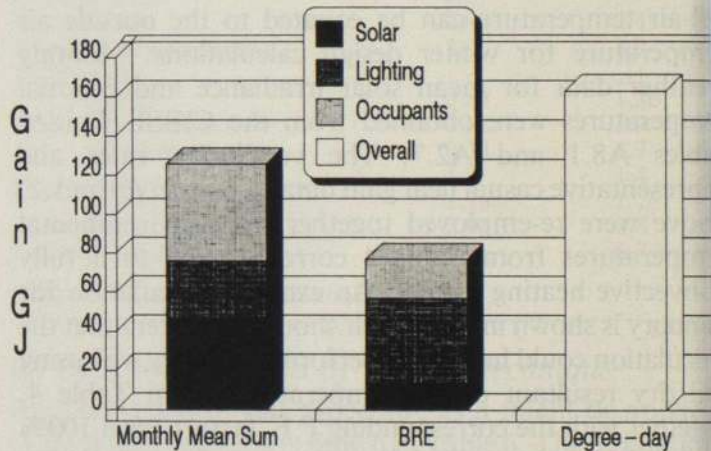


Fig 5 Total heat gains as assessed by each method

by eliminating the complex problems of calculating transient heat fluxes. A drawback is that continuous 24 hours a day operation of the heating plant throughout the heating season is implicit in the method and correction factors have to be introduced in order to account for intermittent operation together with the influence of building construction and location of insulation. Such factors can be useful not only for estimating plant capacity, as previously described, but also for the correction of seasonal energy consumption<sup>23,24</sup>.

The U-value technique is best employed in the estimation of maximum heating plant capacity. Under these circumstances, the uncertainty of solar gains can be ignored since it can be assumed that on the coldest day

ch gains would be low. A judgement may have to be made however, depending on the situation, regarding the importance of casual gains within the building. Refinements to the basic method have been introduced over the years in an attempt to improve accuracy, the most significant of these being the use of factors  $F_1$ ,  $F_2$ ,  $F_3$  and dry resultant design temperatures. Considerable effort has also been devoted to the improvement and availability of design data for both construction and weather.

For the model building, the data presented in Table 3 can be used as the basis for selecting the most cost efficient heating system. For example, it is evident that a warm air system is less suited to the production area in comparison to a radiative system due to the high ventilation rates which simply act to carry the heat away. The necessary host plant capacity to cope with intermittent operation can then be assessed from Table 8. Obviously the final choice of heating system will further depend on a range of other factors such as the relative costs of equipment, whether a requirement exists for hot water, ease of installation, cost of useful heat delivered, choice between using a centralised system or distributed system, heating system response time, reliability, degree of control and automation, aesthetic qualities and safety considerations. When introducing some of these additional considerations, a knowledge of the seasonal heating requirements and fuel consumption can form an important part of the decision-making process. Unfortunately, as this present study has attempted to show, different methods produce different results. Also, the same method can produce wide variations depending upon interpretation. Coupled with these factors are further unpredictable complexities such as combined central heating and hot water systems for which it is not always possible to make a satisfactory allowance for the proportion of fuel used for water heating.

The degree-day extension of the basic U-value method provides one method for estimating seasonal energy consumption. However, the most satisfactory use for degree-days is to provide a basis of comparing, over sufficiently long and different periods of time, the fuel consumption against a period of degree-days at regular intervals throughout the heating season. Similar buildings at different geographical locations can also be compared and the effectiveness of any energy conservation measure followed from one heating season to the next irrespective of changes in the severity of the climate between seasons. The 'weather factors' concept is similar<sup>25</sup>.

A fundamental problem in predicting accurately seasonal energy consumption arises out of the need to make an allowance for internal heat gains. Figure 5 compares the seasonal heat gains from all sources assessed by each method for the parameters specified. Once again, direct comparison is not meaningful except to illustrate differences of approach. The choice of base offset for the degree-day method (see Table 5) is too impersonal, and can easily produce a significant error in the prediction of seasonal energy consumption by either over or under estimating heat gains. It could be argued that the more detailed approaches for estimating casual gains, as laid out in Tables 6 or 7, can be considered to have greater credibility with less scope for variance. It is worth noting that for the calculations presented, the seasonal analysis using the degree-day method resulted in the prediction of the highest energy consumption in spite of also predicting

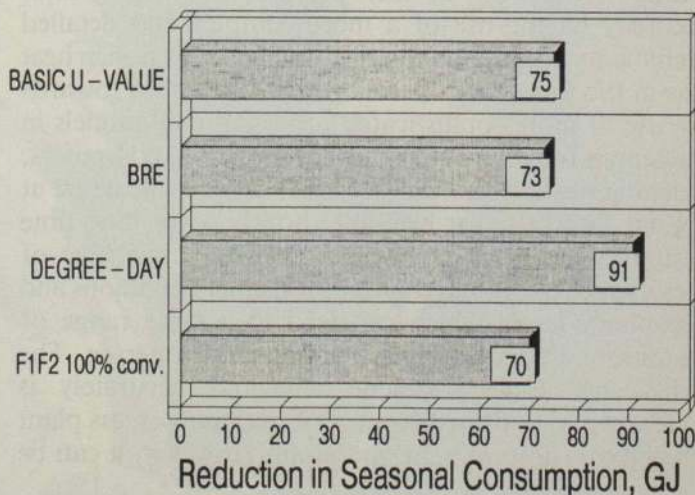
**Table 8: Calculation of response and intermittent heating factor.**

	$\Sigma AU$	$\Sigma AY$	0.33NV	$f_i$	$F_3$
Office/Corridor	283.5	724.0	89.1	2.18	1.58
Production/Store	568.5	2584.0	358.7	3.17	1.85
Workshop	184.6	874.8	175.6	2.92	1.79
Overall	1033.6	4182.8	623.4	2.90	1.79

a larger allowance for heat gains. The choice of correct base temperature can thus be seen to be a fundamental requirement for obtaining an accurate result. The use of internal design temperatures corresponding to dry resultant values instead of the corresponding internal air temperatures in the degree-day calculation would give a result that deviates less from the other methods but would not be totally consistent with the definition of degree-days which are based on dry-bulb temperatures. It would not be unrealistic to say that a practical method does not exist which can correctly account for the fluctuations in internal heat gains caused by occupancy behaviour, intermittent operation of heat producing machinery and so on. Under these circumstances, calculations of the seasonal fuel consumption using the manual techniques described, should only be used on the understanding that they reflect the long term average conditions. A knowledge of the peak to normal conditions caused by short term variations is, however, useful. It would, for example, be possible (subject to the availability of data) to calculate the heat loss given a mean and peak winter temperature using an approach similar to the admittance procedure described previously and to sum all the losses over the heating season.

A problem usually encountered when attempting to compare various methodologies is that a constant frame of reference is not always achievable. An alternative approach is to appraise the effects of changing an important system parameter and observing the relative changes in the predicted result.

Figure 6 shows the reduction in the seasonal heating requirement as assessed by each method if additional insulation were added to the production area ceiling to give an improvement in U-value from 1.76 to 0.35  $Wm^{-2} K^{-1}$ . Although the agreement between methods can be seen to be improved for this particular change, it does not argue the case that comparative calculations of



**Fig 6 Predicted reduction in heating consumption following insulation of factory roof**

this nature can be made with complete confidence when appraising potential energy saving investments.

The intermittent heating factor,  $F_3$ , takes into consideration the thermal response and insulation of the building, ventilation rates and total hours of plant operation, but not the response time of the heating plant to reach operating conditions. When the capacity of heating plant is more than sufficient to meet the prevailing weather conditions, energy can be saved by intermittent operation and reduced preheat times. On the other hand, extra capital costs will be incurred in providing larger than necessary plant margins and plant efficiency may be poor when operating at part load. If, for a particular building and heating times, the value of  $F_3$  is large, it may for example be more fuel efficient during times of less severe climatic conditions to operate continuously at full load with smaller secondary heating plant rather than intermittently with a plant having excess capacity operated at part load. Such decisions will be based on the economics of the extra capital costs involved in providing excess or additional plant capacity weighted against the expected fuel savings, running costs and life of the system. Once again, an investment decision of this type can only be satisfactorily appraised if seasonal heating requirements can be assessed reasonably accurately. In general, the case for the oversizing systems with an output below around 40kW appears dubious<sup>26</sup>. It should be noted that even without boost capacity, plant sized for steady-state winter design conditions will inevitably have excess output when external conditions are less severe and could therefore be satisfactorily operated intermittently for part of the heating season without the need for long pre-heat times. In this context the use of optimum start controllers are preferable.

### Conclusions

Although no attempt has been made to cover all existing manual methods of calculating energy requirements, this work has demonstrated the potential pitfalls that can arise in applying simplified techniques, using broad assumptions and generalised data. Although for many practical applications such methods find favour due to their relative ease of use, large variations can occur in the final result and the temptation under these circumstances is to over-design by incorporating extra capacity for a cost penalty. This safety margin, perhaps up to 25%, may be considered a worthwhile precaution by some, but it rather makes a mockery of any pretence towards greater accuracy by the use of a more complex and detailed preliminary calculations used to arrived at the design heat loss in the first place. Recent moves have been towards the use of more sophisticated computational models in the search for improved accuracy. By using computers, dynamic heating and cooling loads can be calculated at regular intervals, for example, hourly, over long time periods whilst incorporating a detailed knowledge of factors such as diurnal changes in weather conditions and occupancy levels which can lead to a large range of conditions under which a building must operate. The ability to model transient behaviour accurately is fundamental to the assessment of optimum excess plant capacity for intermittent operation. However, it can be

argued that there is still just as great a need for systematic validation studies to be conducted on these models if they are to be used with any greater confidence than the simple manual methods for all situations.

### References

- 1 FITZGERALD, D. Cooling loads by computer: Some Programs Compared, *JIHVE*, **39**, 184-192, (1971).
- 2 BURGESS, K S. Computer Programs for Energy in Buildings, Design Office Consortium evaluation report No 5, Cambridge, (1979).
- 3 Building Research Establishment - IEA Annex I Glasgow commercial building monitoring project: final report, (1984).
- 4 BLOOMFIELD, D. Appraisal Techniques for Method of Calculating the Thermal Performance of Building *BSE & T*, **6**, 13-12, (1985).
- 5 CIBSE Guide, Vol A, Design Data, The Chartered Institution of Building Services Engineers, London (1986).
- 6 ETHERIDGE, D W. Crack Flow Equations and Scale Effect, *Building & Environment*, **12**, 3, (1977).
- 7 WANNER, H U. Indoor Air Quality and Minimum Ventilation, Proceedings of the 2nd AIC conference Bracknell, (1981).
- 8 Building Research Establishment, Digest 210, Principles of natural ventilation, BRE, Garston, (1983).
- 9 BS 5925:1980, Code of Practice for Design of Building Ventilation Principles and Designing for Natural Ventilation, BSI, London, (1980).
- 10 CIBSE Guide, Vol B, Installation and Equipment Data The Chartered Institution of Building Services Engineers London, (1986).
- 11 FANGER, P O. Thermal Comfort, McGraw Hill, New York, (1972).
- 12 HUMPHREYS, M A. Field Studies of Thermal Comfort, *BSE*, **44**, 5-27, (1976).
- 13 RAINE, J H. Variations in Energy Saving Calculation for Industrial Roof Insulation, *JInstE*, **55**, 55-56, (1982).
- 14 PEACH J. Degree Days, *BSE*, **10**, 44, 213-17, (1977).
- 15 BURBERRY, P. Predictions of Thermal Performance *Architects Journal*, **172**, 43-46, (1979).
- 16 Degree Days, Department of Energy (Fuel Efficiency Booklet 7), HMSO, London (undated).
- 17 Building Research Establishment Digest 94, Domestic Heating - Estimation of Seasonal Heat Requirements and Fuel Consumption in Houses, BRE, Garston, (1956).
- 18 BURBERRY, P. Building for Energy Conservation Architectural Press, London, (1978).
- 19 MILBANK, N O and HARRINGTON-LYNN, Thermal Response and the Admittance Procedure, *BSI*, **42**, 38-51, (1974).
- 20 CIBSE Guide, Estimation of Plant Capacity Supplement A9/1, (1983).
- 21 Building Research Establishment Digest 108, Standard U-values, BRE, Garston, (1975).
- 22 CIBS Building Energy Code, Part 2(a), Calculation of Energy Demands and Targets for the Design of New Buildings and Services, CIBS, London, (1981).
- 23 BILLINGTON, N S, COLTHORPE, K J and SHORTER, D N. Intermittent Heating, HUR Laboratory Report, No 26, BSRIA, 1964.
- 24 PAGE, J K. The Development of Systematic Climatological Design Procedures for Solar Building *Sun at Work in Britain*, **6**, 48-50, (1978).
- 25 The Businessman's Energy Saver, How to Compensate for Climatic Conditions, Compiled by NIFES, Formeco Services, (1985).
- 26 BLOOMFIELD, D P and FISK, D J. Seasonal Domestic Boiler Efficiency and Intermittent Heating, *Heating and Ventilating Engineer*, **51**, 6, (1977).

# Concept of the Integrated Rural Energy Centre wins a major award for its originator

Brian Locke's design to widen the availability of electricity in Third World countries was the overall winner of the 1987 Melchett Memorial Award\* of the Design and Industries Association Trust, (as briefly reported in this publication in the Personal column last month). The DIA award of £2500 was presented to Mr Locke by Mrs Kerena Boulton at a ceremony and reception in the Innovation Centre at the Design Centre, Haymarket, London, on 7 October.

The purpose of the Award (which, in future years, will be awarded biennially) is to encourage design for social benefit: designs submitted are therefore expected to fill a basic human need, to make the most economical use of materials, having concern for the scarcity of mineral resources, and must also show evidence of originality and innovation. These criteria are abundantly evident in the concept and reality of Brian Locke's† Integrated and Rural Energy Centres (IRECs) (a visual display of which was on view in the Innovation Centre); and subsequently, following the presentation, Brian Locke talked to their essence, achievement to date and potential

This is immediately apparent in the fact that half the world's population live on land masses between the Pacific and Indian Oceans, often in small villages without electricity supply. In India alone, there are some 600 000 villages and although great efforts are being made to connect them with central electricity supplies there is, as the background to the Award submission points out, still a long way to go.

Again, in Third World countries, the economies are predominantly agriculture-based. Many waste products result. These accumulate and become a nuisance.

In India, for example, there is waste from the 130 Mt of main crops produced per year. In comparison with the UK's 29 Mt, this amount produces an abundance of waste materials, much of which are not biodegradable and cannot be used as a source of methane.

The range of agricultural wastes is wide and really they need to be regarded as energy raw material rather than waste. Some of the main energy raw materials are straw from cereals, coir dust and husk from coconuts, paddy and groundnut husk, cotton plant, rubber trees and other

timber waste including sawdust and woodchips.

Integrated Rural Energy Centres enable this waste raw material to be turned into solid boiler fuels for local industry, and electrical or mechanical power. Such IRECs would be cheap to install, and easy to operate and maintain. The Centres should allow villages which are not on the power grid to expand the scale of the development,

*(continued on p14)*

\* The Melchett Award has been made annually for the last 11 years by the Design and Industry Association Trust in memory of the late Lord Melchett, a former president of the DIA. This award is quite distinct from the Institute of Energy award of the Melchett Medal, which commemorates the first Lord Melchett, formerly Sir Alfred Mond, one-time chairman of ICI, and founder president of the Institute of Fuel in 1927 (see *Energy World*, Brian Locke's Basis for a Diamond Jubilee, pp 2,3, August/September issue and pp 2,5, October issue). The judges for the 1987 DIA Trust Melchett Award were: Leslie Bilsby, Kerena Boulton, Philip Evemy, Sir Montague Finiston, June Fraser, Tom Karen, Prof Heinz Wolff

† Cadogan Consultants

Sir Peter Parker MVO, president of the Design and Industries Association congratulating Brian Locke, winner of the DIA Trust Melchett Memorial Award for 1987 at the recent presentation ceremony (picture by courtesy of the Design Council). Brian Locke is a Fellow of the Institute of Energy which he represents as a member of the Executive of the Watt Committee. He is a member of the Institute's Publications and Conferences Committee, and chairman of the proposed international conference and exhibition: Gasification – status and prospects, 25/27 April 1988 at the Birmingham Metropole, at which conference he will also be presenting a paper: Gasification of agriculture and low-grade fuels in the session devoted to Biomass and refuse.



## *A moribund institute? – not in the branches*

Mr Tipler's Personal viewpoint, August/September 1987, raises a whole lot of questions about our Institute and its impact on the various levels of society from government to local level. Our image as a professional institution does give some cause for concern as we do seem to have been bypassed on many issues over the past few years.

The energy manager movement is thriving in many parts of the country but I wonder how much of this success is due to members of our Institute. It seems to me that few energy managers have joined our ranks despite the efforts to date.

I presume that our staff at headquarters and at Council level are doing their best

and I can only speak of experience at branch level. Up in the North East we have been fortunate in that the local REEO (Regional Energy Efficiency Officer) is a member of our Institute and has encouraged the various members of the local EMG's (Energy Managers' Group) to join our Institute. With backing from the branch Institute of Energy committee we have had some growth from this quarter and indeed cooperation goes on all the time.

Indeed we are fortunate in having good relationships with several similar professional institutions in providing short courses and conferences.

The main problem however is

persuading members to give up a little more of their spare time on Institute business. Too often it is the hardworking half dozen doing all they can with little support from elsewhere.

The challenge for our Institute surely lies in the belief that if the efforts of the few could be magnified by the efforts of the majority then our Institute would be the main reference centre for all energy matters. Let us all get off our bottoms and do something about it.

M G BURBAGE-ATTER

*(Fellow and senior vice-chairman of the North East branch)*

## *Efficiency in industry – the importance of water*

Your issue for August / September contained an interesting contribution from M Roberts on *Efficiency in petroleum refining*, (p13 *Energy World*, Aug/Sep 1987). For me, part of the interest lay in what was not mentioned, except indirectly – the importance of water to the efficiency of the industry.

I have been involved (after the fact, I am glad to say!) in several instances of boiler failure, caused by inadequate

control of water conditioning procedures, which cost the refinery concerned very considerable sums of money: in replacing power and steam from outside or less efficient sources: and in boiler repair.

This leads me to a wider issue. Water is unquestionably the most important means of energy transfer used in industry and commerce, yet the subject of its efficient management, use and treatment is rarely featured in the Institute's

activities and publications, that issue of *Energy World* being a case in point. W Tipler in his Personal viewpoint (p1) reiterates the criticism of the Institute as still being more concerned with fuel than with energy. Is the topic of this letter another example?

T B FIELDEN

*(Water Treatment Consultancy Services)*

## **Concept of the Integrated Rural Energy Centre wins a major award for its originator** *(continued)*

whether in agricultural processing, industry, or domestic life.

The raw material is prepared, then dried when its moisture is high. The dry material can then be briquetted, under pressure. Since the raw material usually has a fibrous structure, after compression the briquette will hold together.

Some of the briquettes are turned into producer gas in gasifiers that work at near-ambient pressure. The gas is then cleaned and used as the fuel for a petrol or diesel engine. The IREC system is more thermally efficient than an internal combustion engine alone and self-supporting in energy because the engine drives the briquetting and preparation machinery, and waste heat from the engine and gasifier carries out the drying of the raw material. Remaining briquettes can be sold as boiler fuel for local

industry, for which they are very suitable; or they too, can be gasified to produce power for other uses.

Integrated Rural Energy Centres bring together known processes and equipment in a way not done successfully before. Attempts have been made to get similar schemes going in the Third World. None has been really satisfactory. The gasifiers applicable for IRECs are recently developed; most standard engines can be adapted simply; and the combined heat and power principle is used that has been applied in Britain, and elsewhere, to obtain higher thermal efficiency and more useful energy output.

A test pilot IREC plant set up by CTC Services was put into action several years ago at Kadirana, Negombo, 50 kilometres north of Colombo in Sri Lanka. Late in 1986, the Indian government initiated a programme to install IRECs in a number of areas in India.

*Orders are being taken now for the proceedings of:*

## **Second International Conference on Small Engines and their Fuels in Developing Countries**

£30 (members), £35 (non-members)

*Orders with remittance to: Publications Department, the Institute of Energy*

## *Fuel and Energy at Leeds*

**A 15 minute VHS video produced by the Department of Fuel and Energy at the University of Leeds**

In only 15 minutes we are whisked through the first year fuel laboratory, all polished equipment and photogenic flames, and on to research equipment; old boys of the department discuss coal marketing and oxyfuel burner design and remark wisely on protecting the environment.

Some of the research is a little difficult to come to grips with; hydrogenation of benzene in a shock tube seems a little *recherché* and nuclear energy is mentioned only fleetingly. The main thrust of the department comes over as improving the efficiency with which fossil fuels are burned and protecting the environment from any pollution so formed.

Fifth and Sixth form students are presumably the target of the video which will give them a fair picture of a 'well found' department teaching a subject which is extremely relevant to the needs of our technological society and producing graduates with good job prospects. My only, rather rueful, caveat is that other university departments will now be forced to produce their own videos so as not to be left behind. Perhaps the Institute should make one to promote energy engineering in general.

Ian Fells

## *Solving problems in applied thermodynamics and energy conservation*

**G J Sharpe  
Longman Scientific and Technical, 1987  
216pp. £7.95**

This book forms the latest in a series of engineering problems books: the others deal with fluid mechanics, structures, etc. The book contains material for BSc, BEng and higher diploma work in mechanical and energy engineering courses as well as chemical engineering and building sciences.

There is a very good coverage of energy problems. The book covers: combustion, rocket propulsion, vapour cycle, internal combustion engines, gas turbines and turbo machinery, heat transfer, refrigeration, heat pumps, renewable energy sources, waste heat recovery, CHP and energy economics. Nuclear power is not covered.

Each chapter consists of some introductory (in fact often very elementary) comments and then an outline of the calculation procedure followed by problems and their answers. For example, in the combustion chapter the methodology is given for questions on dissociation, adiabatic flame

temperature, combustion formulae, excess air and analysis of combustion products. This is a reasonably good coverage of the field enabling problems to be set on furnaces, boilers and turbines, etc with only simple modification.

The book is ideal for students (and staff) as a means of improving their knowledge of particular subject areas. The book, consisting of 216 pages, and with a flexible cover offers good value for money to libraries or students.

Finally to give readers the flavour of the book I reproduce a question:

*The analysis of a domestic refuse is, by mass: 11% cinder, 4% putrescible matter, 40% paper, 27% metal, 15% plastics, 3% rags.*

*The CV of the combustibles are, in MJ/kg, cinder 27, paper 17, plastics 19, rags 13.*

*The refuse collected in a population of 6000 is 6 kg/week per capita.*

*The weekly refuse is burnt in a boiler to raise steam, from feedwater at 20°C, at 20 bar, 250°C.*

*Determine the mass of steam generated, if the boiler efficiency is 0.6.*

*Outline the problems involved in the incineration of refuse, and the benefits of this system.*

The numerical part should be done in three lines, the rest may take longer.

Prof A Williams

## *World offshore markets: can Britain compete?*

**P Gregory, I H McNicoll and L Moar  
Eastlords Publishing, London, 1986  
215pp. £14.95**

This book is intended to provide a rigorous examination of the export potential of the UK offshore oil supplies industry. Over the years the number and size of UK firms serving developments in the North Sea has, up to 1986, grown to such an extent as to establish themselves as a separate and significant industry. With the projected decline in North Sea revenues in the future it was natural that strategically this industry should direct its attention to developing export sales of offshore expertise and equipment.

The book is based on research carried out by the authors during the tenure of a postgraduate studentship through interviews and questionnaires with the 40 largest offshore oil equipment suppliers. It therefore attempts to provide an objective analysis of the views expressed by the members of the industry.

Unfortunately the collapse in the oil price in 1986 has altered the projections and perceived opportunities dramatically. Also the background prepared to support the questionnaires and analyses is based on references from the 1960's and '70's. There is thus a distinct difference in

time perspective expressed in the book compared to the industry needing to respond rapidly to changing world conditions. However Chapter 4 on managerial attitudes to exporting was probably the most revealing and may well prompt some of those companies who participated to reconsider their strategies. The role of government agencies, discussed in Chapter 6, also provides a useful summary of their perceived activities at that time.

While this work was in progress the Scottish Development Agency (SDA), with considerably greater resources and knowledge of the industry than the authors, produced their own reports including *The international oil and gas market* at about the same time. The SDA identified and quantified all aspects of overseas offshore market opportunities. The value of this book is basically of interest to those companies who participated in the study and were thus able to rank their own views with the responses of other companies. Exploration and production activities have been severely rationalised throughout the world in the past year and recovery is likely to be a slow haul for the industry.

D F Rosborough

## *Recently published*

**Energy efficiency handbook**  
Heating and Ventilating Contractors' Association (HVCA), 1987. Price: £17.00 from HVCA Publications, Old Mansion House, Eamont Bridge, Penrith, Cumbria CA10 2BX.

**Improved wood, waste and charcoal burning stoves**  
Intermediate Technology Publications, 1987. Price: £9.95.

**Annual bulletin of coal statistics for Europe Vol XXI**  
United Nations, Geneva, 1987.

**Coal research projects**  
IEA Coal Research, London, 1987.

**GRECO Hydroconversion et Pyrolyse du Charbon**

A summary report on the activities of GRECO Hydroconversion and Pyrolysis of Coal for the period 1 July 1984 to 30 June 1986. For more information contact the directeur, Monsieur H Charcosset, Institut de Recherches sur la Catalyse, 2 avenue Albert Einstein, 69626 Villeurbanne, Cédex, France. Tel: 78.93.34.71

**Safety in Mines Research Advisory Board Annual Report 1986 to the Health and Safety Commission**

Further information on the SMRAB can be obtained from the joint secretary, P G Brierley, Health and Safety Executive, Baynards House, 1 Chepstow Place, London W2 4TF. Tel: 01-229 3456 ext 6325.

## Gas burners British Standard part 2

**BS 5885: Automatic gas burners Part 2 Specification for packaged burners with input rating 7.5 kW up to but excluding 60 kW**

This part will help in the control and operation of automatic gas burners. It is an extension of the original standard (now Part 1) which covers large burners, that is above 60 kW.

Copies of **BS 5885: Part 2** may be obtained from BSI Sales, Linford Wood, Milton Keynes MK14 6LE. Price: £19.10 (£7.64 to BSI subscribing members).

## Save that heat Insulate

Twelve million householders in this country are simply throwing money away – as their expensive heat escapes through uninsulated cavity walls.

Mr Peter Morrison, Minister of State for Energy, was in Chester at the invitation of the National Cavity Insulation Association to see the UK's 2.5 millionth house to have its cavity walls insulated.

He said: 'More than 14 M houses in this country have cavity walls – yet only 2.5 M of them have been insulated. This really is bad housekeeping and is probably the greatest waste of money that householders inflict upon themselves. Up to half a home's wasted heat is lost this way.'

'Cavity wall insulation does save money and make homes more comfortable. It is quite remarkable that 12 M households are still prepared to let expensive heat escape through the walls. It makes no financial sense at all. A house is the biggest investment most families make. Cavity wall insulation is one of the few sure ways to improve a home, maintain its value, and make it a better place to live in.'

'Stopping energy waste through walls, windows and floors of houses and flats could save the country £2 billion a year. As winter approaches the message must be: take action now – it really is worth it.'

Source: *Energy Efficiency Office*

## Monitoring Dounreay Greenpeace rejects offer

Greenpeace have rejected an offer of joint sea and soil sampling and analysis, under independent supervision, at the Dounreay nuclear research establishment in Caithness.

The offer was made two months ago by the UK Atomic Energy Authority 'to help resolve the apparent differences in environmental measurements around Dounreay'.

The Authority had earlier supplied Greenpeace with its own monitoring data and a map showing sampling points and the location of the Dounreay pipeline.

UKAEA chairman, John Collier, said that the Greenpeace reply reveals some serious misunderstandings over Dounreay's operations. 'I therefore regret their rejection of our offer of joint, independently supervised monitoring and hope that they will take up our invitation to visit Dounreay. The offer of tests still stands,' he said.

Source: *UKAEA*

## Freephone . . . . . . Lead-free petrol

Dial the operator and ask for Freephone 2793 and you will be able to find out if your car will run on unleaded petrol.

Texaco set up the Lead-free phone at the same time as it began selling unleaded petrol realising that many motorists are unaware of whether or not their car will run on the fuel. The caller gives their car's make, model, year and engine capacity. The answer will be either yes, no or a referral to the dealer to discover what engine modifications are required.

Source: *Texaco*

## Oil industry R & D spending is up

Mr Peter Morrison, Minister of State for Energy on a visit to Aberdeen, said that oil company spending on research and development in the UK had increased despite last year's drop in oil prices.

Following his first meeting as chairman of the Offshore Energy Technology Board (OETB), Mr Morrison said that the oil industry is spending £70-£90 M a year on research and development. Spending by the Government, universities and the offshore industries together accounted for a further £30-£50 M a year, he said.

'I am greatly encouraged that, despite the fall in oil prices, the evidence points to an increase in R & D spending.'

'This evidence is based on information assessed by my Offshore Supplies Office following the recent tenth offshore licensing round which shows that oil companies are paying increased attention to projects which contribute directly to the development of the UK's offshore industrial capability.'

Mr Morrison also said that the

OETB had reviewed progress on its four priority areas – subsea engineering, topsides weight reduction, drilling and production technologies, and exploration technology.

'A great deal of work is now in hand on subsea engineering in a group chaired by Ken Jameson, formerly of BP. Oil companies and the supply industry are working together to identify the precise needs of future subsea systems, and the R & D projects which will create a strong UK subsea capability.'

'On topsides weight reduction, my Department is actively following up interest awakened by the OETB seminar last July. In particular, there is growing interest in projects to demonstrate the opportunities for the use of aluminium, high-strength steel and composites offshore.'

'The OETB has helped to start six projects in exploration technologies totalling £2.3 M. In drilling and production technologies the OETB is helping to fund 10 projects which are costing a total of £2.9 M,' Mr Morrison said.

Source: *Department of Energy*

## Clean gasification A new study

Converting coal into synthesis gas that is then burned in gas turbines is attracting increasing attention from American power companies as a clean, highly efficient way to generate electric power. A proprietary coal gasification process\* is being used in the Cool Water Coal Gasification Programme in California, a first-of-a-kind demonstration project which removes as much as 99% of sulphur in coal. Its success means that gasifying coal is now being viewed in the USA not only as a candidate for new electric plants but also as a way to modernise ageing power stations.

A new study calls for a two-phase, five year programme that could total some \$17 M in joint US Government/industry funding. In this programme, engineers will examine ways of cleaning sulphur emissions from rapidly moving, hot coal gases while they are still inside the gasifier. The experimental technique involves injecting sorbents, such as iron oxide or calcium compounds, directly into the gasification vessel. The sorbent act as a chemical sponge, absorbing the sulphur emissions as they are released from the gasified coal. The technique could provide an economic advantage through elimination of the separate clean-up step that is currently used at the Cool Water facility. This new technique referred to as *in situ* sulphur capture could reduce or eliminate the need for separate clean-up devices after the

\* Texaco

ynthesis gas is produced from the coal. It would also obviate the need for a complex system of heat exchangers or other devices that are necessary today to cool the hot coal gases to temperatures that can be handled by conventional sulphur removal systems.

The tests will use an existing 1t/h gasifier. Each phase of the five-phase test programme will last about one year and each subsequent phase will be contingent upon the success of the previous one.

Source: *Texaco*

## Indonesia

### Energy conservation

Indonesia is launching a project to improve its policies and systems for conserving energy. Part of the project will demonstrate the benefits of conserving energy in industry by carrying out an energy efficiency scheme at PUSRI, the country's largest fertilizer company.

With partial financing from a \$21 M World Bank loan, the project will provide funds to establish an energy conservation centre, prepare a comprehensive conservation programme, carry out promotional campaigns, and provide energy conservation training.

Indonesia's energy sector provides about 50% of the country's foreign exchange earnings through exports of oil and liquefied natural gas. But the surplus oil available for export has declined in recent years and, to ensure continued oil export earnings, the country is embarking on a programme to develop other indigenous resources for domestic use and stimulate energy conservation and diversification.

PUSRI is providing the equivalent of \$15.1 M to cover the project's overall cost of \$36.1 M.

Source: *World Bank News*

## Australia

### Oil exploration up

The long-term downward trend in oil exploration appears to have changed, according to figures issued by the Australian Bureau of Statistics.

Onshore petroleum exploration expenditure in the June quarter was up Aus \$29.3 M, or 96.1%, on the previous quarter. Offshore petroleum exploration was up Aus \$10.2 M, or 41.6%.

But petroleum exploration expenditure was still lower in the June quarter compared with the same quarter in 1986, with onshore exploration down by 10.9% and offshore exploration down by 2.5%.

Exploration spending in the minerals industry, excluding petroleum and oil shale, was up Aus \$21.1 M, or 27.9%, in the June quarter, compared with the previous quarter, and up 4% on the June quarter last year.

Source: *Australian Information Service*

## 'Monergy' in the Inner City

Energy conservation has a vital role to play in the regeneration of Britain's inner cities, according to a new report prepared by the Association for the Conservation of Energy. It considers six objectives for inner city policy, all of which it argues can be assisted by energy efficiency investments.

Andrew Warren, director of the Association, said: 'For too long, energy conservation has been regarded as simply a good cause. We believe this study demonstrates the many practical ways in which an expansion of energy saving activity assists the Government in its declared goals regarding our cities'.

It demonstrates how energy efficiency can: **Create new jobs** - The report details how up to 110 000 new jobs could be created within our cities over the next decade. Over half of these would be concerned with installing energy saving devices.

**Stimulate new enterprises** - The report shows how installation activities require limited capital to succeed. They are thus ideally suited to small, entrepreneurial firms. Many of these could provide energy surveys and advice.

**Assisting local workforces to acquire new skills** - Although much of the new employment would be for the semi-skilled

and the unskilled, the report draws attention to certain areas of both potential and actual skill shortages. It calls for both the Manpower Services Commission and the new City Technology Colleges to develop more vigorously courses and work experience directly concerned with the needs of the energy efficiency industry.

**Improve the quality of the built environment** - The report considers the implications of instigating specific energy action areas or towns, in preference to dovetailing into existing task forces or urban programmes. It urges the new Development Corporations to promote energy rehabilitation standards, and the financial community to increase lending for energy efficient buildings.

**Improve the efficiency and competitiveness of existing activities** - The report shows how reducing expenditure on fuel can release funds for alternative spending. This increases profits, competitiveness and helps create jobs.

**Reduce social deprivation** - The report details expenditure to assist 2.25 M low income households. It calls for all those in receipt of fuel benefits from the State to obtain help with retrofitting their homes to make them truly energy efficient.

Source: *Association for the Conservation of Energy*

## Power . . .

### . . . without the pollution

Two companies\* are collaborating to market a new process for the generation of base load electricity from coal, which will dramatically reduce the release of the acid gases normally associated with coal-fired power stations. The aim is to provide an environmentally attractive and economically viable alternative to nuclear power.

The process, called Clean Power Generation (CPG), uses a novel concept for the production of clean fuel gas from coal, applicable to any type of high pressure gasifier. The gas fuels a gas turbine/steam turbine combined-cycle system to produce electricity at high efficiency and with minimal environmental effect. Acid gas sulphur and nitrogen oxide levels will be as low as from the combustion of natural gas, that is only one-tenth of the emissions from a conventional coal-fired power station fitted with a flue gas clean-up system.

As the concept is based on commercially proven technologies using standard equipment already available on the market, CPG power stations will be built from shop-fabricated modules to be in operation within three years from the start of site construction.

Economic evaluations establish that CPG power stations will produce electricity at a cost equal to or lower than conventional coal-fired plant.

Higher sulphur petroleum residues or

heavy crudes can be used as an alternative feedstock in the same coal-based plant. The process can also be adapted to fit gasification processes using peat or biomass as feedstock.

Source: *Humphreys and Glasgow*

## Energy management

### A case history

Speaking on heat recovery at the Energy Management Conference in London in November, Alan Campbell† said that he was amazed at the apathetic attitude taken by so many commercial companies towards such a vital matter.

'The technology is so simple, the equipment so relatively cheap and the savings so considerable, that it is incredible that heat recovery is not being more widely used,' he said.

Mr Campbell then gave a case history example of the enormous losses some energy users were unnecessarily, albeit unwittingly, experiencing. He said that in 1974 his company was approached by a consulting engineer regarding plans for a sewage farm in the north of England.

It was decided to incorporate a thermal wheel into one of the buildings to ensure

\* Humphreys & Glasgow and NYKOMB of Stockholm

† Managing director, Acoustics and Environmental

plenty of fresh air for the large number of men who would be working there. In the event, however, the wheel was taken out of the specification, because of a shortage of money. The wheel, itself, would have cost £7900 at that time and with installation the total cost would only have been £12 000.

'As an earnest of good intentions, no doubt, when the sewage farm equipment was put in, space was still left for the thermal wheel. That, though, was the last we heard of the enterprise for 13 years. Until September of this year, in fact, when we were approached to quote today's price of a wheel to fit into the space reserved for it in 1974.

'This intrigued me considerably as the price of the wheel, now, is £17 111 and, with installation, around £25 000. What I wanted to know was what they might have saved had they made the investment in 1974. So, using a computer program which has the British Met Office data already in it, I processed the calculation.

'It showed that the cost of the fuel per annum over the 13 years must have averaged in the order of £25 200, whereas if they had installed a wheel in 1974, the cost of their fuel would have gone down to £8046. This would have represented an annual saving of £17 173 and in 13 years that would have amounted to a saving of £223 250 against an investment of £12 000. As it happened, it represented an unrecoverable loss.

'Despite this and the fact that the cost of today's equipment and installation at £25 000 would pay for itself in just one year – this being what it must still cost the sewage farm to run the building – the heat recovery system has again been turned down.'

Source: Garnett Keeler Public Relations

## British Gas Centralises research

British Gas' plans for a new research station have progressed to the stage where the company has lodged with Warwick District Council an application for outline planning consent to build the station within a 370 acre site near Stoneleigh, Warwickshire. The new research station, which would initially employ some 800 people, could be ready by 1991.

A decision to upgrade the British Gas research and development facilities by closing research stations in Solihull and London and transferring their work to a new purpose-built research establishment was announced earlier this year. The investment involved is more than £30 M.

Of the 800 staff, about 560 would be qualified scientists and engineers, 140 would be technicians and 100 clerical and administrative staff. A significant proportion of these would be existing

staff who would transfer to the new site. However, it is expected that employment opportunities would be provided for the local area through direct employment, through work contracted out and through the need to provide goods and services to the establishment, its staff and to the many visitors who would be expected.

The main emphasis of the work at the new research station will be on improvements in the design and efficiency of gas-fired equipment for industry, commerce and the home and on reducing gas supply costs. The existing stations which will close are the London Research Station and the Watson House Research Station, both in Fulham, London, and the Midlands Research Station at Solihull.

Source: British Gas

## Engineers' role In economic growth

The importance of technology, and the science base which supports it, to economic growth is now widely recognised as a key political issue claims Oscar Roith, president of the Institution of Mechanical Engineers. In his Presidential Address Mr Roith, formerly chief engineer and scientist at the Department of Trade and Industry, said that adequate attention to technology was a primary requirement for general economic success in the longer term. While its application could not guarantee success, failure to apply it would surely lead to decline.

'It is the basic objective of economic and social benefit, in our work, which clearly distinguishes engineering from pure and applied science,' he said, and added: 'The work of the engineer is just as demanding technically as that of the pure or applied scientist. It is the objectives of our work which differ.'

He emphasised the unique role of the professional engineer in providing the essential link between: science and its industrial exploitations; knowledge and its practical use to solve industrial problems; research and its profitable application in products and processes.

Mr Roith said that during this century technology had made it possible to enhance the exploitation of natural resources to a level where the reliance on exploitation of humans could be significantly reduced and the overall quality of work improved. Ownership and exploitation of technology was being used increasingly to offset limitation in the availability and quality of natural resources and the physical capability of human resources.

'The distinction between the developed countries and the undeveloped countries,'

he maintained, 'is that the developed countries have been able to use technology to generate national wealth. Among the developed countries the richest are those that have made the best use of technology. Technology is therefore as important a component of economic development as human resources. It may be more important than the possession of natural resources.'

The impact of technological change must be treated as an essential variable in any economic model. The longer the time scale over which any economic assessment was made, the greater the significance of a sound technological input. 'Useful estimates of these inputs can be made within acceptable accuracy because the science base is already available for the significant technological options for at least the next 25 years. So that by using this time constructively, society can adapt to technological developments within the time scale needed for them to be implemented.'

In reviewing the role of the engineer Mr Roith emphasised that it was much more than implementing assigned tasks, and added: 'It is essential that we all contribute to the policy making process.'

'Technical options are frequently as finely balanced as the relevant political, social or commercial issues. It is only by participating in the discussions on the wider issues, and being aware of them, that the engineer can develop the optimum solution for any set of circumstances.'

Source: Institution of Mechanical Engineers

## Multinational birds European awards

Readers will be interested to know that in European Year of the Environment, Esso UK in conjunction with the RSPB (Royal Society for the Protection of Birds) announced the first winners of the new Birds and Countryside Awards earlier this year.

The awards, in four categories (Individual, Industry, Media and European) were specifically intended to include the continent of Europe.

It was particularly interesting to see that it was one of the major oil companies that sponsored the awards. The energy industries, though often maligned, have an honourable history of caring for the environment while getting on with the work of making modern life possible.

The Industry category was won by H J Heinz Company of Hayes, Middlesex for its 'Guardians of the Countryside' programme. The company is contributing £1 M to conservation – the largest single donation by a company in this country.

## High-pressure duplex filters

**Parker Hannifin's** new 32PD high-pressure duplex filters increase efficiency by eliminating downtime during filter element replacement.

The filter has two elements in separate steel bowls mounted in a common head. Only one element is operational at a time. When dirt builds up on one element, a change-over valve is turned to bring the clean element into operation and to isolate the dirty element, ready for servicing at a convenient time.

The heavy duty series is specifically designed to protect continuous process or high utilisation applications where the cost of downtime is high, and liquids are at high pressure. Applications include machine tools, particularly in the automotive industry, power generation, mining, petrochemicals, paper and plastics.

The maximum flow rate is 250 litre/min, the maximum pressure 210 bar and the operating temperature is -40-120°C.

**Reader enquiry no 12/1**

## Liquid waste incinerator

**Hirt Combustion Engineers** have just completed a liquid waste incinerator for use with a coal gasification plant that is being supplied by Wellman Process Engineering to a ceramic tile plant in China. The liquids to be disposed of are coal tar fuel, distillate oil - both waste products - and a phenol/water mixture. The CTF and the phenol/water mixture are burned in a special Hirt quadraxial gun, the CTF providing the necessary heat for combustion of the phenol/water mixture. The distillate oil is burned through a separate nozzle.

The exhaust gas from the incinerator is at 760°C and is used for raising steam in a waste heat boiler.

**Reader enquiry no 12/2**

## Process integration

**N S Gamble & Partners**, consulting engineers to the food and process industries, have presented a seminar on process integration. It was explained how process integration using 'pinch technology' is a technique that takes the guesswork out of designing complex processes.

It allows the process designer to define targets for capital and operating costs, which can be used to optimise the design of the plant.

Using the HEATNET suite of computer programs, it was shown how these capital and operating cost targets are derived and used in a sophisticated optimisation procedure to achieve the best balance of capital and operating cost for maximum profit. There was a practical case study based on a process for the concentration of malt extract.

Speakers included Prof Per Løken of Trondheim University in Norway, author of the HEATNET software package, and Dr Colin Martin of the National Engineering Laboratory, who is developing and marketing HEATNET in the UK.

N S Gamble & Partners are incorporating process integration in their technical and design consultancy services, and they believe HEATNET is an important tool in the cost-

effective design of processes for maximum profit.

**Reader enquiry no 12/3**

## Energy audit systems for electricity

**The Response Company** are introducing a new energy audit system to help industry account for increasing costs of electrical supply. Response's energy audit systems for electricity and other fuels - EASE systems - interface directly to responder electricity meters and can log pulses from any type of transmitting meter including gas, oil or water.

For localised monitoring, the network manager receives pulses over a single wire pair linking up as many as 100 meters on a single site. For widely dispersed locations and buildings, the network retriever sends back any number of remote meter reading profiles over the public telephone network.

Company network communication products supply consumption data from all sites back to an IBM PC running a special real time energy accounting software package. The complete system logs, displays, calculates, costs, invoices, archives, edits, groups, audits and alarms every facet of energy consumption under the control and according to the needs of the user.

**Reader enquiry no 12/4**

## Portable stack sulphur dioxide monitor

**Neotronics** have been actively involved for the past eight years in combustion test instrumentation for energy conservation. They have now developed a new electrochemical sulphur dioxide sensor that is suitable for use at the relatively high concentrations normally found in stack emissions. This sensor has been incorporated in the SO103 portable stack sulphur dioxide monitor which is designed for use both by fuel users and emission enforcement agencies.

The monitor is powered by a rechargeable ni-cad battery. A continuously operated diaphragm pump draws stack gas through a probe, filter and inter-connecting tubing to the sulphur dioxide sensor within the instrument.

A high brightness LED displays readings from 1 to 3999 ppm concentrations, which effectively covers all emission control requirements. Automatic audible and visual alarms operate when concentrations exceed the maximum; the sensor will not be damaged if inadvertently overloaded.

The SO103 is suitable for monitoring the effectiveness of sulphur dioxide scrubbing systems in power station stacks or chemical processing systems, and enables plant operators to determine when absorption material requires replenishment. The SO103 can also be used by important fuel users to determine sulphur levels on coal or fuel oil.

**Reader enquiry no 12/5**

## Calibration dewpointmeter

**Michell** have introduced a calibration dewpointmeter capable of simultaneously registering dewpoint,

RH and gas temperature. The Series 3020 calibration dewpointmeter is an enhanced version of the company's established Series 3000 DTR, and its primary role is to calibrate other hygrometers and relative humidity instruments. Its extended capabilities make it suitable for applications in which an RH readout is required, where the standard RH probe is either too inaccurate or has unacceptable drift.

An important feature of the Series 3020 is its automatic balance compensation circuitry, which periodically and automatically purges the optical cooled-mirror dewpoint system to obtain a new zero, before returning to normal operation. An integral microprocessor calculates the instantaneous RH value from dewpoint and temperature data, using water vapour pressure tables stored in memory. All measurement parameters are registered on an LED display of 14 mm character height.

Other salient features include the simultaneous display of dewpoint from -60 to +80°C; gas temperature, over the same temperature ranges as dewpoint; and relative humidity, from 0 to 99%. Accuracy is stated as  $\pm 0.27^\circ\text{C}$  and resolution  $0.1^\circ\text{C}$ , giving an accuracy in terms of RH unattainable by any other method. The instrument delivers BCD and linearised outputs in relation to RH dewpoint and ambient temperature, for use by peripheral instrumentation.

**Reader enquiry no 12/6**

## Perkins's 500 Series engine turbocharged

**Perkins's** new four-cylinder 500 Series industrial engine - launched earlier this year - has now been turbocharged. Known as the 504-2T, this two-litre engine is the most compact and lightweight in its class.

A key attraction of the engine to equipment manufacturers is the outstanding power to weight and power to size ratios of the 504-2T - better, it is claimed, than any other comparable engine. It develops 42 kW at 3100 rev/min and weighs only 148 kg. It enables machines it powers to be light and compact enough for towing by lightweight vehicles as well as easily manoeuvred on site.

The use of Trim, Perkins's latest direct injection combustion system, helps the 504-2T to have better fuel economy than any engine of its size - 20% better, it is claimed, than

indirect injection diesels. Further advantages of this system are low noise and emission levels. Service intervals are also extended to 400 hours for oil and filters.

**Reader enquiry no 12/7**

## Mini condensate return unit uses steam or air pressure

**Gestra's** new CRS 3 is capable of pumping large quantities of condensate but stands only knee high and will therefore fit into small spaces. It is suitable therefore for fitting immediately under calorifiers, heat exchangers and all types of steam-heated process plant where many problems of drainage and waterhammer are easily solved. Steam or air pressure is used to pump the condensate.

The design is simple and the only moving parts are the solenoid valves and non-return valves. Level control is by Gestra level electrodes which have been well proven on steam applications.

During operation the vent solenoid valve is initially open so that the vessel can fill with condensate by gravity. As soon as the vessel is full, the level electrode signals the vent valve to close and the steam solenoid valve to open to push out the condensate via the non-return valve. When the vessel is empty the valves change over and the cycle repeats.

**Reader enquiry no 12/8**

## Trade publications

*Design and development services.* **CJB Developments's** brochure describes contract services to develop and manufacture process plant to meet individual customers' requirements. The services range from laboratory/feasibility studies through pilot-scale development to full-scale plant.

**Reader enquiry no 12/9**

*Valves, actuating and control systems.* A new 16-page brochure has been published by **Sulzer Brothers**. Illustrated with photographs, drawings and diagrams, it reviews the chronological development, scope and possibilities for Sulzer products in the field of valves, actuators and control systems for power units at supercritical pressures.

**Reader enquiry no 12/10**

## ENERGY WORLD - COMMERCIAL

(Photocopy acceptable)

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

12/1 12/2 12/3 12/4 12/5 12/6 12/7 12/8 12/9 12/10

Name .....

Address .....

Organisation .....

## The Engineering Council Farewells at Engineering Assembly

At the 1987 Engineering Assembly, held in Edinburgh on 21 and 22 July 1987, Sir Francis Tombs announced that it would be his last as chairman of the Assembly as he will come to the end of his three-year period of office as chairman of the Engineering Council in May 1988. Sir Robert Telford, chairman of the Assembly Committee, paid tribute to Sir Francis who had made a massive contribution to the work and development of the Council.

It was also the last Assembly for Dr Kenneth Miller, director general of the Engineering Council, who retires in spring 1988. Sir Francis thanked Dr Miller for his wisdom, guidance and dedication in shaping the path of the Council and 'serving us all so well'.

## More student engineering places

*The Engineering Council has welcomed a Government reference to a new initiative to provide more places in higher education for engineering students. Following the Chancellor of the Exchequer's Autumn Statement, the Rt Hon Kenneth Baker, Secretary of State for Education and Science, announced that as part of the increased expenditure on education and science provision would be made in 1988/89 and in later years 'for an initiative in manufacturing systems engineering' in the universities.*

The Department of Education and Science told the Engineering Council later

that they accepted that manufacturing systems engineering was an important subject which the Government wished to promote in the universities for the benefit of the national economy. The University Grants Committee are being asked to set aside funds for three years for this.

In March 1987, the Engineering Council called on the Government to provide a further 1700 additional places on first degree and postgraduate courses in engineering. The Council said the emphasis should be on broadly based first degree courses biased towards manufacturing systems engineering. The country must increase the numbers in this area, said the Council, because manufacturing systems engineering lies at the root of increasing the international competitiveness of Britain's manufacturing industry.

Sir Francis Tombs, chairman of the Engineering Council, commented: *'We are delighted that the Government is acting upon our advice. Qualified engineers are wealth creators for the British economy and the message we have received from industry is that manufacturing systems engineers are badly needed'.*

The Engineering Council said industry is prepared to support the initiative by sponsoring students on manufacturing systems engineering courses and providing them with work experience.

The Council was pleased that the National Advisory Body for Public Sector Higher Education, the funding body for the polytechnics, is also supporting this initiative and has received a very encouraging response from polytechnics wishing to start new manufacturing systems engineering courses in September 1988.

## Personal

**Sir Archibald Forster**, chairman and chief executive of Esso UK, has been appointed president-elect of the Institute of Petroleum. He will be elected president at the AGM of the Institute of Petroleum in June 1988.

**J E Lawrence** MBE has taken over as chief executive of the fire and security protection company THORN Security. This follows the recent acquisition by THORN EMI of JEL Energy Conservation Services, the company founded by Mr Lawrence in 1974 and of which he also remains chief executive.

**E A Rowland** (Member) has been honoured with a medal from the USSR for the part he played, more than 40 years ago, on the dangerous convoys to the USSR in World War II.

Mr Rowland spent most of the 2½ years that he served in this sphere of action in the cruiser *HMS Kent*. They were also engaged in shadowing the massive German battleship *Tirpitz* when she attempted to break out into the Atlantic, as *HMS Kent* had the only effective radar system in the Home Battle Fleet.

**Prof J Swithenbank** (immediate past president) has been appointed a member of the Advisory Council on Research and Development by the Secretary of State for Energy, Cecil Parkinson. ACORD advises the Secretary of State on the R&D programme funded by the Department of Energy and on the R&D programme of British Coal and the electricity supply industry.

*(continued on p 2)*

## Russian delegation 1987

A Russian scientific delegation visited the United Kingdom in November 1987, under arrangements made by the Royal Society.

Prof A A Makarov, a corresponding member of the USSR Academy of Sciences and director of the Institute of Energy Research, Moscow, visited Devonshire Street on 10 November 1987 where he was received by C E Pugh, president-elect and chairman of the International Committee and Dr H M Lodge, secretary. Also present, representing the president, was Dr R Morgan, Shell Research and honorary secretary of the British Flame Research Committee, which is based at 18 Devonshire Street.

Accompanying Prof Makarov was Dr V N Terekhin, Second Secretary (Science and Technology) USSR Embassy, London, who acted as interpreter.

Prof Makarov spoke of the work of his institute in the USSR and the work of the Institute of Energy was described by Mr Pugh and Dr Lodge. During his visit, Prof Makarov was given a copy of the Institute's policy document *Energy for the future* and a number of other publications.

It is planned through Prof Makarov to make contact with those departments of the USSR Scientific and Technology Society which are relevant to the interests of the Institute.



*C E Pugh, president-elect of the Institute of Energy (left) welcoming Prof A A Makarov to the Institute*

**M W Wesley** (Member) has been appointed a business development manager in the team forming the New Business Development Department of British Gas under the recently appointed HQ director, New Business Development, Harry Moulson. The Department is part of the Resources and New Business Division, created earlier in 1987 under managing director Chris Brierley, to pursue opportunities outside the core UK gas business.

Mr Wesley joined the gas industry in 1967 as a student engineer with the North West Gas Board. He qualified as a gas engineer and worked on a number of gas manufacturing plants before moving to the Midlands Research Station in 1964. He then spent two years researching and developing new gasification processes, spending three months in Japan commissioning the first commercial plant using the catalytic rich gas process. In 1966 Mr Wesley moved to the West Midlands Gas Board, working initially on gas manufacture and later on transmission operations.

He joined British Gas Headquarters in 1974 and occupied a number of positions in the Production and Supply, Economic Planning, Research and Development and Finance Divisions. In 1983 he was appointed head of Gas Supplies Planning in the Resources and External Affairs Division.

**Sir Frank Whittle** OM KBE CB FRS FEng, Air Commodore RAF (Retd) and a Melchett Medallist of the Institute of Energy, recently visited the United Kingdom from his home in Columbia, Maryland, USA. Best known for his work on the aircraft jet engine, Sir Frank, who is an Honorary Fellow of the Institution of Mechanical Engineers, attended the unveiling of his bust on Thursday 2 November 1987 at the Institution. Sir Francis Tombs, chairman of Rolls-Royce, unveiled the bust, which has been sculptured by Czechoslovakian Miss Jitka Sedlecka, who came to the UK in 1966.

An ante-room in the Institution of Mechanical Engineers' headquarters is to be known as the Whittle Room and will feature items associated with his career or the development of the jet engine.

## New members

### Fellow

**Anthony William Coles**, British Gas, Northern Region, Newcastle upon Tyne (transfer)

**Murray William Fischer**

**John Richard Angwin Lakey**, Royal Naval College, Greenwich, London

## South Coast:

*One-day symposium, 8 September 1988  
(see Branch Conferences above)*

## Member

**James Andrew Burrell**, NIFES

**Charles Bernard Ford**, CEGB, Heysham Power Station, Lancashire

**Geoffrey Harris**, M A Lenihan & Associates, Sheffield

**Mark Helingoe**, Grimethorpe PFBC Establishment, Barnsley, South Yorkshire (transfer)

**Jeremy Richard Lane**, British Gas, Midlands Research Station, Solihull

**Thomas Joseph McHale**, Nottingham County Council, West Bridgford

**Jeremy Mark Pierce**, British Gas, Maelor Works, Clwyd (transfer)

**Philip Frank Ray**, National Nuclear Corporation, Knutsford, Cheshire

**Alfredo Soave**, Blyth & Blyth, Glasgow (transfer)

**Paul Graham Whitfield** (transfer)

**Michael David Windsor**, Edward A Pearce & Associates, Surrey

## Graduate

**Steven John Fulcher**, Emstar, Staines, Middx

**Ernest Ping-Yam Lam** (transfer)

**Andrew John Neeves**, Universal Incineration, Leeds

**David John Smith**, Proctor & Gamble, Newcastle upon Tyne (transfer)

## Student

**Ian McGregor Dougary**, Napier College, Dunfermline

**Robert Alexander MacDonald**, Robert Gordon Institute

**Iain Robert Millar**

**Stephen James Tucker**, Polytechnic of Wales

**Kenneth Leslie Smith**, Napier College

## Institute of Energy

### 1988 Branch conferences

#### North-Western

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

#### South Coast

**8 Sept (Th)**. One-day symposium: *NO<sub>x</sub> generation and control in boiler and furnace plant*. The Crest Hotel, Southsea. In association with the Combustion Institute (UK section).

### 1988 January meetings

#### Midlands

**8 Jan (F)**. Switch over for maximum heat recovery, by Manjit Saimbi (British Gas, MRS). Pedmore House Hotel, Stourbridge. Joint meeting with Society for Glass Technology.

#### East Midlands

**11 Jan (M)**. Modern blast furnace design including energy savings and Korean experience, by C Best and N Younger (Davy McKee). Conference Centre, BSC, Scunthorpe Works. Joint meeting with North Lincs Iron and Steel Institute at 1930 h. Refreshments.

#### Merseyside sub-branch

**13 Jan (W)**. Latest techniques in building insulation, by R Wilberforce (Pilkington Insulation). Feathers Hotel, Mount Pleasant, Liverpool 3 at 1830 h.

#### Yorkshire

**13 Jan (W)**. Legal obligation of the engineer and his employer in the energy industries. Speaker to be arranged. University of Sheffield at 1930 h.

#### North-Western

**19 Jan (Tu)**. BNFL: past, present and future, by A H Derry (BNFL). Lancashire Cricket Club. At **1230 h** for 3-course luncheon (approx cost £6.50); **1400 h** for talk only. Joint meeting with CEA.

#### Scottish

**19 Jan (Tu)**. *John E Rayner lectures*. Students' evening. The John Rayner Shield to be presented by his son, *John D Rayner*. Royal Scottish Automobile Club, Blythswood Square, Glasgow at 1800 for 1830 h.

#### North-Eastern

**21 Jan (Th)**. Advanced methods of generating electricity from coal, by J S Harrison (British Coal, CRE). Neville Hall, Westgate Road, Newcastle upon Tyne at 1800 h (tea and biscuits before meeting). Joint meeting with N of England Inst of Min and Mech E.

#### Scottish

**21 Jan (Th)**. Sizewell 'B' and future prospects, by B V George (Sizewell 'B' Project Management Board). Strathclyde University at 1730 for 1800 h. Joint meeting with IMechE and IEE.

## Obituary

**Sir Henry Jones** GBE, a distinguished gas engineer, died on 9 October 1987 at the age of 81. As chairman of the then Gas Council from 1960 to 1971, Sir Henry was able to steer the gas industry from dependence on coal to a situation in which natural gas was flowing from the North Sea.

Older members of the Institute of Energy will remember Sir Henry as an honoured guest at many Institute functions.

## *Energy for the future: Liverpool (Royal Insurance), 23 and 24 March 1988*

The economic future of this country depends on energy efficiency and the type of energy sources used. As engineers of all disciplines we are unable to divorce ourselves from energy and it is essential that we plan our energy future.

The aim of this conference is to bring engineers up to date in the latest thinking in the energy field and to consider the Institute of Energy's publication *Energy for the future*. A copy of this publication is included in the conference fee.

The Merseyside and North Wales Regional Committee of the Engineering Council is providing a local initiative to deal with common national and international issues. To meet this object and to develop the complete breadth of the profession, *Energy* has been selected as the theme for the conference. The Institute of Energy has supported this initiative and has agreed the basis of the conference as being a review of the 1986 *Energy for the future* report.

Engineers from the five Engineering Council Executive Groups and the Merseyside and North Wales Engineering Council Regional Organisation met together with Institute of Energy members to arrange the conference on *Energy for the future*, which is a topic common to all engineering disciplines.

### *Conference aims*

To identify current and future trends in energy consumption, conservation and technical developments.

To provide an opportunity for delegates to be informed of such trends and contribute to the issues by discussion and syndicate work.

To provide the opportunity for continuing education and training.

To formulate the basis of a report on the conference issues to the Government, the engineering profession and other bodies.

See this issue of *Energy World* for programme and application form.

## *Proposal for new Special Interest Group*

A J Powell (Associate) would like to start a Special Interest Group in order to assimilate information and advise on the *Thermal insulation potential and negative aspects of growing self-clinging climbing plants up walls*.

It seems evident that some insulation benefit can be gained, for perhaps very little expenditure, through growing such plants up walls, as a result of reductions in the wind velocity at the wall surface due to the increased stagnant layer and radiation. The bulk of the expenditure may be through treating the wall (pointing, a coat of silicone waterproofer) to avert any adverse effects.

Three types of plants are possible candidates:

1. *Ivy (Hedera spp)*: evergreen, giving maximum radiation reduction. Clings by roots and bushes out from the wall when mature, giving a thick layer of still air.
2. *Virginia creeper and Boston ivy (Parthenocissus spp)*: deciduous, with good autumn colour; clinging by little suckers so not likely to cause as much damage, especially as the plant does not bush out like the others.
3. *Hydrangea petiolaris and allies*: deciduous, clinging by roots and bushing out when mature, flowering attractively.

Questions to be considered include:

*Will the plant damage the wall?*

*What is the value of the insulating effect?*

*Will the underground roots have a detrimental effect?*

*Will silicone waterproofer be needed to prevent the wall becoming damp? Will the plant still hold?*

*Merits and disadvantages with cavity wall insulation?*

*Are any management measures necessary, eg pruning?*

*How fast do they grow, and what area will they cover?*

*What are their environmental limits?*

*What are the overall costs?*

Some feedback from any member with any experience of these plants would be most welcome. Please write to A J Powell, 2 Wallace Street, Castle, Northwich, Cheshire CW8 1BX.

## *High- and low-temperature insulation for operational plants:*

### *VDI-Society Energy Engineering, Hanover, 24 and 25 February 1988*

The conference will deal with the present state of insulation methods for heat and cold, with new developments and perspectives for the future, especially in relation to:

1. Social-political, technical and economical importance of heat and cold insulation.
2. VDI-standards (Richtlinie 2055), further standards and charts, importance of quality control of insulation material.
3. Insulation materials and systems, measuring and calculation values of heat transmission, auxiliary and erection materials.
4. Examples of modern installations of heat and cold insulation plants, corrosion prevention.

Further information from VDI-Gesellschaft Energietechnik (VDI-GET), Postfach 1139, D-4000 Düsseldorf 1, FRG (tel (0211) 62 14-363).

## *British Flame Days 1988: London (Imperial College), 12-13 Sept 1988*

Contributions are invited for this conference on *Furnace combustion research and its applications* organised by the British Flame Research Committee.

Speakers already invited include:

*Dr H J A Hasenack (head of Thermal Engineering, Shell Research); Dr J Holmes (head of Power Generation, Coal Research Establishment); Dr C J Lawn (head of Fluid and Chemical Engineering, CEGB); Dr T M Lowes (energy manager, Blue Circle Cement), and Prof A Williams (head of Dept of Fuel and Energy, University of Leeds).*

Intending contributors should send an abstract (< 250 words) to Ms S L Dorrell, British Flame Research Committee at the Institute of Energy, 18 Devonshire Street, London W1N 2AU, by 1 February 1988. Acceptances will be mailed to authors by 30 April 1988.

Contributions may take the form of papers for oral presentation, poster displays of work in progress, videos and other forms of display.

## *Electricity in the paper and board industry:*

### *Colloquium, Manchester, 28 January 1988*

This one-day colloquium will be held at Old Trafford, Manchester on Thursday 28 January 1988, organised by the Power Division, PGP4 Committee (Industrial Applications).

(continued on p 2)

### *Special announcements (continued)*

and Processes), Institution of Electrical Engineers.

The colloquium is the tenth in the current series of one-day colloquia being organised by PGP4, featuring electricity utilisation in discrete sectors of UK industry. The colloquium will examine a range of electrical production processes which are having a significant impact on paper and board manufacture by contributing towards substantial improvements in productivity, product quality, working conditions, and energy efficiency.

The morning session (starting at 1000 h) covers papers on electromagnetic drying and finishing, including developments in infrared and dielectric heating; the development and application of steam compression heat pumps for drying paper webs, which can offer substantial cost benefits over conventional steam cylinder drying; the scope for improved energy efficiency of motor drives, by the application of voltage controllers and frequency inverter systems.

The afternoon papers will describe the development of process integration and how the concept influences overall energy demand patterns, including combined heat and power (CHP); a typical case study on steam and power consumption in paper making; the interpretation of the 1983 Energy Act and its impact on potential CHP projects in paper making. Further information from Institution of Electrical Engineers, Savoy Place, London WC2 (tel 01-2401871 ext 272).

### *Desulphurisation for coal processing systems: University of Sheffield, 20-22 September 1988*

The control of sulphur dioxide emissions from the combustion of fossil fuels and of coal in particular has long been of concern because of its effect on the environment. In Europe and throughout the world, legislation to limit the amount of SO<sub>x</sub> emissions from the utilities as well as the industrial sector is becoming increasingly stringent. The implications of this on the many inter-related and inter-active issues associated with coal combustion form the basis of this first European conference and exhibition on *Desulphurisation for coal processing systems*, organised by the Institution of Chemical Engineers.

The main topics in the proposed programme will be: *coal beneficiation; utility boiler applications; their extension to industrial units; operational experience, including choice of materials, effluent disposal and other associated problems; legislation and economics; and future trends, including current research.* Contributions are invited on these and related topics

by intending authors, who should submit a 300 word abstract by 15 January 1988 to the IChemE Conference Section, 165-171 Railway Terrace, Rugby, Warwickshire CV21 3HQ (tel (0788) 78214; tlx 311780; fax (0788) 60833). It is planned to publish the papers in the IChemE Symposium Series and distribute the preprints to delegates before the conference. Intending authors should note that all abstracts and papers will be refereed and that draft manuscripts will be required for this purpose by 18 March 1988.

### *Developments in power station protection, University of Edinburgh, 11-13 April 1989*

This fourth international conference is organised by the Power Division of the Institution of Electrical Engineers in association with the Institution of Electrical and Electronics Engineers Inc (United Kingdom and Republic of Ireland section). The aim of the conference is to discuss the design, application and performance of power system protection and monitoring equipment in the fields of generation, transmission, distribution, and industrial systems, with particular reference to recent developments and future trends.

Further information from Conference Services, IEE, Savoy Place, London WC2R 0BL.

### *BSI Testing offers product compliance*

Many product advertisements contain the statement 'complies with British Standard No. . . .'. These statements are generally unilateral claims made by the manufacturer or supplier. They do not have the backing of BSI's own Testing or Quality Assurance Services.

BSI Testing, Hemel Hempstead, is offering to provide backing to such claims where successful testing has taken place, so that manufacturers can add the words, 'a sample of this product has been passed by BSI Testing as complying with the relevant British Standard (BS ...). Report No. ... refers', in support of their product marketing.

This is a new BSI Testing service, in addition to the testing in support of a number of Quality Assurance schemes including BSI's own Kitemark. It is intended to increase the value of a BSI Test Report. If interested manufacturers or their agents wish to discuss ways in which they can use the BSI statement they should contact Robin Dandy, assistant director, BSI Testing on (0442) 230442.

□

## *Conference notice*

# **Gasification: Status and Prospects**

To be held at the Birmingham  
Metropole Hotel on 25-27 April 1988

For further information  
telephone 01-580 0008

# CONFERENCES

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

## January 1988

### Hydraulic transportation of coal and other minerals

International symposium, Bhubaneswar (India), 20-22 January 1988. Details from Dr J S Murty, convenor ISHT 88, Regional Research Laboratory, Bhubaneswar 751 013, India.

## February 1988

### World coal conference

Sixth annual conference, New Orleans (USA), 10-13 February 1988. Details from MVCEC, 1013 World Trade Centre, New Orleans, Louisiana 70130, USA (tel (504) 566-1001).

### Energy from biomass and wastes Conference, New Orleans (USA), 15-19 February 1988.

Details from Susan Robertson, Inst of Gas Technology, 3424 South State Street, Chicago, Illinois 60616, USA.

### Mineral matter and ash deposition from coal

Conference, Santa Barbara (CA, USA), 21-26 February 1988. Details from Engineering Foundation, 345 East 47th Street, New York, NY 10017, USA (tel (212) 705-7835; tlx 126022).

### Radioactive waste management

Conference, London (Cafe Royal), 25 and 26 February 1988. Details from Miss Louise Marriott, IBC Technical Services, 3rd Floor, Bath House, 56 Holborn Viaduct, London EC1A 2EX (tel 01-236 4080; tlx 888870).

## March 1988

### International approach to nuclear safety

Conference, Verdala (Malta), 1-4 March 1988. Details from Mrs R Campbell (tel 0925 31244 ext 4243/4324).

### Recent developments in domestic coal-fired appliance design

COMA evening meeting, Orgreave, 10 March 1988. Details from R K Smart, chairman, Midlands section, Coke Oven Managers' Association, 35 Woodview Close, Wingerworth, Chesterfield S42 6XG (tel (0246) 77474).

### Severe accidents in nuclear power plants

International symposium, Sorrento (Italy), 21-25 March 1988. Details from Department of Energy, Atomic Energy Division, Thames House South, Millbank, London SW1P 4QJ (tel 01-211 6850).

## April 1988

### Air and water pollution

International conference, Stockholm (Sweden), 11 and 12 April 1988. Details from Dr V M Bhatnagar, Alena Enterprises of Canada, PO Box 1779, Cornwall, Ontario, K6H 5V7, Canada (tel (613) 932-7702).

## May 1988

### Research in thermochemical biomass conversion

International conference, Phoenix (Arizona, USA), 2-6 May 1988. Details from (USA) Jim Kuester, Department of Chemical and Bio-Chemical Engineering, Arizona State University, Tempe, Arizona 85287, USA (tel 602 965-3313; tlx 165878 COLL ENG TMPE; fax 602 965-2012); (UK) Tony Bridgwater, Department of Chemical Engineering and Applied Chemistry, Aston University, Birmingham B4 7ET, UK (tel 021-359 3611; tlx 336997 UNIAST G; fax 021-359 7358).

### FBC technology for utility applications

Seminar, Palo Alto (CA, USA), 3-5 May 1988. Details from Maureen Lenihan, EPRI, PO Box 10412, Palo Alto, CA 94303, USA (tel (415) 855-2127).

### Improving productivity in European Community's coal mines

Information symposium, Luxembourg, 4-6 May 1988. Details from P P Rotondo, CCE, DG XIII - C2, L-2920 Luxembourg (tel 4301-3166).

### Powder and bulk solids

Conference and exhibition, Rosemont (IL, USA), 9-12 May 1988. Details from A S Goldberg, programme chairman, Powder Advisory Centre, PO Box 78, London NW11 0PG (tel 01-455 0011; tlx 8954242 POWDER G).

### Atmospheric ozone research and its policy implications

US-Dutch international symposium, Nijmegen (The Netherlands), 9-13 May 1988. Details from Registration and Information Centre (RIVM), Mrs O van Steenis, PO Box 1, 3720 BA Bilthoven, The Netherlands.

### Environmental pollution, chromatography and spectroscopy

European conference, Düsseldorf, Federal Republic of Germany, 12 and 13 May 1988.

## May 1988 (continued)

Details from Dr V M Bhatnagar, Alena Enterprises of Canada (see address above).

### Process technology for the clean use of fossil fuels

Conference, London, 13 May 1988. Details from P W Sage, Environmental Control Branch, British Coal - Coal Research Establishment, Stoke Orchard Cheltenham GL52 4RZ (tel (0242) 673361; tlx 43568 CBCRE G; fax (0242) 672429).

### Coal science

Third Australian conference, Adelaide (Australia), 16-18 May 1988. Sponsored by the Australian Institute of Energy. Details from Dr P K Agarwal, Department of Chemical Engineering, University of Adelaide, GPO Box 498, Adelaide, SA 5001, Australia (tel (08) 228 5445; tlx UNIVAD AA 89141).

### Biotechnology for chemicals and fuels

Tenth symposium, Gatlinburg (TN, USA), 16-20 May 1988. Details from Dr Charles D Scott, Oak Ridge National Laboratory, PO Box X Oak Ridge, TN 37831, USA (tel (615) 574-6775).

## August 1988

### Heavy crude and tar sands

International conference, Edmonston (Alberta, Canada), 7-12 August 1988. Details from Dr D A Redford, 500 Highfield Place, 10010 - 106 Street Edmonston, Alberta, Canada T5J 3L1 (tel (403) 427-7624).

## September 1988

### Aviation turbine fuel specification

MoD seminar, Bath (Assembly Rooms) 19-21 September 1988. Details from Dr E M Goodger, School of Mechanical Engineering, Cranfield Institute of Technology, Cranfield Bedford MK43 0AL (tel Bedford (0234) 750111 ext 2337/2300; tlx 825072).

### Courses (overseas)

*Solid-liquid separation*, Amsterdam (The Netherlands), 5-8 April 1988.  
*Bulk powder testing*, Amsterdam (The Netherlands), 11 and 12 April 1988.  
*Two-phase separation with cyclones*, Amsterdam (The Netherlands), 13-14 April 1988.  
Details of all three courses from Dr I Svarovsky, deputy chairman, Postgraduate School of Studies in Powder Technology, University of Bradford Bradford, West Yorkshire BD7 1D1 (tel (0274) 733466 ext 378 or 380; tlx 5130 UNIBFD G).