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Personal viewpoint

Privatisation and the independent electricity producer

Limited as they are by pragmatism and the desire for early implementation, the Association of Independent Electricity Producers (AIEP) generally welcomes the Government's proposals for privatising the electricity supply industry (ESI) in England and Wales. Following the failure of the 1983 Energy Act to induce any significant new independent entry into the industry the proposals for England and Wales offer another chance to legislate and regulate in favour of a competitive market in electricity generation. However, with no attempt to separate monopoly distribution activities from generation the proposals for Scotland would seem to offer little chance of encouraging independent competitive generation for customers north of the border.

The present situation is that only 4.7% of the electricity generated in Great Britain is produced outside the state boards, the United Kingdom Atomic Energy Authority (UKAEA) and British Nuclear Fuels (BNFL). Most is used by the producers and only 0.28% of electricity sold by the boards is purchased from independent generators. With the present monopoly of the ESI in areas where this is unnecessary there is little evidence, from present trends, that independent operation will realise the potential identified by Sir Frank Layfield, in his Sizewell Report, of providing capacity equivalent to five Sizewells (5.0 GW) by the year 2000. The test of the Government's privatisation proposals will therefore be whether they stimulate the construction and operation of this level of capacity, or more, by the independent sector, using a diverse range of technologies to improve security of supply. The independent producer should be defined as the entrepreneur outside a privatised ESI.

The two companies to be formed from the CEGB will have huge capital assets, acquired at around 40% of their real value. The Scottish boards will also be sold at knock-down prices, with the added benefit of considerable over-capacity to help keep independents at bay for years. Of added significance is the fact that the ESI's assets have all been secured with below market money rates. This has been decisive in restricting competition from the independent.

Following privatisation, the other major player in the generation game will be France, where the highly centralised government owned company is all set to dump artificially low priced electricity on to the British market. Electricité de France is confronted with a spectacular, and still growing, over-capacity, as well as a phenomenal long-term debt (around $22 billion) and already has a link with the UK mainland.

The rather massive silver spoon benefits to be inherited at birth by the new generating companies in Great Britain, together with the French connection and the abandonment of market forces as far as nuclear power is concerned, is bound to create difficulties for the independent producer, particularly with the monopoly distribution companies racing to become power boards in their own right. Establishing a high profile director general of Electricity Supply with effective powers to positively promote competition will, therefore, be paramount in determining the future contribution of the entrepreneur generator.

AIEP members are hopeful that the lessons of the largely discredited 1983 Energy Act, and the inadequacy of previous privatisation regulation, has convinced the Government that fine words and good intentions are not enough to curb the corporatist, monopolistic and predatory instincts which flourish so easily in the state sector and are frequently carried through to the private sector boardrooms.

With this in mind, ESI privatisation legislation has to be unequivocal on the issue of pricing transparency, as well as the market opportunities for the independent producer. This need for transparency in connection with tariffs is now belatedly recognised in the case of British Gas. The director general of Ofgas, said recently that 'In order to enable potential competitors to judge their chances of success in the market and to avoid being squeezed by predatory pricing, it would be desirable if British Gas's pricing policy was more transparent, more consistent and more logical'. The fact that British Gas's virtual monopoly on supplying natural gas is still in place two years after privatisation clearly points to inadequate legislation in respect of that flotation.

However, it is a little worrying that even where legislation is in place to guard against predatory pricing, a dominant incumbent will still prevail over an unenthusiastic regulator. This is seen from the Government's own failure to act as an effective regulator in connection with the 1988/89 Energy Act tariffs which are to be published at the end of this month by electricity boards in England and Wales. These will further discount the net payments to the independent producers which are already some 23% less than area boards pay the CEGB.

Last autumn, at the request of the Department of Energy, the ESI commissioned an independent study of the CEGB's Bulk Supply Tariff. The ESI has refused to disclose the findings of the study on the grounds of commercial confidentiality. This is in spite of the fact that the ESI is an effective monopoly. It is hard to accept that a monopoly of any kind should be able to maintain a secret formula for arranging its tariffs.

Given the need for a powerful regulator to subject these sort of issues to rigorous public scrutiny when the ESI is privatised, the failure of the Government to set an early example on behalf of the independent generator must be regarded as highly disturbing in the run up to privatisation.

G W Rufford
Chairman, Association of Independent Electricity Producers

European industrial energy consumption

A study entitled *European industrial energy consumption: historical trends and prospects to 1995** has been published. It provides an analysis of energy consumption in 10 industrial sectors for four European countries (Europe 4): France, West Germany, Italy and United Kingdom. The sectors covered were: iron and steel, chemicals (energy use), chemicals (non-energy use), non-ferrous metals, non-metallic minerals, pulp, paper and printing, food, drink and tobacco, machinery and transportation equipment, textile and leather, other manufacturing

Booming industrial activity

After a zero growth over the period 1979-1985, the aggregate production index of the manufacturing industry is projected to grow at a compound rate of 25% pa over the period 1985-1995. Growth is particularly strong in the late 1980s with a compound growth rate of 2.7% pa, and then slows down to 2.3% pa in the 1990s. Performance is not uniform across sectors. However, nearly all sectors register positive growth of their output, the exception being the iron and steel sector. This positive growth is essentially the outcome of our assumptions of no major slowdown in the economies of the four major European countries over the next decade. The explanation of the ranking of sectors according to their compound growth is to be found in their response to the dramatic shock imposed by the 1986 oil price collapse. The oil price decline translated into a fall in all prices though, not in a proportional way. Preliminary indications are that European manufacturers did not fully pass on to consumers the benefit of the drop in the oil price. It is however assumed in our forecast, that they will progressively do so, in order to retain market share in the face of competition from abroad (Table 1).

The essential features that have emerged are:

- Being energy intensive is not sufficient to be in the winners' league: for instance, the iron and steel, and the pulp, paper and printing industries are among the slowest growing sectors.
- High-tech industries (office and data processing machines, electrical engineering) take an ever increasing leadership position and are the main source of growth for the machinery sector. A fairly healthy growth rate is also projected for transport equipment.
- Being energy intensive, on the other hand, helps some sector performance while introducing cyclical behaviour. For instance, non-metallic minerals, and non-ferrous metals are all in the league of rather high growth in the next three years, while their output performance is substantially reduced over the last part of the forecast horizon when the increase in the price of energy resumes.
- Traditionally fast increasing industries are hampered by international competition. This is particularly true of the chemical industry, which was among the fastest growing industries in the seventies and well into the first part of the eighties. Despite its heavy reliance on petroleum, the reduction in cost has not been sufficient to compensate for a relative slowdown of domestic demand accompanied by a surge in imports from the Middle-Eastern petrochemical concerns.
- Some sunset industries will recover thanks to the consumption boom. This is particularly the case for the Italian clothing and footwear industry.

Table 1: Output performance of industrial sectors in Europe 4 (compound growth rate)

	1979-85	1985-95
Machinery and transport equipment	+ 1.2%	+ 3.7%
Non-metallic minerals	− 1.6%	+ 3.2%
Non-ferrous metals	− 0.5%	+ 2.9%
Textile and leather	− 1.2%	+ 2.4%
Chemicals	+ 1.2%	+ 2.1%
Food and tobacco	+ 0.9%	+ 2.0%
Paper, pulp and printing	+ 0.7%	+ 1.6%
Iron and steel	− 2.1%	− 0.5%
Manufacturing Average	**+ 0.6%**	**+ 2.5%**

A steady recovery in industrial energy consumption

After declining by 20% between 1979 and 1985, industrial energy consumption in the four major European economies is projected to increase 1.2% pa in the decade 1985-95. Growth is expected to be stronger in the late 1980s, as falling energy prices provide an additional stimulus to energy consumption (in addition to growing production volumes) (Fig 1).

All fuel prices fall in the first two years of the forecast and increase only moderately in the late 1980s. Energy costs for most industrial sectors are therefore projected to decline in real terms until 1990, and then to increase approximately 1.5% pa in real terms in the early 1990s. Energy costs start increasing more rapidly in the mid-1990s (at the end of the forecast period). Therefore, growth in industrial energy consumption is expected to slow down considerably in the mid-1990s to around 0.5% pa (Table 2).

As might have been expected from the output performance ranking, the sector registering the strongest growth (when feedstocks are excluded) is machinery and transport equipment, with a compound growth rate in energy consumption of 2.7% over the forecast period. However this sector is the least energy intensive and, although it accounts for almost 30% of Europe 4 industrial output, it accounts for only 12% of European industrial energy consumption. Its share of European industrial energy consumption is expected to increase to 14% over the forecast period. The next two strongest sectors, in terms of energy consumption growth, are non-metallic minerals and non-ferrous metals, two energy intensive sectors. The only sector where energy consumption is projected to decline is iron and steel. It is the most energy intensive

* The study was produced by DRI Energy, European Energy Service, 13 rue du 4 Septembre, 75002 Paris, France

sector and the largest sector in terms of levels of energy consumption (26% of European industrial energy consumption in 1985) (Table 3).

Consumption of feedstocks, which already recovered strongly in 1983/84 a recovery that nearly completely compensated the decline of the early 1980s, is projected to increase 2.2% pa over the forecast period. Growth is particularly strong in the second half of the 1980s, when feedstocks costs fall rapidly and the base chemical industry enjoys a strong recovery in Germany and France (production of base chemicals increases 3% pa in those two countries). Growth slows down to 1.8% pa in the first half of the 1990s.

Energy intensity of European industry continues to decline

Industrial energy consumption increases less rapidly than industrial production, indicating a continued decline in the overall energy intensity of industry. The energy intensity of the European industrial sector, which declined 20% between 1979 and 1985, is projected to decline by a further 10% between 1985 and 1995 (Table 4).

Several factors are responsible for the decline in the overall energy intensity of industry: changes in the product mix (structural effect); technological changes that result in the use of more efficient processes (technological effect).

In history, the main cause of the decline in energy intensity has been technological change. The forecast period can be divided into two:

- In the late 1980s, low energy prices do not encourage improvements in energy efficiency. The energy intensity is virtually stagnant in all sectors (or only slightly declining). There is even a small and temporary increase in two energy intensive sectors, iron and steel and chemicals (including feedstocks). However, those two energy intensive sectors are relatively depressed during that period (compound growth rates in output lower than the manufacturing average). Therefore, the structural effect results in a decline in the overall energy intensity of industry.
- In the first half of the 1990s, increasing energy prices induce energy conservation investments and the energy intensity declines in all sectors. The technological effect becomes predominant.

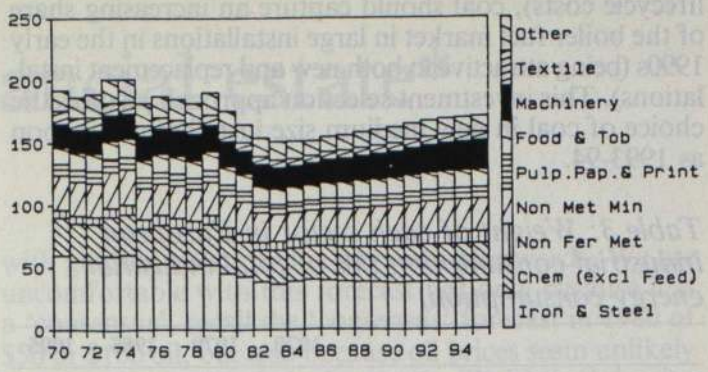

Fig 1: Energy consumption by sectors (Mtoe)

Poor prospects for coal in the boiler fuel market until the 1990s

Approximately 40% of industrial consumption of energy is believed to be used in boilers (50% if the iron and steel sector is excluded). This is also the sector where competition across fuels is most intense.

The choice of boiler fuels depends on the capital costs of the boilers, fuel prices (and fuel price expectations), annual load factors, non-fuel operating and maintenance costs, the size of the unit, the type of installation (new or replacement), and the decision criteria used by industry. For most industries, boiler investments are not considered 'mainstream' investments and industry uses simple payback methods to evaluate such investments, seeking short payback periods.

Under most plausible oil and coal price scenarios, coal should not be selected as a boiler fuel in new installations or in replacement of oil until the mid-1990s, if a two year payback is required. If a three year payback is acceptable, coal should become attractive in new large boiler installations (20 MW or more) in the early to mid-1990s, and in new medium size installations (5-10 MW) after 1995 (Table 5).

If a more sophisticated investment appraisal method is used, taking into account future price levels (such as

Table 2: Energy consumption by sector

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Iron & steel	51999	45351	42690	38229	36431	38774	39865	39347	38543	38132	37895	37636	37895	38019	37792	37765	37887
% Change	6.0	−12.8	− 5.9	−10.5	− 4.7	6.4	2.8	− 1.3	− 2.0	− 1.1	− 0.6	− 0.7	0.7	0.3	− 0.6	− 0.1	0.3
Chemical	71140	65009	62471	58425	62816	64728	64933	65909	66988	68460	69827	71731	73437	75419	76459	77620	78554
% Change	11.4	− 8.6	− 3.9	− 6.5	7.5	3.0	0.3	1.5	1.6	2.2	2.0	2.7	2.4	2.7	1.4	1.5	1.2
of which feed	38496	35647	34820	32827	35520	38079	38011	38433	39751	40829	41874	43177	44153	45398	46000	46822	47456
% Change	16.9	− 7.4	− 2.3	− 5.7	8.2	7.2	− 0.2	1.1	3.4	2.7	2.6	3.1	2.3	2.8	1.3	1.8	1.4
Non-fer metals	7331	7041	6672	6227	7034	7192	7488	7541	7776	8056	8292	8511	8728	8891	9027	9157	9270
% Change	3.0	− 4.0	− 5.3	− 6.7	13.0	2.2	4.1	0.7	3.1	3.6	2.9	2.6	2.6	1.9	1.5	1.4	1.2
Non-set minerals	26523	25718	25569	23855	21782	21435	21163	22039	22469	23395	24027	24491	25174	25735	26565	26469	26548
% Change	4.4	− 3.0	− 0.6	− 6.7	− 8.7	− 1.6	− 1.3	4.1	2.0	4.1	2.7	1.9	2.8	2.2	3.2	− 0.4	0.3
Pulp & paper	9282	8865	8327	8005	7700	7893	7993	8353	8404	8504	8581	8692	8784	8849	8876	8870	8830
% Change	3.4	− 4.5	− 6.1	− 3.9	− 3.8	2.5	1.3	4.5	0.6	1.2	0.9	1.3	1.1	0.7	0.3	− 0.1	− 0.4
Food & tobacco	15323	14775	14174	13281	12625	12454	12361	12868	13099	13302	13467	13670	13880	14109	14299	14442	14531
% Change	6.4	− 3.6	− 4.1	− 6.3	− 4.9	− 1.4	− 0.7	4.1	1.8	1.5	1.2	1.5	1.5	1.6	1.3	1.0	0.6
Machinery	20996	20008	18339	17411	16939	17010	17736	18579	19181	19681	20258	20803	21579	22107	22497	22914	23216
% Change	− 1.2	− 4.7	− 8.3	− 5.1	− 2.7	0.4	4.3	4.8	3.2	2.6	2.9	2.7	3.7	2.4	1.8	1.9	1.3
Textile	8327	7562	7000	6322	6197	5702	5916	6212	6338	6477	6562	6628	6723	6782	6828	6805	6754
% Change	− 0.8	− 9.2	− 7.4	− 9.7	− 2.0	− 8.0	3.7	5.0	2.0	2.2	1.3	1.0	1.4	0.9	0.7	− 0.3	− 0.8
Other	17962	16792	14130	14971	15016	14270	11971	12162	12275	12519	12681	12869	12911	12902	12951	12942	13005
% Change	10.6	− 6.5	−15.9	5.9	0.3	− 5.0	−16.1	1.6	0.9	2.0	1.3	1.5	0.3	− 0.1	0.4	− 0.1	0.5
TOTAL Excl. Feed	190388	175476	164551	153898	151021	151379	151415	154576	155322	157697	159717	161855	164957	167415	169295	170161	171138
% Change	4.7	− 7.8	− 6.2	− 6.5	− 1.9	0.2	0.0	2.1	0.5	1.5	1.3	1.3	1.9	1.5	1.1	0.5	0.6
TOTAL Incl. Feed	228884	211123	199372	186725	186541	189458	189426	193010	195073	198526	201591	205032	209110	212813	215294	216983	218594
% Change	6.6	− 7.8	− 5.6	− 6.3	− 0.1	1.6	0.0	1.9	1.1	1.8	1.5	1.7	2.0	1.8	1.2	0.8	0.7

lifecycle costs), coal should capture an increasing share of the boiler fuel market in large installations in the early 1990s (being attractive in both new and replacement installations). This investment selection approach justifies the choice of coal in new medium size installations as soon as 1993-94.

Table 3: Weight of each sector in European industrial consumption (% of total industrial energy consumption)

	1970	1979	1985	1995
Iron and steel	31.0	27.3	26.3	22.2
Chemicals, excluding feedstocks	15.9	17.1	17.8	18.0
Non-ferrous metals	3.2	3.9	4.9	5.4
Non-metallic minerals	14.5	13.9	14.0	15.5
Pulp and paper	4.7	4.9	5.3	5.2
Food and tobacco	7.0	8.0	8.2	8.5
Machinery	9.6	11.0	11.7	13.6
Textile	5.6	4.4	3.9	4.0
Other	8.5	9.4	7.9	7.6

Coal should recover market share in the 1990s

Coal was the dominant boiler fuel (and industrial fuel) in the early 1960s. It was backed out of the industrial sector first by oil in the 1960s, and then by oil and gas in the 1970s. The two oil shocks induced a recovery in coal consumption and coal share in the early 1980s. The 1986 oil price collapse has halted coal's revival.

The share of coal in industry (excluding iron and steel), which had fallen to less than 7% in the late 1970s, recovered to over 13% in 1985. It is believed to have declined to 11% in 1986 and is projected to stagnate at 9.5-10% in the late 1980s. Coal should regain market share in the 1990s as it becomes attractive again in large boiler installations. Coal's share is projected to recover to 15% by the mid-1990s. Coal's penetration should be largest in those sectors that have large steam raising requirements, with continuous loads (pulp and paper, and chemicals), and in non-metallic minerals, where coal has inherent advantages in cement production.

Table 4: Energy intensity by sector (Mtoe per trillion 1980 ECU)*

	1979	1985	1995	Variations 79-85	85-90	85-95
Iron and steel	672	586	585	−13%	+0.5%	0%
Non-metallic minerals	459	402	368	−12%	− 3%	− 9%
Chemicals (including feedstocks)	391	333	327	−15%	+ 1%	− 2%
Non-ferrous metals	289	303	282	+ 5%	− 2%	− 7%
Chemicals (excluding feedstocks)	180	138	129	−23%	− 3%	− 7%
Pulp and paper	135	111	105	−18%	− 2%	− 5%
Textile	77	59	53	−23%	− 3%	−10%
Food and tobacco	69	53	51	−23%	0%	− 4%
Machinery	54	42	38	−22%	− 3%	− 9%
Average industry	**161**	**131**	**121**	**−20%**	**− 3%**	**−10%**

* Sectors are ordered in decreasing order of energy intensity.

Table 5: Breakeven differential between heavy fuel oil and coal prices for the installation of a coal boiler (1985 $ per toe)

	Two-year payback	Three-year payback
5 MW/Utilisation: 3500 hours per year		
New	79	58
Replacement*	102	73
Premature replacement**	130	92
20 MW/Utilisation: 5000 hours per year		
New	63	47
Replacement*	83	60
Premature replacement**	122	86

* Replacement of an oil boiler by a coal boiler at the end of its life.

** Replacement of an oil boiler by a coal boiler before the end of its life.

Energy Industries Luncheon Club

The powers of the financial estate*

Steven Parla†

In preparing to discuss the Wall Street view of oil and gas events I reviewed a file of energy-related newspaper clippings which I keep in my office, and came across some interesting headlines. *'It's OPEC's turn to worry over oil supplies'* said one, *'Saudi role in OPEC under siege'* declared another, *'OPEC confronts deep split in ranks'* proclaimed a third. These headlines probably sound quite familiar to you, as well they should. In fact, the only surprising thing about them at all is that these headlines are from 1981! Indeed, looking at the late 1970s/early 1980s with perfect 20/20 hindsight, one can only wonder how OPEC managed to defy gravity, not to mention the basic economic forces of supply and demand, for so long. After allowing world oil prices to double in 1979, and witnessing the onset of new non-OPEC oil supplies and an enormous world conservation effort, OPEC awoke to the realisation that oil prices were elastic after all. In fact the only surprise regarding the oil price crash of the 1980s is that it took until 1986 to occur.

After engineering what is probably the greatest transfer of wealth in world history during the 1970s, OPEC in 1979 made the huge strategic blunder of allowing oil prices to rise to the point at which the development of new supplies and conservation induced demand decreases caused its demise. The eternal conflict within OPEC continues to centre around Saudi Arabia, which as you know, controls not only a majority of OPEC's productive capability but also a majority of proven reserves in the ground. With a 100 year reserve life index, and a relatively small population, the Saudis' best interests are served by price restraint, so as not to diminish the world's long-term appetite for oil. Conversely, the price 'hawks' within OPEC, with only a 20 year reserve life and much larger populations, have an urgency to extract the highest current price possible. In addition, the Saudis must balance their role as 'swing' producer with critical considerations in the turbulent Middle East.

These long-term market considerations, together with growing impatience in being OPEC's sole 'swing' producer, led the Saudis to flood world oil markets in late 1985. Thus, using the highly regarded Sheik Yamani as the 'scapegoat', the Saudis engineered the 1986 oil price collapse to slow the development of competing energy supplies, to preserve world oil markets for the long-term, and to signal its refusal to be the sole swing supplier within OPEC.

Just as the pre-crisis oil price of $2 per barrel was too low, the $40 per barrel oil price of 1981 was too high, lacking economic justification. The simple fact is, oil prices have never been determined by market forces alone. Even today's oil price of $18 per barrel, a level at which the world seems comfortable, only represents the short-term equilibrium of OPEC production restraint and current political and economic considerations.

What of the future, in which oil will play a critical role in determining the price of almost all energy forms and related commodities? Well, the 'consensus' forecast is for $18-20 per barrel oil for the next one to two years, with gradual inflation-like increases afterwards. We are uncomfortable with this forecast not only because it is a 'consensus', recall the 'consensus' forecast in 1980 of $50 or $100 oil, but also because oil prices seem unlikely to move in a smooth path, given oil's historical price volatility. Despite this discomfort, we are unable to offer a more plausible scenario. Always a hazardous activity, a forecast of future oil pricing requires answers to the following questions:

- Can the OPEC countries overcome 1000 years of hatred and cooperate to the benefit of their own economic interest?
- What will become of the current hostilities between Iran and Iraq?
- What further military action will take place in the Persian Gulf?
- What changes will be made to enhance the economics of oil exploration and development here and in other parts of the world?
- What will be the course of economic growth?
- What will be the future effects of continued conservation?
- What effect will currency have on OPEC's purchasing power?

Having no answer to these questions, I expect that for planning and investment purposes you should count on near-term stability (the memory of $10 oil remains fresh in OPEC's mind) and further price increases in the 1990s.

In the near-term oil prices will remain a function of OPEC production restraint, Persian Gulf military activity, and the transfer of oil price control to speculative financial markets. Oil futures, representing the collective expectation of investors and speculators, will continue to be a major determinant of oil prices, at least in the near and intermediate term.

Longer-term, inevitable production declines in non-OPEC countries and modest 1-2% annual free-world consumption increases, suggest OPEC will once again regain control of oil pricing at some point in the 1990s. The free-world can only hope that OPEC remembers the lesson of 1979 and exercises price restraint. For when the oil shock of the 1990s comes upon us, there may be no North Sea, no Prudhoe Bay and little incremental conservation to fall back on. We can only hope and pray that the UK, US and other governments have the foresight to realise this and the political will to prepare for it.

Thus, while the industry and investors can plan on future oil price increases, we are reduced to guessing meekly as to the timing. From a Wall Street perspective, the energy stock rally of 1987 clearly signals an end to the secular downturn in energy which began in late 1980 – from this you should take comfort. Reflecting this strong performance it is my personal view that most of the near-term improvement in oil/energy pricing has been discounted, though energy stocks remain attractive for the intermediate term.

In the US market, where merger and acquisition activity has been dealt a significant blow due to the October market fall, activity in the energy area had already cooled considerably from the hectic pace of a

* Presented to the Energy Industries Luncheon Club at the Connaught Rooms, London on 17 November 1987

† Vice-president, Investment Research Department, Goldman Sachs

few years ago. Continued merger activity in the energy area still seems possible, if not likely. Yet the fall of oil and gas prices, the high debt absorbed by acquiring companies and anti-takeover sentiment in the US Congress, all argue for diminished takeover activity in the future. The grandest irony of all in the merger area involves Texaco and Pennzoil, where Pennzoil has won a $10 billion judgement against Texaco, the company which did Pennzoil the huge favour of preventing them from purchasing Getty Oil before the oil crash of 1986!

Investors with insight might also take a clue from T Boone Pickens, the well-respected architect of many oil company mergers. His recent lack of activity in the oil area suggests to me that he sees little near-term value in major US oil companies at current price levels. Why else would he now hold positions in mining and defence companies, given his past success as a raider in the oil patch? Overall, it remains difficult for me to cite any particular benefit from past merger activity: all I can see is a mountain of debt preventing otherwise able companies from conducting much needed exploration activity at a time when drilling costs are low.

Let me make a few comments on the US natural gas industry, since this is my specific area of expertise. Unlike the oil market, which is an international one the US gas market is continental in scope and fragmented by producer, long haul pipeline and local distribution company. This is in distinct contrast to the UK's integrated sole supplier gas system. Formerly under strict regulation on a rate-of-return profit basis, the US gas industry has undergone sweeping changes in the 1980s, with dramatic increases in competition and business risk. This dramatic transformation, an effort to introduce competition as a substitute for regulation, has negatively impacted the profitability of transmission systems, and caused great turmoil and uncertainty throughout the industry. In the past misguided regulatory policies, including wellhead price controls, led to severe shortages of natural gas in the 1970s. Today's convoluted regulatory practices leave most end-users unable to access the low cost gas resulting from a gas 'bubble' or excess supply created by the drilling boom of the early 1980s. Currently, the Federal Energy Regulatory Commission continues to search for the optimal mix between regulation and competition. A futile exercise in my view, and one which has failed to address the significant take-or-pay liabilities incurred by transmission systems due to past regulatory policies. Settlement of these take-or-pay liabilities remains the major impediment preventing regulators from formalising new rules allowing end users to purchase gas directly from producers and transport it on interstate transmission systems. Fortunately, the introduction of free market forces and a gradual decline in the US gas 'bubble' due to low levels of drilling activity, should return the US gas market to a more healthy state by 1989 or 1990 and help eliminate the boom/bust cycles of the past.

As one very familiar with the US market, I can only look with admiration at your gas market. A system which allows price increases only below inflation for domestic customers, remains totally deregulated in the industrial sector and allows all UK citizens to share in the profits thanks to privatisation seems acceptable to me, despite its imperfections. To truly appreciate this, one need only study today's US natural gas market.

In the future it will remain critical that governments provide proper incentives for the consistent development of our remaining free-world oil and gas reserves. Unfortunately, given political realities, governments will have a tendency to act as has my own in the past, expropriating profits in good times and pursuing free market policies in bad times. Given constructive and consistently applied economic incentives, I am fully confident that the energy industry will continue to successfully perform its function, one so vital to the world economy, and remain an attractive area of investment opportunity. □

Certain events have an influence on the course of our lives which may seem out of all proportion to the apparent content of the occasion. An air pilot's landing, a musician's latest performance, may have a profound effect on their future. We are introduced to a stranger and fine a lifelong partner! There is an element of chance in the shaping of our lives, but the more effectively we plan, the more opportunities will open up, and the more prepared we are to take the best advantage of those opportunities.

Attending an interview may be the start of a successful career, it may be a turning point in one's life. Whatever the reason for the interview, whatever the hoped-for result, it is an important event for all concerned. We therefore welcome this contribution to our Students Forum series by the head of Technology Division, Civil Service Commission. In his article Barry Payne gives some very sound advice to those preparing for an interview, and a very illuminating insight to the thoughts of those who have the task of conducting interviews.

As I wrote in the August/September issue of *Energy World,* perhaps the most important event in your career is the start of the first job that is won by qualification, all-round ability, *handling of the interview,* and generally proving to an employer that you are the best candidate for the job.

Your next interview may be some time ahead, but here is *another supply of distilled wisdom to go in your survival kit!* Keep it safely.

James P MacCarthy, chairman, Membership Committee.

What to expect at an interview

Barry Payne CEng MIMechE MIERE RCNC*

Few of us get them right all the time, certainly mine have had their highs and lows, but after nearly three years as a divisional manager in the Civil Service Commission, with the responsibility for recruiting graduates and professionals to careers in engineering and other major professions within government departments, it may be that I can offer some useful guidance in preparing for interviews and how to respond when you take the candidate's seat before an Interview Board

The Commission welcomes every opportunity to lift what would otherwise be a veil of mystery surrounding the selection of candidates for our careers. It was for this reason that I was pleased to be asked by the chairman of the Institute of Energy Membership Committee to contribute to the series of articles about making a successful start to a professional career. My aim is to provide information that you will find both interesting and useful in preparing yourself for the interviews which are the threshold to your future career as well as some background to the way the Commission undertakes its recruitment responsibilities.

My post as head of Technology Division at the Commission is some way out of the ordinary for an engineer. The Commission is part of the Office of the Minister for the Civil Service (OMCS) within the Cabinet Office and involves important interfaces with the Treasury and Central Departments. It is in effect a recruitment agency for departments, although the Civil Service Commissioners also exercise important regulatory powers in ensuring that recruitment into the Civil Service is undertaken in a fair and open manner, a point to which I will return later.

My division, one of seven in the Commission, is responsible for recruiting to the 100 or so specialist disciplines which make up the Professional and Technology Group and are employed throughout the Civil Service. In the main these are engineers, surveyors and architects and I estimate that in the coming year we will undertake some 300 recruitment competitions advertising some 2000 vacancies and receive some 12 000 applications which will result in about 450 graduates and 400 professionals joining the Civil Service. Most graduates are thereby embarking on a structured and monitored professional development scheme leading to professional status with an appropriate Institution and then on to satisfying and challenging careers in their chosen profession.

Why does the Commission do this? In 1853 Mr Gladstone commissioned the Northcote/Trevelyan Report which recommended, among other things, that all situations in the Civil Service should be filled by open competitive examination; this was one of the great landmarks in the history of the Service. Before 1855 all vacancies in the Civil Service were filled almost entirely by patronage and candidates for appointment were nominated either by the Minister of the Department or by the Patronage Secretary of the Treasury (what an honest title!). Sometimes nominees had to pass an examination, but this could degenerate to pure farce and some of those selected have been described as 'the unambitious and the indolent or incapable'. Thus the Civil Service Commission was authorised by Order in Council to change all this and certify the qualifications of those appointed to the Civil Service. The principles established were those of fair and open competition and selection on merit, and these remain the guiding principles of the Commissioners today. Since these guidelines make possible the identification of the most suitable person for a post, they are seen to be a sound and proper approach to recruitment by the public, by employing departments and line managers, as well as the best means of ensuring the continuing efficiency of the Civil Service. It is this which accounts for their continuing influence through all the recruitment activities of the Commission.

The Professional and Technology Group includes some 10 000 professional staff and graduates, and some 25 000 technicians. It covers over 100 specialist disciplines which range from Aircraft Accident Inspectors to Wildlife Officers. Most departments employ members of the P&T

* Head of Technology Division, Civil Service Commission

Group and the requirement for technologists in the Civil Service has shown a marked increase in recent years to reach its present level.

I undertake periodic liaison and review meetings with the major departments who, using their manpower planning information, advise me on a six-monthly basis of their likely recruitment needs, at the same time we review the progress made. Together the Commission and the department plan the forthcoming recruitment strategy. In the course of these same liaison meetings a review is undertaken of the effectiveness of recruitment performance over the past year. We are advised of the

Relax ... do the occasion justice

available vacancies and we initiate the preparation of competition regulations, including a job specification, in consultation with the department and this provides a definition of the recruitment opportunity. It brings together the information needed to advertise the posts in the media to meet the responsibility of the Commission for openness in its selection activities. We advertise in an informative and attractive way providing the essential facts designed to bring in requests for our application forms.

On receipt the application forms are sifted to identify those candidates who on the basis of the information provided appear to offer the most suitable blend of qualifications and experience to meet the needs of the training opportunity or the post being offered. The most suitable applicants are then invited to interview. The Interview Board has to consider the whole picture, a candidate's education, training, qualifications, experience, written test results and reports from employers, school, university or personal referees as well as a candidate's Board performance. The Board then has to integrate *all* this evidence into an overall assessment.

The application form

Many people, and I would include myself amongst them, would regard filling in an application form as an activity tedious almost beyond endurance. Nevertheless it is the information contained in the application form which provides the material for decisions at the sift stage. Time spent on the application form is therefore a sound investment. Complete it comprehensively to provide all the information about your academic career, qualifications, qualities and experiences relevant to the opportunity you seek. Make mention of your outside interests and where remotely relevant tell how you spend your leisure time. Always take care to explain the reasons for your interest in the career opportunity and make a special mention of any experiences which illustrate your aptitude and commitment.

Remember to take the time and trouble to find out about the work of the organisation which you wish to join. Be sure to have read all the information that is provided to you so that, if asked, you can readily demonstrate that you have thought carefully about the relevance of your ability and experience, the challenge and opportunities that you are seeking in your future career, and the contribution you believe you can make.

If it is a training for a professional career that you are contemplating, make contact with your appropriate institute or institution and seek their advice about the approved scheme of training and qualifications necessary that will lead to full membership in due course. Always seek advice from those who are experienced in the career on which you wish to embark or from the various careers advisory services. Most employers make available a wealth of information that in itself is helpful in determining a chosen career path. Those of us worth our salt are keen to help.

The Interview Board

The Board will usually be seated behind tables and there will be a seat for you at the middle facing the person in the chair. The Civil Service Commission prefers a three person Interview Board because this allows members of the Board to concentrate wholly on listening to a candidate whilst one member is occupied in discussion. It also widens the field of assessment and acts as a safeguard against any form of personal prejudice influencing the outcome (although such prejudice is, in my experience, extremely rare). A disadvantage is that, inevitably, the activity has to be structured and gives the appearance of formality. Present practice is to have a Commission chairman, a representative from the recruiting department and an independent specialist member. It is the chairman's duty to guide and control the Board, to review the requirements of the posts and to decide in consultation with his colleagues a plan of approach to the interview and assessment. He has to see that the plan is followed, that the Board is properly conducted, and that the subsequent assessment of the candidate is objective, comprehensive and takes account of all the evidence. It is then the chairman who writes the final Board Report.

In preparing for an interview you will wish to give some thought to your appearance. This is not a critical matter, we all understand that it is you who is important and not how you look. Nevertheless it merits some advice and what I would offer is this: dress so that both you and the interviewers will feel comfortable. Clearly an effort on your part to do justice to the occasion will please the interviewers because they will have done the same and it is thus a way of contributing to the development of the rapport which is helpful to all concerned. We all like to convey messages with our dress and appearance. And why not? it's a vital piece of self expression. Nevertheless perhaps the interview is not the occasion for some of the more overt messages if these could distract attention from matters of greater significance to you, the candidate.

Our intention is that as far as possible the interview atmosphere should be friendly and informal. Candidates are welcomed into the room and introduced to the Board members. Particular attention is given to establishing a climate which enables the candidate to relax and talk freely, to have the opportunity of giving full treatment to the topics raised for discussion. In general the interview will begin with straightforward matters and gradually work towards more complex ones when in-depth discussion of technical matters might take place.

When you sit in the candidate's chair, give your full attention to each Board member in turn. Maintain eye to eye contact and respond as promptly as possible to the matters raised. It is probably best not to try and assess the effect of your responses on other Board members but rather concentrate on the subject under discussion. If you do not fully understand a question, say so and ask for more information. Always keep in mind that the most useful basis for an interview is not a question and answer session but rather a forum for a relevant discussion and exchange of ideas.

Don't worry about being nervous, most candidates feel this way. Interviewers are well used to the symptoms of this uncomfortable state. It is taken as a sign that the candidate is keen to do well and in most instances does not detract at all from the interview performance or result.

It is part of the human condition and not a matter for you to worry about.

Once the interview is over, the panel undertakes its assessment and completes the activity which forms the basis of the Chairman's Report. This includes the final assessment and recommendation. I have described the usual procedure which will be experienced by candidates, and there is no doubt that any candidate can, by some careful preparation, ensure that he or she is able to effectively represent those qualities which are most important to a Board's decision and thereby ensure that the Board will have the best possible outcome. This preparation really starts long before the occasion of the interview. It has its roots in an individual's abilities, aptitudes, interests and achievements. A heart-searching study of these, together with the career opportunities that our society offers, should result in a good decision about what it is that you wish to do with your life and where you can find satisfaction and make a real contribution in a chosen field. It may in practice involve some trade-off but the thought process and decision is important. There is no doubt that an Interview Board will wish to establish the degree of commitment that you have to the activities of the position you seek. I believe that this personal preparation provides a sound basis for a successful interview.

The well prepared candidate looks for an opportunity to offer a subject for discussion

It may surprise you to know that the tension that we all experience on these occasions is not confined to the candidate. It is perhaps encouraging to realise that, as well as the candidate, the panel wishes to do well and to make a good decision. To do this effectively, they must establish good communication with the candidate so that those interests, aptitudes and abilities relevant to the post can be fully explored. A well prepared candidate is able to respond. The candidate who is prepared has come along with something to talk about. The application form contains reference to activities and areas of technological interest which provides a basis that can be developed in exploring a candidate's suitability for the post. The well prepared candidate is looking for an opportunity to offer a subject for discussion to mutual benefit.

What is it then that an Interview Board is looking for and what can you do to demonstrate your suitability? This varies from career to career and post to post. But I think one vital ingredient is a combination of enthusiasm and motivation. If you fully demonstrate these qualities, I believe that most Interview Boards will be forgiving about relatively minor shortfalls in other areas and, let's face it, most of us have more of these than we would wish to confess. A Board will look for an aptitude and genuine interest in your chosen profession. It will look for intelligence and good reasoning powers which can be demonstrated by responding to the Board activity in a constructive way. Personal and inter-personal skills, such as maturity, decisiveness, leadership and the ability to work with others, are also essential, and of ever-growing importance with the increased emphasis being given to the effective management of staff and other resources in the Civil Service. An understanding of people, coupled with a wish to lead as part of your personal approach to life, is therefore a particularly powerful ally in an interview, more especially when your chosen field of endeavour includes management and staff management in its scope.

An opportunity is offered at the end of the interview to ask questions of the Board. Don't feel obliged to 'make a gesture' here, but do use it to supplement or clarify any matters relating to the post, the training being offered or the career which you remain unsure about. My advice is to keep this part to essential matters since time is limited and the Board has a schedule to keep.

Usually you will have a letter from the Commission advising you of the Board's recommendation within seven days of the interview. In certain cases, you may be told of your success at the Board immediately following your interview. The formal offer of a post then comes from the recruiting department once the usual enquiries about health, qualifications and other matters have been completed and the Commissioners' Certificate of Qualification has been issued.

The Assessment Centre

A more recent addition to our basket of selection methods has been the introduction of Assessment Centre techniques. This has been brought into the selection of fast-stream engineers for the Defence Engineering Service. Assessment is undertaken at the Civil Service Selection Board at 24 Whitehall and success at this is followed by an invitation to appear before the Final Selection Board (FSB) which is chaired by a Civil Service Commissioner. The Assessment Centre procedures include a mix of interviews, cognitive tests, and job-related activities, some of which are conducted in groups to test inter-personal attributes. The FSB follows the normal interview pattern but the Board membership is increased to bring in representation from industry and the academic world.

While this form of selection is more comprehensive than the straightforward interview, there are significant components of the extended procedure which make use of interview situations.

The procedures I have outlined to you are, of course, those for the Civil Service and other employers have many different approaches to selection interviewing. Nevertheless, the advice given about the interview situation is quite widely applicable. One message of encouragement to bear in mind is that interviewers want to achieve a positive result from their activity and, while they will be looking for an acceptable standard, they get little satisfaction from turning a candidate away.

May I conclude by wishing you every success with your future interview experiences and, whatever their various outcomes, an enjoyable and fulfilling career in your chosen field.

Student prizes

The Institute is pleased to announce that J Sainsbury is sponsoring two new student prizes, for three years initially, to be awarded to students at the South Bank Polytechnic and the University of Surrey respectively. Both are to be awarded to a student, nominated by the academic body concerned, who has been selected as achieving the best all round performance based upon course work, examinations and project in the MSc Environmental Engineering course (South Bank) and MSc Energy Engineering course (Surrey).

The first of the prizes has already been presented and the recipients were M L Soriano (University of Surrey – seen March *Energy World* p 19) and A K Maiteri (South Bank Polytechnic). To both these gentlemen the Institute offers its congratulations. The Institute is also grateful to J Sainsbury for sponsoring these prizes, which have come about as a result of endeavours by the London and Home Counties Branch.

Education and Membership officer

LETTERS

UK tidal power schemes

H J Hibberd's letter in the January issue of *Energy World* advocates storage of the energy 'harvested' by a tidal scheme, and refers in particular to strategically placed storage by underground water, which he was retained to investigate in the early seventies, and sets it against Dinorwig. It is common ground in comparing alternative storage concepts that high head schemes are more cost effective than low head (that is twin-basin tidal schemes are not usually the best answer). As a rule, those where nature has provided the high differential, as in a mountain area, will be more cost effective than those where it has to be created by excavation.

As Mr Hibberd says, once turned into electricity, the energy is readily transportable and there is no particular reason to consider storage of the electricity generated by the tide separately from the general question of energy storage which regularly preoccupies electricity utilities. Location is then more likely to be determined by the capacity of the transmission system relative to the demand than by the needs of a tidal scheme as such. There is an exception where the power is intended to supply a demand in a supply system which is not the same as the one containing the tidal scheme, for instance at Bay of Fundy whose market would be in the Northern United States: for those circumstances, storage is treated as an element in 're-timing' tidal generation.

Of course matters are further complicated if the tidal scheme involves pumping during the flood to enhance the head, because the power for pumping has to be supplied in what may be inconvenient circumstances.

Perhaps by the time this letter appears we may have learnt how privatisation could affect all these factors.

P C WARNER
Past president

Electricity privatisation – will the City be the only winner

I listened to Prof Eden's lecture on the *Privatisation of the electricity supply industry* on 9 February with interest (London and Home Counties branch meeting). However the large attendance and many questions meant that time precluded comment on his paper.

It is apparent that he is a proponent of privatisation but the premises for preference appear extremely doubtful. He, himself states that the electricity supply industry (ESI) has been effectively constrained in its actions by the Government who have decided policy both technical and financial. Yet he points out the benefits of privatisation as being freedom from government interference, the ability to choose fuels, including imported coal where cheaper. These policies could be followed now without the upheaval of privatisation.

The load graphs he showed apply to either structure. The only benefit there may be of privatisation is possibly the introduction of different methods of generating the steam such as the Benson Boiler which is widely used throughout the world including Germany and Japan. In its selection of processes the CEGB is somewhat monolithic after it has carried out its market surveys. However it does not require privatisation to solve this problem.

Competition is supposed to bring benefits to the consumer and *ipso facto* to the economy! This has been proven to be not necessarily the case. The projected rise in prices of electricity, not required by the ESI, allows a margin for privatisation to reduce them a little thus showing the benefit claimed. If the capital required for the construction programme cannot be generated internally I am sure the monies could be raised by the ESI.

Prof Eden states that the UK industry could not handle the programme. I do not believe this to be the case. Overall we have the labour and companies for building refineries, chemical plants as well as power stations. In many instances the labour is working abroad, including the EEC as work is not available here. Quoting his mention of Germany, the recent flue gas desulphurisation programme in Germany has been carried out to a large degree by the use of East German and Polish labour, so I do not think we should be misled by EEC opportunists, who see a slow down in their markets in the 1990s and a chance to enter ours at cut throat prices.

The structure hypothesised by Prof Eden appeared somewhat 'woolly' in that no clear path of authority was evident and certainly no effective watchdog over the consumer's interests. For the consumer it is a myth to believe that competition will bring him benefits as he has no choice.

May I suggest that the scheme provides the city 'mandarins' with a glorious opportunity to line their pockets at the expense of the consumer and the wider and small shareownership.

J S GRAY
Member

The cost of lost nuclear power

Those who have difficulty in following the complex arguments of the Sizewell B public inquiry or the levellised cost technique of the Cambridge Energy Research Group* will be encouraged by the simple approach recently adopted by the technology correspondent of the *Daily Telegraph*. Writing on 25 January 1988, he stated that the Central Electricity Generating Board is losing around £40 000 for each day of operation at Dungeness A nuclear power station because the reactor is running at 350 MW instead of its normal output of 410 MW. This adds an interesting new dimension to the debate on the real cost of nuclear power. According to the figures published in the World Nuclear Industry Handbook 1988, it can be calculated that the average output of Dungeness A has been only 329 MW during its lifetime (21.5 years up to June 1987). Compared with what is now stated to be its 'normal' output, Dungeness A has had an average daily 'loss' of £54 000 over its lifetime – a total loss of over £420 M. Caveat emptor?

DR J C McVEIGH
Fellow

* See BOOKS on p 12

The design and sizing of active solar thermal systems

T A Reddy
Oxford University Press, 1987
391pp. £50.00

This book has been written for those who are already familiar with the fundamentals of solar energy and who wish to extend their knowledge in the field of the design and sizing of active solar systems. The material was originally developed for use as the principal text in a one term post-graduate course and was written when the author was in the Division of Energy Technology at the Asian Institute of Technology, Bangkok.

During the late 1970s several detailed large computer simulations of solar systems were developed. At the same time practising solar architects and engineers started to use various rules of thumb. Some of these were reasonably satisfactory, but it became apparent that more precise methods than the rules of thumb but less expensive and easier to use than the detailed simulations were needed. The objective of this book is to present and discuss a number of application-orientated theoretical concepts and to outline various design and sizing procedures.

The book is divided into two main parts. The first group of five chapters covers the classification and description of solar thermal systems, modelling of components, economic analysis, estimation of solar radiation on horizontal and tilted surfaces and the long term performance predictions of flat-plate solar collectors under various operating modes. The second part concentrates on the different design approaches with chapters on usability, empirical correlation, the simplified analytical approach and the simplified numerical simulation approach. The final chapter examines some potential applications. There is a very comprehensive series of appendices which includes a list of exercises involving the preparation of appropriate computer programmes for system simulation and sizing studies.

One of the many useful features of this very well-written text is the reference to the more detailed work of other authors whenever it is not possible to pursue a particular topic in sufficient depth. It will be a valuable companion to the few major graduate texts currently available in this specialised field.

Dr J C McVeigh

Energy conservation in IEA countries

International Energy Agency, 1987
259pp. £19.50

This is the first attempt by the International Energy Agency to assess the role of energy conservation in the context of general energy policy after more than 10 years of concerted effort by consumers and governments.

Between 1973 and 1985 the *energy intensity* of IEA economies fell by 20% (where *energy intensity* is defined as *total primary energy requirements per unit of gross domestic product,* for example toe per $1000 of GDP). This fall is partly associated with changing industrial structure (for example a reduction in the heavy energy intensive industries and a growth in light industry and in the service industries) improvements in energy efficiency in the industrial, commercial, domestic and transport sectors but little change in the efficiency of electricity generation. The most important single factor behind the substantial improvements in energy efficiency over the past 10 years has been the increase in real energy prices especially between 1978 and 1982, aided by government programmes to promote the efficient use of energy.

By 'energy conservation' the IEA means 'using energy more efficiently whether through behaviour, improved management or the introduction of new technology'. The gradual decline in real energy prices between 1982 and 1985 reduced but did not reverse the trends towards lower energy intensity. In spite of the drop in crude oil prices in 1986 the IEA would urge the case for maintaining the momentum of energy conservation on the following grounds:

- energy conservation extends the availability of non-renewable energy resources;
- energy markets are likely to tighten before the end of the century; energy conservation will delay and lessen the impact;
- energy conservation reduces the environmental consequences of energy conversion processes;
- investment in energy conservation can provide a better return than investment in electricity generation;
- investment in energy conservation can often be undertaken in stages and can offer a flexible approach at a time when the energy outlook is uncertain.

To this we might add that while investment in energy efficiency creates or saves jobs at the time that the investment is being made it also leads to annual savings which can be reinvested.

Looking to the future the authors draw attention to:

- the considerable potential for further improvement on an economic basis in the efficiency of energy use;
- limitations in the energy conservation market which prevent this potential from being fully realised;
- the effectiveness of carefully planned government policies in reducing these limitations.

To aid the rapid transfer of information the authors provide: an Executive Summary; Overview; a report on *Improving energy efficiency – trends, opportunities and obstacles;* a report on *Conservation policies and their effectiveness;* eight annexes giving details of energy policy discussed by IEA energy ministers, data and analyses supporting the main text, an examination of methodological issues and an overview of the main energy efficient techniques and a bibliography of 183 references.

This worldwide survey is illustrated by 20 tables and 11 graphs. While statistics drawn from many countries and agencies require careful handling and interpretation there is a wealth of information here that is valuable for anyone concerned with energy policy and the efficient use of energy.

Dr J Barr

FGD handbook

Jonas S Klingspor
IEA Coal Research, 1987
271pp. £50.00 (member countries)

This is a very useful guide to the complex subject of flue gas desulphurisation published by the International Energy Agency Coal Research. It summarises sulphur dioxide emission standards for many countries worldwide. It classifies modern FGD systems and gives a summary and diagram of all known modern processes together with the manufacturers, number installed, where they are installed and their claimed efficiency.

It is a particularly useful book for those studying flue gas desulphurisation to reduce atmospheric pollution who may wish to compare the different types of processes available.

It is the modern trend to use acronyms and abbreviations but I think that it is wrong to use an acronym in the title of a book, particularly if it is hoped to sell the book abroad.

B Lees

Engineering science

E Hughes and C Hughes
Longman Scientific and Technical, 1988
£7.50

This recently published edition, the third edition, by Edward and Christopher Hughes, was first published 18 years ago. It has been so much in demand that it has seen many reprints over the years.

The third edition includes the introduction of new material and some reorganisation of the original text. The aim of the book has been to produce a book which covers comprehensively basic engineering science. This it does well.

The main topics dealt with are, the principles of mechanics, heat, electricity and sound. The latter topic however, is only given a few pages of the text. The other defect, in an otherwise well presented book is the omission of any explanation of capacitance and inductance when dealing with electrical theory.

Each chapter has worked examples

with exercises at the end of the chapter – the answers are also provided. The opening chapter on units is excellent, preceded by a short account of the symbols and the abbreviations used throughout the book.

It is admirably suited for a number of BTEC, City and Guilds courses in basic engineering and will it seems, continue to act as a major text book for such students.

F J L Bindon

Application of optimal control theory to enhanced oil recovery

W Fred Ramsey
Elsevier Applied Science, 1987
244pp. DFl150.00

The book is written in lb, ft, °F, US $ units, which are quite acceptable in the oil industry, but are a nuisance to those now trained in SI units. The first chapter introduces various thermal, chemical, and miscible displacement processes for increasing the yield of an oilfield, because traditional secondary water flooding still leaves about 30% available crude oil underground. It introduces the technical and economic parameters, including worked examples.

The second chapter is an exposition on optimal control theory which is easy to follow by those familiar with mathematical optimisation methods. The next five chapters include mathematical modelling and applications to recovery methods. Model parameters with solutions at each of several iterations will be of interest to those wishing to compare other methods of solution and the correctness of computer programming methods.

The book is well presented and illustrated by graphs and diagrams. The range of references includes early articles up to 1984. Changing economic conditions and local geological features are likely to result in quite different optimum solutions when the methods are applied to particular locations.

D N Gwyther

Nuclear economics and the price of coal

Nigel Evans and William Bullen
Cambridge Energy Research, 1987
54pp. £95 (inc p & p)

This report consists of 54 A4 typed pages and has been produced '... as a contribution to the continuing debate on the relative economics of coal and nuclear for power generation ...'. The starting point for the analysis was a report published in 1986 by the OECD Nuclear Energy Agency (NEA) in Paris (projected costs of generating electricity from nuclear and coal-fired power stations for commission in 1995). Wherever possible the authors have used the same assumptions and input data as the NEA '... to show how the use of alternative economic indicators can significantly affect the perceived merits of alternative forms of power generation ...'.

The NEA produced a ratio for coal: nuclear electricity generation costs using a technique for discounting levellised costs in constant money terms. When this ratio is greater than unity, coal is more expensive than nuclear for base-load generation and for values less than one, coal is the cheaper option.

The levellised value is effectively a weighted average of the value of the parameter throughout the life of the plant and is very dependent upon the discount rate. The higher the discount rate the more the levellised value is weighted towards the value in earlier years. All annual costs and benefits which vary throughout the life of the plant are included in the analysis to give the total (net) discounted levellised costs for the particular technology, either coal or nuclear.

The authors point out that the actual choice of the discount rate has a very significant impact on the relative economics of coal and nuclear power. Because nuclear power plant has significantly higher capital costs than coal-fired power stations, higher discount rates act against nuclear power. Further, because of these significantly higher capital costs, delays during the construction of a nuclear power plant would have a very serious effect on the overall economics. A second reason for the importance of discount rates is the move in some countries to transfer ownership of electric utilities from the public to the private sector. In the UK the Treasury apply a 5% discount rate for new generating plant. But such a low rate of return on an investment is quite unrealistic in the private sector.

The Cambridge Energy Research (CER) methodology is broadly similar to that adopted by the NEA, in that they also use levellised discounted electricity generation costs as the cornerstone of their analysis. However, the CER calculate a break-even levellised coal price, defined as the price of coal to the utilities at which the economics of coal and nuclear power generation are the same. The great advantage of this method is that it is conceptually much easier to understand. No prior view on coal prices need be specified. As global energy markets change with time a quick assessment can be made of the likelihood of either technology achieving a cost advantage. As the authors point out, removing the requirement to make assumptions regarding the future price of coal removes a potential source of confusion and possible bias in any analysis.

A series of studies using different discount rates for base case results sets the scene for a detailed series of sensitivity tests. For each test summary results are presented for the 12 countries discussed in the earlier chapters (Belgium, Canada, Finland, France, Federal Republic of Germany, Italy, Japan, Netherlands, Norway, Spain, UK and USA), with a graphical presentation for France, Germany, Japan, UK and USA. Although the authors are careful to point out that they have not sought to focus attention on any one particular country, the key feature of their analysis for the UK must be to examine how their results compare with the general economic conclusions drawn from the Report of the Sizewell B Public Inquiry. They do not correspond.

Sir Frank Layfield states (90.9 c) '... the probability of a coal station having lower costs than Sizewell B is very small: my broad judgement is about one chance in 40'. CER find that the break even levellised coal price for Sizewell B, expressed in 1986 prices, is $53/t and $85/t at 5% and 10% discount rates respectively. In the early part of 1987 steam coal was being imported into Europe at $29 to $43.5/t with a sulphur content of 1% or less and a calorific value of 24.7-27.9 GJ/t. '... Current perceptions are that steam coal prices may well lie in the range $30-$50/t (at current prices) for many years, given the potential for bringing new coal supplies into production ...' it would appear that the probability of coal being able to compete on economic grounds with nuclear power is substantially above the 2.5% indicated in the Sizewell Report.

This CER report represents an important contribution to the literature. It is very well written and free from the economic jargon which makes many other texts difficult to follow. It will be very useful for all involved in the analysis of the costs of electricity generation.

J C McVeigh

Recently published

Energy statistics
Institute of Petroleum, 1987

The proceedings of a conference held on 29 September 1987. Copies are available from the Institute of Petroleum, 61 New Cavendish St, London W1M 8AR (tel 01-636 1004). Price: £12 (UK and Europe), £15 (Overseas).

Russian-English science and engineering dictionary
Technical Dictionaries, 1988

Copies are available from the company at: Box 2130, Mt Vernon, ME 04352, USA.

Techniques and decision making in the assessment of off-site consequences of an accident in a nuclear facility
IAEA, 1987

Temperature and infrared thermometry handbook (fifth edition)
Calex Instrumentation, 1988

Copies are available free from the company at: PO Box 2, Leighton Buzzard, Bedfordshire LU7 7AG (tel (0525) 373178).

Coal Research Centres
IEA Coal Research, London, 1988

1988 Continuing Education Programme
The Institution of Chemical Engineers, 1987

□

Electricity privatisation
Plans unveiled

The Government's plan to break up and privatise the Central Electricity Generating Board were unveiled in the Commons by Mr Cecil Parkinson, the Energy Secretary, reports the *Financial Times*.

A white paper outlines proposals for the future of electricity generation, transmission and distribution in England and Wales. Legislation will be in the next session of Parliament, with the sale in two or three years.

The major question yet to be resolved is the detail of how the newly privatised industry will be regulated. The Electricity Council has been strongly lobbying for 'light' regulation but the CEGB and others in Whitehall believe it is essential that the regulator should be given strong powers to protect the consumer.

The plan envisaged that the CEGB be allowed to retain only about 70% of power plant, including nuclear stations and the new generation of pressurised water reactors. The remaining plant will be hived off into a separate private company to compete in the generation and the development of new power stations.

The CEGB will also lose the national transmission grid which will be separated into a non-profit-making company owned by the area distributors.

The area boards will be privatised as distribution companies which will be given new roles. They will take over from the CEGB the statutory duty to maintain lighting and power to consumers.

The two Scottish boards – the South of Scotland Electricity Board and the North of Scotland Hydro-Electric Board – will be sold separately. They already combine the roles of generation and distribution and will be permitted to compete with the privatised English and Welsh companies.

The decision follows a lengthy debate in the Government and among economists about the feasibility of introducing competition into electricity. The CEGB and its defenders argued that an integrated generation and transmission system would be more efficient and would guarantee supplies.

However, ministers believed that it was necessary to secure as much competition as possible, not least because of the criticism of the privatisation of British Gas as one unit and following the controversy over the standard of service of British Telecom.

Source: Financial Times

Energy in 1987
Consumption is up

Provisional statistics showing energy production and consumption in 1987 as a whole, and in the fourth quarter of 1987, have been published by the Department of Energy.

Energy consumption

Total inland energy consumption of primary fuels in 1987, which includes deliveries into consumption, was equivalent to 336.3 Mt of coal, 0.3% more than in 1986. Coal consumption increased by 1.9% whilst petroleum consumption decreased by 3.2%. Consumption of natural gas rose by 1.7%, whilst that of primary electricity rose by 4.6%.

Consumption of primary fuels during the fourth quarter of 1987 was equivalent to 90.8 Mt of coal, 3.9% more than in the fourth quarter of 1986. Coal consumption increased by 6.7% and that of petroleum by 2.5%. Consumption of natural gas rose by 6.3%, whilst that of primary electricity fell by 9.2%.

Energy production

Production of indigenous primary fuels in 1987 was equivalent to 404.6 Mt of coal, 2.3% less than in 1986. Production of coal decreased by 3.4% to 104.5 Mt, and production of petroleum fell by 3.0%. Production of natural gas rose by 3.8%, whilst that of primary electricity fell by 7.7%.

Production of indigenous primary fuels in the fourth quarter of 1987, at 107.8 Mt of coal equivalent, was 1.9% higher than in the same quarter of 1986. Production of coal fell by 2.9% to 28.0 Mt, whilst production of petroleum rose by 2.8%. Production of natural gas rose by 12.9%, whilst that of primary electricity fell by 15.8%.

UK petroleum production and use

Total petroleum production in 1987 was 123.2 Mt. This includes 5.7 Mt of natural gas liquids, production of which decreased by 0.1 Mt, or 2.3%, compared with 1986. In the fourth quarter of 1987 total petroleum production was 31.8 Mt, including 1.3 Mt of natural gas liquids.

Total use of petroleum, including non-energy use, in 1987 was 75.0 Mt, 3.0% less than in 1986. During the fourth quarter of 1987 total use was 19.8 Mt, 2.2% more than in the fourth quarter of 1986.

Petroleum product deliveries for energy uses in 1987 were 2.6% lower than in 1986, and deliveries for non-energy use 1.4% lower. Deliveries of motor spirit increased by 3.3% and Derv by 7.8%. Petroleum product deliveries for energy uses in the fourth quarter were 3.2% higher than a year earlier, and deliveries for non-energy use 2.4% higher. Deliveries of motor spirit increased by 3.4% and Derv by 8.7%.

Source: Department of Energy

OFGAS
No need of extra power

The regulatory framework set up to monitor British Gas has shown itself to be robust and well up to its job. On the basis of last year's experience, therefore, OFGAS (the Office of Gas Supply) has no need of additional powers.

This was the conclusion of Mr James McKinnon, director general of Gas Supply, in his statement which appeared in the OFGAS annual report for 1987.

Mr McKinnon reviewed the results of the first full year of regulation in the gas industry. He also discussed the increasing rate of customer disconnections and competition.

He made the point that strong regulatory powers were available for the protection of domestic users of gas who had neither the financial resources to change readily from one source of energy to another, nor the individual influence to change decisions of a powerful monopolist supplier (British Gas plc).

'There was considerable unease among some commentators that the regulatory mechanism, particularly in the industrial market, would prove to be inadequate. I did express the view at the outset of my assignment that a subtle and effective system, of which OFGAS was a component, had been set in place. Furthermore, I asked that time should be allowed for the system to operate in the knowledge that it had a built-in capacity to change and to respond to altered circumstances,' Mr McKinnon said.

Without speculating upon the outcome of the current Monopolies and Mergers Commission study of British Gas pricing policies, Mr McKinnon suggested that experience had shown that the regulatory apparatus relative to the industrial market was likely to be able to adjust satisfactorily as self-correction became necessary.

On the issue of competition, Mr McKinnon said: 'The environment created by the Gas Act 1986 within which competition can develop among large suppliers of natural gas is very helpful to potential customers. It is not possible to regulate a situation to force competition; to do so would be a contradiction in terms.

'Competitors in gas supply will emerge if the prospect of eventual sustained long term profit can be attained.'

While submitting that the balance between control and freedom in the industry had been broadly achieved, Mr McKinnon made the point that not everything was completely satisfactory. 'A number of things remain to be done. But the framework has shown itself to be robust and up to the job it was created to do.'

He continued: 'Our powers relate heavily to the protection of the interests of tariff customers. We have been able to obtain such information as we require

from both British Gas and private gas suppliers. Our powers are clearly understood and accepted by British Gas, who have cooperated in providing factual information in regard to the many individual cases with which we have dealt during 1987.

'We have made full use of our own resources and have also mobilised the efforts of many other organisations in support of tariff customers. We have been able to highlight a large number of issues and to offer solutions to them. We have responded quickly and fully to any request for assistance from any tariff customer who has contacted us.

'I believe that we have identified and evaluated all potential demands on our resources and have developed adequate plans to deal with the challenges which these demands are likely to pose. Up to the end of 1987 there has been no occasion on which OFGAS has been forced to deviate from its chosen course of action because of a deficiency in the powers vested in it, or from the lack of information which it has requested.

'I conclude, therefore, that at this time I see no need to seek enhancement of the powers which have been given to OFGAS. Furthermore, I believe that we can continue to give full value for the resources with which we are entrusted and that we can operate effectively and with the speed of response which is characteristic of a small but well focused organisation.'

Commenting on the issue of debt and disconnection, Mr McKinnon pointed to increased consumer inability to pay for gas. He outlined his proposals submitted to British Gas for alleviating customer difficulties in this area. It was an issue which required considerable study and one on which discussions between OFGAS and British Gas were currently taking place.

Source: OFGAS

Increased electricity prices
Will hit jobs

The Confederation of British Industry (CBI) has reinforced its continuing opposition to the proposed increases in electricity prices, which it regards as inflationary, damaging to future competitiveness; and for some industries a serious threat to profitability and jobs.

Members of the CBI Council rejected arguments put forward by the Government to justify electricity price increases as 'unsound in business terms'. They said that the damaging effects of the increases on major sections of British industry had been severely underestimated and called for them to be urgently reviewed.

After the meeting, CBI president, Sir David Nickson said that for intensive users of electricity, including the steel, chemicals, paper and man-made fibres industries, prices in Belgium, France and Italy were up to 25% lower already, even before the proposed increases.

The facts spoke for themselves. In all, electricity cost British businesses more than £6 billion a year, or some 10% of corporate profits. For some businesses electricity costs were higher than labour costs and could exceed 30% of profits and 10% of total production costs, for instance, electricity accounted for more than 25% of the cost of converting scrap into steel, 19% of the production costs of flour-milling, and 15% of the costs of producing paper and board.

The proposed electricity price increases would add some £1 billion a year to business costs by the end of 1989, equivalent to the profit earned by more than 300 000 people in the business sector as a whole. For some firms, electricity prices represented as much as 25% or more of value added.

For one steelmaker, the 15% increase in electricity prices over two years would be equivalent to 25% of the company's sales margin. This would have the same impact as imposing a poll tax of £1000 a head on each of the employees in the company's steelmaking division and the consequent lack of competitiveness would require 500 redundancies to offset it. For a company which had already reduced its workforce by 75% since 1979 this was not a practical alternative.

Sir David added prices should be determined by the market and should reflect short-run marginal costs of power generation. They should not be used to encourage future investment since this would distort patterns of demand and investment. 'Higher prices, designed to finance new capacity, could actually have the effect of reducing demand to the point where the new capacity was not required'.

Source: CBI

Small power stations
End to oil and gas rules

Regulations to end the controls on the use of oil and gas in small power stations (under 10 MW) came into effect in January.

Peter Morrison, Minister of State for Energy, said that proposers of bigger schemes should be fully aware that the Government wished to give the go-ahead where the schemes were economically justified.

Prior to the order, operators or proposed operators of stations under 10 MW had to notify the Department of Energy. For gas-fired stations, this also covered the gas supply arrangements.

These requirements are abolished by The Electricity Generating Stations (Fuel Control) Order 1987, which was laid on 17 December 1987, and which came into force in January.

Mr Morrison said: 'Gas is the fuel favoured by private generators, particularly for combined cycle technology with its important environmental benefits and improved thermal efficiency.

'Two central themes of Government policy are to reduce the administrative burdens on industry, and to introduce greater private sector involvement and diversity into energy supply. This Order does both, by abolishing an unnecessary procedure, and by removing a possible deterrent to people wishing to develop small private power stations.'

He added: 'Certain European Community Directives do not permit me to remove controls on larger projects, but they do give considerable discretion.

'I intend to use this discretion to the full. I want potential operators to know that they should not be deterred by these requirements, which should not be a bar to major power station projects that are economically justified.'

Source: Department of Energy

Solar energy
Research warms up

A £3 M research package into increasing the use of solar energy was announced today by Michael Spicer, Minister for Energy. The research will encourage wider use of solar features as part of energy efficient design in buildings.

Mr Spicer visited three buildings in the City of London which already make good use of solar and energy efficiency design, before going on to receive a report on solar energy design*.

During the visit Mr Spicer said: 'Solar and energy efficiency techniques not only make good design sense they make good economic sense too. Research has shown that fuel bills can be halved in buildings incorporating best design practice. Nearly half the energy produced in Britain goes into providing heat and light for buildings. The total bill amounts to some £13 billion a year. Our aim is to reduce bills and at the same time raise the quality of life in both home and workplace.

'These new projects bring the total funded by the Department to 36, worth some £6 M. The new contracts will provide firm evidence of the financial and non-financial benefits of passive solar design. Many of the leading architectural practices and Schools of Architecture in this country are involved in these studies and I very much hope that this will result in more energy efficient buildings in the towns and cities of the future.'

Source: Department of Energy

Waste to heat
In Newcastle

A company† which specialises in producing low cost energy in the form of heat, steam and electricity using waste and waste derived fuels approached the City of Newcastle during the summer of 1986, and offered to demonstrate their ability to reliably and efficiently burn RDF (refuse derived fuel) pellets, to provide heat for the Byker District Heating Scheme.

The company was to install a new base

* Ove Arup and Partners

† Energy Supplies

load boiler to their design at their cost and using its own locally recruited operational engineers. It guaranteed the plant output, efficiency and ability to remain on line with the minimum of cleaning. If it failed to meet its guarantee then it would remove the plant at its own cost.

If the project succeeds then Phase II will be put into action and heat will be provided to the entire estate and additional boiler plant, burning RDF pellets will be installed.

Fuel for the boiler plant is provided by City of Newcastle Environmental Health Department from the waste treatment and pelletisation plant at Byker. This plant which is operated by Newcastle has been developed and refined over many years with assistance from the Department of the Environment and now produces high quality fuel with only 10% ash and a calorific value over 8000 BTU/lb.

The project is assisted financially by the Department of Energy who provided a 50% loan which covers part of the cost of intensive research and development. This R&D work is to determine the most effective method of reducing the problem of boiler fouling when burning waste derived fuel and includes various methods of soot blowing, use of chemical additives etc.

To date the plant is operating reliably with efficiencies approaching 80% and real progress in reducing the problems of fouling has been made. Plant outputs of 18 M Btu/h are common and at times all the heat for the Byker District Heating Scheme has been provided using Newcastle waste.

Source: Energy Supplies

Wind power
Kent gets a new turbine

Site work is to start in May for the construction of the largest wind turbine in England and Wales at Richborough power station in Kent.

The 45 m high, 1 MW machine, which at full output is capable of meeting the electricity demands of 1000 homes, is expected to be producing electricity for the local network in a year's time.

The turbine is designed to achieve simplicity, reliability and high efficiency in order to minimise generation costs. Its performance will be extensively monitored to confirm that the design objectives are being achieved.

The manufacture of components started in January, and should take until August, followed by shop assembly and testing. The tower and major components are being manufactured and assembled in Glasgow and the blades in Southampton. Construction of the turbine is due to commence in November and commissioning is planned for January or February next year.

The turbine will have a cylindrical tower three metres in diameter and the three blades will be made of wood and epoxy laminates with a 55 m diameter. The turbine, which reaches its maximum output at a wind speed of 30 mph, will feed electricity into the South Eastern Electricity Board network and is expected to generate around 2 000 000 units of electricity a year. The average domestic customer uses around 4000 units of electricity a year.

In December 1986 the European Commission signed an agreement to provide £1.05 M funding for the turbine. The project is one of three being supported by the European Commission; the others are at Esbjerg in Denmark and Cabo Villano in Northern Spain. Design information has already been exchanged and test results will also be shared.

Source: CEGB

Radiation dangers
Improved safety

A new monitoring system to help control health risks to workers in the nuclear industry has been devised by UKAEA's Safety and Reliability Directorate at Culcheth, Cheshire.

The prototype device consists of a personal radiation dosemeter continuously transmitting data to a computer by radio. The worker concerned is watched by a video camera and information about his dose rate is superimposed on the picture to pinpoint areas where the radiation hazard is high. The combined image is recorded on video tape and the dose rate data are stored by computer.

By analysing recordings of routine operations the particular tasks giving the most dose can be identified and methods for reducing future doses can be developed. Field trials have been carried out at UKAEA sites at Winfrith, Dorset, and Harwell, Oxfordshire.

At Winfrith SIMVIDOSE (Simultaneous Video Dose) has been used during maintenance work on the steam generating heavy water reactor and in refurbishing the 'caves' where nuclear fuel rods are cut up and examined. At Harwell the system has been used by workers removing irradiated silicon from the Pluto reactor.

The value of a system which linked detailed radiation dose data to the work being carried out was identified by SRD and developed in conjunction with the Instrumentation and Applied Physics Division of AERE Harwell.

Source: UKAEA

Australia
Ultra-clean coal

The Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO) has developed an ultra-clean coal which is a viable alternative to the heavy fuel oils being used in Japan and many other industrial countries.

In a statement announcing the development of the new coal, the CSIRO said it was a low-sulphur coal which offered to help alleviate the problem of acid rain in the northern hemisphere. The ultra-clean coal, available in liquid or powder form, had the advantage over heavy fuel oils of generating lower levels of atmospheric pollutants such as sulphur oxides, which contribute to acid rain.

It was estimated that if Australia could capture 5% of the Japanese heavy-fuel-oil market, exports of ultra-clean coal to Japan alone might amount to Aus $300 M a year.

The chief of the CSIRO division of fossil fuels, Prof Ming Leung, said negotiations were under way with commercial backers to establish a coal-cleaning pilot plant. Research would be carried out into the product's use in furnaces, low-speed diesel engines and gas turbines.

Source: Australian Information Service

FGD in Finland
A new method

A dry method of desulphurising the flue gases emitted by coal and oil fired power stations has been developed by a Finnish company*. The process, called Lifac, is based on the principle of trapping sulphur in calcium carbonate (limestone) dust. The company claims that an activation reactor which is connected to the flue raises the scrubbing efficiency to over 90%.

Finely pulverised limestone injected into combustion chambers of coal or oil fired power stations immediately absorbs a proportion of the sulphur from the combustion gases. The Lifac process injects water into the activation unit, thus increasing the water content of the flue gases and thereby activating the unbound calcium. Raising the water content in this way results in an increase in the capacity of the limestone dust to absorb sulphur.

It has been established that the sulphur content can be reduced more effectively as the temperature of the process gets nearer to the flue gas dewpoint. The sulphates produced by the reaction are dry and can be separated with the other combustion products by an electrostatic precipitator.

The first industrial scale plant is in use at the Imatron Voima coal-fired power station in Inga, Finland. The best recorded result with this installation has been a 90% reduction in flue gas sulphur content. The percentage reduction is dependent on the relationship between the limestone dust, the amount of sulphur present and how near the flue gases are to their dewpoint when the Lifac process takes place.

At 1986 prices the cost of desulphurising lay between four and six Finnish marks per megawatt-hour (heating power) in the size range 150 to 1250 MW.

Source: Industrial News Service

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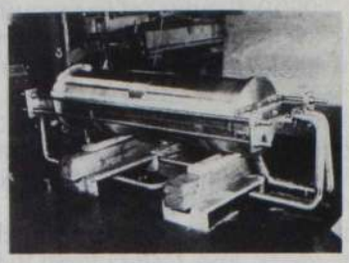
* Tampella

Cartridge heat exchanger

The *Crest TBM* cartridge heat exchanger, which is designed to overcome the problems of fouling and leakage from gaskets, is being introduced to the UK and Europe from the USA by **Crest Process Engineering.** The patented design has no tubes or plates, but consists of a series of cartridges that fit together like a telescope.

The basic component of the heat exchanger is a cartridge consisting of a hollow flange with a hollow walled pipe attached to it. Inside this hollow wall – on the inner wall – is welded a double helix baffle. The heating medium enters at the hollow flange and flows spirally inside the hollow wall up the cartridge to the other end, reverses direction and flows spirally back to the flange. On the outside of the cartridge is welded a single helix baffle. A complete heat exchanger consists of a series of these cartridges fitting one inside the other. Flanges are at alternate ends.



Crest TBM cartridge heat exchanger

The principal application for these heat exchangers is for process fluids which foul, including those containing solids. Because there is a uniform cross-section in the single helix path, there is no dead space. Should fouling begin, the cross-section will narrow, increasing the velocity of the product and providing a simple but effective self-cleaning action.

Reader enquiry no 4/1

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Export order for steam generator

Foster Wheeler Power Products have been awarded a contract for a third 50 t/h skid-mounted steam generator by Pertamina for Indonesia. The boiler, which may be either gas- or oil-fired, or a combination or both, is capable of delivering 50 t/h of steam at a pressure of 44 kg/cm² and at a temperature of 399°C.

An interesting feature of the contract is that the steam generator is skid-mounted for ease of transportation and simplification of erection on site. Contained in the unitised skid-mounted installation will be the boiler, superheater, economiser and associated ductwork; oil/gas burners, turbine/motor-driven forced draught fan; sootblowers, valves and mountings, instruments, controls and local control panel, together with all the interconnecting wiring, pipework, ladders and galleries.

Reader enquiry no 4/2

Modern office equipment

Building techniques have altered to meet the electronic revolution. Similarly the methods of heating, ventilating and air conditioning modern offices have also changed. It has been realised that centralised plant is cumbersome to operate and does not answer the important need of flexibility. **Thermal Technology,** therefore, offer designers a useful range of air conditioning/ventilation products for use in 'high tech' buildings.

Reader enquiry no 4/3

Advanced heat pump model

Stelrad Ideal and **British Gas** have worked together to introduce a full-size model of a gas absorption heat pump at the 1988 *Daily Mail* Ideal Home Exhibition.

The pump, linked to a heat recovery unit to provide total control of the home environment, is a natural progression of work previously carried out by British Gas and Stelrad Ideal into condensing boilers. While condensing boilers have efficiencies of up to 90%, the gas heat pump has an operating efficiency considerably in excess of 100%.

To warm the home, low-temperature heat from the outside air is enhanced by the heat pump. Waste heat from the kitchen, bathroom or laundry is also utilised to pre-warm the incoming air. Economical domestic hot water is supplied from the same system. An option in summer is for the pump to remove heat from the air in the house in a similar manner in which heat is removed from food in a refrigerator. The heat collected is then dissipated to the outside air via a finned heat exchanger working like the coil at the back of a fridge.

Reader enquiry no 4/4

Axial pipe cutter

RIDGID (Ridge Tool (UK)) have introduced their No 208 axial pipe cutter. Used with standard RIDGID radial pipe cutters, it makes lateral cuts in metal pipe so a cleanly cut 'window' can quickly and safely be removed. Developed primarily for gas companies, who commonly insert plastic pipe into old metal pipelines to eliminate leak hazards and improve service pressure, the axial pipe cutter eliminates the need for chisels, hammers or torches which have proved to be hazardous or destructive. No sparks, heat or any other potentially explosive or destructive techniques are involved. The axial cutter pushes the metal aside, rather than abrading it which could cause sparks. It is recommended for use wherever a pipe must be opened without heat or risking damage to whatever is inside.

Reader enquiry no 4/5

Portable gas analysis system

For compliance with new EEC directives on air quality standards and smoke stack emission levels, **ADC,** the infrared gas analysis specialists, have developed a new portable SO_2/NO_x gas analysis system.

Designed to monitor emissions of nitric oxide (NO), sulphur dioxide (SO_2) and oxides of nitrogen (NO_x) from smoke stacks, the system comprises a NO_x-NO converter and hot membrane dryer, a pump for the dryer and infrared gas analysers for NO and SO_2.

It is claimed that the system is suitable for monitoring emissions at several locations where a fixed sampling probe is fitted to each stack to be monitored. By transporting the system to each site in turn, accurate concentration measurements in the range of 0-500 ppm for NO_x and SO_2 can be obtained quickly.

Heated flexible lines can be supplied which ensure that any water vapour in the sample gas does not condense and convert the sulphur dioxide (SO_2) to sulphuric acid (H_2SO_4). The hot membrane dryer removes the water as vapour, allowing for a simple analysis of SO_2. The system can also be extended to measure carbon monoxide (CO), carbon dioxide (CO_2) and oxygen (O_2) concentrations of between 0-100 ppm.

Reader enquiry no 4/6

Multichannel hygrometer

Michell have introduced a multichannel hygrometer, which, it is claimed, is a flexible and economical means of continuously monitoring dewpoint levels at up to nine process locations.

The 1000E MC multichannel hygrometer is designed for applications typically in the fibre-optic and semiconductor industries, where simultaneous monitoring at a number of process stages is usual. It is user-expandable by the insertion of additional Eurocard modules into its front panel, each with an associated sensor. Each module delivers a 0 to 1.0 V output, and contains a continuously rated alarm relay with voltage-free contacts. The states of the various channels may be registered on an analogue or digital display and associated selector switch, while individual channels register their alarm state on an integral LED lamp.

Operational specifications for the 1000E MC include display in ppm or °C dewpoint; resolution of 1°C above −40°C, and 2.5°C below; accuracy of ±3°C above −70°C, and ±5°C below; and four optional ranges of −80 to −25°C dewpoint/1 to 600 ppm V; −60 to −5°C dewpoint/10 to 3000 ppm V; −40 to 10°C dewpoint; and −20 to +20°C dewpoint.

A zero depression facility enables the scale of any channel to be individually depressed, so that dewpoints wetter than the calibrated range can be monitored. They would otherwise cause the instrument to read off-scale. This feature is especially useful during plant start-up, when process gas dewpoints may be initially very high.

Reader enquiry no 4/7

Gas analyser systems

Servomex are expanding their activity in providing complete analyser systems to industry.

Their capability to manage specific high-quality design projects has been strengthened by the introduction of CAD at their Crowborough plant, and quality assurance procedures for analyser systems have won approval to BSI 5750. This equipment is expected to facilitate considerably the development of Servomex analyser systems, individually tailored for a broad range of different industries which regularly include iron and steel, pharmaceutical, power, food processing, construction, chemical and petrochemical.

Servomex appoint a team to manage each project, from the initial concept stage to installation and commissioning. Once the analyser system is operational, after-sales service is provided throughout its life.

Reader enquiry no 4/8

Fixed-point gas blenders

Fixed gas dilutions of 0, 10, 20, 30, 40, 50, 60, 70, 80, 90 and 100% from the **Signal** Model 821 gas blender offer, it is claimed, reliably accurate standards for gas analysis calibration.

Gas blenders have the advantage over certified gas cylinders in that they need less space for gas cylinder storage. In a typical air pollution laboratory, up to five gas analysers may be required and this would necessitate up to 10 gas cylinders. These can be replaced by the Signal Model 821 gas blender reducing the cost of calibration significantly.

The Model 821 has 10 identical capillary tubes through which the main gas and the dilutant are directed. This allows precise ratios to be obtained. Combined with precision pressure regulation upstream of the capillary tubes, this ensures equal pressure of both gases irrespective of the range selected. The results can be verified by a front panel differential gauge.

Reader enquiry no 4/9

Trade publication

Immersion heaters. A new 48-page colour brochure featuring industrial immersion heaters and matching controls is now available from **Eltron.**

The brochure, complete with descriptions, drawings and photographs, details the Eltron range of screwed, flanged and vat/over the side heaters for both safe and hazardous areas. A particular feature are the heater selection tables which are designed to take the user through a step by step procedure to help select the correct heater for his application from the range of 2500 standard heaters from 1 kW to 1000 kW. A special section deals with the Eltron range of controls, from simple on/off control to sophisticated thyristor systems.

Reader enquiry no 4/10

ENERGY WORLD – COMMERCIAL
(Photocopy acceptable)

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

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

Name .....

Address .....

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Organisation .....

The president-elect: C E Pugh CBE

Ted Pugh was the managing director of the National Nuclear Corporation at Knutsford until he retired in September 1987. He joined the Institute in November 1956 as an Associate Member of what was then the Institute of Fuel. He became a Fellow in February 1988. He is also a Member of the Institution of Mechanical Engineers and an Honorary Fellow of the Institution of Nuclear Engineers. He was educated at Bolton Technical College and is married with three grown-up children. He lives in Cranage in Cheshire.

Ted was born in 1922 and brought up in Bolton in Lancashire. He left school at the age of seventeen and joined a local engineering firm as an apprentice draughtsman. In 1942 he joined the Lancashire Electric Power Company as a junior construction engineer and was associated with the construction of additional plant for the company. He was a member of the team which constructed the C extension of Kearsley Power Station, which consisted of 2 × 50MW sets and associated spreader stokers. This was the major plant owned by the Lancashire Electric Power Company. It was here that his great enthusiasm for designing and building power stations was born.

When the power industry was nationalised in April 1948, he became a senior mechanical engineer in the North West division of the then British Electricity Authority. In this capacity he was responsible for the extensions to Blackburn Power Station consisting of 2 × 40MW units with extensive reconstruction of the whole station. At the same time he was responsible for the construction in the Fylde area of 3 × 30MW sets at Fleetwood. He was appointed a project engineer in 1951 and became responsible for a series of coal-fired stations including Agecroft C, the first of the 120MW sets, and Padiham B, which had a cyclone boiler and a slag tap boiler. In this 10 year period he was involved in the design and construction of five major coal-fired stations together with a number of construction activities on rivers, weirs and tunnels.

After this he then took on the responsibility for the last of the Magnox reactors to be built, located at Wylfa in Anglesey, and for 10 years led this massive undertaking which consisted of 2 × 660 MW reactors and 4 associated turbines. This plant has proved to be very successful and is operating at a load factor which makes it a highly profitable station. During this time he was responsible for placing contracts for the AGRs at Heysham 1 and Hartlepool.

The construction and design groups of the CEGB were combined and transferred to Gloucestershire in 1971. This was a new organisation for the design and construction of power stations, and he was responsible for setting up one of the major activities: the Electrical, Control and Instrumentation Branch.

He later took special responsibility for corporate planning involving improvement in performance of design and construction activities for the Barnwood Division.

In 1976 he was made the responsible director for the Advanced Gas Cooled reactor programme. This included Dungeness B and Hartlepool and Heysham 1. He spent the next eight years in completing the construction and commissioning of this plant. He was also responsible for Hinkley B AGRs and Drax A 660MW sets at the later stages of completion.

In 1982 he transferred to NNC to lead the PWR design team which was located at Whetstone at that time. This was a combined team of CEGB and NNC personnel together with Bechtel and Westinghouse staff. He worked in this capacity for two years during which time a revised design was produced and the safety case established to enable the project to be submitted for planning approval and the rigours of the Public Inquiry for Sizewell B.

He became managing director of the National Nuclear Corporation in January 1984. He served in this capacity for almost four years before his retirement in 1987. During his period as MD he had the overall responsibility for the construction and commissioning of the AGRs at Heysham 2 and Torness and also for the Fast Reactor development including the European cooperation. He was part of the management team responsible for the PWR programme during the Public Inquiry stages and the subsequent post-approval stage.

Since retirement he has retained his interest in the power industry and follows the privatisation plans with keen interest. His hobbies include, gardening, walking, wood turning and pottery.

He was awarded the CBE in the New Year's Honours List of 1988.

The Engineering Council *New director general*

The Engineering Council has announced that **Denis Filer** FEng, director of engineering at Imperial Chemical Industries, is to be the new director general of the Council. Mr Filer, aged 55, will take up his post on 1 August 1988, when the present director general, **Dr Kenneth Miller** FEng retires. Dr Miller was appointed the first director general of the Council in July 1982.

Mr Filer was promoted within ICI in 1981 to be director of engineering with corporate responsibility for the establishment and operation of the centralised engineering department and execution of a £450 M per annum capital programme in the UK and continental Western Europe. He was also involved with elements of the worldwide capital programme, totalling £700 M.

He joined ICI in 1955 and became a project manager in 1960. Other posts at ICI included: assistant works manager at Wilton Works, Teesside (1973); engineering manager of the plastics division at Welwyn Garden City (1976); and engineering and production director of the plastics division (1978).

Mr Filer went to Manchester University, gaining a BSc in mechanical engineering. He also gained a BA degree at the Open University last year. Mr Filer is a Fellow of the Institution of Mechanical Engineers and a Fellow of the Fellowship of Engineering (FEng).

He has been a Member of the Engineering Council since 1986 but resigned in order to accept his appointment as the new director general. He has also resigned from the Council's committees and, in particular, from the chairmanship of its Continuing Education and Training Committee.

Britain 'needs more engineers as managers'

British industry needs to put more effort into developing Chartered and Technician Engineers into managers. In a report *Management and business skills for*

(Continued, 3rd col, p19)

Branch report – North-Eastern
Renewable energy research and development within the UK

The final meeting of 1987 held by the North-Eastern branch (organised jointly with the Institution of Electrical Engineers) was a presentation on 14 December 1987 by **Godfrey Bevan** of the Department of Energy. His theme was the prospects for *Renewable energy research and development within the United Kingdom.*

Mr Bevan began by outlining the scale of funding for research and development. Since 1975 six hundred contracts have been commissioned utilising £100 M of Department of Energy funds. This has resulted in over five hundred reports being made available on such developments as geothermal hot dry rocks and passive solar housing design.

Mr Bevan, a member of the energy efficiency management team at the Department of Energy, examined the sources of income for research and development. A total of £14 M per annum is set aside for R & D with external contributions amounting to a further £3 M per annum. This compares with a public sector (DTI, CEGB, etc) outlay of £3.5 M per annum and the private sector, although no figures are available, are assumed to set aside around £10-20 M per annum for their own energy research.

Before outlining individual projects Mr Bevan discussed the classification system used for any projects undertaken. Every new project is assigned one of three categories – shown in the table 'Alternative energy sources'. First, there is 'economically attractive' which implies that the energy source has excellent potential for being commercially viable. As a result the development of the project is encouraged and publicised. Next is the 'promising project' status, indicating that the possibility of a particular project becoming economically attractive relies upon large cost improvements or a fuel price rise. The objective, therefore, is to try and achieve a cost reduction and improve performance so that it may be determined whether the project does have economic viability. Finally, projects which will only be viable in the unlikely event of a dramatic fuel price rise or the equivalent reduction in costs are given the 'long shot' status.

With the use of many colourful slides Mr Bevan described the projects presently being funded. One of the newest and most exciting technologies is the utilisation of geothermal hot dry rocks. Here the hot rocks present at considerable depth heat circulating water which is then used to generate electricity. The resource is defined as promising, but problems have been encountered in creating the necessary underground fracturing systems which allow water to circulate. Plans have been drawn up, however, for commissioning a 10 MW plant by the early 1990s.

Another of the promising projects is land-based wind power. This method of generation can produce electricity at 2.5-3.2p/kWh. At present there is a 3 MW horizontal axis wind turbine feeding power into the national grid from a site in Orkney. The machine is the most heavily monitored in the world – reflecting Department of Energy interest in this form of electricity generation. At present the public acceptance of the large scale deployment of wind turbines is seen as a potential problem associated with future development.

Of all the projects described, one of the largest potential contributors is tidal power. If every reasonably practical estuary were to be employed, the resource could generate energy equivalent to a fifth of present electricity consumption in England and Wales.

The last of the renewable energy sources discussed is probably the most promising of all. The group of projects comes under the general description of biofuels which encompasses the use of crops or waste as fuel, as well as gas from landfill sites as a source of energy. The potential contribution from biofuels has been estimated at 40.2 Mt of coal equivalent (Mtce) with an expected contribution of 23.6 Mtce by 2025.

Mr Bevan concluded his presentation by discussing the future trends in developing methods of marketing and improving project management. In the future, research and development will be concentrated on the more promising of the projects described above. The Government has indicated that there should be a drive to obtain private sector funding for projects plus greater technological transfer and promotion, hopefully increasing awareness of the projects leading to greater public acceptance once the marketing stage is reached.

At the end of the meeting Mr Bevan answered a wide range of questions from the audience. This was followed by a vote of thanks, proposed by Dr D A Hall, for a well presented and entertaining lecture.*

Colin A Johnston and Andrew W Cox

* The Department of Energy now publish a quarterly journal on renewable energy sources *Review*. This takes over from *RE News*, the newsletter produced since 1979 by ETSU. For more information about the Renewable Energy Research Development Programme, contact: Renewable Energy Enquiries Bureau, ETSU Building 156, Harwell Laboratory, Oxfordshire OX11 0RA (tel (0235) 432450)

Scottish branch: (left to right): Robert Stafford; Alasdair Thomas; Scottish branch chairman Dr John Barr; Jim Leach (education and membership officer, Institute of Energy); Ian Melville (Energy Efficiency Office); Scottish branch vice-chairman John Moyle

Scottish: John Rayner Shield competition

The Scottish students' evening was held at the Royal Scottish Automobile Club, Blythswood Square, Glasgow on Tuesday 19 January 1988.

There were two entries this year, both of a higher standard than in previous years:

Robert Stafford read a paper on *Combined heat and power.* This grew out of his experience working for the North of Scotland Hydro-Electric Board. It was largely a paper exercise but he presented the paper in an able manner, illustrating his talk with many good slides, and he dealt with questions afterwards adequately.

Alastair Thomas had worked with Tetley who make tea bags but also make a cereal called *Ready Brek*. A cereal slurry is cooked and dried on heated rollers. Alasdair explored the possibility of controlling the dryer automatically. He presented a good analysis of the measurements which would be required to control automation. In the question time that followed

(Continued, 3rd col, p 19)

Table: Alternative energy sources

Technology	Category	Economics (Estimated power costs p/kWh)§	Prospects in UK	Constraints on widespread deployment in UK
Renewable energy technologies which produce heat:				
Passive solar design	★★★★★	Many applications cost effective against 1985 fuel prices.	Estimated 2 Mtce/y by 2025 in domestic sector plus many opportunities in the non-domestic.	Rate of new building and renovation. Uptake by the building industry.
Geothermal aquifiers	★	Not yet cost effective.	Limited (<0.25 Mtce/y) unless constraints are circumvented.	Lack of heat loads near productive aquifiers. High initial financial and geological risks.
Active solar heating: – water	★	Not generally cost effective except for swimming pool heating.	Generally limited, but some scope in special cases.	Poor economics.
Active solar heating: – space	★	Not cost effective.	Very limited.	Complex technology. Low load factor. No clear way to improve economics.
Renewable energy technologies which produce electricity:				
Hydropower: – large scale central generation	★★★★★	Already deployed by the generating boards.	Almost fully exploited.	Most available sites already developed. (4.3TWh)
Hydropower – small scale (up to 5MW)	★★★	Depends on site.	Uncertain: under study at present.	Rates and extraction charges. Environmental impact.
Wind power – on land	★★★	2.5 – 3.2 depending on site.	Uncertain, but could reach 15GW by 2030, or 10% of present electricity generation.	Public acceptability. Rate of installation.
Tidal power	★★★	Ranges from 3.0, depending on estuary.	23 TWh/y (11 Mtce/y) from those estuaries with estimated costs of 5p/kWh or less.	High capital costs and large lead times of large projects. Public acceptability.
Geothermal HDR	★★★	3 – 6 (1985)	Technology is not yet proven technically and economically.	Undeveloped technology. Risk of failure to create a productive well.
Wind power: – offshore	★	4 – 7	Offshore technology not yet proven technically and economically.	Technology yet to be proven in the harsher environment.
Wave power: – large, open seas (2 GW)	★	9 – 14 (1982)	Limited by poor economics of present devices. Still scope for improvement.	Economics. Technology not yet proven and developed.
Wave power: – small, shore mounted (1 MW)	★★★	Could be competitive now in some locations.	Total resource limited by available sites.	Availability of sites. Commercial devices not yet developed.
Photovoltaics	★	8 to 64 from system costing £1 to £8 per peak watt.	Very limited without a major breakthrough on costs.	Cost. Mismatch between supply (summer) and demand (winter).
Biofuels technologies:				
Dry wastes: – domestic – industrial – commercial	★★★★★	Some applications cost effective now.	For all dry wastes: 5 Mtce/y economic at 1985 fuel prices.	Reliability of plant not yet proven.
Dry wastes: – straw	★★★★★	Some applications cost effective now.		High cost of transport of straw. Needs in-field compaction equipment.
Dry wastes: – wood wastes – forest thinnings	★★★★★	Some applications cost effective now.	Estimated 8 Mtce/y by 2025.	Competing for supply against other uses.
Wet wastes: – landfill gas	★★★★★	Cost effective in favourable situations at 1985 fuel prices.	For all wet wastes: 0.8 Mtce/y at 1985 fuel prices.	Availability of users near the landfill site.
Wet wastes: – sewerage & industrial effluent	★★★★★	Cost effective in many applications at 1985 fuel prices.		Confidence in use for treating industrial effluents.
Wet wastes: – animal and crop wastes	★	Not yet cost effective.	Estimated 1.6 Mtce/y by 2025.	Poor economics in absence of environmental credit.
Energy crops: – forestry	★★★	Vary with site and with the crop.	3 Mtce/y economic now at 1985 fuel prices. Up to 10 Mtce/y by 2025.	Lack of supply infrastructure.
Energy crops: – other crops	★	Uncompetitive against 1985 fuel prices.	Some scope for harvesting bracken, to use like straw.	High production costs, low yields.

KEY: ★★★★★ Economically attractive ★★★ Promising but uncertain ★ Long shot
§ 1984 costings except where stated.

Scottish branch: Alasdair Thomas (left) receives the 1988 John Rayner Shield from Ian Melville (Energy Efficiency Office)

he indicated the kind of management system he proposed to use. He also raised the question of slurry preparation and said that he hoped to examine this during the summer vacation of 1988.

Guests for the evening were staff from Napier College, Edinburgh; *Jim Leach* the Institute's education and membership officer from London; and *Ian Melville* from the Energy Efficiency Office. While the panel of adjudicators was reaching its decision, Jim Leach talked to the young engineers about the Institute of Energy. Since the branch started the John Rayner Shield competition, the number of Student Members and TEng Members has increased considerably.

Adjudicators' decision

On the return to the adjudicating panel, Scottish chairman *Dr John Barr* reported that the adjudicators were unanimous that the two papers were both superior to the paper which won the Shield last year. On balance they judged the second paper to be the winner. Alasdair Thomas had got his hands dirty exploring a real engineering situation and had impressed them with the logic of his engineering analysis.

Ian Melville presented the John Rayner Shield 1988 to *Alasdair Thomas* with a cheque for £25 and the runner-up prize of £25 to *Robert Stafford*. John Rayner's son, another John Rayner, had been invited to present the Shield, but he had to be in Switzerland on that night.

Before the presentation, Dr Barr spoke of John Rayner's long service to the Scottish branch as honorary secretary and as chairman. He reminded them of the fascinating history Mr Rayner wrote of the Scottish branch. There was hearty applause as the meeting agreed to send warm greetings to Mr Rayner, who now lives in Australia.

The Engineering Council (continued)

*engineers**, the Engineering Council says that if more British companies are to compete effectively in world markets 'we need to ensure that our best resources are used to achieve forward-looking leadership to meet future needs'.

* Copies of *Management and business skills for engineers* can be obtained free from the Engineering Council, 10 Maltravers Street, London WC2R 3ER (tel 01-240 7891)

The president of the Institute of Energy, Dr E G Masdin, presented David Fishlock OBE, science editor of the Financial Times, *with his Companion's Certificate at a luncheon party held at the Shell Centre on Friday 5 February 1988. Our photograph shows (left to right): M C Roberts (Member of Council); N G Worley (Publications and Conferences Committee chairman); Dr E G Masdin (president); Prof B J Brinkworth (vice-president); Dr A-M Warris (Member of Council); Prof Alan Williams (honorary secretary); David Fishlock OBE; C E Pugh CBE (president-elect); B G Gills (Executive Committee chairman). A Shell photograph, by courtesy of Shell UK Administrative Services*

The Engineering Council (continued)

The report goes on: 'Our leading industrial competitors appear to make better use of qualified leadership in the running of their industries'. The proportion of company directors who have graduate or other professional qualifications is 24% in the United Kingdom, compared with 62% in West Germany, 65% in France, and 85% in Japan and the USA. 'We need to ask ourselves,' says the Council, 'whether we are making the best use of the potential of those young people who train as engineers'.

The report explains how engineers, by virtue of their education, training and experience, are ideally suited to be trained and developed into managers. 'Much effort must be made by the individual, and a potential manager should be self-selecting,' says the report 'but it is up to employers to provide the opportunity for training and development if engineers are to grow to become successful managers.' It spells out the roles that employers, individual engineers, engineering institutions, providers of education and training, or Government can play in helping to bring about real progress in this important field. 'If we take heed and act on the suggestions given, the long-term benefits to this country will be very far-reaching and should help to improve the country's industrial competitiveness in world markets,' says the report.

Key technologies

Companies are urged to identify those 'key technologies' which are likely to have most impact on their future business so that they are in a good position to use them and stay competitive. The call comes in *The key technologies: Some implications for education and training*, published by the Engineering Council and the Further Education Unit on 4 March 1988.

The Engineering Council defines key technologies as newly emerging topics in science and engineering which are likely to have a major evolutionary effect on an existing product or process or may lead to a revolutionary new product or process. It says that engineers and technicians must not only recognise the importance of key technologies but must also have the educational background to be able to work with them.

To provide that background, educational establishments should identify, in consultation with their industrial partners, which of the changing technologies they should use as examples in their teaching. Regular reviews of technology-based curricula would ensure that course content and methods of learning would be up to date.

Obituary

R J Davies (Fellow) has died at the age of 55. He joined the Institute of Fuel (now Energy) in 1966.

Dr C C Hall CB (Senior Fellow) died in November 1987 after a long and painful illness. Dr Hall was a former director of Warren Spring Laboratory, Stevenage.

He joined the Institute in 1954 and was elected to Council 10 years later. In 1967 he also became a member of the Fuel Abstracts Panel and in the following year took over as chairman. He continued as chairman until half way through 1971, when Council agreed that it would be more appropriate for the Panel to become a sub-committee of Publications Committee rather than of Finance and General Purposes Committee.

Dr Hall had joined Finance and General Purposes Committee in 1968, but after the sudden death of the chairman, G F J Murray, in December 1968, he himself agreed to take up the chairmanship in the new year. He remained as chairman until he retired from Council in 1972. J H Flux (past president), who succeeded him as Committee chairman, has written: *It was always a pleasure to attend a meeting under the leadership of Dr Hall. The members were allowed a free and full rein in discussion and then brought back to the realities of the subject by his quiet and masterful summing up.*

Dr Hall had also in 1969 been appointed one of the Institute's six vice-presidents. He continued to serve in this office again until the annual general meeting in May 1972.

H S Horsman (Senior Fellow) died on 14 January 1988 at the age of 97. Mr Horsman was a Founder Member of the then Institute of Fuel.

J C Longley (Member) died in February after a long and distressing illness, at the age of 82. He joined the Institute more than 40 years ago in 1947, and had always shown great interest in the Institute's activities.

Personal

B Deakin (Member), works engineer at the University of East Anglia, has been elected chairman of the Association of University Engineers. This association has 120 members from 46 UK universities.

Since 1985 Mr Deakin has also been chairman of the Norwich Energy Management Group and a member of the Eastern Area Chairmans Committee. He represents the Group on the Norwich Energy Action Campaign Steering Group whose aim is to encourage all citizens to make better use of energy in 1988 and beyond. The campaign was launched at Norwich City Hall on 10 March 1988 by Bryan Emmett, director general of the Energy Efficiency Office, in the presence of the Lord Mayor of Norwich.

The Rt Hon Lord Gray of Contin has agreed to become a member of the Council of Management of the national charity Neighbourhood Energy Action, in the position of a vice-chairman. Lord Gray was Minister of State for Energy from 1979 to 1983.

Sir Eric Neal AC (Member) was appointed on 26 January 1988 a Companion in the General Division of the Order of Australia, for service to commerce and to the community.

New members

Fellow

Raymond Glyn Herapath, University College of Swansea *(transfer)*

(Continued on p23)

REGISTER OF ENERGY COURSES

Course No 00-396

Title: Avoiding contractual pitfalls.
Duration: 1 day.
Location: Wolverhampton Polytechnic.
Starting: 4 May 1988.
Content: Examination of the commonly used forms of contract. Contract and specification drafting to avoid misunderstanding and properly to define responsibilities. The differing approaches of specifier, contractor and manufacturer.

Course No 00-397

Title: Arbitration, practical procedures.
Duration: 1 day.
Location: Heriot-Watt University, Edinburgh.
Starting: 5 May 1988.
Content: A guide through the arbitration process from the decision to go to arbitration to the award.

Course No 00-398

Title: VAV air conditioning design.
Duration: 1 day.
Location: Heriot-Watt University, Edinburgh.
Starting: 10 May 1988.
Content: Variable air distribution. Terminal geometry. Heating methods. System types. Fan capacity control. Noise. Space occupied. Energy consumption. Running costs.

Course No 00-407

Title: Efficient use of electricity and lighting.
Duration: 1 day.
Location: Polytechnic of the South Bank, London.
Starting: 10 May 1988.
Content: Efficient lighting design. Efficient light sources. Light switching and motor control. Electrical tariffs and monitoring.

Course No 00-399

Title: Managing people profitably.
Duration: 1 day.
Location: CIBSE, London.
Starting: 11 May 1988.
Content: Building teams. Diagnosing organisation problems. Efficient use of management resources. Building an effective company. Strategic planning for the future. Environment, government, economic and competitive forces.

Course No 00-401

Title: Domestic heating and hot water service – practical design.
Duration: 1 day.
Location: CIBSE, London.
Starting: 18 May 1988.
Content: Heating and hot water systems. Heat losses. Small bore, microbore, sealed systems. Boiler, radiator and system selection. Pipe sizing and distribution. Controls. Flues. Pumps-sizing and positioning, cylinder sizing and pipework.

Course No 00-402

Title: Control system integration.
Duration: 1 day.
Location: CIBSE, London.
Starting: 19 May 1988.
Content: Control principles and regimes. Simple theory and applications. Control system components, optimisers, compensators. Control characteristics. Matching HVAC systems and their controls.

Course No 00-408

Title: Statistical analysis for management.
Duration: 3 days.
Location: Polytechnic of the South Bank, London.
Starting: 23 May 1988.
Content: Representation of statistical data. Statistical measure. Correlation and regression. Discrete and continuous data. Confidence levels and basic statistical tests. Operational research techniques – linear programming. Identification of feasible solutions by analytical methods using constraint profiles. Stock control by analytical means. Planning techniques for resource allocation and programming including critical path methods of network analysis.

Course No 00-403

Title: Managing the commissioning of HVAC plant.
Duration: 1 day.
Location: Wolverhampton Polytechnic.
Starting: 24 May 1988.
Content: Past and current practices. Pre- and post-tender procedures. Design provisions. Planning. Works testing. Site quality control. System defects and remedies. Controls commissioning. Supporting specialist suppliers. Handover procedures.

Course No 00-393

Title: Understanding heat treatment.
Duration: 3 days.
Location: Wolfson Heat Treatment Centre, Aston University.
Starting: 24 May 1988.
Content: Basic metallurgical theory of heat treatment. Quenching principles and practice. Surface hardening theory and practice. Furnace types, materials and heating methods. Salt bath heat treatment. Atmosphere theory, production and control. Temperature measurement. Quality control and laboratory testing of heat-treated materials.

Course No 00-404

Title: Avoiding contractual pitfalls.
Duration: 1 day.
Location: CIBSE, London.
Starting: 25 May 1988.
Content: (See course no 00-396).

Course No 00-405

Title: Control system integration.
Duration: 1 day.
Location: Wolverhampton Polytechnic.
Starting: 26 May 1988.
Content: (See course no 00-402).

Course No 00-394

Title: Combustion of solid fuels.
Duration: 1 week.
Location: The Netherlands.
Starting: 19 September 1988.
Content: Solid fuels: sources, properties and impacts. Combustion aerodynamics. Devolatilisation of solid fuels. Coal ignition and extinction. Gas phase combustion of volatiles. Heterogeneous char combustion. Fundamentals of NO formation and destruction (gas and solid phase). SO_x fundamentals. Further combustion-generated by-products. Thermal radiation in coal-fired combustors. Mathematical modelling of coal-fired combustors. Research in the area of solid fuel preparation. Pulverised fuel boilers. Non-utility application of solids combustion. Fuel-related problems in boiler operation. Removal of noxious components from flue gases. NO_x abatement during combustion. Fluidised bed combustion. Removal of solids from flue gases. By-products of solid fuel combustion.

Institute of Energy AGM

The annual general meeting will be held at the Institute of Energy, 18 Devonshire Street, London W1N 2AU on *Thursday 26 May 1988* at 1030 h.

South Wales and West of England: meetings

Wednesday 11 May 1988. An afternoon works visit has been arranged to the newly refurbished Port Talbot works of the British Steel Corporation. Numbers are limited and applications to the chairman will be considered in order of receipt. Closing date *1 May 1988.*

Friday 1 July 1988. Dr Frank Fitzgerald FEng (managing director, technical, British Steel) will deliver the 15th Walter Idris Jones Memorial Lecture at the Court Colman Hotel, near Bridgend (see loose insert).

The practical application of energy efficiency: Stockton-on-Tees, 8 June 1988

The Department of Civil and Structural Engineering and Building, Teesside Polytechnic are holding their seventh annual one-day energy conference at the Swallow Hotel, Stockton-on-Tees on *Wednesday 8 June 1988.*

The cost is £35.00 (including VAT and one set of papers), which covers lunch, morning coffee and afternoon tea.

Provisional timetable

0900-0930	Reception desk opens for delegates.
0930-0935	Welcome to hotel by assistant director (resources), D G Leyland.
0935-0950	Opening paper by chairman for morning session, *M G Burbage-Atter* (chairman, North-Eastern branch of the Institute of Energy and the Institution of Plant Engineers).
0950-1010	Paper 1 – *L Gillis* (South Tees Area Health Authority).
1010-1030	Paper 2 – *R Harrop* (B.A.S.F. Chemicals, Seal Sands).
1030-1050	*Coffee.*
1050-1120	Paper 3 – *Dr P Sedgwick,* (Durham County Council).
1120-1140	Paper 4 – *E McLanders* (Associated Heat Services). *Contract energy management.*
1140-1210	Discussion on morning papers.
1210-1400	*Lunch.*
1400-1405	Introduction by chairman for afternoon session, *J Barton* (chairman, Teesside Energy Managers Group).
1405-1425	Paper 5 – *A Proud* (Yorkshire Regional Health Authority).
1425-1445	Paper 6 – *C R Hall* (Resinous Chemicals, Gateshead).
1445-1505	Paper 7 – *J Richardson* (formerly North Yorkshire County Council).
1505-1520	*Tea.*
1520-1550	Open forum.
1550-1600	Closing remarks.

Further information from M G Burbage-Atter, Teesside Polytechnic, Department of Civil and Structural Engineering and Building, Middlesbrough, Cleveland TS1 3BA (tel 0642 218121).

Energy efficiency in buildings: Newcastle upon Tyne, 12 October 1988

M G Burbage-Atter, chairman of the Institute's North-Eastern branch, is organising, on behalf of the branch, a one-day energy conference and exhibition with the theme: *Energy efficiency in buildings.* This will be held in the Civic Centre, Newcastle upon Tyne on Wednesday 12 October 1988. Full details to be announced.

Petroleum exploration and production management: Oxford, June 1988

The College of Petroleum Studies, Oxford have arranged the following courses for June 1988.

6-10 June	A five-day course in Oxford. *Petroleum economics – from crude and gas to petrochemicals.* Course code OV1.
13-17 June	A five-day course in Oxford. *Crude oil supply, transportation, refining and trading.* Course code SP1. This course will be repeated 10-14 October 1988.
20-22 June	A three-day course in Oxford. *Understanding the international condensates business.* Course code NG1. *New course.*
20-24 June	A five-day course in Oxford. *Natural gas – the technical issues.* Course code NG2. *New course.*
27 June-1 July	A five-day course in Oxford. *Natural gas – the commercial realities.* Course code NG3. *New course.*

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

The future of pumping: Offers of papers for 11th BPMA conference invited

BHRA, the Fluid Engineering Centre, are collaborating with the British Pump Manufacturers Association and the National Engineering Laboratory, East Kilbride, in organising the eleventh BPMA technical conference at Churchill College, Cambridge from 17 to 19 April 1989. The theme of the meeting will be *New challenges – where next?* and offers of papers are invited.

Throughout industry there is a strong demand for improved performance in terms of higher efficiency, reliability and safety, as well as longer life for both plant and the pumps used within a system. As deepwater and marginal oil and gas reserves are exploited, subsea systems will require pumps which can handle gas/liquid mixtures effectively in order to achieve economic production. In process plant too, users are now seeking improved product quality and reduced production costs. Manufacturers and users need to combine to ensure accurate specification and quality assurance. This meeting aims to bring together designers, manufacturers, contractors, users and researchers to discuss the future of the pump industry and methods of meeting the challenges of the 1990s and beyond.

In addition to the technical sessions, a number of workshops on specialist topics will be arranged covering: subsea pumping; biotechnology; automation; costs; and environmental requirements.

Offers of papers should be sent to the BPMA (11th technical conference), Artillery House, Artillery Row, London SW1P 1RT by the end of *May 1988.*

Further information can be obtained either from the BPMA or from the conference organiser (Pumps), BHRA, the Fluid Engineering Centre, Cranfield, Bedford MK43 0AJ (tel (0234) 750422; tlx 825059).

Gordon Research Conferences 1988

The 1988 Gordon Research Conferences will be held at various locations in New Hampshire and Rhode Island, USA from 13 June to 26 August. We publish below the programme of the conference on *Fuel science* which will be held in the

(Continued on p23)

Special announcements (continued)

New Hampton School, New Hampton, New Hampshire from 4-8 July 1988.

M L Gorbaty, chairman; T G Squires, vice-chairman

4 July.
(E C Moroni, discussion leader): F P Burke, *Carbon isotope ratios of fossil fuels and derived products;* C W Curtis, *Interactive chemistry of coal-oil reactions;* B C Bockrath, *Identifying reaction mechanisms in complex media;* (E C Moroni, discussion leader): J G Gatsis, *Chemical behaviour of asphaltenes in coal/oil interaction;* J Potter, *Optical methods to study thermal degradation of coal.*

5 July.
(D D Whitehurst, discussion leader): E Fitzer, *Model compound studies of coking mechanisms;* H P Stephens, *Hydrogen transfer and 'coke' formation on coal liquefaction;* J D Bacha, *Importance of alkyl substituents in coke formation;* D D Whitehurst, discussion leader): L S Singer, I C Lewis, R A Greinke, *Kinetics and mechanisms of pitch polymerisation.*

6 July.
(H Marsh, discussion leader): A Oberlin, *Structural and microtextural descriptions of mesophase and coke formation;* I Mochida, *Modelling and control of delayed coking for needle coke;* K van Heek, *Physical and chemical properties of coal hydropyrolysis chars;* (M Siskin, discussion leader): M Siskin, *Structure of Rundle Ramsay crossing oil shale kerogen;* I R Kaplan, *Role of minerals in the thermal decomposition of kerogen and coal.*

7 July.
(M Siskin, discussion leader): A K Burnham, *Modelling the kinetics of petroleum generation;* D N Taulbee, *Concentration and characterisation of macerals from Devonian oil shales;* T O Mitchell, *Low severity oil shale liquefaction;* (M L Gorbaty, discussion leader): R M Perhac, *The acid rain issue.*

8 July.
(H L Retcofsky, discussion leader): M Francisco, *Sulphur structures in petroleum residua;* E W Hagaman, *DCP MAS C13 NMR – a new method for gaining structural information at coal reaction centres;* Y Sanada, *In-situ monitoring of pyrolysis and hydrogenation of heavy hydrocarbons with high temperature and high pressure NMR and ESR.*

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Institute news (continued)

Member

Hon Fai Chan, Environmental Protection Dept, Hong Kong
Paramjit Sihre, British Gas, Midlands Research Station *(transfer)*

Graduate

Stuart John MacPherson, Premier Products, Livingston
Stephen David Roser, British Gas South Western, Gloucester *(transfer)*
Brian Geoffrey Samuel, Suffolk County Council *(transfer)*
Anthony James Scorer, W S Atkins & Partners, Middlesbrough

Student

Jane Louise Arrowsmith, University of Leeds
Hamid Reza Asadi-Aghdam, University of Leeds
Jameel Basheer Ahmed, University of Leeds
Alexander James Arthur Bristor, University of Newcastle upon Tyne
Timothy William Burns, University of Leeds
Lwando Chitumbo, University of Newcastle upon Tyne
Delyth Churchill, University of Newcastle upon Tyne
Martin James Curtis, University of Newcastle upon Tyne
John Malcolm Dickens, Portsmouth Polytechnic
Kenneth David Duncan, Napier College of Commerce & Technology
Paul Guy Foster, Polytechnic of the South Bank
David George Richard Gudgeon, University of Leeds
Alice Jessica Hallidie, Portsmouth Polytechnic
Jonathan Reay Harris, University of Leeds
Jane Louise Harvey, University of Sheffield
Paul Christopher Hassall, Wirral College of Technology
Parvez Sayeed Hussain, University of Aston, Birmingham
Peter Alexander Haweis James, Portsmouth Polytechnic
John Morrison Latimer, Polytechnic of Wales
Raymond Liu, University of Leeds
Steven Myszkowski Marshall, Napier College of Commerce & Technology
Timothy O'Doherty, University College, Cardiff
Jonathan Edward Paddison, Loughborough University
Neil Edwin Presland, Portsmouth Polytechnic
Callum Forbes Stuart, Napier College of Commerce & Technology
Joanna Barbara Stuart, University of Newcastle upon Tyne
Ian Colin Vinton, Portsmouth Polytechnic
Richard Peter George Winter, University of Leeds
Hui Keat Wong, University of Sheffield

Institute of Energy

1988 Branch conferences

South Coast

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

North-Eastern

12 Oct (W). One-day energy conference and exhibition: *Energy efficiency in buildings.* Civic Centre, Newcastle upon Tyne.

1988 May meetings

North-Eastern

4 May (W). AGM. ICI Wilton, Teesside.

South Wales and West of England

11 May (W). Afternoon visit to newly refurbished Port Talbot works, BSC. Numbers limited. Applications to chairman considered in order of receipt. Closing date *1 May.*

National

26 May (Th). AGM. Institute of Energy, 18 Devonshire Street, London W1N 2AU at 1030 h.

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Institute of Energy AGM

Thursday 26 May 1988

18 Devonshire Street, London W1N 2AU
at 10.30 a.m.

CONFERENCES

The following conferences, courses and meetings are organised by bodies other than the Institute of Energy. For Institute conferences please see IFC and p 23.

May 1988

Safety of next generation power reactors

Conference, Seattle (USA), 1-5 May 1988.
Details from Alan Waltar, Westinghouse Hanford Co, PO Box 1970, Richland, Washington 99352, USA.

Power generation and the environment

Evening meeting, Exeter, 12 May 1988.
Details from Institution of Electrical Engineers, Savoy Place, London WC2R 0BL (tel 01-240 1871; tlx 261176 IEE LDN G; fax 01-240 7735).

Northern control & instrumentation

Exhibition and conference, Manchester, 17-19 May 1988.
Details from: *(exhibition)* MGB Exhibitions, 30 Calderwood Street, London SE18 6QA; *(conference)* Michael Yates, Institute of Measurement and Control, 87 Gower Street, London WC1E 6AA (tel 01-387 4949).

Coal preparation

Fourth Australian coal preparation conference, Gladstone (Queensland, Australia), 23-27 May 1988.
Details from Coal Preparation Society of Queensland, GPO Box 908, Brisbane, Queensland 4001, Australia.

June 1988

Wind energy

European Community conference and exhibition, Herring (Denmark), 6-10 June 1988.
Details from H S Stephens & Associates, conference organisers, Agriculture House, 55 Goldington Road, Bedford MK40 3LS (tel 0234 49474).

Installation engineering

Third international conference, London (IEE), 7 and 8 June 1988.
Details from Conference Services, Institution of Electrical Engineers, Savoy Place, London WC2R 0BL (tel 01-240 1871 ext 222).

The Australian contribution to Britain

Conference, London (Royal Society), 7 and 8 June 1988.
Details from the secretary, Australian Studies Centre, 28 Russell Square, London WC1B 5DS (tel 01-580 5876).

Eurocon 88

Eighth European conference on electrotechnics, Stockholm (Sweden), 13-17 June 1988.
Details from Eurocon 88, c/o Stockholm Convention Bureau, PO Box 1617, S-111 86 Stockholm, Sweden.

June 1988 (continued)

Cogeneration

1988 congress, Atlantic City (NJ, USA), 13-17 June 1988.
Details from Alma McFarland, Association of Energy Engineers, Suite 340, 4025 Pleasantdale Road, Atlanta, GA 30340, USA.

Engineering aspects of magnetohydrodynamics

26th symposium, Nashville (TN, USA), 20-22 June 1988.
Details from Dr J W Muehlhauser, University of Tennessee Space Institute, Tullahoma, TN 37388, USA (tel (615) 455-0631).

June/July 1988

Energy 88

Exhibition, Moscow (USSR), 27 June-2 July 1988.
Details from Yvonne Sulfrian, Glahe International Group, Woodcroft, Bures Hamlet, Suffolk CO8 5DU (tel 0787 228086; tlx 98424 GLAHE G; fax 0787 228164).

July 1988

Proman 1988

Conference and associated exhibition on the project management of the Heysham 2 and Torness power station construction programmes, Blackpool, 20-22 July 1988.
Details from Miss Y Brooks, British Nuclear Energy Society, Institution of Civil Engineers Conference Office, 1-7 Great George Street, Westminster, London SW1P 3AA (tel 01-222 7722).

Heat transfer

Conference, Houston (TX, USA), 24-27 July 1988.
Details from Ms Marie Stewart, AIChE, 345 East 47th Street, New York, NY 10017, USA.

September 1988

The formation of engineers in an integrated European framework

Conference, University of Southampton, 6-7 September 1988.
Details from Conference Office, Institution of Civil Engineers, 1-7 Great George Street, London SW1P 3AA (tel 01-222 7722 ext 283).

Emcon 88

International seminar on energy conservation, Hyderabad (India), 7-9 September 1988.
Details from the chairman, Technical Committee, Seminar Secretariat, Emcon-88, Copes House, 1-10-175 Begumpet, Hyderabad-500 016, India.

RSC 1988 autumn meeting

University of Birmingham, 20-22 September 1988.

September 1988 (continued)

Details from Dr John F Gibson, Royal Society of Chemistry, Burlington House, London W1V 0BN (tel 01-437 8656).

Inpower 88

Exhibition and conferences, London (Heathrow), 27 and 28 September 1988.
Details from Inpower 88, Queensway House, 2 Queensway, Redhill, Surrey RH1 1QS (tel 0737 768611; tlx 948669 TOPJNL G; fax 0737 761685).

October 1988

Landfill gas and anaerobic digestion of solid waste

International conference, Chester, 4-7 October 1988.
Details from Mrs G A Cole, conference manager, ETSU, Building 156, Harwell Laboratory, Oxon OX11 0RA (tel 0235 24141 ext 3467).

POWER INDIA 88

International exhibition for electricity, oil and gas industries, New Delhi (India), 5-8 October 1988.
Details from Hasu Ramji, *POWER INDIA 88,* Industrial and Trade Fairs International, Oriel House, 26 The Quadrant, Richmond, Surrey TW9 1DL (tel 01-940 6065; tlx 8951389).

Decommissioning of major radioactive facilities

Conference, London (IMechE), 11 and 12 October 1988.
Details from Institution of Mechanical Engineers, 1 Birdcage Walk, Westminster, London SW1H 9JJ (tel 01-222 7899).

Euroforum new energies

Congress, Saarbrücken (FRG), 24-28 October 1988.
Details from H S Stephens & Associates, conference organisers, Agriculture House, 55 Goldington Road, Bedford MK40 3LS (tel 0234 49474).

November 1988

Coal 88

Seventh international conference and exhibition on coal technology and coal trade, Amsterdam (The Netherlands), 21-23 November 1988.
Details from Industrial Presentations (Europe) BV, Europaplein 8, 1078 CZ Amsterdam, The Netherlands (tel +31 20 5491212; tlx 16017 RAIGE NL; fax +31 20 464469).

Landward oil and gas

Conference, London, 22 and 23 November 1988.
Details from Nadia Ellis, IBC Technical Services, Bath House (3rd floor), 56 Holborn Viaduct, London EC1A 2EX (tel 01-236 4080; tlx 888870).
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