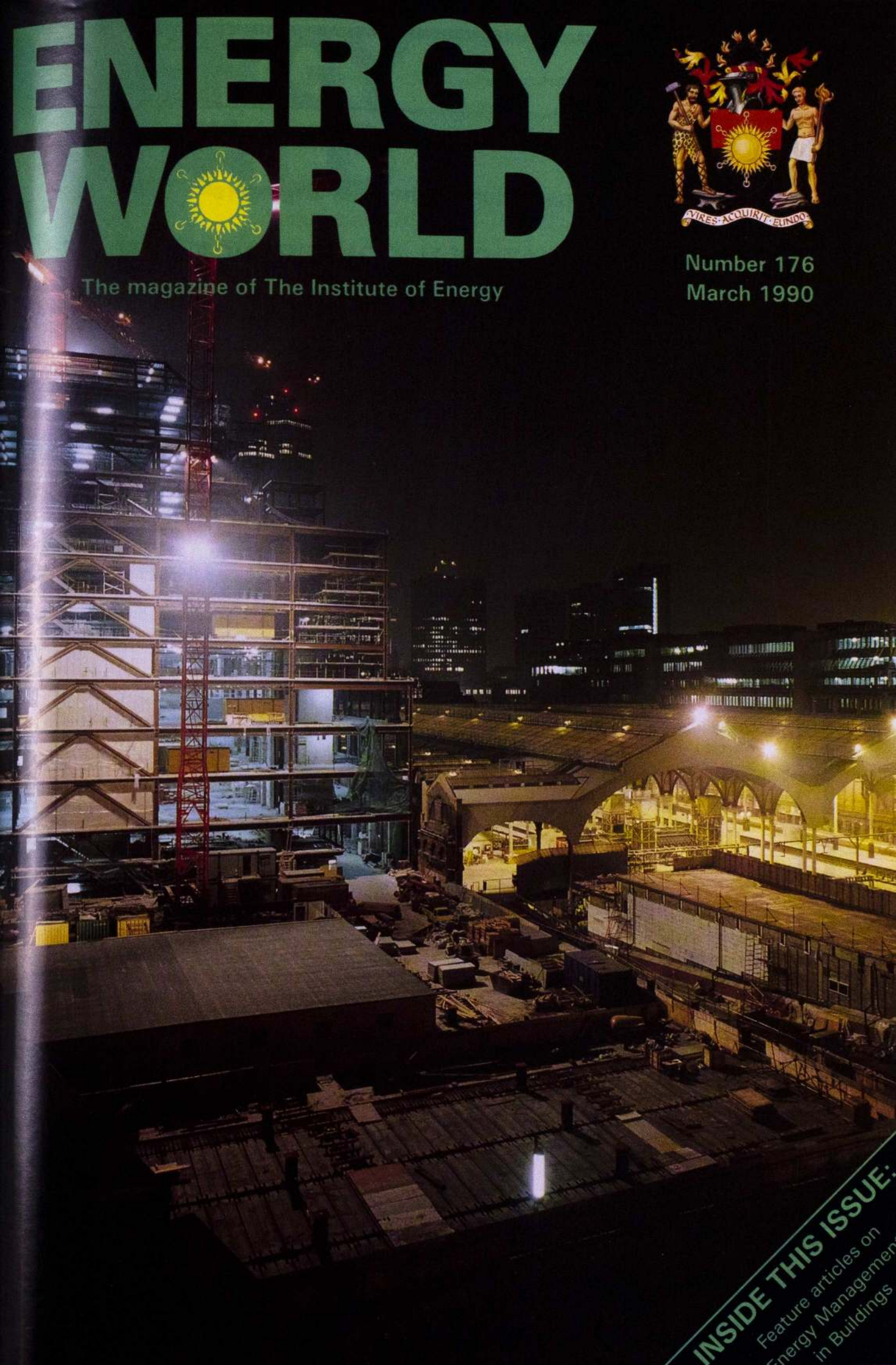
ENERGY WORLD

The magazine of The Institute of Energy

Number 176
March 1990



INSIDE THIS ISSUE:
Feature articles on
Energy Management
in Buildings

The Institution of Chemical Engineers

2ND INTERNATIONAL CONFERENCE AND EXHIBITION ON DESULPHURISATION

TECHNOLOGIES AND STRATEGIES FOR REDUCING SULPHUR EMISSIONS

20-21 MARCH 1991, SHEFFIELD

FIRST ANNOUNCEMENT AND CALL FOR PAPERS

Following the success of the first international conference held in Sheffield in 1989, the Institution of Chemical Engineers, in conjunction with the Institute of Energy, will be holding a second three day conference on desulphurisation. This conference will concentrate on technologies and strategies for reducing sulphur dioxide emissions from both large utility plant and small industrial systems.

Papers are invited from a wide spectrum of industry (oil, electricity, coal, chemical, manufacturing) and regulatory and environmental organisations. Academic papers will be considered although preference will be given to those covering areas of up-to-date practical interest.

The following topics are of special relevance

Technologies for limitations of sulphur dioxide emissions

Sulphur dioxide emission abatement strategies

Product and waste disposal

Costs of control technologies

Papers on the above, or other relevant topics, are invited. Titles and an abstract (250 words) should be sent to the address shown below by 30 April 1990. The proceedings will be published as a volume in the Institution of Chemical Engineer's Symposium series and all papers will be refereed prior to final acceptance for presentation at the Conference.

Anyone wishing to submit an abstract, take part in the exhibition or register to receive further details, should contact:

Richard Marshall
The Conference Section
The Institution of Chemical Engineers
165-171 Railway Terrace, Rugby CV21 3HQ
Tel: 0788 78214 Telex: 311780 Fax: 0788 60833

ENERGY WORLD

MARCH 1990 **Number 176**

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

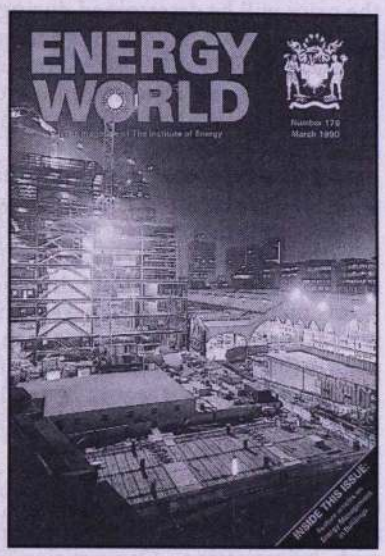
Editor: Kenneth B Harrison NCTJ

Editorial assistant: Johanna Fender BA

Advertisement sales: David Speculand, Tel. 0235 833815

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

COVER STORY



Our cover picture shows a night time view of the Broadgate redevelopment project next to Liverpool Street Station in the City of London. After four years' site work, this massive 14-phase fast track project is now nearing completion.

The Broadgate development has probably done more to influence the design of modern building management systems than any other single complex in the UK. Some phases employ hundreds of microprocessor-based controllers spanning the control of heating, air conditioning, lighting, lifts, fire protection, smoke dispersal and access.

As a result of projects such as Broadgate, today's building management systems can offer much in addition to basic energy management.

Trend Control Systems of Horsham, Sussex, are the building energy management systems supplier for the Broadgate development, which includes the building shown on the left of the picture. They are also designing and project managing similar systems for other phases of the project.

* For a more detailed appraisal of current issues and developments in the building energy management field, turn to our series of feature articles beginning on page 9.

CONTENTS

TERMS OF CONTROL **Energy World is circulated free of charge to all paid up members of The Institute of Energy. To libraries, organisations and persons not in membership it is available on a single subscription of £70 for 11 issues. Energy World is also available with the Journal of The Institute of Energy (quarterly) at a combined annual subscription of £130.**

The case for electricity privatisation

WRITING in 'Viewpoint' in the January edition of *Energy World*, Dr Robert Hawley, Managing Director (Operations) of Northern Engineering Industries plc, was critical of a number of aspects of electricity privatisation. He concluded by raising the spectre of energy shortages in this country within the space of the next five years.

Dr Hawley is of course an extremely distinguished engineer and industrialist, as well as a highly regarded author on the topics of power generation and energy, so his views deserve the utmost respect and attention.

Nevertheless on this occasion I believe that he protests too much. By ignoring even the possibility of any positive consequences from electricity privatisation — which in my view are likely to prove considerable — Dr Hawley leads his readers towards some exaggeratedly pessimistic conclusions, which are certainly not widely shared within the electricity industry itself.

As perhaps might be expected, he particularly cites my decision at the end of last year to withdraw the remaining nuclear power stations from the flotation of the electricity industry, and to defer the decision to build further PWR stations beyond the completion of Sizewell B, as examples of the "high degree of confusion" surrounding the process of electricity privatisation.

I certainly don't under-estimate for a moment the difficulties and the disappointment that these decisions must have caused a leading power equipment maker like NEI — or indeed the unsettling effect of the changes on those who work directly in the nuclear sector.

But I believe the decision to retain the nuclear element within the public sector became inevitable as a result of the financial institutions' increasing nervousness about what they saw as the financial risks associated with nuclear power.

And what I think Dr Hawley, for his part, fails to acknowledge is that in practice my decision has actually helped to simplify the future structure of the industry, resolving a number of the outstanding difficulties, whilst at the same time ensuring a continuing nuclear option.

The decision not to include any new PWR stations beyond Sizewell B within the Non Fossil Fuel Obligation for the time being will also result in a bigger competitive market. The number and variety of potential new entrants into the generation market — particularly gas-fired projects — has reduced the need for new nuclear stations on diversity grounds alone, and my decision will reduce the element of market distortion which was previously thought necessary to ensure security of supply.

More generally, though, I suspect that the root cause of the difference between us is that Dr Hawley seems to regard an increase in competition — whether in the domestic context alone, or in the wider perspective of the Single European Market — as both unwelcome and potentially disruptive, whereas I regard it as providing an important opportunity for British industry.

His assumptions still appear to be to some extent shaped by the monolithic state monopoly structure which has dominated the electricity industry since the War. He asks: "How is the electricity industry gearing itself to fight the serious competition of gas, rather than fighting in its own ranks? Would all this have happened if the UK Government had an energy policy?"

But of course the whole point of privatisation is to increase efficiency by introducing more competition, so that decisions are shaped by market forces rather than being taken by government departments. It remains up to the *industry* to get its competitive strategy right, whether in gas-fired technology or in any other area. I simply don't believe that this will be achieved by trying to shelter companies from competition — particularly in the run-up to 1992.

In my view those who continue to argue, like Dr Hawley, that we need a national energy policy, miss the point. We already have one. What they really appear to mean is, why don't we have a National Energy Plan, which is a rather different matter. That has never worked in this country — and I don't believe that it ever will.

By contrast, an energy policy which puts its faith in the freedoms of the market place inevitably results in a much less cosy and settled world, to which our industry is now increasingly having to adapt. So although I readily accept that the privatisation of the electricity industry has created an unwelcome degree of upheaval and uncertainty, I believe that the most important question is whether it will all prove worthwhile? And I am now more certain than ever that major benefits will flow from the changes we have set in motion.

A radical new structure is now in place which provides greater opportunities for independent generators and introduces fundamental changes in the way in which electricity itself will be traded through a pool or "spot" market in which the price will be determined during every half of trading by the balance between supply and demand.

Just as importantly, as Dr Hawley himself implicity admits, all this is already resulting in a more commercial approach, a transformation in attitudes, and an exciting range of wholly new ideas for economic electricity generation.

So when he argues that these changes, taken in conjunction with the rapid approach of 1992, will make the UK market "a happy hunting ground for many more suppliers than there have been in the past", I believe that he is approaching the issue from completely the wrong direction.

It is precisely *because* a more competitive electricity industry is now emerging in this country that we should become better placed than anyone to take advantage of falling barriers in Europe. Certainly it would be fatal if the electricity and power plant industries were to adopt a predominantly defensive response to 1992.

Nor can I accept that the need for governments to address complex environmental concerns, including global warming and the greenhouse effect, is an argument against proceeding with privatisation. Competition will undoubtedly have the effect of increasing the efficiency with which energy is used, whilst the legislation will contain a totally new duty for public electricity suppliers to meet set standards of performance in promoting energy efficiency.

Whatever the future holds, I am in little doubt that a more competitive electricity supply industry will be able to meet the challenge of the threat to the environment more effectively than one in which the disciplines of the market do not provide the same spur to increased efficiency.

The truth is that Dr Hawley has already been largely overtaken by events in his call for less confusion and greater certainty within the electricity sector.

All the major decisions have now been taken. The final structure is in place. The timetable for the flotation has been agreed, with vesting day on 31 March. Agreement on the complex structure of electricity supply contracts between the generating companies and the 12 distribution companies is on the point of being reached, even as I write.

Already the first contracts for new power plant have began to be awarded under the basis of the new system, and the pace seems likely to quicken as the privatisation process develops. The market is now awakening to an abundance of new opportunities in power generation, and in these circumstances I have no reason whatever to share Dr Hawley's fears of a shortfall in energy supply in the years ahead.

Rt Hon John Wakeham MP
Secretary of State for Energy

W European energy outlook to 2010

THE long-term energy outlook to the year 2010 for Western Europe was released in February from the Paris office of DRI/McGraw-Hill.

The report forecasts a steady growth in energy consumption until 2010.

Rising oil prices after the mid-1990s are predicted, slowing the overall growth in energy demand. The consequent switch away from oil is expected to benefit gas consumption and solid fuels.

Merger approved

SHAREHOLDERS of Combustion Engineering Inc (C-E), meeting in Connecticut, US, in January approved the merger of C-E into a subsidiary of Asea Brown Boveri Inc (ABB).

This move doubles the sales of Asea Brown Boveri Inc to approximately $7 billion and increases the number of employees to about 40,000.

Based in Stamford, Connecticut, Asea Brown Boveri Inc is part of the ABB Group, the world's largest electrical engineering company, with a worldwide order intake (including C-E) of more than $25 billion and with more than 200,000 employees in 140 countries.

The merger is the second and final step in the acquisition of C-E by ABB. In December 1989 more than 90 per cent of the outstanding common stock of C-E was purchased by ABB pursuant to a tender offer of $40 cash per share, or approximately $1.6 billion.

BP to retain BP Coal USA

BP America has announced that it has decided to retain its remaining BP Coal USA assets and operations in the United States and to reorganise them into an independent wholly-owned subsidiary within the company. The new subsidiary will have its own management and board of directors and will operate free of any other ties to the BP corporate organisation.

Ballymoney power plant the best option for NI, say consultants

A coal-fired power station operating at Ballymoney in Northern Ireland in the mid-1990s would give the greatest benefits to the Province by providing the cheapest electricity, say international power industry consultants Putnam Hayes and Bartlett (PHB) of the USA.

In a special report for Meekatharra Minerals released in late January, PHB said the study focussed solely on the cost of electricity. The consultants did not quantify the extra benefits to Northern Ireland of utilising an indigeneous fuel resource.

The conclusions of the study are revealed in the December 1989 quarterly report of Meekatharra Minerals, licence holders of the Ballymoney coal deposits.

Part of PHB's brief was to determine independently the optimum size and timing for commissioning a new Ballymoney base load power station and/or possible completion of Kilroot II power plant; components for the latter were purchased well before new EEC directives on environmental pollution.

The report said: "If Kilroot II requires flue gas desulphurisation (FGD), the optimal expansion strategy would be to construct Ballymoney lignite fired capacity instead.

"If Kilroot II does not require FGD the optimal generation expansion strategy would be to construct the first Ballymoney lignite station concurrent with Kilroot II.

"These conclusions rest on a conservative analysis of the Ballymoney generation option," PHB added.

Commenting on the study, Don O'Callaghan, Chairman of Meekatharra, said: "The report demonstrates that whether or not Kilroot proceeds, a new Ballymoney station should be operating in the 1990s. The use of local fuel is consistent with already stated plans to reduce the dependence on imported coal and oil.

"There will be added direct and indirect regional economic benefits," he added.

Report published on European cogeneration

A NEW pan-European report on the 40,000 MW market for cogeneration systems — equipment which provides both heat and power — says demand for heating and electricity, and government legislation, could hold the key to increased capacity over the next five years.

The report, from international market research publisher, Frost & Sullivan, analyses the performance of products and manufacturers in 17 countries.

The predicted increase in the cogeneration capacity of systems installed in Europe, will push the value of sales from 1989's $2.2 billion, to just under $2.4 billion by the end of this year, and to $2.8 billion by the end of 1993.

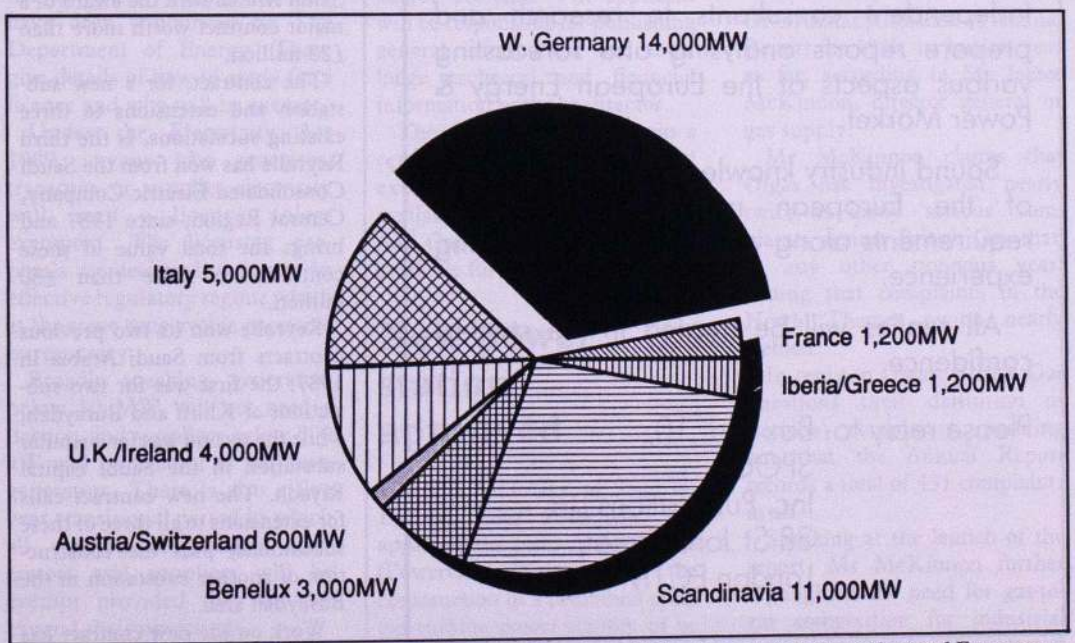
Of the 40,000 MW total capacity of all types of cogeneration systems used throughout Europe, just over half, 22,000 MW, are accounted for by industrial sites.

The highest expected growth rate will be in the three Benelux countries, where 2,300 MW will be added by 1993, to push capacity to 5,300 MW. Here, favourable legislation and a plentiful natural gas supply will continue to help cogeneration projects, particularly in the Netherlands.

Cogeneration growth will be the slowest in France, which is likely to record increases of no more than 500 MW, and in Austria, where capacity will rise by 200 MW during the review period.

This outlook is in spite of a backdrop of comparatively modest current levels of installed cogeneration capacity. Continued reliance on nuclear power in France and the additional availability of cheap hydropower in the Alps will keep centrally generated power costs very low in these countries.

The report is available from Customer Service, Frost & Sullivan Ltd, Sullivan House, 4 Grosvenor Gardens, London SW1W 0DH.



Regional analysis of installed cogeneration capacity based on 1988 returns which showed a total European capacity of 40,000 MW.

Long-term coal supply

The Narama Joint Venture, comprising Costain Australia Limited (50 per cent) and Nardell Colliery Pty Ltd (50 per cent) has been awarded a long term contract by the Electricity Commission of New South Wales. The contract calls for the supply of two million tonnes of coal per year for 20 years commencing in January 1993.

The coal will be supplied from a new mine which is adjacent to Costain Australia's existing Ravensworth South mine in the Hunter Valley. Costain will manage the Narama Joint Venture.

Spanish electricity coup

WESTINGHOUSE Systems Limited, Hawker Siddeley's control systems specialist has won multiple load despatch system contracts for its Wesdac 32 systems for electricity companies in Spain.

Power plant contract for Pakistan

by Frank Gray, Editor 'Power in Asia'

AN international power plant consortium, involving Hawker Siddeley Power Engineering of the UK, Xenel Industries of Saudi Arabia and four Japanese companies, have won a landmark deal in the form of a contract to supply Pakistan with a 1,300 MW oil-fired power station complex.

The so-called Hab River Power Project at Hub Chowki, 50 km west of Karachi, calls for the consortium to build four 323 MW power plants. Work began at the end of March; the first unit is to be commissioned in January, 1993, and the final unit is to be commissioned the following September. Oil will be piped to nearby Port Qasim from Karachi.

A formal contract for the deal is expected to be signed this month following the all-important initialling of the contract in Islamabad on 24 December. The project was given final clearance by the Bhutto government's Board of Investment on 27 December. Talks had been going on for 20 months following the signing of a letter of intent in May, 1988.

The project agreement represents a breakthrough for the World Bank as it is the first time the institution has been able to put together a power sector package using its special Private Sector Energy Development Fund to encourage local private sector involvement in power development. It is using Pakistan as a test-bed for the PSEDF and has set up a low-interest, long-term fund of $300 million to attract private sector shareholding in the project. Further funds have been set aside to fund Pakistani investment in other planned electricity generating enterprises.

The project is being undertaken on a build-operate-transfer (BOT) basis, which means that HSPE/Xenel and other shareholders will have a "leasehold" on the project for 30 years. Revenues earned from the sale of electricity to the Water and Power Development Authority (WAPDA) will finance the project and generate profits for the shareholders. At the end of 30 years, it will be turned over for a nominal fee to the Pakistani authorities.

Hat-trick for NEI

NEI REYROLLE, of Hebburn, UK, has scored a hat-trick in Saudi Arabia with the award of a major contract worth more than £25 million.

The contract, for a new substation and extensions to three existing substations, is the third Reyrolle has won from the Saudi Consolidated Electric Company, Central Region, since 1987 and brings the total value of these contracts to more than £80 million.

Reyrolle won its two previous contracts from Saudi Arabia in 1987: the first was for two substations at Khuff and Buraydah, while the second was for a similar substation in the Saudi capital Riyadh. The new contract calls for extensions to all three of these substations, plus the construction of another substation in the Buraydah area.

Work on the new contract has already started at Hebburn and it is due for completion in 1991.

Danube hydro scheme to be rethought

by Matthew Rodda

LEADING Czech scientists involved in the controversial Danube hydro-power scheme have admitted that their original plans will have to be drastically revised and they may be moving towards an accommodation with Hungary.

Czech hydrologists have privately conceded that after a stormy meeting last September with their Hungarian opposite numbers, the only course of action open to Czechoslovakia is to at least halve the generating capacity of the Danube scheme. Which is being built by Czechoslovakia at Gabcikovo 20 km from Bratislava.

This represents a substantial climb down by the Czech side in the dispute over the unfinished dam. The original Czech position was that 95 per cent of the waters of the Danube were to be diverted as agreed in the Brezhnev era to the Gabcikovo dam via a new channel. This aroused Hungarian opposition as the remaining waters would have been insufficient to sustain the unique Danube forests on the Hungarian side of the river.

The Hungarian side seem to have forced the Czechs to back down by threatening not to complete a further dam downstream of Gabcikovo. Without this balancing dam the flow of the Danube would vary wildly during a few hours from nothing at all to a massive 3,000 cubic metres per second, causing enormous problems downstream.

The solution now being privately advocated by Czech scientists is the least damaging way of resolving the dispute over the project. If the Hungarians co-operated with the Czechs to run the Gabcikovo scheme at half capacity with half of the Danube still in the original channel some accommodation could be made between conservation and electricity generation.

Electricity generation would be halved from 750 to about 350 MW and the scheme might not pay for itself for up to 40 years instead of around 20 as previously planned. Yet without a compromise the nearly completed Gabcikovo dam would remain a very expensive white elephant for the Czechs.

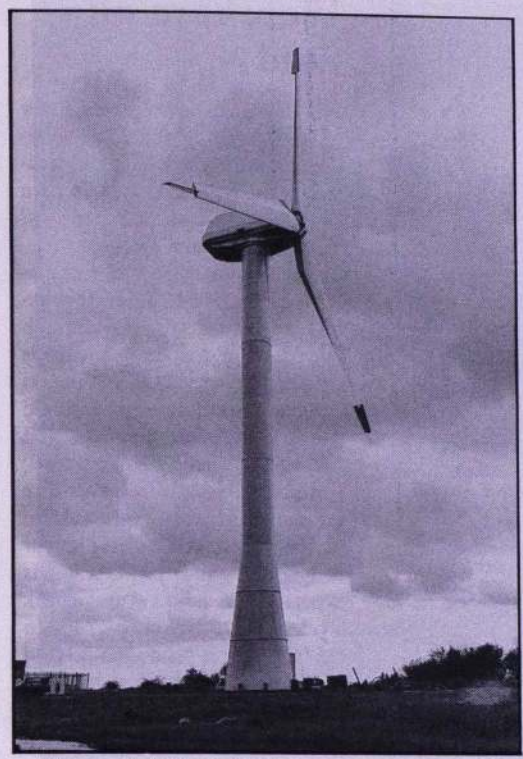
Emission control options: report published

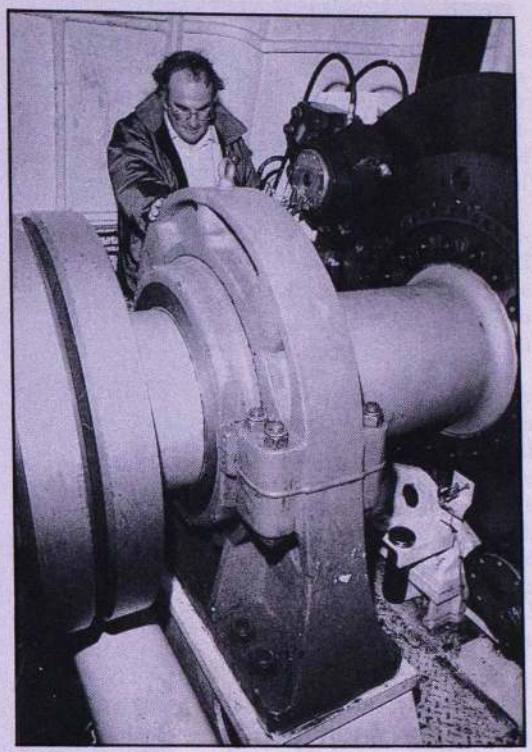
THE UK Department of Energy has published the report submitted to the Intergovernmental Panel on Climate Change (IPCC) in November on the technical options available to the UK to deal with the problems of climate change.

The report, *An Evaluation of Energy Related Greenhouse Gas Emissions and Measures to Ameliorate Them* was prepared for the Energy and Industry subgroup of the Response Strategies Working Group of IPCC. The purpose off this IPCC Group is to provide a basis for discussion of policy options open to the international community. The IPCC is to report to the Second UN World Climate Conference in November this year.

The aim of the UK study is to illustrate the practical technical options, and their possible costs, which may be available to curtail emissions of the 'greenhouse' gases from the many energy related activities of the UK society. Similar studies are being submitted to the IPCC by many other countries worldwide.

Wind turbine trials completed at Richborough





The new 1 MW wind turbine generator at the CEGB Richborough site (left), and the interior of the 45 metre machinery tower (right), where Cooper split roller bearings support a weight of 34 tonnes.

A NEW 1 MW wind turbine generator, designed and built by Howden Wind Turbines Ltd, will shortly be handed over to the CEGB after successfully completing its commissioning trials.

Erected at the CEGB power station at Richborough in Kent, the 45 metre high unit with its 55 metre diameter rotors, is the largest of its type in the UK.

Wind turbine generators are designed to operate at air speeds between 10 and 55 mph, and to withstand wind speeds of up to 150 mph, so they are suitable for most geographical areas.

Howden wind turbines are already operating in Shetland, the Orkneys, Carmarthen Bay, Gothenburg Harbour in Sweden, and at the Altamont Pass Wind Farm in California.

Recent studies suggest that between 25 and 30 per cent of electricity consumption in Britain could be supplied by alternative environmentally friendly energy sources within the next 35 years.

Brushing up oil industry's image

TEXACO Chairman, Mr Peter Bijur, called on the oil industry 'to put sufficient resources into communication and then do it candidly, clearly and proactively.'

Speaking at the Oil Industries Club in February, Mr Bijur presented the results of some recent public opinion research carried out by Gallup for Texaco. While more people than for any other industry spontaneously said that the oil industry contributed most to the nation's economy, there were clearly negative perceptions about "profiteering," "colluding on pricing" and "being a major polluter of the environment."

Mr Bijur pointed out that the favourable perceptions of the industry were largely due to the North Sea, and that "the public relations windfall" provided by this will lessen as people take the UK offshore achievement increasingly for granted.

DoE licensing regulations

THE Application Regulations and Exemption Regulations for the electricity supply industry have been announced by The Department of Energy. These give details of how to apply for a licence and who will be exempt.

Under the Electricity Act 1989, anyone who generates, transmits or supplies electricity will need a licence unless exempted. The licensing proposals are designed to ensure an effective regulatory regime which at the same time avoids excessive bureaucracy.

Broadly speaking, generators below 10 MW will not need a licence, and suppliers below 500 kW will be exempt as will own generators. There is also a five year transitional period in which all existing independent generators and suppliers will be exempt provided they do not expand their operations.

All applications for licences must be sent to the director general of Electricity Supply at his principle office in England and/or Scotland. The applicant will be responsible for publishing general information, and must lodge technical and financial information with the director.

The directors will maintain a register of licences and exemptions which will be available for free public inspection. Copies of the register will be available for a small fee.

New power station approved

UK SECRETARY of State for Energy, John Wakeham, has approved the plans of the CEGB (PowerGen Division) for the construction of a combined cycle gas turbine power station, to be known as Killingholme "PowerGen," in Humberside.

Ofgas publishes its annual report

OFGAS has published its Annual Report for 1989, its busiest year so far, according to Mr James McKinnon, director general or gas supply.

Mr McKinnon claims that Ofgas has investigated nearly twice as many 'serious' complaints against British Gas than in any other previous year, adding that complaints in the North Thames region nearly trebled.

In reply to Ofgas, British Gas questions their definition of 'serious' complaints, pointing out that the Annual Report records a total of 431 complaints in all.

Speaking at the launch of the report, Mr McKinnon further highlighted the need for gas-to-gas competition for industrial customers, and a concerted energy efficiency programme.

New BG inspector approval centre

A candidate carries out a magnetic particle inspection of a weld root on a section of pipeline.

A NEW centre for the British Gas Inspector Approval Scheme was officially opened at the National Pipelines Maintenance Centre at Ambergate in Derbyshire in February.

Previously located at the British Gas Engineering Research Station near Newcastle, the Inspector Approval System was originally set up in 1968 to meet the need for properly qualified pipeline inspectors when British Gas gave the go ahead to a massive engineering programme to construct a new national transmission system to supply Britain with natural gas from the North Sea.

The national transmission system consists of 5,500 km of high pressure pipelines, together with all the associated installations to enable it to operate with the utmost flexibility, including coastal terminals, compressor stations and both onshore and offshore gas storage facilities.

Go ahead for Wareham oil field

UK ENERGY Minister, Peter Morrison, has approved development and production plans proposed by BP for the Wareham onshore oil field, situated just west of Wareham, Dorset.

The Wareham oilfield was discovered in 1964. It is approximately 5 km west of BP's Wytch Farm oil field. The licence was originally awarded in 1968 to Gas Council (Exploration) Limited and BP in equal shares. GCE subsequently sold their interest.

Recoverable oil reserves are estimated at about six million barrels. First oil is forecast for early 1991 and production is expected to reach an average peak level of 2,800 barrels per day in the first year of production. Field life is estimated at 35 years. The amount of associated gas is small and will be fed into the Wytch Farm Gas Processing Train.

Two pipelines (one oil, one water injection) will link the Wareham wellsites to the Wytch Farm Gathering Station. Consequently, there will be no need for processing facilities at Wareham. The main pipelines were installed at the same time as the Wytch Farm export pipeline in order to minimise disturbance to the area. The stabilised crude oil will be exported via the Wytch Farm export pipeline to the Hamble Terminal.

Gloomy forecasts mere 'guesswork'

FORECASTS of colliery closures and job losses following the privatisation of the coal industry have been described as 'guess-work' by British Coal.

The forecasts were made by the Chairman of the Coalfield Communities Campaign, Hedley Salt.

In response to the CCC's gloomy predictions, British Coal have issued a statement describing the privatisation forecasts as 'seriously over-stated.'

They further point out that no in-depth discussions have yet taken place on the shape and size of a future privatised coal industry between British Coal and the Government, nor are any such discussions planned for the near future.

1990 Whitworth Scholarships

APPLICATIONS for the 1990 Whitworth Scholarships are invited from outstanding young engineers by the Institution of Mechanical Engineers.

Whitworth Scholarships are adimistered by IMechE on behalf of the Department of Education and Science. Ten Scholarships — each with a current value of £1,300 — are available every year for excellence in any branch of engineering.

For further details and application forms contact Karen Borley, IMechE, QET Office, PO Box 23, Bury St Edmunds, Suffolk IP32 6BN. Tel: 0284 763277 ext 470.

Closing date for applications is 1 June 1990.

Obituary

Teresa Butler

The following tribute to Teresa Butler (*Member*), was submitted by her colleague, Roger Collins of WS Atkins Planning and Management Consultants Ltd.

It is a very sad occasion to lose a young woman with Tess' zest for life and we must all feel the loss keenly. Tess managed to pack so many activities into her 30 years that it is difficult to summarise her academic and business career in this short tribute.

Tess read metallurgy at Newcastle University where she obtained a good degree, and then decided to switch to energy as a specialisation.

On the advice of her professor at Newcastle, Ian Fells, she took an MSc in environmental technology at Imperial College, where her academic career blossomed. Her tutor there was Dr Nigel Lucas who is unfortunately in Indonesia, but Ray Tomkins at Imperial tells me that she was an outstanding student in a strong year.

She displayed great initiative, an independent mind and a strong spirit — characteristics which were evident throughout her business and academic career. Her approach to university studies, as at Newcastle, was mature beyond her years and she achieved a very good Masters. This confirmed her career in energy.

Following a period as an inspection engineer at Texaco's Milford Haven refinery, she worked for two and a half years at *Energy Manager*. She progressed from Editorial Assistant to Deputy Editor, playing a key role in running the magazine. Tess got on well with everyone and will be missed by the staff of *Energy Manager* and all others with whom she came into contact within the energy publishing scene.

Her work at *Energy Manager* and the many energy surveys she undertook for Atkins have made Tess extremely well known throughout the energy world, as well as in local authorities in England, Scotland and her homeland of Wales. She was also one of the few women members of The Institute of Energy.

Tess is particularly well known for her work in recent years for BRECSU on Monitoring and Targeting, which has laid down some of the foundations that M&T is built on and has influenced energy management at local authorities by disseminating information on best practice. Many now common practices derived from her ideas, especially the concept of MT&M, with the addition of staff motivation, the second "M" as the most important ingredient of energy management.

Tess was working on another key study, in this case for ETSU, into Passive Solar building design; her insight and knowledge will be irreplaceable for this work.

These qualities and her wide experience would have ensured success in her latest venture as an independent consultant, which has been so tragically cut short.

To quote her tutor Donald Maxwell, "she will be remembered with affection by all the staff at Newcastle" and this is just as true for all her subsequent posts. She remained throughout her business life an unfailing good-tempered, helpful and amusing colleague with whom it was a pleasure to work. She will be sadly missed by me and my colleagues at Atkins and by all her friends in the energy world.

Kodak Student Prize presentation

Mike Walker, engineering manager of Kodak Ltd, presenting the Kodak Student Prize to Dr Jon Gibbins of Imperial College, at a meeting of the Institute's London and Home Counties branch.

A man of many talents

INSTITUTE member Vilnis Vesma, better known for his energy management computer programs, has recently completed a slightly different kind of software commission: a set of cartoons.

Twelve cartoons were produced as illustrations for a staff energy booklet written by the energy manager of Islington Health Authority, Robert Gevargiz.

Mr Gevargiz did not originally realise that Vilnis Vesma was a cartoonist: "I rang him to ask if he knew of a suitable artist and he asked if he could submit some ideas of his own," he explained, adding that he had been delighted with the result: "His cartoons were excellent, exactly what I needed, and they were delivered by the promised date."

Gil Blackman appointed CEGB Chairman

New CEGB Chairman, Gil Blackman CBE.

GIL BLACKMAN CBE, FEng and an Honorary Fellow of The Institute of Energy, has been appointed Chairman of the CEGB until the end of March.

Mr Blackman had been Deputy Chairman of the CEGB since 1986. He has had a long career in the electricity supply industry which he joined in 1948. Following a series of technical and managerial posts, he was made a member of the CEGB Board in 1977.

A member of the Institute since 1964, Mr Blackman takes over from the previous Chairman, Lord Marshall, who resigned in December.

New field manager for Rough

DAVID PRESTON CEng, MInstE, has been appointed manager of the Rough Gas Field off the Humberside coast, owned and operated by British Gas.

He will be responsible for all field operations and for Rough Field's management support base at Easington and the Great Yarmouth Marine Support Base. He will also be responsible for day to day operation of the Amethyst gas field when that comes on stream in the autumn.

Mr Preston trained as a gas engineer with the North Eastern Region of British Gas in 1962, who sponsored him to take a degree in gas engineering at Salford University in 1965.

Graduating with honours, he went on to hold engineering production posts in British Gas North Eastern and North Western and at Bacton Gas Terminal. He became manager of the Easington Terminal in 1979, just as it began a major expansion programme.

Mr Preston joined The Institute of Energy in 1975.

Obituary

Robert Thompson

Robert Howard Thompson (*Member*) died in April 1989. Rob was born in Londonderry and received his education at Foyle College in that city and George Watson's College, Edinburgh, as well as Edinburgh University, where he graduated with a First Class Honours in Chemistry, becoming President of the Chemistry Society.

Two years after graduating, he moved south to join Lever Brothers at Port Sunlight, where he served for the next 42 years.

In 1933 he married another Edinburgh Honours Chemistry Graduate, Jean Gordon Ogilvie, and together they brought up their five children.

Although knowledgable in chemistry and the process of soap making, his real interest developed in the energy field, and he became renowned throughout the company as "King of the Lancashire Boilers" at the time when there were almost 100 coal-fired units on the Port Sunlight site alone. The combination of his commercial and technical instincts, plus a commitment to the work ethic, ensured that his constant objective was to maximise efficiency of fuel useage.

Practical as well as theoretical, he did not leave his beliefs at the factory gates. He pursued them at home and elsewhere. Particularly in his local Church, St Mary's, Eastham, where, in addition to roles such as youth leader, church warden, and member of the parish council, he was self-appointed energy advisor-cum-stoker (never averse to handling the shovel himself).

Stories of Rob are legion, but one which well illustrates the combination of his interest and commitment was when, at the age of almost 80, he was found at the top of a 30ft ladder replacing roof insulation in the church.

Port Sunlight being the parent company, meant that engineers from Unilever companies throughout the world came for training, so Rob became a legend far beyond the confines of the factory and UK.

In the late 1950s he was seconded to the company plant in Nigeria to train local staff on boiler plant operation. Even there he established a reputation for self-involvement previously quite unheard of for Europeans.

On his return to the UK, he was transferred to the newly formed Unilever Services Company, UML, to manage the oils and fats handling operation, he also took the role of pollution control.

After his retirement in 1973 he continued giving professional advice where needed.

In addition to his highly active career, Rob was a hard-working committee member, and attended all his branch meetings. In 1983 he was presented with the Special Award in Recognition of Services to the Institute.

Eric Curd

New members

Member

Gary John Astill, Searchrite Limited *(transfer)*
Jaime Peers Beckett, NIFES Consulting Group, Birmingham *(transfer)*
Toh Beng Kam, British Gas, Midlands Research Station, Solihull
Donald Leslie Lane, Veba Kraftwerke Ruhr AG, West Germany
Dennis Leslie Loveday, Loughborough University of Technology
John Maxwell, Dyer Warner Partnership, Leicester *(transfer)*
Alan John Powell, CEGB PowerGen Division, West Yorkshire
James Paul Ross, Ferguson & Partners, Birmingham

Associate Member

James Stephen Bailey, Royal Mail, Engineering Div, Colchester
Kenneth Robert Briggs, MRM Partnership, South Glamorgan
Robert Andrew Evans, British Gas East Midlands, Chesterfield
Robert Mark Hurley, Brightside Yay Ltd, Notts
Nicolas James King, British Gas East Midlands, Notts

Graduate

Robert Timothy Reed, Zenith Engineering Consultants, Lincoln
Richard John Short, Hamon-Sobelco Limited, Surrey

Student

Siti Noridah Adnin, Polytechnic of Wales
Kenneth Cass, Napier Polytechnic of Edinburgh
Kok Wai Cheong, Loughborough University of Technology
Darren Hewerdine, Loughborough University of Technology
Christopher James Hide, Loughborough University of Technology
Christopher James Hood, Napier Polytechnic of Edinburgh
Mehran Kamfarfar, Middlesex Polytechnic
Simon Langridge, University of Leeds
Lars Nicolas Mangal, Napier Polytechnic of Edinburgh
Graeme Lee McCridle, Napier Polytechnic of Edinburgh
Amirrudin Razali, Polytechnic of Wales
Christina Maria Rodrigues, University of Leeds
Ian Sanderson, University of Newcastle-upon-Tyne
Michael William Scott, University of Newcastle-upon-Tyne
Gerald Tan, Loughborough University of Technology
Geza Vamos, Napier Polytechnic of Edinburgh

Group Affiliate

Ahlstrom Pyropower Ltd, Harrogate, N Yorks
Hat Contracting Services Ltd, Horsforth, Leeds

Sick Building Syndrome — fact or fantasy?

*by Terry Casey BSc**

The phenomena known as Sick Building Syndrome has been popularly attributed to poorly controlled or badly designed air conditioning or total environmental control systems. One of the principal motives that lies behind the installation of such systems is to assist the control and reduction of energy costs. In the following article, based upon a paper presented at last year's NEMEX conference, Terry Casey describes the typical symptoms and causes of Sick Building Syndrome, and provides some guidelines for averting the problem.

SICK Building Syndrome has become recognised in the last few years as a distinct and quantifiable problem relating to some, usually air-conditioned, buildings.

In a sick building many of the occupants suffer from a number of minor ailments such as runny nose, headache and tight chest. These ailments are not medically serious but they do definitely impair efficiency and effectiveness in the workplace and are an indication of inadequacies inside the building.

Although Sick Building Syndrome has been recognised by its symptoms, the causes have been far more difficult to detect. It seems unlikely that a single cause will emerge but rather there are a number of factors which can contribute to this effect. Fortunately, there are practical things which will avoid Sick Building Syndrome and can help to eliminate the characteristics in buildings that are already sick.

What is it?

Sick Building Syndrome is recognised in a major building, like an office block, where a significant proportion of the occupants exhibit one or more of these symptoms:

- lethargy,
- runny nose,
- dry throat,
- headache,
- eye irritation,
- chest tightness.

Occupants will also tend to complain about the air quality, often criticising it as too warm, too dry or too stuffy. The symptoms of Sick Building Syndrome are all non-specific. That is they cannot be linked with a specific cause. However, they are clearly associated with the building symptoms growing worse during the working day and rapidly receding after leaving the building. It is difficult to put a cost on Sick Building Syndrome as rates of absence may not be particularly high but efficiency and effectiveness are reckoned to fall markedly in the sick building.

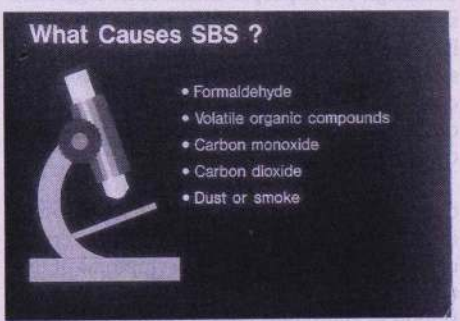
There are a number of building related illnesses which are popularly grouped with SBS but are, in fact, quite separate maladies.

Legionnaire's Disease is an often fatal form of pneumonia caused by a bacterium which is widespread in water but is only infectious if inhaled into the lungs. The water mist produced by air-conditioning cooling towers and sucked into the buildings air intake makes an ideal method of catching this disease.

Humidifier Fever is similar to a mild case of 'flu but is normally only noticed on the first day of the working week. It is caused by a bacterium in the water system of cold spray humidifiers and can be avoided by careful cleaning and maintenance of the system. Humidification by steam injection does not carry risk of Humidifier Fever.

Concrete Cancer is a little understood phenomenum which causes concrete to crack and disintegrate a number of years after construction. Despite its emotive name, concrete cancer is no direct health hazard to humans.

What causes it?



No specific cause of Sick Building Syndrome has been identified and research has been directed at a number of quite different areas leading to a diversity of opinion as to the likely causes.

It is unlikely that SBS is caused by a bacterium in the same way as Humidifier

The author

A co-founder of Trend Control Systems, Terry Casey is now the company's Chairman. He has seen the company develop from its start-up in 1980 to become one of the largest suppliers of building energy management systems (BEMS) in the UK. The company currently has a workforce of about 400 employees and an annual turnover of around £25 million.

Prior to Mr Casey's involvement with Trend, he had several years' experience in applying electronic controls to industrial control systems and process control systems while with the Eurotherm Group. A graduate in electronic engineering from Southampton University, he has specialised for much of his career in control engineering.

Mr Casey has become a leading figure in the BEMS industry; he is a member of the steering committee of the BEMS Centre, and is the current Chairman of the Energy Systems Trade Association (ESTA).

**Chairman, Trend Control Systems Ltd and Chairman, Energy Systems Trade Association*

Fever. Research has concentrated instead on toxic materials that may be present in low concentrations in the building environment.

Indoor and outdoor pollution

One of the first questions is whether the substances which cause SBS originate inside the building are circulated by the air conditioning or whether they originate outside the building and are introduced by the air-conditioning.

Analysis has shown that the general level of particles, micro-organisms, and as gaseous pollutants, including ozone, are significantly lower inside the building than outside because of the filtering effects of the air-conditioning plant.

Substances suggested to cause SBS include:

- formaldehyde,
- volatile organic compounds,
- carbon monoxide,
- dust and smoke,
- ionised air,
- poor light conditions.

Formaldehyde is a substance which is giving general cause for concern. It is a known irritant in low concentrations and has caused cancer in rats and mice at high concentrations. It is given off from furnishing, particularly when new and from Urea Formaldehyde foam which can give off significant quantities if badly prepared.

The substance has been found in above average concentrations in some but certainly not all sick buildings.

Volatile organic compounds. There can be a large number of these compounds present in offices at very low concentrations from various substances used in the office environment, eg correction fluids, cleaning substances, carbonless copy paper. The effects of these low concentrations have not been clearly established but no clear link to SBS is illustrated.

Carbon monoxide results from incomplete combustion. Tobacco smoking is the most significant source of carbon monoxide in buildings. Most people smoke filter cigarettes so their nocotine and carbon monoxide intake is reduced by the filter. However, the side stream smoke which comes directly from the cigarette is not filtered and so the non-smoker can receive quite high levels of nicotine and carbon monoxide as a passive smoker.

Carbon monoxide is extremely toxic at low concentrations. It bonds to the haemoglobins in the blood and prevents them transferring oxygen round the body. The symptoms of this are headache, lethargy and loss of concentration — symptoms clearly central to SBS.

Carbon dioxide is exhaled by humans and animals. It is not toxic but by reducing the oxygen concentration in the air that we breathe then mild forms of oxygen starvation can result. In our enthusiasm for energy efficiency many people have reduced the fresh air rate into their buildings which may be increasing levels of carbon dioxide and other pollutants to above acceptable levels.

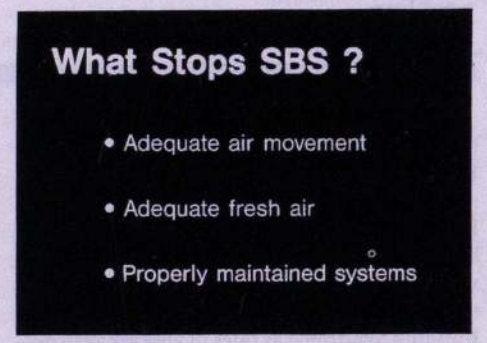
Dust and smoke. Smoke, particularly from tobacco, is really a vapour, not particles and so is not effectively removed by the filtration system. Dust and smoke can be irritants to the eyes and throat. However, properly maintained air-conditioning will effectively filter out dust more than a non-air conditioned building, so this is unlikely to be the cause of SBS.

Although no one of these pollutants solely gives rise to SBS it is clear that in extreme cases any of these can give rise to SBS symptoms.

What prevents or cures SBS?

Fortunately, although the causes of SBS are unclear there are a number of straight forward methods which will normally prevent or cure the condition.

Most incidences of SBS occur in fully sealed, air conditioned buildings where any pollutants can be circulated rapidly round the building. Keeping an adequate flow of fresh air round the building is consistantly the best way to keep SBS at bay. Unfortunately, some of our attempts at energy efficiency may have contributed to these problems as we seek to minimise the fresh air rate in order to minimise energy consumption. It's cheaper to recirculate the air in the building than it is to heat or cool, humidify or de-humidify the outside air.



What contributes to SBS?

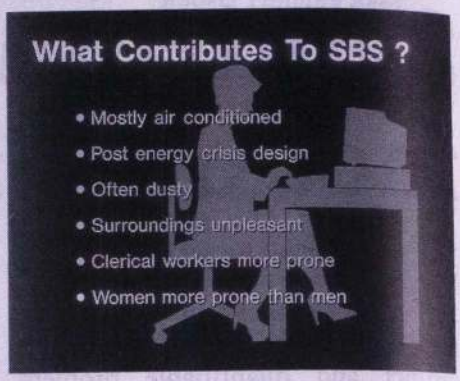
- Mostly air conditioned buildings affected.
- Post energy crisis design are worst affected.
- Often dusty environments.
- Unpleasant or dull surrounding.
- Clerical workers are more prone than managers.
- Women are more prone than men.

The solution is to maintain a sensible balance between providing fresh air and energy efficiency and not to reduce the fresh air rate below the CIBS guidelines for the various types of activity.

Clearly the maintenance of the air-conditioning is important, blocked or broken air dampers and blocked filters can critically reduce air flows and are all too common in our buildings.

Sensitive planning of office partitioning is also required. Offices are frequently created that have inadequate ventilation because the building design is not flexible enough. When the usage of an area changes, for example to a conference room, then it becomes important to reset the air flow so that it meets its new occupation rate, but this is rarely carried out.

Psychological factors play their part too. Offices that are dusty, poorly layed out, dull, with poor lighting have a higher incidence of SBS than lighter, brighter, more welcoming environments. If staff start complaining about SBS symptoms then they are highly unlikely to go away if ignored. It seems important to show interest, concern and some action to contain any such symptoms.



Lessons for the future

If the SBS is to be avoided in buildings of the future then a number of simple and common sense guidelines will help considerably:

- Air conditioning should be fully designed into the original building plans if adequate duct sizes and air flow rates are to be achieved. Retrofit air-conditioning is more likely to be problematic.
- Establish design conditions for air flow and fresh air rates and make sure these are met. It is a sad truth that very many air-conditioning systems are inadequately set up, tested and commissioned in the building process because of constraints of time and sometimes cost.
- The system must be sufficiently capable and adaptable so that it can meet the immediate and future needs of the occupants. Check that it has been designed to permit not just open plan arrangements but also cellular offices and ensure you know what grid they can be set up on and how the air-conditioning will cope with changes in internal layout.
- Once installed, actively check that the system is maintained and that the air criteria are still being met.

Conclusions

Although SBS is mainly associated with air conditioned buildings, a properly designed, installed and maintained air-conditioning system will give a perfectly satisfactory environment. It should also be remembered that maintenance is not just keeping the mechanical plan functioning, it is also adapting the system to keep in step with the changing uses and layout of the building interior so that all areas within the building receive appropriate rates of fresh air for the tasks that are to be performed in them. □

Future trends in building energy management

*by Keith Rouse BA, PhD, Dip Tech, FInstP, AIOD**

In the following article Dr Rouse traces the development of building energy management systems (BEMS) since the early 1970's, observing that the industry's development has paralleled that of the micro-electronics industry. He identifies the major problems with BEMS in the areas of training, cabling, compatability and user/friendly operation; highlighting the looming skill shortage as a problem requiring urgent attention if we are to exploit future technological advances. Dr Rouse concludes that user awareness and ability has to catch up with the rapidly changing technology in order for BEMS to meet the challenges of the next decade.

THE UK experience of using and operating building energy management systems (BEMS) has a short but interesting history. Firstly, it is necessary to consider just what is meant by the terms 'BEMS' since the multiplicity of interpretations of this term frequently causes general confusion. For this article BEMS refers to all features that are included in the operation of buildings and their facades.

BEMS have enjoyed a continued growth in sales terms within the UK but development and implementation has not been without incident. The improved cost performance and control capabilities available with today's systems over those available five years ago are discussed together with some of the difficulties perceived by users of these advanced control systems. These difficulties form the basis of many of the enquiries received by the BEMS Centre since it opened for business just over a year ago, and range from the frustrated BEMS owner desperately searching for the solution for a failed installation at one extreme, to the bewildered potential purchaser wishing to distinguish between the wide spectrum of systems, all promising comprehensive facilities.

This provides the challenge to which the industry must respond by developing more reliable, better quality and usable systems to take us into the 1990's. Finally, the effect on the industry in Europe of the removal of the standard EEC barriers in 1992 will be briefly discussed.

Development history

The development history of BEMS has paralleled that of the microprocessor and computing technology. It has been strongly influenced by the political and economic climate prevailing in the country of origin which has led to distinct differences in design approach, particularly between the USA and European countries.

The USA can almost certainly claim to have operated the first BEMS in the early 1970's based on a centralised processor with all the executive control occurring at the central station — now generally referred to as 'centralised' systems. These types of systems were more appropriate for installation in single, large buildings where the cable runs between sensors, actuators and the processing device could be most easily achieved. From a political viewpoint, this architecture fitted the large corporate buildings approach very well and these were undergoing significant growth at this time.

The UK however, possessed a different market with many smaller units operated within large distributed estates. The slightly later entry of the UK and European manufacturing companies into the market place presented the opportunity to exploit the then emerging microprocessor into their products and so the concept of the 'intelligent' outstation was born. This configuration permitted the control algorithms, and hence the executive function of the device to be developed closer to the plant being controlled. The resulting stand alone capability freed the central station from the need to maintain continuous communications with the sensors and actuators making it feasible to use the British Telecom network to access sites geographically remote from the central station.

The reduced cost of the microprocessor in the last decade has opened up a wider market for BEMS which is currently worth around £70 million per annum and growing at a rate of about 10 per cent per annum. In 1981 the smallest system on offer would probably have cost tens of thousands of pounds — in 1986 a system could be bought for less than £1,000 which would offer all the features of the earlier systems. Indeed, the cost of processing has dropped to the point where it is reasonable to consider one controller per plant item (as yet still largely unrealised) thus developing the intelligence about as far as it can go. This now blurs the distinction between conventional stand alone controllers and BEMS to the point where they almost completely overlap and some within the industry consider the term 'advanced building services controllers' to be more appropriate terminology. I do not accede to this view, since I believe BEMS offer considerably more information than that generally available with conventional controllers.

So this then, is the present state of the art. What are the problems, what is the challenge and what must be done to meet this challenge for the future of the industry?

Perceived problems

During the initial year of operation of the BEMS Technical Centre numerous enquiries have been received, mainly from users of BEMS, expressing general concern about the quality and reliability of current systems and their operation. Broadly, these perceived problems fall into three main categories, namely:

- skill shortage
- costs
- lack of standards

The industry has readily acknowledged the serious shortage of graduate engineers currently available in the market place, which is anticipated from a recent survey to be at least 230 per annum less than required by the industry up to 1992. This shortage in the supply of professional, technical and vocational skills is already regarded as a handicap to growth by some companies and will also prevent the full exploitation of BEMS from being achieved.

System hardware costs are approximately 10 per cent lower than those of the early 1980's. Nevertheless, installation costs — the bulk of which is alterations and additions to existing

**Commercial Director, Illuminated Management Associates*

trunking or new wiring — can frequently account for about 50 per cent of the total costs. The slow progress made with systems compatibility and the additional need for specific customer programming have kept the cost of software at a relatively high level.

BEMS equipment has many complex electrical and mechanical parts, a number of which need proper regular maintenance if they are to function correctly over long periods. The simplest arrangement for maintenance is often through a contract with the equipment supplier, usually based on annual payments of a fixed percentage of the initial capital cost.

However, many users have been very disappointed to find that this potentially high cost outlay sometimes only covers call-out to repair faults as and when they occur, but provide no preventative maintenance. The provision of full maintenance cover is usually only offered at a prohibitive cost to the purchaser.

Very few engineers will have acquired in their background training all the skills and knowledge necessary to assist and advise in every area of BEMS technology which crosses all the traditional boundaries of engineering. The lack of system user-friendliness often results in operatives with all the required skill levels being specially recruited or at least provided with training, either from the manufacturer or external courses. All of these items add to the overall cost of providing an effectively operating BEMS in a building.

The lack of industry standards is a real barrier to development and further cost reductions, since it restricts the ability to extend existing systems purchased from different suppliers without the use of costly system interfacing. Fortunately the approach of 1992 is spurring leading companies to press for the establishment of standards, especially in the area of communications. The industry has matured to a point where there are many established suppliers who have built up a reputation. But there are also others still offering undeveloped products. Many purchasers have unwittingly acted as hosts for the development of systems which promised the full contents of Pandora's Box, only to find it filled with dust and sand upon delivery.

The challenge

These then, briefly define the problem areas which provide the challenge to the future development of the technology. They can be further subdivided and summarised as follows:

- training
- user/friendly operation
- pertinence
- cabling problems
- compatibility
- commissioning problems
- quality and reliability

Each of these will be considered in turn with a view to finding a possible solution.

Training

Education and training hold the key to realising the full potential of building energy management systems. The training offered by suppliers is usually restricted to an operational level. The most effective use of the information from BEMS can involve organisational changes well outside the scope of most suppliers. So users need additional sources of training to that available from the supplier of their system.

Nationally there is considerable debate about the quality of education in general, and about the career image of the building services industry in particular. Recruitment is hampered by the poor image of the building industry and the public lack of awareness of building services as a career. There are not sufficient building service graduate engineers being educated.

Indications are that the industry is seeking about 350 graduates per annum whilst universities and polytechnics are producing about 130. This situation will be further exacerbated by the rapidly reducing number of school leavers with five O level and three A level subjects which will reach a minimum in about 1992. The effort to ensure that engineering courses both at universities and technical colleges have an appropriate content can only be effective in the long term. A parallel effort must commence now to persuade engineering graduates to enter the industry, which must become involved with local schools and be prepared to sponsor and train entrants to building services, if a crisis is to be avoided in the future. The BEMS Centre has started a programme of training initiatives aimed at attacking the problems in the short term. These comprise a series of training workshops, the provision of computer assisted learning packages together with a series of distance learning units.

The problems of skill shortage in the building services industry is becoming acute and must be urgently addressed if the benefits of future technological advances are to be fully exploited.

User-friendly operation

The effective operation of a building requires both skill and judgment. Engineers today need more information than ever before about their building and plant, presented in a more coherent and co-ordinated manner to facilitate improved decision making. Modern systems require highly visual operating systems which can provide for multiple 'windows'; a 'mouse' to eliminate the need for most keyboard operations, and more user-friendly packages for improved data display (for example, good colour graphics with spreadsheets, trend logging and data collation). A form of communication with the computer which is quickly gathering strength is the use of legends and touch-screen typing.

Voice communication is another way of gaining access to information. Most speech recognisers under development choose 'candidate' words using a statistical model drawn from an analysis of multi-million word database. As speech continues, new candidate words are chosen and the initial candidates are re-evaluated in the light of these new data. The most probable word can frequently be displayed within a second or two. Future work will be needed to improve resistance to noise and eliminating the need to pause between words.

All buildings are wired for the use of telephone communication and ideally such a scheme would form part of a single common wiring system throughout the whole organisation. Much work and development is still needed before voice and data networks can be implemented which will provide the full benefits of easy expansibility of all the information systems in a building.

Pertinence

Not too many years ago, starry-eyed proponents of BEMS imagined computers would eventually bring about the paperless office. But the converse has proved true. As it happens, computers are actually generating more paper than ever before — mountains of printout which are filed as back-up material. It is also a fact that different makes of computer are mostly unable to communicate with each other, leaving paper versions of information as the only feasible way of communicating information between people.

Future systems must minimise the quantity of data transmitted to keep transmission costs down and must evolve a strategy for data handling firstly to decide the type of data required and then produce it in the most useful manner possible. A simple message to the operator stating that 'all is well' may suffice instead of voluminous repetitions of non-alarmed readings which only add to the problems of data diarrhoea!

The introduction of expert systems may provide additional support in this area and permit a higher level of de-skilled operation of systems but a concerted effort will be needed by all sides of industry if it is to take full advantage of the improved facilities which the introduction of these systems can provide for the operation of BEMS in the future.

For the technology to make a real impact on the scaling of these paper mountains, there will need to be a radical reorganisation and restructuring in the way in which people work, and such changes rarely happen overnight!

Cabling

An issue which frequently arises in connection with relocation to a new building, the refurbishment of an existing one or simply when carrying out improvements to current office, commercial, or industrial practices, is cabling and cable management. Cabling whether for power, telephone or data, serves equipment which provides facilities crucial to the success or failure of an organisation. In many of the newly built high-rise buildings in the City the risers and ducts are already proving inadequate to meet the cabling needs of the occupants. Until recently, the purchase of a particular information network also required the purchase of cables and connectors specific to that network and, in general, incompatible with other systems. This has led to a multiplicity of many different types of cabling in a building, causing serious and complex management problems. What is needed is a shared cable approach for all the communication requirements in the building

such as voice, high and low-speed data, facsimile printing, plotters and graphics, conference videoing and BEMS communications. In addition, it will need to allow for easy extension.

Fibre optic technology is rapidly being adopted for the telecommunications industry. Cost per unit distance is reduced dramatically as higher frequencies are used in bandwidths in the region of 20 MHz used over one kilometre. Being light in weight, strong, extremely small and capable of transmitting vast quantities of information over hundreds of miles without amplification, make them an obvious choice for communications in the future. Add to this their immunity to electromagnetic and radio frequency interference, groundloop and cross-talk effects and inherent safety in hazardous areas, and you can see why the photon is the natural successor to the electron!

In approaching the level of the individual sensor, technology for optical coupling is a key factor. Nevertheless, for short distances the ease of branching and splitting with copper connectors is hard to match, despite bandwidth capacity and low power loss properties of fibre. Until recently the evolution of techniques for effective branching and splitting have been slow, being relatively crude and cumbersome. It is hoped that the emerging technology of micro-optics, fibre fusion, fibre lapping and those using planar waveguide principles will assist here.

It is well to remember that telephone lines and copper cables are a very poor medium for the transmission of high speed information requiring special protocols and error correction, whereas a radio channel is more linear and does not require modern techniques. The power requirements are minimal since a sensor need only transmit when something unusual happens, or when it is required to do so. It can be placed in a similar category to hand-held units used to open garage doors or controlling television sets with a battery which lasts for several years. The established amateur use of 'packet' radio linked through 'digi-peaters' shows how this technology could open the communication horizon for future use in conjunction with BEMS.

Compatibility

Recent years have seen increasing user interest in the integration of each and every element of the company's activities. In particular, the integration of fire and security monitoring and control is much talked about but what has been achieved has been done via software — not true hardware — links. All BEMS manufacturers already ensure that their products are compatible — but with their own products, not those of other manufacturers. While a customer continues to use the products of one manufacturer compatibility is not an issue (although backward compatibility may be).

Difficulties arise when you try to mix the products of different suppliers into one system and this is where the story really starts. Of course compatibility means different things to different people. To some it is the ability to connect intelligent outstations from different vendors to one central station, whilst for others it is the ability to use a common data wiring loop to connect the totality of the services together thereby reducing wiring costs. In all cases the common link is communications protocols. The BEMS Technical Centre is adopting a four-layer methodology to approach a concensus, firstly between vendors offering HVAC intelligent controls, but in the long term, to gain common acceptance throughout the other building services functions. The four elements of communication involved are:

- central station/outstation
- outstation/outstation
- intelligent sensor applications
- central station/central station

The centre is employing a major software and communications company to construct a draft standard for BEMS communications. The first part of the work programme deals with the feasibility of drawing up such a standard with the major BEMS companies indicating their own preferences. From this effort the broad specification of the standard will emerge.

The second part involves detailed drafting of the documents sufficient to enable a technical implementation of the work to proceed in the future. It is envisaged that full use will be made of existing related standards such as the ISO 7 layer model, MAP and TOPS applications, together with full cognisance of similar activities in the international scene. This will enable us to present firm recommendations to the international community rather than enter into interminable debate. It must be realised however, that this is only the beginning and it will take several years, perhaps five or six, before all the manufacturers have incorporated the new standard(s) into their products.

Commissioning

Commissioning is the advancement of an installation from the stage of static completion to full working order; it includes setting all plant and equipment to work and the necessary balancing and regulation of systems.

Unfortunately in practice, too little time is allowed for satisfactory commissioning, partly because the client, designer and installer are all pressing for completion of the project rather than checking to ensure everything is satisfactory. Commissioning frequently becomes a process of starting up and operating plant and systems to demonstrate that they do work, rather that showing that they perform in accordance with the original specification.

It is hardly surprising, therefore, that proper consideration of commissioning is the exception rather than the rule, and that the complaint that commissioning was not done satisfactorily continues to be a common occurence.

However, help is at hand! The feasibility of dedicating an intelligent controller to each piece of plant, such as air-handling units, chillers, or boilers, implies that commissioning can take place at the suppliers premises off-site and each item can be networked into the total system when convenient. No longer do the suppliers or contractors for each item of building services plant need to be brought together on site all at the same time.

Quality and reliability

The real demand from many sides of the industry is for a certification scheme for BEMS products. Users and consultants require a scheme enabling them to distinguish between reliable products obtained from those who have the resources and reputation to deliver a full service, from those that cannot. The BEMS Centre intends to start operating such a scheme early in 1989.

A BEMS should meet the complex needs of the services in a building, not exceed them. Current developments in the technology are undergoing rapid change and there is always a danger of considerable over-specification. Several organisations have already provided documents giving advice and guidance on the specification of the BEMS and it is essential that a single co-ordinated standard document be provided urgently to assist potential procurers of BEMS to reduce the number of so-called failures of installations.

What about 1992?

The BEMS market in Europe remains strong with a good double-figure growth rate predicted up to the year 2000. West Germany and the UK provide the biggest markets, especially with regards to refurbishment potential of older building stock. The cost of energy remains at a relatively high level and is likely to increase further in the future and there is good government support for continuing energy efficiency. Europe has not been badly affected by the recession, and with BEMS production costs falling, and a much improved technical performance of products, the current UK share of the BEMS market — which presently stands at 24 per cent, second only to West Germany at 38 per cent — is likely to increase.

There are no major legislative or regulatory reasons for manufacturers outside Europe to regard as barriers to entry, and all the major economic factors affecting the European market are also positive growth factors for this technology.

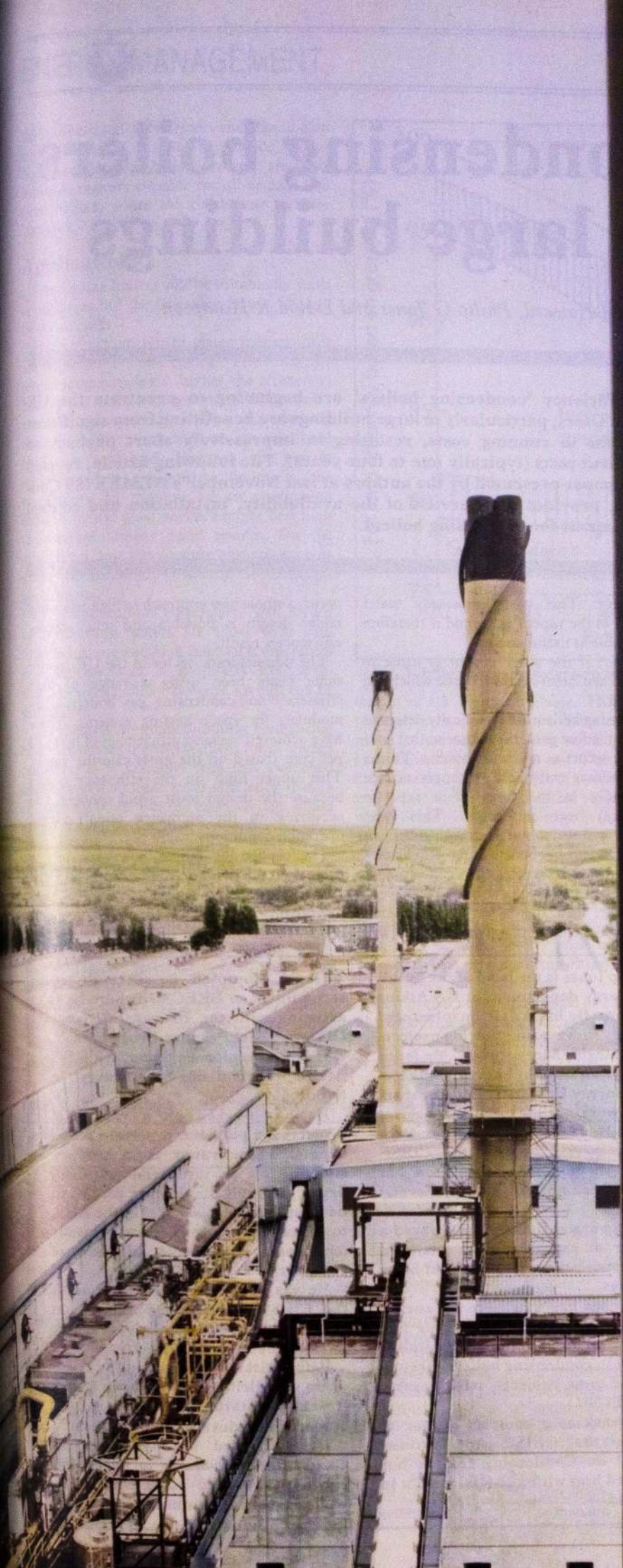
Conclusions

Building energy management systems have been evolving over the last decade and are now established as an important tool for enhancing the management of building estates. Much of this evolution has closely followed the development of the micro-electronics industry which has enabled the size and cost of systems to reduce to a point where today they are a realistic alternative to conventional controls in nearly all non-domestic buildings. The efforts of the developers have been concentrated on producing reliable systems which adequately control building plant and services.

Nevertheless, the last ten years have indicated that rapid growth in technology is only of value to society when it is paralleled by a growth in people's awareness and ability to exploit that technology to maximum effect. It is to this end that the BEMS Technical Centre will be directing many of its activities in the coming decade. □

HIS ENERGY SEEMED TO BE BOUNDLESS.

But what did it cost him?



THE cost of raw materials, the cost of plant, the cost of heating and electricity. Containing them, understanding them, predicting them, day by day, leaves managers exhausted.

Just imagine being able to guarantee these costs over the next 10 years. Yet electricity prices for industry and commerce will remain in doubt until privatisation is settled and probably – beyond.

Fuel oil prices will continue to ride the Opec switchback. Gas will tend to follow oil with perhaps the occasional nasty shock from the regulator.

So who could possibly predict fuel costs?

Quite simply, British Coal.

The restructuring of the industry has been going on apace since 1985. Productivity has increased by 90%. Operating costs are down 34% and prices have fallen more than 25% in real terms. Add to this startling improvement in performance the certainty of hundreds of years of reserves and British Coal looks a sound bet for the future.

That's why British Coal can offer the electricity supply industry long-term contracts, with prices no greater than the UK inflation rate. These attractive terms are also available to our industrial customers.

You can benefit from burning low cost fuel in clean, environmentally friendly, fully automatic plants and predict your future energy costs.

Forecast the future accurately by switching to coal and don't let uncertain fuel prices sap any more of your valuable energy.

For more information contact British Coal Industrial Marketing Department on 01-235 2020.

WAKE UP TO THE NEW AGE OF

British COAL

Condensing boilers in large buildings

by Nigel Howard, Philip G Jones and David R Hampton

High efficiency 'condensing boilers' are beginning to penetrate the UK market. Users, particularly in large buildings are benefitting from significant reductions in running costs, resulting in impressively short payback of investment costs (typically one to four years). The following article, revised from a paper presented by the authors at last November's NEMEX '89 Conference, provides an overview of the availability, installation and control requirements for condensing boilers.

THE UK is currently seeing increased acceptance of the new generation of high efficiency condensing boilers. Designers and installers are becoming conscious of the need to provide heating systems that are more energy efficient. Some customers are beginning to demand this type of equipment. Most early designs originated on the continent but UK designs now exist. Many users of condensing boilers, both in housing and large buildings alike, are reaping the benefit of significant running cost reductions.

In order to promote energy efficiency improvements nationally, the government-run Building Research Energy Conservation Support Unit (BRECSU) manages research, development and demonstration schemes on behalf of the Energy Efficiency Office.

In particular, BRECSU has sponsored demonstrations of condensing boilers in a variety of building types. Paybacks of between one and four years are typically achieved without resort to radical changes in the design of the rest of the heating system.

The recently-published CIBSE Applications Manual on Condensing Boilers resulted from collaboration between BRECSU and the Chartered Institute of Building Services Engineers, with W. S. Atkins retained as contract authors.

This article provides an introduction to the technology for those who may be interested in possible investments.

About 10 per cent of the total gas input to a boiler is normally lost up the flue in the form of latent heat. This heat keeps any water produced in the vapour state, and is therefore not available as useful energy.

However, if the water vapour is made to condense then latent heat is released which can be utilised.

Condensing boilers are specifically designed to reduce the flue gas temperature so that condensation occurs as much as possible. This is done by adding extra heat exchanger surface area usually in the form of a separate (secondary) heat exchanger. This heat exchanger will also capture extra sensible heat.

Thus condensing boilers offer efficiencies that will always be greater than conventional designs. Their efficiencies also tend to be very good at part load, due to very low standing losses. By accepting that condensation will occur, a whole new approach to high efficiency boiler design is possible and much higher efficiencies result.

The non-domestic sector in the UK has for some years been using a range of high efficiency non-condensing gas boilers, often modular, for space heating systems. These have achieved seasonal efficiencies of up to 82 per cent (based on the gross calorific value). This upper limit on the efficiency occurs because the design must avoid condensation occurring in the appliance under normal operation conditions.

The condensing boiler, however, aims to promote condensation. Materials are used that are insensitive to mildly corrosive condensation products. In this respect, condensing boilers are inherently tolerant of

The authors

Nigel Howard is the head of the commercial and public buildings section of BRECSU (Building Research Energy Conservation Support Unit). The section manages a range of research, development and case study demonstration projects on behalf of the Energy Efficiency Office of the Department of Energy.

Before joining BRECSU in 1987, Mr Howard worked for the SE region of British Gas, managing a section of development engineers working on various aspects of pipeline gas distribution and storage.

Mr Howard is a Chartered Chemist by training but with very diverse experience, having worked on corrosion and materials, industrially contaminated land, computer modelling of dust migration, the economics of novel mains repair methods and energy efficiency in buildings. He has worked in industry and for the Greater London Council.

Philip Jones is the head of the buildings energy department at WS Atkins in Epsom. He has a daily involvement in energy surveys, monitoring projects and strategic energy studies. Mr Jones obtained an MSc in energy engineering at Surrey University and spent six years working for British Gas at Watson House Research Station. During this period he won the CIBSE Dufton medal for his work on hot water consumption in commercial buildings.

Later work at British Gas covered a number of extensive field trials on condensing boilers in a range of large buildings.

Mr Jones has now been an energy consultant with Atkins for over five years. He has maintained a detailed interest in condensing boilers through some of these projects, most notably for BRECSU.

His work as a contract author in writing the CIBSE Applications Manual on Condensing Boilers has provided him with a special insight in this field.

David Hampton is currently on secondment to BRECSU, where he is assisting with the Energy Efficiency Office's "Best Practice Programme".

He is a senior engineer with WS Atkins, specialising in energy in buildings.

He has worked on a variety of projects for public and private sector clients. These range from trouble-shooting on an industrial (cat-food) dryer, through monitoring combined heat and power (500 kWe) in the NHS, to a study of high-efficiency domestic (condensing) boilers in an estate of compact new housing.

He was one of the contract authors of the CIBSE Applications Manual on Condensing Boilers, and gives regular talks on the subject.

Before Atkins, he worked for seven years with British Gas' Watson House Research Station in Fulham, on research and development projects.

He graduated in engineering at Cambridge University in 1980, and previously worked as an apprentice with Marconi Communications.

design and installation factors and should gain wide acceptance as user experience grows. Some condensing boiler designs are now available that are suitable for oil or dual fuel fired boilers, where the condensate is more corrosive.

Applications

Condensing boilers will be suitable for most applications but the following factors need to be considered.

Heating system return water temperatures are important but not critical. The lower the return temperature the higher the efficiency, but at all temperatures these boiler out-perform conventional design. Condensing boilers further out-perform conventional boilers as part load. However, the key to selection of a condensing boiler is the economics. An example of an application unlikely to give good payback might be a high temperature radiant panel system. On the other hand, low temperature systems such as underfloor heating, provide the most efficient applications.

Other applications particularly well served by condensing boilers are those with continuous heating and high internal temperature requirements (such as hospitals). Even with standard sized radiator systems, savings can be substantial.

The biggest myth surrounding condensing boilers concerns the requirement for oversized radiators. It is certainly true that oversized radiators will squeeze extra efficiency from a condensing boiler but the extra savings would rarely, if ever, be justified economically.

Available equipment

Until recently there was only one British made condensing boiler, applicable to the non-domestic market, available in the UK. Even this boiler, the 'Trisave', only has one foot in the commercial sector as it has a maximum output of only 24 kW. Most of the other condensing boilers being sold in this country are imported from Europe. Those being marketed in the UK are shown in Table 1 along with some details of the design and output of the boilers available. The relative price of these appliances is a factor to bear in mind, as the secondary heat exchanger adds extra expense to the capital cost. These boilers can cost up to twice the price of a conventional boiler but the high efficiencies achieved can still provide payback of overcost in one to four years in suitable applications.

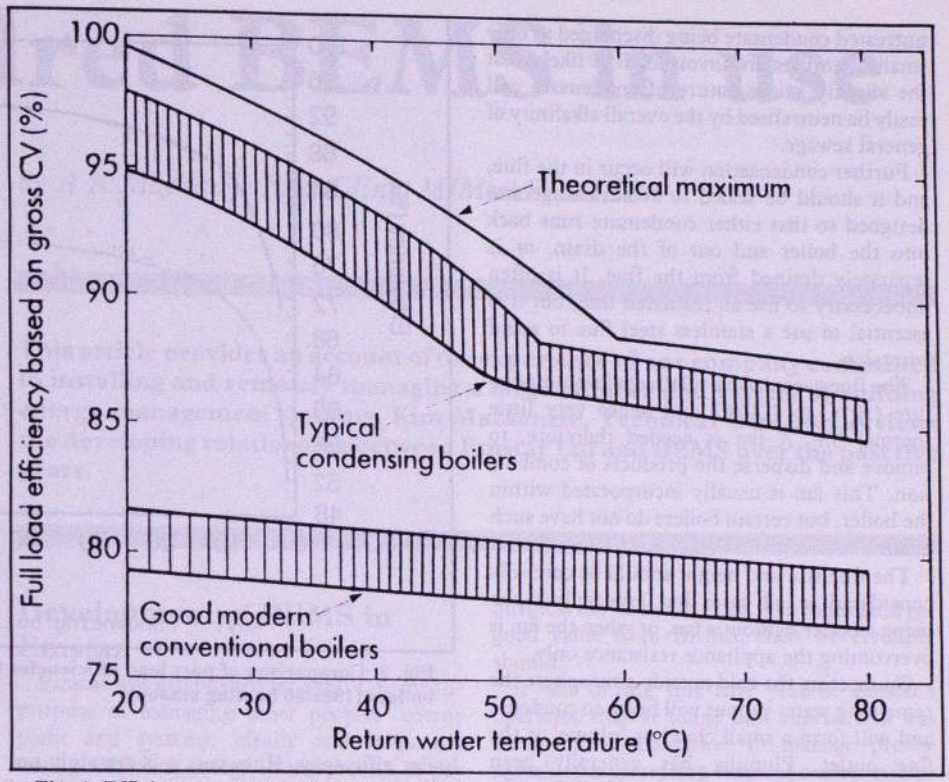


Fig. 1: Efficiency vs water return temperature.

Purpose-designed

One of the first to be introduced to the UK was the 'Seagold' boiler. This unit is a standard cast iron sectional boiler with an add-on secondary heat exchanger consisting of aluminium finned and plain tubes.

Of the other boilers mentioned in Table 1 the 'Atlantic' and Combat designs both represent purpose-designed condensing appliances, with several advanced features. These compact boilers also require less space and generally have very low case losses.

All the designs have greater heat exchange surface than conventional appliances and so the efficiency in the non-condensing mode is increased.

Most condensing boilers operate at about 86 per cent when not condensing. When the return water falls to 45°C the efficiency rises to 90 per cent. Efficiencies as high as 95 per cent can be achieved when operating at a return temperature of about 30°C.

The maximum theoretical condensate rate is about 1.5 kg per cubic metre of gas. For example, a boiler with an input of 250 kW, operating at 40°C return water temperature will produce about 14 litres/hr (three gallons/hr) of condensate.

Installation requirements

There are some special considerations when installing condensing boilers. Certain acids are formed when condensation occurs and consequently the condensate is very slightly acidic (pH 3.6). However, the materials involved (flue and drains) will be in contact with the hot condensate throughout their working life and need to be resistant to corrosion.

The condensate is usually disposed of from a drain point at the bottom of the secondary heat exchanger. The drain should be run in plastic pipe and must incorporate a trap to avoid leakage of combustion gases into the boiler room. Where the boiler is below ground level a sump can be used to collect the condensate. A corrosion resistant pump must be used to dispose of it.

Tests on common materials used in drains such as claypipe and PVC have shown no corrosion problems. Cast iron water pipes, because of their thickness, are not seriously affected.

Water authorities have not objected to the

Table 1: Condensing boilers marketed in the UK — non-domestic (> 20kW)

Name	Model	Size range	Condensing heat exchanger material
Atlantic Boilers	Condensamax Maximagaz Totaleco	90-7,650kW	stainless steel
Babcock Robey	Ygnis EMK	75-3,500kW	stainless steel
Beaumont UK	Speedmaster	88-146kW	steel
Beeston	Berkeley	75-155kW	aluminium
Broag	Seagold OD	20-1,900kW	aluminium
Combat Engrg	RX Integral	70-320kW	aluminium
De Dietrich		80-430kW	cast iron
Froling UK	FSM/RK	120-1,100kW	stainless steel
Glotec	GT	18,024kW	stainless steel
Hoval Farrar	GS+	65-260kW	aluminium
JLB Trisave		18,024kW	aluminium
Kidd		18-366kW	patented coating
Microstar		24kW	stainless steel
Potterton	Diplomat Derwent	40-348kW	aluminium
Stokvis	Condensamax	112-1,020kW	aluminium
Stelrad	CXC	44-106kW	aluminium

untreated condensate being discharged as only small quantities are involved. It is likely that the slightly acidic nature of condensate will easily be neutralised by the overall alkalinity of general sewage.

Further condensation will occur in the flue, and it should be sealed to avoid leakage and designed so that either condensate runs back into the boiler and out of the drain, or is separately drained from the flue. It is often unnecessary to use an insulated flue, but it is essential to use a stainless steel flue to avoid corrosion.

The flue gases have a relatively low temperature (30°C to 100°C) and hence very little thermal life. A fan is needed therefore, to remove and disperse the products of combustion. This fan is usually incorporated within the boiler, but certain boilers do not have such a fan.

The flue size and height should be carefully considered in all cases but especially when using a boiler without a fan, or when the fan is overcoming the appliance resistance only.

On meeting the cold outside atmosphere the remaining water vapour will begin to condense and will form a small cloud or 'plume' at the flue outlet. Pluming has generally been avoided when using conventional boilers in the past but a condensing boiler reduces the gas temperature to such a degree that it is unavoidable.

The presence of a plume at the flue outlet will not normally be a problem providing the terminal location and prevailing wind direction are considered. It may even be welcomed, as a sign of a highly efficient boiler.

Boiler controls

As with conventional boilers in the non-domestic sector, the control problems involved can be simplified by separating the heating and hot water systems. The higher temperatures required to produce hot water can then be avoided and the heating system may then be controlled independently.

Alternatively, split boiler designs allow the provision of hot water from the same boiler. Many commercial buildings have radiators which are oversized, and any excess in emitter size can be utilised by controlling the system at low water temperatures which will improve boiler efficiency. However, it is certainly not necessary or desirable to increase the size of radiators to benefit from the use of condensing boilers.

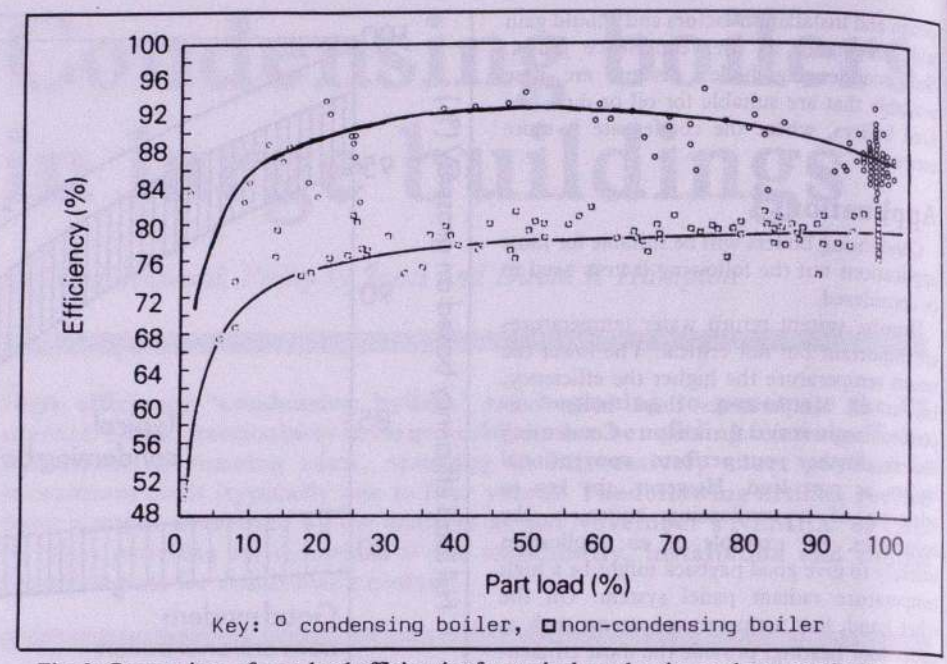


Fig. 2: Comparison of part load efficiencies for typical condensing and non-condensing type boilers (1985/86 heating season).

An effective form of control is the use of a standard outside air compensator which is now commonly used in commercial buildings, and reduces the heating water temperature as the outside air temperature rises. This results in lower return water temperatures and hence higher running efficiencies in mild weather.

The compensator usually controls the position of a three way mixing valve and the secondary heater exchanger is positioned as shown in Figure 3. However there is an alternative configuration requiring only two pipe connections. As shown in Figure 4, a mixing valve is not required and the compensator acts directly on the burners. This approach requires less capital cost and can have lower system heat losses.

The use of weather compensation allows efficiencies of over 90 per cent to be achieved during the mild weather. The efficiency on a design day would probably be about 86 per cent. The likely season efficiency is therefore about 88 per cent, as opposed to approximately 75 per cent for the best conventional system. It is probable that this would result in a simple payback on the extra costs involved of about three years. Applications in low temperature systems such as underfloor heating will show even higher seasonable efficiencies and even shorter paybacks.

In hospital applications, even with conventionally sized radiators, paybacks of overcost of one year have been achieved due mainly to high and continuous heating loads.

Conclusions

The condensing boiler can provide efficiencies well in excess of those boilers now in widespread use in Britain. In most cases they are simple to install and provide attractive payback periods due to significant running cost reductions.

The capital cost of these units is likely to reduce in future as applications become more widespread. This will make the payback period even more attractive. □

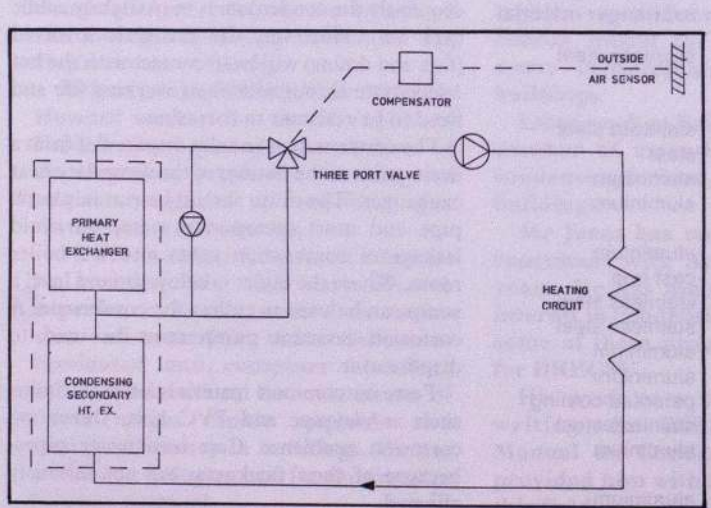


Fig. 3: Condensing boiler with compensator acting on mixing valve.

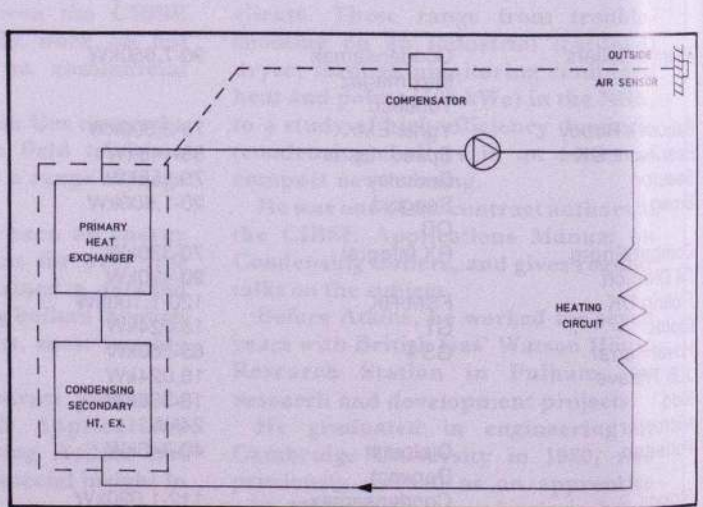


Fig. 4: Condensing boiler with compensator acting directly on boiler.

One hundred BEMS in use

*by A K Mackenzie BSc, CEng, MIMechE, MIEE**

This article provides an account of the experience of one company committed to installing and remotely managing a large number and variety of building energy management systems. Kim Mackenzie, Technical Director, reviews the developing relationship between Emstar Ltd and BEMS over the past five years.

IT WAS not that long ago, little more than a decade or so, when building energy management systems (BEMS) first arrived on the building services scene. Acclaimed as a revolutionary approach to building system management, they were expected to sweep the country — and no doubt the world — making enormous energy savings.

Many of us who tackled the design, installation and commissioning of such systems in those early days found it was a mind-stretching exercise to get them to work properly, let alone keep on top of them thereafter. It was certainly no great surprise to me that many fell into partial or total disuse after installation.

With rapidly advancing technological developments we all felt it would only be a couple of years before the man/machine interface was made much more easy and friendly, so that any engineer worth his salt could specify and subsequently operate these systems without any undue effort.

In fact, the latest *Proplan* report on the use of BEMS in Europe shows that rapid growth and hence wide acceptance of BEMS is only now beginning to happen. It forecasts that 'scales will double by 1993'. The report, as quoted in a recent *Energy Today* article, also stated that this development was accompanied by, and linked to, the emergence of third party involvement (known as Contract Energy Management (CEM) companies in the UK).

The purpose of this article is certainly not to act as a sales pitch for CEM, but to draw from my own experience in a company operating in this field. It is interesting to reflect back on the early problems we found, and in many cases these are the same problems that individual BEMS users will encounter today. So bear with me whilst I look back five years, to 1984/5 when Emstar Ltd, was just evolving.

Development of BEMS in Emstar

Emstar was established by Shell UK for the purpose of managing other peoples' energy plant and systems, ideally and frequently saving sufficient energy in the process to pay for the new equipment, upgraded controls, etc that were provided as part of the package.

To help in this task, a natural thought was whether we could make full and effective use of BEMS. To cut a long story short, after a full year of investigation we did go ahead with a plan to use BEMS equipment as a substantial part of our business. The main advantage perceived at the time was enhanced energy savings as a result of replacing stand alone controllers, plus a few other associated benefits.

There were, however, considerable disadvantages in taking this route:

- high investment cost in equipment, training and familiarisation;
- the need for a wide range of systems to suit different clients' needs;
- considerable development cost to minimise the complexity to the users, and to optimise the benefits.

We encouraged ourselves with the thought that since energy management was our prime business day in and day out, if anyone could get good value from BEMS, then we certainly should.

It was during this first year of Emstar's operation that we found how expensive it was in terms of manpower to manage professionally the increasing range of remote energy plant that we were becoming responsible for. Possibly our systems are more remote than most in-house energy managers have to cope with, but the principles are still the same. There is a constant need to:

- monitor the correct and efficient operation of the plant;
- measure and analyse energy consumption;
- produce reports to management and discuss the results;
- respond "instantaneously" to problems;
- manage changing needs;
- assess plant maintenance requirements.

We therefore also looked to BEMS to see if any inroads could be made into the manpower costs associated with these activities.

So, problem no 1 = excess manpower costs

The next fundamental area of difficulty we faced was to find a way of operating, including heavy remote access to, a range of BEMS from different manufacturers. We felt this was essential to give us independence from any one supplier, and to provide a range of facilities to suit all types of clients' needs.

The apparent solutions were to have either a control room full of individual supervisor screens and computers, or equipment to convert the various communication, logic and display protocols into a common format. We initially selected the latter route, but soon found through early investigations and development work that far more time and effort would be needed than we could afford.

So problem no 2 = excessive hardware costs

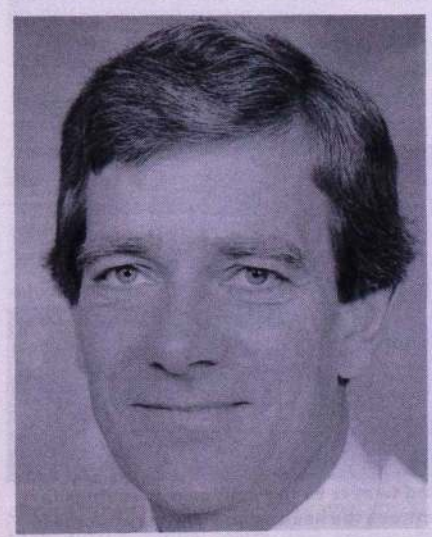
We also found that the concept of a central control room had severe limitations in practice.

The author

Following his post-graduate training, Kim Mackenzie worked as a project and design engineer for the Department of the Environment. In addition to his work for the DoE, he also worked for the British Australian and New Zealand forces in Malaya.

In 1973 Mr Mackenzie joined an in-house consultancy group, of which he was subsequently promoted to manager.

He joined Emstar Ltd as their technical director in 1984.



**Technical Director, Emstar Limited*

Yes, one central location was necessary to receive alarms of problems or failures, but on receipt of an alarm that left two options:

- contact the engineer responsible for the site and send him off to investigate, or
- task the controller to interrogate the BEMS (remotely) to see if further details of the problem could be ascertained thereby.

Neither option provided the ideal solution. The first could often result in wasted time, and the second failed because only an engineer familiar with a site or system can carry out a fully 'intelligent' interrogation of his plant, and Emstar now has BEMS equipment operating on over a hundred separate sites, looked after by 20 or so supervisors across the country.

So problem no 3 = how to provide an 'intelligent' response to alarm calls

The practical solution

The common solution to these three problems, was to develop a suite of software, and a kit of hardware in the form of a lap top computer and a modem housed in a briefcase, that could be carried by all our supervisors and used from any location with a suitable BT socket and line. This could be, and frequently is, in the home, the office, the car, or whichever plant room an engineer happens to be in at the time. Remote access to any site can thus be achieved by simply inserting the appropriate disk into the lap top computer, each engineer carrying sufficient disks to cover all of the sites for which he is responsible.

We provide similar suites of software on hard disk for engineers to use from PCs in our control room or regional offices.

All that then remained was to find a cost effective solution to receiving alarms from the variety of systems on our sites into the control room. Again, lap top computers, with software developed for the purpose, proved to be the answer.

We found this to be a practical solution, which over the last couple of years has been operating most successfully — but that is not the end of the story. First, let me put Emstar's current operation of BEMS into perspective:

Under a contract to manage London Zoo's energy services, Emstar monitors and controls individual heating zones to ensure the best environment for the animals, and cost savings for the zoo.

Energy management systems

- five types of BEMS
- 200 outstations
- 5000 points of control
- 100 sites

If the question were asked, 'have all of these systems operated satisfactorily from day one?', the answer would have to be, for some at any rate, 'no'.

We have had a few specific problems with hardware, more often with the way it is installed, but perhaps the most common weakness with our earlier systems lay in the particular software prepared for each outstation — in other words the configuration of the control strategy required by the design engineer into a computer programme.

Originally, we contracted this task to the BEMS suppliers, but with pressures of time and lack of good controls engineers, they suffered. Many of the strategies we ended up with did work, but not in the tidy, flexible and robust way we really wanted. Poor communications on both sides were probably a contributory factor as well. (The specification of a BEMS system is a learning exercise in itself).

Other sources of problems were the quality of installation and cabling, and the testing thereof, as well as the commissioning of the whole BEMS system. These areas were, and still are, hindered by the lack of good industry standards and accepted specifications.

For quality and consistency, and indeed economy, we have found the effective solution for all these difficulties is to have engineers trained to do the work in-house, and to supervise closely, in the case of installation, the work done by specialists.

Perhaps of more significance, than the problems we faced and how we overcame them, is the change in our attitude towards BEMS, and the change in our perception of BEMS, that has occurred over the last few years.

To illustrate this change, I no longer see BEMS primarily as an energy saving device. Indeed, I do not know how much, if any, energy has been saved by BEMS systems on each of our sites, and yet that is still the most common question I get asked. In response to a query to one of our supervisors about the benefits he sees from having his lap-top-computer/modem-briefcase (we call them mobile packages), his reply was:

Mobile package benefits

- reduced operational costs
- faster response to alarms and site problems

Emstar's energy management system has contributed to over 65 per cent energy savings for NEI IRD, achieving a carefully controlled balance between the heating and cooling systems in the building.

- remote control of environmental conditions
- remote switching of emergency or stand-by plant
- immediate condition and client information reports

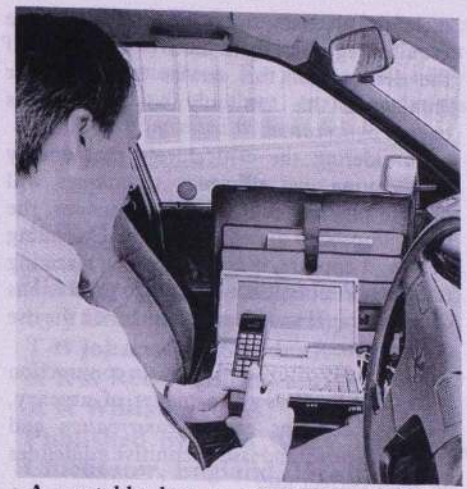
Again, no mention *per se* of energy savings. Obviously energy costs are part of operational costs, but the point is that we find a BEMS in practice has a much wider purpose, and hence benefits, that we originally appreciated.

Add to the above list the enormous flexibility of a BEMS to meet the potential concerns or tasks of today, and be changed (almost literally), to match those of tomorrow, and it can be seen as a facility with enormous power – and even greater potential.

Lessons learned

A few of the key lessons learned over the last few years can be summarised as follows:

- A BEMS user, or an agent closely involved with the ongoing success of his system, must be able to write his own programme – configure his own systems – as only he knows what he really wants from the BEMS, now, and in the future.
- The full benefits of a BEMS are never achieved on day one. The operator must be able to develop and enhance the use of the system.



A portable lap-top computer, enabling energy managers to access energy management systems remotely from their car, home or office.

- A BEMS user must be in a position to recognise if he is being used as a guinea pig to test out new products. He needs somebody able to keep him slightly ahead of the field.
- BEMS used properly can avoid wasting large quantities of energy – by early warning of control failures, by analysis of unsatisfactory performance by detecting interference with controls, and by watching for trends.

I had summarised earlier that 'a BEMS can be a facility with enormous power and even greater potential'. Perhaps I should have said '. . . could be . . .'

Because one thing is certain: the learning process Emstar has been through, and it must be the same for other BEMS users, has not been easy. We succeeded, and can now confidently offer to engineer and operate systems for our clients covering a wide range of purposes, simply because energy management is our business – we have no distractions, we have no higher priorities.

Reverting back to my opening remarks, I believe it is therefore no coincidence that the forecast rapid increase (I hope successful) in the use of BEMS will be closely linked to the expanding use of CEM companies to provide the necessary engineering expertise, commitment, and ongoing management services necessary. There will of course always be individual users who can set up and run schemes entirely satisfactorily, but the effort, the pitfalls to be overcome, and the management support, do combine to form a major obstacle to newcomers.

To close on a brighter note, the final point I should like to make is the overriding impact of the very real and valuable management information that BEMS can provide. For this reason alone there are few, if any, of our clients that would now revert to stand alone control systems. □

CONFERENCE REPORT

Third international conference on Tidal Power

Rule changes bar way to tidal power

THE Institute of Civil Engineers held their first tidal conference after publication of the Bondi Committee's report in 1981; the second followed the Severn Tidal Power Group's 1986 report; and now this one (co-sponsored by The Institute of Energy) marked the end of another STPG study. Nine papers on all aspects of the Severn, five similarly on Mersey and a few general ones.

This series of conferences has punctuated our crabwise endeavours to harness the most promising of our native renewable energies: excellent progress on engineering and environmental impact, but frustration on how to organise and finance the projects; and small wonder, as the rules are for ever changing.

The Bondi committee had assessed the Severn as a *public sector* project. In their first study, STPG had to explore its financeability in the *private sector* with competing conventional power still in *public hands*. Half way through the second STPG study came *privatisation but not quite*. The authorities realised that the "market" disliked long term projects, namely those with high capital and low operating costs, like nuclear and renewables, so they devised the non-fossil fuel quota. Next they learned that the "market" disliked risk too, and took nuclear back into *public hands*. Nobody seemed to know what criteria the renewables now had to meet, and as Hammond said in presenting his paper "Mersey Prospects", it would be ironic if that decision intended to ensure nuclear continuity turned out harmful to tidal power by mistake. Speakers from both Severn and Mersey pronounced themselves unable to make progress in these confused circumstances.

The net result was that no work could be reported on organisation and financing, allowing attention to concentrate on some impressive engineering and environmental progress, especially on Severn, which is further ahead and has a larger team; nothing was said to suggest much economic difference between the two projects but Severn is ten times bigger. A great deal had been done on regional impact, and warm comments came from a representative of the local authorities, but Clare (who heads the Severn operation) mentioned hostile comments by Friends of the Earth on the day of the press release (26 October), made before they could have received his report, let alone read it.

In 1981 Bondi found that Severn was cheaper than coal but not than nuclear. Since then tidal's capital costs and output have moved favourably and there is much greater confidence in them, while coal and nuclear have gone backwards: coal mainly for environmental reasons, nuclear for varied ones. So why is tidal power still struggling to get on terms?

That was one of the questions pondered by the conference's concluding panel of wise men. Another was the practice of financial pundits to take future inflation as zero, which it obviously will not be. It is called "working at constant prices", and the paradox is illustrated by the Rance tidal scheme; Electricity de France say its power is the cheapest on their system but that to build a similar scheme today would be too expensive (we were told the same applied to Scottish hydro stations, so it is an international problem). The audience dispersed musing why anyone should think financial and short term market criteria were the right ones for energy policy: a mystery that will not strike members of The Institute of Energy as a new one. □

Philip Warner (Hon treasurer)

Energy terminology

Sir,

The Centre for Energy and Environmental Techno-Economic Studies (CEETES) is undertaking a contract for the Department of Energy to develop a methodology to determine the environmental costs of energy technologies and in the new year will co-ordinate all similar studies in the EEC.

Despite the wide range of new terminology relating to environmental costs that the energy professions will have to reach agreement on, I was extremely concerned to hear at a recent conference, that there is still no clear agreement on fundamental terminology relating to energy — *conservation* and *efficiency*.

The term energy *conservation* appears to have been greatly replaced in public discussion by energy *efficiency*, and the two are used by many, particularly by the media and politicians, synonymously. However, energy *efficiency* only has any real meaning when it refers to the conversion of energy from one form to another. The phrase 'energy efficient building' is totally meaningless, that is why the phrase 'low energy building', accepted by professionals in the field, has come in to use.

If we consider space heating, for example, when an energy survey of a building is undertaken, three distinct components are involved. Firstly, the energy *demand* is calculated; then an allowance is made for ambient energy gains; and finally, the efficiency of the *supply* system is taken into account. From these the energy costs can be predicted.

Any recommendations for improvements such as insulation, draughtproofing, ventilation heat recovery and, notably, alternative use of the building itself (good housekeeping measures), would reduce energy *demand*. Though I do not personally like the term, because of confusion with the law of the conservation of energy, these demand reducing techniques are most appropriately described as energy *conservation*, as it is by now a widely used term, and they clearly have the potential to conserve energy resources.

Energy *efficiency* should only be used to describe those techniques which relate to improvements in the efficiency of energy *supply*, such as condensing boilers and intelligent control systems. Energy efficiency is only relevant to the energy cycle which, taking all resources and energy inputs into account, starts at the energy resource and finishes at the point of utilisation, ie, the technology used to provide the service required (eg, heat, light, motive power, etc). If the demand for this service is reduced or eliminated, this can only be described as energy *conservation*.

Considering the critical role that energy conservation *and* efficiency techniques will have to play in reducing CO_2 emissions, the most important factor in global warming (which, it appears, is occurring at an alarming rate), it is essential that the energy professions come to a rapid and clear agreement on the use of these terms.

Will The Institute of Energy, in conjunction with CIBSE, please as a matter of urgency, discuss the terms energy *conservation* and energy *efficiency* and issue definitive guidelines for their correct use?

Ross Ferguson *(Member)*
Newcastle upon Tyne.

On the wrong track

Sir,

At a time when most countries in Europe are improving their rail networks and increasing their subsidies, our Government is once again reducing the subsidy to British Rail: with the inevitable results of increased fares, more passengers and freight deserting the railways, and the spawning of more vehicles onto our congested roads. In a recent article in the *Observer* it was claimed that the Prime Minister considered the railway system 'inefficient, cumbersome and outdated', implying that it could be left to wither away under the chill winds of market forces. I should like to use your columns to put the opposite case, in the hope of provoking a debate on the subject.

As regards *efficiency*, it is surely true that rail transport, over low-gradient tracks and with uninterrupted movement over long distances and into city centres, is very much more efficient than road transport in terms of energy consumption/(load × distance). Far from being cumbersome, rail transport is much more economical in land usage: compare a two-track railway (possible with signalling) with the equivalent six-lane motorway which is necessary for uncontrolled mixed traffic. (Compare also the space occupied by 20 businessmen in a first class carriage with 20 businessmen each moving and parking his individual motor car!)

With growing recognition of the importance of reducing *air pollution*, the road vehicle lobby must concede one outstanding advantage of an electric railway (including tram/trolley bus): that it is the only transport system completely free from local air pollution in itself (disregarding for other reasons bicycle, horse and sail). As long as fossil fuels are used to generate electricity, there will be CO_2 emission from primary generators, but other emissions such as SO_2, NO_x, hydrocarbons etc can be much more effectively and economically dealt with at a central power station than at individual IC engine exhausts. And when the fossil fuels run out, or their use is restricted on environmental grounds, the electric railways can continue to run (unlike the lorries, cars and aircraft), whether the primary power source is nuclear, wind, wave or tide.

In answer to the argument that rail transport still needs road links at either end, it can equally be argued that road vehicles need a lift from rail through the Channel Tunnel; and given the existence of rail platforms capable of carrying cars and trucks, the system can be extended. Short range delivery vehicles could be specifically designed to load onto trains for the major part of their journey, and they could be electrically powered, with batteries charged during the rail trip, thus further reducing air pollution in city centres. Factories could revive the rail sidings which they have closed in recent years, and the Motorail system could be greatly extended and made much cheaper (by subsidy!), to get long-distance motorists off the roads.

A road-traveller by present necessity, but a rail traveller by choice.

Eleanor MacNair *(Senior Fellow)*
Monkton Combe, Bath

Congratulations Bill!

Sir,

Congratulations to William 'Bill' Ryder on his being awarded the title of European Engineer (*Energy World*, December 1989).

EurIng Bill Ryder now joins hundreds of UK engineers who have already received this prestigious title which is an indication of the high regard to which our engineers are held on the continent and overseas generally.

This fact must give us great confidence in the run up to 1992 and we must thank The Institute of Energy and other members of The Engineering Council for their successful role in gaining this recognition of our engineering standards.

Charles Gray *EurIng (Fellow)*
Southend-on-Sea, Essex

A good introduction

'Gasification: its Role in the Future Technological and Economic Development of the United Kingdom' Watt Committee on Energy Report Number 20
Edited by Alan Hedley and Fraser Ferguson
Published by Elsevier Applied Science Publishers, London and New York, 1989
115 pp. £42.00

In the foreword to this report, it is suggested that it would be wise to prepare for the inevitable decline of natural gas production as an energy source from the North Sea. A better understanding of the uses of gas is essential for the more rational and efficient use of the UK's available gas resources. An appreciation of the economics of production and distribution is a vital component towards that end.

The working group whose individual contributions are contained in this volume presented their work at a Conference in London in 1986. The subsequent discussion at the Conference appears in full in the report and adds to the value of the preceding chapters.

Gasification is the creation of gas from a carbonaceous solid or liquid feedstock. The gases formed may themselves be hydrocarbons, hydrogen, oxides of carbon or mixtures of these. The gases are chemically different from the feedstock and the conversion process is physically irreversible. The degree of conversion, quality and composition depends upon the conditions under which the chemical reactions are taking place.

The ten chapters supply the reader with an excellent introduction to the subject. There is a short, well presented account of the gas industry in Britain. The industry has a large consumer base with a highly developed technology. From the days of the production of gas by coal carbonisation, the industry has shown itself to be remarkably safe and efficient. The report describes the future work being undertaken to supplement declining natural gas supplies.

In industry, gasification is the energy form utilised by many gas producers, including fluidised bed technology. The economics of gas distribution forms an interesting section where there are complications caused by a range of factors clearly explained.

The potential of waste materials offering conversion to gas use is examined in some detail. A perceived problem is the imperfect match between market requirements and technical capability. The enormous quantities of waste produced each year cannot be allowed to lie unused for they have a significant energy content. The technology of the use of landfill gas forms an interesting chapter.

The final section of the report gives a series of conclusions and recommendations mainly directed to showing that we need to secure the future of the UK's energy supplies. Improvements are required to the technical base from which process technology and equipment can be marketed. Twelve recommendations are aimed at the Government and also at major energy organisations. For a successful energy future, action on these recommendations should be progressed without delay.

F John L Bindon

An optimistic view

'Energy for a Sustainable World' by J Goldemberg (Brazil), T B Johansson (Sweden), A K N Reddy (India) and R H Williams (USA)
Published by John Wiley and Sons, Chichester, England, 1988
517 pp. £35.50

This is an important book which is of interest to all who are concerned about future energy supplies in a world of increasing population with rising expectations of standards of living. The authors consider the situation in both Western industrial countries and in the developing countries. They analyse the technical facts and suggest practical solutions and political moves and policies which can maintain progress in standards of living, without increasing demands on energy resources and increasing pollution.

The authors are four academics from both the industrial and developing world: Sweden, the United States of America, Brazil and India. The general theme is one of considered optimism. The authors conclude that there are clear indications that both the rise in carbon dioxide levels and the energy requirements of the world can be contained.

The main reason for optimism is that technology exists, in most cases without impairing economic efficiency, for important energy-using industries to give the same or better results while using considerably less energy than the average today. Obvious examples are the steel industry, automobiles and building developments. The book gives detailed information on these and many other examples. The switch in the major 'developed' countries to less energy-intense industries and the use of materials to replace metals that have a high energy element in their manufacture are only in the early stages. By continuing and encouraging wide adoption of these practices, our present standards can be improved while using less energy.

The major challenge is political — the least efficient energy users are the poor, who can least afford it. They have the worst and most inadequately insulated homes and operate the oldest and least efficient vehicles and equipment. In fact, the level of investment necessary to improve this situation is not unacceptably high. It requires publicity and political will.

In the developing countries, the authors can point to local developments which show the way for improvement. One of the keys must be the combination of better and more efficient wood-burning stoves and cultivation and controlled use of quick-growing woodland plantations. The authors recommend availability of cheap kerosene for the urban poor and for locations where wood is not available. Electrification is considered to play a key role in these economies. A case is made for growing crops in hot countries as a source of alcohol for motor fuel. The problems of developing countries are however immense, not the least, high energy use by their influential rich.

The remedies therefore for these countries are less convincing than those for the developed world. Styles of government and public pressures in environmental matters are favourable for many of the effects predicted for the industrial West. The autocratic and often military regimes in many developing countries are not so easy to influence, nor is there a strong, influential public lobby. However, in the democracies of Brazil and India, there are some encouraging signs.

When discussing policies for implementing energy strategies, the authors analyse how the market economy can help to improve energy use and conclude that market forces should be used wherever appropriate. Techniques are reviewed such as rationing, allocation, subsidies, regulation, taxes, administrative setting of priorities and government support of research and development and the creation of policy agents. For an engineer this is the most difficult but also the most rewarding part of the book. It is not enough to know how to achieve desirable objectives; the political means and methods must be understood if engineers are to be effective.

N G Worley

A crucial problem

'Deposition from Combustion Gases'
Edited by A R Jones
IOP Publishing, 1989
160 pp. £20.00

This booklet consists of eight papers presented at a one-day meeting of the Combustion Physics Group of The Institute of Physics, held on 4 October 1989 at Marchwood, Southampton. The organisers deserve to be complimented for putting together the 'state of the art' of a cross-section of this crucial problem encountered during the release of energy from fossil fuels.

The presenters are all well-known workers in their respective fields. Starting with the fireside deposits from low rank coals, the problems associated with the bituminous and subbituminous coal in pulverised fuel firing as well as in fluidised bed combustion systems have been addressed. The paper attempting to model the deposition from pf firing is also very welcome.

Depositions from municipal refuse and Orimulsion (a serious contender for Heavy Fuel No 6) have been studied. Deposition in gas turbines in internal combustion engines have been addressed as regards their mechanism and means of alleviation.

These papers will also serve as a valuable reference source for detailed investigation in their respective fields. The booklet will be a worthwhile acquisition for any library.

Dr A Sanyal

Electrical drives

'Variable Frequency ac Motor Drive Systems'
by David Finney.

Published by Peter Peregrinus, Stevenage, UK, 1988
391 pp. £49.00

Experiences with the range of IEE publications have shown that they are pertinent to the subject matter, published at the right time and written by experts in the particular field. These are the standards which have previously been set for this book. Does it reach them?

Taking the author first, one finds that David Finney, as chief engineer for large variable speed drives at GEC, is undoubtedly a person of eminence at the sharp end of his business in designing, manufacturing and selling large ac motor control drives. He has been associated with the use of power electronics, which are at the heart of these systems, since the inception of the subject.

The book is certainly pertinent to the topic. The ac induction motor is the most common electric motive power converter in use worldwide. In most cases (ie, the 'squirrel cage' form), it requires electrical connections only to the stator of the machine and this makes it a simple rugged device capable of withstanding the abuse, such as massive overloads, it receives in many applications. However it suffers from the disadvantage that at constant supply frequency (ie, mains frequency), it is a nominally constant speed machine. It has been difficult to achieve the variable speed operation which may be advantageous in providing better, more efficient behaviour in many applications (eg, driving circulation fans) in which the load power can vary. Where variable speed is an essential requirement, the traditional route has been to use a dc motor or a wound rotor induction motor with external control resistances. Both of these are more expensive and less efficient than a conventional induction motor. A variable frequency supply would enable an ac motor to run at variable speed. The idea is simple but the variable frequency must be obtained from the electrical mains supply (ie, 50 Hz) and, at the powers required, has been impractical until the advent of reliable power electronic devices — transistors, thyristors and the now emerging gate turn-off devices. The simple concept is now to change the 3-phase mains to dc and to invert this to a new 3-phase frequency using the power electronics. The practice is more difficult and careful design, particularly of the inverter systems, is essential for reliable operation.

All this work is covered in this book at a level suitable for all those concerned with applications of these drives. The book opens with descriptions of the fundamentals of both induction motors and electronic power switching devices. It then leads into power switching circuits and applications to the conventional induction motor as well as synchronous and other motors. Typical calculations are included in the descriptions and these help to explain the theory. The author covers what are now conventional methods of rectification and inversion as well as possible new developments. The subject is well presented in a logical manner and is easy to read.

The timeliness of the book is also clear. The stage has been reached where applications engineers now consider variable speed drives for new and existing plant as a matter of course, but they are frequently unable to obtain necessary information except from the equipment suppliers. Now they can find the questions that they must ask of those suppliers.

This book is a must for all those concerned with electrical drives.

R G Herapath

For the business world

'Energy Storage Systems: Past, Present and Future Applications'
by D Oliver and S Andrews.
Maclean Hunter Business Studies, 1989
80 pp. £150.00

The authors, from Energy Advisory Associates and Independent Electricity Consultants respectively, have used the initiative of the privatisation of electricity to review energy storage with relevant 1989 costs in £ per GJ stored. They give examples from many parts of the world.

The strength of the book is in domestic, business and commercial storage and it produces a good balance with electricity storage and its alternative, aimed at a proposed market of smaller electricity generating stations linked to local heat sinks for a better overall thermal efficiency. The term 'coolth', the antithesis of warmth, is introduced and discussed to emphasise the growing importance of refrigerated storage.

Many aspects are considered, such as alternative energy, combined heat and power/district heating and industrial energy storage. A number of the SI abbreviations are incorrect and irritating to the engineer. As this is a small book, the authors have been forced to omit, for example, the theory, properties of materials and the specialist technical problems known to exist in some industries.

The book is recommended for the business person and is supported by many modern references.

Dr Nigel Gwyther

A useful summary

'Solar Optical Materials'
Edited by M G Hutchins.
Pergamon Press, 1988
180 pp. £25.00

This is a set of papers originally presented at a conference organised by the UK Section of the International Solar Energy Society in April 1988, and covers the applications and performance of coatings and materials in buildings and solar energy systems.

The papers are divided into four main sections, beginning with a section on transparent media for advanced window applications. A comment from the paper of the principles and properties of heat mirror coatings highlights the need for a low emissivity coating for a window which provides visual transparency but little solar energy input, preventing the glare and extreme temperatures encountered in rooms subject to direct solar gain, but retaining the heat or cold already separately provided through solar conversion or environmental heating or cooling. Another interesting paper in this section came from the Research in Building Group at the Polytechnic of Central London, who have been working for some years on 'superglazing' — with a low U-value in the order of 0.9 W m^{-2} K^{-1}. Included in their work is the monitoring of five houses at the Milton Keynes Energy World site. An excellent paper from the Solar Energy Technology Centre at Cranfield on the forward scattering of insolation through transparent and translucent materials concludes the section.

The second section examines window coatings. Here a paper from the Chalmers University of Technology in Sweden looks at the special requirements for automotive window coatings and shows how the concepts of advanced automotive functional window coatings can subsequently be applied to the general architecture sector. Selective absorber surfaces are discussed in the third section. It is interesting to note that while they have been commercially available now for 30 years the only significant application area is still in domestic water heating. A review of the present position from the Birmingham-based Inco Group is followed by several papers emphasising the importance of durability testing and service lifetime prediction. The final section concentrates on the various surface measurement techniques, with papers from Sweden, the Federal Republic of Germany and two from the UK.

Overall the papers represent a useful state-of-the-art summary, concentrating on applications with high commercial development potential. It is a pity that the list of participants was omitted and that there is no index.

Dr Cleland McVeigh

Recently published

'Dangerous Substances, Their Classification and Labelling — A Guide to Current UK Practice'
by E W Bruce.
The College of Petroleum Studies, 1990. 103 pp. £67.50 (discounts available for bulk purchases of five or more copies)

'Mechanical Vapour Recompression'
VDI — Gesellschaft Energietechnik, 1989. 100 pp. DM 30.00.

'Steam Tables in SI-Units'
Edited by U Grigull, J Straub and P Schiebener.
Springer-Verlag, 1990. 133 pp. DM 29.80

A-level system: a bottleneck

REFORM of courses for pupils aged between 16 and 18 must follow the introduction of the national curriculum in schools if we are to overcome the serious national shortage of technical and engineering skills that threaten future economic development, says a new report from The Engineering Council and the Secondary Heads Association.

The report *Engineering the future: A view from the schools* examines possible responses to this problem, made more urgent by demographic decline that will cut the number of school leavers by more than 30 per cent between peak figures and 1995.

It condemns current 16-19 structures, under which only 11 per cent of 18 year olds achieve three A-level passes: "No other country limits its pool of potential graduates in this damaging way," says the report.

The A-level system is described as a double bottleneck "undesirably constraining the supply of potential entrants to higher education both at 16 — when the difficulty and intensity of A-level courses, particularly in science and mathematics, deter many students from undertaking them — and also at 18."

The narrowness of A-level options is criticised for forcing premature specialisation and opting away from science and mathematics — for example an 18 per cent decline in entries for Joint Matriculation Board A-level physics between 1985 and 1987.

The report calls instead for a broadly-based model, advocated in the 1988 Higginson report, of five subjects, together with the further development of AS level courses, modular 16 plus options and expanded provision of BTEC and SCOTVEC courses.

The development of these new styles of study is among the positive elements identified by the report as it looks back on the decade since the Finniston report examined many of engineering's underlying problems.

Further positive trends are noted, such as the significant increase in the number of women applying for engineering degree courses in recent years, the greater practicality encouraged in schoolchildren by GCSE and the TVEI initiative and the great improvement in careers education — making students more aware of their opportunities and increasing engineering's appeal as a creative, problem-solving discipline.

But many of the problems identified by Finniston remain and must be tackled. Further and higher education institutions are asked to reconsider the structure of their degree courses. Some higher education institutions demand high level initial grades of skill in mathematics and physics which deter many potential applicants, and may encourage premature specialisation. Broader-based courses such as The Engineering Council's new Integrated Engineering Degree Programme and four-year courses developed for non-science applicants are endorsed along with provision designed to encourage access for mature students.

IEE-IProdE merger on the cards

TWO of Britain's leading Engineering Institutions — the Institution of Electrical Engineers (IEE) and the Institution of Production Engineers (IProdE) — are to hold detailed talks leading to a possible merger.

Allowing for the support of the members of both Institutions and the approval of the Privy Council, the proposed merger is likely to become effective in late 1991.

The Institution of Electrical Engineers, founded in 1871, has 107,000 members and the Institution of Production Engineers, founded in 1924, has a membership of 20,000.

New engineering degree

SIXTH forms throughout Britain are being sent a bright new leaflet by The Engineering Council to explain the benefits of a new engineering degree.

The new Integrated Engineering Degree is being piloted on courses at the universities of Durham, Southampton, Wales (Cardiff), Strathclyde and Queen's University, Belfast, and the polytechnics of Portsmouth, Nottingham (Trent) and Sheffield City.

Funding to launch the project has been provided by the Department of Trade and Industry and considerable industrial support has been given by national and local companies.

The leaflet *The Integrated Engineering Degree Programme*, which gives details about the universities and polytechnics offering the new course and the industrial companies supporting them, is available free from The Engineering Council, 10 Maltravers Street, London WC2R 3ER.

Fundamental changes required

BRITAIN'S culture and our attitude towards engineering must be changed if we are to remain competitive in world markets.

These were some of the conclusions of leading educationalists, employers and professional bodies at a conference held in London in January to discuss *Wider Entry to Engineering Higher Education*.

Britain must "market" engineering to schoolchildren; improve engineering literacy; encourage school leavers — especially more women — to enter and study engineering; introduce vocational qualifications into schools alongside A-levels; and review the educational system including the way mathematics is taught.

"We are not producing enough qualified engineers — and we are falling a long way short of what is needed," conference chairman Sir Christopher Ball, RSA/BP Fellow, told the meeting which was organised by The Engineering Council, the Royal Society of Arts, the Training Agency and Industry Matters.

Commending The Engineering Council for its work in marketing engineering in schools, Tim Eggar, UK Employment Minister, said that we needed further partnerships between employers, high education and schools.

Professor Alan Smithers, of the School of Education, University of Manchester, said that higher education provision in engineering and technology had been expanded as far as it would go at present because students were not coming forward to take up the places.

The fundamental answer lay in the nature of our culture, Sir Christopher believed — a view endorsed by Mr Graham Anthony CEng, Director Industry and Regions, The Engineering Council, and later by the conference as a whole.

COSHH Companion

THE COSHH Companion is an interactive computer-based training and management package, designed to give staff at all levels a thorough knowledge of the new Control of Substances Hazardous to Health (COSHH) Regulations (1988) and associated Approved Codes of Practice (ACOPs).

The Companion consists of approximately ten hours of training integrated with comprehensive question and answer sessions, which can be used as parts of a formal training course, or as informal browsing or study periods of any length. Each copy can be used to train any number of learners, thus making it the most cost-effective method of training available.

A special feature of the Companion is that it can maintain a separate record for each user, showing the training received, the level of understanding reached, and any refresher training, including results of pre-course and post-course tests. This enables employers to assess whether or not an employee has reached a satisfactory level of understanding. These records are automatically saved on diskette and can be printed out as hard copy and stored.

It runs on any IBM PC or true compatible microcomputer with hard disk, colour monitor and Microsoft mouse. It can be used by anyone from director to employee, even if they do not normally work with a computer.

For futher information contact Eurotech, Oakfield Road, East Wittering, Chichester, West Sussex PO20 8PS.

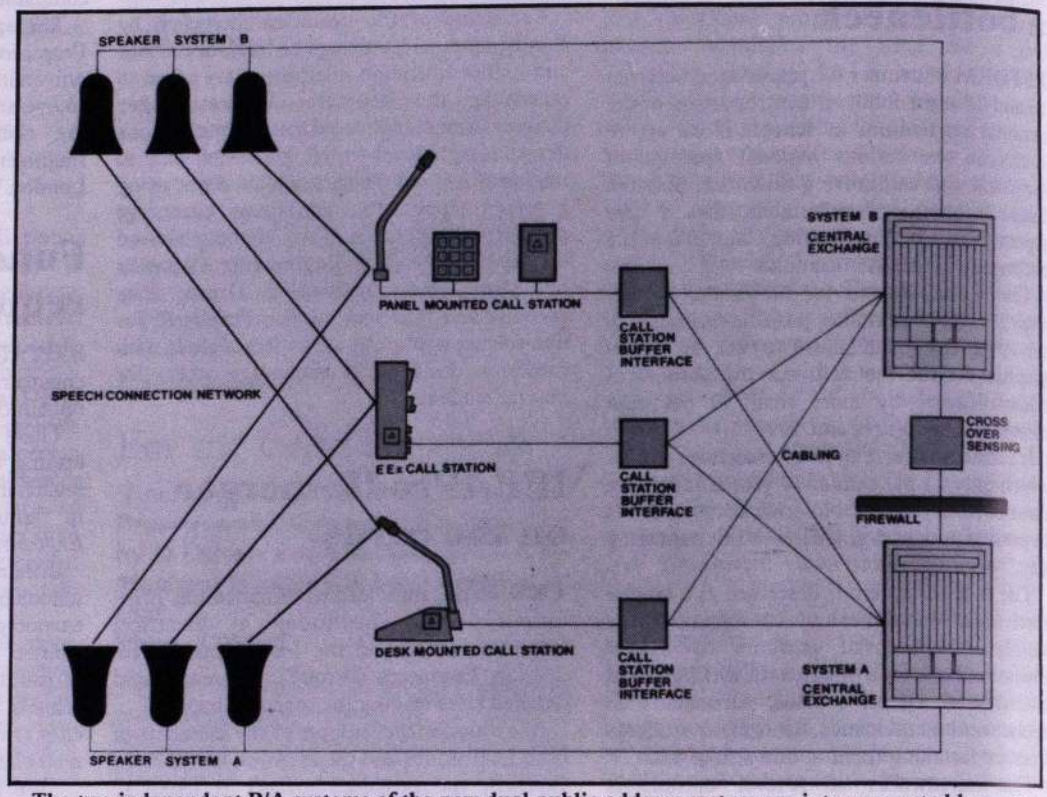
New BS on hoses

THE British Standards Institution have announced the publication of BS 4089: *Specification for hoses and hose assemblies for liquefied petroleum gas.*

The new standard specifies requirements for design, construction, inspection and testing of hoses and hose assemblies covering three types of construction, all to be used for the transfer of liquefied petroleum gas, superseding BS 4089: 1966.

Copies of this standard are available priced £30.60 (£15.30 to BSI subscribing members) from BSI Sales, Linford Wood, Milton Keynes MK14 6LE.

Public address system for hazardous areas



The two independent P/A systems of the new dual public address system are interconnected by many sensing points: in the event of a large section being destroyed, the alternative system carries on.

COMMUNICATIONS specialist, Neumann Communication Systems of Harpenden, is launching a dual public address system for oil platforms and dangerous areas which is claimed to have a major new advantage over all existing systems.

In the event of a large section being destroyed by fire or explosion, the alternate system can carry on operating.

The new system has been developed in answer to the oil companies' calls for such P/A systems following the Piper Alpha oil platform disaster.

The new Neumann Dual Public Address System is essentially two independent systems interconnected by many sensing points. Unlike conventional P/A systems, which rely on one central exchange, the Neumann system has two, which can be placed as far apart as required on either side of the fire wall or at the extreme ends of the platform if desired.

Providing one of the central exchanges carries on working, so will most of the P/A system. In this way it is "doubly reliable", claims the company.

For further information contact Neumann Communication Systems Ltd, Lea Industrial Estate, 151 Lower Luton Road, Harpenden, Herts AL5 5EQ.

Plant reliability simulator

SCICON Ltd has released a new IBM PS/2 version of Miriam, its plant reliability simulator. This offers users the flexibility of a stand-alone system while retaining all the features of the mainframe version.

Miriam is a computer simulation model which enables engineers to make the right decisions about design questions affecting the operational performance of continuous production plant and transportation networks. Miriam's speed and accuracy allow alternative designs and operating strategies to be compared quickly and easily at any stage of a project.

Miriam is particularly suited to applications such as offshore and gas production systems, chemical plants and communications networks, where it has enabled engineers to design in the optimal level of equipment redundancy and spare capacity, thereby maximising return on investment.

For further details contact Neil Colliver at Scicon, 49 Berners Street, London W1P 4AQ.

Intrinsically safe pressure transducer

PT186 is a highly accurate pressure transducer, developed by Instech, which is intrinsically safe to EEx ia, BASEEFA certification number Ex86B2271.

Its applications include the measurement of fluids such as gas and petrochemicals, where the fluid is explosive or a potential fire hazard.

Both gauge and absolute models are available with operating pressure ranges up to 200 Bar.

For further information please contact Instech, Pippins House, Lockhams Road, Curdridge, Nr Southampton, Hampshire SO3 2BD.

FGD pumps cut SO_2 emissions

A RANGE of flue gas desulphurisation pumps — crucial to FGD plants — is now available in Britain from SPP Pumps.

Manufactured in Duplex stainless steel for high wear and corrosion resistance when pumping limestone slurry, the SPP FGD pumps are designed for ease of maintenance. Discharge branch sized range from 50 mm to 900 mm and flow rates up to 16,000 m_3/hr are attainable.

For further information contact SPP Pumps, Theale Cross, Reading, Berks RF3 7SP.

Title: **Shell Boilers**
Location: Cardiff
Duration: 3 days.
Starting: 3 April 1990.
Content: Industrial boiler design. Combustion practice. Heat transfer in boilers. Efficient boiler operation. Pollution aspects.
Contact: Mrs Ann Lock, The Polytechnic of Wales, on 0443 480480.

Title: **Understanding heat treatment**
Location: Aston University, Birmingham.
Duration: 3 days.
Starting: 24 April 1990.
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 and control. Quality control, specifications and defects in heat treatment. Laboratory testing of heat-treatment materials.
Contact: Course Administrator, Wolfson Heat Treatment Centre, Aston University on 021-359 3611 x5212.

Title: **Fired process heaters**
Location: Hotel des Indes, The Hague.
Duration: 4 days.
Starting: 24 April 1990.
Content: Introduction to fired heaters. Radiant and convection zones thermal design and combining for total thermal design. Burners. Fuels and combustion. Combustion air supply and control. Instruments and safety devices. Improving efficiency. Design of tubes. Heater operation, testing, and tune-up. Control of emissions. Refractories. Corrosion and fouling.
Contact: The Centre for Professional Advancement, The Netherlands on 010 31 20 662 30 50.

Title: **Process analysis: a road to safety and efficiency**
Location: University of Warwick.
Duration: 5 days.
Starting: 29 April 1990.
Content: System design considerations. Principles and techniques. Benefits of microprocessor technology. Optimised maintenance. Industrial hygiene safety environmental control. Future trends in process analytical instrumentation.
Contact: The Conference Section, The Institute of Measurement and Control on 01-387 4949.

Title: **Rural energy planning and environment**
Location: University of Twente, Enschede, The Netherlands.
Duration: 9 weeks.
Starting: 7 May 1990.
Content: Technological aspects of rural energy and environment. Planning methodologies. Problems of implementation and resource management.
Contact: The Course Administrator, Technology and Development Group, University of Twente on 010-31-53-893539 or 893545.

Title: **An appreciation of aviation fuel and its quality**
Location: Egham, Surrey.
Duration: 2 days.
Starting: 10 May 1990.
Content: Tracing the history of the development of aviation fuel as a guide to current practices, the course covers engine performance and fuel hydrocarbons, fuel requirements of the airlines, the role of the specification, measurement of specified properties, aviation fuel production, distribution and quality control, additives, and a number of other fuel related topics.
Contact: Dr E M Goodger, Route SouthWest Ltd on 0908 582120.

Title: **Investment appraisal for engineers**
Location: IChemE, London.
Duration: 2 days.
Starting: 14 May 1990.
Content: Introduction. Basic arithmetic of appraisal. Basic accounting concepts. Definitions/behaviour of costs. Costs of capital. Modelling projects. Sensitivity analysis. Models/ sensitivity analysis. Probability in modelling.
Contact: The Conference Section, IChemE on 0788 78214.

Title: **Flow measurement**
Location: National Engineering Laboratory, East Kilbride.
Duration: 5 days.
Starting: 14 May 1990.
Content: Pipe flow and properties of measuring instruments. Ultrasonic and differential pressure meters. Calibration. Standards. Two-phase flow measurement.
Contact: The Conference Section, NEL on 03552 20222.

Title: **On-line monitoring of particle size**
Location: London.
Duration: 1 day.
Starting: 16 May 1990.
Content: Particle populations. Distributions of particle size. Reasons for on-line measurement. Measures of central tendency and their use in particle size monitoring. On-line particle size analysis. Stream scanning and field scanning methods. Continuous sampling. Differential flow fractionation methods. The use of existing process separators for particle size monitoring. The use of light-particle interation in on-line particle size analysis.
Contact: Dr L Svarovsky, University of Bradford on 0274 733466 × 378 or 375.

Title: **Modern wind-power**
Location: National Engineering Laboratory, East Kilbride.
Duration: 5 days.
Starting: 21 May 1990.
Content: Choosing and appraising a site for a wind turbine development. The basic engineering features and options available. Legal, administrative and institutional considerations.
Contact: The Conference Section, NEL on 03552 20222.

April 1990

Pumped Storage
International conference, 2-4 April, London.
Details from The Conference Office, Institution of Civil Engineers, 1-7 Great George Street, London SW1P 3 AA. Tel: 01-222 7722 ext 272.

The European Auto Diesel Challenge
Conference, 4 April, London.
Details from Miss Caroline Little, Conference Officer, The Institute of Petroleum, 61 New Cavendish Street, London W1M 8AR.

Tunnel Construction '90
Conference and exhibition, 3-4 April, London.
Details from Mark Povey, Brintex Ltd, 178-202 Great Portland Street, London W1N 6NH. Tel: 01-637 2400, fax: 01-631 0360.

Drillex '90
Conference and exhibition, 5 April, London.
Details from The Conference Office, The Institution of Mining and Metallurgy, 44 Portland Place, London W1N 4BR.

Coal & Slurry Technologies
International conference, 23-26 April, Florida, USA.
Details from The Coal & Slurry Technology Association, 1156 Fifteenth Street, NW, Suite 525, Washington, DC 20005, USA.

Technological Responses to the Greenhouse Effect
Conference, 24-25 April, London.
Details from Mr J G Mordue, The Watt Committee on Energy, Savoy Hill House, Savoy Hill, London WC2R 0BU. Tel: 01-379 6875, fax: 01-240 7735.

Safety in Offshore Drilling — The Role of Shallow Gas Surveys
Two-day international conference, 25-26 April, London.
Details from The Society for Underwater Technology, 76 Mark Lane, London EC3R 7JN. Tel: 01-481 4001, tlx: 886841, fax: 01-481 4001.

May 1990

Sick Buildings — Cause, Effect & Cure
One-day conference, 2 May, Stockton on Tees, England.
Details from M G Burbage-Atter, Conference Organiser, Teeside Polytechnic, Middlesbrough, Cleveland TS1 3BA. Tel: 0642 218121, tlx: 587537 TP LIB, fax: 0642 226822.

ConChem '90
Symposium, 7-9 May, The Hague, The Netherlands.
Details from ComChem '90 c/o KIvI, PO Box 30424, 2500 GK The Hague, The Netherlands. Tel: +3170 391 98 90, fax: +3170 3 91 98 40.

Control & Instrumentation in Nuclear Installations
International conference, 8-10 May, Glasgow, Scotland.
Details from The Conference Secretary, The Institution of Nuclear Engineers, Allan House, 1 Penerley Road, London SE6 2LQ. Tel: 01-689 1500, fax: 01-695 6409.

Worldcare Action 1990
Exhibition, 8-11 May, Bergen, Norway.
Details from Ms Hilde Thorud, Chief Information Officer, Norwegian Trade Fair Foundation, 0121 Oslo 2, Norway. Tel: (+47 2) 43 80 80, fax: (+47 2) 43 89 87.

1990 Jim Ellis Memorial Lecture: 'Investing in Environmental Technology'
Lecture, 11 May, Droitwich, England.
Details from B Croft. Tel: 021 423 2345.

Tec 90 — The Window on the World behind Power Generation
Exhibition, 15-17 May, Leatherhead, England.
Details from Westrade Fairs Ltd, 28 Church Street, Rickmansworth, Herts WD3 1DD. Tel: 0923 778311, fax: 0923 776820.

Electrical & Mechanical Engineering Contracts
Two-day conference, 22-23 May, London.
Details from CASEM-UK, Old School House, East Grafton, Marlborough, Wilts SN8 3DB. Tel: 0672 810768 or 01-580 5522, fax: 01-436 2596.

Energy '90
Exhibition, 23-24 May, Birmingham, England.
Details from Claire Pouncey, Bofoers Exhibition Ltd, 12 Bentinck Court, Bentinck Road, West Drayton, Middlesex UB7 7RQ. Tel: 0895 421111, fax: 0895 431252.

Instrumentation for Monitoring Hazardous Gases & Vapours in Workplaces
Two-day conference, 23-24 May, London.
Details from Angela Lonergan, The Institute of Measurement and Control, 87 Gower Street, London WC1. Tel: 01-387 4949, fax: 01-388 8431.

June 1990

1990 ASME Turbo Expo — Land, Sea & Air
Exhibition, 11-14 June, Brussels, Belgium.
Details from The International Gas Turbine Institute, 6085 Barfield Road, #207 Atlanta, Georgia 30328, USA. Tel: 404/847-0072, tlx: 707340 IGTC ATL, fax: 404/847-0151.

Partners in the Environment
Conference, 25-29 June, Harrogate, England.
Details from The Conference Office, Institution of Civil Engineers, 1-7 Great George Street, London SW1P 3AA. Tel: 01-222 7722.

July 1990

Development of Intelligent Buildings in the Tropics
Conference, 12-13 July, Singapore.
Details from The Total Building Conference Secretariat, 95 South Bridge Road, #09-01 South Bridge Centre, Singapore 0105. Tel: 532 5933, tlx: RS 27176, fax: 532 3055.

September 1990

Oil Recovery Hose & Seals: Problems & Solutions
Conference, 3-4 September, London.
Details from Kay Royle, Rapra Technology Ltd, Shawbury, Shrewsbury, Shropshire SY4 4NR. Tel: 0939 250383.

15th Annual Symposium of the Uranium Institute
Symposium, 5-7 September, London.
Details from The Registrar, Conference Associates UIS, Congress House, 55 New Cavendish Street, London W1M 7RE. Tel: 01-486 0531, tlx: 934346 CONFAS G, fax: 01-935 7559.

Interfluid
International congress, 10-14 September, FR Germany.
Details from DECHEMA, Abt Tagungen, Attn Interfluid, POB 97 01 46, Theodor-Heuss-Allee 25, D-6000 Frankfurt am Main 97, FR Germany. Tel: (069) 7564 242/243/254/280, tlx: 412 490 dcha d, fax: (069) 7564 201.

October 1990

Energy and Environment
International conference, 16-19 October, Bournemouth, England.
Details from Mrs T Cone, Conference Manager, ETSU, Building 156, Harwell Laboratory, Oxon OX11 0RA. Tel: 0235 433635.

Intelec '90
Conference, 21-25 October, Florida, USA.
Details from T M Taylor, Bellcore, Room 2L185, 445 South Street, Morristown, NJ 0795-1910, USA. Tel: 201-829-4951, fax: 201-267-9753.

January 1991

International Air-Conditioning, Heating & Refrigeration Exposition
Exhibition, 21-23 January, New York.
Details from Bob Wilkinson on 06285 31186.

April 1991

Tunnelling '91
Symposium and exhibition, 14-18 April, London.
Details from The Conference Office, The Institution of Mining and Metallurgy, 44 Portland Place, London W1N 4BR. Tel: 01-580 3802, tlx: 261410, fax: 01-436 5388.

THE INSTITUTE OF ENERGY
SOUTH WALES AND WEST OF ENGLAND BRANCH

THE SEVENTEENTH WALTER IDRIS JONES MEMORIAL LECTURE

'COAL AND THE ENVIRONMENT'

to be presented by

Jim Harrison
(Director, Coal Research Establishment)

on Friday 25th May 1990 at 11.30 am
(coffee and reception at 11.00 am)

at the

TREVITHICK BUILDING
UNIVERSITY OF WALES COLLEGE OF CARDIFF

to be followed by

THE BRANCH ANNUAL LUNCHEON
at 12.30 (sherry) for 1.00 pm (start of luncheon)

Admission to the lecture is free but those wishing to attend should apply for tickets, using the form below.

Tickets for the luncheon should also be applied for, using the form below. These will cost £5.00 a head inclusive of sherry and wine.

Early application is recommended as numbers for the luncheon are limited to 100.

Tickets will be sent out in early April.
(RTZ Consultants Ltd are sponsoring this event).

To: Mr D H Mustoe
20 Park Court Road
Bridgend, Mid Glamorgan CF31 HBW

1. Please send me . . . . . tickets (free) for the seventeenth Idris Jones Lecture to be given on Friday 25th May 1990.
2. Please send me . . . . . tickets for the lunch. I enclose a cheque for £ . . . . . (made out please to The Institute of Energy)

Name (block capitals) . . . . . .

Position . . . . . .

Address . . . . . .

. . . . . .

Office . . . . . Signature . . . . . .

INSTITUTE OF ENERGY CONFERENCES

The following programme is currently being organised by The Institute of Energy, and its associated overseas societies, and other UK societies 'in association'.

For further details please contact Judith Higgins on 01-580 0008.

In 1990

29 March — **The Role of Government in Energy**
In association with the Parliamentary Group for Energy Studies
Venue: The Institution of Mechanical Engineers, London SW1
Chairman: Prof I Fells (University of Newcastle)

9-11 April — **Ceramics in Energy Applications — New Opportunities**
Venue: Sheffield City Polytechnic
Chairman: Mr M L Hoggarth (British Gas)

19 April — **Orimulsion: The Wonder Fuel?**
In Association with Financial Times Management Reports
Venue: The Conference Forum, London E1
Chairman: Mr D M Willis (Institute of Energy)

17-20 May — **Institute of Energy Annual Conference & Social Weekend**
How Green is Our Energy?
Venue: Hotel St Nicholas, Scarborough
Chairman: M G Burbage-Atter (Institute of Energy)

30 May — **Innovations for the Next Decade: Building Energy Management Update**
Venue: South Bank Polytechnic
Chairman: Mr M C Roberts (PA Consulting Group)

19 September — **The Costs of Flue Gas Desulphurisation**
Venue: Scientific Societies Lecture Theatre, London W1
Chairman: Dr A Sanyal (Babcock Energy)

October — **Electricity from Gas**
Venue: to be arranged
Chairman: Mr J Masters (British Gas)

Conferences with which the Institute is in association

In 1990

26 April — **Industrial Oil Fuels for the 90s**
Contact: Combustion Engineering Association on (0685) 879119

5-7 June — **IMEX 90 Maintenance Management and Engineering Conference**
Contact: Rosemary Wood, Institution of Plant Engineers on (025125) 4702/5117

July — **Comadem 90 International**
(Congress on Condition Monitoring and Diagnostic Engineering Management)
Contact: Dr Raj Rao, Birmingham Polytechnic on 021-331 5441

17-18 July — **3rd International Conference on Small Engines and their Fuels for use in Rural Areas**
Contact: Mrs P Harris, Reading University on (0734) 875 123

September — **Piper Alpha - Lessons for Life-Cycle Safety Management**
Contact: Conference Office, Institution of Chemical Engineers on 0788-78214

15-18 October — **3rd International Conference on Circulating Fluidised Beds**
Contact: Professor Hira Ahuja on (902) 439-8300 ext 2014 (Canada)