ENERGY WORLD

The magazine of The Institute of Energy

Number 227
April 1995

INSIDE THIS ISSUE
The global energy business

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Photograph: Husmo-foto

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ENERGY WORLD

APRIL 1995 **Number 227**

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COVER

A subsidiary of a joint venture company formed last November between First Philippine Holdings Corporation and British Gas, the First Philippine Gas Power Corporation, recently signed a power purchase agreement with the Manila Electric Company for a 400MW combined-cycle plant at Batangas in the Philippines.
Left to right, front row; John Wales, Overseas Trade Services (DTI), Philip Rogerson, Manual Lopez. Back row; Alan Montgomery, British Ambassador to the Philippines. Rizalino Navarro, Philippine Secretary of Trade and Industry, President Fidel V Ramos of the Philippines, and Michael Heseltine, President of the Board of Trade.

Energy now, and the next 50 years

A YEAR ago, the Watt Committee celebrated its 18th anniversary. To commemorate the event it was decided to launch an enquiry into 'energy now and the next fifty years'. This theme was examined at a series of three seminars, held in July, September and November of 1994. The papers, the discussion, together with arisings from the final consultative conference held in London in February will be published in due course.

Founder of the Watt Committee, Sir William Hawthorne FRS, was concerned with fuels and heat waste: a concern fostered by the OPEC crisis of the '70s. This, according to a pointed reference by the House of Commons Select Committee on the Environment, is now equivalent to the total output of British Gas. The waste continues unabated

The Watt Committee received astonishing initial support from 62 learned and professional institutions, but has since lost the support of three of the major engineering institutions — the Civils, Mechanicals and Electricals — amongst others. Membership total now stands at 43.

The definitive and consultative meeting of the commemorative enquiry was held at the London City Conference Centre in February. The ten papers presented were a distillation of the three preceding seminars, not necessarily repetitive but with individual themes designed to present current policies and progress, together with such sensible projections as could be justified by mathematical modelling.

While speakers representing institutional R&D were able to show a growing control of a vast number of constantly changing parameters, other were unable to resist opportunity to promote sectarian interests: two papers advanced nuclear energy as the ultimate resort for a clean environment; one, surprisingly, advanced the case for a single industrial giant (ICI), its record of improving energy economics and, surely out of place at this meeting, a demand for lower electricity tariffs, a threat of referral to the MMC. This presentation was the only one mentioned in a report on the meeting by *The Times*.

Sir John Mason, veteran meteorologist, concentrated on global warming. In his usual precise manner he surveyed recent progress and the results generated by the world's largest and fastest supercomputer. Succinctly he dealt with temperature rise, the influence of deep ocean changes and the likelihood of ocean level change. Since then, of course, his thunder has been stolen by the Antarctic iceberg now at large.

The Watt Committee is not alone in trying to establish guidelines for the future: concern for the consequences of inaction has been rife since the '70s fuel crisis first demonstrated how vulnerable we all are in relating supply to demand. The addition of concern for the environment has merely bedevilled an already — virtually impossible — calculation, introduced doubling of informed opinion, increasing doubt and dissension.

The World Energy Council, apparently forsaking its former specialist power remit began with the Montreal meeting of 1989 a project that has since seen publication as *Energy for Tomorrow's World*, a prestigious and truly global effort involving less than 57 people, management and contributions. It has had a mixed reception. Action, as they say, is pending.

Michael Jefferson, deputy secretary-general of the World Energy Council, gave an excellent paper. Comprehensive and erudite, his 'Population levels and their implications for energy demand' may well be statistically unassailable, and as with other contributions, it did little or nothing to indicate what and where effective energy action is needed.

As an 18-year anniversary summation this event was a considerable disappointment. References to any of the many other energy meetings this organisation has sponsored and staged over the years were conspicuous by their absence. In all such events, where the highest level of academic, professional and industrial achievement has been canvassed to obtain guidance for the future, one has to note the absence also of recommendations to government or higher authority, no unanimous resolution for action, no such action in fact at all.

At a recent conference of like nature, sponsored by the Royal Society, Sir Denis Rooke did at least call for a show of hands for a preferred course. But even he — and the meeting — ignored and disregarded completely the significance of fuels waste, and the success elsewhere in its exploitation.

However, the Watt Committee meeting did discuss briefly the question of CHP. Fortunately there was no talk of 'cogeneration'. But, unprogrammed, the subject was introduced from the floor by a questioner complaining that the nuclear proponent, John Wright, had completely ignored this technology. Prof Anthony Challis, in the chair, former scientific advisor to the Department of Energy, took this up and asked why the subject continued to be ignored. Was it, he asked, a conspiracy?

An intervention by Timothy Horn, a member of the Watt Committee Management, asked why in all such discussions basic fuels-use in energy conversion was not taken into consideration.

The erudition, single purposeness, skill and status of the independent speakers selected for this occasion need not be questioned.

Undoubtedly, they all contributed, their bound papers will be collectively studied and quoted, no doubt in and out of context. Regrettably, the total contribution, if not to an understanding of the situation as we know it, then to some small idea of what we leave to the future for the benefit of our grandchildren, was virtually non-existent. It may be said, and was expressed by numerous speakers, that the future is unpredictable. But what about the avoidable waste of fuel, that package that measures up to the output of British Gas: can we accept continuing uncertainty, and what that connotes, while the success of distributing heat is ignored?

Could it be that the Watt Committee has had its day, that Prof Challis' question can be answered in the affirmative?

Norman Jenkins

Engineer and technical journalist, Norman Jenkins, is an independent analyst with more than 30 years' experience specialising in international energy strategy. Organiser of the Five Cities Seminar in 1991, he has since published 'Local Energy Supply'.

The 40-year-old Birsfelden power station, pictured above, is Switzerland's largest run-of-the-river plant, and it is to be modernised to increase its electricity production by 23.085 GWh, or 4.2%. The order, won by Sulzer Hydro of Switzerland, covers modernisation of the four large Kaplan turbines, including the supply of new 7200 mm diameter runners, and wicker gate conversion to environmentally compatible grease-free bearings. In order to minimise loss of production, rebuild work will be carried out in four phases. Each August one unit will be dismantled, while the others remain in operation. From 1996 to 1999 a rebuilt turbine with new runner will go into service every May. The completion of the rebuild, scheduled for 1999, will make a significant contribution to the Energy 2000 campaign of the Swiss Federal Department of Transport, Communications and Energy, which aims for a 5% increase in hydro electric power production by the year 2000.

The bold architecture of the power station will be unaffected by the modernisation work.

Electrifying Johannesburg

UK Trade Minister, Richard Needham, opened ESKOM's new regional electricity distribution control centre in Johannesburg in March.

Computer control equipment was supplied by Westinghouse Systems Ltd to ESKOM, one of the largest electricity utilities in the world, supplying 97% of South Africa's electricity.

A further four regional centres, in Cape Town, East London, Pretoria and Durban, will be supplied later this year. Westinghouse also supplied the national control centre system in 1991.

THERMIE at Powergen '95

THERMIE's stand at Powergen '95 in Amsterdam will give an overview of the EU's efforts in the demonstration and promotion of energy technologies.

Powergen '95 is at Amsterdam RAI from 16-18 May.

EU energy centre for Poland

ENERGY technology improvements in Central and Eastern Europe identified by the EU as political and social priorities have made those countries eligible for cooperation through the THERMIE programme.

In order to improve cooperation activities, DGXVII has established 15 energy centres in the region. Recognising the importance of the clean utilisation of coal, a centre dedicated to solid fuels will be inaugurated in May in Katowice in Upper Silesia, Poland.

The centre will provide a full range of promotional activities, covering innovative technology for combustion, gasification, waste as well as conventional technologies. It will encourage joint venture partnerships between western and eastern European countries, as well as foreign investment.

The end of 1994 saw 'Russian Week' in central Lancashire. A group of Russian scientists visited the UK in November to attend a two-day seminar, *Fire, Explosions and Related Problems* in Preston, and took the opportunity to meet their UK colleagues from research and engineering centres and other institutions. Russian Week was initiated by the University of Central Lancashire, where a Centre for Research in Fire and Explosion Studies has been recently established. The seminar aimed to encourage UK specialists to become familiar with Russian studies in the field, and to provide a catalyst for future exchanges and collaborative links between the University and Russian research and educational centres.

Pictured above, from left to right, back row: Prof J P Roberts (University of Central Lancashire); B Harris (Cape Board Ltd); Prof B I Nigmatulin (Electrogorsk Research & Engineering Centre of Nuclear Plant Safety); Brian Booth (University of Central Lancashire); Prof G M Makviladze (Centre for Research in Fire and Explosion Studies); Prof A V Zabegaev (Moscow University of Building). Front row, Prof D Klimov (Institute for Problems in Mechanics)(left); and Prof V Fortov (High Energy Density Centre).

CHP in the Royal Docks

EAST London's Royal Docks could soon have its own energy company to supply new developments with cheap, environmentally friendly energy, with an additional payoff for developers of savings on capital costs.

The London Docklands Development Corporation (LDDC) has entered into negotiations with an international consortium of Canadian Utilities, Cofreth and London Electricity plc to establish jointly the East London Energy Company (ELEC).

The new company will offer power, heating and cooling through a linked network of CHP plants direct to new developments in the Royal Docks in London Docklands. These include the new 1500 home urban village at West Silverton, and the London International Exhibition Centre at the Royal Victoria Dock.

The company will be committed to energy efficiency, and will provide technical advice on load optimisation and energy management, as well as a building design and consultancy service.

Negotiations with the consortium are expected to conclude during the summer, with a joint venture company being set up soon after. Along with the urban village and the exhibition centre, the project is being promoted under the Government's Private Finance Initiative.

LDDC say the savings to developers and users will hinge upon the high degree of flexibility built into the scheme. Using a modular approach, supply infrastructure will be established in incremental steps to meet demand as it grows.

"This partnership approach between supplier and customer will be a radical departure from the traditional method where there is little incentive for energy efficiency," commented LDDC chairman, Michael Pickard. "As a highly efficient energy provider, we believe ELEC will be attractive to developers in the Royal Docks."

Team initiative on waste

THE largest ever waste minimisation project in the UK was launched in the Team Valley in April.

'Project Team' aims to save £millions in wastage for companies on Europe's largest industrial estate, and should also have a significant environmental impact.

Locally the initiative is being spearheaded by Northumbrian Water, the University of Northumbria, The Newcastle Initiative and Wearside Environmental Action & Resource (WEAR).

Nationally it is backed by the Government's North East Office, the DTI, the DoE, the National Rivers Authority and HMIP. Sponsoring organisations include Nuclear Electric.

The potential of Project Team has been demonstrated by two smaller projects in Yorkshire and Merseyside, which each saved over £2 million in waste in the first phase of operation, as well as identifying major year-on-year savings.

The Yorkshire Project concluded that the financial case for adopting waste minimisation was 'so overwhelming, companies should need little further encouragement'.

Tough tasks ahead for coal

LIKE other privatised industries, coal has had to come to terms with market realities and corporate economics, Richard Budge, chairman of RJB Mining, the successors to British Coal, told the Coal Industry Society at their March luncheon.

"Put simply, job security depends primarily on lowest cost and secondly on secure and consistent supply. Without those ingredients you will lose market share, resulting in job losses," he warned.

He said that now was not the time for union threats of industrial action. If union members were to vote in favour of such action it would send the wrong message to customers at a most crucial time.

"We are asking union leaders to be realistic, to work with change rather than fight it; help us develop the business profitably, secure markets, and give customers the confidence they have a right to expect."

Mr Budge said that British Coal's reduction by 47 million tonnes in three years had probably over-compensated for the dash for gas. The industry could displace 6m tonnes of imported coal, worth £250m. Given that nuclear would probably not displace further significant tonnages of coal, when all the gas stations were operating the bulk of the generating market would be strategically divided into three: nuclear, gas and coal — probably not a bad basis for a new energy policy.

"We look forward to reading one day of a brighter future for coal. We are lean, fit and world competitive. We have a bright future and our employees and shareholders deserve the recognition that this is the case."

Mr Budge said that attempts to establish a single body to represent the 'broader facets' of the coal industry had been successful and a new organisation — to be known as the UK Coal Association — was to be formed. Its aim would be to represent the industry as a whole and would be based at first at the CoalPro headquarters in Wakefield, under the CoalPro director general Gerry Mousley.

He said the aim was for all other associations to become affiliated so that the UK Coal Association could provide the necessary interface with the Government and its agencies, thus fully representing a cross section of the problems faced by coal and to seek the level playing field everyone in the industry desired.

Bill for competition in the gas supply industry

THE Government's new Gas Bill, introduced by Energy Minister, Tim Eggar MP, amends Part 1 of the Gas Act 1986 in order to introduce a new licensing framework appropriate to the establishment of full competition to the gas industry in Great Britain.

It provides for the separate licensing of gas suppliers who will sell piped gas to consumers, public gas transporters who will operate the pipeline system, and gas shippers who will arrange with gas transporters for appropriate amounts of gas to be moved through the system.

Tim Eggar said that the assumption for nearly 150 years that gas supply to the domestic market could only be undertaken as a monopoly was wrong. "Only the local distribution pipelines are a natural monopoly. The Bill would provide for a restructuring of the industry to bring customers the benefits of competition," he said.

"According to the independent suppliers, prices could fall by around 10%, reflecting the falls in the industrial sector. Competition would not only provide a powerful downward pressure on prices, it would also promote efficiency and innovation and enable customers to insist on the quality of service they want."

He said the Bill would also ensure that safety would remain of paramount importance; that special services to pensioners, the blind and disabled, and those with genuine difficulties in paying for their gas would be a requirement for all suppliers; that the interests of consumers would continue to be represented by the Gas Consumers Council; that security of supply would be maintained; that price schedules would have to be made public; that future supplies would be on a contract basis and the contracts subject to regulation; regulated British Gas service standards would be linked to price formula; and put on the Secretary of State and the DGGS as new duty to take account of environmental factors in conveyance activities.

Draft standard licences will be published in time for the Bill's committee stage, so that Parliament is fully consulted.

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Romanian clean-up contract

ROMANIA'S state-owned power industry is planning a massive clean up programme using UK technology and expertise.

CRE Group Ltd of Cheltenham is leading a major study into the efficiency and environmental performance of Romania's generating plant with a view to expanding the use of circulating fluidised bed combustion (CFBC) technology to cut down pollution.

CFBC is seen as the best answer to Romania's coal quality problems — the fuel is low in calorific value and high in sulphur. In addition the country's power plants are inefficient due to under investment, and poor environmental controls.

Funding has been provided through the UK Know-How Fund.

Designing a new elephant house gave the managers at Twycross Zoo the chance to provide the greatest possible comfort for their three Asian elephants. Their heating was provided by East Midlands Electricity in the form of efficient, short wave infra red heating.

The prime concern was to create a temperature of around 17°C to keep the elephants comfortable in their spacious new building. In combination with electric underfloor heating, quartz heaters were able to fulfil this requirement whilst conserving energy.

Additional constraints on the system centred on the practical aspects of keeping elephants. Hosing them down safely without interfering with heating equipment meant that heating units, electrical connections and pipework at low level had to be avoided. Radiant heaters at 4.5 m solved this problem.

Orange solution

AS Sizewell B nears completion, site contractors faced a difficult task in identifying a safe alternative degreasing solvent to 1.1.1 trichloroethane, to clean high precision plant and equipment without compromising safety or quality.

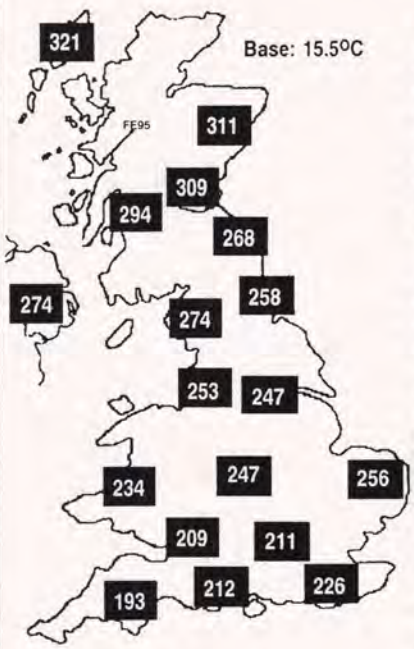
The high temperatures and the environmental levels at which the nuclear supply steam system operates, require a very high degree of cleanliness to ensure there is no deterioration of the contract material during the life of the plant.

The use of 1.1.1 trichloroethane was banned from the site, as vapours produced by the chemical are dangerous for personnel working in confined spaces. Such practices usually require a permit to work system, involving costly control documentation, full safety equipment and additional personnel.

After testing alternatives, Pronatur Orange solvent was chosen, having already received approval for general use in the nuclear power industry, and for cleaning steel by BNFL. A major advantage of the Orange solvent is that no harmful vapours are produced, negating the requirement for breathing apparatus or other safety equipment. Produced from the waste materials of the orange juice industry, the solvent is non-toxic to human, animal and plant life and totally immiscible in water.

DEGREE DAYS: FEBRUARY 1995

Source: **Degree days direct**



These regional figures, calculated from daily outside air temperatures, provide an index of demand for space heating over the month and thus enable excessive consumption to be detected.

A well-controlled heating system should manifest a straight line relationship between monthly fuel used and the local degree-day value; any significant deviation from this 'target characteristic' is likely to signal the onset of avoidable waste (such as a stopped timeswitch or an open isolating valve).

Readers can get more information on the use of degree days from Vilnis Vesma, 17 Church Street, Newent, Glos GL18 1PU (01531 821350)

 Note: with effect from the January 1995 report onwards, the figures given here have been adjusted to correspond more closely with those published by government sources. However, because of differences in observing stations, close agreement cannot always be guaranteed.

HE's birthday treat

THE gas business of Hydro-Electric, Vector Gas, has celebrated its first year of operation with a major new contract from John Brown Engineering of Clydebank. The deal involves a total energy package combining gas and electricity.

Vector Gas, a joint venture between Hydro-Electric and Marathon Gas, was 'born' a year ago last November, when the gas industry was deregulated, allowing gas to be sold competitively to commercial and large domestic users.

Graham Watson, general manager at Vector Gas, is confident that their experience in the first year of trading provides a solid base for the future.

"Our customer base of 2000 has exceeded out target, while our first year's performance has been in line with expectations.

"We will continue to offer our customers the kind of excellent service that Vector Gas and Hydro-Electric have become known for in its own region."

Air CHP unit delivered

SAFEWAY'S store in Milton Keynes has taken delivery of the first air CHP unit, developed by Biddle Air Systems of Nuneaton.

Air CHP generates electricity and hot water in the same way as small-scale CHP, but the difference is that the gas engine powering the generating set is housed within the return air section of an air handling unit.

Safeway's unit will produce 750 000kWh of power and 1m kWh of heat, with an efficiency of more than 60%.

Into the global power market

*by Graham Hadley**

In December of last year, the Institute of Energy held a major conference on the subject: *Internationalisation — power & energy services: business opportunies for UK companies* in London. Amongst the distinguished line-up of speakers was National Power International's Graham Hadley. The following article is based on his paper *Independent power producers and equipment suppliers.*

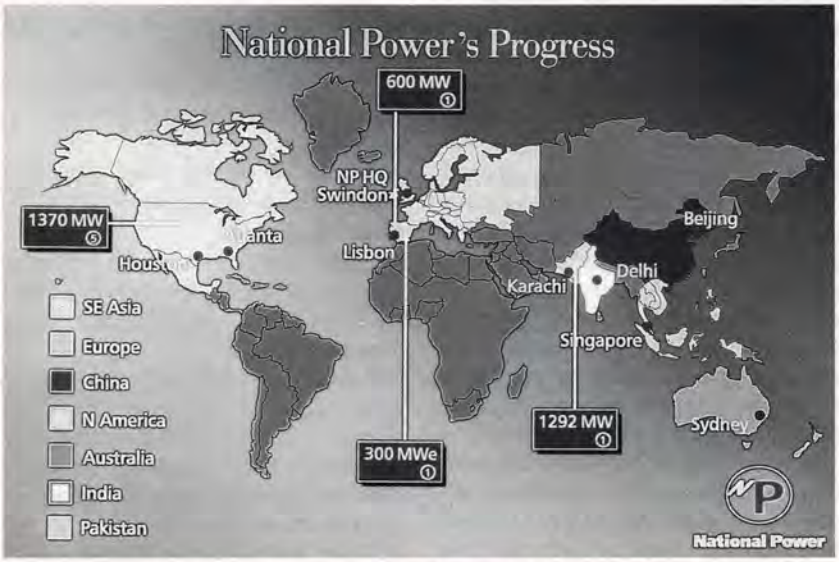
IN the following article, I shall discuss how British suppliers can benefit from the global power market — a market in which National Power is now a leading participant.

The independent power market is a relatively recent phenomenon. It took off seriously in the USA after the reforms of the late 1970s, but it is now growing, in different ways, in many countries across the world. The reasons vary: sometimes the motive is to reduce the role of the state, often there is a desire for the efficiency and price gains that can be brought about through competition, but probably the most widespread objective is to attract outside investors to reduce the drain on public sector finances, especially in those countries where substantial new capacity is needed.

As a result, the independent power market is taking a growing share of what used to be utility businesses. The World Bank has estimated that up to the early part of the next decade some £500 billion of investment in new power plant will be required. Perhaps 20% of this will be provided by independent power producers (IPPs) rather than utilities; the proportion could be higher.

National Power has become a leading participant in this market in quite a short period of time. We were motivated to enter the market partly because, under regulatory pressure, we faced an inevitable decline in our market share in the UK; but we also realised that we had real competitive advantages in the new international market. These include our acknowledged technological strength and operational experience; our experience of privatisation and adaptation to the competitive market; our international experience, going back 15 years (through British Electricity International, the consultancy arm of the nationalised electricity industry, vested in National Power at privatisation); and our strong balance sheet, which meant we had investment funds available for suitably profitable projects.

National Power has put a lot of effort into enhancing our existing capabilities in order to exploit our competitive advantages effectively in the international market. We have offices throughout the world: in Houston and Atlanta in the US, Lisbon, Karachi, Singapore, Delhi, Beijing and Sydney. These reflect the areas of our present international activities.



I shall describe four projects already closed.

We acquired American National Power in 1993. It was previously the IPP subsidiary of a major US gas pipeline corporation. On acquisition it had interests in five gas and coal-fired power stations in the USA. Two of them were under construction, and were successfully commissioned last year.

The Pego power station in Portugal is a 2 x 300 MW coal-fired station, with an option for a further two 300 MW units. This project was the first major power privatisation project in continental Europe, and the largest cross-border investment in Europe in 1993.

The Elcogas project is the construction of a 300 MW integrated gasification combined cycle (IGCC) clean technology plant at Puertollano in Spain. We have a small equity stake in this project, which will give us valuable knowledge and experience of IGCC technology.

The Hub River project in Pakistan is about to reach financial close. National Power is the operator and lead investor in this project for a 1200 MW oil-fired station, in which the World Bank has been closely involved. The project was an important 'first' for the funding of major infrastructure projects in developing countries where sovereign risk can inhibit commercial lending.

We are pleased with our progress so far. Unfortunately in none of these projects have we yet had the opportunity to place major equipment orders, but we hope that British suppliers will benefit from the growing market, and that we will be helpful to them. If suppliers are to succeed, it is essential that they understand the nature of the IPP business, which is very different from the traditional utility business, and suppliers must adapt to it.

An IPP project should be viewed not in terms of building a power station, but of establishing a local business, and suppliers must adapt to it.

An IPP project will normally be promoted by a consortium, and largely debt-financed.

*Managing Director, International Business Development, National Power plc

Typically a project will be financed 20-30% by equity, 70-80% by debt. To ensure commercial success for the project, the project developers will need to negotiate agreements on the debt, on plant supply, on fuel supply, on operations and maintenance, and on sale of the output. The result of all these agreements must give the equity holders an acceptable return on their investment.

For the project to succeed, key agreements must be negotiated in a way that allocates risks to those best able to bear them, and provides each party with a return acceptable when set against the risks it is taking. One of the parties is the customer; the price under the power purchase agreement must be competitive with that offered by rival projects. Of course, there are other success factors too: the need for government and regulatory approvals to be secured, and in some markets the acceptability of the project promoters. It is obvious why it can take a long time to close a deal; and it is clear also that the competitiveness of the project depends on the developers being able to secure competitive terms for plant supply and fuel.

The financing of projects is rarely straightforward — and for Pego we employed some innovative techniques. Country risk is a fundamental issue: in any country that has poor, untested or limited borrowing capacity and record in the international capital markets, it will be difficult to raise debt. Export credit is particularly important in higher risk countries; and the extent to which it is made available by the export credit agency (ECA) of a particular country will effect the competitiveness of that country's suppliers. Risks can also be mitigated through guarantees or funding from international agencies. Our Hub River project, for example, utilises World Bank loans. In other countries, government guarantees can be useful — for example, in India leading 'fast track' projects are being given guarantees by the government to cover default by state electricity boards.

There is international competition for capital; investors will go where returns are best in relation to the risks involved. If suppliers can take equity stakes in projects that can often be very helpful. In recent years we have seen the development of 'power funds' organised to invest in power projects — those of ABB and General Electric, for example, are well known.

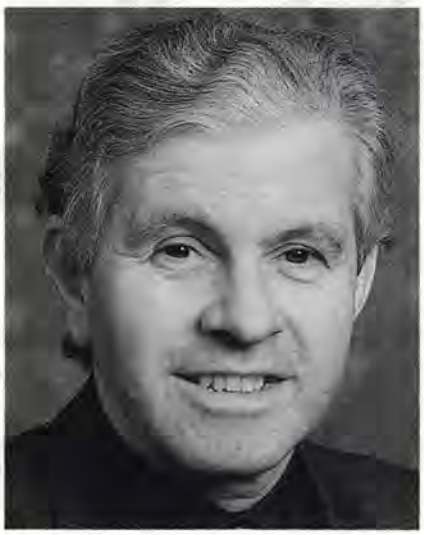
As far as suppliers are concerned, the following are key features of the IPP business:

- it is fiercely competitive;
- it involves joint decision making through consortia;
- there is often an advantage to consortia if they are international in composition;
- often there is a requirement for a significant local element in a project — perhaps a local industrial partner, a local fuel supply or local equipment supply;
- the IPP project company is not normally involved in ordering equipment, except at the turnkey level;
- the turnkey supplier himself may be motivated to take a stake in the project and share the developer role;
- some projects involve the acquisition of assets which already exist or are under construction, ie, the supplier decisions have already been made.

It follows that in these circumstances British suppliers must always be competitive on price and quality, and even when they are competitive it will not always be possible to contract with British suppliers. However, we want to see British suppliers do as well as possible, and in fact we believe it is in our interest if suppliers are British. Given the increasing role of ECAs in the financing of IPPs, the competitiveness of ECGD's terms as against those available to our main international rivals will be of growing importance. We can't select British equipment if this makes financing the project more difficult, however competitive the price of the equipment.

What attributes, then, do British suppliers need to show if they are to succeed in winning orders in the international IPP market? I believe the key points are: competitive price, strong technical qualities and reliability; local reputation and track record; commitment to the project; cultural affinity, especially for big projects — it is helpful to eliminate cross-cultural problems between the developer and main contractor; the ability to work in consortium arrangements; willingness to take risks, through fixed prices and penalty clauses in contracts; very important is good backing from ECGD in export credit terms.

Organising for success thus means not only competitiveness on price and strong technical standards — although these are essential — but also adaptation to the requirements of local markets and a willingness to take a share of the risks. We hope British suppliers will succeed — for their own sakes, but also for ours. ❑

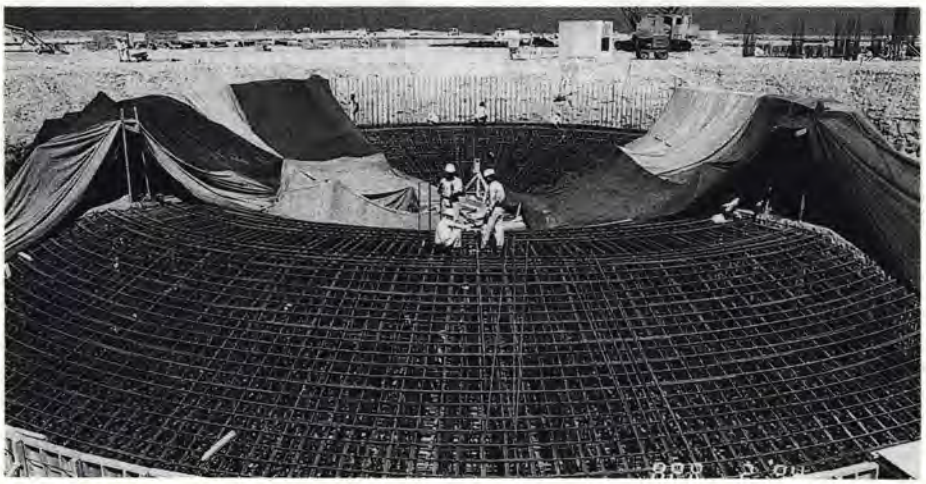


The author

Graham Hadley has been an executive director of National Power since the company was set up in 1990. Since January 1992 he has had responsibility for the development of overseas interests, and in July 1993 became managing director of International Business Development.

From 1983 to 1990 he served as secretary to the Board of the CEGB, and was closely involved in preparations for privatisation.

Prior to joining the CEGB, Mr Hadley held a number of posts within the Civil Service, including under secretary and head of the electricity division of the Department of Energy.



The Hub River project in Pakistan.

Nuclear power — a world industry

by Arthur Francis

THE Chernobyl accident, the collapse of the Soviet Union and the UK electricity industry privatisation have all had far reaching effects in their own right, but together they have helped create the circumstances which prompted Scottish Nuclear to set up an international subsidiary.

Post Chernobyl it became clear that there was a need for western operating utilities to work with their East European counterparts to improve the way Soviet designed nuclear power plants were operated. This not only meant carrying out in depth engineering studies, but involved engineers with experience of operating and maintaining nuclear power plants in the west to improve safety culture, advise on operational and maintenance management and, an area where Scottish Nuclear International is particularly active, help to produce the technical specifications for equipment upgrades and help manage the interface with western suppliers and funding agencies on behalf of the Eastern Bloc operators.

Organisations such as the European Community and the European Bank for Reconstruction and Development (EBRD), whose nuclear safety account has funds supplied by donations from the G24 group of nations, require the services of experienced nuclear power plant operators to set up project management units charged with managing the equipment upgrade programmes at the power plants throughout Russia, the Ukraine and the rest of the former COMECON empire.

Scottish Nuclear has been involved in this work from the start, and was part of the first international team sent to Kozlodui nuclear power plant in Bulgaria. Since then the company has been most active in Russia, where they manage the EU TACIS programme of on-site assistance at Smolensk nuclear power plant, and in Lithuania where, in association with NNC Ltd, a GEC group company, SNI operate the project management unit, set up by the EBRD to implement a £24 million safety improvement package.

The changing power market in the UK, and the ever more apparent need for dissemination of information to Eastern European regarding their nuclear power installations have prompted Scottish Nuclear to set up an international division.

The purpose of the TACIS assistance in nuclear power plants is to develop a common understanding between western and eastern European experts of the main safety-related design deficiencies and to transfer modern western know-how and operating practices. The programme implies the long-term presence of western experts at the nuclear power plants and the implementation of concrete safety improvement measures.

The two projects presently underway at Smolensk are the introduction of GOMIS, a management information system specific to nuclear plant and the enhancement of non-destructive testing. The principle employed in the EU's TACIS programme is to introduce particular techniques at one site and then develop this site as a centre of excellence, which can be used as an example for other nuclear power plants to follow. GOMIS is a nuclear power station specific Generation Operation Maintenance Information System. It has been used in power stations in Scotland since 1988, and during this time has had many refinements built into it to cater for the requirements of specific nuclear plant. The concept is not new, and similar systems are now in common use in western plants, but there were no such systems available for use within Russia's nuclear power stations. GOMIS is

The author

Arthur Francis graduated in electrical engineering from Leeds University in 1965. He began his career as a graduate apprentice at C A Parsons & Co, where he spend much of his time at Ferrybridge C in Yorkshire, commissioning their first 500 MW turbo-generators. This led to a series of posts with the CEGB at Fiddlers Ferry, Wylfa and Hinkley Point, and then with the SSEB at Hunterston B, where he spent a number of years as shift supervisor and outage controller.

Following privatisation of the esi and the formation of Scottish Nuclear, Mr Francis was appointed as a manager in the newly-formed corporate development group to examine a number of general strategic issues, including the UK energy market, renewable energy projects and development of overseas opportunities. He was then appointed to head up a separate business development unit established within Scottish Nuclear's engineering division. This has led to his appointment to manage the day to day operation of Scottish Nuclear International

Two projects are currently underway at Smolensk nuclear power plant (pictured above): the introduction of GOMIS, and the enhancement of non-destructive testing.

especially useful in regulated environments, where safety or legal requirements must be met, and this is seen as a major benefit to the management of maintenance at Smolensk.

A further important project underway at Smolensk concerns NDT methods and capability. It comprises two components: enhance ment to manual methods; and investigation into automated techniques.

The enhancements to manual methods project is essentially a replacement programme for equipment presently in use with state-of-the-art western products. In carrying out this replacement process, two main benefits have been identified: better inspection techniques, with the capability to achieve greater reliability and repeatability of the results. The second benefit is the reduction of the received man dose, due to reduced inspection times and a reduction in numbers of reinspections.

Apart from being bulky and unreliable, some of the existing equipment was obsolete and provided from countries outside Russia (eg, Yugoslavia) making spare parts almost impossible to obtain.

To enhance the Russian operators techniques and skills using standard ultrasonic equipment, a training course has been organised, similar to that used by the electricity supply industry in the UK.

In addition, allied to the supply of the new equipment is a comprehensive training scheme to be carried out by the equipment supplier. First time use on site will be monitored by an experienced utility NDT expert, which, in a similar manner to the GOMIS work, will be in a position to give advice on best western techniques and practice.

Automated NDT methods for RMBK plant are being developed by a number of institutes in Russia and the west. The main concern is to develop inspection methods in areas where examination has been very difficult, if not impossible, due to access difficulties and radiation dose levels. Of particular concern is the primary circuit pipework, steam separator drums and pump inlet and outlet heaters.

Scottish Nuclear International staff have been intimately involved in the programme to procure new equipment which uses best western practices for non-destructive examination of critical components for both Ignalina and Smolensk nuclear power plants.

These projects with secure funding packages formed an ideal opportunity for Scottish Nuclear to open up new markets for its skilled technical staff. Here the timing of the privatisation programme in the UK helped to create a greater degree of commercial freedom — even for those companies which remained in state ownership — and the drive for improved operating efficiency helped to free up the staff to carry out the various assignments.

But this is just a start, the nuclear power industry is very much a world industry with common designs being used by many operators. Those areas of the world with the greatest demand for new generating plant are looking increasingly to nuclear power to help meet their development programmes, and Scottish Nuclear will be looking to Asia, the Pacific rim countries and South America for further work.

Just as the commercial activities of the nuclear industry cross national boundaries so too can the consequences of a serious incident, as the Chernobyl unit four accident demonstrated so clearly. This makes it essential for any prospective contract for work at a nuclear facility to be carefully examined by the company's legal department, to ensure that the resources of the company would not be jeopardised by, for example, working in a country which is not a signatory to the Vienna Convention and related protocols. This could expose the contracting company to third party claims in the unlikely event of an incident rather than the organisation owning the plant and its national government.

Though Russia is not yet a signatory to the Vienna Convention, Scottish Nuclear International's work at Smolensk is protected by a Memorandum of Understanding between the CEC and the Russian Government.

Not surprisingly this internationalisation of the nuclear industry has created the need for a common language, and that language is English.

Native English speakers are thus at a considerable advantage when at the focus of an international project. However, this only partially compensates for the British people's legendary inability with foreign language. Scottish Nuclear International is now looking for its staff to have, if not foreign language skills, at least a willingness to learn, and learn quickly! ❑

Energy UK 2011?

—give us just a little more time

by K Darkwa MSc CEng MInstE MCIBSE MASHRAE and Professor P W O'Callaghan MSc PhD CEng FIMechE***

The following article analyses the trends from 'published proved' fossil reserves, consumption and lives, both in the UK and globally. Despite fears of global warming, and the 1988 Toronto Protocol, energy consumption rates globally have increased 25% over the past two decades. And although they fluctuate, UK rates have not declined significantly. In the absence of imports UK indigenous fossil fuels will be depleted in 2011. The UK has vast reserves of coal, shale oil and peat, but is currently unable to compete with cheap imported fuel. The authors urge continuous review of the economic, political and social factors.

ACCORDING to the BP Statistical Reviews of World Energy the global reserves of the fossil fuels alter as new fields are discovered, or economic factors alter. 'Published proved' world reserves of coal, natural gas and oil are defined as the amount of each remaining in the ground, which geological and engineering information indicate with reasonable certainty to be recoverable, from known reserves, under existing economic and operating conditions.

The projected lives of these fuels therefore vary from year to year, and are also affected by consumption rates. This article examines how these variations affect UK energy policy. The data included exclude shale oil and tar sands.

Coal reserves listed in the Review include anthracite and bituminous coal, and sub-bituminous coal and lignite. Taking average values for the calorific values of these from the *Mark's Standard Handbook for Mechanical Engineers* (9th edition), one obtains 29450.6 and 20825.6 MJ/tonne respectively. The tonnages listed under reserves sums both categories, but the tonnages of each category have been weighted by the differing calorific values to produce the MJ equivalent. Proven world coal reserves increased from 800 billion tonnes to over 1000 billion tonnes over the period 1981-93. Consumption peaked in 1988 and the life of coal varied between 230 and 288 years.

Proven world natural gas reserves increased from 82 x 10^{12} m^3 to 142 x 10^{12} m^3 over the same period. Consumption continues to rise, as does the life of natural gas, from 52 years in 1981 to about 68 years in 1993.

The increase over the same period in proven world oil reserves was from 92 billion tonnes to about 136 billion tonnes, with the consumption rate continuing to rise, but life increasing as new reserves were discovered.

The energy content of proven total world reserves increased from 28 x 10^{15} MJ to 38 x 10^{15} MJ from 1981-93. The consumption rate increased from 28 x 10^{13} MJ to 32 x 10^{13} MJ, but the total life increased from 101 to about 118 years.

Figure 1 shows the world fossil fuel consumption between 1971 and 1993. The effects on oil consumption of the 1973 oil crisis and the 1980 Iraq-Iran war are clearly indicated, although the use of coal and natural gas continued to rise throughout the period. The overall rates of fossil fuel combustion increased from about 240 x 10^{12} MJ in 1971 to 320 x 10^{12} MJ in 1993, despite fears of global warming, local pollution problems and the expressed desire to conform to the Toronto Protocol, which, in 1988, called for a reduction of carbon dioxide emissions to 80% of their 1988 levels by 2005.

In 1988 the world total consumption of fossil fuels was 7099 x 10^6 toe and 80% of this is 5677 x 10^6 toe. Total consumption in 1991 was 7097 x 10^6 toe. In order to reduce 7097 x 10^6 toe to 5677 x 10^6 toe by the year 2005, world energy consumption must be reduced by around 2% per annum successively, starting back in 1991.

Then the total world reserve of fossil fuels corresponded to 37 x 10^{15} MJ and the annual consumption rate was 32 x 10^{13} MJ, with a life of 115 years. In order to achieve a sustainable energy future (ie, effectively infinite life), world rates of fossil fuel consumption must be reduced successively by 1%, starting in 1991.

In the UK proven coal reserves decreased from 9.5 billion tonnes to 9.1 billion tonnes between 1986 and 1990, but were axed by economic factors to only 3.8 billion tonnes (by 58%) in 1991. Consumption rates fell from 67 million tonnes to 59 million toe, but the indigenous life of UK coal collapsed from 93 years to only about 48 years, depleting in the year 2040 (figures for UK coal reserves were not provided by the Review prior to 1986).

In the same period proven UK natural gas reserves decreased from 0.7 x 10^{12} m^3 to 0.5 x 10^{12} m^3. Despite this consumption continued to rise, and consequently the indigenous life of UK natural gas has fallen from 14 years in 1981 to only 8.5 years in 1993, depleting in the year 2002.

UK proven oil reserves decreased from 1.8 x 10^9 to 0.6 x 10^9 tonnes between 1981 and 1993. Despite this, consumption continues to rise (from 74 x 10^6 tonnes in 1981 to over 84 x 10^6 tonnes in 1993). Consequently the indigenous life of UK oil has fallen from 24 years in 1981 to only seven years in 1993, depleting in 2000.

The energy content of proven total fossil fuel reserves indigenous to the UK decreased from 0.33 x 10^{15} MJ in 1986 to 0.16 x 10^{15} MJ (a decrease of 51%) as coal mining was considered to be uneconomic compared with the use of oil or gas. The overall annual rate of consumption of the fossil fuels remained almost constant, at around 9.0 x 10 MJ, but the indigenous like of UK fossil fuels has been decimated, from 37 years in 1986 to 18 years in 1993, depleting in 2011.

It has been said of the British mainland that it is an island of coal surrounded by a sea of oil, belching natural gas. We used to be concerned about saving fossil fuel resources for our great grandchildren. Now we may not have enough for ourselves.

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Table 1: World fossil fuel reserves, consumptions and lives (1981-1993)

Year	reserves ($x10^{15}$MJ)				consumption ($x\ 10^{13}$MJ)				life (yrs)	depletion date
	coal	gas	oil	total	coal	gas	oil	total		
1981	21	3.2	4.2	28.4	9.1	6.0	13	28	101.07	2082
1982	23	3.3	4.2	30.5	9.3	6.0	13	28	107.77	2090
1983	23	3.5	4.2	30.7	9.5	6.0	13	29	107.72	2091
1984	24	3.7	4.4	32.1	9.6	6.4	13	29	110.69	2095
1985	24	3.8	4.3	32.1	10.0	6.8	13	30	107.72	2093
1986	26	39	4.3	34.2	10.0	6.8	13	30	114.77	2101
1987	26	4.1	5.5	35.6	11.0	7.1	13	31	114.47	2101
1988	26	4.3	5.6	35.9	11.0	7.4	14	32	110.80	2099
1989	29	4.3	6.2	39.5	10.0	7.8	14	32	124.21	2113
1990	28	4.6	6.2	38.8	10.0	7.9	14	32	121.63	2112
1991	26	4.8	6.1	36.9	9.9	8.0	14	32	115.67	2107
1992	26	5.3	6.2	37.5	9.8	8.1	14	32	121.36	2113
1993	26	5.5	6.2	37.7	9.7	8.1	14	32	117.81	2111

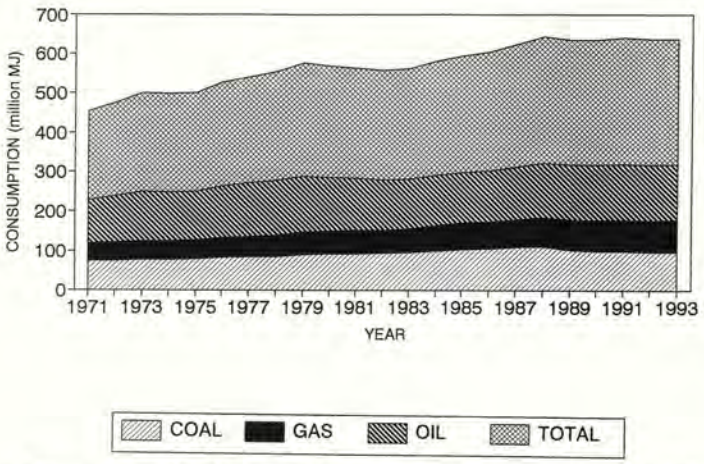
Figure 2 shows the consumption of fossil fuels in the UK between 1971 and 1993. The diagram charts the rise in the consumption of natural gas and the declining uses of coal and oil. The substitution of oil for coal for the purpose of power generation during the miners' strike of 1984 is clearly indicated, yet the rate of coal combustion has not significantly declined since then. The rate of total fossil fuel combustion exhibits peaks in 1973 and 1979, and is currently rising, due to the increasing use of cheap oil and gas, despite the British Government's statement that it is prepared to set itself the target of returning carbon dioxide emissions to 1990 levels by 2005, in conformity with the EC's indicated desire to stabilise carbon dioxide emission at their 1990 level by the year 2000.

The UK's consumption of fossil fuels in 1990 was 195.3 x 10^6 toe. Consumption in 1991 was 200.5 x 10^6 toe. In order to reduce this consumption to 1990 levels by the year 2005, UK energy consumption must be reduced by around 0.2% per annum successively, starting in 1991. In 1990 the UK's reserve of the fossil fuels corresponded to 0.3 x 10^{15} MJ and the annual consumption rate was 8.9 x 10^{12} MJ, with an indigenous life of 35 years.

In order to achieve a sustainable indigenous energy future, it was estimated that the UK rates of fossil fuel consumption must be reduced successively by 3% per annum, starting in 1987. In 1991, UK reserves of the fossil fuels corresponded to 0.15 x 10^{15} MJ, and the annual consumption rate was 9.12 x 10^{12} MJ, with an indigenous life of 16 years. Therefore, in order to achieve a sustainable indigenous energy future, the UK rates of fossil fuel consumption must be reduced successively by 6% per annum, starting in 1991.

The UK is an industrial nation which relies heavily on the import of fuels to feed manufacturing industries. Because of this reliance, the 1973 oil crisis affected the UK to a greater extent than many other countries. It has been stated in 1978 that, in the immediate future, North Sea oil and gas may be able to supply all internal needs for a period of up to 25 years (ie, until 2003). The danger is that, during this era of relative self-sufficiency, the UK may forget the energy crisis, whilst others conserve. Then, when all the indigenous fuel is used up, we will be left with outmoded energy technologies, poorly insulated buildings, and energy-hungry machines and processes.

The key factor here is the definition of 'published proved' reserves of the fossil fuels as the amount of coal, natural gas and oil remaining in the ground, which geological and engineering information indicate with reasonable certainty to be recoverable in the future, from known reservoirs under existing economic and operating conditions. The UK has vast reserves of coal, shale, oil, peat, etc, which at present cannot compete economically with cheaper forms of fossil fuels, either produced at home or abroad. Thus the dominant factors in specifying the indigenous lives of fossil fuels are not the remaining reserves, but the short-term economic, political and social factors prevailing. It is to be hoped that these factors are subject to continuous review. ❑



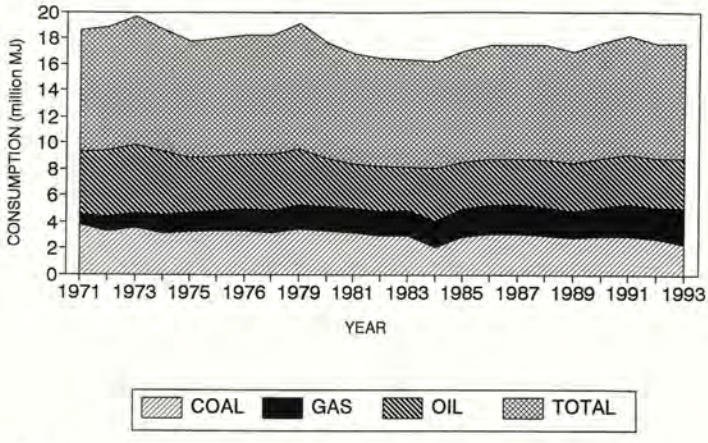


Figure 1 (left): World fossil fuel consumption rates. Figure 2 (right): UK fossil fuel consumption rates.

Renewable energy — life after NFFO 3

by R G Loram

Following on from his Viewpoint article in the February issue of *Energy World*, Geoff Loram looks at the history of the renewables orders in the UK, reviewing their achievements so far. He gives a detailed analysis of the progress towards price convergence, and speculates on what will be required of a future order if the Government is to meet its declared targets.

THE publication on 20 December 1994 of the third renewable energy order (NFFO 3) puts in place the latest building block in the UK Government's programme for encouraging power generation from sources of energy that can be regarded as broadly renewable, and it presents a suitable opportunity for a review of that programme and the future for renewable energy.

The Government's basic policy is clearly set out in Energy Paper 55, *Renewable Energy in the UK: The Way Forward* and which dates from 1988. At that time the Government saw its role as encouraging and subsidising R&D schemes, with a view to developing the various technologies then being explored to a state where they would be 'economically attractive'. This policy has been pursued since the mid-1970s, falling into three phases.

The first phase would identify and give initial support to all those technologies that could be worth supporting — a sort of coarse screening — and this phase was already complete by the time Energy Paper 55 was published. The second phase would sort the sheep from the goats, and decide which of the technologies had reasonable potential for economic viability. This was expected to be accomplished in the mid '80s to early '90s. The final phase, occupying the mid to late '90s, would see the chosen technologies developed to the stage where they could compete in the market place. The whole programme is intended to be complete by the year 2000.

At the time of Energy Paper 55 there was no indication of how much renewable energy capacity the Government wished to see developed. As the programme progressed, phase two saw hot rocks and wave power discarded and, with privatisation looming large, support for research into tidal power was stopped.

Prior to the Electricity Act, 1989, the only access to the electricity market was under the terms of the Energy Act 1983. This required the area boards to publish tariffs at which they were prepared to sign contracts for the supply of electricity with independent generators, the latter having a right to such a contract. This Act aimed to encourage independent generators to compete with the CEGB, but was singularly unsuccessful in that respect. It is interesting to note that if an allowance is made for 10 years inflation, the average price per kWh under those tariffs would be found to be close to the weighted average prices granted to the 'municipal and industrial waste' band of the NFFO 3. But of course, the market price for fossil fuel-fired electricity generation has fallen considerably in the last year or so, due to a combination of lower coal and oil prices, and pressure from the more efficient CCGT plants.

The complex process of sorting out the details of how the electricity industry was to be privatised threw up a 'Treasury friendly' (if one may be permitted a bit of awful 1990s jargon) means of funding the support for renewable energy, by using the electricity customer's money in place of that of the taxpayer. This was done by tacking a renewables support scheme onto that devised to deal with the problem of the uncompetitive nuclear power generation, when it became clear that the latter could not be sold off at the same time as the fossil fuel generation capacity.

The scheme worked by allocating part of the REC's obligation under the Electricity Act, 1989, to purchase a percentage of their power from non-fossil fuel fired sources — the NFFO — and the levy that went with it, to renewable energy schemes. Aspiring renewables generators would be invited to bid for contracts at whatever price they felt was needed to make their project commercially viable. The scheme would be operated as a series of tranches, each resulting in the Minister issuing a Renewables Order, authorising the RECs to sign contracts, through their joint agent, the Non Fossil Fuel Purchasing Agency, for a number of specified renewable energy projects which had emerged from the selection process. The intention was that succeeding orders would set progressively lower prices at which bids were accepted, so forcing the price paid for renewable energy ever nearer the market price.

This scheme was, by its very nature, a lash up, and it suffered from one serious flaw: the EC required that arrangements for subsidising nuclear power were due to be phased out in 1998. The result was that, after allowing for the time taken to build and commission a facility, the subsidised premium prices would only be paid for five or, at most, six years, after which the plant was at the mercy of the market, in terms of both price and length of contract. Inevitably this distorted the bid prices to a degree which rendered any comparison with the market price nugatory. This situation was remedied after the first two tranches, with the agreement of the EC, by extending the available contract period to up to 15 years.

In March 1993, the Government took the opportunity of the Coal Review White Paper to announce its intention of working towards a figure of 1500 MW of renewable energy generating capacity in the UK by the year 2000.

As might be expected in the circumstances, the structure of NFFO 1, announced in October 1990, was rather ramshackle. It was confined almost entirely to existing projects, or proposals that were well advanced with prices virtually negotiated, although upper limits were set, and not every project was accepted. The Order authorised the NFPA to sign contracts with 75 suppliers for a total of 102 MW of new capacity, and for some 50 MW of capacity already operating: the contracts under which the latter were sold were subsumed into the NFFO scheme.

Building on the experience of NFFO 1, the next tranche, announced in November 1991, was a more structured affair. The types of renewable energy were separated into six bands, and the proposers had to submit their projects to OFFER for thorough scrutiny. Having cleared these initial hurdles, bids were submitted naming the declared net capacity (dnc) they wished to sell, and the price they wanted for it. OFFER, working with the Department of Energy and the NFPA, then decided a 'strike price' for each band, and bids at or below were accepted, those above rejected. All projects coming in below were paid the strike price, no matter

what their actual bid was.

Originally, 282 schemes were submitted to OFFER's scrutiny, but only 205 met their criteria, and bids were finally accepted from 122. One of OFFER's criteria upon which a great deal of emphasis was placed was that proposers had to convince them that their bid would result in dnc being made available. This became known as the 'will secure' test. Bidders had to show their projects to be both technically and commercially viable, and that the necessary funding would be available. The only unknown factor that was supposed to be permitted under the 'will secure' test was the obtaining of planning permission.

In the event, although 82% of the schemes accepted under the first two Orders have gone ahead, they only provide some 340 MW of dnc, which amounts to about 59% of the 576 MW originally contracted for, and not all of that is operating as yet. About 90% of the shortfall is due to four large municipal waste burning plants not going ahead. Cory Environmental's large-scale Belvedere project, for example, did not obtain planning permission, and this accounted for half of this. Had all the projects in this band obtained planning consent, it is unlikely that they would have secured all the capacity they claimed. This is because SELCHP at Deptford, the Belvedere project and National Power's Northfleet project were competing for the same waste for substantial proportions of their inputs. In addition, the tonnages quoted by Cory indicated that they were relying on obtaining all the waste carried down the Thames by Cleanaway to their Pitsea landfill site. Not surprisingly, Cleanaway have other ideas.

The exertions of producing the Second Order must have exhausted the authorities: despite the Government's original intention to announce a tranche at yearly intervals, the third renewables tranche was not announced until October 1993. It set a programme that should have resulted in the Order detailing those projects that were accepted for contract being made public a year later, but the timetable slipped a bit, and the Order was not made until the end of last year.

Although the third tranche largely followed the pattern of the second, some changes were made. The bands were partially realigned. A miscellaneous band was dropped, as was sewage gas. Wind energy was split into two two — above and below 1.6 MW dnc, and a new band — Energy Crops & Agriculture & Forestry Waste — was introduced. This last band was split into two for pricing purposes; the first covered energy crops and forestry waste gasification; while the other is somewhat enigmatically labelled Residual (Other). This split was necessary as the gasification technology is still at an early stage of development, and now needs a period of operational experience at a commercial scale, to refine the designs and get them working with consistent efficiency, requiring a higher level of subsidy than the more established technologies.

Table 1: NFFO 1 bands, no of projects in each, total capacity and strike prices

Band	no of bids	total dnc	strike price	% of Order
Municipal & industrial waste	10	271.48 MW	6.55 p/kWh	57.5
Wind generation	49	84.43 MW	11.00 p/kWh	17.9
Landfill gas	28	48.45 MW	5.70 p/kWh	10.2
Other waste & non-fossil fuels	4	30.15 MW	5.90 p/kWh	6.4
Sewage gas	19	26.86 MW	5.90 p/kWh	5.7
Small hydro	12	10.86 MW	6.00 p/kWh	2.3
Totals	**122**	**472.23 MW**		**100**

Another significant change from NFFO 2 is that instead of all the projects in a band being paid the strike price, they will only be paid the price at which they bid into the band. But the all-important change was that the Order covers the period up to November 2014, allowing contracts to be signed for up to 15 years duration.

The tranche was heavily oversubscribed, with 520 firm bids, amounting to a total of 2464 MW of capacity, being accepted for consideration after undergoing the selection procedure. This gave OFFER a fair degree of latitude in deciding which projects should be recommended for inclusion in the Order.

In his review of the bid situation prior to the final selection of successful projects, DGES notes that the Public Accounts Committee of the House of Commons had, in July 1994, expressed their concern that only 50% of the generation capacity contracted for under the 1990 and 1991 Orders was actually operating. He then goes to great lengths to rationalise why this is so, but with a logic so tortured and tortuous that it is difficult to credit that it comes from a distinguished academic. We are told that they never really did believe that all the proposals that had apparently passed the strict 'will secure' test, would, in the event, secure the capacity they said they would and, therefore, more needed to be contracted for than the intended size of the tranche! Strangely, nothing was said of this at the time and presumably the PAC were not made aware of the thinking, or they would not have been making their comment. Looks like a bit of *post hoc, ergo propter hoc.*

This strange philosophy has been carried over to the Third Order, in which 627 MW of capacity has been approved in the hope that it would manage to result in 300-400 MW actually being commissioned. And this after stressing once again the 'will secure' test.

As a base against which to measure the convergence of bid prices with the market price, as required by the Government, DGES made a calculation of the equivalent of the 1991 bid prices, updated for inflation, on the basis of a 15-year contract period. This was done by assuming that those bids showed a positive net present value (npv) on a contract period of seven years, and calculating what bid price would be needed to show the same npv. He then looked at the bid prices received in the context of the size of the Order though appropriate by the Minister — 300-400 MW — to see how much convergence could be achieved. He concluded that a 30% convergence of average prices could result in about 300 MW finally being commissioned, allowing for a 25% failure rate.

DGES put forward two ways of selecting the projects to make up the Order. The first of these was a straightforward one of picking out the cheapest set of projects that would yield 400 MW. This turned out to be 42 landfill gas schemes, producing 82 MW, 24 waste burners, producing 303 MW and four windfarms, worth 15 MW. These, he thought, would result in a total of 316 MW eventually being commissioned. The second method would be to set a common convergence rate for all bands and to allow a slightly larger spread of average prices between the bands. On the same basis of selecting 400 MW of capacity to end up with something over 300 MW, this only increased the overall cost by about 12%, but resulted in a very different pattern of projects. Wind energy is increased eightfold, landfill gas by 50%, and these increases are paid for by more than halving the amount of energy from waste. Neither hydro power nor energy crops figure in these scenarios, because their bid prices were too high.

In the event, whoever was responsible for advising the Minister on his final choice adopted something of a 'pick 'n mix' strategy. Landfill gas is lifted direct from the 'minimum cost' list, wind is virtually from the 'uniform convergence' criteria; and waste is scaled down a bit from what it would have been under 'minimum cost', but not as much as it would have been under 'uniform convergence'. Some 120 MW of energy crops/biomass capacity has been added, together with a very small amount of hydro. The whole Order amounts to 627 MW, which is half as much again as OFFER was recommending. The Minister still expected this to result in 300-400 MW of capacity being eventually commissioned, so his other advisors must be less sanguine than OFFER about the failure rate of the will secure test. There are a lot of cooks stirring this particular broth!

The Government has set the renewable energy industry twin targets to be achieved by the end of the century — 1500 MW of capacity operating with the final parts of it being paid at market prices. In the NFFO scheme it has provided a mechanism, imperfect yet quite workable, through which the industry can try to attain those goals. The Government cannot hit these targets: only the industry can. What are its chances?

Several questions arise: how much scope is there, realistically, for further reductions in the cost of generation in the various renewables bands? How many more windfarm sites can expect to get planning permission — assuming they drastically reduce their costs? How much more landfill gas is there still available, that can be economically exploited at even lower costs? And perhaps most relevant of all, what is the true market price for electricity, and what will it be in 2000?

The last question merits more detailed consideration. If prices are to converge close to the market price it becomes, *ipso facto*, essential to know what the market price is. *Res ipsa loquita* as the lawyers say. As far as can be ascertained by a relative outsider, the market is made up of a large number of contracts, mainly between the RECs and the generators, which may vary in length and precise terms. The details of these contracts are treated as commercially confidential, so they are not known to the public. There would seem, however, to be a respectable argument for saying that — post contract — these prices should be in the public domain as, for the ordinary consumer, there is not yet an open market in electricity. In a regulated monopoly the pricing structure should surely be more transparent — a view that is shared, at least unofficially, by OFFER. The recent furore over the profitability and stock market value of the RECs shows the problems inherent in DGES having to play blind man's bluff to try to obtain the data that he needs to carry out his regulatory function.

In the calculations he made for assessing NFFO 3, DGES used a notional Pool price of 2.6p/kWh for the beginning of the contracts, rising to 2.9p/kWh at the end. But is the Pool price a valid guide to the market price? It certainly was not so at the time of NFFO 2, as the generators contracts were evidently about 3.3p/kWh (National Power's half-yearly report) whilst the average Pool price over 1991 was about 2.1p/kWh. More recently DGES said: "The prices in these (five year) contracts are higher than Pool prices and short-term contract prices observed to date ..." (from *Decision on a Monopolies and Mergers Commission Reference*, February 1994). Will the major generators future contracts come down to present Pool prices? If they do not then it is illogical to try and bring renewable energy prices down to a Pool price that does not represent the true market price.

Another question which needs addressing now if the final stages of the NFFO scheme are to make any sense, is what follows after 2000? This is particularly relevant because NFFO does two things: it sets the prices but, just as importantly, it embodies those prices in long-term contracts. If the Government's answer to the question is to shrug its shoulders and point to a market open to any competition, they should not be surprised if very little renewable energy appears on the market after the NFFO scheme has ended. This will be because the RECs have a statutory duty to purchase their power at the most economical costs and, on present showing, will be unwilling to enter into the sort of long-term contracts that are needed to justify the building of even moderate sized plants, as they cannot predict what will be economical more than a few years ahead.

It is suggested that a way out of these troubles would be to replace the bands in NFFO 4 with a single set of tariffs based on the demand pattern. This tariff could be set very close to market level — if DGES can discover what that is — and would be something like those published under the 1983 Energy Act; it ought to represent an undistorted Pool price. (In the MMC report DGES said he thought Pool prices were too flat). Such a tariff would eliminate one of the glaring faults of the NFFO scheme, in that it pays generators premium rates to produce electricity at times when there is low demand, and the rest of industry is paid very low prices. This idea would not be welcomed by the manufacturers of the old-fashioned mass-burn waste incinerators, but it would encourage the use of the more efficient fluidised bed technology which can be switched off at nighttime, and even over the weekend. Feasibility studies made in the days of the '83 act tariffs showed that, for a given waste input, it was always more economic to build a larger plant and operate it for 17 hours a day, five days a week, rather than smaller plant, operated 24 hours a day, seven days a week. Landfill gas could follow the same pattern, by storing the gas under low pressure during the night, and consequently using bigger capacity plant during the day. Even wind energy might benefit, if it can ever get down to the market price, because wind tends to blow more strongly during daytime.

One interesting consideration is the way in which proposers have been able to reduce bid prices, sometimes dramatically, between 1991 (using OFFER's equivalents) and 1994 without, as far as one can see, any great changes in technology having taken place. It would be interesting to know what were the factors that allowed the wind energy price to be reduced by 50%, landfill gas by 31% and the waste energy price by 20%. In so far as these differentials may represent generous pricing in the second Order, they indicate that further reductions of a similar degree

Table 2: NFFO 3 list of bands, capacity in each and prices bid

Technology band	contracted capacity MW dnc	no of projects	lowest contracted price p/kWh	weighted average price* p/kWh	highest contracted price p/kWh
Wind					
above 1.6MW dnc	145.92	31	3.98	4.32	4.80
below 1.6MW dnc	19.71	24	4.49	5.29	5.99
Hydro	14.48	15	4.25	4.46	4.85
Landfill gas	82.07	42	3.29	3.76	4.00
Municipal & industrial waste	241.97	20	3.48	3.84	4.00
Energy crops/ forestry waste gasification	19.06	3	8.49	8.65	8.75
residual (other)	103.81	6	4.90	5.07	5.23

*average price to be paid, weighted according to the expected output from each project.

may be hard to achieve.

There is one nagging question regarding wind power: at what stage in the growth of its available capacity will the normal peak load spare capacity no longer be able to replace it when the wind ceases to blow? At the moment there appears to be enough surplus capacity, but how long will the major generators keep so much surplus available? Plainly, if plant had to be kept available solely to replace wind farms not generating during calm or gales, wind power would be wholly uneconomic.

I started this article before *Renewables in Northern Ireland* (*Energy World* February 1995), and several of the points I have raised have been addressed by the authorities in Northern Ireland. The STOD weightings used to adjust the bid prices would result in just such a tariff as has been advocated here, and the decision was taken to limit wind energy to 2.5% of total demand.

There was considerable criticism of the NFFO scheme before the third tranche was announced on the score of the cost of the exercise to the bidder, as a great deal of money had to be spent on the design work and economic appraisal, in order to make a competitive bid. That work had to be sufficiently detailed for the bidder to have confidence that he could enter into a binding contract at that price. The volume of such criticism has considerably increased since the publication of the third Order, which resulted in a larger number of disappointed bidders. There is anecdotal evidence that these cost considerations may significantly limit the number of bidders for the next tranche. Once again, the setting of tariffs — they could be varied for different technologies — would obviate the problem of uncertainty. A cheap initial study would tell a potential bidder whether it was worth spending money on a full feasibility study or not, and the latter could lead directly to an application for a long-term contract. It there was thought to be a danger that too many plants could qualify if the tariffs were set too high, one only has to remember that, of the otherwise acceptable bids, 380 (73%) worth 1873 MW (75%) failed to get into the Order on price; at the same time NFFO 3 will probably only take the total capacity to around half of the Government's target.

It would appear that the renewables industry will struggle to meet the Government's twin target. There is an awful long way to go on capacity, and quite a bit yet on price. But the latter does depend on what the market price really is, it may be the 2.6-2.9p/kWh used by DGES, but he has not demonstrated that it is and, indeed, would seem to be unable to do so.

There is a respectable argument for saying that renewable energy should have a modest, but it must be modest, subsidy; if only to ensure enough capacity to help meet the Rio commitments. But it is suggested that this would be best administered by setting an open tariff and granting long-term contracts to those projects than can operate under it. In the unlikely event of a threatened oversupply of renewables, the tariffs could always be lowered or the supply of contracts curtailed.

Although I have concentrated here on the NFFO scheme, it should be mentioned that there now exists another market for electricity, in that any licenced generator can now make his own contracts direct with users of more than 100 kW. The price obtainable should be higher, but the difficulties are likely to be in arranging long enough contracts to ensure adequate funding. It is, however, a market that renewable generators should be examining with care.

It is hoped that the comments and ideas set out here may make a contribution to the debate about renewable energy and encourage members of the Institute to take part. It looks as though the Government needs your help! ❑

The changing face of systems integration

by Johanna Fender

BACK in November 1993 following a period of restructuring and refocus, British Telecommunications plc relaunched its customer systems division, and Syntegra was born.

The name of the new division was chosen, after wide-ranging research and consultation, to create the right image for the new business. It was felt that the name 'Syntegra' combined human issues with technology, whilst suggesting integrity, synergy and synthesis and implying a high quality of service. It was also scrutinised in the context of different languages and cultures, as BT intended that the new business should address the global market.

'Syntegra' gave the business a distinct identity and enabled it to compete in a market quite different to that of traditional communications, but with the strapline 'The systems integration business of BT', the links with its parent company were nevertheless quite clear.

The company's business is divided into seven key sectors, one of which is the utilities. While the seven industry sectors might appear to be very different — there are, in fact, many common business issues to be addressed. These issues, which Syntegra can help customers address, are concerned with efficiency, time-to-market for new products and services, and customer service. A customer care survey carried out for Syntegra in February 1994 highlighted the utilities sector as having the greater interest in customer care, compared to other sectors. 80% of utilities companies asked gave a high priority to training programmes to improve customer care, with 84% providing such training for their staff. Equally high percentages took a proactive role in measuring customer care and its effectiveness. But the major constraints when developing such programmes were cost and staff resources.

Utilities sector marketing manager, Stephen Booth, believes BT's own experience, as the first of the public sector utilities to be privatised by Margaret Thatcher's government, puts Syntegra in a unique position. It has encountered at first hand the problems associated with such a fundamental change in business culture, and is perfectly placed within the market to disseminate this acquired knowledge in a practical business sense.

The result of the process of privatisation and deregulation is a dramatic shift towards improving customer care whilst undergoing a massive organisational restructuring and simultaneously cutting core costs. BT has already addressed many of these issues, which are currently faced by the gas, electricity and water industries.

Typically Syntegra's customers are multinational corporations and major national organisations. It currently has contracts with, for example, British Gas and the National Health Service. The company's task is to provide and deliver large-scale solutions, enabling the customer to achieve business change and development through the application of information technology (IT). This can involve computer hardware and software, communications and business consultancy. The aim is to help the customer exploit opportunities presented by the integration of IT with new change management and organisational structure philosophies. As well as the utilities sector, Syntegra covers wholesale and retail finance, transportation and logistics, manufacturing, defence and civil government.

In August last year Syntegra won a £200 000 order from British Gas TransCo to develop a system electronically linking the company with its customers.

TransCo — the transportation business unit within BG — handles the transportation and storage of gas for the Public Gas Supply and Business Gas units, as well as for shippers. Because of the enormous amount of meter, billing and other information generated for its customers, TransCo was anxious to move from a paper-based to an electronic system as a direct response to the increasing liberalisation of the gas supply market.

The new system will provide a network of fast, direct routes to customers by linking TransCo's DEC VAX-based billing server over ISDN with independent suppliers' own IT systems. Syntegra will provide the ISDN network and lifecycle support, and will develop software to allow integration with TransCo's DEC system. TransCo will then supply its customers with a PC to connect into the network.

The system will initially provide a one-way flow of information between TransCo and its customers, but TransCo plans to develop the system to allow for a two-way flow of traffic. Thus Syntegra's system will be a building block to the future.

The global market for large-scale, strategic communication and computer systems has been estimated to be worth £25 billion a year, and Syntegra aims to be be one of the leading international players in this market by the turn of the century. ❑

Stephen Booth (left), is utilities sector marketing manager for Syntegra. He feels the company is well-placed to understand the problems faced by the utilities during the process of privatisation and deregulation. Pictured right is Bill Halbert, director of Syntegra.

Internationalised combustion engineering

THAT combustion engineering is an international activity is nowhere better demonstrated than at Peabody Engineering Ltd in Maidstone.

Now a member of Hamworthy Combustion Engineering Ltd, Peabody have consistently exported over two-thirds of their production for the past 40 years. This long experience of international specifications contributed to the development of the Peabody LNOG low NOx oil/gas burners which spearhead the company's activities in the 1990s.

The standards set for control of NOx emissions vary internationally. New plant standards for large combustion plant to be fully achieved by 2001 in the UK, have generally required earlier implementation elsewhere in EU countries, while in many Eastern European, Far Eastern and Third World countries are only now being introduced. At the same time local legislation, notably in USA, Germany and Scandanavia, is setting far higher standards. For example, 350 mg/Nm³ NOx emission required by UK new plant standards compares typically with 100 mg/Nm³ or lower for gas combustion required in those countries. It is inevitable that the rest of the world will eventually follow the higher standards.

Thus to supply the world's power, utility and refinery markets the burner manufacturer must combine flexibility to meet varying standards today with ongoing development to satisfy the world's environmental pace setters. Peabody agents and Group overseas offices provide both local knowledge and the high standard of after sales service essential for international success. Continuing development at the group technical centre with its uniquely comprehensive test rig facilities ensures that company products comply with increasingly stringent standards rightly set to protect our planet.

The Peabody LNOG Burner was first introduced in 1990 as a staged combustion burner designed to comply with European legislation. It had been developed as a purpose-designed low NOx burner, not a modified 'standard' burner, and would accommodate other combustion modification techniques to supplement staged combustion if required. Each LNOG burner is customised to its specific application to take into account fuel, furnace, and local environmental standards.

Over 400 units have been supplied to customers in 15 countries spread from Alaska through Europe to Indonesia. Applications range through power station, utility and process steam boilers to refinery fired heaters combusting heavy, medium and light oils, orimulsion, and natural and refinery gases. Individual burners supplied range from 1 MWth to 100 MWth.

The range of standards and applications is demonstrated by a cross section of performance guarantees.

In 1990, four staged combustion LNO burners were successfully supplied to a Portuguese 100 MW steam boiler to combust 0.4% N HFO to comply with maximum acceptable emissions of 450 mg/Nm³ NOx, 50 mg/Nm³ particulates.

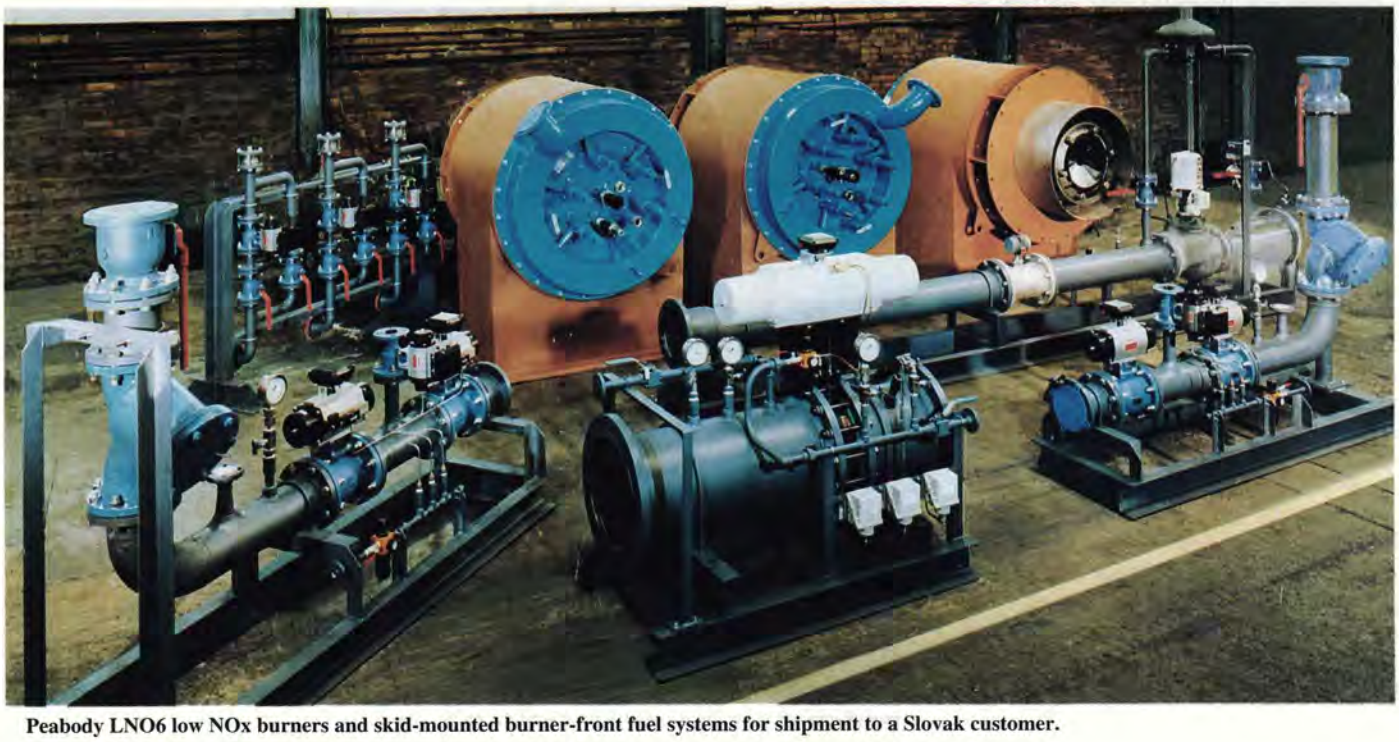
Two 50 MW boilers for a German customer in 1993 are equipped with two each dual fuelled LNOG burners achieving NOx 380 mg/Nm³ for HFO, and 100 mg/Nm³ for gas firing.

Also in Germany, flue gas recirculation was included with three off LNOGs for a 20 MW refinery gas application to guarantee 100 mg/Nm³ NOx.

In 1993 Peabody combined with a Swedish contractor to achieve exceptionally low emissions coupled with a significant increase in boiler efficiency. At a district heating station, flue gas condensation plant and low NOx burners were installed resulting in a 10% increase in efficiency, coupled with NOx emissions of 60 mg/Nm³.

Elsewhere, including in the UK, new and retrofitted installations are recording NOx emissions of 250-450 mg/Nm³ for various oils; and 60-150 mg/Nm³ for gases, including a 70% NOx reduction at a retrofitted Irish power station.

These are some examples of varying requirements met and the 'internationalisation' of Peabody activities. ❑



Peabody LNO6 low NOx burners and skid-mounted burner-front fuel systems for shipment to a Slovak customer.

1995 Ellis Memorial Lecture

THE Midland branch of the Institute of Energy has announced that Cedric Brown FEng, chief executive of British Gas plc, has agreed to deliver the 1995 Jim Ellis Memorial Lecture.

His paper will be entitled *A strategy for leadership in the international gas industry*, and will be delivered at the Gas Research Centre, Ashby Road, Loughborough on Wednesday, 10 May 1995.

A coffee reception will be held at 11 am, followed by the lecture at 11.30. A buffet lunch with wine and coffee will take place at 12.30 pm.

Admission is by ticket only, priced at £10 each. Those attending the lecture will also have the opportunity to tour the Gas Research Centre.

Tickets are available from D E A Evans, New Wood Lodge, 2a Hyperion Road, Stourton, Stourbridge DY7 6SB. Please make your cheque payable to 'Institute of Energy — Midland Branch'. Prompt application is advised, as demand is expected to be high.

Training through open learning

LEARN the solution to saving your energy costs. Now there is an opportunity to improve your organisation's bottom line financial performance and at the same time help the environment. The Institute of Energy has recently released TEMOL — training in energy management through open learning. The materials have been developed as a response to reduce the continually rising costs of energy, and the need to conserve fossil fuels. Written for individuals who now, or will in the future, have a responsibility for managing their organisation's energy utilisation, TEMOL is the flexible response to improving performance.

A wide range of purchase options exist: ranging from a fully certified course; through resource materials which can be used on in-organisation programmes; to individual topic elements. The content, focusing on practical problems found in the work place, covers both technical and managerial aspects of managing energy resources.

The open learning material is designed to provide the maximum assistance to the individual learner and The Institute of Energy is able to provide professional tutor support if needed.

For a free information pack contact: Louise Evans, The Institute of Energy, 18 Devonshire Street, London W1N 2AU. Tel: 0171 580 7124; fax: 0171 580 4420.

Branch Events

May 1995

North Eastern

Wednesday, 10 May, 11 am.
AGM followed by lunch at 12.15, technical meeting at 1.15 on 'Hospital Energy Services' concluding with a tour of Wansbeck Hospital.
Contact: Mr A W Potts, tel: 01670 712861.

North Western

Friday, 12 May, 7.30 for 8 pm.
Annual Dinner at Haydock Thistle Hotel.
Contact: Mr E Curd, tel: 0151 231 3617.

S Wales & West of England

Friday, 19 May, 10.30 for 11 am.
22nd Idris Jones Lecture, presented by John Collier FRS FEng, Chairman of Nuclear Electric. 'The role of nuclear power in a changing world' Applications to Mr D H Mustoe, 20 Park Court Road, Bridgend, Mid Glamorgan CF31 4BW. Free admission, but tickets must be applied for. Luncheon costs £8 per head.
Contact: Mr S Wilce, 01454 201101.

Merseyside sub section

Thursday, 26 May, 5.30 pm
Sub section AGM. Consolux 78 Mount Pleasant, Liverpool.
Contact: Mr E Curd, tel: 0151 231 3617

Mid May — Mid June 1995

S Wales & West of England

Trip on the paddle steamer 'Waverley' departing Penarth Pier and meeting up with members from the West of England at Avonmouth for a trip under the Clifton Suspension Bridge
Contact: Mr S Wilce, tel: 01454 201101

June 1995

S Wales & W of England

Friday, 16 June
Annual Lunchtime Lecture — CRE Group Ltd, Cheltenham. To be advised.
Contact: Mr S Wilce, tel: 01454 201101

North Eastern

Friday, 23 June
Joint meeting with the Institution of Chemical Engineers. To be advised.
Contact: Mr A W Potts. tel: 01679 712861.

October 1995

North Eastern

Tuesday, 24 October, 6 pm
Joint meeting with the Institution of Chemical Engineers. 'The work of CRE Group Ltd', Mertz Court, University of Newcastle. Tea & biscuits in the Buttery.
Contact: Mr A W Potts, tel: 01670 712 861

November 1995

North Eastern

November (date to be confirmed)
Dinner dance. To be advised.
Contact: Mr A W Potts, tel: 01670 712861

December 1995

Headquarters

3-5 December — two-day event
2nd International Conference on Combustion & Emissions Control, Commonwealth Institute, London W8. Contact IoE HQ. Tel: 0171 580 7124.

Midland branch AGM and works visit

NOTICE is hereby given that the 1995 annual general meeting (AGM) of the Midland branch of the Institute of Energy will be held in the Presentation Suite at the offices of Messrs Land Rover, Lode Lane, Solihull, West Midlands B92 8NW, on Wednesday, 24 May 1995, starting at 5 pm.

Members attending the AGM should arrive at the Lode Lane main gate, where there is a visitors' car park and report to reception, inside the factory, where they will be directed to the Presentation Suite.

The AGM will be preceded by the branch's 1995 works visit, also at Land Rover. Those attending will be met at reception inside the factory at 2.15 pm, and will be escorted round the plant and its CHP installation. The tour will take about two hours, and will be followed at 4.30 pm by a light buffet tea, and the AGM at 5 pm.

Members wishing to attend the AGM should note that places are restricted to 30, and applications will be dealt with on a first-come first-served basis. Please contact the Honorary Secretary, D E A Evans, New Wood Lodge, 2a Hyperion Road, Stourton, Stourbridge DY7 6SB. Early application is advised.

Energy efficiency training from the InstE

THE Institute of Energy has recently published three authoritative new energy efficiency training packages for use in professional training organisations, academic centres and in-house training companies.

'The Energy Efficiency Training Series' consists of three technical training packages, on *Energy Efficient Refrigeration, Energy Efficient Electric Motors & Drives* and *High and Low Temperature Heat Recovery*. The series, which was developed by ETSU on behalf of the Energy Efficiency Office, Department of the Environment, and supported by the SAVE programme was published by the Institute of Energy in association with Energy Publications.

Each package was compiled by a leading UK consultancy organisation, and provides self-contained presentation modules which can be used individually or as a whole. Detailed lecturer's notes are printed alongside slide illustrations, originals of the slides for use as overhead projection transparencies are provided, and student sheets with slide illustrations and provision for note taking are included. Each package costs £250 including postage and packing in the UK.

❑ *Energy Efficient Refrigeration* ***£250.00**
Introduction ● cooling loads ● cooling systems ● component efficiency ● tutorial examples ● operation & maintenance ● current affairs
ISBN 1-8744334-02-1

❑ *Energy Efficient Electric Motors & Drives* ***250.00**
Economics & efficiency opportunities ● motors & drives technology ● characteristics & system features ● application areas ● selection considerations ● evaluation techniques & economics
ISBN 1-874334-005

❑ *High and Low Temperature Heat Recovery* ***250.00**
Assessment of heat recovery opportunities ● principles of heat transfer ● boiler heat recovery techniques ● industrial high temperature heat recovery ● industrial low temperature heat recovery ● commercial sector heat recovery ● worked examples
ISBN 1-874334-01-3

*An 'early bird discounted price' of £199.00 each is available for purchases made by 30 December 1994. Please note that this offer applies to each pack. All prices are inclusive of postage and packing within the UK.

A similar training package *Small-scale CHP — A Teaching Programme for a Modern Technology*, developed by ETSU for the Energy Efficiency Office in conjunction with Manchester Metropolitan University, was published earlier this year by the Institute of Energy in association with Energy Publications. Details of the successful pilot study carried out at six universities and further information about the package are described in Best Practice programme, General Information Leaflet 14, which can be obtained directly from ETSU or the Institute.

❑ *Small Scale CHP — A Teaching Programme for a Modern Technology* ***£150.00***
Principles of CHP ● buildings services interface ● site appraisal ● selection of CHP system ● fuel supplies ● economics of CHP ● installation & connection with existing boilers ● exhaust systems ● contractual terms and commissioning ● plant operation
ISBN 1-874334-03-X

For further details on any of these packages, please contact Louise Evans, Institute of Energy, 18 Devonshire Street, London W1N 2AU. Tel: 071 580 7124; fax: 071 580 4420.

Three authoratitive training packages from the Institute of Energy.

Looking for a venue?

THE central location of the Institute of Energy offers a pleasant and convenient venue for small meetings and functions.

We are in the West End of London, at 18 Devonshire Street, between Harley Street and Portland Place, within minutes of rail termini and London Underground connections.

Nearest underground stations are Great Portland Street and Regents Park (both within 5 minutes' walk), with Oxford Street and Warren Street only 10 minutes away.

For further information on availability and rates, please contact Derek Smith on 071 580 7124.

Innovative postgrad programme

AN INNOVATIVE new postgraduate programme has been announced by the University of Sheffield's division of Adult Continuing Education.

The MA/MSc/Diploma/Certificate in Energy Studies will start in September 1995. The new programme of qualifications in energy studies will respond to strategically important themes, such as the environment and the energy economy. It will offer a wide choice of relevant multi-disciplinary course module options, 16 of which are grouped around these two broad themes.

Course modules include: corporate structure and strategy in the oil & gas industries; state/company petroleum licence contracting; privatisation and liberalisation in the esi; energy management; conservation, environmental law and fuel technologies & pollution control.

The modular structure makes it very flexible, both in terms of tailoring a selection of course modules to suit specific requirements, and in terms of the different qualification levels on offer. In addition they may be taken full-time (one year for an MA/MSc), part-time over two years, or by credit accumulation, whereby the participant studies at his or her own pace.

Thirdly, while offering the possibility for participants to study a wide choice of course modules across a range of disciplines, specialisation is not excluded.

While applicants will normally be expected to have a good first degree in a discipline relevant to the proposed selection of modules, relevant professional experience may also be considered as suitable qualification. Further details are available from Dr Philip Wright at the Division of Adult Continuing Education, The University of Sheffield, 196-198 West Street, Sheffield S1 4ET. Tel: 0114 2825400; fax: 0114 2768653.

A complex picture

Energy Paper 65 'Energy Projections for the UK Energy Use and Energy-Related Emissions of Carbon Dioxide 1995-2020'
Published by the Department of Trade and Industry, £15.95, HMSO Publication.

AS always, the economists and statisticians who painstakingly compile these energy papers and provide the most comprehensive tool for energy analysis available anywhere outside the US, have painted a picture of massive complexity from which it is almost impossible to draw detail without distortion.

With the benefit of long experience, they have carefully avoided the traps of firm prediction into which some of their forebears were plunged. They wisely underline the importance of "not underestimating the uncertainties inherent in projecting the future path of energy demand."

Rather than rely on single forecasts, the projections provide a view of possible future levels of UK demand based on six growth scenarios in the economy and world fossil fuel prices. Yer pays yer penny and yer takes yer pick!

In some areas, however, there is unanimity across the range of projections. For example, they all agree that against a background of growth in electricity demand, particularly given that a large amount of existing generating capacity will be retired from service between 2000 and 2010, there will be a need for considerable power station build. In all scenarios, the demand for coal remains substantially below historic levels, mainly due to commitments to CCGT and further gas build and restrictions assumed to be applied by Pollution Inspectorate. The one bright point for coal is that it could retain a significant market share, particularly if oil and gas prices rise considerably, as they are projected to do in the high level scenarios.

Gas demand will continue to rise to around 2005 or 2010, but thereafter remain steady or actually fall, either because it is displaced by coal or orimulsion — as in the high price scenarios — or because the generators constrain its spread in order to maintain a strategic diversity of fuel mix.Oil burn, in the low fuel price scenarios recovers by 2000, but falls thereafter as the impact of sulphur abatement begins to bite on heavy fuel oils. In the high price scenarios, oil remains too uncompetitive to rise above its 1995 levels.

Orimulsion burn will increase after 2000 if Pembroke power station modification plans go ahead. A further 500 MW of existing plant, as yet unspecified, is also assumed to be converted by that time, and after 2005 some of the projected IGCC plant may also run on orimulsion.

Post 2000, nuclear fuel inputs are expected to decline. Nuclear will form only a very small proportion — 3-4% — of total fuel inputs by 2020. Renewables, on the other hand, are expected to increase in the longer term. Nearly 3 GW of capacity may be in place in 2000 rising to between 3.5 and 5 GW in 2020.

Peter Heap

Overview of strategies

'Alternative approaches to pollution control and waste management' by Janis D Bertstein. Published under the Urban Management Programme of The Work Bank, Washington, 1993, 66 pp.

THIS paper gives an overview of the most common strategies and policy instruments, eg, regulatory and economic, that are used to achieve pollution control and waste management objectives in both developed and developing countries. It is divided into two chapters.

The first discusses the two main approaches to pollution control and waste management, namely command-and-control and economic strategies. Governments have tended to use the former as it gives the regulator a reasonable degree of predictability about how pollution levels will be reduced. A three-page table describes the various regulatory and economic instruments and their advantages and disadvantages.

The second chapter discusses applications of these instruments as they apply to surface water pollution control, ground-water protection, air pollution control, solid waste management and hazardous waste management. Examples are given from both developed and developing countries on how the instruments have been used, with some results. There are over 60 references cited, the great majority being from works published since 1988.

The report is described by the author as a background study forming part of a series of World Bank working papers, to develop an overall report on strategic options for urban environmental management. Although it was primarily directed to policy makers at all levels of government, it gives an informed overview of all the main issues which could be particularly helpful for those wishing to enter the field, or to get an appreciation of these regulatory and economic instruments.

Dr Cleland McVeigh

Encouraging sustainability

'Making Development Sustainable' published by The World Bank, 1994.

I SHOULD start by pointing out that 'sustainable development' is a self-contradiction. Just as perpetual growth is impossible, so is permanently sustainable development. The correct expression is 'development towards sustainability'.

I shall therefore examine the book from the point of view of which projects lead towards a permanently sustainable relation between humanity and the ecosphere, and which are temporarily palliatives, or actually causing harm to the ordinary person by 'involuntary resettlement', or by causing unemployment or loss of traditional lifestyles.

The necessary vision can be called 'equilibrium society' and it must be produced by 'equilibrium economics' (in which there is a stable relation between rich and poor, and worthwhile employment for everyone) and 'equilibrium engineering and agriculture'.

Eventually even the mining of coal, mineral ores, clay and limestone will have to cease, but if we extend our vision from the myopic two decades to two centuries, then the requirements are:

- no production of harmful gases, liquids or solids;
- reduction of world consumption of fossil carbon to a third of the present figure to avert further global temperature rise;
- eking out the supplies of accessible oil and gas as long as possible;
- permanently sustainable agriculture, forestry and fishing providing a healthy diet for everyone;

preservation of enough virgin forest, wetlands and 'wilderness' to maintain a full balance of plant and animal species;
restoration of mining areas and man-made deserts.

The authors of this book assume that the mistakes of the 'west' should be copied by developing countries, and the wealthy in those countries mostly agree. They state that the World Bank's central mission is the relief of poverty, and indeed that are one or two examples where they are achieving this, eg The Grameen Bank and the Tunisian Mountain Project. However, more often they help the rich to the detriment of the poor. They are involved in 're-settling two million people', ie kicking them out of their homes where their families have lived for centuries to build a dam, which will last less than a century; or to produce exports instead of growing food for themselves. The Yellow River dam in China will generate 1800 MW, but requires the resettlement of more than 180 000 people. The World Bank excuses itself from blame by saying that they are only responsible for less than 3% of all resettlement, and that they are trying to help resettlement. It is as bad as war!

I quote: 'Bringing essential services to

large numbers of poor people by installing major hydropower dams or irrigation systems or by extending transport networks has also entailed displacement, hardship, and deprivation for some'. I do not think these works bring essential services to any of the really poor at all, they merely enable the comparatively rich to be as extravagant as we are.

The Oxfam report *Africa— make or break* says: 'Now there is a chance to divert these resources (military) to the more worthwhile challenge of eradicating global poverty, and to the establishment of a new international order built on the foundations of justice and stability. What is needed is the vision, the political will, and sense of moral purpose to build that order. Unfortunately ... the industrial countries have allowed Africa, the world's most impoverished region to become increasingly marginalised. Financial resource flows are stagnating in real terms, debt relief measures have been inadequate, and there has been no attempt to improve the region's external trade environment. To make matters worse, the international donor community and multilateral agencies — the World Bank and the IMF — continue to insist on economic policy reforms which have manifestly failed to generate recovery, while imposing huge social costs'.

This was written two or three years ago, and the book shows some signs of remorse, ie projects that will really help the poor in Africa, and increased 'operational partnerships with NGOs'. However the basic problem of debts incurred by aping our mistakes seem to remain unsolved. One example is that roads are built with imported materials, labour and machinery instead of using local materials and labour as taught by TRL and Intech.

History has shown us that the only form of agriculture which is stable for centuries is small holding. Even that breaks up when there are too many children generation after generation, as does the nomadic way of life. This is confirmed in the excellent book *The Greening of Africa* by Paul Harrison, which surveys the successes and failures in Africa. He concludes that the most important development for African agriculture is to replace the traditional fallow period by such methods of sustainable fertilisation as 'alley cropping' with leguminous trees which can also be coppiced to provide fuelwood.

Western science and technology should assist traditional small holders and nomads to apply their traditional wisdom to increase output in a fully sustainable way. This would be the way towards 'investing in people, which reduces poverty and population growth' (*Making development sustainable*, frontispiece).

The World Bank finds it difficult to lend sums smaller than $1 million, and for smaller projects, like the Grameen one lending money to small local cooperative village women's banks, it has to work through NGOs. It does try to support projects which rally help the poor in several cases (the Tunisian Mountain project), the attempts to reconcile the needs of local populations with biodiversity and forestry, and to secure legal recognition and protection of access to natural resources. Some projects must be done on the large scale, for example, the attempt to restore some of the man-made damage to the Mediterranean, Black and Baltic Seas, the Danube river basin, the Aral sea and Lake Victoria. We can only pray for their success.

However it is in my own field of energy that I find the Bank causing the worst deviation from permanent sustainability. They are attempting to copy the Western mistake of huge power stations or dams which generate so much electricity that it is necessary to construct costly distribution systems and have customers who use ten times as much as really need. It is now quite clear that the megalomania of building 1000 MW power stations makes less electricity much more expensive than small local stations of less than 0.5 MW with local distribution only.

It is equally certain that such a system could never be constructed to serve the 'two billion people who lack access to electricity'. The only fully sustainable way is to provide 20-40 W per person to a village or small suburb, from renewable energy (wind, biogas, biofuels, sun, micro hydro and so on). If we did this, they would come to equilibrium engineering before we in the west reduce our per capita consumption of electricity and fossil fuels to no more than one-fifth of our present level.

In the shorter term, I am glad to see that the Bank is encouraging 'clean'\coal technologies by particulate removal and desulphurisation. For the longer term they are also trying to encourage more sustainable forms of producing biofuels. In my view this is the most important of the work that needs doing. Coppicing or pollarding of leguminous trees planted from agro-forestry is needed all over the world, to supply fuelwood and fertiliser. The production of artificially fixed nitrogen requires large amounts of energy. Some years ago, I did calculate that the straw produced on a British farm could provide three times the energy needed to fix the nitrogen with which it had been grown, but this requires initial investment, which rules it out for most of the world.

Certainly our use of electricity for low grade purposes, like water and space heating, is an extravagance that cannot be permanently sustained. The book says that the cost of photovoltaic cells has come down to $6000 per unit of peak capacity, but that this form of solar power is still not fully commercial, except for small-scale, off-grid applications. While I think that fully sustainable renewable energy systems should not be lumbered with interest costs higher than 2-3%, because they are permanent, I think that pv cells are not the most promising solution. I believe we should investigate micro CHP systems, producing both electricity and hot water from the sun or biofuels grown locally.

I conclude that the best way to help the poor in any area is to work closely with a pilot plant group to see what are their real needs and wishes, and work out how to supply these on a permanently sustainable basis, with a minimum of interference with their traditions and customs. My friend Michael Carey has been working with a village in S Tanzania in this way for ten years, studying their needs and wishes. The charity PowerAid has obtained a grant to enable him to complete this work, and to see whether they really want electricity. It is already providing an example of steps to relieve poverty in that area.

We must cease to assume that our western civilisation leads towards a viable or satisfying future for mankind, or that the quality of life of the poor will rise if we transmit it to them. The only way to help is development towards permanent sustainability by means of equilibrium engineering.

Professor M W Thring ScD FEng

Recently published

'An Analysis of Major International Electrical Engineering Consultants and Their Markets'
Market research report, first published 1993, revised and updated 1995, ABS Energy and Power, 436 pp, £550.00. Available from ABS, tel: 01276 474828; fax: 01276 471796.

'Introduction to Differential Calculus'
18th title in the IEEIE's open learning programme: Mathematics for Engineers and Technicians. Enrolment fee for new module, inclusive of support, postage and VAT, £20.00. Available from the IEEIE, tel: 0171 836 3357.

'1995 NSCA Pollution Handbook'
Edited by Loveday Murley. Published by the National Society for Clean Air and Environmental Protection, Brighton, 1995, 504 pp, £23.95 inc p&p, from NSCA, 136 North Street, Brighton, BN1 1RG. Tel: 01273 326313.

Striking a balance

I entirely and enthusiastically agree with Richard Courtney's statement (*Energy World*, January/February 1995) that the UK should have a balanced energy policy, including inter alia nuclear power. As far as I am aware, none of my colleagues have ever argued that nuclear power should be the sole source of electricity in the UK.

But the rest of his comments hardly support this admirable sentiment.

Nuclear fission's role in a sustainable energy policy for the very long term does indeed rely on the use of plutonium. Mr Courtney says that 'only' Japan is continuing significant work on developing that fast reactor (though many of us rather admire Japan's record in picking winning technologies which have been developed elsewhere). Even setting aside the fact that Superphenix in France has recently been relicensed, and that BN-600 has been the best-performing reactor in the former USSR for the last two years, the change in attitude towards the fast reactor in recent years has been more one of timescale than of nature. There is dramatically more uranium than was realised 20 years ago. There is also dramatically more fossil fuel, which has reduced the demand for nuclear power in those areas lucky enough to have access to cheap oil and gas — though not in France and Japan, which do not enjoy such a wonderful, if temporary, privilege. As uranium depletes, the arguments for the fast reactor will reemerge. In the meantime, the possibility of using plutonium in mixed oxide (MOX) fuel for thermal reactors will significantly extend the lifetime of uranium as a resource.

To repeat a point, the fossil fuels, as Mr Courtney outlines, have vital alternative uses. We might as well be using uranium for fuel today; by doing so we will not deprive future generations of the benefits of the plastics, artificial fertilisers and the like. 'To cater for the needs of current generations without preventing future generations from catering for theirs' — the definition of sustainability.

Nuclear power in the UK is not receiving an operating subsidy, of course; the nuclear levy is designed to pay for liabilities inherited by Nuclear Electric from the CEGB in 1990. Nuclear Electric has never made any secret of the fact that it would be delighted to lose the levy and the liabilities. What alternative way of discharging these liabilities would Mr Courtney suggest? Perhaps, like the coal industry, nuclear power should simply receive £billions direct from the Treasury to deal with cleaning up past activities.

The nuclear industry would be perfectly happy to compare the environmental effects of 1950s coal technology with those of contemporary nuclear facilities. The point is that the future will be based on best practice now.

Mr Courtney's other claims, especially that the nuclear industry has always told lies, are hardly helpful to a serious debate. Can he please give chapter and verse on the 'too cheap to meter' quote; I have never been able to identify it, and indeed, it seems bizarre that anyone could claim that any commercial activity would be undertaken without someone paying for it!

I hope that harking back to past operations does not imply that the coal industry has given up the fight for its future. It has always seemed to me quite mad that the UK should turn its back on such a valuable resource, especially one which cannot be disputed, no matter what happens in the Middle East or the former USSR.

If the recently published Energy Paper 65 is correct, prospects for nuclear power and coal look grim against the all-conquering march of gas. Much as gas is to be welcomed as an extra element in security and diversity of supply, it cannot be any more healthy to see our economy dependent upon any one source of energy. The arguments for a continued presence in nuclear and coal technologies, though differing in environmental and resource details, are fundamentally the same, and misleading attacks can hardly aid coal or nuclear power in establishing the advantages for Britain of the balanced energy policy advocated by Mr Courtney.

Malcolm C Grimston
Energy Issues Adviser, BNIF

Nuclear power: overcoming the hurdles

My claim about the financial success of Nuclear Electric plc and Scottish Nuclear, supported by facts on the technical performances of their nuclear stations since 1990, is clearly portrayed in annual reports, and therefore indisputable.

For example, nuclear power stations produced 61 TWh in 1993/94, a staggering increase of 44% over 1990/91. At the same time, excellent management techniques have combined to drive down prices in operating costs from 5.2 p/kWh to 3.1 p/kWh over the same period.

Their success is not due to state subsidies. In fact the opposite is the case. Let me remind readers that under the Electricity Act 1989, an order was imposed on each REC requiring them to make arrangements for securing the availability of a specified amount of non-fossil fuelled (nuclear and renewables) generation (except Scotland). For this, Nuclear Electric receives a premium over and above the market price for an output up to a specified figure, above which only the market price is paid. At present that amount is 40 TWh, about 70% of Nuclear Electric's annual output. Further, the company has to bid competitively into the Pool.

I have to emphasise that the levy is not needed to subsidise Nuclear Electric's operations because the company's income is sufficient to meet all operational cash flows and fund capital investment.

The UK Government saw fit in the late autumn of 1989 to remove the nuclear stations from the privatisation process. The new state owned nuclear company when formed in England and Wales, inherited financial liabilities of £10.7 billion from the CEGB.

The levy when introduced, ran counter to EU rules and had to be cleared by the European Commission, who only authorised it on condition it was ended in 1998. In actual fact, the amount of income received by Nuclear Electric is decreasing in real terms. Nuclear Electric must be congratulated in that despite all the odds against success, from such a poor start its share of the electricity market has been continually rising. Nuclear has shown it is highly competitive in the face of the availability of gas and low price contracts. The Regulator, Professor Littlechild's capping of Pool prices in 1994 registered another hurdle to be overcome.

British Coal received over £14 billion of subsidy in the ten years 1982-92.

Two further points. One is the absurd claim over the question of Sellafield's change of name. Again, the facts: the Windscale accident to which Mr Courtney referred in his letter, occurred in October 1957, a year after the opening of Calder Hall. In the space of four months, a few miles south of Cumbria, Welsh communities fought hard to secure the building of a nuclear station at Trawsfynydd. So much for the fickleness of public opinion.

As for the idea that the nuclear industry itself gave rise to the claim on power too cheap to meter, I suggest Mr Courtney refers back to what I call the sensational and ill-informed press.

Eur Ing F John L Bindon *(SFInstE)*
Bangor, Gwynedd

The editor welcomes readers' letters on any energy or energy-related issue. Please keep your submission to 500 words or under, and send it to: The editor, Energy World, The Martins, East Street, Harrietsham, Kent ME17 1HH; fax number: 01622 850100. We are unable guarantee publication, but will try to include all letters received.

May 1995

Exterior lighting design practice
Mid-career course, 2 May, London. Details from Mrs Ann Chapman, Mid Career College, PO Box 20, Cambridge CB1 5DG. Tel: 01223 880016; fax: 01223 881604.

Building Electric Basics 1 — choosing electricity supplies
Mid-career course, 4 May, London. Details from Mrs Ann Chapman, Mid Career College, PO Box 20, Cambridge CB1 5DG. Tel: 01233 880016; fax: 001233 881604.

Corrosion prevention of the European gas grid
Conference, 3-4 May, Amsterdam. Details from Nadia Ross, IBC Technical Services Ltd, Gilmoora House, 57-61 Mortimer Street, London W1N 8JX. Tel: 0171 637 4383; fax: 0171 631 3214.

Gas Turbine Power Generation
Conference, 4 May, London. Details from IChemE Conferences & Courses section, 165-189 Railway Terrace, Rugby CV21 3HQ. Tel: 01788 578214; fax: 01788 577182.

The place for heavy fuel oil in your energy strategy
Conference & exhibition, 4 May, Manchester, 9 May, Coventry & 1 June, Glasgow. Details from CEA Conference Office, Allen House, Boltro Road, Haywards Heath, W Sussex RH16 1BP. Tel: 01444 458080; fax: 01444 441215.

Financing energy efficiency investment
One-day workshop, 11 May, Swansea. Details from Sadie Primmer at ETSU, tel: 01235 433942; fax: 01235 436461.

Engineering Horizons
Seminar, 15-16 May, Belfast. Details from Dr F Gaston, Dept of Electrical & Electronic Engineering, Queen's University, Belfast BT7 1NN. Tel: 01232 245133.

Creating value through improved strategic decision making in upstream oil & gas
Two-day senior executive briefing 15-16 May, London. Details from Nadia Ross, IBC Technical Services Ltd, tel: 0171 637 4383; fax: 0171 631 3214.

Energy demand and supply — economics & policies in a changing world
Course, 15-19 May, Oxford. Details from The Registrar, The College of Petroleum & Energy Studies, Sun Alliance House, New Inn Hall Street, Oxford OX1 2QD. Tel: 01865 250521; fax: 01865 791474.

The petroleum forecourt in a competitive retail market
Conference, 16 May, London. Details from Caroline Little, The Institute of Petroleum, 61 New Cavendish Street, London W1M 8AR.

Embedded generation — problems & solutions
Conference, 16 May, London. Details from Sarah Ashmore, IBC Technical Services Ltd. tel: 0171 637 44383; fax: 0171 631 3214.

Power-Gen '95 Europe
Exhibition, 16-18 May, Amsterdam. Details from Power-Gen Europe '95, PO Box 9402, 3506 GK Utrecht, The Netherlands. Tel: +31 30 650963; fax: +31 30 650928.

Rural electrification with renewable energy technologies: policy options & strategies
International seminar, 21-26 May, Southampton. Details from International Seminars Department, The British Council, 10 Spring Gardens, London SW1A 2BN. Tel: 0171 389 4264; fax: 0171 389 4154.

The North Sea 1995
Conference, 22-23 May, London. Details from The Conference Division, Lloyd's of London Press Ltd, One Singer Street, London EC2A 4LQ. Tel: 0171 250 1500; fax: 0171 253 9907.

Understanding electricity production economics
Course, 22-24 May, Oxford. Details from CPS, tel: 01865 250521; fax: 01865 791474.

Energy efficiency: domestic grants
Seminar, 23 May, Peterborough. Details from the Council for Energy Efficiency Development, P O Box 12, Haslemere, Surrey GU27 3AH. Tel: 01428 654011; fax: 01428 651401.

International Caspian oil & gas
Conference & exhibition, Baku, Azerbaijan. Details from Spearhead Exhibitions Ltd, Ocean House, 50 Kingston Road, New Malden, Surrey KT3 3LZ. Tel: 0181 949 9222; fax: 0181 949 8186/8193.

Strategies for clean electricity generation
Course, 25-26 May, Oxford. Details from CPS, tel: 01865 2500521; fax: 01865 791474.

Sunrise
Introductory seminar, 30-31 May, London. Details from Peter Beacock, Dept of the Built Environment, University of Northumbria at Newcastle, Ellison Building, Newcastle upon Tyne NE1 8ST. Tel: 0191 227 4722; fax: 0191 227 3167.

Management techniques for energy efficiency
One-day seminar, 31 May, Preston. Details from Lorraine Watling at ETSU, tel: 01235 4320014; fax: 01235 436461.

The energy industries & the environmental challenge
Course,, 31 May - 1 June, Oxford. Details from CPS, tel: 01865 250521; fax: 01865 791474.

June 1995

Oil Project Finance
Conference, 5-6 June, London. Details from John Bridges, IBC Financial Focus, tel: 0171 637 4383; fax: 0171 323 4298.

ASME Turbo Expo '95
40th gas turbine & aeroengine congress, 5-8 June, Houston, Texas. Details from IGTI, ASME, 5801 Peachtree Dunwoody Road, Suite 100, Atlanta, Georgia 30342-1503 USA.

Marichem Asia '95
Conference, 7-9 June, Singapore. Details from London RAI, Glen House, 200-208 Tottenham Court Road, London W1P 9LA. Tel: 0171 436 9774; fax: 0171 436 5694.

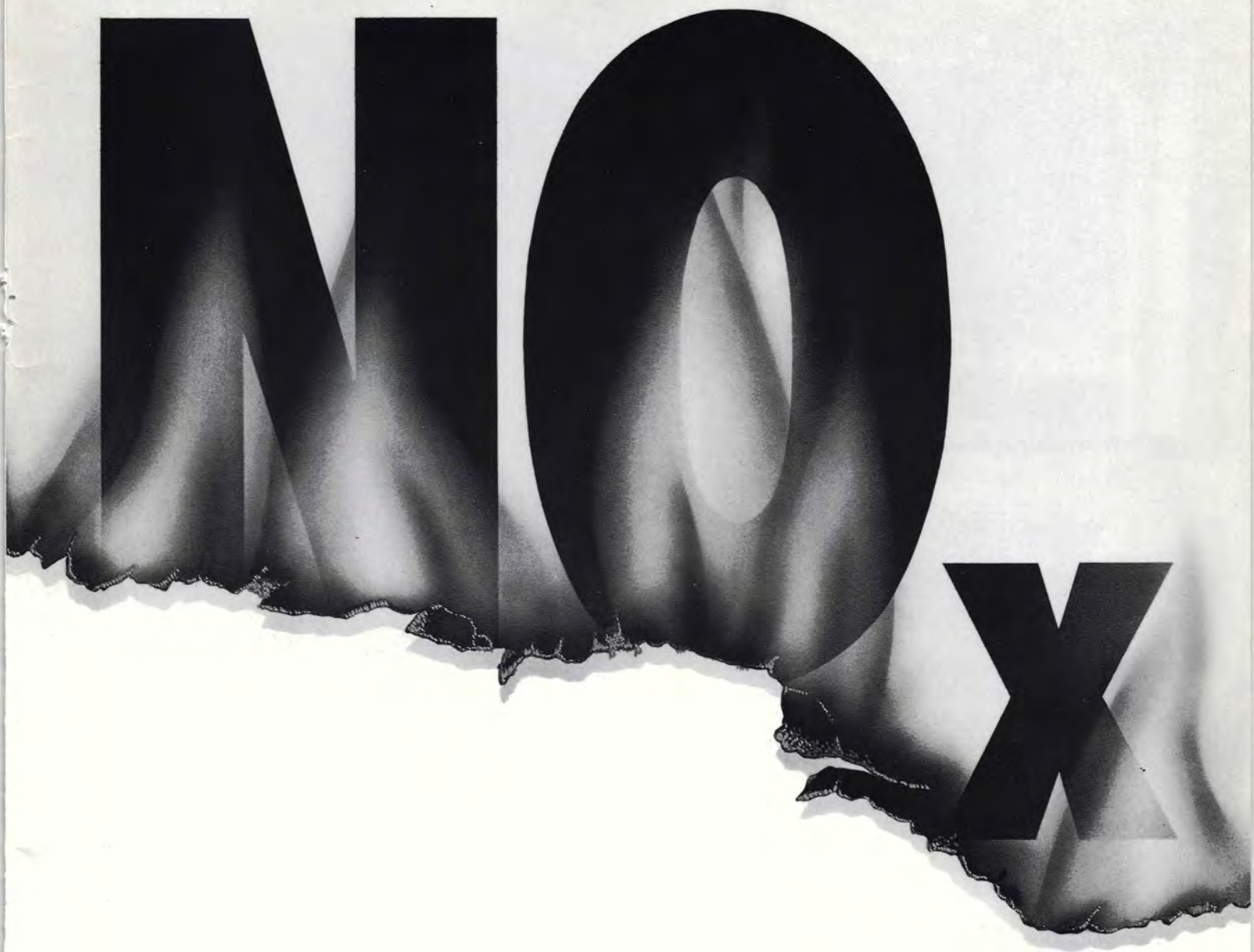
Lighting modelling in architecture
One-day seminar, 8 June, Maidenhead, Berks. Details from Mrs M Bartholomew, BEPAC Administrator, 16 Nursery Gardens, Purley on Thames, Reading RG8 8AS. Tel & fax: 01734 842861.

UMEX '95
Utilities management exhibition, 6-7 June, London. Details from Richard White, Management Events Ltd, P O Box 351, Basingstoke, Hants RG27 9YY. Tel: 01256 762460; fax: 01256 7661224.

The gas industry ... global growth
132nd AGM of IGasE & conference, 12-13 June, Newcastle upon Tyne. Details from Rex Cooke, IGasE, 21 Portland Place, London W1N 3AF. Tel: 0171 636 6603; fax: 0171 636 6602.

The exploration & production of oil & gas in the FSU
Conference, 13-14 June, London. Details from Philippa Giles, Business Seminars International Ltd, tel: 0171 490 3774; fax: 0171 490 2362.

Electricity: strategic responses to competition
Conference, 14-15 June, London. Details from AIC Conferences, 2nd floor, 100 Hatton Garden, London EC1N 8NX. Tel: 0171 242 2324; fax: 0171 242 2320.



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