ENERGY WORLD

MAY/JUNE 1989 **Number 169**

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

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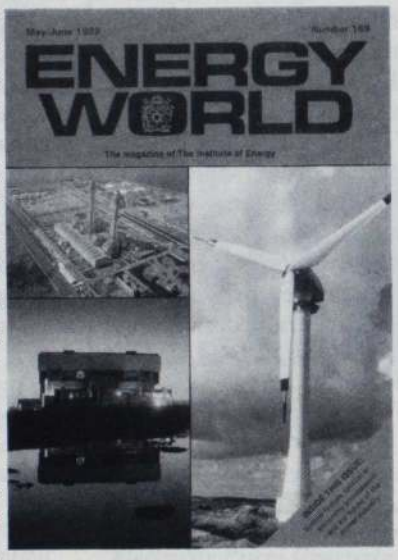
Printed by Headley Brothers Ltd, The Invicta Press, Ashford, Kent

COVER STORY



Our picture montage on the cover of this issue depicts some of the maturing technologies for electricity production that are destined to be joined in fiercer competition as the UK's electricity supply industry completes its restructuring following its imminent privatisation.

Top left: an aerial view of the 2000 MW Futtsu combined cycle power plant located near Tokyo, Japan. Operated by the Tokyo Electric Power Co (TEPCO), the power plant is the world's biggest of its type and comprises 14 GE-designed combined cycle units, each with a maximum capacity of 165 MWe. Each c-c unit incorporates the GE 109E open cycle, single-shaft gas turbine. Picture reproduced by kind permission of Tokyo Electric Power Co, Inc.

Lower left: a late evening view of the Heysham 2 AGR nuclear power station on Britain's Lancashire coast. The photograph was shot on 23 June last year just as the new power plant's No. 1 reactor went critical for the first time. Picture by courtesy of NNC Ltd.

Right: the definitive, contemporary wind turbine electricity generator — an increasingly prevalent sight in parts of Europe, Scandinavia, North America and Asia. The model shown is a Howden 750 KW machine installed in Sweden. Picture by courtesy of Howden Wind Turbines Ltd.

*See our series of articles on the electricity industry, beginning on page 7.

CONTENTS

Facing challenges with vigour

I feel that the Institute has had a year of substantial change due to a large turnover of staff because of retirements and people leaving in the normal way. We now have a headquarters team tackling our problems with vigour so we have new opportunities for change which, in my opinion we must seize.

An analysis of our financial situation over the last few years indicates that our income has not been keeping up with our expenditure and, but for astute investments, we would have been showing a further loss this year. Positive steps have been taken to improve the situation by rigorous budgeting and control.

The new look to *Energy World* is aimed at improving our internal and external image. Revenue derived from advertising in our publications is essential. We can increase this by ensuring that advertisers feel that it is to their advantage to be seen in *Energy World*, the *Journal* and the *Energy World Year Book*.

Overseas contacts are very important and any input from them into *Energy World* is more than welcome. We have now got a standard form of agreement for working in association with groups overseas. Energy in Europe is a vital activity and 1992 will soon be upon us. We have made contact with European groups similar to our own and are in the process of identifying common areas that should be pursued.

It has been decided to go ahead with an Annual Conference in 1990 to inaugurate the new President. This will give everyone a chance to get to know him and hear what he has to say. This event will be supported by speakers on topical subjects and will include a social programme.

I feel that privatisation, particularly of the electricity industry is going to result in many more people being involved in energy production than was previously the case. This must be an opportunity for the Institute to become more influential in the power production field, and at the same time enable us to increase our membership.

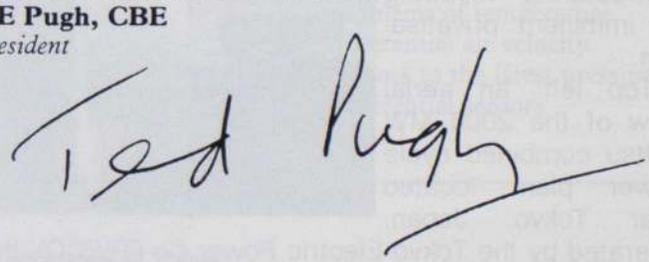
All these activities will bring about change and we need to seize the opportunities that are presented to us if we are to become more influential and make lasting improvements.

However in spite of the recruitment of new members, the loss of existing members is leading to a decline in the total membership. As I have said elsewhere, we have a higher percentage of Chartered Engineers as corporate members than any of the other Institutions. In my opinion, whilst this gives us the technical edge, it should not prevent us from recruiting other desirable people. Energy is a vital subject in the world, which points to the need for more influence from Institutes such as ours. This in turn means that we should have as many members as possible, whether they be non engineers who are qualified to be corporate members or others who are in positions of influence in the energy field.

Chernobyl, Exxon Valdez, the Greenhouse Effect, the depletion of the ozone layer, concern us all and yet as long as energy pours into our homes and cars, we sit back and forget these problems. This is understandable and it is up to us to emphasise the need for adequate research and economy in the use of energy. The development of renewables, fast reactor, fusion, fluidised bed combustion and CHP are vital to the needs of the industrial society of today. After all, protection of the environment in the end, must come down to controlling the amount of pollutants we discharge into the atmosphere. It behoves us, as a learned society to promote and encourage education in all these matters through our activities and publications.

During my attendances at various functions and meetings at both branches and headquarters, I have been very impressed by the enthusiasm and hard work of our members country wide. Everyone is keen to see the Institute more influential and universally acknowledged as an authority on energy matters. Technically this is easily attainable if you look at the abundance of skills and experience which we encompass, but the real challenge is to harness this expertise for the Institute and also to sell ourselves in an ever changing and competitive society. I look to you, the members, to take up this challenge for the future, by actively supporting the Institute in all its endeavours at both branch and national level.

C E Pugh, CBE
President



The author

C E (Ted) Pugh was the managing director of the National Nuclear Corporation at Knutsford, Cheshire from January 1984 until his retirement in September 1987. A native of Bolton, his long association with the electrical power and energy industries began in 1942 when he joined the former Lancashire Electric Power Company as a junior construction engineer.

When the power industry was nationalised in 1948, he became a senior mechanical engineer in the North West division of the British Electricity Authority.

He was promoted to project engineer in 1951 and became involved over the next 10 years in the design and construction of five major coal-fired stations together with a number of construction activities on rivers, wiers and tunnels.

This was followed by his appointment as project manager for the construction of the last of the Magnox nuclear power reactors to be built in Britain, at Wylfa, Anglesey.

When the construction and design groups of the CEGB were combined in 1971, Mr Pugh was made responsible for setting up one of the new division's major activities: the electrical, control and instrumentation branch. He later took responsibility for the division's corporate planning.

In 1976 he became the division's director responsible for the Advanced Gas Cooled Reactor programme.

In 1982 he transferred to the National Nuclear Corporation initially to lead the Sizewell 'B' PWR design team, followed by his appointment as managing director of NNC in 1984.

Energy skills shortage worries Watt Committee

EFFORTS to make more efficient use of electricity, a key to combating the Greenhouse Effect, could be hampered in the UK by a lack of skilled manpower, said the Watt Committee in a recent report to a House of Lords sub-committee.

The Watt Committee is worried generally by the decline in the numbers of engineers both undergoing training and working in the field of electricity use within industry and commerce. Prof David Langman, speaking on behalf of the Watt Committee, told the Lords that, "over 60% of all power engineers are currently over the age of 47", a statistic which Lord Shepherd (Chairman of the Sub-Committee) described as, "shattering!" Prof Langman went on to emphasise that it was essential to attract more talented young people, not only into the engineering profession as a whole, but particularly into power engineering on which the future of the whole electricity supply industry and its customers depends.

The Sub-committee of the European Communities Committee of the House of Lords is studying proposals by the European Commission to achieve greater efficiency of electricity use through information, advice and market forces. In its evidence, the Watt Committee drew their Lordships' attention to the Department of Energy's Annual Report which states that research and development in the whole area of electricity use is not limited by lack of finance, as is popularly assumed, but by shortage of manpower.

"The Electricity Council", said Prof Langman, "appreciated the contribution that power and electricity utility engineers had to make to increasing electricity efficiency. With the forthcoming demise of this body, we trust that the new distribution companies will recognise the need to promote electricity efficiency."

The Chairman of the Watt Committee, Dr Geoffrey Pardoe, stressed the need for mechanisms that would allow the public and industry to choose more efficient electrical appliances and plant.

Survey of world electricity prices

UNITED KINGDOM electricity prices to typical domestic and industrial customers remain in the mid range of prices charged in the European Community and the developed world. This is shown in the latest edition of "International Electricity Prices Quarterly" published by the Electricity Council.

Commenting on the survey's findings, Mr John Marsh, Head of Tariffs at the Electricity Council, said: "The survey gives the position as at last October, but preliminary work on the current position indicates that UK prices remain in the competitive mid range despite last month's tariff increases."

He added: "The price comparisons on our survey are not only the most comprehensive undertaken in this country but are determined on a rigorous like-for-like basis with the full co-operation of 40 utilities in 20 countries. This ensures that the information provided is free from the distortions of more limited and selective surveys."

The survey shows that on domestic prices:

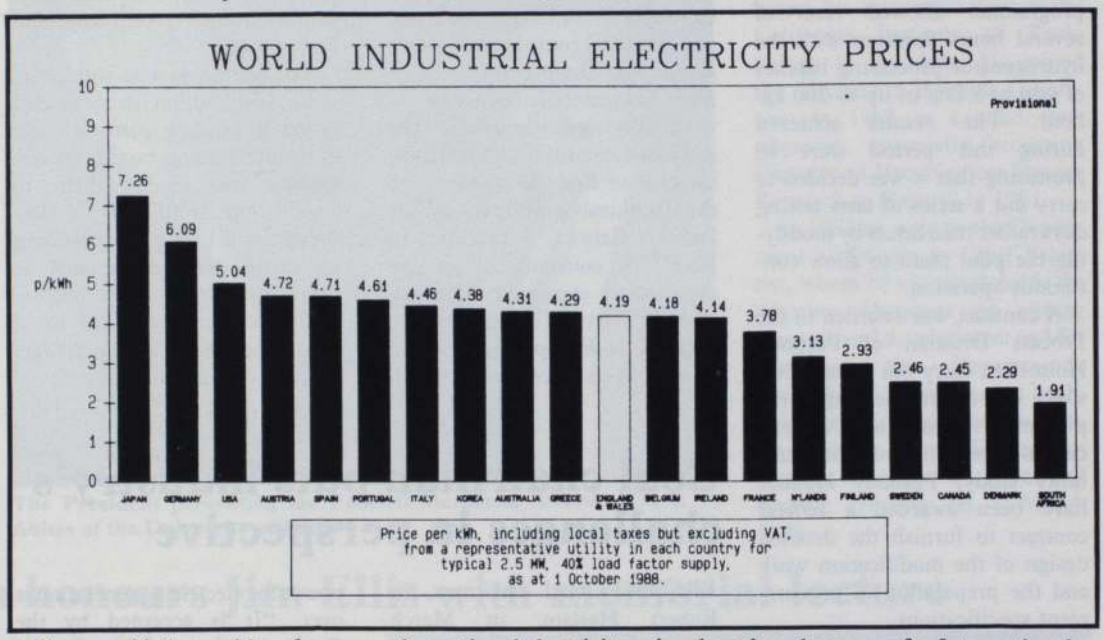
- More than half of the 20 developed countries surveyed worldwide charge typical domestic customers more than the UK.
- Eight of the 12 European Community countries charge domestic customers more than the UK.

For prices to typical industrial customers, the survey shows that:

- Ten of the 20 countries surveyed worldwide charge more to typical industrial customers than the UK. These included such major competitors as Japan, the United States and the Federal Republic of Germany.
- Five out of 12 European Community countries charge more to typical industrial customers than does the UK.

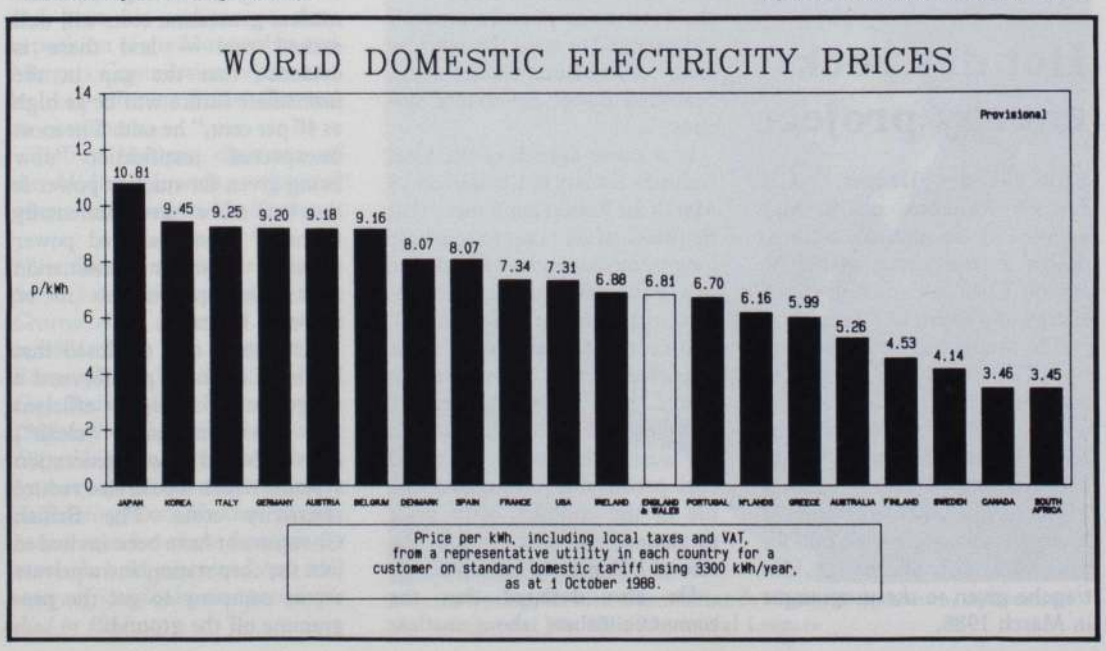
All price comparisons in the survey are based on the average price per kilowatt hour calculated on an annual basis.

Copies of "International Electricity Prices Quarterly" (Issue 88/2) are available from the Electricity Council, 30 Millbank, London SW1P 4RD, Price £20.



Above and below: tables of comparative national electricity prices based on the survey for *International Electricity Prices Quarterly*.

Reproduced by courtesy of The Electricity Council



Feasibility study on hydrogenation pilot plant

BRITISH GAS plc and the Osaka Gas Company Ltd of Japan are carrying out a joint research programme to develop a hydrogenation process to produce substitute natural gas and hydrocarbon liquids from coal.

The heart of the process is the coal hydrogenator, in which gas is produced by reacting powdered coal and hydrogen at high temperatures and pressures leaving a residual char. This is used to make the hydrogen required by the process.

The first stage of the research programme allowed tests of several hours duration with the hydrogenator processing batches of coal at a rate of up to 200 kg/hour. The results achieved during this period were so promising that it was decided to carry out a series of tests lasting days rather than hours by modifying the pilot plant to allow continuous operation.

A contract was awarded to the Process Division of Peabody Holmes to carry out a feasibility study into the engineering of the pilot plant modifications. On successful completion of the feasibility study, Peabody Holmes have been awarded a second contract to furnish the detailed design of the modification work and the preparation of procurement specifications.

Hot dry rock energy project

BARONESS Hooper, UK Energy Minister, on 8 May announced the start of a study to design a commercial system to exploit Cornwall's hot dry rock energy at a depth of 6 km.

The study will be carried out by RTZ Consultants Limited in association with the Central Electricity Generating Board, the South Western Electricity Board and Kentings Drilling Services Limited. The UK Department of Energy is allocating £466,000 for the work out of the £8.15m tranche given to the programme in March 1988.

Economy of Portugal is right for biomass energy systems

WASTE materials such as sawdust are now being developed for use in combined heat and power (CHP) generating systems by Portugal's national engineering laboratory (LNETI) in Lisbon.

The project, which is considered economically viable in Portugal because of local energy costs, has an important element of Anglo-Portuguese cooperation because it involves Sheffield University and two British companies; Noel Penny Turbines and Flow Simulation.

The use of waste materials as fuel has long been considered environmentally appealing, with research and development activity in a number of European countries — but both economic and technical considerations have meant that the pace of development has generally been slow.

In Portugal, however, the economic conditions provide the impetus to find the solutions to the technical problems, as Dr Isabel Cabrita, director of LNETI's conventional energy department explained: "Energy costs in Portugal are among the highest in Europe, and so we have a great incentive both to improve energy efficiency and to develop new energy sources."

The project has already reached the demonstration level and is now ready to launch — both for industrial heating and for power generation.

'Clean coal' power plant with FBC

PLANS to generate the first electricity in Britain from 'clean coal' using the latest circulating fluidised-bed burning technology, were announced on 27 April by Slough Estates, a leading international property company, and British Coal.

The company, who will invest some £30 million in new coal power generating plant at their Berkshire trading estate, say the scheme will enable them to 'export' up to 40 MW of electricity to the local grid depending on estate demand, as well as supplying some of the heating and processing needs of firms occupying 7.5 million square feet of space on the trading estate.

Coal chairman puts industry's challenges in perspective

BRITISH COAL chairman, Sir Robert Haslam, in March reviewed the corporation's strategy to become the supplier of choice to the privatised electricity industry and to assist the development of environmentally clean coal-fired power generating systems.

In a major speech to the Coal Industry Society in London on 13 March Sir Robert announced that British Coal are ready to conclude long-term contracts with all the new potential electricity generators, with "unique selling points" that cannot be matched by oil or imported coal. These selling points are based on secure supplies of British coal based on the sustainable price of world coal predictable throughout the life of the contract, with price escalation confined within the rate of UK general inflation.

He also declared that the economic debate about nuclear power for electricity generation is over. "It is accepted by the Government and the Central Electricity Generating Board that nuclear generation costs will well exceed coal — and there is evidence that the gap in the immediate future will be as high as 40 per cent," he said. The most unexpected justification now being given for nuclear power is that it is more "environmentally friendly" than coal-fired power stations. "Further examination shows that proposition to be flawed," he stated.

Sir Robert also disclosed that British Coal have put forward a programme for highly efficient and environmentally "clean", new coal-fired power generation systems which would also reduce electricity costs. The British Government have been invited to join the corporation and a private sector company to get the programme off the ground.

250 MWe IGCC power plant for Holland

THE Samenwerkende Electriciteits Productiebedrijven NV (SEP) in The Netherlands have announced that they have selected the Shell Coal Gasification Process (SCGP) as gasification technology for the 250 MWe Integrated Coal Gasification Combined Cycle (IGCC) demonstration power plant to be built at their Buggenum site near Roermond, The Netherlands.

The plant, which will be the first power plant in The Netherlands employing coal gasification technology, is planned to start up in 1993 and will be the largest IGCC power plant in the world.

The choice of type of gasification technology has been made on the basis of a study carried out by Comprimo, an Amsterdam-based engineering consultancy, which compared the preliminary designs for the power plant based on the coal gasification processes of Texaco, Shell and British Gas/Lurgi.

The study showed that all three processes offered good prospects for use in electricity generation, but the Shell process was preferred in this case because it offered greater flexibility in the use of different types of coal, combined with a high efficiency, and it was also felt that it would offer marginally lower electricity production costs. It was also felt that the Shell process had the advantage of flexibility for scaling up to capacities greater than the 250 MWe demonstration plant.

Dubai contract

EWBANK PREECE, the international engineering consultancy based in Brighton, UK, has been retained by the Dubai Electricity Company (DEC) to design and project manage a new gas turbine power and desalination station at Al Mamzar, Dubai. The new station will be the largest power generation and desalination plant in Dubai and will provide a total power output of about 400 MW and a desalination output of 56 million imperial gallons per day.

Leaders of industry gather at luncheon

MORE THAN 260 members and guests of The Institute of Energy, including a number of the most prominent personalities in industry and the professions, gathered at the Inn on the Park hotel near London's Hyde Park for the Institute's 1989 annual luncheon on 25 April.

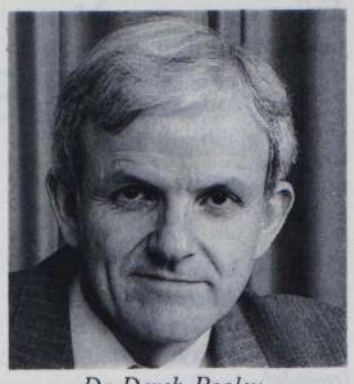
The number of guests totalled 263 and included Sir Philip Jones, Chairman of the Electricity Council, Sir Ian Lloyd MP, Chairman of the Parliamentary Select Committee on Energy, Sir Peter Walters, Chairman of BP, Mr Terry Harrison, Chairman of Northern Engineering Industries plc, Mr G A W Blackman, Deputy Chairman of the CEGB, Mr A Hadfield, Chief Executive of the Northern Ireland Electricity Service, Mr W Kerss, Chief Executive designate of the National Grid Company, and Mr A M Brown, Managing Director of GEC Turbine Generators Ltd.

The principal guest and speaker was Robert Malpas, the Managing Director of BP and Chairman Designate of PowerGen, one of the prospective electricity generation companies. Mr Malpas took as the theme for his address: *Electricity privatisation — competition is real.*

The President, C E Pugh, CBE, welcomes Lord Gregson, an Honorary Fellow of the Institute to the luncheon

The President presenting the Foxwell Memorial Award to M K Abbas of the University of Leeds

New Director for Winfrith



Dr Derek Pooley

THE UK Atomic Energy Authority Establishment at Winfrith in Dorset has a new Director, Dr Derek Pooley (Fellow).

Dr Pooley read chemistry at Birmingham University and began his research career at the California Institute of Technology in Pasadena. He joined the UKAEA's Harwell Laboratory in 1963 as a solid state physicist, eventually becoming Director of Non-Nuclear Energy Research at Harwell in 1981.

In 1983 he went to the Department of Energy as Chief Scientist, where he was responsible for advising Ministers on energy research and development and for managing the Department's research on new energy technologies, especially renewables. Dr Pooley joined Winfrith as Deputy Director in 1986 and became Director on 1 March 1989.

Midland branch honours Jim Ellis with memorial lecture

THE inaugural Jim Ellis Memorial Lecture initiated by the Midland branch of the Institute of Energy was held at British Gas West Midlands Regional Headquarters on Tuesday 25 April.

The lecture, *Gas offshore to the West Midlands market*, was presented by regional chairman Donald A Young to an audience of almost 100 members and guests of the Institute, including Mrs Ellis.

During the lecture Mr Young said Mr Ellis had worked in a fascinating period in the history of the gas industry during which considerable and dramatic changes had taken place. He said the industry today was facing an equally fascinating and exciting period ahead, one which was full of opportunity.

Mr Young also touched on the history of the industry from nationalisation to privatisation and gave his audience a clear exposition of the Monopolies and Mergers Commission report and its likely effect on British Gas and its customers.

Jeffrey Masters, chairman of the Midland branch, welcomed guests and thanked Mr Young.

**Jim Ellis served the gas industry for 49 years before retiring as East Central Area industrial manager in 1981. Born and brought up in Birmingham, Jim had joined the City Council's Gas Department in 1932 and worked all his life in the City. He was affectionately known by many of his industrial customers as Birmingham's Mr Gas. He had been a member of the Institute for more than 20 years and had held many offices during that period. He died in 1984.*

Donald Young, British Gas Midlands regional chairman, delivering the inaugurual Jim Ellis Memorial Lecture

New members

Fellow

James Allan, British Gas, Newcastle-upon-Tyne
Peter Bradwell, Cleveland County Council, Middlesbrough (*transfer*)
Barry James Cohen, Peabody Holmes, Maidstone, Kent (*transfer*)
Kenneth Alfred Cox, City Air Associates, Surrey
Clive John Hoskins, Anglo-American Clay Corps, USA (*transfer*)
Thomas Kellett, Pilkington Energy Advisors, Merseyside (*transfer*)
Dudley Robert Shelmerdine, British Gas North Western, Cheshire (*transfer*)
Charles Yves Wereko-Brobby, Minister of Fuel & Power, Ghana (*transfer*)

Member

Mark Cameron Anderson, Gloucestershire County Council
Richard Hugh Ballard, Energy Research Institute, South Africa (*transfer*)
John Benson Butler, Nuclear Power Training Centre, Avon
Nicholas Richard Carter
John Strothers Curran, Eastern Electricity, Ipswich
Allan Cameron Jordan, CEGB Midlands Region, Ratcliffe-on-Soar
Paul Edward Jeffery, British Petroleum, London
Parisima Khajehhoseini, SLR Energy Group, London
Andrew William MacOwan, Derick Sampson & Partners, Glasgow (*transfer*)
Saffa Bashir Riffat, Loughborough University of Technology
Richard Alan Siddons, British Gas, Leicester
Bernard Wai Lum Wong, Sinnett Partnership, London
Geoffrey Michael Willis, Max Fordham & Partners, London
Simon Sai-Man Yiu, University of Sheffield

Associate Member

James Mark Cannon, British Gas, Sheffield
Ian Jeffrey Greenall, Sefton MBC, Merseyside
Christopher John Roper, Hereford & Worcester County Council

Associate

Colin Michael Fitzgerald, BP International, London

Graduate

Stanley Chipeta, ZCCM Technical Services, Zambia
Charles Peter Dobb, W S Atkins Energy, Edgbaston, Birmingham (*transfer*)
Christopher Stuart Ellis, R Simon (Dryers), Notts
Jonathan Harold Ford, Property Services Agency, Bristol
Patrick Ohene-Djan, Eastern Electricity, Luton, Beds
Tom Peter Migun Ogada, Moi University, Kenya
Richard Mark Staines, Monodraught Flues, Bucks

Student

Claire Louise Bailey, Cranfield Institute of Technology
Peter Antony Bosanquet, Loughborough University
Robert L. Brown, Napier College
Annette Bunka, University of Leeds
Chee Mun Choong, University of Newcastle-upon-Tyne
Kevin James Donaldson, Napier College
David Frederick Horton, Leicester Polytechnic
Christina Mei Cee Phang, University of Sheffield
John Michael Piggott, Leeds University
Ali Radhi, Napier College
Fawzi Mohamed Salih, University of Leeds
Neil Edward Turley, Wolverhampton Polytechnic
Michael James Wardman, University of Sheffield
Allan Geoffrey Westlake, Lancashire Polytechnic, Preston
Yajue Wu, University of Sheffield

Obituary Martin A Elliott

DR MARTIN ELLIOTT, whose death at the age of 79 was reported in the March edition of *Energy World*, was one of the giants striding through the fuel research field in the United States during the exciting quarter century following the Second World War. Although his activities covered a wide range, the research for which he will perhaps be chiefly remembered was his immense contributions to the development of processes for conversion of coal to gaseous and liquid fuels.

Martin Andrew Elliott was born in Baltimore, Maryland, in 1909. His technical education was at Johns Hoskins University, where he received his Bachelor's degree in Gas Engineering in 1930, and his Doctor of Philosophy degree in Gas Engineering in 1933.

His subsequent career began as assistant to the superintendent of gas manufacture at the Consolidated Gas, Electric Light & Power Company of Baltimore (now the Baltimore Gas & Electric Company). In 1938 he moved to the US Bureau of Mines in Pittsburgh, Pennsylvania, where he rose to become chief of synthetic liquid fuels research. He left the Bureau in 1952 and moved to Chicago, where he was appointed research professor in the mechanical engineering department of the Illinois Institute of Technology. In 1956 he moved to the Institute of Gas Technology as its Director, but returned in 1961 to the Illinois Institute of Technology as a Vice President in charge of academic affairs. Finally in 1967, Dr Elliott moved to Houston, Texas, as Corporate Scientific Advisor of Texas Eastern Transmission Corporation.

Martin Elliott displayed a keen intellect and the gifts of logical thought and lucid expression. His outgoing personality was exemplified by the abilities of enthusiastic advocacy. These characteristics, together with his training and vast experience in the fields of coal research and gas supply, ensured his distinction as a top-flight researcher in a wide range of energy-related problems. Already a notable figure in coal research, he was Chairman of the 1954 Gordon Research Conference on Coal.

The breadth of his experience was nowhere more widely gained than during his years with the US Bureau of Mines. Thus, an early achievement was as the leader of the team that investigated the failure of the commercial liquid methane storage tank and the resulting disastrous fire in Cleveland, Ohio. The potential for using diesel engines for haulage in coal mines was another early subject for his attention; he made intensive theoretical and experimental studies of carbon monoxide and nitrogen oxides emissions from engines running in atmospheres containing low methane concentrations. He became a principal investigator, under H H Storch, of the production of liquid fuels from coal, and in 1950 he made a study of synthetic fuel processes and the production of fuel gases in the major European countries.

An illustrious personality in any field receives many awards, and Martin Elliott was no exception. Particular mention can be made of the presentation in 1952 by the Secretary of the Interior with the Distinguished Service Medal — the highest award of the Department of the Interior — in recognition of his achievements at the US Bureau of Mines, the Percy Nicholls Award of the Fuel Division of ASME and the Coal Division of AIME for his contribution in the field of solid fuels (1967), and the first presentation by the American Gas Association of the Gas Industry Research Award for his numerous contributions in synthetic gas research.

Raymond Hoy

Appointments

Antonio Cardoso e Cunha is Commissioner for Energy in the new European Commission which took up its responsibilities in January 1989. He is a former Portuguese Minister for Agriculture and Fisheries and was appointed as Commissioner with special responsibilities for Fisheries after Portugal joined the European Communities in January 1986.

Sir Denis Rooke CBE FRS FEng (Honorary Fellow), Chairman of British Gas plc, has been appointed as Chancellor of Loughborough University of Technology. Sir Denis will be the third Chancellor of the University.

David Wood (Member), chief executive, is to head the new Mechanical and Electrical Division of Sir Alexander Gibb and Partners, international consulting engineers. The new division will more effectively coordinate the work in-house and with GIBB's other civil, building or architectural divisions to provide clients with an integrated approach.

The future for electricity — the challenge of change

by Sir Philip Jones, CB, Chairman, The Electricity Council

THE impending privatisation of the electricity industry will be the biggest privatisation ever. Big because in England and Wales alone, the industry has net assets of £37 billion; employs 130,000 staff and supplies 22 million customers.

In previous privatisations like BT and British Gas the existing organisation was taken as it stood. In the case of electricity the industry will undergo a radical restructuring before it is privatised. Why? In the words of the Americans "if it ain't broke don't fix it". The industry certainly isn't broke, indeed it is highly profitable and has been the envy of many countries abroad. Why then privatisation? Simply the belief that companies operate better and give better service when in the private sector, freed of the controls of Whitehall. This is not something you can prove one way or another. It is very much a question of one's political belief.

The proposed structure has been dictated by the problem of nuclear power,

The recent rapid progress of the Electricity Bill through the House of Commons together with an early second reading in the House of Lords leads one to presume that the completion of the legislative process that will 'privatise' the electricity supply industry is now imminent. In a recent address to the Energy Industries Club, Sir Philip Jones, the current Chairman of the Electricity Council, expressed his views on the future of the industry under its prospective new structure. The following article is based upon this address.

to which I shall return later, and the wish to complete the sale of the industry within the lifetime of the present Government. Whether this last can be achieved remains to be seen. I am however clear that, but for nuclear power, the Government would have preferred to split the CEGB generation activities into three or four separate companies in order to obtain more competition at the outset.

If the industry could not be privatised as a single corporation, and the Government made it clear at the outset that they would not contemplate this, then I believe that they were right to transfer the obligation to supply to the distribution side of the industry — I personally would not have had 12 distribution companies — and to take away the control of the grid from the CEGB.

Transferring the obligation to supply, taking away the control of the grid together with the splitting of the CEGB in order to introduce competition in development were, in my view, all desirable features once the initial premise of privatisation had been accepted. The structure of the industry has for a long time left much to be desired — it has been dominated by the CEGB which effectively operated on a cost plus basis with 12 captive customers, the Area Boards.

The industry has up to now been producer rather than customer led with the Electricity Council trying unsuccessfully — because it did not have adequate powers

The author

SIR PHILIP JONES has been Chairman of the Electricity Council, the central policy formulating body of the electricity supply industry in England and Wales, since 1983. In this position he is directly responsible to the Secretary of State for Energy.

A graduate of Jesus College, Oxford, Sir Philip began his professional career in the Civil Service in 1955 after two years' military service in the Royal Artillery. His first post was as an Assistant Principal at the Ministry of Supply. Four years later he was promoted to Principal at the Ministry of Aviation.

From there his career progressed with successive senior appointments at the Treasury, at the Ministry of Aviation, where he was Principal Private Secretary to the Minister, at the Ministry of Technology and at the Ministry of Aviation Supply. This phase of his career culminated in his appointment as Under Secretary and Director General, Concorde, at the Department of Trade and Industry.

His next appointment, in 1973, brought Sir Philip into direct association with the energy sector for the first time when he became Under Secretary, Electricity Division, at the Department of Trade and Industry, a position which was subsequently moved to the Department of Energy. This was followed in 1976 by his appointment as Deputy Secretary with responsibility for energy policy and energy conservation.

In 1980 his responsibilities became oil and gas policy and UK Continental Shelf operations.

He was made a Companion of the Most Honourable Order of the Bath in 1978 and received a knighthood in the 1986 Queen's Birthday Honours.

In addition to his responsibilities as Chairman of the Electricity Council, Sir Philip was, until recently, Chairman of British Electricity International Ltd, the company set up by the UK electricity authorities to provide a consultancy service throughout the world.

Sir Philip was Chairman of the Nationalised Industries Chairmen's Group in 1986/87, and was a member of the British Overseas Trade Board for three years to September 1988. He serves on the Executive of the British National Committee of the World Energy Conference and is also a member of the Bureau, Directing Committee and European Communities Committee of UNIPEDE (the Union Internationale des Producteurs et Distributeurs d'Energie Electrique). He is Honorary Vice-President of Opportunities for the Disabled and a Member of the Court of Governors of the Henley Management College.

— to hold the balance in the middle. The industry, if you like, has been dominated by the wholesaler rather than the retailer. I cannot think of any other industry where that pertains. It is in my view certainly not desirable.

At present, the Area Electricity Boards have to buy the electricity they require from the CEGB at Bulk Supply Tariff rates. As generation costs account for about 80 per cent of the final price of electricity, their scope for reducing prices to customers has been strictly limited.

But, after privatisation, the public supply companies will contract for the cheapest power available from generators at any one time. Obviously, the generators will have the clearest incentive to produce electricity as economically as possible and the public supply companies will wish to take power from the cheapest sources.

Additionally, any large customer will be able to contract direct with generators, including independent and other suppliers who will be on an equal footing with the successors to the CEGB and the Area Boards.

Competition in generation

The most significant effect of this restructuring will be to introduce competition into generation and place the key strategic decisions largely in the hands of the new public supply companies who, because of their obligation to supply will have to assess current and future demand in their areas and ensure that they contract for sufficient capacity to meet that demand. The purpose of this will tip the balance away from a producer-led industry to a customer-led market place.

Some have argued that in just splitting the CEGB generation into two you are simply creating a duopoly instead of a monopoly and duopolies are just as bad. More competition would certainly have been desirable. It would however be unrealistic to expect perfect competition on Day 1.

What is important is to create the climate for competition and for competition to grow and this, I believe, the Government have done. Nor should we in any case underestimate the amount of competition there will be on Day 1. National Power and PowerGen will be competing against each other, against nuclear electricity imported from Scotland and France, against other independent generators and against the public supply companies themselves.

Within National Power and PowerGen there will be a sharper emphasis on competition. The generating companies, for instance, will run each of their power stations as a profit centre with the station manager accountable for its performance. In future, each individual power station will be selling its output to public supply companies at the station fence, perhaps on a set by set basis. Different sets may be contracted to different customers. Some output may also be sold to large industrial customers using the grid system as a common carrier. All of this means that power station managers will have an even greater incentive than now to scrutinise their station's costs, and to explore opportunities for savings.

So the pressure on reducing costs and maximising performance is now on in earnest as the two major generators address the challenge of making their plant competitive to keep their share of the electricity market.

The national grid

The new National Grid Company will be owned jointly by the public supply companies and act as a common carrier. You can argue that it might have been better if the grid remained owned by the Government or floated as a separate company. What I do not think one can seriously entertain is that the grid — a national asset and system — should be owned by one private generating company which would have little interest to encourage other generators to use its system.

The grid will still operate as an integrated network, instructing power stations to supply on a merit order basis, but it will be a merit order based on quoted prices and, not, as before, on costs.

The National Grid Company proposes to call on stations to generate on the basis of prices they quote to supply electricity. To fulfil their obligations to supply, the public supply companies will need a portfolio of generating contracts to cover their basic energy requirements and capacity demands throughout the year. Each direct contract will specify a price for energy and a price for capacity. There will, therefore, be direct contracts between the generators and suppliers with separate contracted arrangements for use of the transmission system.

Under the new arrangements, generators will receive the contract energy price for units taken under the contract. However, the generator will be able to subcontract production of units to any generator which can supply more cheaply. The most efficient way for this to happen would be to create a generators' pool run by the grid company. Generators would bid published prices to the pool and the station with the lowest bid would be dispatched first, followed by the second lowest and so on until total demand on the pool is satisfied. Supply companies would benefit from the pool by being able to negotiate finer terms in their contracts in the light of the published bid prices.

The National Grid Company will use all these contracts to dispatch power in an order related strictly to the lowest price available. As generators may wish to vary their price offers for energy supplied from those they have quoted in their contracts, this will mean that the National Grid Company will look closely at how a spot market for electricity trading can be developed. Competition in this way should serve to drive prices downward and benefit customers. These arrangements are a far cry from the Bulk Supply Tariff. They are undoubtedly very complex. But they can and will, I am sure, be made to work.

Nuclear power

One area where the free run of market forces will not operate is nuclear power. For reasons of security and diversity of supply in the national interest, the Government intends that public supply companies shall be obliged to take between 15 and 20 per cent of electricity from non-fossil fuel sources, at least until the turn of the century. In reality, this means largely from nuclear sources. This obligation is termed the Non-Fossil Fuel Obligation. To ensure that all customers contribute to the additional cost of meeting this obligation a levy will be imposed on all suppliers.

This is clearly a distortion of the market as it means that supply companies will not be totally free to obtain their electricity from whatever source they wish without incurring an added cost penalty. It is perfectly right and proper for a Government to take a view in the national interest but one can argue about whether that interest should be reflected as a cost to the taxpayer or to the electricity consumer.

At the heart of the matter is whether private companies, given a free choice, would invest in nuclear. For a given amount of electricity generating capacity, a nuclear station costs about 1.7 times as much to build as an oil or coal-fired station. In a privatised industry, funds come from shareholders and from loans, and both expect a reasonable level of return. The current real rate of return on nuclear is certainly lower than the eight or nine per cent plus expected in the private sector. This has obvious implications for the funding of nuclear power. The CEGB, for instance, believes that its proposed Hinkley Point 'C' pressurised water reactor would be substantially cheaper than new coal stations at the 5 per cent real rate of return previously set by

the Government for nationalised industries.

It would also be competitive with a new inland coal station at a real rate of return between 7 and 8 per cent. For a 10 per cent return, a new nuclear station is likely to be more expensive than a coal based alternative, unless coal prices are sustained at high levels.

Financial analysts are, not unexpectedly, cautious in assessing the financial risks associated with nuclear power, not only on the grounds of their current economic performance but also regarding the unquantified cost of their eventual decommissioning. Although the Government is willing to provide up to £2.5 billion as a protection against any future government policy change on the safety and environmental front, National Power which will operate the nuclear capacity in England and Wales is keen to have as many unpredictable risks as possible underwritten by the Government before it offers itself to the market.

Nuclear power is now on trial. It is no longer being argued on economic grounds but on diversity of supply and beneficial effect on the environment. Nuclear power will be ring fenced and separate accounts maintained.

Price regulation

Prices, generally, in the newly privatised industry will be regulated by a Director General of Electricity Supply on the grounds that the public supply companies will largely remain a natural monopoly. Annual price increases by public supply companies will be regulated on the basis of a Retail Price Index −X+Y formula. 'X' will be an efficiency factor designed to put direct pressure on supply companies' own costs and may be applied at different levels to different supply companies. The 'Y' factor will determine the extent to which changes in generating costs may be reflected in prices.

In setting the 'Y' factor, the Government and the Director General of Electricity Supply will seek to ensure that this not only provides an adequate incentive to supply companies to seek supplies at least cost, but also ensures that the customer benefits.

Customer protection will be a major part of the Director of Electricity Supply's role. He will, for instance, oversee a new national scheme to compensate domestic customers who are affected when standards fall below agreed levels. This will mean new rights for electricity consumers with 'money back' schemes where standards are not met.

The result of all these proposals will be to create a new climate of competition in which electricity generators and suppliers will need to be even more responsive to customer needs and market opportunities if they are to succeed.

Effect on fuel industries

The fortunes of the electricity industry of course affect the fortunes of the other fuel industries, namely coal and gas. Already there is added pressure on coal prices and this will continue. Gas, especially its use in small combined-cycle plants, is looking increasingly attractive as generators and suppliers examine the benefits of smaller, more flexible plants with less environmental impact.

The revolution in attitudes resulting from re-structuring is already underway. The key question is — will it work? Well, I am certain that the lights will stay on. The benefits really depend on how much competition in generation actually materialises. There is a lot of interest at the present time — some 20 private generators ranging from Thames Power consortia's 1,000 megawatt gas-fired station at Barking to British Coal's 200 megawatt fluidised bed coal-fired plant proposed in association with the Area Board in the East Midlands. Although we cannot be sure how many of these projects will come to fruition, the greater the amount of competition the greater the downward pressure on prices.

It might be difficult after the event to demonstrate to what extent the effects on customer prices and service standards have flowed from privatisation or whether they would have occurred without it. What is clear is that the onset of privatisation is already bringing a change of attitudes.

The CEGB are now saying they can no longer operate on a cost plus basis.

Area Boards are tumbling over themselves to agree things which, in the past, they would have found impossible.

A more entrepreneurial approach is developing and, as I have indicated, the possibility in the longer term for competition in generation.

Tomorrow's electricity industry will undoubtedly be a different industry than it is today. It will certainly be a heavily regulated industry, regulated on everything from prices to standards of service. Looking at the powers of the Director General of Electricity Supply, it may not be long before some come saying: "Come back the Department of Energy and the Electricity Council — all is forgiven". Hopefully, it will be an industry providing an even better service, more responsive to customers' needs and a leaner and more competitive industry. Certainly it will be one which, as now, will give all the other fuels more than a run for their money. □

Electricity privatisation — its impact on technology

Lewis Tozer, Fellow, Inst of Energy, looks at some of the issues and options

WITH the passing of the Electricity Bill in the House of Commons and a second reading in the Lords in April, the Government's proposals to privatise the electricity supply industry are well on course to become law by July 1989.

The next important day after that is Vesting Day, probably, 1 January 1990. On that date, the 12 area boards will become 12 distribution plcs, the CEGB will be split into two generating companies — National Power and PowerGen — and its transmission division will become a separate company — National Grid — which will manage its own affairs on a day to day basis, but owned ultimately by the distribution plcs. In Scotland, two new companies will replace the South of Scotland Electricity Board and the North of Scotland Hydro-Electric Board.

Early in 1990, shares in some of the companies — probably the distribution companies — will be offered for sale to the public; this will be flotation day for the companies affected and all being well they will then have formally entered the private sector. Because the value of the electricity companies is so large, and because there are different types of companies to be sold, it is liiely that there will be four separate flotations — of the supply plcs, National Power, PowerGen and the Scottish plcs — at different times. So it may not be until late 1991 that the last company comes to the Stock Market. All the companies will function as plcs as from Vesting Day but they will be owned by the Government until the flotation date eventually selected for each company.

Licence to supply — with a money back guarantee

The idea that electricity customers will be legally entitled to have their money back if specified standards of service are not provided by suppliers is one of the features of the Electricity Bill. The money back guarantee reflects the Government's declared intention that privatisation must restore the balance of priority in the direction of satisfying customers' interests rather than those of producers. The Government's strategy is based on the premise that competition will make producers strive for greater efficiency in the interests of their customers. To make sure this happens, a Director General of Electricity Supply will be appointed who will enforce the terms and conditions of licences issued to the companies.

Draft licences were published in January this year covering the generation, transmission and supply of electricity in England and Wales. Of the four basic types of licence, that relating to the supply of electricity by the area boards' successors obliges a licensee to purchase electricity from the most economic sources. The supply companies will therefore have a direct incentive to shop around for the cheapest source of electricity — privately generated, that from National Power, PowerGen, the Scotish companies, AEA and EDF, as well as that which they may choose to generate themselves. A supply company licence will impose a limit on the amount of generating capacity which the licensee may own, or have an interest in, amounting to 15 per cent of a supplier's total contracted capacity. Any generating venture in which the supplier has the controlling interest — more than 50 per cent — will be treated as wholly owned. Otherwise, it will be the supplier's percentage interest that counts towards the limit.

A great deal of scope is therefore available to the supply companies to exploit a range of energy sources and technological solutions to fight the competition battle. An overview of the restructured, privatised electricity industry, compared to the former structure can be seen in Figure 1.

Independent suppliers

The Secretary of State for Energy recently reported that 20 proposed independent power projects, totalling over 5000 MW of new capacity, were in prospect. As the supply plcs will be permitted to install and own up to 15

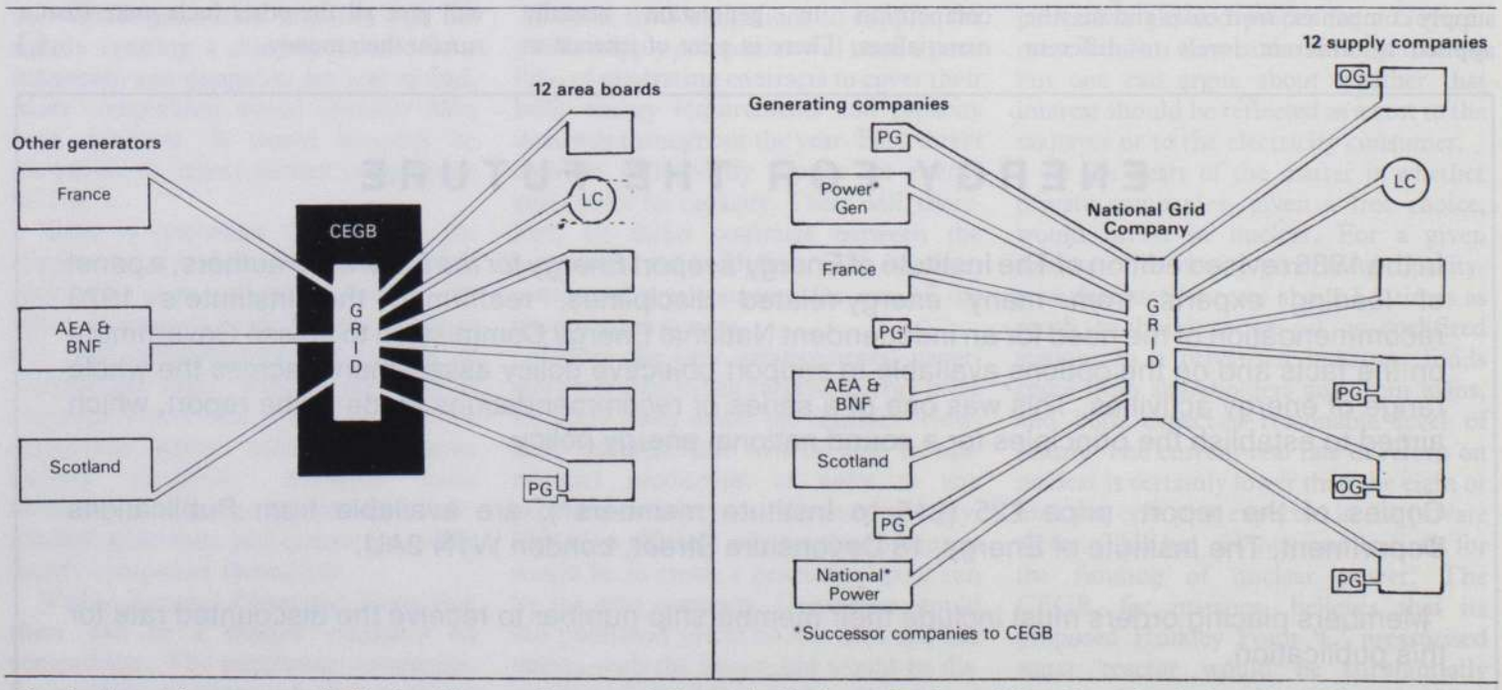


Fig. 1: above left, structure of UK electricity supply system before privatisation and, above right, after privatisation. Key: PG — private generation, LC — large customer, OG — Own generation distribution company.

per cent of their contracted capacity — 7000 MW in terms of their 1987/88 maximum demands — there is clearly a potential opportunity for at least 12,000 MW of new plant to compete with the output of National Power, PowerGen, the Scottish companies, the AEA and EDF. The suggested 12,000 MW of new plant represents a considerable contribution to the CEGB's estimate of new capacity requirements of some 15,500 MW by the year 2000. But a cautionary note is necessary — the CEGB's figure will have to be revised downwards if the pressures to conserve and use energy more efficiently become mandatory unless there is, of course, a compensating upward movement in the national economy.

The first casualties

One of the immediate effects of these various possibilities has been the recent announcement by the CEGB that it has abandoned plans for a £1300 million, 1800 MW coal fired power station at Fawley. The CEGB was unable to secure the necessary assurances that the output would be taken up by the embryo supply plcs. At the time of writing, it is generally thought to be unlikely that the CEGB will proceed with similar installations at West Burton in Nottinghamshire, and at Kingsnorth in Kent. West Burton was to have been assigned to National Power and PowerGen was to have inherited Kingsnorth. A further consequence of these cancellations is that Northern Engineering Industries and General Electric Company will suffer setbacks. They had boiler design and turbine design contracts respectively for all three stations.

Renewable sources

Energy Paper Number 55, which considers 'Renewable Energy in the UK', ranks wind energy as one of the most promising of the renewable sources for generating electricity. The longterm technical potential for onshore generation is estimated to be 45 TWh/y and that for offshore generation 140 TWh/y. The CEGB has been interested in assessing the reliability and cost of wind turbines since 1981. In February this year, the Secretary of State for Energy was asked to consent to the construction of two wind turbine generators at Carmarthen Bay. A test installation can be seen in Figure 2. Their 830 kW capacity will be connected to an existing South Wales Electricity Board 11 kV overhead line. Presumably, in suitable circumstances, wind energy is now judged by the CEGB to be a potentially viable and competitive generating technique, set against the background of privatisation, and can be expected to receive increasing attention.

In March 1988, following disclosure of the Government's privatisation plans, Lord Marshall announced the CEGB's intention to produce electricity from Britain's first wind "parks" and from the world's first offshore wind turbine. The three wind parks, each with 25 wind turbines generating some 8 MW, hopefully in 1993, will be located in Wales, the South West, and the Pennines respectively. The £28 million wind parks' programme is to be jointly funded by the Department of Energy and the CEGB. The £2 million offshore 750 kW wind turbine is a collaborative, prototype project by the Department of Energy, the CEGB, Eastern Electricity Board, the turbine manufacturers and the EEC. It will be located off the north Norfolk coast.

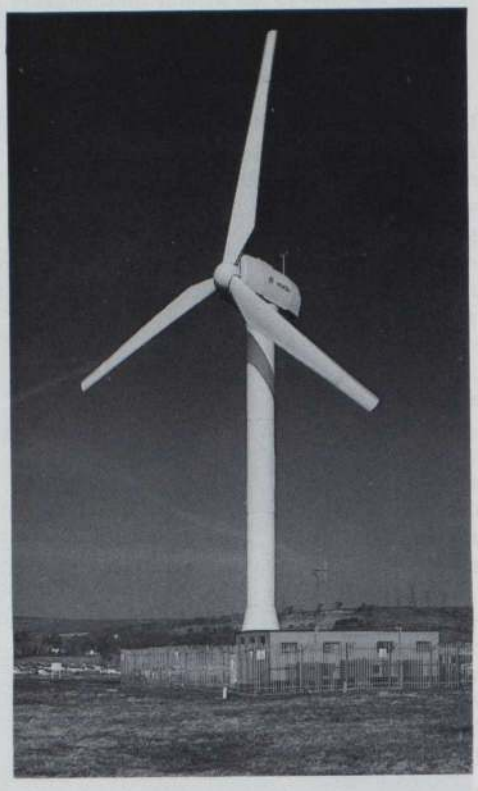


Fig. 2: the three-bladed 300 kW wind turbine generator currently operating on a CEGB site at Carmarthen Bay, South Wales. The machine was designed, built and installed by James Howden and Company Ltd of Scotland.

Also, in February 1988, it was announced that site work would start on a new wind turbine installation at Richborough power station in Kent. The turbine will have a maximum capacity of 1 MW and will feed the South Eastern Electricity Board network. In Lord Marshall's words: "If all goes well, the wind will give us some 1000 MW of economic electricity generation early next century".

Energy Minister, Baroness Hooper, when announcing a study to be undertaken by NORWEB and ETSU into electricity generation from renewable sources in December 1988, said: "This is a significant example of how the Bill to privatise electricity is already beginning to affect attitudes within the electricity industry". The study will examine the possibilities from wind, biofuels, geothermal, hydro, wave and tidal energy and is expected to take six months. The Minister went on to say: "If this study shows economic potential, which I am sure it will, it will pave the way for other distribution companies to follow".

At the 1988 conference of the British Wind Energy Association it was suggested that energy could be sold profitably for about 2.6p/kWh. Speaking at the conference, the Chairman of Eastern Electricity Board, James Smith, commented that he hoped wind would play a full part in helping the supply companies to meet their responsibility for the supply of electric power as well as for its distribution. Small, well proven windmills, each of a few hundred kWs capacity, arranged in farms offshore off the Norfolk coast would seem to be the preferred Eastern Board approach.

Eastern Board is also interested in the possibility of purchasing power generated from landfill gas. There are sites in the Board's area which have become a nuisance and they could be exploited.

A relative newcomer among renewable sources for power generation has been welcomed by East Midlands Electricity Board recently. It is an initiative based on the use of farm crops. Small trees, four or five years after planting, would be harvested and converted into electricity for sale to local distribution companies.

CHP — a view from the top

Energy Secretary, Cecil Parkinson, has acknowledged that there is considerable potential and scope for combined heat and power installations. The privatisation proposals would, in his opinion, create for the first time, conditions which would allow CHP schemes to proceed on an equal basis with conventional generation. The proposals would also open the way for CHP to become a "successful competitor in supplying electricity".

Non-industrial CHP

Reports circulating in 1987 put the total installed capacity of CHP systems in non-industrial buildings at around 7 MWe. The figure at the end of 1988 had risen to 20 MWe. A recent ETSU commissioned study of the market for CHP in non-industrial buildings concluded that over the next nine years, new CHP plant with a total generating capacity of 320 MWe could be installed cost effectively at some 4000 sites. Prime candidates are hospitals, residential establishments, leisure centres, high rise flats, sheltered housing and hotels requiring, in all, some 7600 units. Suggested sizes range from 15 kWe to 440 kWe.

Industrial CHP

The market for larger, industrial type, CHP plant is one which is likely to grow. At the present time, some 150 industrial companies are thought to operate CHP plants. The increased availability of gas, the development of 'clean coal' combustion technology and combined cycle generating techniques, coupled with the facility to sell electricity via National Grid, could lead to fairly rapid change.

A recent example is that of Tunnel Refineries Limited which has signed a ten year, £50 million contract for power and heat to be produced from two 6 MW gas turbine generators linked to two new waste heat boilers working with an existing, steam turbine driven 2.2 MW generator. Surplus electricity will be made available to London Electricity Board and during breakdowns or maintenance of the

new plant, electricity will be imported from the Board. Emstar, a subsidiary of Shell UK, will install and operate the plant at the Greenwich refinery.

Plans to generate the first electricity in Britain from 'clean coal', using the latest circulating fluidised-bed burning technology, were announced by Slough Estates and British Coal at the end of April. The £30 million scheme will enable Slough Estates to make available up to 40 MW capacity to the local electricity grid depending on estate demand, as well as supplying some of the heating and processing needs of firms on the trading estate.

British Coal say it will be the first time in the UK that a combined heat and power station has used this type of 'environmentally friendly' coal burning technology. It will also be the first coal fired plant in this country designed to meet new EEC regulations in relation to sulphur and nitrogen emissions.

Another interesting, but slightly less conventional, CHP innovation has recently been announced by the North West Water Authority. CHP plant for ten effluent treatment works has been ordered. Gas engines, fuelled by sludge gas, will be used to provide heating, lighting and pumping. Surplus power will be taken up by the national grid.

City CHP

Large scale CHP is unlikely to develop widely until substantial, high density heat loads with suitable demand characteristics can be exploited. The most promising opportunity would be space and water heating for domestic and commercial premises supplied via district heating schemes. In the absence of a regionally, if not nationally, based approach to formulating energy policy, it is difficult to see how district heating will receive the necessary political push. Fortunately, the Government has provided resources to support feasibility studies of city CHP schemes in Belfast, Leicester and Edinburgh.

The Leicester Project

A large scale CHP/district heating scheme is, in fact, being pursued by Leicester Energy Limited, a company in which the CEGB is one of ten shareholders. The company will negotiate contracts for the construction of the project, the purchase of fuel and sale of electricity, and the sale of heat in the form of steam and hot water to industrial and public sector customers. The proposal includes up-rating the existing gas turbines at Leicester power station and adding new gas turbine and steam boiler/turbine plant. Investigations into further possible CHP schemes in Sheffield, Tyneside and London are continuing with the CEGB's full cooperation.

It is just possible that the Electricity Bill may, conceivably, if unintentionally, have provided a helpful stimulus to these interesting developments. It is interesting to note, in passing, that district heating in Germany for example accounts for 8.5 per cent of the heating load. European Commission pressure on member states to reduce atmospheric pollution and energy consumption could also help to stimulate the political will.

Fig. 3: a modern refuse incineration CHP plant located near Munich, West Germany.
Picture courtesy of Asea Brown Boveri

Private generators

A number of companies have announced plans to operate private power stations. Thames Power Limited is planning a 1000 MW gas fired, combined cycle plant at Barking and other, similar, stations are envisaged. S & W Berisford, the parent company of British Sugar, and Yorkshire Electricity Board are exploring the possibility of building a 140 MW power station at Brigg, South Humberside, alongside an existing sugar beet factory. Fuelled by natural gas, a combined cycle plant is likely to be favoured.

The Energy Minister, Peter Morrison, has announced approval for a new 355 MW station to be built at Peterborough by Hawker Siddeley. Combined cycle gas turbines will use gas supplied by British Gas.

Unlike North Eastern Electricity Board whose strategy is to buy in all the power it needs, East Midlands Electricity Board is interested in generating a considerable proportion of its electricity demand. The board has in mind a 350 MW gas-fired, combined cycle installation at Corby, costing about £120 million. In addition, EMEB anticipates obtaining power from a combined cycle gas-fired plant at Leicester with a capacity of 194 MW. Bilsthorpe Colliery, in the EMEB region, has been identified as the most promising site for a possible new power station in North Nottinghamshire. EMEB and British Coal have appointed financial advisers and engineering consultants for the project which is likely to have a capacity of 200 MW.

British Coal is also studying possible sites for a chain of pithead power stations to supply power to the privatised electricity market in the 1990s. In addition to Bilsthorpe, an adjacent pit at Rufford is favoured. A plan to improve British Coal's fluidised bed combustion technology, using a new 'topping cycle', in association with Ahlstrom Pyropower Limited, is expected to bring lower generating costs resulting from a suggested 20 per cent increase in efficiency over that from pulverised fuel plant fitted with flue gas desulphurisation equipment.

South Eastern Electricity Board has commissioned feasibility studies for a 100–200 MW station using either coal or natural gas. The final choice is likely to be between a coal fired plant with circulating fluidised bed boilesrs or a combined cycle gas turbine unit. Other opportunities for generating power in its supply area are also being considered.

National Power

The haste to move away from very large coal fired units — 900 MW in the case of the abandoned plan for Fawley — to smaller combined cycle gas turbine units stems from a number of factors. Many of the area boards were never really happy for example with the 'bigger must be better' plant philosophy adopted by the CEGB. Now that the boards, as plcs after privatisation, will take over responsibility for supply from the CEGB, as well as retain their former responsibility for distribution, the drive is on to broaden and, hopefully, to cheapen the supply options. Major capital expenditure decision making has effectively been transferred therefore to the supply plcs from the CEGB and hence from its successors, National Power and PowerGen.

The other major factor to enter the arena is that until recently an EEC directive precluded the large scale use of gas for electricity generation. This is no longer the case. It is not surprising therefore that the new found freedom that boards and others have savoured and contemplated has encouraged them to jump on the 'short build time — high efficiency' plant bandwagon that gas offers. The CEGB has been forced to follow suit in order to be able to compete.

Graham Hadley, CEGB Secretary, has commented: "In future, it will be important for the successor generating companies to be able to offer the distribution companies a balanced portfolio of plant options from which to select their requirements. There was almost certainly going to be an increased role for gas turbine plant. The days when planting programmes were determined by one main player are fast drawing to a close, but given National Power and PowerGen's breadth of engineering experience, they will be well placed to offer the full range of options and to compete effectively with potential new entrants to the generating business".

To reinforce Hadley's message, National Power is seeking Government approval to build combined cycle gas turbine power stations at Killingholme on South Humberside, and at Little Barford on the border of Bedfordshire and Cambridgeshire. Each station would be constructed in modules of about 340 MW. Three modules would be installed at Killingholme, and two at Little Barford. It is expected that the stations would burn natural gas with possibly some limited use of distillate oil.

PowerGen

Robert Malpas, Chairman-designate of PowerGen, has declared himself to be a great supporter of energy efficiency particularly in the area of energy use. In his opinion, energy use should form the basis for developing energy policy. At a meeting of the Fellowship of Engineering he identified barriers which act contrary to the attainment of greater energy efficiency. He cited: "Investments in electricity generation are based on long lead times: utility rates of return require payback periods of 15 to 20 years or more. On the other hand, decisions affecting energy demand, taken daily by millions of individuals and corporations, are based on very short payback periods of three to six years. There is no way at present to reflect in these decisions their long term consequences both for future supplies and the ecology".

The idea of positively assisting the introduction of incentive schemes to promote the installation of energy saving measures, in a way rather similar to that adopted by some US utilities, suggests that the Privatisation Bill and the choice of Robert Malpas as Chairman of one of the main private generating companies, could produce some interesting, if not surprising, repercussions. In the meantime, Mr Malpas' company is taking positive steps to ensure that the lights do not go out — a fear expressed in some quarters — and is pursuing the possibility of building Britain's first power station to be supplied directly from a North Sea gas field.

PowerGen has an arrangement with a group of oil and gas companies led by Ranger Oil (UK) Limited to convert the existing oil fired power station at South Denes, Great Yarmouth, to a modern, combined cycle gas turbine plant. The scheme includes the construction of a new pipeline to give access to dedicated gas supplies from the Anglia Field and possibly other North Sea fields. Under the privatisation proposals, South Denes will become the responsibility of PowerGen, which will own some 30 per cent of the CEGB's current generating capacity.

Subject to government consent, PowerGen plans to install 1000 MW of gas-fired combined cycle plant on the Killingholme site, alongside the National Power installation referred to earlier. Consent is also being sought to install 700 MW at Rye House, Hertfordshire, and a further 1000 MW on the Marchwood site, near Southampton. Another scheme based on the use of natural gas imported from Russia via a new pipeline which would connect into the existing 4000 km pipelines supplying West Germany from the gas fields of Siberia has been suggested. The intention would be to use the gas in a new 600 MW PowerGen station on the CEGB's Richborough site.

British Coal's fluidised bed technology never sat really comfortably alongside the CEGB's big plant philosophy and the CEGB pulled out of its involvement in the project some while ago. But the prospect of using the 'supercharged' version — British Coal's "topping cycle" in which gases produced by a pressurised combustion process have their temperature boosted by the addition of gas from a separate coal gasification system — has won support from PowerGen.

Conclusions

Whatever arguments may persist about the political wisdom of privatising the electricity supply industry, it is apparent that the act of privatisation has, in fact, released new enthusiasms and positive attitudes towards exploiting new opportunities. It is perhaps fortuitous that the move to privatisation has coincided with renewed pressures to use energy more efficiently and with urgent demands for reduced environmental hazards.

Among non-fossil sources of energy, nuclear is intended, by Government decree, to provide 20 per cent of electricity demand. The use of renewable energy sources is also being encouraged and, of these, wind power can be expected to grow quite quickly in the short term. The prospects for CHP and district heating are encouraging and it is to be hoped that the incineration of refuse will be taken on board.

But the smart money is rapidly gravitating to combined cycle gas turbine generation. Even Rolls-Royce and Northern Engineering Industries have proposed a merger of interests to exploit gas turbines within the newly structured electricity supply industry. □

The author

Lewis Tozer is currently the head of an independent engineering consultancy specialising in technology transfer and information transfer with particular reference to energy and advanced manufacturing technology. He has been involved recently in projects commissioned by the UK Department of Energy and the Electricity Council as well as undertaking international business development activities related to the planned 1992 European Common Market.

A Fellow of The Institute of Energy since 1971, Mr Tozer established his consultancy practice following a 20-year career with the Electricity Council (1966–1986), where he was a consultant to area electricity boards and their industrial customers on technical/economic aspects of energy generation, conversion and use in industrial processing and manufacture. At one stage he was involved with feasibility studies of and economic appraisals on numerous combined heat and power/district heating proposals.

He entered the energy industry as a result of the 1947 energy crisis, when he joined Babcock & Wilcox Limited and became a project design engineer. In 1956 he joined the electricity supply industry as a boiler plant development engineer with the British Electricity Authority in London, subsequently transferring to a similar position with the CEGB on its creation in 1958. In this role he was responsible for design studies and economic evaluations of new steam generating concepts for conventional and nuclear power stations.

From 1961 to 1966, Mr Tozer was with Bailey Meters & Controls Ltd as sales manager, with responsibility for the company's sales/marketing in the UK and abroad.

Electricity privatisation — an historical appreciation

by John Bindon, C Eng, F Inst Nuc E, M Inst E

To provide a complete understanding of the issues surrounding electricity privatisation, one feels that the setting of this issue against its historical background is essential. In the following article, John Bindon, who worked for many years as a senior engineer in some of Britain's major power stations, provides a brief account of the history of the electricity supply industry in Britain since 1881.

THE FIRST public supply of electricity anywhere in the world was introduced in October 1881 in a small village street in Godalming in the county of Surrey, England. A small water-powered generator was installed by a German owned company, Siemens, to illuminate two or three streets and to supply a few private consumers.

The electric lamp had not been fully developed and so the lighting in Godalming was poor and often erratic. Nevertheless, it was the beginning of what in Britain and around the world was to grow into a massive industry, providing an essential need for society. An 'Energy for Life'. It would provide our modern day society with a greater standard of living than had ever been experienced by the mass of the population before.

The first steam-powered electric generators were located at a station at Holborn Viaduct in 1882, the brain-child of Thomas Edison of the electric lamp fame.

The first Electric Lighting Act of Parliament was enacted in 1882. Before that time it was an offence to break up a street in town or village for any purpose whatsoever. In the early days of electricity supply, cables actually ran along the gutters of the streets where electricity was installed. Gas, although more for the large town, where coal was available to produce the supply, was the dominant fuel for many purposes, including lighting. It was much cheaper to install and use than electricity.

The advantages of electricity after 1882 were fast becoming apparent as more ambitious men staked their commercial future on the new discovery. It is a lesson, that is as true today, that all new discoveries need people of courage to develop them for the good of all. It does not depend, nor should it, on monolithic organisations.

Rapid growth

In the years from 1882 to 1900, electricity generation increased until by the turn of the century, some 38 million units of electricity were being produced, mainly for lighting. Long distance transmission was not then feasible. Furthermore, private companies were often discouraged because of the intense competition from gas.

One major reason which caused a slow down in finding private money for electricity expansion, came from the nature of the 1882 Electricity Bill. This contained a clause which was called The Reversionary Purchase Clause, and by its provisions, discouraged many investors. It gave local authorities the right to purchase a private electricity company after 21 years from installation.

In a later Act of 1888, this was extended to 42 years and this did encourage private investors to build and install power plants. However, one discouraging feature of the 1888 Act, was that it did not allow such undertakings to take electricity supplies outside their immediate area.

As the number of electricity companies grew, so did the diversity of electrical systems. Some generated *ac*, some *dc*, all with a wide range of voltage and frequency which precluded interconnections.

Obviously, as the number grew, some further legislation became necessary. In 1909, undertakings were licensed for the first time to provide bulk electricity supplies outside

An artist's impression of the first electric street lighting in Godalming, England, reproduced in the *Graphic* dated 12 November 1881.

The author

John Bindon has spent some 37 years as an engineer in the electricity supply industry where he devoted a significant part of his career to the development and implementation of operation and maintenance procedures and practices.

He began his career at the Hams Hall group of power stations near Birmingham at the advent of the power industry's nationalisation in 1947. In 1959 he moved over from the conventional plant to the nuclear side of the industry, training at Calder Hall before taking an operational appointment at Bradwell nuclear power station at the time of its commissioning. He was involved in the commissioning of Wylfa power station and had long experience in the operational and maintenance systems at that station.

During the past few years he has been involved in technical publishing as the Technical Editor of *The Nuclear Engineer* and as a member of a number of editorial boards, including The Institute of Energy's Publications and Conferences Committee.

John is a Chartered Electrical Engineer, a Fellow of the Institution of Nuclear Engineers, and he joined the Institute of Energy in 1954 as a corporate member.

their respective areas, where that was technically feasible. The total supply of electricity had by now reached 1000 million units of which nearly half was being consumed by British industry.

The 1914-18 War greatly highlighted the problem of having so diverse a system of electricity supply and in 1919 the Electricity Commissioners were established. This body was set up to investigate the whole of the supply industry. However, they had no compulsory powers and so progress was slow.

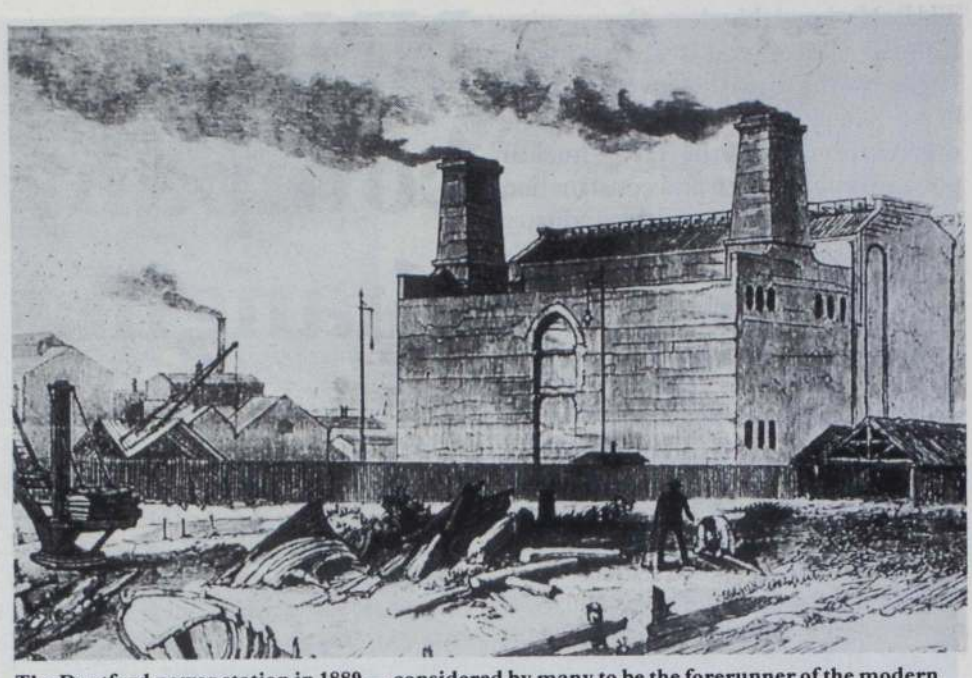
National grid

It was not until the Electricity Supply Act of 1926 was passed that the Central Electricity Board, or CEB was formed. The Bill was required because of the total inadequacy of the supply companies to match the growing demand for electricity.

The CEB was charged with constructing a national grid network, which would allow the interchange of demand between power stations and selected bulk distribution points. By 1934, a stable grid system was operating at 132 kV serving large areas of industrial Britain. The system showed substantial economies in the capital and operating costs of electricity generation together with improved availability and reliability in supply.

The 1926 Act gave the CEB powers to operate as a trading unit, buying and selling electricity, from and to various supply undertakings. As the system demand increased, efficiency increased also and the costs of generation fell. By 1937, some £22 million had been saved by having a grid system. As an example, in 1914, one tonne of coal could produce 443 units while by 1939, 1566 units could be generated. Today, the figure is nearer 2150 units.

In 1937, total electricity production in Britain exceeded 19 million MWh, or 419 units per head of the population. By 1945, this figure had reached 31 million MWh. It is worth noting that the price of the unit had decreased from 2.48d per unit in 1921 to 1d per unit by 1939. (1p and 0.4p respectively).



The Deptford power station in 1889 — considered by many to be the forerunner of the modern generation of fossil-fired electricity generating stations.

Despite all the improvements that a privatised electricity supply industry brought about and the tremendous record of achievement through five years of the World War, the newly elected Government of 1945 set its sights upon nationalising the industry.

The Electricity Bill 1947 brought into public ownership the electricity supply industry of England, Wales and southern Scotland. The north of Scotland had been separated in 1943 as the North of Scotland Hydro-Electric Board.

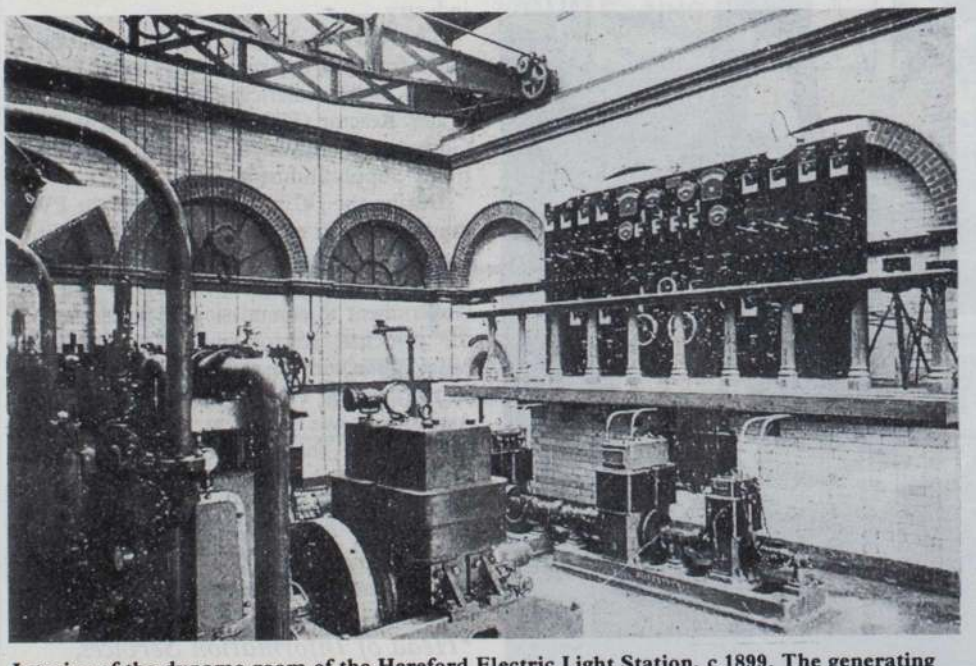
Over 560 undertakings were integrated into a new statutory industry comprising 14 separate Boards. Twelve were in England and Wales and two in southern Scotland. In the latter case, the responsibility of generation and distribution was served by one Board. In England and Wales, a new body called the British Electricity Authority, BEA, was given the responsibility of central coordination and policy.

In the 40 years that have followed, two facts emerge. The first being the development of electricity in Britain, its massive growth matched with an excellent technical performance by its power stations, transmission and distribution system. The period saw the development of a new power source. Nuclear energy was seen as offering considerable commercial benefits in the generation of electricity. It led to the building of the first nuclear power station at Calder Hall in 1956. Today, nearly 20 per cent of electricity generation in Britain is by nuclear means.

The second fact which has dominated the industry has been the large amount of organisational change that has occurred. Some were due to Government policy changes, while others were due to changes in the managerial structure in the industry. Both had an unduly negative effect upon the overall performance of the industry, the differences in nuclear power policy being only one example. From being a world leader in the 1950s, Britain has slipped disastrously down the World league since then. The losers have been British manufacturing industry. We did export two nuclear power stations in 1960. Today, our export potential is virtually non-existent, save for specific pieces of equipment.

The most important change since nationalisation perhaps occurred with the Electricity Act of 1957, which saw the birth of the CEGB as the bulk supplier of electricity in England and Wales to 12 Area Boards or Distribution Companies.

From the day of the Conservative Party's election in 1979 under Mrs Thatcher, Britain has seen its Government's policy directed towards de-nationalising all its service industries. □



Interior of the dynamo room of the Hereford Electric Light Station, c 1899. The generating plant comprised two Bellis-Silvertown steam dynamos, each having an output of 100 kW at 450 rpm.

NNC — a changing company in a changing world

*by R R Marshall**

The impending privatisation of the electricity supply industry coupled with current UK Government policy on equity shareholding in private sector companies has already led to major changes for at least one company traditionally associated with the electricity industry — the former National Nuclear Corporation Limited, now designated NNC Limited. In the wake of NNC's acquisition by the GEC Group of companies late last year, the following article reviews this company's development and describes the changes that are taking place in its business activities.

THE National Nuclear Corporation Limited was originally set up in the 1970s by the British Government to bring together into one single organisation all of the UK's nuclear power station design and construction expertise. Jointly owned by industry (65%) and Government (35%) NNC's role was to ensure that the latest proposed AGR nuclear power stations — Heysham 2 and Torness — restored the British public's faith in the construction side of the industry.

In April 1978, on behalf of the Central Electricity Generating Board and the South of Scotland Electricity Board, NNC was asked to carry out a design study for the two proposed stations. They were to be based on the successful twin reactor design utilised at Hinkley Point 'B' and Hunterston 'B' and which had been built and commissioned by TNPG, a forerunner of NNC.

By the autumn of 1979 sufficient work had been done to show the economic and technical status to be sound and viable. Tenders were prepared for each Board and submitted in the spring of 1980, which led to a commitment to proceed with permanent site work in August of that year.

An agreement which placed NNC in the role of agent for the generating boards provided for full access to and interchange of information with the clients including costs and resourcing. Although it took some time for this new style of management to be appreciated, the arrangements have been one of the cornerstones of the success of these projects.

Seven and a half years later, the first unit to start-up was the first reactor at Torness. The start-up sequence began on 25 March 1988 when the reactor was taken critical and the 20% power tests of the decay heat system, the boiler start-up system, the turbine initial run-up and electrical tests and the first engagement of some of the auto control systems were carried out.

Following a period of planned testing and upgrading of reactor support systems, full load on the first Torness reactor of 660 MW was achieved on 23 August last year.

The start-up of the first unit at Heysham 2 began with criticality being achieved on 23 June and the main turbine was synchronised on 12 July. On completion of the reactor trip tests from 20% and 60% power the raise power programme progressed until full load was achieved in 70 days on 1 September 1988.

First criticality was achieved on the second reactor in the evening of 1 November 1988 and the main turbine was synchronised on 11 November. The raise power programme on this reactor progressed rapidly until full power (660 MWe) was achieved on 15 December last year. The period of 44 days from criticality to full power on this reactor is understood to be a world record for any type of reactor.

As the Heysham 2 and Torness stations were being built, two major decisions were taken which had a dramatic effect on the British nuclear power generation construction industry.

The first was the Government's decision to move from the Advanced Gas-cooled Reactor (AGR) to the American-designed Pressurised Water Reactor (PWR). The second was the Government's decision to privatise the Electricity Supply Industry.

During the 1970s UK interest in the PWR grew as a result of its popularity with utilities throughout the world. In 1976, the continuing problems with the earlier AGRs led the Government to commission an assessment of the principal reactor options by NNC in consultation with the electricity authorities and British Nuclear Fuels. This Thermal Reactor Assessment was aimed at securing a better definition of those aspects of each of the options material to a decision on the choice of system. In line with the conclusions of the assessment, the Government decided to authorise the construction of the Heysham 2 and Torness stations and one PWR, subject to

NNC engineers engaged upon the commissioning of instrumentation equipment for Reactor 1 at Heysham nuclear power station.

**Head of Information Services, NNC Limited*

the safety of the PWR being acceptable to the UK Licensing Authority.

Following the Government's decision the Nuclear Installations Inspectorate published the results of the generic review of PWR safety, the main conclusion being that there was no fundamental reason for regarding safety as an obstacle to the selection of the PWR for commercial electricity generating in the UK. This led in April 1980 to the CEGB giving NNC a Letter of Intent for the design and construction of Sizewell 'B'.

In the autumn of 1981, the CEGB and NNC agreed a working arrangement for completing the design and carrying out the construction of the station. This arrangement was called the Joint Project Team (JPT) because it brought together staff from NNC, CEGB, Westinghouse and Bechtel within NNC's organisation structure with C E Pugh (now President of The Institute of Energy) as the Project Director.

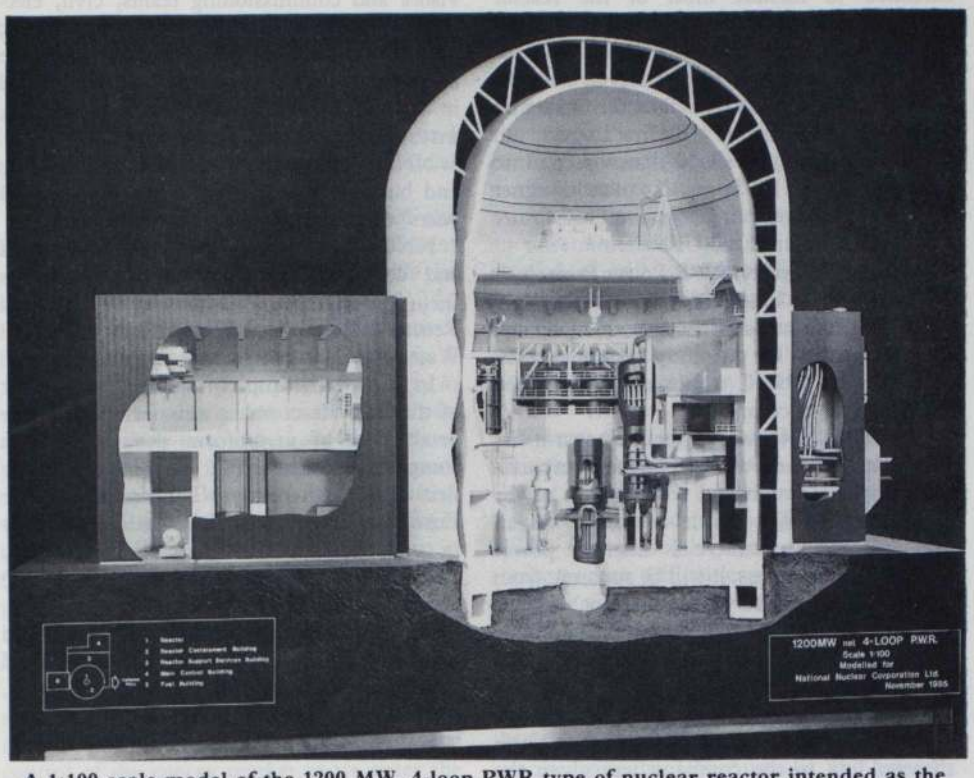
The Public Inquiry by Sir Frank Layfield opened in July 1982 with very wide terms of reference, covering economic, safety, environmental as well as planning aspects. In addition to giving evidence to the inquiry on its own role, NNC provided substantial support to the CEGB in presenting evidence on the design and safety case, which of course, was largely based on work carried out by NNC.

Organisational changes

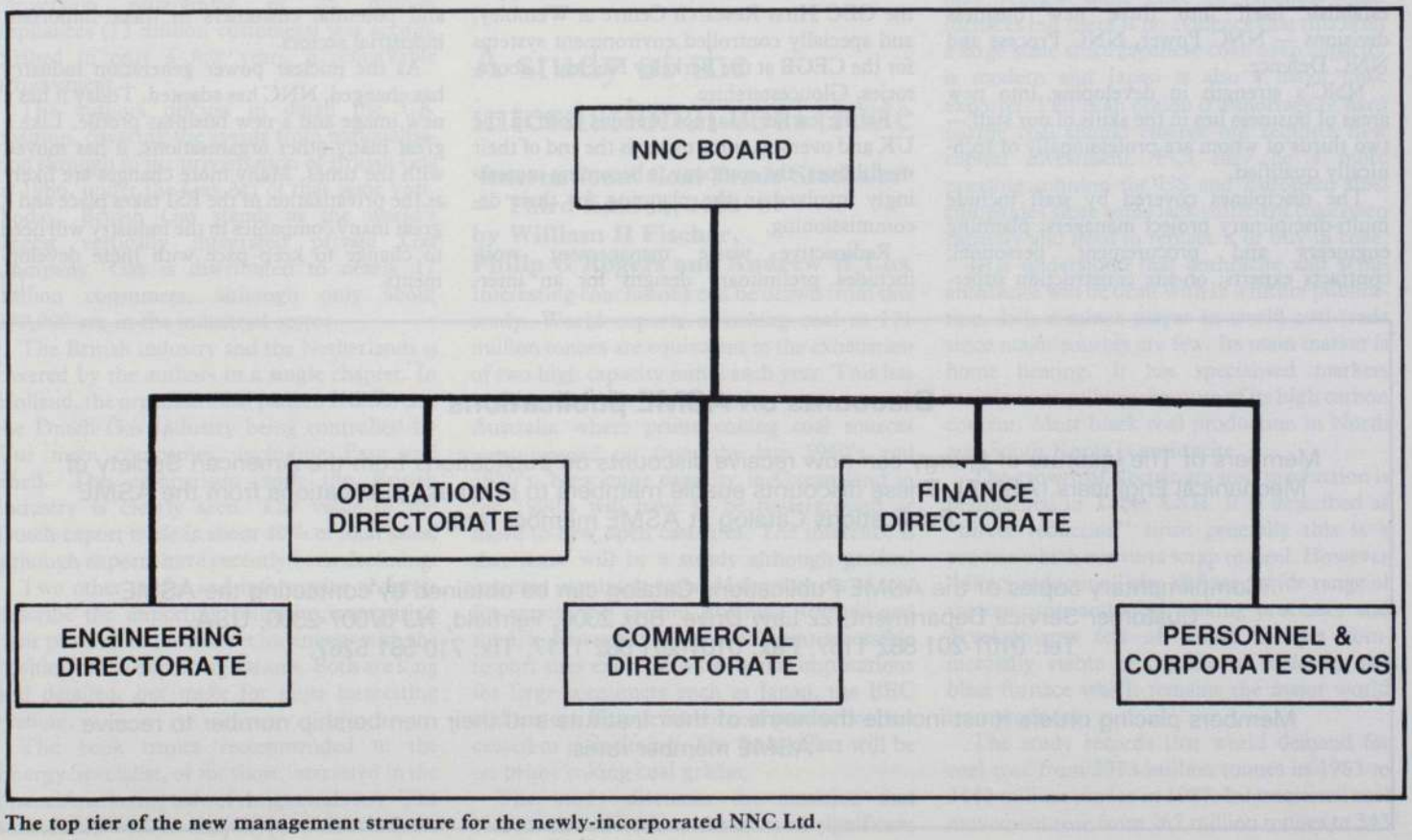
In January 1984, during the Public Inquiry, the CEGB announced a further change to organisational arrangements for Sizewell 'B'. The Board stated that for a first station of a reactor type new to the UK the accountabilities of the CEGB for safety, procurement policy and expenditure of the Board's monies were such that the Board should itself undertake the leadership of the project. A Project Management Board (PMB), reporting direct to the CEGB Executive was set up for this purpose and took over from NNC in June 1984. Most of the NNC staff previously working on the PWR continued to do so under contracts from the PMB. These contracts provide for the secondment of over 100 experienced NNC staff to work in the PMT itself, and approximately twice that number to carry out system design, safety analysis and engineering support work in NNC's own offices.

In late 1988, the NNC staff on secondment to the PMT and who were working on the PWR project, were transferred to the CEGB.

The PMB placed a contract on Westinghouse for the supply of the Primary Circuit for Sizewell 'B'. This contract was subsequently



A 1:100 scale model of the 1200 MW, 4-loop PWR type of nuclear reactor intended as the design for the Sizewell B nuclear power station, now under construction in Suffolk, England.



The top tier of the new management structure for the newly-incorporated NNC Ltd.

extended to include most of the reactor auxiliary systems and equipment comprising the Nuclear Steam Supply Systems. At the same time Westinghouse and NNC, with the encouragement of the CEGB, agreed to set up a Joint Company in the UK, first to carry out this work for Sizewell 'B', and second to become the UK PWR nuclear plant designer and constructor for a programme of future PWRs to be built in the UK.

The joint company, PWR Power Projects, is based at NNC's headquarters at Booths Hall, Knutsford and has staff from both NNC and Westinghouse. It currently employs 100 people, mainly NNC employees. It is owned equally by both companies.

Naturally, NNC is disappointed that it has not been entrusted with the overall responsibility for the design and construction of the Sizewell 'B' PWR, as it has been on all previous UK commercial nuclear power stations. Nevertheless, it will be apparent from the foregoing that NNC has a major involvement in the UK PWR programme, and is totally committed to its success.

With the Government's decision to privatise the ESI came the decision to sell off its 35% shareholding in NNC. GEC, with a 30% shareholding in the company was given the option of acquiring the Government share. This GEC did and subsequently bought out the remaining industry shareholding of 35% from British Nuclear Associates (a group of major construction and engineering organisations).

New image

As a member of the GEC Group of companies, the company decided in the Spring of 1989 to change its name from National Nuclear Corporation Limited to NNC Limited; to introduce a new logo and then establish itself into three new business divisions — NNC Power, NNC Process and NNC Defence.

NNC's strength in developing into new areas of business lies in the skills of our staff — two thirds of whom are professionally or technically qualified.

The disciplines covered by staff include multi-disciplinary project managers; planning engineers and procurement personnel; contracts experts; on-site construction supervisors and commissioning teams; civil, electrical, electronic and mechanical engineers; computer programmers; quality assurance specialists; and a strong complement qualified in the basic sciences of physics, chemistry, mathematics and metallurgy.

NNC's wide ranging capability in designing and building power plant is the result of 30 years' experience.

NNC staff have been involved in the design and construction of nuclear power plants incorporating Magnox, Advanced Gas-cooled Reactors, Pressurised Water Reactors, Heavy Water Reactors and Fast Reactors.

In Europe, the emphasis on the development of the Fast Reactor has now switched to the production of a uniform design for cost competitive construction early in the twenty first century. Recently NNC signed a major European Fast Reactor Industrial Agreement in collaboration with Novatome (France), Ansaldo (Italy), Interatom (West Germany) and Belgonucleaire (Belgium).

Other achievements include the design and turnkey contracting role for the 2000 MW oil fired power station at Inverkip, near Glasgow.

The future

Looking to the future, NNC is currently engaged in a feasibility study for British Nuclear Fuels plc for the construction of new nuclear power stations, which may eventually replace the Magnox stations BNFL operates at Calder Hall, Cumbria and Chapelcross in Dumfries.

In the high technology buildings sector, NNC designed and is constructing the European Tritium Handling Experimental Laboratory (ETHEL), a key facility in the European Fusion programme, at Ispra in Northern Italy. A suite of sophisticated clean rooms for micro-electronics research activity at the GEC Hirst Research Centre at Wembley, and specially controlled environment systems for the CEGB at the Berkeley Nuclear Laboratories, Gloucestershire.

As the earlier Magnox stations both in the UK and overseas come towards the end of their useful lives, the company is becoming increasingly involved in the planning for their decommissioning.

Radioactive waste management work includes preliminary designs for an intermediate and low level waste repository, and studies on the immobilisation, transport and storage of radioactive waste in above ground and deep burial facilities both on land and offshore.

Other services include a specialist system for sealing water leaks in inaccessible pipework. This service has been provided for organisations in Canada, USA, Korea, West Germany and India.

Current projects

Currently, NNC is engaged on an important seven year Facilities Project Management Contract for the Ministry of Defence at the Atomic Weapons Establishment, Aldermaston, and providing additional consultancy services and support to the Ministry.

Extensive management and consultancy services are being carried out for the Property Services Agency at the Royal Navy's Clyde Submarine Base at Coulport and Faslane, and at Rosyth, and Devonport Dockyard. The work includes preparation of safety cases for numerous facilities, together with commissioning supervision, quality assurance and design support.

Other work undertaken includes the turnkey design and construction of special controlled environment buildings for the Royal Navy at Beith, Scotland.

NNC Limited is rapidly developing from its traditional role of nuclear power station design and constructor to one which offers a much wider, more diverse range of services in engineering and project management for the power, process and defence industries. The same high standards of engineering and attention to detail — instilled in staff through decades of undertaking complex nuclear power tasks — are now readily available to existing and potential customers in these important industrial sectors.

As the nuclear power generation industry has changed, NNC has adapted. Today it has a new image and a new business profile. Like a great many other organisations, it has moved with the times. Many more changes are likely as the privatisation of the ESI takes place and a great many companies in the industry will need to change to keep pace with these developments. □

Clear analysis of a complex structure

'Natural gas in Europe — markets, organisation and politics' by Javier Estrada, Helga Ole Bergesen, Arild Moe and Anne Kristin Sydnes.

This book is the result of a Norwegian research project completed at the end of 1987. The four authors, J Estrada, H Ole Bergesen, A Moe and Anne Kristin Sydnes, are all from the Fridtjof Nansen Institute in Norway. Between them, they describe the development of the West European natural gas scene over the years since the 1950s.

The organisation of gas suppliers in a number of countries is examined and the increasing competitive position between them. The way in which political issues tend to influence the market in both home production and in international trade, are matters discussed fully in this book.

In Britain, Norway, Europe and the USSR, natural gas is part of everyday life as a major source of energy. The USSR, the world's largest producer of natural gas, has witnessed a massive build up of its gas industry. An annual growth rate of about 8% over the last 20 years has been witnessed. From originally being a net importer, the USSR today is a major exporter and depends very much on foreign currency from gas exports.

In Britain, we have also witnessed great changes since the 1960s. The years 1966 to 1986 saw a remarkable expansion from ten billion cubic-metres to a production of 50 billion cubic-metres. With the arrival in the UK of gas having a higher calorific value, a conversion programme of 35 million appliances (13 million customers) was accomplished in only a few years, a remarkable achievement.

The authors discuss in detail the UK position, covering the events from nationalisation through to the privatisation of British Gas in 1986, under the Gas Act of that same year. Today, British Gas stands as the world's largest vertically integrated private Gas Company. Gas is distributed to nearly 17 million consumers, although only about 870,000 are in the industrial sector.

The British industry and the Netherlands is covered by the authors in a single chapter. In Holland, the organisational pattern is different, the Dutch Gas Industry being controlled by four main companies, including Esso and Shell. The comparison with the British Industry is clearly seen. The value of the Dutch export trade is about 40% of total sales, although exports have recently been declining.

Two other useful and informative chapters describe the importing countries, comparing their position in the market for energy with the position of the exporting nations. Both are long and detailed, but make for most interesting reading.

The book comes recommended to the Energy Specialist, or for those interested in the finance/marketing side of the gas industry. The authors do well to simplify and discriminate between the many factors surrounding a highly complex industry. They speak of a secretive industry. The intention is to analyse the organisational structure of the market, clarifying the effect made by political forces and institutional directives in many commercial applications.

A more than adequate description of the European gas scene is presented. Excellent evaluation has been carried out to indicate the strength and weaknesses of the market. The latter part of the book looks at the alternatives for this energy source in 1990 and beyond.

Following an early description of the way in which the gas industry has evolved, the performance against its competitors in the latter part of this century is compared. Three more chapters discuss the structure of the industry, with a special mention of the large natural gas transmission systems which have grown up in the last three or four decades. A final chapter gives a summary of all the many factors appertaining to gas, with a list of detailed conclusions.

The industry, which has hitherto shown remarkable capacity for meeting technological change, will need to maintain a high degree of control of the energy market as we enter the 21st Century, if it is to keep its place as a foremost energy source. One fact strongly supports the use of gas for the future. Without doubt, it represents the cleanest of the fossil fuels and therefore is more environmentally acceptable.

F John L Bindon

Published by Pinter Publishers, London and New York, 1989
274 pp. £35.00

A study of the international coal trade

'International Coal Trade Statistics' — Third Edition, 1983–87 by William H Fischer, Philip G Rogers and Andrew W Cox

Interesting conclusions can be drawn from this study. World exports of coking coal at 171 million tonnes are equivalent to the exhaustion of two high capacity mines each year. This has implications for such major exporters as Australia where prime coking coal sources were opened up from the late 1960's and 1970's. New mine capacity in Queensland in the 1990's will have to be underground or move to new open cast sites. The inference is that there will be a steady although gradual increase in mining costs. Major sources of coal for export will remain Australia, Canada and the US. Few other major coal basins accessible to port sites exist. This has major implications for large consumers such as Japan, the EEC and eastern Europe where coal production has ceased or is declining. The main effect will be on prime coking coal grades.

The study discusses the situation and records the relevant statistics in all significant coal producing, importing and exporting countries. Prices in the exporting countries need to rise if new mines are to be opened to meet demand. Investment will not take place if an adequate return is unlikely to be forthcoming. Some diversified mining groups are turning back to base metal mining. The oil companies have found the coal industry to be an unremunerative venture. Much coal production is still subsidised by governments. Many private concerns have had profits cut to the bone by competition and pressure from large buyers such as Japan which profited from periods of over capacity in the mid and late 1980's.

Nevertheless coal has increased its status as a major contributor to world energy supply with China, the USSR and the USA being the largest coal producers although China and the USSR for reasons of domestic demand and transportation difficulties are unlikely to contribute greatly to export supply in the 1990's.

Generally the present picture is of world coal demand tending to outstrip supply possibilities. Even with additional coal sources such as Colombia, Venezuela, Indonesia opening up they cannot hope to do more than supplement supply from the US, Australia and western Canada and do not have the range of qualities to replace them.

The substitution of steam or weakly coking coal for prime grades of coking coal especially in Japan is discussed. This is a complex subject and there are few independent observers with data on blast furnace operations in Japan. What seems clear is that Japan can use 10% to 20% of "soft" coking coal in its blends as a source of cheap carbon but relies on specific mine sources of hard coking coal for over 80% of requirements which has remained constant since the early 1970's. Pulverised coal injection may replace some coke in Japanese blast furnaces but there is no evidence that this is on a large scale since Japanese coke oven capacity is modern and Japan is also a major coke exporter. PCI is an option if a shortage of hard coking coal should emerge but requires new capital investment. PCI may be a more pressing solution for US and European steel companies since some lack sufficient coke oven capacity and need to replace it or buy in coke.

It is understood that anthracite and semi-anthracite will be dealt with in a future publication. It is a minor player in world coal trade since major sources are few. Its main market is home heating. It has specialised markets mainly in metallurgy because of its high carbon content. Most black coal production in North and South Korea is anthracite.

The growth of electric arc steel production is highlighted in Table XXII. It is described as "direct reduction" since generally this is a process which converts scrap to steel. However "direct reduction" also defines a wide range of esoteric iron and steel making processes and developments few of which are yet commercially viable or capable of replacing the blast furnace which remains the major world iron producer.

The study records that world demand for coal rose from 2973 million tonnes in 1983 to 3442 million tonnes in 1987. International coal movement rose from 267 million tonnes to 343

million tonnes during the same period — about 10% of world production. Steam coal strengthened its position considerably. World demand for many end uses — mainly power generation rose from 2479 to 2904 million tonnes from 1983 to 1987. The growth in coking coal demand was much less due to weak performance in the steel industry. However international coking coal trade rose steadily due mainly to the closure of mines in the EEC and increases in steel production in the Pacific.

K E Bayliss

Published by Resource Data International, Boulder, Colorado, USA, 1989
207 pp. US$495

Soviet energy technology

'Scientific and Engineering Problems of Energy System Reliability (1987)' — Volume 3 of Soviet Technology Reviews
Editors: L A Melentiev (Moscow), Yu N Rudenko (Irkutsk)

This book is one of a series on Soviet energy technology, the first being on Nuclear and the second on the Unified Gas System. The material is written in Russian and "promptly translated and published in English".

Soviet energy papers are generally available in English in Teploenergetika but in general these papers are too brief to provide technically satisfying material. These monographs, which pursue their subject in some depth, are therefore to be welcomed.

In the Soviet Union, with the central organisation of all industry linked to five year plans, energy has considerable importance and problems. Although Soviet energy resources are enormous much of the fuel resources and reserves are remote from the centres of use and population. In electricity, the generating capacity has no reserve capacity. Both the land lines and the oil and gas pipelines are of considerable length and are the most extensive integrated systems in the world. With the severe weather conditions line failures are not unusual.

With the extreme pressures on the system it is not surprising that reliability studies have received considerable attention in the USSR.

Although the book has a main editor (Academician Melentiev died in 1986 and the editing of the book and series was taken over by Yu N Rudenko) each of the sections has one or more specialist authors. It is interesting to note that the authors invite comments and the editors would welcome suggestions for topics and authors for future volumes. Doubtless members of the Institute would be able to make suggestions here and there may be scope for them to be forwarded in the name of the Institute. Improved knowledge on Soviet developments in energy technologies is to be welcomed.

The first report covers the theoretical aspects of energy systems reliability analysis. This covers areas like production quality and decision making, the problems of mathematical modelling such as the human factors.

The second report covers the special problems associated with system expansion on reliability, which is a relatively new and unexplored area but one that is vital as new plants are added to a system and old ones retired — systems are in a perpetual state of change.

Much of the material in the book is mathematical and specialised. There is, however, nothing on the importance of quality assurance and design of equipment (pumps, valves, motors etc) for high reliability and safety and how the effort on maintenance links with reliability. Above all there is little numerical information on plant or system performance. All the same, both the book and the series is to be welcomed.

N G Worley

Published by Harwood Academic Publishers, New York, 1988
350 pp. $180

Questionable premise

'Earthing electricity — the environment and electricity privatisation'
by UK CEED

A controversial book, it commences by describing the main challenge of the prospective privatised electricity supply companies to be their environmental performance. That is questionable.

What is not questionable, is that these new companies will have to operate within the letter and the spirit of the new Electricity Bill, now before Parliament. They will have to select policies which conform with the wishes of their shareholders.

The authors of this book ask more from the electricity companies when privatised, than other energy industries, all of which, apart from the coal industry are now in private hands. Why they do so is not made clear.

A programme of industry and government action is advocated to reduce the magnitude of future environmental pressures and to direct the industry to look towards the advantages which could accrue from the ever increasing technological progress of our age.

Looking at the generation side of the industry, it can be said that efficiency divides into two important sub-divisions. One is thermal efficiency or operating performance. This has been rising unhindered since the industry began over 100 years ago. One has only to examine the statistical data to see the truth of this.

The other sub-division is what could be called the economic efficiency factor. Here, the relative cost of a unit of electricity has been falling in real terms since 1900. What is open to debate is, could more have been done? To have had suggested answers in this book would have been useful. Such thoughts might have suggested what the future of the industry might be, leaving out the less environmental overtones.

As little as a decade or so ago, the use of fossil fuels for electricity generation was considered harmless. Today, the drive is for vast amounts of money to be spent in controlling emissions. Who will pay, other than the consumer?

The authors of this book maintain they are writing from a personal point of view. They seem to demand action, based solely on environmental issues. Future shareholders in electricity supply companies will be looking more for a high performance, geared to a good return on their investment. That is a fact which must be faced.

In reading this book, one of many on this same topic, one feels the pendulum has swung too far towards the environmental. While it is so popular to score many political-socio points in favour against industry, the way people conduct their lives is left untouched. Litter, dirt and untidiness abound in our society, witnessed in urban and rural areas alike. There is a balance to be struck, which the authors have not addressed.

We cannot expect the high standard of life of our society to be maintained, let alone increase, if we do not look to our industrial performance. This finds little consideration in this book.

Another weak argument advanced, surrounds electricity research. Research must continue. As important, is the requirement to pursue the development and commercial exploitation of that research. Money has to be found. The authors recommend a body being set up on the USA's EPRI model, which they claim is independent. That is not true. It is dependent upon those who fund it. The benefactors must expect a pay-back for their support. The authors suggest a similar research institute set up in Britain. The question has to be, who will give the financial support? Any Government contribution in the form of direct financial aid is doubtful.

F John L Bindon

Published by the UK Centre for Economic and Environmental Development (CEED), London, 1989
140 pp. £30.00

Recently published

Radiation monitoring around CEGB nuclear power stations.
Published on behalf of The Watt Committee on Energy by The Institute of Physics. Price: £15.00 net.
Available from: The Meetings Officer, The Institute of Physics, 47 Belgrave Square, London SW1X 8QX.

The application of monitoring & targeting to energy management.
Department of Energy. Price: £11.50 net.
Available from: HMSO Publication Centre, PO Box 2876, London SW8 5DT.

Aims and objectives

THE Engineering Council takes a new look at its aims and objectives in its Annual Report for 1988 published on 11 May 1989. Its *six main aims* in support of its policy of developing and promoting all aspects of engineering for the public good and the well-being of the national economy include:

* Increasing awareness of the essential and beneficial part engineering plays in all aspects of modern life;
* Advancing engineering knowledge through education and training;
* Spreading best engineering practices to improve the efficiency and competitiveness of UK businesses.

The Engineering Council stresses the need for a proper balance between efficiency, public safety and the needs of the environment when carrying out engineering activities.

Sir William Barlow FEng, Chairman, calls on all engineers to play an active part in the development of their profession and the enhancement of its prestige.

12 objectives

The Council's 12 other objectives to help it achieve its aims include:

* Advising, and when necessary lobbying, the Government, in conjunction with public and private sector representatives, on the national level policies, actions and resources essential to ensure the proper supply and quality of qualified engineers and technicians;
* Promoting, maintaining and expanding the register of Chartered Engineers, Incorporated Engineers and Engineering Technicians as the recognised hallmark of achieved standards;
* Seeking to optimise the benefits of European integration through discussions with industry, learned societies, the professional institutions and Government;
* Utilising the Council's national network to the full in order to spread 'The Engineering Message'.

The Council also wishes to develop co-operation between institutions and to encourage timely and advantageous institutional mergers. This should concentrate professional engineering resources and so strengthen their influence.

Engineering guidance

STAFF in schools, colleges and higher education establishments are being given guidance booklets to help them promote equal opportunities for girls and women. The booklets also urge educational staff to encourage more girls and women to take up careers in science and engineering.

In a foreword to one of the two booklets — both entitled *Engineering Equals* — aimed at staff in schools and colleges, Sir William Barlow, FEng, Chairman of The Engineering Council, and the Rt Hon Norman Fowler, Secretary of State for Employment, point out that women work in every branch of engineering and technology and now no less than 11 per cent of engineering undergraduates are female.

Engineering provided exciting, challenging and well paid careers for young men and women. Opportunities existed across a wide range of industries and public services. They hoped therefore that this booklet would encourage everyone in primary and secondary schools and colleges in the United Kingdom to take an even more positive attitude towards the challenge of greatly increasing technical literacy as well as make an even greater effort to encourage more women into science and engineering.

The other booklet is aimed at staff in higher education institutions and vocational training establishments.

The booklets — endorsed by 20 educational organisations — are part of the Council's Women Into Science and Engineering (WISE) campaign. They list key factors to encourage girls and women into science and engineering, give examples of good practice and provide a checklist for action that staff could take. There are also useful addresses and details of relevant publications.

Copies of the two booklets can be obtained free from the WISE Secretariat, The Engineering Council, 10 Maltravers Street, London WC2R 3ER.

Catching the wind

What is claimed to be the first ever natural ventilation system of its kind in the UK has been launched by Monodraught Flues.

The Windcatcher natural ventilation system is based on Monodraught's established vertical balanced flue chimney system. It is claimed that Windcatcher has many advantages over mechanical ventilation. It has no moving parts and is therefore noiseless and it utilises natural wind energy and thermal forces thereby lowering running costs. It is also virtually maintenance free and installation is simpler and quicker when compared to a mechanical ventilation system.

The roof-mounted ventilation unit is constructed in class 1 flame retardant glassfibre, and works on the principal of entraining outside air through four air intakes sited at the top of the unit. Any prevailing wind, however slight, is encapsulated by the air intakes on the windward side of the unit, forcing cold air down into the room below and allowing the warm air to rise naturally through the three remaining air ducts pre-formed inside the unit. The thermal forces of differential pressure maintain this air movement, even when there is no outside air movement. Since the space to be ventilated would be closed off to other external air requirements, a balanced condition is created. This balancing action is maintained, regardless of wind direction.

For further information contact Monodraught Flues Ltd, 150 West Wycombe Road, High Wycombe, Bucks HP12 3AE.

Harwell launches new software

Gas cyclones are used in process engineering plant to separate particulate matter from gases for product collection or before final cleaning by filters. They work by spinning the dusty gas and separating the particles by centrifugal action.

Engineers at the UKAEA's Harwell Laboratory have introduced Cyclone, a new computerised method for designing and evaluating gas-solid separation plant.

The Cyclone programme means that designers are no longer constrained by traditional cyclone geometries and can, for the first time, tailor design to make the best use of existing plant and space limitations. The programme also doubles as a performance check on the efficiency of existing plant.

Cyclone takes the user via a series of menus and easy-to-use tables through the input of operating conditions, dust size distributions, geometrical constraints and performance criteria. Problems of mixed units and conversion factors are eliminated as the programme takes care of all conversions automatically whilst giving the designer control over the unit scheme that he prefers. The results are presented both graphically and as a table of possible designs. From here the user can modify any individual geometry to optimise the design. Final results can then be printed out with full details of the conditions used. The programme uses the latest screen presentation techniques, and will run on any IBM PC compatible microcomputer with at least 512k memory.

The Cyclone programme is the latest design aid for members of Harwell's separation process service (SPS), an international club that provides firms with engineering expertise for the process industries. SPS provides information on the selection, design and operation of crystallisation, drying, gas cleaning, solid-liquid separation and liquid-liquid extraction equipment to over 80 companies worldwide.

For further information contact Richard Bahu, Building 488.T6, Harwell Laboratory, Oxon OX11 0RA.

Sellworthy move into heat recovery

Heat exchangers from Sellworthy, the Birmingham-based heat transfer specialists, have moved into a new niche as heat recovery units on oil treatment plants.

Edwards High Vacuum International are now using Sellworthy's compact brazed heat exchangers as standard factory fitted accessories for the TS range of oil treatment plants based on porous element heater technology.

The Sellworthy exchangers are used to recovery heat from the outlet or degassed oil and for warming up the inlet or non-degassed oil.

All the exchangers are sized to give a 50-60 per cent heat recovery and this enables the actual heat input to the plant to be reduced by half.

This in turn allows large capacity plant to be used at half power at smaller substations where only welding ring main supply is available.

For further information contact Sellworthy HTI 021-359 6043.

High-power laser shutter gives precise control

The new LS010 industrial laser shutter from Lambda Photometrics is suitable for the precise control and pulsing of output energy from modern high-power industrial and/or laboratory lasers. It can handle 10 kW of continuous CO_2 laser power yet still operate at switching times of 30 milliseconds. The standard beam aperture size is 3.2 cm^2 but other sizes can be provided to suit individual industrial applications. In fully automated systems the shutter can be computer-controlled via an interface. The unit uses light trap technology which effectively sinks all laser radiation into the device itself virtually eliminating undesirable back-scatter radiation.

A built-in heat exchanger removes the laser energy and requires a flow rate of only 7.6 litres of cooling water per minute.

For further information contact Lambda Photometrics Ltd, Lambda House, Batford Mill, Harpenden, Herts AL5 5BZ.

£1 million power plant pumps contracts for Sulzer in PR of China

Sulzer (UK) Pumps of Leeds has been awarded contracts totalling over £1 million to supply pumps to the People's Republic of China.

The main contracts were awarded by GEC Turbine Generators for pumps to be used at a new coal-fired power station serving the City of Yue Yang in Hunan province. Four pumps are for pumping silty water from the Yangtze river for cooling purposes; four are condensate pumps and others are small end-section pumps for auxiliary duties.

The cooling water pumps are Sulzer type BS, required to pump 6.5 cubic metres per second against a head of 19 metres, driven by 1630 kW electric motors at 420 rpm. Sump model tests will be completed on the pumps before delivery.

The condensate pumps are a new generation of the proven Sulzer type BDC design, fitted with a caisson, 4.15-metres long, and driven by 600 kW motors at 1480 rpm. These are capable of pumping 275 litres per second against a head of 172 metres.

The new power station is situated 14 km away from Yue Yang at Chengli Ji and will be equipped with two 263 MW turbine generators supplied by GEC Turbine Generators. It will be operated by Huaneng International Power Development Corporation.

Sulzer's other contract in China was awarded by ASEA Brown Boveri of Switzerland for two condensate pumps at Shi Dong Kou power station in Huaneng province. These are also BDC pumps with 4.6-metre long caissons, capable of pumping 1570 cubic metres an hour against a head of 312 metres, driven by 1875 kW motors at 1480 rpm.

For further information contact Sulzer Publicity Department, Farnborough, Hampshire GU14 7LP.

Title: **Essential skills for the part-time energy manager.**
Location: Dunblane, Scotland.
Duration: 1 day.
Starting: 26 June 1989.
Content: Key technical and managerial techniques. Ideal both as a grounding for newly-designated energy managers and as updating for established appointees.
Course No: 00-510

Title: **Managing energy with a desk-top computer.**
Location: Dunblane, Scotland.
Duration: 1 day.
Starting: 27 June 1989.
Content: A practical hands-on workshop designed for energy managers with little or no computer experience.
Course No: 00-511

Title: **Build your own monitoring and targeting system.**
Location: Dunblane, Scotland.
Duration: 1 day.
Starting: 28 June 1989.
Content: A practical workshop for intermediate users of Lotus 1-2-3 and compatible spreadsheet systems. Covers the theoretical principles, practical techniques and spreadsheets needed to create an automated system for detecting and diagnosing waste.
Course No: 00-512

Title: **Modelling of building energy systems.**
Location: Polytechnic of North London.
Duration: 4 days.
Starting: 3 July 1989.
Content: The elements of building energy and environmental performance modelling including hardware requirements, theoretical basis of building systems and air flow models, problem formulation and model creation, performance assessment and application potential, current developments.

Title: **Understanding the international condensates business.**
Location: Oxford.
Duration: 3 days.
Starting: 3 July 1989.
Content: The growth of condensate production worldwide. The problems of producing and marketing condensates. Technical, market and pricing options for condensate users and producers on an international basis.
Course No: 00-504

Title: **Noise control for engineers in processing industries**
Location: Southampton University.
Duration: 5 days.
Starting: 10 July 1989.
Content: Both the fundamentals of acoustics and vibration and their application to specific topics including: measurement and instrumentation; enclosures and screens; silencers; structure borne noise isolation; acoustic treatment of factories; equipment noise and specifications; total plan noise, propagation and prediction; and hearing conservation.
Course No: 00-480

Title: **Decision support systems for supply, refining and trading — using micro computers.**
Location: Oxford.
Duration: 5 days.
Starting: 10 July 1989.
Content: The wide range of applications for micro computers in refinery operations and supply planning including use of spread sheets, supply planning, crude oil value analysis, refinery modelling, the use of interactive and on line databases, decision support systems.
Course No: 00-505

Title: **Calibration of pressure and temperature instruments.**
Location: Portsmouth Polytechnic.
Duration: 10 days.
Starting: 10 July 1989.
Content: Principles of pressure and temperature measurement. Instrument characteristics. Errors and uncertainty of measurement. Primary and secondary calibration standards. Practical session.
Course No: 00-502

Title: **Buying a control computer.**
Location: Teesside Polytechnic, Middlesbrough.
Duration: 2 days.
Starting: 17 July 1989.
Content: Introduction. Feasibility study/budgeting. Objectives and scope of the system. Production of enquiry specifications — extent of supply, functional specification, hardware and software requirements. Project organisation and control. Commercial requirements. Demonstration of facilities available on the department's computer control system. Case study evaluation. Tendering and system selection. Procurement and acceptance testing. Installation and commissioning.
Course No: 00-508

Title: **Introduction to process plant management.**
Location: Nottingham University.
Duration: 5 days.
Starting: 17 July 1989.
Content: The manager's job. Management organisation. Labour organisation. Motivation. Approaches to leadership. Quality assurance. Management accounting. Industrial relations. Safety.
Course No: 00-509

Title: **Adding value in refinery non-fuel markets — process oils, waxes, bitumen, petroleum coke and solvents.**
Location: Oxford.
Duration: 5 days.
Starting: 24 July 1989.
Content: The wide range of opportunities in refinery non-fuel streams, produced without resort to chemical synthesis. The products technology, business structure and prospects for each sector will be analysed, as will the end-use markets.
Course No: 00-506

June 1989

Power Plant UK '89

Conference and exhibition, 20-23 June, NEC, Birmingham, England.
Details from Exhibition Organiser, Power Plant UK '89, Holly Road, Hampton Hill, Middlesex TW12 1PZ, UK. Tel: 01-783 0055, Fax: 01-783 1678, TX: 21697 Drakho G.

July 1989

Control of emissions from industrial combustion processes

Conference, 4-5 July, London.
Details from Katie Lye, IBC Technical Services Ltd, Bath House, 56 Holborn Viaduct, London EC1A 2EX. Tel: 01-236 4080, Fax: 01-489 0849, TX: 888870.

September 1989

Uranium Institute

Annual symposium, London, 6-8 September 1989.
Details from the Secretary General, Uranium Institute, 12th floor, Bowater House, 68 Knightsbridge, London SW1X 7LT. Tel: 01-225 030, tlx: 917611 URINST G, fax: 01-225 0308.

Energy for Tomorrow

14th WEC Congress, Montreal, Canada, 17-22 September 1989.
Details from British National Committee, World Energy Conference, 34 St James's Street, London SW1A 1HD. Tel: 01-930 3966, tlx 264707 WECIHQ G, fax: 925 0452.

Ceramics

Forum, 25-29 September, Limoges, France.
Details from: Gerard Majewski, Charge de Mission, CREEL, 27 Boulevard de la Corderie, 87000 Limoges, France. Tel: Int+55 45 18 30, fax: Int+55 77 77 89.

Pittsburgh Coal Conference

International Conference, 25-29 September, Pittsburgh, USA.
Details from Pittsburgh Coal Conference, MEMS, One Northgate Square, 2 Garden Center Drive, Suite 211, PO Box 270, Greensburg, PA 15601, USA.

October 1989

The profession: privatisation and competition

Seminar, 3 October, London (Regents College).
Details from: Mrs B O'Donoghue, Conference Office, Institution of Civil Engineers, 1-7 Great George Street, London SW1P 3AA. Tel: 01-222 7722.

Underground coal gasification

International symposium, 1989, Delft University of Technology, The Netherlands, 9-11 October 1989.
Details from Delft University of Technology, Congress Office/ Mrs M H P Komen-Zimmerman, PO Box 5048, NL-2600 GA Delft, The Netherlands. Tel: +31 15 781340, tlx: 38151 butud nl, fax: +31 15 781855.

Energy, Environment and Technological Innovation

Conference, 22-26 October, Central University of Venezuela, Caracas, Venezuela.
Details from Publicis Inc, Parque Central, Nivel Lecuna, Ofic. No. 29, Entrada Tunel, Postal 17614, Caracas, Venezuela. Tel: +582 5729975, Fax: +582 5736642.

Coal Science

Conference, 23-27 October, Tokyo, Japan.
Details from: Dr Masami Takayasu, Secretariat for ICCS, Coal Conversion Department, NEDO, Sunshine 60 Building, 1-1, Higashi-Ikebukuro 3-chrome, Toshima-ku, Tokyo 170, Japan. Tel: Int+3 987 9442, tlx: J32148, fax: Int+3 981 1059.

November 1989

World Water

Conference and exhibition, Wembley, London, 14-16 November 1989.
Details from Institution of Civil Engineers, 1-7 Great George Street, Westminster, London SW1P 3AA. Tel: 01-222 7722, tlx: 935637 ICEAS G; fax: 01-222 7500.