# ENERGY WORLD

The magazine of The Institute of Energy

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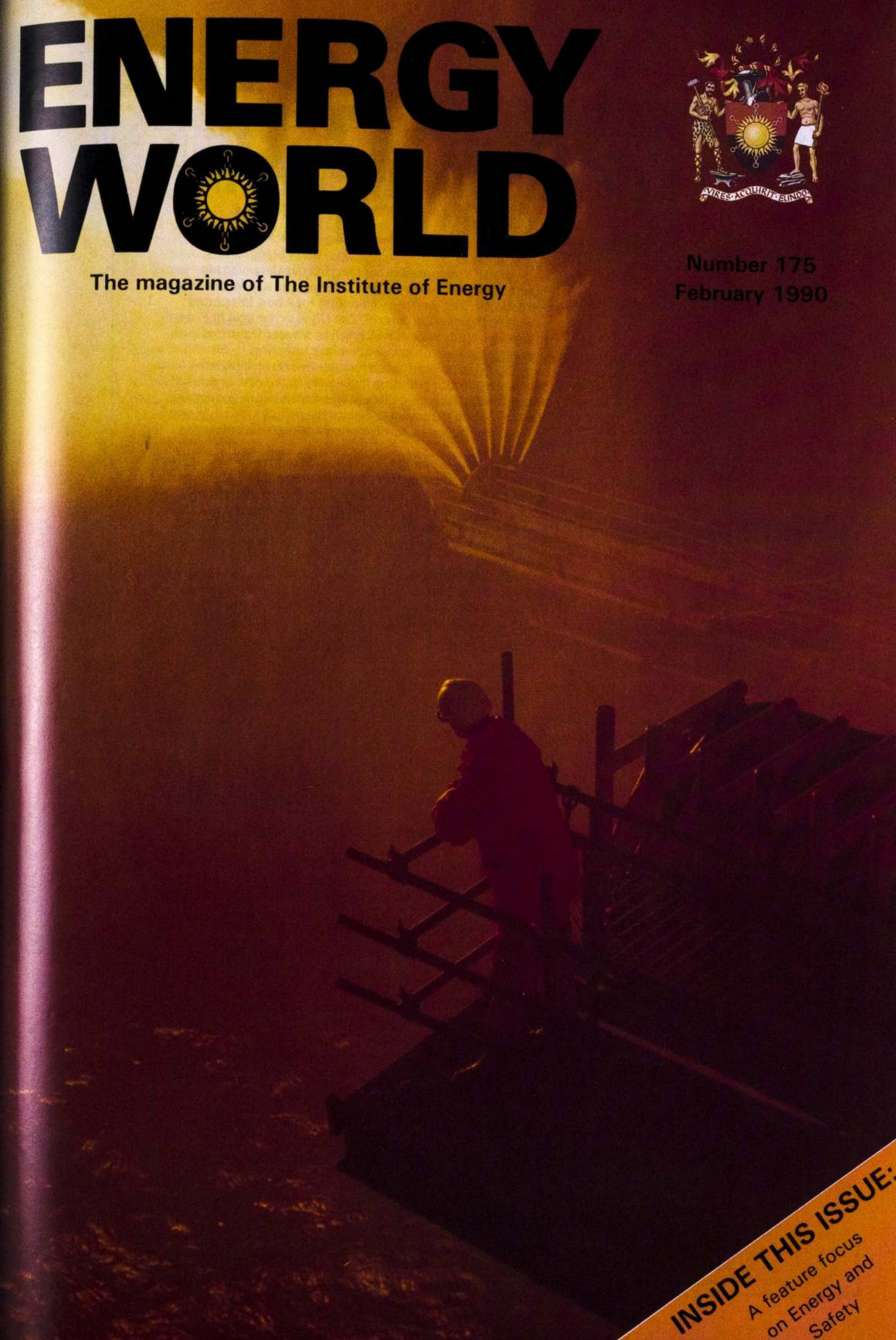

INSIDE THIS ISSUE:
A feature focus on Energy and Safety

# KEY APPOINTMENTS IN POLLUTION CONTROL

HMIP is responsible for carrying out the pollution control functions of central Government in England and Wales. Its formation in 1987 laid the foundation for a new integrated approach to pollution control. The UK is in the lead in Europe in developing this system, which will be a major feature of forthcoming legislation on environmental protection.

HMIP has recently been restructured on an integrated basis. Vacancies exist for pollution inspectors in the new organisation. We are looking for high-calibre professionals with a good understanding of how to prevent or reduce the pollution of air or water, of waste management, or of the management of radioactive substances.

Candidates must have an honours degree or equivalent in chemistry, chemical engineering or other similar disciplines, and at least 5 years' relevant industrial experience, especially in the process industries. Chartered membership of a relevant professional institution is desirable. An ability to take initiatives, to make considered judgements, and to communicate effectively is essential.

The posts provide challenging opportunities to help protect and improve the environment at a time of growing awareness of "green" issues, and in an expanding organisation. This calls for a high level of professional expertise.

Responsibilities of the posts include:

- Administering statutory controls on the discharge of gaseous and liquid effluents from industrial processes, and on disposals of radioactive wastes and the handling of radioactive substances.
- Ensuring the proper design and operation of plant and of pollution control equipment.
- Monitoring the performance of waste disposal authorities, and advising them on best practice.
- Developing technical policy and preparing guidelines on pollution control.
- Advising Government Departments and Ministers.

A successful candidate is likely to work in most of these areas in the course of a career.

The posts are located in London SW1 and in regional offices in Bristol, Leeds and the Bedford area.

The appropriate salary scale will be determined according to qualifications and experience, and will be within the range of £18,485 to £24,075; up to £2835 higher in London.

RELOCATION ASSISTANCE UP TO £5000 MAY BE AVAILABLE.

For further information contact David Mead, telephone 01-276 8645, or Ian Handyside, telephone 01-276 8109 in HMIP.

For an application form (to be returned by 27 April 1990) write to Civil Service Commission, Alencon Link, Basingstoke, Hants RG21 1JB, or telephone Basingstoke (0256) 468551 (answering service operates outside office hours).

**Please quote ref: T/955.**

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**INSPECTORATE OF POLLUTION**

**Department of the Environment**

# ENERGY WORLD

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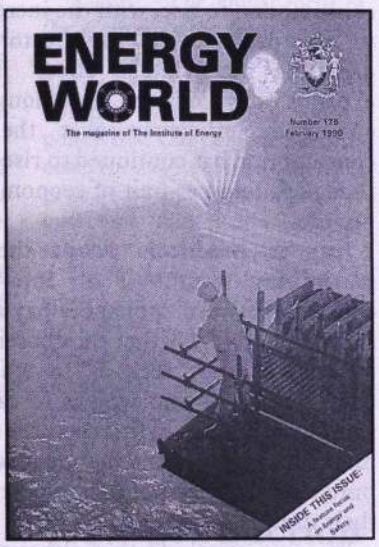
## COVER STORY




Our cover photograph shows a gas flare off operation in progress from the side of a North Sea gas production and storage platform. Although the photograph dramatically reflects the hazardous environment in which many workers in the energy industries operate, the controlled flaring of surplus gas is usually undertaken to reduce explosion risk and to enhance safety.

Although the offshore and onshore oil and gas industries have always been strictly regulated, a series of accidents in recent years has led to searching inquiries and even greater attention being focussed on this aspect of the industries' activities. With this concern in mind, *Energy World* has devoted a significant part of its editorial in this issue to cover safety matters relevant to the energy sector, starting on page 8.

The offshore platform from which the cover photograph was taken is the Rough Platform, operated by British Gas and located in the southern North Sea approximately 20 miles off the Humber Estuary. The platform was originally commissioned in 1975 as a gas production platform, but in 1984-85 it was converted to become the world's first offshore gas storage facility on a partially depleted field. Photograph by courtesy of Peter Kelleher, British Gas.

## CONTENTS



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

# The 'fifth fuel' and the Greenhouse Effect

ENERGY efficiency aficianados argue that there is benefit to be obtained on a substantial scale by substituting capital (and/or labour) for energy. This implies that the present allocation of available economic resources is sub-optimal. It follows that if they are right and we do what they ask the efficiency with which economic resources are allocated will rise to produce an increase in output at the macroeconomic level. There will, in other words, be an improvement in multifactor productivity at that level. This improvement may well be greater than the improvement at macroeconomic level in energy productivity, resulting in total energy consumption rising notwithstanding any fall in consumption per unit of output.

Veteran energy economist Sam Schurr of the US Electric Power Research Institute found that it was only when economic activity was constrained by rising energy prices that energy productivity growth exceeded multifactor productivity growth — which might actually fall in such circumstances. When energy supply was not a constraint multifactor productivity growth exceeded energy productivity growth to produce an increase in total energy consumption. Schurr's findings were supported by econometric studies by Professor Dale Jorgenson of Harvard.

In a paper to the 1982 annual conference of the International Association of Energy Economists, the writer pointed out that responding to energy price rise by using energy more efficiently amounted to accommodating the price rise, shifting the energy price/demand curve to the right and causing the balance between supply and demand to be struck at a higher level of production and consumption than if there had been no energy efficiency response.

In short, when energy supply was identified as a constraint responding (very properly) by using energy more efficiently caused energy consumption to fall by less than if there had been no energy efficiency response; and when it was not a constraint total energy consumption continued to rise even when consumption per unit of output was falling.

In practice, producers make capital investment decisions on the criterion of maximising returns to all inputs taken together. Even though they may be satisfied that they will save more in lower energy costs that they might spend on energy saving measures they may still opt for new plant that uses more energy per unit of output *at the existing level of production* than the old if for example it results in a more than compensating saving in labour. Paradoxically if all producers adopt this criterion it may result in energy consumption per unit of output falling at the macroeconomic level (although total energy consumption would certainly rise) because the rate of increase in total economic output may exceed the rate of increase in energy consumption; and this according to Schurr's studies has been actual experience over the greater part of the last several decades.

Not by any means all of the secular great improvement in energy efficiency over the last 150 years has taken this illusory form — ie, simply a consequence of increased efficiency of the production process as a whole. Much of it has been due to the 'vintage effect' — the tendency for new plant to be more efficient in all respects (including energy conversion) than the plant it replaces. There have also undoubtedly been many anecdotal examples at the microeconomic level where substituting capital and/or labour for energy has been the sound response at that level even when there was no general energy supply constraint on the economy — when for economic optimisation at the macroeconomic level the general substitution should be in the other direction.

The energy efficiency vintage effect has continued and indeed increased during periods of falling energy prices, because technical progress of all types tends to be greatest during periods of buoyant economic activity which in turn are stimulated by falling prices for important inputs like energy. However, once again, the net result has been for energy consumption to rise, with the increase in economic output due to improvement in multifactor productivity more than offsetting the 'vintage effect' in energy efficiency. This explains why, despite enormous improvements in energy conversion efficiency over the last 150 years, energy consumption has continued to rise both in total and per capita, though falling per unit of economic output over much of this period.

Just as producers adopt the investment criterion of maximising returns to all inputs so domestic consumers choosing between appliances pay at least as much attention to first cost and to whether the chosen appliance can best provide the service they seek as to whether it minimises energy consumption — and who is to say they are wrong? Even if significant savings in fuel costs are achieved the money so saved must find an outlet and in industrial societies it is likely to be in purchases that consume energy in their production if not also in their use.

We may conclude that although improvements in energy efficiency may bring benefits, reduction in total energy consumption is very unlikely to be among them. In the words of Environment Minister Virginia Bottomley speaking to the International Association for Meteorology and Atmospheric Physics last August, 'it is unhelpful and confusing to pretend, as some have done, that energy efficiency is the fifth fuel'; and the same must apply to claims that improvements in energy efficiency alone can solve fuel-related environmental problems.

This conclusion is not by a new one. Economist Stanley Jevons writing in 1865 about the security of Britain's fuel supplies in the ensuing 100 years said: 'Nor will the economical use of coal reduce its consumption. On the contrary, economy renders the employment of coal more profitable and thus the present demand for coal is increased ... It is wholly a confusion of ideas to suppose that the economical use of fuel is equivalent to diminished consumption. The very contrary is the truth.'

In modern economic parlance Jevons was saying that for a commodity to find itself in a world of more efficient use is for it to enjoy a reduction in its implicit price with all that that implies for demand. Much nervous energy has been needlessly expended and much ink needlessly spilt because this splendid piece of insight has gone unheeded.

**Dr L G Brookes** *(Fellow)*
*Energy and Economics Consultant*
*and former Chief Economist, UKAEA*

## Diesel power plant a first for British supplier

AN £11.5 million turnkey contract for a 17.4 MW diesel power station has been awarded to Hawker Siddeley Power Engineering Ltd (HSPE) of Burton on the Wolds, Leicestershire, by the Water and Power Development Authority of Pakistan (WAPDA).

The new power station will be the first major diesel-powered plant to be entirely supplied by a British company.

Financed by the Overseas Development Administration, the station will be built at Pasni on the Makron coast, 640 km west of Karachi, and will use Hawker Siddeley's Mirrlees Blackstone K9 diesel engines, driving 4.36 MW alternators manufactured by Brush Electrical Machines, also a Hawker Siddeley company.

In addition to the design and supply of all equipment for the power station, HSPE will also be responsible for shipping, transport to site, installation and commissioning, as well as for all civil works associated with the project which is due for completion towards the end of this year.

## Successful test drilling

PHILLIPS Petroleum Company Norway, operator for the Phillips Norway Group, completed drilling and testing the 2/7-21S well in the South Eldfisk area of the Norwegian North Sea in January.

The well was drilled by the Ross Isle rig in a water depth of about 230 feet.

The 2/7-21S well was drilled deviating from the same location as the 2/7-20 discovery well drilled in 1988. Bottom-hole location was about 3,700 feet southeast of the 2/7-20 well and the actual vertical depth was approximately 15,400 feet.

Drill-stem tests yielded a maximum production of 7,772 barrels per day of oil and 15.8 million cubic feet per day of natural gas through a 48/64-inch choke.

The 2/7-21S well will be temporarily abandoned pending a review of the test results.

## Centre for global energy studies is established

A NEW non-profit making organisation, the Centre for Global Energy Studies was inaugurated in London on 15 January. The primary aim of the Centre is to serve as a forum for more international cooperation in the field of world energy.

A statement issued for the launch of the new organisation says that the Centre aims to achieve clarity and homogeneity of thinking to promote a better understanding of energy problems from an objective viewpoint, taking into account the interests of all participants in the world energy trade and to narrow the intellectual gap that exists between the various players on the world energy scene.

It adds: "The global focus of the Centre stems from its basic belief that energy issues should be viewed globally within the optimal overall world energy policy that can help all interests concerned to reap the benefit of growth in energy trade and to overcome the major energy-related problems that may arise."

The Centre's first Chairman, and a leading figure in the founding of the new organisation, is Sheikh Ahmed Zaki Yamani, the former Oil Minister of Saudi Arabia. Other leading figures on the governing board are the Rt Hon Edward Heath MP, former British Prime Minister, Abdel Aziz Hijazy former Prime Minister of Egypt, the Rt Hon Denis Healey MP, former Chancellor of the Exchequer, Yousef Al-Shirawi, Minister of Development and Industry in Bahrain, Baroness Hooper, Britain's former Under Secretary of State for Energy, and Fadhil J Al-Chalabi of Iraq, the former Deputy Secretary-General of OPEC.

The Centre was inaugurated with an address delivered by Sheikh Yamani in which he assessed the main events and trends in the world oil trade during the 1980s and discussed the various interactions of market forces which were likely to influence the course of events for the oil trade in the coming decade.

He warned that if no action is taken to invest more heavily in the global oil supply infrastructure and in creating the conditions for price stability at a level that both consumers and producers are comfortable with, then the world may well be heading towards another damaging oil crisis.*

The Centre for Global Energy Studies will be based at 17 Knightsbridge, London SW1X 7LY.

* A full report on the address given by Sheikh Yamani will be published in a future edition of *Energy World.*

## New production reactor

STONE & WEBSTER Engineering Corporation has been awarded a contract to perform conceptual engineering for a new type of production reactor planned by the US Department of Energy.

The project's prime contractor is CEGA Corporation, a company formed by Combustion Engineering Inc and General Atomics Company. The reactor would produce tritium.

Stone & Webster has begun conceptual balance-of-plant design work for the modular high temperature gas-cooled reactor, which would use helium as a coolant. An inert gas, helium remains unaffected by the action of either chemicals or neutrons. The use of advanced coated nuclear fuel particles coupled with the use of helium and a graphite reactor core structure offers significant safety advantages.

## US report on hydrogen fuel

SIGNIFICANT movement from fossil fuels to non-polluting hydrogen could begin as early as the year 2000, according to a new report by Frost & Sullivan.

The study, *Hydrogen fuel: a technology impact report*, predicts that the economic costs of converting to non-polluting hydrogen will by then no longer appear prohibitive, particularly in view of the destruction of the environment. Pollution damage will by then be further advanced and, on the positive side, more widely appreciated.

The report details efforts by scientists to improve current hydrogen production technology. These include improved electrolysis of water; high temperature methods based on solar and nuclear energy; combinations of thermal, chemical and electrolytic processes; use of bacterial or algal photosynthesis agents; and photolysis by sunlight using light-harvesting semiconductors.

Frost & Sullivan forecasts that environmentalist concerns will be taken up strongly by governments by the turn of the century. Free enterprise will be encouraged to shift to non-polluting fuels through economic incentives and discouraged from use of fossil fuels through disincentives. Still, the conversion will have obvious economic costs.

Copies of the report are available from Frost & Sullivan Ltd, Sullivan House, 4 Grosvenor Gardens, London SW1W 0DH.

## British Gas acquires shares in Catalana de Gas

BRITISH GAS has agreed to purchase the 6.55 per cent stake in Catalana de Gas, currently held by the cement company, Asland, at a price of approximately £48 million. British Gas currently owns approximately 1.2 per cent of the shares of Catalana de Gas and its total holding will therefore be 7.75 per cent of the issued share capital.

This investment is being held with the agreement of Catalana de Gas and is being made following discussions over a period of time when Catalana de Gas and its major shareholder, Caixa de Pensiones, about possible opportunities for collaboration in Europe and the Spanish speaking world. Caixa de Pensiones owns about 24 per cent of Catalana de Gas and following the proposed merger with Caixa de Barcelona will own some 31 per cent of Catalana de Gas.

British Gas is keen to expand its international presence in the gas industry and has been actively seeking partners in Europe for some time.

Catalana de Gas is the largest private gas company in Spain and is the fourth largest gas company (in terms of customers) in Western Europe. The turnover in 1988 was £250 million.

## UK wind turbines go to Italy, Spain and N Ireland

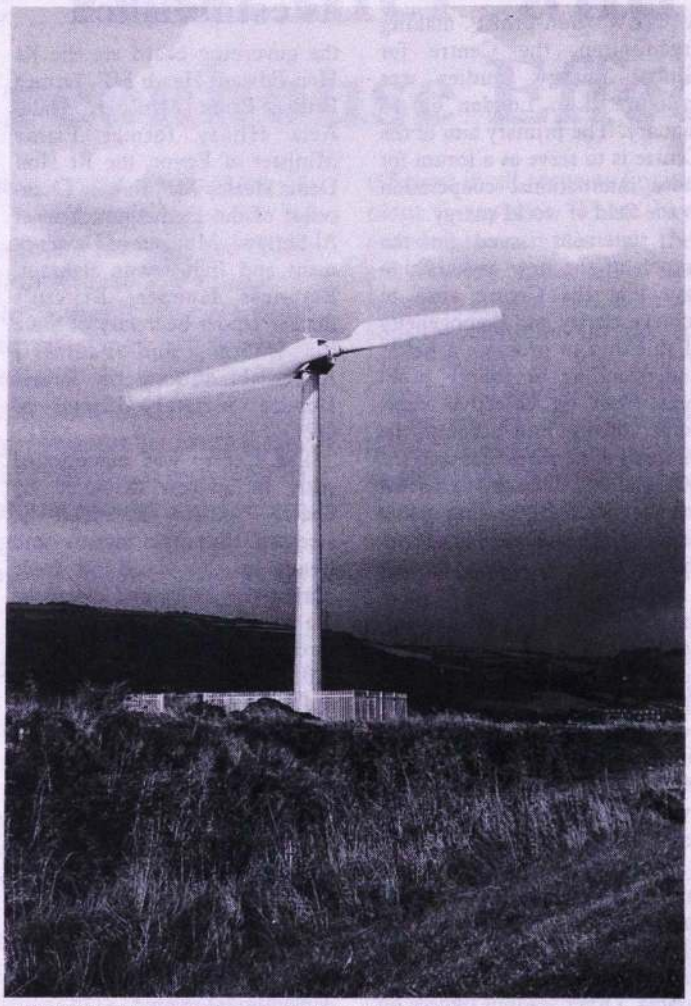
ITALY'S national electricity generating organisation Ente Nazionale per l'Energia Elettrica (ENEL) are acquiring three 300 kW wind turbines from Wind Energy Group Ltd, a joint company of British Aerospace and Taylor Woodrow. These will be supplied through Aeritalia, the giant Italian aerospace company who WEG have appointed to distribute and service MS-3 turbines in Italy.

One of the turbines is to be installed at Alta Nurra, which is a demonstration site in Sardinia, whilst two others are to be erected in the Aqua Spruzza area of the Appennines.

An identical turbine has been ordered by Northern Ireland Electricity for installation in the Antrim mountains north of Ballymena which is to allow the potential for further wind based energy to be assessed.

A fifth turbine has been purchased by UNELCO — the generating authority responsible for electricity supplies in the Canary Islands. This machine is being erected at Granadilla in the south western part of Tenerife. It will be operational by March 1990.

Twenty WEG turbines have been operating in California for the last three years. They have supplied over 31 million kWh to the grid of the Pacific Gas and Electric Company. There are other WEG turbines at Ilfracombe, Carmarthen Bay and on Orkney. The Orkney site at Burgar Hill has WEG's largest turbine, rated at 3 MW.



**The Wind Energy Group's MS-3 wind turbine generator located at the CEGB's Carmarthen Bay site, South Wales. The MS-3 has a two-bladed rotor, 33m from tip to tip, and has a maximum output of 300 kW at a wind speed of 11.5 metres/second (25 mph).**

## Extended IPE trading hours

AS OF 11 January the International Petroleum Exchange has extended its trading hours to 8 pm London time, 3 pm New York time.

The extended hours have been initiated in response to the demands of major participants in the market. It is believed that this move will greatly enhance the volume and liquidity of the Exchange's contracts.

In addition, the Commodity Futures Trading Commission (CFTC) has recently lifted its foreign options ban in respect of IPE options contracts, enabling US customers to trade options contracts for both Brent crude oil and gas oil.

## Removing organic sulphur from coal with enhanced bacteria

GENETICALLY enhanced bacteria designed to remove organic sulphur from coal are being developed by Battelle under a new, three-year $690,000 contract with the US Department of Energy's Pittsburgh Energy Technical Centre.

The enhanced bacteria would convert organic sulphur in coal to a water-soluble inorganic sulphate that could be washed away easily.

Battelle's programme manager Dr John Litchfield said: "Thiobacillus bacteria already can remove inorganic sulphur from coal, but organic sulphur is bound up in the structure of the coal. It cannot be removed by conventional techniques.

"We want to genetically modify thiobacillus to create a fast-growing strain of the bacteria that will remove the organic as well as inorganic sulphur from coal."

Development of such a technique is important because up to half of all sulphur in coal can be organic. Appalachian coal, for example, is especially high in organic sulphur. In its development programme, Battelle will use high-sulphur coals from Ohio and Illinois.

Thiobacillus, which is found in nature, draws its energy from the conversion of sulphur. Currently, it converts inorganic sulphur in coal through a series of steps into sulphate, which can be washed from the coal with water.

"With our experience and knowledge of molecular biology," Dr Litchfield says, "we're developing a cost-efficient and simple-to-engineer — yet natural — method for removing sulphur from coal."

Ohio State University will participate in the development of the bacteria under a subcontract.

## Exploratory drilling in Malaysia

BRITISH GAS (Malaysia) SA, the operator and its partners, Occidental Petroleum (Malaysia) Ltd and PETRONAS Carigali Sdn Bhd have begun a three well exploratory drilling programme for oil and gas in Sabah Block 2 offshore East Malaysia. The 'Jim Cunningham' semi-submersible drilling rig, has been contracted from Reading and Bates Malaysia for this work.

The group began drilling the first well, named Gajah Hitam-1 in January, in 520 feet of water. It is located 60 miles northwest of Kota Kinabalu, and 15 miles north of the Tembungo Oilfield.

This first phase of exploration in Sabah Block 2 began in 1988 when nearly 5,000 km of seismic data was acquired. These and other data have been interpreted to allow for the planning of the current drilling campaign. To handle the exploration and drilling operations, British Gas (Malaysia) SA has three fully staffed offices in Kuala Lumpur, Kota Kinabalu and Labuan.

## $DeNO_x$ installation

BABCOCK Contractors Limited have been instructed to proceed with proposals for the enlargement of the scope of the Hong Kong and China Gas Company Phase II contract.

Earlier this year BCL were awarded the HK$1 billion contract to provide the Phase II town gas plant. The enlargement to the contract, valued at HK$25 million, includes the design and installation of a $DeNO_x$ facility into the Reformer Flue Gas section of the new installation.

The $DeNO_x$ facility utilises the Selective Catalytic Reduction Process (SCR) to reduce $NO_x$ from the four Phase II Reformer Flues by about 90 per cent to meet the Best Practible Means criterion now being imposed by the Hong Kong environmental authorities.

The technology is being provided under licence from Babcock (Hitachi) of Japan.

This award brings the total value of orders for BCL during this financial year to over £100 million.

## High gas prices 'making UK industry uncompetitive'

UK INDUSTRY is paying over the odds for its gas supply, according to Mr James McKinnon, director general of the Office of Gas Supply (Ofgas).

Speaking at a Chemical Industries Association conference in London in January, Mr McKinnon envisaged increased pressure on UK industry's ability to compete by 1992, if there is no significant decrease in British Gas prices.

Mr McKinnon called for an acceleration in the rate at which competition within the gas industry is being introduced, in the hope that this will reduce the price of gas to industrial consumers, thus helping British industry to become more competitive.

## British Coal debt to be written off

A REFERENCE in the Queen's Speech to a new Coal Industry Bill was swiftly followed by the Bill's publication in November.

The proposed Bill makes provision for a major capital reconstruction of British Coal, effectively writing off its debts, in the hope that the corporation will be able to achieve self-suffiency in the foreseeable future.

Unrelieved losses from 1987-89, with further losses expected for 1989-90, together with falling coal prices will leave British Coal with an expected accumulated loss of around £5 billion by March 1990.

Energy Secretary, John Wakeham, stated that given this financial position, the Government was unable to continue advancing loans to British Coal, making the need for capital reconstruction 'essential and urgent'.

British Coal's Chairman, Sir Robert Haslam, welcomed the Bill, but expressed his surprise at the timing of the Government's announcement on the liberalisation of the limits for licensed private mines and opencast operations. This measure, said Sir Robert, would have been expected in the industry's Privatisation Bill, which he saw as the most appropriate way of handling the matter.

## Inenco Chairman condemns Government's 'dual standards'

ROGER KIRBY, Chairman of the Inenco Group plc, issued a statement on 2 January condemning what he sees as the Government's dual standards on energy and the environment.

In the statement, Mr Kirby claims UK Energy Secretary, John Wakeham's proposals contained within the electricity privatisation package could frustrate Inenco's plans to put mini-power stations, generating cheap $CO_2$-free electricity in every building in the UK, including houses.

He went on to point out that research carried out by his organisation indicates that the biggest single source of $CO_2$ — one of the greenhouse gases — is large CEGB electricity only power stations, producing up to 30 per cent of the UK's $CO_2$.

Mr Kirby claims that converting all UK power generation to the new mini power stations would cut UK production of $CO_2$ by 30 per cent.

Mr Wakeham's proposals, which allow the CEGB to sign long-term contracts with the Area Boards, ensure that the trend remains towards large, inefficient power stations, rather than the more efficient, environmentally friendly mini power stations.

Should the proposals remain unchanged, Roger Kirby envisages that five years from now there will be no mini power station industry.

## Safety award for NEI-IRD

NEI International Research and Development Ltd, of Newcastle upon Tyne, has won the Engineering Employers' Federation's Gold Hand Award for safety for 1988.

This success follows the company's achievement in winning the EEF's Three Star Safety Award for safe working in the years 1985, 1986 and 1987.

The Gold Hand Award is made for the company's continuing progress in accident prevention.

## North Sea discovery confirmed

**Oil well testing in progress from the semi-submersible drilling rig, Sonat Rather.**

MARATHON OIL, on behalf of the Brae Group, has confirmed a hydrocarbon discovery, adjacent to and partially underlying, its North Brae Field which has been on production since April 1988. The discovery is located 155 miles north east of Aberdeen.

The drilling rig Sonat Rather was recently contracted to re-enter and test Well 16/7a-30z which has encountered hydrocarbons during drilling operations in 1987.

The well flowed at a rate of up to 1319 barrels of condensate per day and 12.9 million cubic feet per day of gas, through a ½-inch choke.

## Government publishes energy statistics

PROVISIONAL statistics showing UK energy production and consumption and petroleum product prices in the three months September to November 1989 were published in January by the Department of Energy.

Total inland energy consumption of primary fuels — which includes deliveries into consumption — during the period September to November 1989 were equivalent to 82.6 million tonnes of coal, 2.9 per cent less than in the corresponding months of 1988. Consumption of natural gas and coal decreased by 7.3 per cent and 5.6 per cent respectively. Primary electricity and petroleum consumption increased by 4.3 per cent and 0.6 per cent respectively.

Production of indigenous primary fuels in the three months September to November 1989, at 88.8 million tonnes of coal equivalent, was 7.3 per cent lower than in the same period a year ago. Production of coal fell by 10.6 per cent to 24.9 million tonnes, but production of primary electricity increased by 3.8 per cent. Total petroleum production in the period September to November 1989 was 42.5 million tonnes of coal equivalent, a fall of 5.2 per cent on the corresponding period in 1988. Natural gas production fell by 11.7 per cent.

## Sellafield — new safety equipment

A NEW £1.5 million computer-based environmental radiation surveillance and recording system has been installed at the Sellafield site in Cumbria of British Nuclear Fuels plc.

The work carried out by Laboratory Impex, a nucleonics company based in Middlesex, involved installing continuous perimeter fence monitoring equipment for alpha, beta and gamma radiation, plus an additional detector to monitor specifically iodine-131, from 22 locations around the site.

The system replaces an existing surveillance network based on manual inspection of air samplers by staff.

## Engineers take the initiative on training

FED UP with waiting for many engineering employers to start updating their employee's knowledge of new technology, more and more engineers are taking the initiative; placing themselves on training and updating courses and having to pay for it themselves.

The Panasonic Trust receives applications from professional engineers to help pay for such courses. In recent months there has been an increase in the number of engineers needing assistance most of whom are getting no support at all from their employers. In the last six months there has been a 65 per cent increase in the number of engineers needing assistance.

To date, a total of £103,000 has been awarded to 256 engineers to help with further training in new technology.

The grant awarded is normally 50 per cent of the fees for the course, the engineer's employer is encouraged to pay the remaining 50 per cent, however many engineers have to find it from their own pockets. The Trust is administered by The Fellowship of Engineering which is the UK's national academy of engineering.

Further details and application forms are available from: The Panasonic Trust, Education Affairs Department, The Fellowship of Engineering, 2 Little Smith Street, Westminster, London SW1P 3DL.

## 1989 PEP Awards

A FAMILY brewery in Wisbech, Cambridgeshire, and a carpet manufacturer in Kendal, Cumbria, have won the UK electricity supply industry's national Power for Efficiency and Productivity (PEP) Awards for 1989.

Sir Philip Jones, Chairman of the Electricity Council, presented the awards to Elgood and Sons Ltd and Goodacre Carpets Ltd, who were judged the winning entries from those submitted by 346 companies throughout Britain.

The PEP Award scheme is organised by the electricity supply industry to reward companies which have significantly improved their business performance by adopting an electrical process or service.

## New combustion test rig on stream

**A furnace on the new Airoil Flaregas test rig being prepared for a performance trial.**

AIROIL FLAREGAS have commissioned a new test firing rig at their West Drayton headquarters in November.

The rig has been installed to help the company study and monitor constantly $NO_X$ and particulate reduction techniques on oil and gas fired burners.

With a maximum capacity of 9 MW, the new rig is designed to work with a wide range of liquid and gaseous fuels including heavy fuel oil, diesel oil, naptha, natural gas, hydrogen, propane and nitrogen. All these can be mixed to precisely simulate customer's requirements.

## Energy journalist award

ANDREW HOLMES has won the British Institute of Energy Economics' Energy Journalist of the Year award.

Mr Holmes began his career in the energy sector in the Department of Energy press office.

In 1982 he became editor of the Financial Times Business Information's newsletter, *World Solar Markets*.

Since that time he has edited the *European Energy Report*, *Energy Economist*, of which he remains deputy editor, and *Power in Europe*, which started in May 1987.

However it was the advent of the electricity privatisation saga which brought Mr Holmes' talents to the fore. The quality of his analysis, as well as his revelations concerning the technical and political facts behind the official announcements, served to raise the level of public debate, as a result of which he has been much sought after by both television and radio news programme producers.

The BIEE intend inviting Mr Holmes to one of their meetings in 1990 to receive his award in person.

## Minister approves plans for Piper

AT THE end of November, UK Energy Minister, Peter Morrison approved proposals for the £580 million redevelopment of Occidental's Piper field.

The redevelopment plan incorporates a fixed steel integrated drilling, production and quarters platform designed to accommodate 24 wells and export up to 140,000 barrels of oil per day to the Flotta oil terminal via the existing 30-inch pipeline.

## PowerGen wins direct supply contract

POWERGEN has won its first contract for the direct sale of electricity — a £50 million infrastructure and energy package for the huge new Toyota plant in Derbyshire, it was confirmed in December.

The 10-year deal is believed to be the first such arrangement in the run-up to the privatisation of the electricity supply industry.

Toyota will require up to 40 MW of power at the £700 million manufacturing plant being built at Burnaston with a planned capacity of 200,000 cars a year.

PowerGen will also install and maintain the electricity infrastructure to the site for Derbyshire County Council – including the building of a substation and a half mile 132kV line linking into the National Grid.

## Wind farm for the Tees?

WIND power experts from Denmark recently visited the South Gare breakwater at the mouth of the Tees to discuss the prospects for a group or 'farm' of wind turbine electricity generators.

Cleveland Centre for the Development of Alternative Products had picked this area as suitable for generation of wind powered electricity. The Danish specialists agreed and estimated that at least 2 MW of power could be supported by the site. The land owners, Tees and Hartlepool Port Authority, have expressed interest in the proposal and have provided detailed records of wind speed and direction at the site.

Considering the winds to be expected at South Gare, the manufacturers, Vestas Wind Systems, A/S, would guarantee a minimum production in the region of five million kWh per year or almost £200,000 worth at current prices, and likely to increase after electricity privatisation.

The total investment would be well under £2 million, some of which could come as grant aid from the EC and a substantial proportion of the work could be placed with local steelworkers and civil engineers. This could amount to between 25 and 30 person-years of work.

## Student award

THE MIDLAND Branch of the Institute will award a prize of £100 for the best student paper submitted for inclusion in the branch programme for 1991/1992.

The prize was introduced in 1978 in memory of the branch's former treasurer, Mr H K McAndrew.

The topics of papers submitted for this award should be within the range of subjects considered suitable for inclusion in the branch programme. Preliminary advice on suitable topics may be obtained from the secretary of the Midland Branch, or its education officer, whose addresses are given below. Papers should normally be between 2,000-3,000 words.

The text of a paper submitted for this award should be sent to the secretary of the Midland Branch by 1 September 1990. The entries will be considered by a small panels of members of the Midland Branch Committee and the results advised to all competitors by 1 January 1991. The winning paper will be included in the branch's programme as soon as possible thereafter by arrangement with the author.

It is hoped that candidates submitting papers for this award will be student members of The Institute of Energy. However, submissions from non-members of the Institute will also be welcomed for consideration. Candidates for this award should normally be not more than 27 years of age.

The decision of the Award Panel will be recommended to the committee of the Midland Branch of The Institute of Energy, whose decision will be final. If no suitable papers are forthcoming, the award may be withheld.

Entries for the McAndrew award may also be submitted for publication in the *Journal of The Institute of Energy*.

For further copies of these conditions and further details, telephone or write to: Mr L Green, Honorary Secretary, Midland Branch, The Institute of Energy, Dunlop Int Technology Ltd, PO Box 504, Erdington, Birmingham B24 9QH, tel: 021-384 8800 (ext 315); or to The Education Officer, Dr R G Temple, Dept of Chemical Engineering, Aston University, Aston Triangle, Birmingham B4 7ET, tel: 021-359 3611 (ext 4622).

## Gold award for Institute Fellow

JASPER MARDON, a Fellow of The Institute of Energy and President of Omni Continental (1986) Ltd in North Vancouver, BC, Canada, has been honoured with TAPPI's Gunnar Nicholson Gold Medal Award. The award is the highest honour that the association can bestow on an individual for significant contributions to the technology and science of the paper and related industries.

The award will be presented to Dr Mardon at a special awards ceremony during the 1990 TAPPI annual meeting in Atlanta, Georgia, 5-8 March.

TAPPI is a worldwide professional society dedicated to advancing technology and professional achievement in the paper and related industries.

Pulp and paper mills throughout the world, especially in their paper machine operations, have benefitted from Dr Mardon's research and development efforts for four decades. Techniques he developed for analysing paper machine performance have led to the identification and solution of many of the problems which constrained the speed of machines, hence clearing the way to higher production speeds and lower operating costs. His elucidation of the forces acting on wet webs has led to the increased use of mechanical and chemimechanical pulps in newsprint, with consequent reductions in wood use and environmental problems. His early work on wire flow photography and the use of frequency domain techniques to characterise headbox performance have been adopted as standard tools throughout the industry.

Dr Mardon is the author or co-author of over 120 technical papers, and he has been granted numerous patents.

For his professional achievements he has been widely honoured in Europe and North America. He was designated a TAPPI Fellow in 1968 and was the first to receive the TAPPI Paper and Board Manufacture Division Award. He is a three-time recipient of the Weldon Gold Medal of the technical section of the Canadian Pulp and Paper Association. In 1987 he was elected to the Canadian Academy of Engineering. Dr Mardon is also a former member of Canada's National Research Council.

He earned BA, MA and PhD degrees from Cambridge University. Dr Mardon subsequently studied hydrodynamics at the University of Manchester Institute of Science and Technology. Before founding Omni Continental in 1974, he had been affiliated with Bridgend Tissue Mills of Wiggins Teape Co, Anglo Paper Products, Oxford Paper Co, and MacMillan Bloedel.

## Book aid — branch help required

IN THE February 1989 issue of Energy World there was a request from the Chairman of the International Committee for branch help in starting a book aid scheme.

Unfortunately only two branches offered their assistance and as the scheme will not succeed without branch help, the International Committee is now making another plea for support.

Members willing to help in getting the scheme started should send a note of their names, addresses and branches to the Chairman, International Committee, The Institute of Energy, 18 Devonshire Street, London W1N 2AU.

## The Journal — late publication

REGULAR readers of the *Journal of The Institute of Energy* have unfortunately been kept waiting for their December issue. Distribution was delayed by production problems, and has had to be re-scheduled for February. Schedules for the March and subsequent issues will not be too seriously affected.

## New Year Honour for Fellow

ONE of The Institute of Energy's Fellows, David Jefferies, the Chairman-designate of the National Grid Company (Gridco), has been awarded a CBE in the New Year Honours list.

Mr Jefferies, who joined the Institute as a Fellow in 1985, was appointed Chairman-designate of the National Grid Company in June 1988, and has been Deputy Chairman of the Electricity Council since February 1986.

Mr Jefferies has previously held several senior posts within the electricity supply industry, including those of chief engineer of the Southern Electricity Board, a director of the North Western Region of the CEGB, director of personnel management of the CEGB, and Chairman of the London Electricity Board.

Mr Jefferies is a Chartered electrical engineer and a Member of the Fellowship of Engineering. He is also a past member of the Council of the Institution of Electrical Engineers, and also immediate past Chairman of the Management and Design Division of the IEE.

He is a Freeman of the City of London and a Liveryman of the Wax Chandlers Company.

## Past Presidents' reunion

OF THE 25 surviving Past Presidents of the Institute, 16 attended a reunion Christmas lunch at the Royal Thames Yacht Club on 5 December.

The lunch was hosted by two Past Presidents, Geoffrey Gollin and Charles Roast, and was attended by an additional 14 Past Presidents: Dr G Whittingham, Dr G G Thurlow, Mr P C Warner, Mr D F Rosborough, Dr N M Potter, Mr J H Flux, Dr J E Garside, Professor A Williams, Dr J Gibson, Mr F E Ireland, Professor J Swithenbank, Professor M W Thring, Dr J H Chesters, and Mr C E Pugh CBE.

The first of its kind, the function was enjoyed by all who attended, some of whom expressed their intention to hold another ex-presidential reunion in a year or two.

# The human factor in safe plant operation

## *Lessons learned from investigation of some major incidents*

*by Keith Wilson ARIC, CIChemE**

**Three explosions and fire incidents on separate plants on a large refinery operation resulted in four fatalities. The incidents occurred during plant maintenance, plant cleaning and after plant modification. In the following article, the circumstances of each incident are outlined and the influence of the human factor is described. Management control of the human factor to complement systems of work and physical safeguards is recognised.**

FATAL accidents occur even in the large petrochemical industries where the principles of self regulation embodied in the Health and Safety at Work Act may be expected to be carried out. Prevention of some accidents however requires a greater reliance on the human factor for control than others.

This article discusses three incidents that occurred at a major refinery within the space of three months. The incidents resulted in four fatalities and, in one case, necessitated a major plant rebuild. The examples chosen illustrate the diversity of the human factor. They reinforce the points made in HSE Publications[1, 2] on maintenance hazards in the chemical industries and on human factors, that a plant and its operating personnel are at their most vulnerable during times of maintenance and abnormal running conditions.

Attention to technical aspects (the hardware) of safe plant operation can sometimes overshadow management systems (the software) required to assure and complement the effectiveness of the engineering safeguards. Management systems, in this context, are about control of the human factor — plant supervisory, operating and maintenance personnel.

The following comments taken from reports of incidents in the UK and abroad in recent years, show the influence of the negative side of the human factor, ie, misunderstanding, failure to appreciate hazards and consequences, failure to follow instructions. The positive side of the human factor includes correct assessment and response to plant output data, adherence to plant instructions and company codes, attention to safe operation.

*'An inexperienced electrician's mistake sparked off a full scale emergency. The worker misunderstood instructions in a routine trip test. A screwed plug blew out of a relief valve causing an uncontrollable escape of process gas into the compressor house'.*

*'Instructions to the operators were very strict indeed but the operators ignored them nevertheless. Operator errors involved systematic, persistent and conscious violation of clearly stated safety rules'.*

*'The persons responsible for issuing the permit failed to recognise the significance of solid deposits in the pipeline'.*

* *Principal Specialist Inspector, Technology Division, Health and Safety Executive*

The types of incident quoted in the previous column are not unique and this article describes incidents that the author has been involved in investigating. The article does not contain a detailed description of the investigations nor a discussion of how potential causes of the incidents were assessed and eliminated to arrive at a consensus opinion as to the most likely cause. These are described in a full HSE report.[3]

## The author

**Keith Wilson joined the HSE in 1976, after working for ICI for several years. After a short period in London, he transferred to Birmingham to work in the Fire & Explosion discipline.**

**He is currently working in Scotland, where he heads a Process Safety team.**

### Plant maintenance

The first incident was on the main site flareline system. The system had evolved over many years, it was seldom shutdown, it was large, complex and had a high volume, low pressure throughput of gas and gas liquids.

The need arose to replace a crossover valve which was passing gas between two streams. A method was devised for isolating the particular section of pipework; scaffolding was erected and the line checked for liquid. A permit to work was then issued. The permit recognised the possible presence of pyrophoric ferrous sulphide scale and so contractors working on the valve were instructed to wear self contained breathing apparatus to protect them against the possible presence of toxic hydrogen sulphide vapours. A compressor was provided for auxiliary air line breathing apparatus sets and a mobile crane was brought in to support and lift the valve during the maintenance operation. Site rules required that the compressor was fitted with a flame arresting exhaust box, however earlier mechanical failure meant that this rule was not complied with. As the valve flanges were being released the line sprang open and liquid poured out and fell to ground level where it ignited, presumably on the compressor, and enveloped two men on the scaffold staging in flame. The bodies could not be removed from the site of the incident for about 24 hours until the flames were snuffed using a nitrogen purge.

The sample point used to test that the line was liquid free was remote from the part of the system where the job was to be done. It was also prone to blocking with scale. The remedies proposed to prevent similar occurrences were simple in that they were to mark valve bodies and stems to show the open and closed positions and to provide drain and sample points on or close to identified critical valves in

the system.

A major point about this incident was that hazards involved in the operation were recognised but the consequences of those hazards being realised were not thought through and then acted upon to prevent their occurence.

## Plant modifications

The second incident occurred on the hydrocracker unit on the plant. The hydrocracker was used for the catalytic hydrogenation of waxy sulphur containing residues to give more valuable products. The hydrogenation reactors operated at around 2,250 psi and 350°C with a throughput of about 50,000 gallons per hour. Liquid from the reactor beds was cooled to around 50°C to partially outgas hydrogen. Pressure was then reduced to about 120 psi to remove further hydrogen before liquids were passed forward to be fractionated.

Critical aspects of the plant operation, from the production point of view, included control of reactor bed temperature to maximise the product yield and control of hydrogen quality because too much light hydrocarbon impurity could give rise to excessive compressor vibration with the potential for long and expensive shutdowns.

The incident itself centred around the principal high pressure/low pressure interface within the system. Liquid flow through this interface between high and low pressure separator vessels could be controlled by either of two parallel valves operating in the manual or automatic mode.

In practice, both valves were used together to reduce vortex effects in the high pressure vessel. In the original design of the hydrocracker a turbine was included on the outlet side of the high pressure separator to utilise the energy available from the 2000 psi pressure drop. This turbine was designed with low and extra low level protection to shut off liquid flow and thus prevent damage to it from breakthrough of high pressure gas. Although the turbine was removed in the very early days of plant operation, the cut-off protection switches remained. This high/low pressure interface in the system relied on single valve operation for process control and safety isolation. Not all operators understood that the level control switches had a wider function than just protection of the (defunct) turbine.

On the day of the incident the plant was on standby and only a small amount of liquid feed was passing forward through the plant. The plant was on manual control and downstream the low pressure separator was boxed in. Just after a shift changeover the plant blew up, shock waves were felt 18 kilometers away, metal fragments of up to two tonnes in weight travelled up to 1.2 kilometers from the scene of the explosion. One contractor was killed by the fireball associated with the explosion. There was no damage caused to other plant units on site by flying debris that led to any escalation of the incident.

A principal factor in this incident was failure to successfully control the high pressure/low pressure interface between two vessels designed for different duties. The downstream

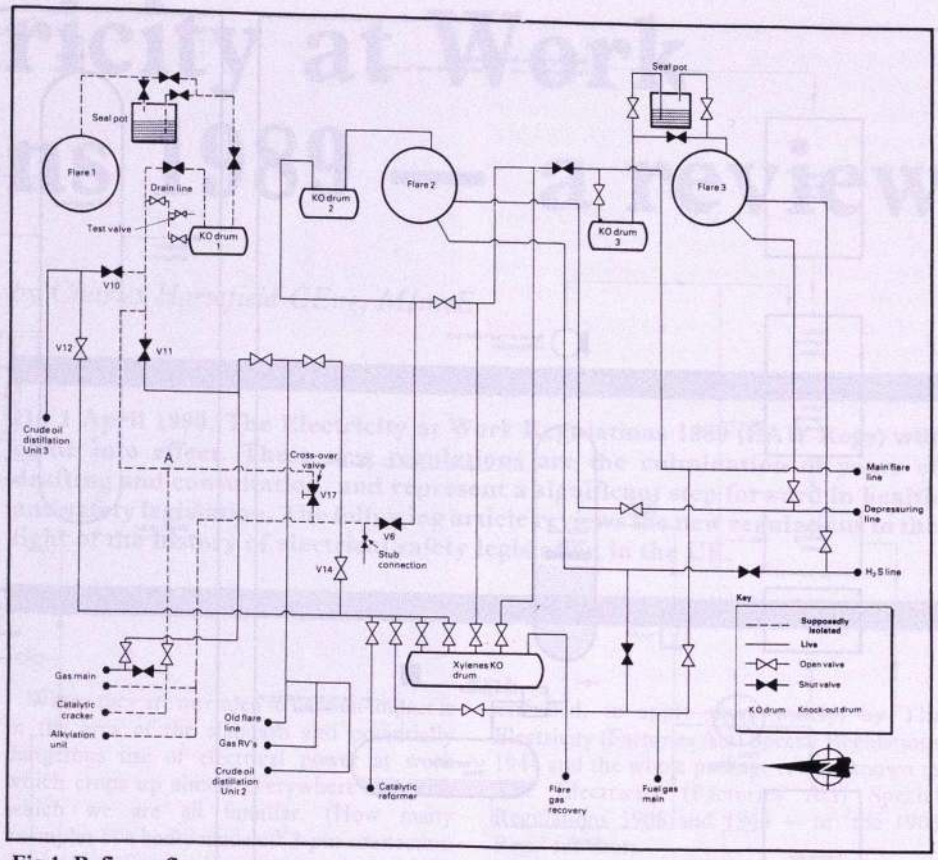



**Fig 1: Refinery flare system.**

vessel was designed to handle the passage of liquid at low pressure. It was not designed to withstand the high pressure that could result from gas breakthrough when its liquid and gas outlets were shut.

During a maintenance period several years before the incident a solenoid on one of the flow control valves had been by-passed. This solenoid was intended to dump air to the control valve on actuation by the extra low level switch on the high pressure vessel. The alarm signal announcing the trip condition had also been disconnected in an instrument panel in the control room. No record of the modification, its approval, reasons for carrying it out or analysis of the consequencies could be found. It was suggested that trip function was a bit inconvenient as it caused unwanted plant stoppage.

Removal of the solenoid from the control loop meant that the protection provided by the extra low level trip was no longer available so that the system relied on the normal automatic process control to shut one valve and manual intervention to shut the other. With these critical valves mounted in parallel, any failure of either one could allow the high pressure vessel to empty of liquid. Loss of liquid seal would then mean that high pressure gas could feed forward into the low pressure vessel. Loss of the trip function meant that any failure of process monitoring or mis-interpretation of control room data by operators could result in valves mistakenly being opened or left open causing loss of the liquid seal level in the high pressure vessel with consequent gas breakthrough.

The consequences of disconnecting vital trips was not fully examined nor was the significance of these trips to plant safe operation appreciated. Although all the plant trips continued to be shown on the P & I diagram, the reality was that the system relied on a single valve for both isolation and control. There was nothing to protect the plant against the possibility of human error.

## Systems of work

The third incident involved the cleaning of a floating roof tank used to store stabilised crude oil. With the waxy nature of North Sea crude, sludge banks build up even in stirred tanks. In an 80 metre diameter crude oil tank, banks of sludge had built up to a height of about two metres and covered a large proportion of the base after only a few years of operation.

One way in which these tanks could be successfully cleaned was for people to go inside them and remove the sludge either mechanically or by hand. To do this, the tank had been drained and allowed to vent naturally through opened manholes but it was not purged nor provided with additional mechanical ventilation. The contractors employed to remove the sludge had been used before and were aware of site safety rules. They brought on site their own hydraulic pumps, hydraulic tractor unit and diesel generators to provide hydraulic power. They also supplied their own airline breathing apparatus for use inside the tank.

During the cleaning operation a fire started in the tank followed by a low power explosion in which one of the men working in the tank died. The investigation revealed that the sludge the company believed to have a flashpoint of about 15°C actually flashed below 0°C. It was likely, therefore, that there would always be vapours within the flammable range somewhere within the tank. The range of

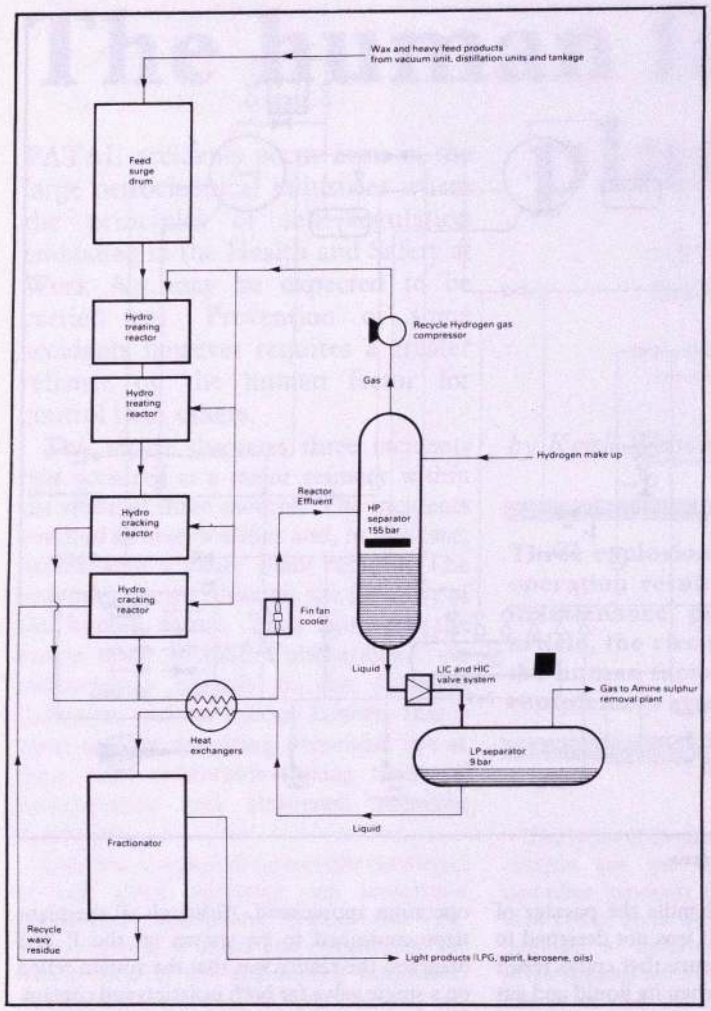



**Fig 2: Hydrocracker process flow system.**

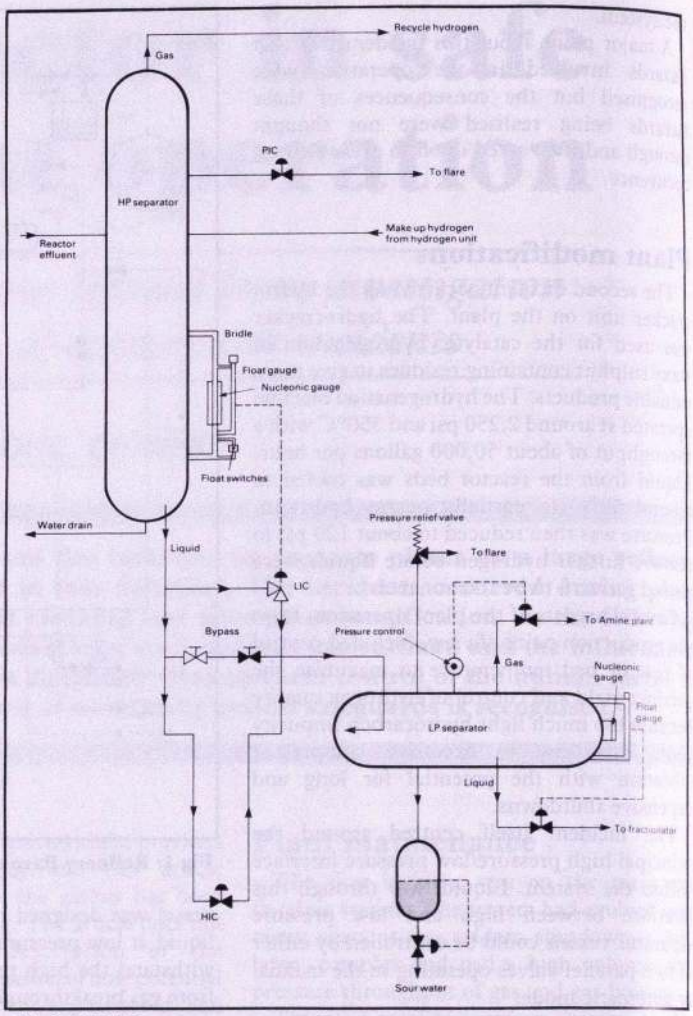



**Fig 3: HP/LP separator control system.**

potential sources of ignition for such vapours included pyrophoric scale; generation of static electricity on clothing, on flexible hoses, etc; the proximity of diesel power packs to the tanks; hot surfaces on hydraulic pumps used within the tank, etc. During the course of the investigation to discover which was the most likely of the many possibilities one of the contractors admitted to smoking in the tank. This turned out to be custom and practice for some of the cleaning gang including the outside fire watchman, who himself occasionally went inside for a smoke. The site was petroleum licensed and the contracting company had provided a specially designated smoking cabin for the contractors.

The salient points in this incident were that standards of supervision and control by the contractor's company were lax; monitoring of the contractors' competence and actual standards by the contracting company were not sufficiently thorough; observance of site procedures including dematching (which was a standing instruction) was poor but, in the end, disobeying fundamental safety rules either through ignorance of the dangers or foolhardiness caused the incident.

## Comments — Inspection

These three incidents occurred before CIMAH safety reports for the sites had been completed and submitted to the HSE but even if this were not the case it is questionable whether HSE inspectors reading the report or carrying out normal inspection duties on site would have been able to prevent four men dying. For instance, in the case of the hydrocracker examination of P & I diagrams showed protective systems to be in place. On paper the interface between the high and low pressure sides of the system seemed acceptable with both monitoring and alarm systems present. Finding that they were not, required painstaking inspection in inaccessible and remote parts of a physically large plant. Hindsight would lead to examination of a small part of a relatively small part of a large refinery, but when time is at a premium other parts of other plants may have to be omitted. Inspection has to be planned and targeted.

## Management

The incidents involved the negative aspects of the human factor and it is a function of safety management to control and avoid the unacceptable consequences of these negative aspects. A determined person may succeed in carrying out deliberate acts such as smoking in a controlled area, as in the case of the tank fire. Nevertheless many things could and should have been done to deny the man the opportunity to smoke in the tank. In the case of the flareline, permit systems were used but more rigorous examination of the job should have highlighted the problems of sampling on an overhead line which was prone to scale formation. Plant safety management has to commit time resources to monitoring the effectiveness of laid down safe working procedures, to training and supervision of workers, to modifications and updating in the light of experience.

## Conclusions

Many individual lessons can be drawn from these incidents and these are described in the full report.[3] However, the main points of this paper are: firstly, that it is vitally important for all persons involved with chemical plants whether in a production or a safety role, to take full account of the physical safeguards provided, to ensure they are adequate and continue to be so and; secondly and equally important, that these persons are alive to the human factor, its management and control. The costs of neglect in either area can be catastrophic. □

## References


1 *Dangerous Maintenance: a study of maintenance accidents in the chemical industry and how to prevent them*. Health and Safety Executive available through *HMSO*.

2 *Human Factors in Industrial Safety*. Health & Safety Executive.

3 *Fires and Explosion at BP Oil (Grangemouth) Refinery Limited at Grangemouth and Dalmeny, Scotland, 13 March, 22 March, 11 June, 1987*. Health & Safety Executive.

# The Electricity at Work Regulations 1989 — a review

*by Charles Horsefield CEng, MInstE*

**On 1 April 1990, The Electricity at Work Regulations 1989 (EAW Regs) will come into effect. These new regulations are the culmination of years of drafting and consultation, and represent a significant step forward in health and safety legislation. The following article reviews the new regulations in the light of the history of electrical safety legislation in the UK.**

IN THE same way that the Control of Substances Hazardous to Health Regulations 1988 were the most far-reaching industrial health legislation so far produced under the Health and Safety at Work etc Act 1974, The Electricity at Work Regulations 1989 are the most far-reaching safety regulations to date, touching, as they do, on almost every work activity where electricity in used. An additional 16 million people at work will now for the first time be covered by specific electrical safety legislation.

For the most part the new regulations are expressed in general terms, describing ends to be achieved and a memorandum of guidance has been published which is intended to help duty-holders in all industries to identify the good practices which must be followed to achieve compliance. One part of the regulations, Part III, refers specifically to mines, however, and a separate Approved Code of Practice has been produced to cover it. In addition, there is an Approved Code of Practice which explains how the regulations apply to quarrying.

Neither of these areas of work will be covered by this article as the intention is not to highlight the relevance of the EAW Regs to specific parts of the energy industries but, rather, to explain how they will be of general significance in industry, commerce, research and education. After all, the extractive industries, like the electricity supply industry, have a well established close interest in electrical safety and the new regulations are not intended to interfere with existing good safety practice.

Where they are intended to have an impact is in the area of the slapdash and potentially dangerous use of electrical power at work which crops up almost everywhere and with which we are all familiar. (How many examples of a badly made-off 3-pin connection does one see in a typical week — whether it be in the office, in the lab or on a piece of industrial equipment?). Most particularly they are intended to address the problem of unnecessary 'live' working which leads to so many fatal injuries.

## History of electrical safety legislation

If well-established good electrical safety practices exist already in many industries, why then was it necessary to introduce all-encompassing regulations at this point in time? To answer this question it is necessary to go back to the turn of the century.

The first Electrical Inspector of Factories, G Scott Ram, was appointed in 1902 soon after the Factories and Workshops Act 1901 had introduced powers by which the Secretary of State would make regulations. Scott Ram drafted The Electricity Regulations 1908 which remain in force today; they were extended, to apply more widely, by The Electricity (Factories Act) Special Regulations 1944 and the whole package is now known as The Electricity (Factories Act) Special Regulations 1908 and 1944 — or 'the 1908 Regs' for short.

Although generally recognised as a very effective piece of legislation the 1908 Regs have seen their day coming, as they did long before the existence of the National Grid. Notwithstanding the undoubted vision of Scott Ram his regulations could not have been expected to keep pace with 80 years of technological development. Think for example of the standardisation of double insulation which did not come until the 1960s. Where the 1908 Regs are expressed in prescriptive terms, they could actually be seen to impede innovation in safety practice. Furthermore, even as extended in 1944 they cover work in factories and what are known as "notional factories" (eg, docks, wharves, quays and building operations) but not in farms, colleges, research laboratories, offices, shops, etc.

One of the principal recommendations of the Robens Commission on Health and Safety legislation, when they reported in 1972, was that piecemeal regulations should be rationalised and made universally applicable to all at work. They specifically identified the hazard of electricity as one suitable for the application of a new approach which would reconcile flexibility with precision. What were required, wherever practicable were ... "statements of broad requirements in terms of the objectives to be achieved".

Out of *The Robens Report* came the Health and Safety at Work Act 1974 (HSWA) and this enabled the making of such regulations. Work was begun on the EAW Regs almost immediately and reached the stage of informal consultation with the CBI and the TUC in 1981. This led to the approval of a formal public consultation on the draft regulations and three codes of practice by the Health and Safety Commission (HSC) in 1984.

There was a massive response from a wide range of organisations including several

## The author

**Charles Horsefield is one of HM Inspectors of Factories based in the Safety and General Policy Division of the Health and Safety Executive in London. He has been with the Factory Inspectorate since 1976 and had 12 years' experience as a field inspector in the northern Home Counties area before moving to his present appointment in the electrical safety section of the Safety and General Policy Division.**

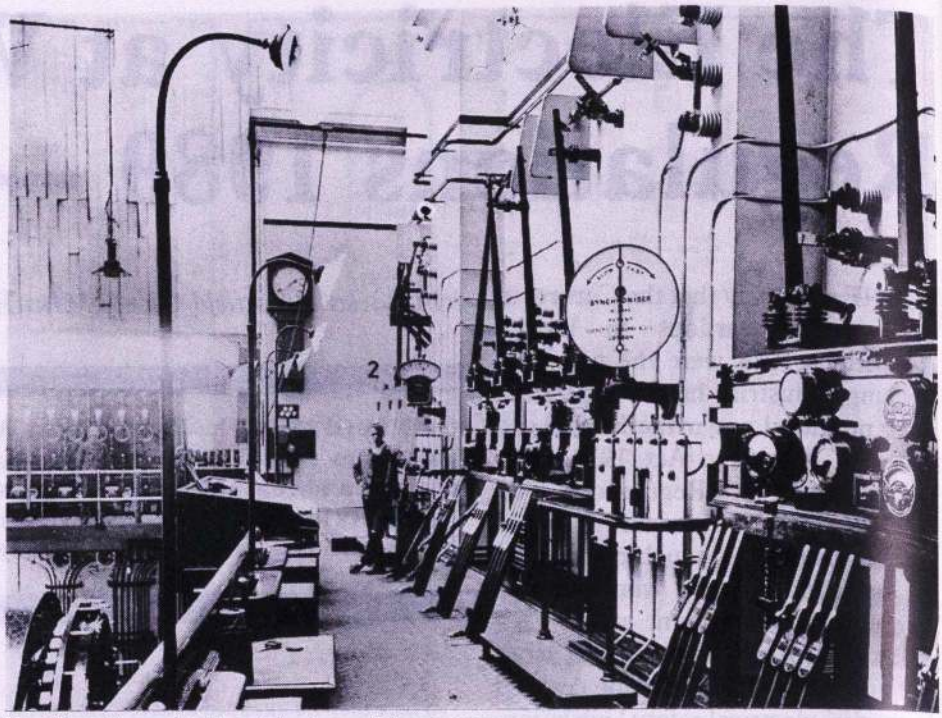
**He began his career as a graduate apprentice with the Parkinson Cowan Group after graduating at the University of Leeds with a BSc in fuel science. He later worked on gas fired process heating equipment at Wild Barfield Limited and subsequently at Barlow Whitney Limited, progressing to the position of product manager for gas-fired infra-red equipment with both companies.**

**He now specialises in electrical safety policy and legislative matters in the UK and the EEC for the Health and Safety Executive.**

**Mr Horsefield has been a Member of The Institute of Energy since 1972.**

professional institutions though not, strangely enough, from The Institute of Energy. The general view supported the draft proposals except in relation to the concept of an Approved Code of Practice on the generally applicable provisions of the regulations — as distinct from the mining and quarrying codes. The overwhelming majority were in favour of a memorandum of guidance on the lines of the 'blue book' which provides commentary on the 1908 Regs.

Subsequently by a slow and gradual process the varying and sometimes conflicting interests of the interested parties were accommodated or balanced, as necessary, until we arrived at the package finally launched by the Chairman of HSC in June 1989. It would be too much to hope that such a compromise package would meet with any individual's unreserved approval — in fact, if it did, it would be rather worrying. It is hoped, however, that the EAW Regs will enable the development of better safe electrical working practices, where they are needed and if the "1989 Regs" last half as long as the 1908 Regs they will do very well.



**Deptford Power Station at the turn of the century.**

## Essentials of the regulatory package

One of the problems to be overcome by those drafting wide-ranging and all-embracing regulations under HSWA is the overriding requirement that there should be no lowering of standards of safety established in law under existing legislation (HSWA Section 1(2)). Where existing legislation, which is to be revoked, is expressed in specific and absolute terms it is not easy to accommodate this within general provisions applying everywhere.

The approach taken in the EAW Regs is to refer in almost every regulation to 'danger' or 'injury' — terms which are defined at the outset — and to require adequate or suitable means of prevention. What is meant by 'adequate' and 'suitable' will depend to some degree upon the circumstances. It is important to note that where terms are defined in regulations the meaning given is specific to those regulations and 'danger' will not have precisely the same meaning under the EAW Regs as it has under the 1908 Regs. On the one hand 'danger' in 1908 extended to include danger from "other injury attendant upon ... use of electrical energy" — whereas the 1989 definition is confined to risk of *electrical* injury (shock, burn etc).

Danger consequential to machine malfunction arising from electrical causes is, therefore, not covered as it was previously — but there have been many machinery safeguarding legislation developments since 1908.

On the other hand, whilst the 1908 definition of danger is confined to 'injury to persons employed', the 1989 definition makes no such distinction and all potentially at risk are covered. It is, therefore, very important to see such a code of regulations within the context set by its 'interpretations' section — in this case, Regulation 2.

Other regulations which set the scene are:

Regulation 3 — which describes the various duty-holders under the EAW Regs. Essentially, all who have anything to do with electricity at work (employers, the self-employed, and employees) are required to comply with these regulations to the extent of their control.

Regulation 29 — which provides a defence for those who have contravened an absolute requirement but can show that they took all reasonable steps and exercised all due diligence to avoid such a contravention.

Regulation 31 — which extends the application of the regulations outside Great Britain to cover off-shore coal mining — but not work in oil-extraction, and

Regulation 32 — which disapplies the regulations in relation to some ship-board activities on sea-going ships and to moving hovercraft and aircraft — but note that they do apply to vehicles in general.

Part II of the regulations, which is entitled 'General', comprises a series of hardware requirements (Regs 4-12) followed by some 'software' provisions (Regs 13-16) and all apply to almost every place of work whether it be an electric locomotive travelling at 90 mph, a school physics laboratory of an oil refinery.

I do not propose to reproduce the text of the individual regulations here or indeed to comment on them but the following list of regulation headings gives an idea of the scope of Part II:

Regulation 4 — Systems, work activities and protective equipment.

Regulation 5 — Strength and capability of electrical equipment.

Regulation 6 — Adverse or hazardous environments.

Regulation 7 — Insulation, protection and placing of conductors.

Regulation 8 — Earthing or other suitable precautions.

Regulation 9 — Integrity of referenced conductors.

Regulation 10 — Connections.

Regulation 11 — Means for protecting from excess of current.

Regulation 12 — Means for cutting off the supply and for isolation.

Regulation 13 — Precautions for work on equipment made dead.

Regulation 14 — Work on or near live conductors.

Regulation 15 — Working space, access and lighting.

Regulation 16 — Persons to be competent to prevent danger and injury.

The memorandum of guidance is intended to be of interest and practical help primarily to engineers (including those involved in the design, construction, operation or maintenance of electrical systems and equipment), technicians and their managers. Whilst it reflects the HSE's view on interpretation of the regulations it has no legal status such as an Approved Code of Practice would have. One of its main functions is to direct duty-holders towards more detailed sources of guidance, such as HSE Guidance Notes on specific topics and British Standards. One of the most frequently made references is to the Institution of Electrical Engineers "Regulations for Electrical Installations" — a non-statutory code of practice which mirrors the International Standard IEC 364 on electrical installations.

In one key respect the EAW Regs actually go beyond the specific safety requirements established in law over the last 80 years. Whilst good practice demands that an electrician, or

an electrical engineer, working on part of a system which would be dangerous if it was live, switches off first, this is only required in the 1908 Regs when the supply is at over 650 V. Most fatal electrical accidents to those at work involve electrocution or burns from a supply at less than 650 V and, more often than not, there is no real justification for approach whilst the parts are live.

Regulation 14 is worded to address this problem as follows:

Work on or near live conductors

14 No person shall be engaged in any work activity on or so near any live conductor (other than one suitably covered with insulating material so as to prevent danger) that danger may arise unless:

(a) it is unreasonable in all the circumstances for it to be dead; and

(b) it is reasonable in all the circumstances for him to be at work on or near it while it is live; and

(c) suitable precautions (including where necessary the provision of suitable protective equipment) are taken to prevent injury.

In the electricity supply industry there is a duty to maintain the public supply and in some circumstances it would be unreasonable for the conductors to be dead. Similarly it is not always possible to carry out diagnostic work on machinery control panels dead — or there might be other overriding considerations that justify live working. If that should be the case, reasonable circumstances must be provided in which a person can work at or near live conductors and then injury *must* be prevented. The memorandum describes what might constitute suitable precautions.

Table 1 shows the numbers of electrical accidents reported to HSE in 1987/88. Three things should be borne in mind in looking at these figures however:

1 there is believed to be substantial under-reporting and

2 many potentially fatal electrical incidents result in little or no injury — it is often simply a matter of chance as to whether the circumstances add up to a fatal current passing across the heart or the victim walks away unharmed. So it follows that . . .

3 if you suffer a reportable electrical injury of any kind — it is more likely to prove fatal than most other categories of injury — the chances are 1 in 'X'.

**Table 1: Injuries to employees reported to enforcement authorities under The Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1985 involving contact with electricity or an electrical discharge**

| Fatal | Major | Over 3 day (absence from work) | All reported injuries |
|---|---|---|---|
| 20 | 309 | 540 | 869 |

## The future

The EAW Regs were not required to be made to implement any European directive; as I have indicated they are very much an inevitable product of the development of industry and of UK health and safety legislation. The way in which they have been drafted is very much in keeping with the current trend in European worker protection legislation, however. Following on from the 'framework' directive on worker safety last year the European Commission have been putting forward a series of directives on generic topics relevant to most workplaces — eg, work equipment safety, VDU safety and use of personal protective equipment. It may well be that a directive on safe electrical working practices will follow. If it does and if it follows the established pattern by requiring a minimum acceptable level of safety and specifying a series of ends to be achieved in terms of 'essential safety requirements' there would be no conflict with the EAW Regs. As indicated above in many instances the memorandum of guidance points duty holders towards IEC 364 which CENELEC (the European electrical standards — making body) is in the process of adapting into a European Standard so there is some prospect of a relatively painless harmonisation process.

In the shorter term it is clearly essential that all organisations and individuals arrange any necessary training to ensure that they are able to fulfill the duties required of them under the new regulations. A 12-month period was allowed by Parliament to give duty-holders a chance to prepare and many training organisations have taken advantage of this and produced special short courses. The Institution of Electrical Engineers have organised colloquia throughout the country; these have proved very popular amongst technical managers and will continue over the next few months. It is to be hoped that management have ensured that necessary training has penetrated to all parts of the organisations where it is needed so that, come 1 April, their staff are complying with the law. And, more importantly, that by 'switching-off first' they are reducing the numbers of avoidable accidents.

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4 Approved Code of Practice, *The Use of Electricity in Quarries* — Booklet COP 35 (HMSO).

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*UK-ISES meeting on Energy Policy and the Environment*

# Solar energy — bridging the gap

*Conference report by Philip Warner (past-President)*

THE UK section of the International Solar Energy Society (ISES) had put together an interesting programme consisting of a keynote paper by Gordon Adams, well-known as a CEng MEP specialising in energy, five detailed papers through the day, and a concluding panel of political "spokespersons"; all this punctuated by discussion.

It was my first real experience of the ISES, and as I was there as an invited speaker I can hardly comment on the various set-pieces except to say that their coverage was comprehensive; I shall just report a few personal impressions. Printed proceedings (not the discussion) are now available, through the Institute if all else fails you. The negotiations for stronger links between our Institute and the society, a welcome and sensible move, enhance our interest in its conferences.

It was obvious from the atmosphere of the discussions that the ISES enjoys the trust of the people whose main interest is in "alternative energies": that opinion was well represented in the hall. The reason I suspect is that everyone can be in favour of solar energy without any sacrifice of objectivity, because it is a mainly benign single form of energy; the only question is how much it can contribute. The Institute on the other hand, with its wider remit embracing all forms, must come to a balanced view about them all on the national and world scene with findings that may be controversial. The familiar unwillingness to quantify, for example, and to face the implications of numbers was represented at the conference. Thus one participant counselled against trying to bring the standards of the poorest nations up to our own. The facts are that the energy per head available to them is up to 15 times less than for us in the West and, because of the enormous and growing numbers of the have-not populations, even bringing them to today's world average would already demand more resources than could be found. How do you deal with these potentially huge pressures from developing peoples? Not by misreading the numbers.

Another theme on display at the conference from "alternative energies" people the plea for more money to be spent on R&D. It is of course a good idea in principle, but it is not helpful to imply that alternatives as a whole are still at an early technical stage. Some may be, but others rely on well proven technology (eg CHP, tidal power); what they need is not R&D but help with project launching costs, for design and legal work and drawing up the environmental impact assessment; and also some long-stop support for what investors insist on regarding as uncharted risks. We need to coordinate the enthusiasm better.

There is far too little effective dialogue between them; let us hope the negotiations are sionals, such as make up the Institute's membership, and the large number of commited advocates of "alternative energies" drawn from a variety of groups. The UK-ISES seems to be very well placed to form a bridge between them; let us hope the negotiations are successful. □

# The effects of clock change on lighting energy use

*by Paul J Littlefair MA, PhD, CEng, MCIBSE**

**A change in UK clock time to harmonise with the EEC is currently under consideration. It has been claimed that one of the possible options: a changeover to Single/Double Summer Time (SDST), would result in substantial savings in UK lighting energy use. In the following article, Dr Littlefair analyses the resulting changes in patterns of lighting use, and concludes that the introduction of SDST would in fact lead to extra lighting energy costs, probably to the tune of £10 million per year.**

A RECENT Government Green Paper[1] has considered three options for the setting of clocks in relation to daylight hours. The first is to retain the current system of Greenwich Mean Time in the winter, with British Summer Time between the end of March and the end of October. Option two would be to have the same end date for summer time (at the end of September) as the rest of the EEC, while keeping UK time an hour behind EEC time. The third option would be full harmonisation with nearly all other EEC countries. This would involve having British Summer Time in the winter, and double Summer Time from March to September (Single/Double Summer Time, or SDST).

A report by the Policy Studies Institute[2] has investigated the implications of changing to SDST. Among other things it claims that annual energy savings of £100 million could arise from better harmonisation of daylight availability with working hours (the Green Paper quotes savings of £25-£35 million). The purpose of this article is to report a fuller study by the Building Research Establishment of the effects of clock change on UK energy used for artificial lighting.

A change to SDST would definitely lead to a better match between working hours and daylight hours. Tables 1 and 2 give the times that sunrise and sunset would have occurred had SDST been operative during 1989, for a number of places in the British Isles. These include three major centres of population in London, Manchester and Glasgow, plus, for comparison, four locations in the extreme north and west of the British Isles: Lerwick in Shetland (60°N, 1°W), Stornoway in the Outer Hebrides (58°N, 6°W), Londonderry, the westernmost major town in the UK (55°N, 7°W), and Tralee in western Ireland (52°N, 10°W). Tralee is included because following a UK change in clock time Eire would be under pressure to follow suit, to avoid cross-border time changes.

The effects of latitude and longitude are apparent from the tables. For places in the west of the country both sunrise and sunset are later, and the extra hour of clock change makes them later still. Going north, the days become shorter in the winter and longer in the summer; thus sunrise is later in the winter and sunset later in the summer.

Nevertheless, inspection of the tables reveals that for the average person[2] rising at 7.15 am and going to bed at 10.30 pm, a switch to SDST would result in an improved correlation between waking hours and daylight hours. This can be seen by comparing times in the tables with the situation under GMT/BST, where one hour is subtracted from each time (except in October). The improved correlation under SDST occurs even in the north and west of the British Isles.

However, for energy savings to occur it is not enough that daylight is available; artificial lighting needs to be switched off in response to that daylight. BRE has carried out a comprehensive study of lighting controls and how they interact with daylight[3] and the results of this can be used to assess the effects of clock change.

## Commercial buildings: automatic control

Photoelectric switching, where lighting is switched off when a particular daylight illuminance is reached indoors, is the easiest to predict. Table 3 gives annual lighting use, expressed as a percentage of full load, in an office (0900-1700 working hours) and factory (0700-1700 working hours). Lighting use is given as a function of the daylight factor, the ratio of the daylight illuminance at a point

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## The author

**Paul Littlefair is the project leader for the Building Research Establishment's programme of daylight research.**

**He joined BRE in 1979 on graduating from the University of Cambridge.**

**In 1982 he received the CIBSE's Walsh Weston Award for a paper on sky luminance modelling, and in 1984 was awarded a PhD for a thesis entitled 'Daylighting design and energy conservation'.**

**Dr Littlefair has published over 40 papers on all aspects of daylight, including a BRE Information Paper on energy savings from lighting controls.**

**In 1988 he co-authored a BRE Report called 'Daylighting as a passive solar energy option: an assessment of its potential in non-domestic buildings.'**

**His current research activities include the integration of daylight and lighting into thermal modelling programs and the provision of technical support on daylighting to the Department of Energy's Passive Solar Programme.**

**Dr Littlefair is currently a member of the BSI Committee producing a new Code of Practice on daylighting.**

**Table 1: Times of sunrise (am) under SDST**

| | Feb 15 | Apr 15 | Jun 15 | Aug 15 | Oct 15 | Dec 15 |
|---|---|---|---|---|---|---|
| London | 8.14 | 7.05 | 5.43 | 6.46 | 7.24 | 8.59 |
| Manchester | 8.27 | 7.09 | 5.39 | 6.48 | 7.35 | 9.18 |
| Glasgow | 8.41 | 7.11 | 5.30 | 6.47 | 7.47 | 9.41 |
| Lerwick | 8.43 | 6.47 | 4.39 | 6.17 | 7.44 | 10.02 |
| Stornoway | 8.56 | 7.14 | 5.20 | 6.47 | 8.00 | 10.06 |
| Londonderry | 8.51 | 7.26 | 5.50 | 7.03 | 7.58 | 9.47 |
| Tralee | 8.54 | 7.42 | 6.17 | 7.22 | 8.03 | 9.41 |

**Table 2: Times of sunset (pm) under SDST**

| | Feb 15 | Apr 15 | Jun 15 | Aug 15 | Oct 15 | Dec 15 |
|---|---|---|---|---|---|---|
| London | 6.13 | 8.55 | 10.17 | 9.21 | 6.06 | 4.50 |
| Manchester | 6.17 | 9.08 | 10.37 | 9.35 | 6.11 | 4.47 |
| Glasgow | 6.19 | 9.21 | 11.01 | 9.51 | 6.15 | 4.41 |
| Lerwick | 5.53 | 9.21 | 11.28 | 9.56 | 5.53 | 3.55 |
| Stornoway | 6.20 | 9.36 | 11.30 | 10.08 | 6.18 | 4.32 |
| Londonderry | 6.33 | 9.31 | 11.07 | 10.00 | 6.28 | 4.59 |
| Tralee | 6.50 | 9.34 | 10.59 | 10.01 | 6.42 | 5.24 |

**Table 3: Number of hours between 0715 and 2230 for which the sun is above the horizon**

| | Feb 15 | Apr 15 | Jun 15 | Aug 15 | Oct 15 | Dec 15 |
|---|---|---|---|---|---|---|
| London GMT/BST | 10.0 | 12.7 | 14.0 | 13.1 | 10.7 | 7.9 |
| SDST | 10.0 | 13.7 | 15.0 | 14.1 | 10.7 | 7.9 |
| Manchester GMT/BST | 9.8 | 12.9 | 14.4 | 13.3 | 10.6 | 7.5 |
| SDST | 9.8 | 13.9 | 15.3 | 14.3 | 10.6 | 7.5 |
| Glasgow GMT/BST | 9.6 | 13.1 | 14.8 | 13.6 | 10.5 | 7.0 |
| SDST | 9.6 | 14.1 | 15.3 | 14.6 | 10.5 | 7.0 |
| Lerwick GMT/BST | 9.2 | 13.1 | 15.2 | 13.7 | 10.2 | 5.9 |
| SDST | 9.2 | 14.1 | 15.3 | 14.7 | 10.2 | 5.9 |
| Stornoway GMT/BST | 9.4 | 13.4 | 15.3 | 13.9 | 10.3 | 6.4 |
| SDST | 9.4 | 14.4 | 15.3 | 14.9 | 10.3 | 6.4 |
| Londonderry GMT/BST | 9.7 | 13.3 | 14.9 | 13.8 | 10.5 | 7.2 |
| SDST | 9.7 | 14.1 | 15.3 | 14.8 | 10.5 | 7.2 |
| Tralee GMT/BST | 9.9 | 13.3 | 14.7 | 13.8 | 10.7 | 7.7 |
| SDST | 9.9 | 13.9 | 15.3 | 14.7 | 10.7 | 7.7 |

indoors to the external horizontal illuminance, under standard overcast conditions.[2]

From table 3 it can be seen that there is a small increase in lighting use under SDST compared with GMT/BST. This is because in summer the working day is less symmetrical about solar noon, which would occur at approximately 2 pm under SDST. The relative size of the increase depends on the daylight factor and on working hours. For a museum, for instance, with a 1000-1800 working day, there would be a small decrease in lighting use under SDST.

Under a photoelectric dimming system, lighting use would be significantly less, but the relative difference between GMT/BST and SDST is similar. Lighting use also varies with window orientation, but again this has little effect on the comparison between the two clock regimes.

## Manual control

Even in commercial buildings fully automatic control is rare; manual control is generally in use. BRE studies of manual switching in medium sized offices and schools have revealed that switching activity is almost entirely confined to the extremes of a period of occupation. People tend to switch on the lights — if needed — only at times when entering a space, and they rarely switch off the lights until the space becomes completely empty. Also, the probability of someone switching on the lights is related to the daylight illuminance at the darkest point of the working area.

Figure 1, taken from reference 3, shows how lighting use under manual switching can be calculated. It gives the probability, over a whole year, that people will switch the lights on at the start of the working day, as a function of minimum daylight factor in the interior and start time (GMT/BST). Figure 1 can be adapted for SDST by adding one hour to each of the times on the X axis.

Table 4 gives annual percentage lighting use for an office (0900 start) and factory (0700 start), assuming that the space does not become empty until the end of the working day and hence, as is most commonly found, the lighting is not switched off all day. The table shows that a change to SDST would result in a significant increase in lighting use. This is because it would be darker in the early morning, when building occupants decide whether to have the lighting on.

Because of the switching patterns outlined above, considerably energy savings can often by made by installing a time switch to turn off the lighting at lunchtime; people then can make a fresh decision whether to switch on the lighting, based on higher daylight levels. Table 5 gives lighting use under this type of control. Again there is a significant increase in lighting use under SDST, but less than the increase without the midday switch off.

All the lighting use figures in the tables have been calculated using Kew data. Lighting use values can also be calculated for other UK locations[5]; in fact, however, the lighting use effects of changing to SDST do not vary markedly within the UK.

**Table 4: Percentage lighting use under manual switching**

| Minimum daylight factor in interior, % | Percentage lighting use Office GMT/BST | Office SDST | Factory GMT/BST | Factory SDST |
|---|---|---|---|---|
| 0.2 | 83 | 90 | 97 | 99 |
| 0.5 | 62 | 73 | 90 | 98 |
| 1 | 43 | 59 | 78 | 93 |
| 2 | 28 | 42 | 67 | 86 |

**Table 5: Percentage lighting of use under manual switching with lunchtime switch off**

| Minimum daylight factor in interior, % | Percentage lighting use Office GMT/BST | Office SDST | Factory GMT/BST | Factory SDST |
|---|---|---|---|---|
| 0.2 | 76 | 80 | 83 | 85 |
| 0.5 | 52 | 57 | 65 | 70 |
| 1 | 33 | 40 | 50 | 58 |
| 2 | 19 | 26 | 38 | 48 |

## Overall energy effects of clock change

Calculation of the overall energy impact of clock change necessarily involves making a number of assumptions. For example, in offices we assume that half the UK's office area has access to daylight, and that of these daylit offices 50 per cent have manual lighting control, 40 per cent have manual control with lunchtime switch off and 10 per cent have automatic control. A change to SDST would under these assumptions give an increase of just over 5 per cent in lighting use in offices and similar buildings. Since this total use amounts to some 18 petajoules/year when government offices are included,[6] the extra annual energy use under SDST would be 0.9 PJ.

The most critical assumption above is that concerning the proportion of offices with access to daylight. For proportions greater than the 50 per cent assumed, the energy penalty of SDST would increase. Table 6 gives similar estimates for other types of non-domestic building, using lighting data from the Electricity Council. Overall in non domestic buildings it appears that extra lighting energy costs of around £34 million a year would be incurred under SDST. In the future a change to more efficient lighting control systems would reduce the energy penalty of SDST, but not eliminate it altogether.

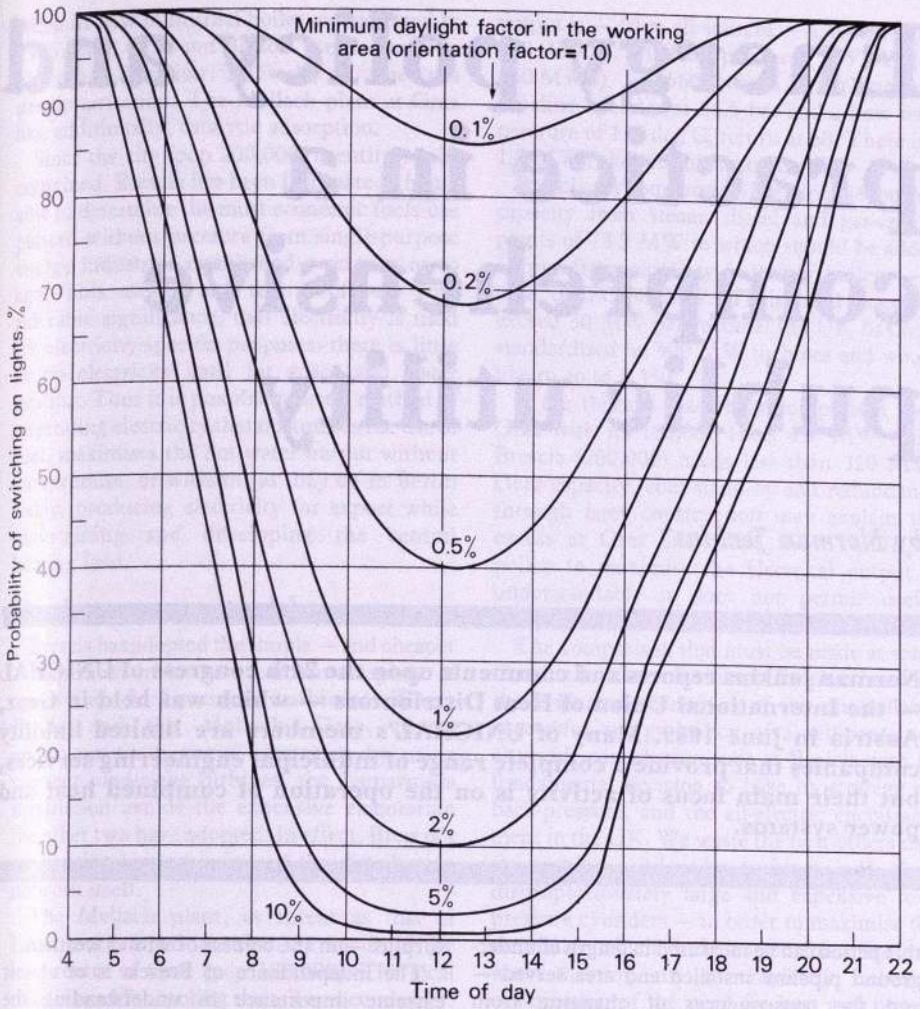


**Fig 1: Probability, over a whole year, of manual switching on of lights, as a function of daylight factor and time of day.**

## Lighting use in domestic buildings

In domestic buildings there are no empirical data on the way people use lighting. However the manual switching model described above can be adapted for housing, with the important exception that in their own homes people do switch off lighting as daylight levels increase. The lighting use in table 7 were therefore calculated using figure 1, but assuming that a fresh switching decision (on or off) is made every half an hour during occupancy. (In fact, if switching decisions are made at different intervals this has little effect on the overall difference in lighting use between SDST and GMT/BST).

Table 7 shows that a change to SDST would reduce domestic lighting use by around 20 minutes/day, for both sets of daylight factors and occupancy patterns studied. Over the entire domestic sector (assuming every home is daylit) this would result in energy savings of just over 5 per cent, totalling around £23 million a year.

## Conclusions

The overall figures in table 6 indicate that changeover from the current clock system to Single/Double Summer Time would in fact increase UK lighting energy consumption, not reduce it as claimed in a recent Government Green Paper[1] and a Policy Studies Institute report.[2] The energy savings in domestic buildings are outweighed by the extra energy cost in the non-domestic sector. This would occur despite the improved match of daylight with waking hours, and is due to the detailed way in which people control electric lighting. The total magnitude of the energy cost of changeover to SDST is likely to be just over £10 million a year.

Although there is uncertainty in the final figure it is unlikely that uncertainty would imply an energy advantage for SDST rather than a penalty. In addition to the assumptions stated above, there may be implications of changeover because of the alteration of times of peak demand in daily load curves of electricity generation. Nor has this article mentioned the non-energy issues of road safety, trade, tourism and working hours which constitute other important arguments for or against clock change. Nevertheless it can be concluded that energy issues do not support a change to Single/Double Summer Time, since in buildings energy consumption is likely to increase.

## Acknowledgements

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**Table 6: Effects on UK annual lighting energy use due to change to SDST**

| | Lighting energy use (PJ) | Estimated increase due to SDST (PJ) | Approximate extra cost of SDST (£m) |
|---|---|---|---|
| Offices | 18 | 0.9 | |
| Schools | 5 | 0.6 | |
| Hospitals | 3 | 0.1 | |
| Industrial & warehouses | 18 | 0.4 | |
| Total non domestic | | 2.0 | 34 |
| Domestic | 26 | −1.4 (saving) | −23 (saving) |
| Total | | 0.6 | 11 |

**Table 7: Hours of lighting use in a house (manual switching, reviewed every half hour)**

| Minimum daylight factor in interior, % | Hours of occupancy (excluding sleep) | Hours of lighting use/day GMT/BST | SDST |
|---|---|---|---|
| 1 | 7.15-8.15, 17.30-22.30 | 5.04 | 4.74 |
| 1 | 7.15-9.45, 15.00-22.30 | 7.10 | 6.88 |
| 2 | 7.15-8.15, 17.30-22.30 | 4.56 | 4.20 |
| 2 | 7.15-9.45, 15.00-22.30 | 5.92 | 5.60 |

# Energy policy and practice in a comprehensive public utility

*by Norman Jenkins**

**Norman Jenkins reports and comments upon the 24th congress of UNICHAL — the International Union of Heat Distributors — which was held in Graz, Austria in June 1989. Many of UNICHAL's members are limited liability companies that provide a complete range of municipal engineering services, but their main focus of activity is on the operation of combined heat and power systems.**

WE in the UK do have an energy policy although nothing is acknowledged; the existence of any specific plan has at no time ever been admitted. But it does not require more than a broad look at the *fait accompli* to see how the hand of government directs the provision of fuel and the use of energy — however loose that degree of control may be.

Competition, and conflict of political dogma are at the root of the dilema we now face in the consequences of the policy imposed to date and those of 'privatisation' yet to come. What the thinking, considerate and impartial energy observer must be asking is: 'Why cannot we have the best of both worlds?' There is a danger we shall have the worst instead.

Such a conclusion can only be justified by comparison of our own achievement with one or more examples of independent growth over comparable time. The activities of UNICHAL now show recorded data that enables such side-by-side examination, and in meticulous, extensive statistics. The absence from the records of the UK is explicable — monopoly interests have defeated development of comparable industry.

Until very recently Unichal's own direction has been seen as diverse — in that the 110 members do not all conform to one set pattern. The working method has only one common aim, the distribution of heat either as hot water or steam and, in the case of hot water, this can vary from a flow and return, two-pipe system with or without a mandatory undertaking to maintain a constant outgoing temperature, to a three-pipe system with fixed and ambient-variable temperatures, common return. Some authorities, also or solely, supply steam: Paris is outstanding in this latter respect, a factor in the debate of which Lord Marshall was clearly unaware until August of last year. Surprisingly perhaps, the metering of heat supplied, still a difficult and expensive exercise despite a quantum leap in accuracy and reliability, is entirely avoided by some of these energy utilities. Berlin is one, Vienna is another. Assessment based on heated volume and calculated heat loss, although obviously rule of thumb, appears to be so much less expensive to operate. The reflection in tariffs compensates for the expense of more precise metering by kWh measurement.

Of the three major developments, whose primary features were described in several papers, and which are recorded, those concerning Vienna, Graz (the conference venue), and Brescia, Italy, should be examined in the detail the results obtained deserve.

## Austrian experience

First, Vienna, where the results of twenty years of expansion are now recorded in a separate, glossy brochure whose text is only available in German. This, too, leaves a number of questions unanswered. The main and notable achievement is plain: expansion in this period can be measured in length of underground pipeline installed and area served — and the consequences of changing from diffuse, multiple, uncontrolled energy supply to, in this case, no less than eight separate heat sources, one of which is a refinery. In 1969 there were six sources, of which only one now contributes but by a major service tunnel hydraulically pushed under the river Danube to link up with the western and larger areas of this ancient city. There are 290 km of pipelines in the network where 31.5 per cent of the 222,000 buildings are supplied with heat.

Three of the heat sources are rubbish incineration plants contributing some 133 MW, the remainder a further 1,700 MW. The Vienna Heizbetriebe GmbH, acts as heat distributor only.

The other two case histories now available have, as common factor with Vienna, centralised heat distribution under one authority but they differ sharply in that both Graz and Brescia, the former is Austria's second city, while Brescia is one of many industrial centres, have all municipal services grouped into one single unit. Graz has its own limited liability company, Die Grazer Stadwerke AG; Brescia, its Azienda Servize Municipalizzati. These both distribute gas, electricity, cold and hot water, maintain street and traffic lights, trams and buses — as well as being responsible for rubbish.

There is, however, a major difference between Graz and Brescia. Whereas the Austrian city has to buy its supplies from the regional authority, Brescia generates its own heat and power, buying and burning its own coal, oil and gas (from the USSR or Algeria at choice), exporting electricity only when it has surplus — in the coldest of winter weather.

The independence of Brescia is of almost extreme importance in understanding the tremendously wide gulf that now exists between the working of UK energy policy and that which might have been, or may still have to be when the twin issues of emission control (green pressure) and depletion of fuel reserves begin to demand change of direction. The occasional glut of oil and gas has done nothing to change the opinions — and advice — of our most responsible geologists: the barrel has a bottom; the only question is whether our children, and their children, will find there is none left — at other than global-scale, famine prices.

Brescia could well represent the ideal strategy in energy macro-symbiosis: macro as in photography, one-to-one, without enlargement or reduction; symbiosis, the inseparable functions of generation and distribution of heat and power in combination, with all losses minimised. And, in consequence, and also quite inseparably since the amount of fuel burned is reduced to half or less for the same energy output — at lower temperature — the pollution emissions are reduced.

As an additional bonus, the lower temperature and lesser volume of flue gases work out far easier and cheaper to scrub filter and absorb noxious emissions, dusts and micro particulates. $NO_X$ is proportional to the temperature at which atmospheric nitrogen is oxydised. Brescia, 100 km east of Milan, at the foot of enclosing mountains, has no alternative

**Specialist writer on Energy Strategy*

when its new multi-fuel boiler was planned in 1985. Both Graz and Brescia use electrostatic and bag filtration as well as flue gas desulphurisation. The Mellach plant at Graz has, additionally, catalytic adsorption.

Since the city (pop 200,000) is entirely self-contained, Brescia has been fortunate in being able to determine the most economic fuels-use pattern without pressure from single-purpose energy industries established a century or so ago. This means, and this is of very considerable significance, that electricity is used for electricity-specific purposes: there is little or no electricity used for space and water heating. Thus it is possible to use a method of generating electricity that maximises the use of fuel, maximises the hot water output without compromise, or without, as they do in Berlin today, producing electricity for export while maintaining and developing the central heating load.

## Back pressure turbines

Brescia has adopted the simple — and cheaper — expedient in its new Lamarmora plant of specifying *back-pressure* turbines. Where Berlin and the Mellach, Graz, plants endeavour to maximise electricity by using *pass-out condensing* turbines, the Lamarmora installation avoids the expensive elaboration the other two have adopted. In effect, Brescia's condensing section is indeed the distribution network itself.

The Mellach plant, as recent as that at Lamarmora, is no less than 18 km from the load centre of Graz (pop 180,000). The local river is used for cooling the tail end condenser, two expensive auxiliaries the Italians have eliminated. The Mellach plant has been constructed for operation by STEWEAG, the Stryian regional energy authority whose total output is — from all sources — 1,100 MW(e), 450 MW(t). Mellach produces 225 MW(e), 180 MW(t). The 660 mm dia 18 km long dual pipeline operates at 24.5 bar and a flow temperature of 130 deg C, return at 60. There is a 1.8 MW(t) loss in this distance.

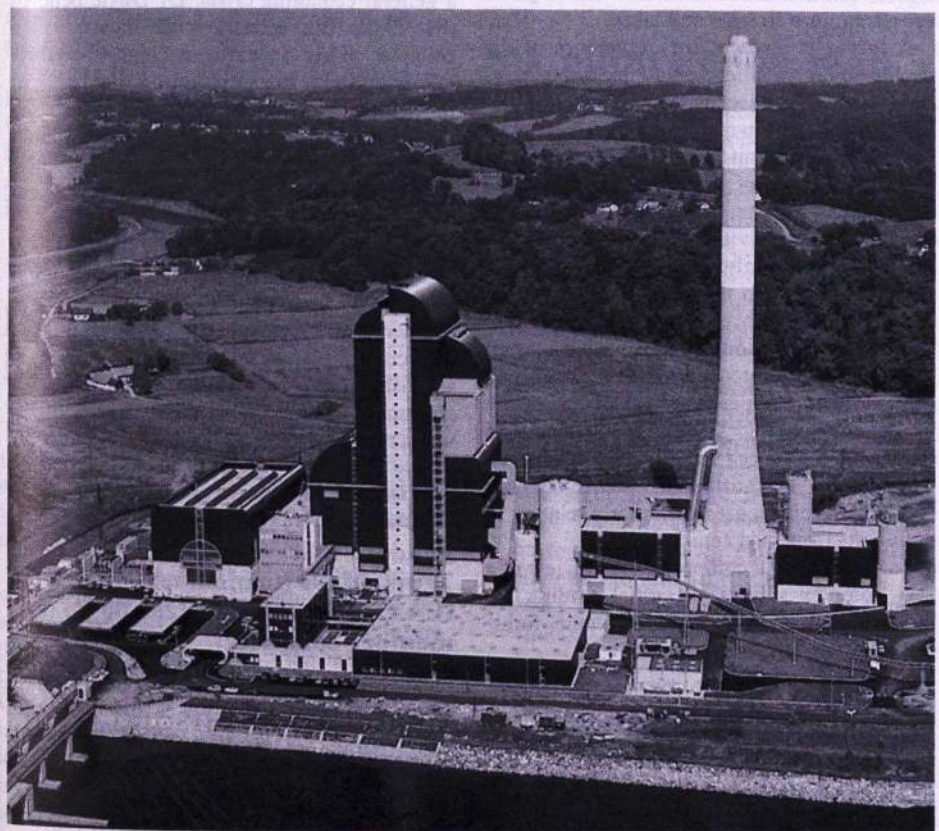
Brescia, by comparison, has a total (e) output capacity from steam, diesel and gas-engine plants of 73.2 MW to which should be added output from auxiliary heat-only boilers — a total of 313.88 MW. Their need does not exceed 30 MW per turbine: the UK has now standardised on 900 MW turbines and would like to go to 1,350.

If the thermal loads bear comparison then Graz with its 180,000 takes 450 MW while Brescia (200,000) needs less than 320 MW. Over capacity, cold stand-by and redundancy through later construction may explain the excess at Graz and while the STEWEAG policy to maximise the electrical output is understandable it does not permit useful comparison.

The comparison that must be made at some time in the not too far distant future is between the evaluated economics of the unassailably successful energy policy of a self-contained city-wide conurbation such as Brescia with its fundamental decision to base its strategy on back-pressure, and the all-electric encouragement in the UK. We waste the heat others use; we employ condensing turbines with their disproportionately large and expensive low-pressure cylinders — in order to maximise the electricity which is then used for space and water heating. In a completely unbiased examination of the need for heat and power, taking the end product away from the possibly sentimental, certainly long familiar and established custom, uninfluenced by sheer size and capital investment, a decision will have to be made. Whether or not combined heat and power is to be fully exploited, or in the interests of the status quo, the established electricity and gas industries of the UK must be protected from this competition — that is the crucial question. The conflict of interest is real, the consequences are gigantic. Half measures just will not do.

What we in the UK must, but have yet to know, is the simple ratio in our real need at bottom for heat and power: how much for any given average area of dense population (where CHP can work) of heat and how much of power. And, as for power, the need for electricity-specific purposes. The output of a simple back-pressure steam turbine is in ratio of 2.86/1 (Brescia average). The operation of a number of small back-pressure turbo-alternators, differentiating between them according to load would have no difficulty in matching a 3/1 heat to power demand. It is a strategy we shall have to investigate much more thoroughly than the Marshall Committee did in its five year gestation period from '74 to '79 — an activity that served to negate its original terms of reference, to continue the frustration of CHP development in the UK for the past 25 years.

Both Lamarmora and Mellach are sufficiently economic to permit shutdown for the six summer months. But there is insufficient evidence to suggest that this halving of the machine intensity-use has been conditioned at the design stage by the experience of other CHP turbine users. Berlin, Stockholm and others report turbines continuing in service after 60/70 years, a factor of considerable planning importance, particularly when in the UK we have been scrapping all such capital-intensive plant after a mere 20/40 years.



**The integrated energy utility of HKW Mellach, Austria.**

## UNICHAL yearbook

The papers produced for this conference and printed in the substantial three-volume reports are in any of three languages but with summaries in French, English and German. The outstanding features of these papers have been extracted by specialists and are repeated — in English — in the UNICHAL yearbook and in a special 'Study Committee Report' devoted to costs — and examples of inexpensive district heating production. Guides to the papers and the reports appear in a slim A5 list accompanied by a smaller, concise version of achievement statistics. The yearbook and the two guides are, initially, of more value to the student than the heavy volumes of papers. All are available. External publications, also understood to be available from the originators, include the 20-year celebratory brochure from Vienna (in German), description of Brescia's multi-fuel boiler (in English) which also describes the full system, the Mellach plant (in German), and an additional brochure by STEWEAG describing (in German) 25 years of DH in Graz; also a summary of Italy's proposals for CHP/DH (in English) — produced by AIRU of Milan — the Associatzione Italiana Riscaldamento Urbano. Similarly, Brescia has available a 180 pp volume outlining its energy programme up to AD 2000. □

## North Thames saga

**'Always under Pressure
A history of North Thames Gas since 1949'
by Malcolm Falkus**

This very detailed story of North Thames Gas since 1949 to privatisation will no doubt be compulsory reading for many of those who worked for and owed their allegiance to the Gas Light. The North Thames Gas Board was formed around and largely based on the Gas, Light and Coke Company.

However, for those not connected with the Gas Light, or even with the gas industry, this book is a fascinating study of an industrial company with a very strong paternalistic organisation that was nationalised and yet carried on with the same outlook. It was only when a financial crisis threatened in the late sixties that the succession of chairmen from the Gas Light was broken, and in 1970 a chairman was brought in from outside to reorganise the Board.

The author has made a very good job of consulting written records and relevant people in North Thames. However, it was inevitable that this approach was bound to reflect the views of the North Thames Board and its staff. So the book is bound to reflect the strengths and, to some extent, ignore the weaknesses of the Board. For example, although they ran two large research and experimental establishments, they did not make proper use of them but regarded their function as trouble shooting. They did make good use of them for recruiting by bringing in good people to these establishments and then moving them out into the main stream of the business. Another example is the heavy emphasis given to the commercial market and a corresponding underemphasis on the industrial market. This was reasonable for the original Gas Light territory but not for the area of the North Thames and, in any case, was to some extent self-fulfilling since this was how the Gas Light saw its business.

All large organisations are dependent on the qualities of the man at the top. However, this is even more true of a paternal type of organisation, such as the North Thames, than of other types of organisation. While this system works very well while things are going well, and the right man is at the top, it has an even greater inbuilt resistance to change than other systems. It is interesting that when the Board ran into difficulties and eventually a chairman was brought in from outside to put things right, the first incumbent had to spend his term in office breaking down this inbuilt resistance to change so that his successor (also brought in from outside) could actually implement new policies.

The other effect of using North Thames sources to provide the material for the book is that the overall picture is very North Thames centred. It is to be hoped that no one reads the book as a history of the gas industry over the period concerned. While the contribution of this Board to the industry was very large, and greater than that of any other Board, it was nothing like as great as one would gather from the book.

To sum up, this book not only gives a detailed history of the North Thames Gas Board from its inception to its demise following privatisation (and this includes a wealth of important information), but also provides a fascinating study of the cycle of success, difficulties, reorganisation and success again for a large organisation.

*Dr W A Simmonds*
**Published by Macmillan Press, Houndmills, UK, 1988**
**219 pp. £35.00**

## A complex subject

**'Acidic Deposition — Ecological Effects on Soils and Forests'
by Pamela Harter**

This report is one of a series published by IEA Coal Research covering the emission, distribution and possible effects of acidic pollutants from coal combustion.

It deals with the effects of air-borne pollutants on soils and with their relationship to the novel forest damage which was first extensively observed and studied in the Federal Republic of Germany and has now been reported in several European countries and in North America. The many publications reviewed are mainly German and American.

The review of acidification of soils in forests indicates the complexity of the subject. Extensive research has been carried out related to the magnesium deficiency which may be caused by acidification and also to the release of aluminium which can damage tree roots and which can be drawn off into the aquatic ecosystem into streams and lakes.

A survey is made of the occurrence of the decline of both coniferous and deciduous trees but again the subject is very complex. Considering each of the major pollutants, sulphur dioxide, oxides of nitrogen, hydrocarbons and ozone, the cause of the deterioration of the forests cannot be directed against any mechanism involving only one specific pollutant. Certainly, there is no direct correlation between the zones of high annual sulphur dioxide concentration and the areas of forest deterioration. The period when extensive forest deterioration was noted may coincide with the period of expansion in the use of road vehicles and, particularly, an increase in high speed and heavy duty vehicles. The subject is considered extensively and carefully in this report, particularly relating to pollutants from coal combustion.

An excellent and comprehensive review of a very complex subject. Essential reading for those studying soils pollution and forest deterioration.

*Byrom Lees*
**Published by IEA Coal Research, London, 1989**
**74 pp. £60.00 (to member countries of IEA Coal Research); £180 (to non-member countries)**

## Not too encouraging

**'Prospects for Polish and Soviet coal exports'
by Guy Doyle**

Poland and the Soviet Union are two long-established coal exporters. As early as the mid-1970s their combined exports exceeded 40 million tonnes per year. By the mid-1980s their exports were about 60 million tonnes. However, despite this record of growth and their long-standing commitment to the coal trade, their combined share of total trade has been declining in recent years. Also, since 1984, the absolute volume of exports has fallen. This report examines the reasons for this decline and concludes that this trend will continue.

The prospects for the volume of exports from these countries depend on the balance of internal supply and demand. Other considerations, such as the role of coal in earning foreign exchange, contractual commitments and the preferences of coal buyers will have more influence on the pattern of exports than on the overall volume.

The report is structured in a way that reflects the essential arithmetic of the export equation. Chapters 2 to 4 deal with the supply side (producing and moving coal), while Chapter 5 examines the internal demand for coal. Chapter 6 widens the analysis of supply and demand fundamentals by reviewing the policy/strategic setting of coal in Eastern Europe and East-West trade.

The report, written during 1988, concludes that the economic and political changes promoted by Gorbachev in the Soviet Union could generate serious internal political and economic problems that could then erupt into a general economic crisis. Dr Doyle believed that under this scenario coal exports would collapse. This scenario is highly credible following the serious disruption that occurred in the Soviet coal industry during July 1989.

The report also contains an important postscript concerning Polish coal exports. On 7 December 1988 the Polish Government formally approved a plan to wind down the country's coal exports to zero by 2000. This reassessment was caused by the growing cost of staying in the export business and the problems of supplying the domestic market. The central planners have apparently been in anguish: factories short of fuel cannot produce consumer goods or exports, while frozen workers may protest.

*Dr Andrew W Cox*
**Published by IEA Coal Research, London, 1989**
**70 pp. £85.00 (to member countries of IEA Coal Research); £255.00 (to non-member countries)**

## Recently published

**'Oil and Gas 1990'**
The *Financial Times* International Year Book. Longman Group UK, Harlow, UK, 1989. 592 pp. £90.00.

# More CIBSE members can now register for CEng status

THE ENGINEERING COUNCIL has approved a procedure to enable up to 2,800 Corporate Members of the Chartered Institution of Building Services Engineers to register as Chartered Engineers.

The procedure affects engineers who become Corporate Members as a result of assessment by a panel including government appointees in 1976, when the Institution of Heating and Ventilating Engineers (IHVE) amalgamated with the Illuminating Engineering Society (IES) and the new institution, the Chartered Institution of Building Services (CIBS) received its Charter. At the time they were not able to register as Chartered Engineers because CIBS was not a member of the Council of Engineering Institutions (CEI), the predecessor of The Engineering Council.

However, CIBSE became fully recognised by The Engineering Council in June 1987. As a result, Corporate Members of CIBSE can register as Chartered Engineers if they hold a degree, the requirement since 1973.

CIBSE has for some time felt that many of its older members, who hold HNC and HND qualifications, should be able to be recognised as fully qualified Chartered Engineers. Prior to 1973 their qualifications might well have been sufficient for CEng status if the IHVE or IES had been a member of the CEI.

After considering the matter, The Engineering Council has developed a procedure to enable this particular category of CIBSE members to demonstrate that they satisfy the requirements and grant them the opportunity to achieve Chartered Engineer registration.

Professor Jack Levy, director — Engineering Profession, The Engineering Council, said: "The Council welcomes this new opportunity for more people to demonstrate their qualification by registering as Chartered Engineers."

# Hong Kong institution affiliated

THE ENGINEERING Council announced in November that the Hong Kong Institution of Engineers (HKIE) has become one of its institution-affiliated bodies, the first overseas institution to do so.

This new status for HKIE means that those of its members who are suitably qualified can apply to become UK Chartered Engineers (CEng). The arrangement will be operated through an agreement with the Institution of Civil Engineers in London with which a number of other chartered engineering institutions have agreed to be associated. Their involvement will enable HKIE members who are in fields other than civil engineering also to come within scope of the agreement.

# Winning wind energy poster design


**Anjana Khatwa receiving her cheque from Dr Musgrove, while Tim Franke of The Engineering Council holds up her winning design.**

IN DECEMBER, Anjana Khatwa, a pupil at Upton Grammar School, Slough, was awarded a cheque for £25 by The Engineering Council in recognition of her poster design.

The poster was used to promote the third in the annual prestige lectures given by Dr Peter Musgrove, an aerodynamic engineer who works as Technical Director for The Wind Energy Group Ltd. He is also an acknowledged leader in both Europe and America on the subject of wind energy.

The two lectures, held at Thames Valley College, were given to an audience of pupils and parents from local schools in the Slough area.

Dr Musgrove spoke on the topical subject of the present status and future prospects of wind energy. The aim of the lecture was to bring state-of-the-art engineering topics to a wide audience of school children in the hope that interest will be stimulated in the pupils for taking up an engineering career on completion of their education.

After his lecture, Dr Musgrove then presented Anjana with the first prize award in the competition which was organised by The Engineering Council and attracted over 100 entries from local schools.

# Six point action plan

A SIX-POINT action plan to improve the image of engineering has been sent to British industrialists by Sir William Barlow FEng, Chairman of The Engineering Council.

Sir William has sent individual letters to 280 Industry Affiliates of the Council outlining the points which were supported by the Council's recent annual Industry Forum.

The six points in the plan ask industrialists to:

1 Encourage engineers on your staff to support the Neighbourhood Engineers Scheme. This scheme links three or four engineers and technicians into the life of a local secondary school. It helps each school meet their own objectives. It does, however, depend on employers allowing engineers to visit schools in daytime.
2 Make the profession of engineering more visible by using effective teams of Engineering Technicians, Incorporated Engineers and Chartered Engineers. Ensure your corporate policies encourage the "Registration Matters!" campaign designed to increase the number of Incorporated Engineers and Engineering Technicians registered with The Engineering Council.
3 Collaborate with other employers to increase sponsorship, to promote "engineering" on the annual "milk round" and at career conventions. Devise new initiatives with quality and style to match those of other sectors of the economy.
4 Co-ordinate activities throughout your company to ensure that the informal message generated at all levels in your company supports the new images projected by the "Engineering for People" campaign. "Engineering for People" is a new pamphlet which projects the image of modern engineering. It will be given to all 14 year olds in the United Kingdom during February 1990.
5 Improve opportunities for women by actions to promote WISE (Women into Science and Engineering). Introduction to career breaks and returner schemes for women, novel and flexible work and career patterns, and determined efforts to reduce sex stereotyping.
6 Demonstrate that you are using pay and other market forces to improve the recruitment from schools. Offer good training, early responsibility and career progression, use of technical as well as managerial ladders, challenge and excitement.

## Leak detection and location software

Simulation software specialists Scientific Software-Intercomp (SSI) are now able to supply a stand alone software package for use by existing pipeline companies for the primary purposes of leak detection and leak location.

Called the Pipeline Monitor, the system has been sold to several major oil companies and operates on a PC 386 based computer. The primary function of the Pipeline Monitor is to provide sensitive and responsive leak detection. Leak location is achieved using transient mathematical modelling. The user is provided with the size and probable location of any leak, minimising any environmental impact loss of production. Preliminary analyses of a particular pipeline configuration provides the detailed performance expectations (ie minimum leak detectable, leak location accuracy and minimum time required to detect a leak) for the Pipeline Monitor.

Because transient simulation is the technological basis of the Pipeline Monitor, a number of additional pipeline monitoring and management functions can also be achieved:

- batch tracking (liquid pipelines)
- minimum/maximum pressure detection
- instrument analysis (ie, automated instrument maintenance)
- pig or scraper tracking
- gas composition tracking (gas pipelines)
- dynamic inventory analysis
- survival time analysis (gas)

For further information contact Mr Joseph Summa on 01-222 6464.

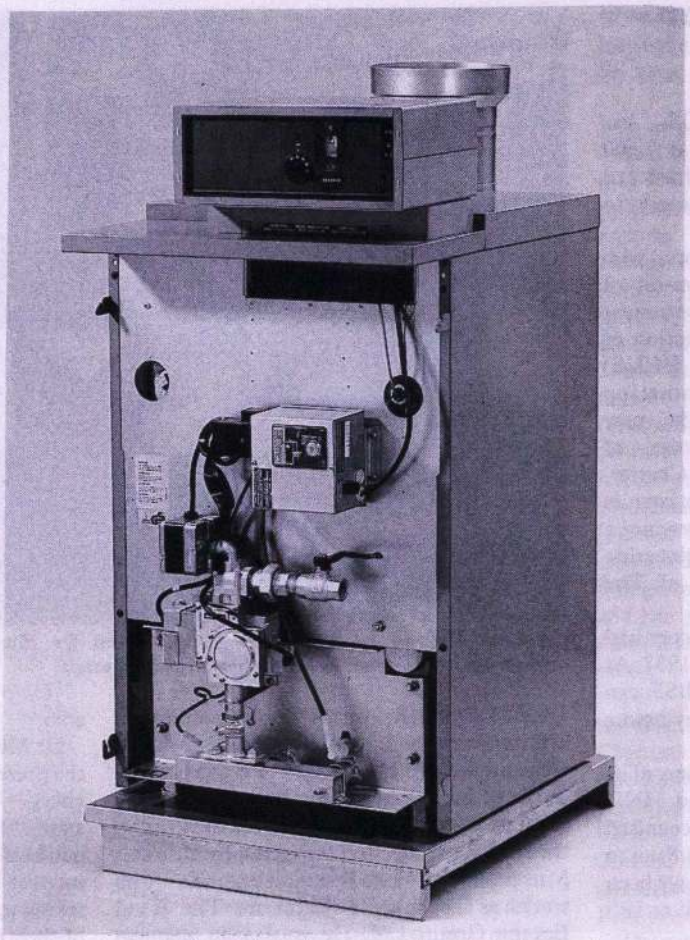
## Heat flux sensors

A SERIES of heat flux sensors which provide accurate and continuous monitoring at practically any point on the boiler walls or floor, is now available from Land Combustion.

Information provided by the sensors can be used to perform ash or slag monitoring, problem solving and boiler mapping.

For further information contact Land Combustion, Dronfield, Sheffield S18 6DJ.

## New boilers meet rigorous legislation



**Atmospheric boiler with jacket door removed to show automatic gas ignition and low $NO_X$ multi-bar burner.**

RIGOROUS legislation in West Germany has encouraged boiler manufacturers wishing to sell there to improve the performance of their equipment. This includes combustion efficiency, insulation, and, with atmospheric boilers, reducing the volume of chimney pollutants.

Clyde Combustions' new range of atmospheric cast iron boilers, made by Buderus, Europe's leading manufacturer of commercial boilers, incorporates design improvements which achieve high standards of efficiency and performance.

Designed to meet strict efficiency legislation, the top of the range 'E' models incorporate fully automatic ignition controls with Lownox ($NO_X$ <150mg/kWh) multibar burners. Boilers can be supplied to run on natural gas, propane gas, butane/air mixture or biogas and incorporate established features such as a low level draught diverter, matching control modules, easy access for brush cleaning and hydraulically tested boiler sections.

These boilers represent the latest advance in atmospheric cast iron designs that not only provide fuel savings for the user but offer reduced exhaust emissions in an age of increasing environmental awareness.

For further information contact Bill Moses, Clyde Combustions Ltd, Cox Lane, Chessington, Surrey KT9 1SL. Tel: 01-391 2020.

## Brochure published on burners

WEISHAUPT have produced a 36-page publication describing their research and engineering resources and their range of oil, gas and dual fuel burners.

The German-based manufacturers, who have marketing bases in Slough and Willenhall in the UK, currently manufacture burners for industrial, commercial and domestic appliances covering a performance range from 10 to 29,000 kW.

A copy is available from Weishaupt (UK) Ltd, Stoke Gardens, Slough SL1 3QD.

## Crossflow separation for marine fuel

Vokes Ltd has secured the exclusive UK rights to develop marine applications of a high efficiency fuel filtration system based on crossflow membrane separation. The licence has been granted by Separation Dynamics Inc. (SDI) who originally developed the system for the treatment of aviation fuel.

The technique removes both particulates and water from the fuel in a single operation, offering a much more efficient yet economic solution than conventional filters and coalescers.

Although cross flow separation is widely used in process applications, including the food industry, this is believed to be the first time that it has been applied to the filtration of fuels.

The method makes use of a phenomenon in fluid dynamics whereby water and particles suspended in a fluid stream passing at certain velocities and shear rates through a cylindrical geometry (eg, a hollow membrane fibre) will tend to concentrate near the centre of the stream.

The SDI technology employs modules comprised of many hollow membrane fibres with a diameter of about 2mm and a pore size of 0.2 micron. While the contaminants concentrate in the centre of each fibre (eventually to be dumped into a reservoir) the clean, dry permeate flows adjacent to the walls and is encouraged by the pressure differential to migrate through the membrane. Hence, with a single pass through a module, particle removal superior to that of a cartridge filter is combined with effectively 100% water removal.

Tests have shown that the system can handle solids loadings of a few parts per million to 15% over long periods without significant reduction in the flow rate.

Although Vokes is developing the system with SDI for marine gas turbine engines, the company believes the technology has potential for many other applications using hydrocarbon fuels or liquids which must be free of water as well as particulate matter.

For further information contact Julian Griffiths, Vokes Ltd, Henley Park, Guildford, GU3 2AF.

*Title:* **Product management skills for the process industries**
*Location:* Watford.
*Duration:* 3 days.
*Starting:* 13 March 1990.
*Content:* An introduction and update to the concepts, processes, skills, success factors and problems associated with being an effective product manager, building an effective product team and influencing the functions and territories involved.
*Contact:* Conference Section, Institution of Chemical Engineers on 0788 78214.

*Title:* **Classification and sorting of solids**
*Location:* Bradford.
*Duration:* 3 days.
*Starting:* 27 March 1990.
*Contact:* Dr L Svarovsky, University of Bradford on 0274 733466 × 378.

*Title:* **Building energy management systems**
*Location:* Institute of Environmental Engineering, South Bank Polytechnic, London.
*Duration:* 2 days.
*Starting:* 29 March 1990.
*Content:* Explanation of the principles of BEMS, their hardware and software. The operation of a BEMS. Setting up and configuring an intelligent outstation. Communication of BEMS and the compatibility problem between various manufacturers. Specifying a BEMS, and user experience at a number of sites. User reaction to BEMS and an analysis of the savings and losses made by BEMS. A demonstration of various BEMS. Future trends.
*Contact:* Director of the Centre for CPE on 01-928 8989 × 2025/2112.

*Title:* **Computer aided process engineering**
*Location:* Amsterdam.
*Duration:* 3 days.
*Starting:* 2 April 1990.
*Content:* The engineering process. Process synthesis. Flow-sheeting technology. Steady state process simulation. Process optimisation. Dynamic simulation. Physical properties data. Equipment design. Computer graphics. Data management for process engineers. Engineering databases. System alternatives. Achieving integrated CAE. Future trends.
*Contact:* The Centre for Professional Advancement, The Netherlands on 010 31 20 662 30 50.

*Title:* **Control and management of batch production**
*Location:* Teesside Polytechnic, Middlesbrough.
*Duration:* 4 days.
*Starting:* 2 April 1990.
*Content:* Control system configuration and packaged software. Continuous and sequence control strategies. Unit operations. User interface. Design strategy. Recipe building. Building new unit operations.
*Contact:* Dr B Buxton, Teesside Polytechnic on 0642 218121 x4286.

*Title:* **Two-phase separation with cyclones**
*Location:* University of Bradford.
*Duration:* 3 days.
*Starting:* 9 April 1990.
*Content:* Solid-liquid, solid-solid, liquid-liquid, solid-gas and liquid-gas separation. Specific cases of three-phase separations will also be mentioned.
*Contact:* Dr Svarovsky, University of Bradford on 0274 733466 x378.

*Title:* **Gas fluidisation technology**
*Location:* University of Bradford.
*Duration:* 4 days.
*Starting:* 9 April 1990.
*Content:* Overview of fluidisation. Characterisation of single particles, fixed and aerated beds. Bubbling and slugging beds. Bed expansion. Fundamentals of solids mixing. Regimes of fluidisation. Segregation and defluidisation. Gas distributor design. Gas/solid contacting. Scaling laws and scale-up. Heat transfer and instrumentation in fluidised beds. Entrainment. Cyclone separators. Standpipes and L-valves. Pneumatic conveying. Circulating fluidised beds.
*Contact:* The Conference Section, Institution of Chemical Engineers on 0788 78214.

*Title:* **Industrial furnace technology**
*Location:* Portugal.
*Duration:* 3 days.
*Starting:* 17 April 1990.
*Content:* Combustion fundamentals and practice. Furnace heat transfer. Furnace modelling. Efficient operation of furnaces.
*Contact:* Professor Reis, CENERTEC on Portugal 561159.

*Title:* **Process measurement and instrumentation**
*Location:* Amsterdam.
*Duration:* 3 days.
*Starting:* 18 April 1990.
*Content:* Level measurement. Pressure measurement. Flow measurement. Temperature measurement. Analysers. Control valve sizing. Weighing. Water pollution related analysers. Viscosity measurement.
*Contact:* The Centre for Professional Advancement, The Netherlands on 010 31 20 662 30 50.

*Title:* **Process control and optimisation**
*Location:* Amsterdam.
*Duration:* 3 days.
*Starting:* 23 April 1990.
*Content:* Single variable control loop. Multi-variable advanced controls. Chemical reactors. Boilers. Control and optimisation of cooling systems. Strategies to minimise operating costs. Pumps and pumping stations. Centrifugal and reciprocating compressor controls. Building energy management and optimisation.
*Contact:* The Centre for Professional Advancement, The Netherlands on 010 31 20 662 30 50.

*February 1990*

**Application of Advanced Material Technology in Fluid Machinery**
Seminar, 27 February, London.
Details from Vanessa Whitehead. Tel: 01-222 7899 ext 222, Tlx: 917944 IMELDN, Fax: 01-222 4557.

**Electrex '90**
Exhibition, 26 February-2 March, Birmingham, England.
Details from The Administrator, ASEE, Wix Hill House, West Horsley, Surrey KT24 6DZ. Tel: 0483 222383.

**UK Coal Challenge for the 90s**
Symposium, 2 March 1990, Cardiff, Wales.
Details from Mrs Maureen Ellis, Symposium Secretary, School of Engineering, University of Wales College of Cardiff, Newport Road, Cardiff CF2 1XH. Tel: 0222 874826.

*March 1990*

**Furnaces '90**
Conference, 6-7 March, Solihull, England.
Details from Ken Stanford, FMJ International Publications Ltd, Queensway House, 2 Queensway, Redhill, Surrey RH1 1QS.

**Operating Reliability and Maintenance in Nuclear Power Plant**
Seminar, 8 March, London.
Details from Vanessa Whitehead. Tel: 01-222 7899 ext 222, Tlx: 917944 IMELDN, Fax: 01-222 4557.

**Intherm '90**
International trade fair, 13-17 March, Stuttgart, FR Germany.
Details from CES (Overseas) Ltd, Bridge House, 181 Queen Victoria Street, London EC4V 4DN. Tel: 01-236 0911, Fax: 01-329 0347.

**Decommissioning of Nuclear Plant**
Two-day seminar, 19-20 March, London.
Details from Sara Mountford, IBC Technical Services Ltd, Bath House (3rd floor), 56 Holborn Viaduct, London EC1A 2EX. Tel: 01-236 4080, Tlx: 88870, Fax: 01-489 0849.

**Small Scale Basic Steam Plant**
Seminar, 22 March, London.
Details from Vanessa Whitehead. Tel: 01-222 7899 ext 222, Tlx: 917944 IMELDN, Fax: 01-222 4557.

**British Wind Energy Association**
12th Annual Conference, 28-30 March, Norwich, England.
Details from BWEA 12, Climatic Research Unit, University of East Anglia, Norwich NR4 7TJ. Tel: 0603 592994, Fax: 0603 507784.

*April 1990*

**Fundamentals of Hydrocarbon Oxidation and Applications to the Role of Additives in Gasoline and Diesel Fuels**
Seminar, 10 April, Leeds, England.
Details from Dr J F Griffiths, School of Chemistry, The University, Leeds LS2 9JT. Tel: 0532 336462.

**Future Trends in European Science and Technology**
Conference, 10-11 April, Edinburgh, Scotland.
Details from Edinburgh Science Festival (PROMPT Conference), 20 Torphichen Street, Edinburgh EH3 8JB. Tel: John McGhee 031-445 5601, Fax: 031-445 5602.

**Future Trends in Distribution Switchgear**
International conference, 23-25 April, London.
Details from DS 90 Secretariat, IEE Press Office, Savoy Place, London WC2R 0BL. Tel: 01-240 1871 ext 222.

**Energy Management in Industry and the Tertiary Sector Engineering and Services**
Seminar, 23-27 April, Paris, France.
Details from Agence Francais pour la Maîtrise de L'Energie, 27 rue Louis Vicat F-75015 Paris, France. Tel: (33-1) 47 65 20 00.

**Corrosion '90**
Symposium, 23-27 April, Las Vegas, USA.
Details from NACE Conference Manager, PO Box 218340, Houston, Texas 77218. Tel: (713) 492-0535, Tlx: 792310, Fax: (713) 492-8254.

**CHP at Work**
One-day conference and exhibition, 25 April, Falkirk, Scotland.
Details from The Institution of Plant Engineers, Tel: 01-730 0469.

*May 1990*

**First International Symposium on the Biological Processing of Coal**
1-3 May, Florida, USA.
Details from Dr Kee H Rhee, US Department of Energy, Pittsburgh Energy Technology Center, PO Box 10940 MS 141/L, Pittsburgh, PA 15236 USA. Tel: (412) 892-5913.

**7th European Oil & Gas Conference**
21-22 May, Amsterdam.
Details from the Financial Times Conference Organisation, 126 Jermyn Street, London SW1 4JU.

**European Energy Week**
Conferences and exhibitions, 21-23 May, Amsterdam.
Details from European Energy Week, RAI Gebouw bv, Europaplein, 1078 GZ Amsterdam, The Netherlands. Tel: +31 20 5491212, Fax: +31 20 464469.

**6th BEAMA International Insulation Conference**
21-24 May, Brighton, England.
Details from Mrs Joan Caven, BEAMA Publicity Department, 8 Leicester Street, London WC2H 7BN.

**European Applied Research Conference on Natural Gas**
Conference, 28-30 May, Trondheim, Norway.
Details from Norwegian Petroleum Society, Gas Group, PO Box 6050, N-7003 Trondheim, Norway.

*July 1990*

**OVE International Renewable Energy Seminar**
15-21 July, Denmark.
Details from Gunnar Boye Olesen (International Secretary), OVE, Willemoesgade 14, DK-2100 Copenhagen Ø, Denmark. Tel: −45−31429091.

**COMADEN '90**
International congress and exhibition, 16-18 July, Birmingham, England.
Details from Dr Raj B K N Rao, Comaden Centre, Faculty of Engineering, Birmingham Polytechnic, Perry Barr, Birmingham B42 2SU.

*September 1990*

**A Minimum Facilities Approach to Oil and Gas Production**
International conference, 10-11 September, London.
Details from Nadia Ellis, IBC Technical Services Ltd, Bath House (3rd floor), 56 Holborn Viaduct, London EC1A 2EX. Tel: 01-236 4080, Tlx: 888870, Fax: 01-489 0849.

**Research Activities on Advanced Heat Pumps**
International workshop, 24-26 September, Graz, Austria.
Details from Dr H Schnitzer, Organisation Committee, Workshop on Research Activities on Advanced Heat Pumps, Institut für Verfahrenstechnik, Inffeldgasse 25, A-8010 Graz, Austria.

*October 1990*

**Chinapec Inst '90**
Exhibition, 6-10 October, Shenzhen, China.
Details from Tri-Oil Company Ltd, RM 404, Dominion Centre, 43-59 Queen's Road East, Wanchai, Hong Kong. Tel: 5-8662135-7, Tlx: 69299 TOC HX, Fax: 852-5-8660266.

*November 1990*

**Gulf Oil, Gas, Petrochemicals & Energy Technology Exhibition**
4-8 November, Saudi Arabia.
Details from Nasser U Nayyar, Middle East Trade & Exhibitions Ltd, 17 Wigmore Street, London W1H 9 LA. Tel: 01-486 3741, Tlx: 24637 G, Fax: 01-486 3743.

**Offshore Drilling Technology**
Conference and exhibition, 28-29 November, Aberdeen, Scotland.
Details from Nadia Ellis, IBC Technical Services Ltd, Bath House (3rd floor), 56 Holborn Viaduct, London EC1A 2EX. Tel: 01-236 4080, Tlx: 888870, Fax: 01-489 0849.

## An invitation to participate in

# THE INSTITUTE OF ENERGY ANNUAL LUNCHEON

Tuesday 24 April, 1990
Inn on the Park, Hamilton Place
Park Lane, London W1

**PRESIDENT:** Prof B J Brinkworth MScEng PhD CEng FInstE MIMechE MRAes MInstP

**PRINCIPAL GUEST AND SPEAKER:** Rt Hon John Wakeham, MP, Secretary of State for Energy

**RECEPTION:** 12.30 pm **LUNCHEON:** 1.00 pm prompt

**PRICE OF TICKETS:** £42 (£36.52 + VAT)

Applications for company tables and individual tickets are requested on the form below. Numbers will be limited and early application is advisable.

**Note:** Tables are round and accommodate 10 or 12 persons. Every effort will be made to keep smaller groups separate but it may be necessary to share tables.

The list will be closed on 16 April 1990 and commitments will not permit refunds on cancellations received after that day.

**Names of guests** should accompany the application for tickets where possible, but must in any case reach the Institute not later than **8 April 1990,** for inclusion in the printed list.

**Wines.** Wine orders can be made to order in advance through to the Banqueting Manager of the Inn on the Park (tel: 01-499-0888). All wine orders should be placed direct with, and paid to the hotel.

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**ANNUAL LUNCHEON 1990**

**TO:** The Secretary
The Institute of Energy
18 Devonshire Street
London W1N 2AU

Date received:

Ticket number issued:

(To be completed at the Institute)

Please send me . . . . . tickets for the Annual Luncheon on 25 April at the Inn on the Park, Hamilton Place, Park Lane, London W1. I enclose a cheque for £ . . . . . .

| **The names of my guests are:** (block letters please) | **Designation/Affiliation** (required for guest list) |
|---|---|
| ..... | ..... |
| ..... | ..... |
| ..... | ..... |

Your name (block letters please) .....

Address .....

Telephone number .....

# INSTITUTE OF ENERGY CONFERENCES

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

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

**In 1990**

15 March
**The Nuclear Dilemma**
**Venue:** Millbank Tower, London SW1
**Chairman:** Mr C E Pugh (Institute of Energy)

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

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

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

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

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

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

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

**Conferences with which the Institute is in association**

**In 1990**

5-7 June
**IMEX 90 Maintenance Management and Engineering Conference:**
**Contact:** Maureen Carter, Institution of Production Engineers on 01-579 9411

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

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

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

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