ENERGY WORLD

The magazine of The Institute of Energy

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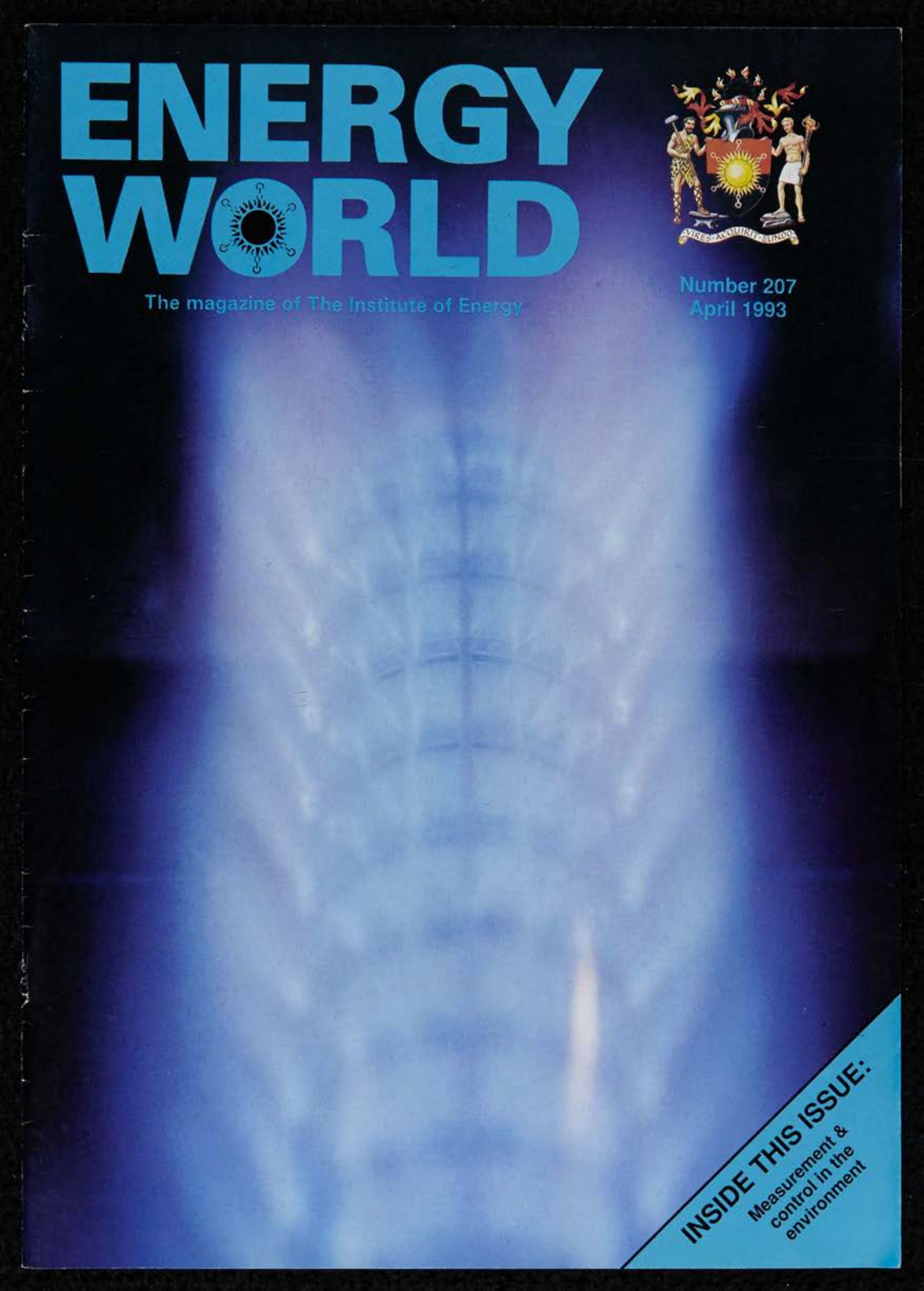

INSIDE THIS ISSUE:
Measurement & control in the environment

The Institute of Energy
FIRST ANNOUCEMENT AND CALL FOR PAPERS

SECOND INTERNATIONAL CONFERENCE ON

CERAMICS IN ENERGY APPLICATIONS

APRIL 1994, LONDON, UK.

The conference will consider materials solutions to new and existing applications of interest to energy suppliers and users. Important aspects of materials innovation in energy saving will be explored.

We would be pleased to receive abstracts on the following areas:

New Developments & Applications
- Developments & Manufacture
- Design
- Manufacturing Processes

Energy Saving & Heat Transfer
- Combustion Chambers; heat exchangers; burners; furnaces; radiant heating and fluidised beds

Evaluation & Performance
- User experience
- Thermomechanical Performance
- Fabrication / Construction
- Corrosion, fatigue, thermal shock resistance, modelling, life-expectancy, initial specifications

Power Generation
- Fuel Cells
- Turbines
- Engines
- Renewable Energy (solar, nuclear, wind)

Sensors & Catalysts
- Energy & environmental aspects

Energy Efficiency
- Manufacturer / user experience

Submission of Abstracts

Deadline: Friday, 30 July 1993

Please send to:
Ms Judith Higgins, Institute of Energy,
18 Devonshire Street, London W1N 2AU, UK

Tel: 44 71 580 0008 Fax: 44 71 580 4420

Authors will be informed whether their abstract has been accepted by 27 August 1993

The conference proceedings will be published in the form of a bound volume.

CALL FOR PAPERS

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CONTENTS

COVER

The cover photograph shows the main burner on a standard 24 series boiler made by Clyde Combustions Ltd, which have the advantage of giving low NOx emissions. The low level of NOx is achieved by reducing the flame temperature above the aspiring burner bars, as NOx is mainly produced when flame temperature is maintained above 1300°C. Clyde's low NOx burners have high temperature steel rods mounted directly above the burner bars. The blue/white flame on the cover shows the high combustion temperature created without the addition of the new technology.

A question of identity

THIS Institute, be it of Energy Engineers or Energy, is at a crossroads regarding its future. We have to decide whether we are going to continue as an Institution of Energy Engineers, or whether we really are going to follow the path initiated 14 years ago, when we changed our name from the Institute of Fuel to the Institute of Energy, purposely to reflect the changing UK market. Since then we have resisted change to a considerable degree, and, until very recently, paid little more than lip service to our new emerging markets. Here are some facts and some views on our future.

The traditional market for energy engineers is shrinking fast for many reasons, including population change, a decrease in student numbers reading engineering, and technological advancement replacing engineers with computerised machines. Power generation, oil refining, steel making, gas distribution and the process industries all provide excellent examples of this.

At the same time the market for those requiring energy knowledge, because of their involvement in a rapidly expanding energy market, is growing fast. There is the energy management field, many of whom are needing a home or Institution to represent them. There is the environmental scene, now assuming worldwide importance, from Prime Ministerial level downwards, energy being seven-eighths of this issue.

Privatisation of the utilities has created many new positions and activities for professionals with energy experience and a need for energy knowledge. Examples include those involved in bidding prices, the Regulators whose need for more knowledge of the subject is abundantly obvious, those on the options market and investment scene, and of course all the solicitors and legal experts for whom energy has been a wonderful growth industry.

On top of all that there is the developing world and Eastern Europe, where the energy issues are immense.

Surprisingly, within the Institute, we continue to put a huge priority on energy engineering in our recruitment process. And this is despite our 'future shape' study and programme, initiated two years ago, clearly identifying that area as yesterday's market, and all the issues I have mentioned being our future.

A number of other countries have recognised the changing scene and emerging needs. For example, in Hong Kong energy is seen as an integral part of the environmental equation and is being addressed accordingly. Additionally, there the local Institution of Engineers is promoting that concept and has openly encouraged membership from individuals engaged in environmental and energy-related employment.

All of this is good news. We agreed under 'future shape' that we should move this way. Others are doing so already, and we should take rapid steps to expand all these aspects of our Institutional activities, and regain our leadership in this field. There is absolutely no doubt that energy and environmental issues increasingly are going to be at or near the top of all national and international agendas well into the next century.

Of course I know the one barrier to all of this is our view, or our perceived view, of the Engineering Council, and their increasingly engineering-orientated, and somewhat bureaucratic, requirements, which they impose on their affiliated institutions, of which we are one. That their requirement should be imposed on our engineering members must be accepted, although the caveats above need addressing. That they should impose any requirement whatsoever on our non-engineering members, and would-be members, is nothing short of scandalous. It must be a primary task to have such barriers removed without further delay. We need to initiate this as well as taking a tough line about it.

Turning now to the Engineering Council, about which I have been, I feel, justly critical, what is going on? We need a body that represents the engineering profession to the outside world, a body that goes out of its way to enhance the standing of professional engineers in all walks of life, and a body that helps ensure the title of 'Engineer' is reserved for those who are professionally qualified to use it. These are some of the issues that many believed the Fairclough initiative would address. But that does not appear to be the case.

Increasingly, it seems, the Fairclough initiative is looking inwards, and talking about such issues as unification, subsuming the Engineering Council, establishing professional standards, and addressing other details probably better handled by the individual institutes and institutions, such as training and professional development. And much of this appears to be carried out by a former civil servant, working with questionnaires from an office within the Engineering Council, and failing to get out and see for himself what happens at the sharp end. If only they could first establish and agree the true needs, the solution must be that much easier to determine.

The priorities must include:

- determining how best the engineering profession may be represented and enhanced to those outside it;
- recognising and stating that the existing Engineering Council has demonstrably failed in that role, which should have been its primary task;
- identifying and building on the very considerable strengths of the existing 47 member bodies of the Council;
- identifying the increasingly bureaucratic aspects of the Council's existing systems and procedures, so that they may be eliminated;
- Determining how best to train engineers to be effective managers, if they wish to be, and that means recognising that this must start at University, as it does for other professions, and not four or five years subsequently, when the accountants, solicitors and arts graduates are already well established in management roles.

These are some of the real needs, particularly recognition that the Engineering Council has failed, and once those needs are properly identified, the logical way forward should be very much clearer.

To me, the state of the engineering profession, as currently portrayed by the Engineering Council, is an added reason as to why we should consider very carefully whether we wish to be an Institution of Energy Engineers or a true Institute of Energy, freely available to all professionals with an interest in energy, irrespective of the directness or remoteness of those interests and beyond reach of the Engineering Council. Before long, I believe, our Institute will be faced with making just that decision: to remain an Institution of Energy Engineers or to become an Institute of Energy. This needs careful consideration — NOW!

Michael Roberts
President, and Chairman of MCR Energy

Bulgaria tackles shortages

BULGARIA hopes to be able to meet demand for electricity and cut back on power imports through a project, partly financed by the World Bank.

The project includes the completion of facilities at Chaira, south east of Sofia, Bulgaria's capital. These will provide a potential 432 MW of 'peaking' power. In addition, technical assistance will be available to Bulgaria's national electric company to help the organisation become more commercially orientated.

Acute energy shortages arose in Bulgaria two years ago, when low-cost oil imports from the former Soviet Union dropped off. Bulgaria itself has limited energy resources, consisting mainly of one mining complex, producing low-grade, high-sulphur lignite.

Joint venture in Bahrain

THE BAHRAIN Ministry of Works, Power and Water has granted exclusive rights to British Gas (BG) to develop and confirm the feasibility of a large private power station within a 12-month exclusivity period, allowing for power station proposals and an associated desalination plant to be submitted.

The new facility is likely to be operated by a joint venture of BG and the Bahraini private sector. It will be gas-fired and is required to satisfy the anticipated growth in demand for power and water for several years to come.

Commercial operation of the plant is expected to commence in late 1996.

Development of the project will be undertaken by the Global Gas unit of BG. The technology and power generation directorate of Global Gas is actively pursuing a number of other power generation projects in the UK and overseas. They also operate the 1000 MW Ballylumford power station in Northern Ireland, purchased in 1992.

EC initiative helps Lithuania tackle energy crisis

ECONOMIC slow down and temperatures of -10°C have recently highlighted the severity of the energy crisis in Lithuania.

Faced with shortages of oil and gas, and a decline in its traditional export markets for electricity, the country is to be the subject of a national energy planning initiative, funded by the EC PHARE initiative.

UK based consultants ERL Energy, part of Environmental Resources, are working with German and Danish consultants to develop a National Energy Strategy for Lithuania. The international team is working on a comprehensive assessment of the entire energy sector: "Lithuania can no longer afford to import fossil fuels and has a chronic shortage of oil and gas," explained Ray Tomkins, director of Environmental Resources. "But there is tremendous scope for reducing demand by improving energy efficiency."

The study will examine the potential for a recovery in Lithuanian energy exports, suffering because of economic problems in the Baltic and Russia — traditional markets for Lithuanian power. It will also look at the future of the Ignalina nuclear power station, which currently meets domestic demand and is potentially Lithuania's largest export earner; and the security of energy supply in Lithuania.

Global initiative launched in UK

A WORLDWIDE technology partnership initiative was launched by UK Prime Minister, John Major, at the *Global technology partnership conference* held in Birmingham in March.

Organised by the UK DTI, speakers at the conference represented a sizeable number of countries, many of whom were from leading energy organisations.

The programme included contributions from the International Energy Agency, the UN Environment Programme, DG XVII, World Industry Council for the Environment and the Confederation of Indian Industries, to give the viewpoint of developing countries.

The initiative itself, launched by Mr Major on the second day of the conference, sets up a network involving non-governmental organisations worldwide, which will inform and encourage partnerships between the countries of the developed and developing world.

Toping cycle technology could be developed in Europe and US

BRITISH COAL engineers working on the 'topping cycle' power generation project have begun talks in the US in a bid to licence the technology to companies aiming to secure funding from the US government's clean coal technology programme.

Discussions are also taking place with equipment manufacturers in the UK and Europe which could lead to topping cycle components being manufactured and used in a number of European projects.

"The talks are still in the very early stages, and much of the information is still commercially sensitive," pointed out Dr John Whitehead, head of the Coal Research Establishment (CRE). "But we believe the topping cycle has commercial potential, both in terms of the total concept and as components of other systems."

The talks follow two major breakthroughs on the project. The first came when the topping cycle plant at Grimethorpe, Yorkshire, ran for 1800 hours, proving it could operate a high-temperature gas turbine on coal derived gas.

The second success came when the pressurised coal gasification test facility at CRE successfully completed a 1500 hour test run using a wide range of coals. The gasification rig, a major element of the topping cycle process, converts coal to gas, retaining the sulphur.

These success stories justify CRE's request for modest government funding, said Dr Whitehead: "We need around £3-4 million a year in the short term, until we can develop our business and attract funds from elsewhere.

"The Government is actually in a win-win situation with CRE. For a very small investment it will maintain the UK's technological lead and will have a valuable product for its money — world beating technologies."

Know how fund provides assistance to Kazakhstan

UK experts are to advise on improving operation and environmental impact of coal-fired plant in Kazakhstan.

The contract has been awarded to the UK Coal Research Establishment (CRE) under the UK Government's 'know how fund' to provide technical assistance for the Central Asian Republic, which produces 130 million tonnes of low-grade coal a year, and has a population of 17 million.

Under the terms of the one-year programme, CRE will lead a consortium including PowerGen, Babcock Energy as well as international economic and energy consultants. The first field mission takes place this month.

The study aims to review existing stations, determining the need for replacement or retrofitting. It will also establish the technical viability of emissions control systems, and the introduction of inherently cleaner, more efficient technologies. The consortium will carry out feasibility studies on the best emissions control and clean coal options available and will recommend appropriate funding strategies.

White Paper — black outlook: 'Prospects for Coal' published

THE GOVERNMENT'S White Paper — *The Prospects for Coal* — published on 25 March, and debated in the Commons a mere four days later (thus allowing just one weekend for the assimilation of 150 closely packed pages of labyrinthine argument) appears to throw a lifeline to only 12 of the 31 pits threatened with closure last October.

The 12 are told in effect that they may remain open for production, although there is no certainty that there will be any market for their coal, and that while the Government is prepared to put an unspecified amount of subsidy at the industry's disposal to make up the apparent difference between their prices and world traded coal, there will be no attempt to interfere with those inequalities within the total energy market, which are at the root of the disastrous problems confronting British Coal.

A further six pits are to be put on 'care and maintenance', while another will go on producing but without further development, so that it will work itself out of available reserves in a matter of months.

It quickly emerged — in an admission from British Coal itself — that what might have at first appeared to be a reprieve could in fact turn out to be no more than a stay of execution for 12 months or less. It was an admission that added some spice to a Commons debate which was otherwise a bland and tasteless dish.

Apart from the promise of subsidy, nothing has changed materially for the coal industry since the closure announcement on 13 October. It is quite clear from the lack-lustre responses by British Coal that they see little prospect of anything but a continuous decline in the overall market, not only for ESI coal, but for all other users.

The DTI seem, however, to contrive a more up-beat view. While the White Paper firmly puts responsibility on British Coal to go out and dig up new business, it believes that scope for further cost reductions to improve coal's competitive position lies in more efficient management practices and more productive mining techniques. The White Paper is vague about the precise nature of those practices and techniques except to declare the Government's intention to repeal what it describes as 'unnecessary' restrictions on working hours in the industry, apparently a reference to the 1908 Coal Mines Act which limited underground shifts to seven and a half hours plus one winding time.

While on the one hand the White Paper says categorically that if British Coal can improve its performance more pits will have the chance to stay open in the longer term, it states just as plainly a few pages on that sales to the electricity market are set to fall and there is no prospect of increased sales in other areas. Independent experts confirm that the decline over many years will probably continue. From this, many observers of the coal industry conclude that no matter how hard the miners work at improving their productivity and overall performance, no matter how great are the gains in management efficiency, everyone remaining in coal is being exhorted to work themselves out of a job in the shortest possible time.

Reading between the lines of the White Paper, it is clear that the Government's great anxiety is to get the coal industry to privatisation by the shortest and least troublesome route.

To that end, so that all British Coal's commercial operations can be sold to the private sector, the Government propose a new form of regulatory structure to remove the potentially serious conflict of interest which could arise from British Coal licensing competitors. It proposes a new public body — to be called the Coal Authority — to take responsibility for licensing all coal mining activity in the UK. The authority, which will be based in Nottinghamshire, will itself be barred from mining. The constraints of public ownership are blamed by the White Paper as largely responsible for the position that British Coal finds itself in now.

As well as the sale of individual pits, British Coal are said to be prepared to consider proposals for the sale of regional packages. The White Paper expresses the view that there are considerable attractions to the private sector mining companies having the opportunity to run pits that would otherwise close, a view received with wary caution by the companies themselves.

One specially shiny nugget, however, catches the eye. The future of coal research had caused particular worry among supporters of clean coal technology, bearing in mind the fate of research when electricity was privatised. The White Paper promises that the Government will continue support of research into new coal technologies — particularly into clean-burn, environmentally friendly systems in which the UK led the world in the 1970s and 80s. Without specifying amounts, the White Paper says there will be extra funding for the Coal Research Establishment.

The White Paper was approved by the Commons on 29 March by a Government majority of 22. Only four of the original Tory 'rebels' voted against the Government, all of them represent Northern seats.

Sizewell B: Greenpeace claim cracks increase meltdown risk

CRACKS have been discovered in eight out of 10 of the French PWRs tested so far by operators Electricite de France (EdF).

The faults occur in the casing of the control rods, situated in the reactor vessel head, which control the operating temperature of the reactor, and would be used to shutdown the reactor in an emergency.

Greenpeace, who published a study on the issue on 26 March, claim the fault compromises the safety of Sizewell B, "sharply increasing the risk of a meltdown". Nuclear Electric deny this, saying the fault could "never cause a meltdown as (Greenpeace) claim".

Replacing the vessel head at this stage would delay the opening of the UK's first PWR, due to go into production next year. But Nuclear Electric say they will install extra monitoring equipment, in case the cracks appear, which, they point out, may never happen.

Len Green, a spokesman for Sizewell, pointed out that the cracks are longitudinal rather than circumferential, discounting the Greenpeace claim that the control rods could shoot out of the vessel head, making it impossible to shut down the reactor. The worst effect he could envisage would be a small leak of boronated water which would be contained, causing no risk to the public.

The cracks discovered in the French PWRs, as well as in those sited in Sweden, Switzerland and Belgium, occur because of the failure of the nickel-based alloy, Inconel 600, used in the construction of the control rods. French evidence suggests that the cracks take four years to appear, and a further seven to propagate through. Replacement of the entire vessel head, manufactured by Framatome, is estimated at £5 million by Nuclear Electric. A replacement head would use a different alloy, Inconel 690, which doesn't suffer from the same stress problems as Inconel 600.

EdF has ordered that no new reactors be started up unless the lid of the reactors are replaced. They have reduced the operating temperature of PWRs now on stream to minimise the danger of corrosion, as have the Swedes.

Budget top-up for Joule II programme

THE EUROPEAN Community R&D programme, JOULE II, is expected to receive an additional 60 MECU (£48 million), to be allocated to new projects through out the Community.

The UK DTI will issue a call for proposals following the formal announcement of the additional funding. The expected deadline for submission of proposals to Brussels is 25 June.

As usual, projects will have to involve partners from more than one EC country, and grants should cover up to 50% of project costs, with 100% of marginal costs for universities being met.

The EC will seek proposals in three separate areas. Around 15 MECU should be available for Area II: energy production from fossil fuels using advanced technologies; security of supply of hydrocarbons; and more effective and cleaner utilisation of hydrocarbons.

Approximately 30 MECU is expected for Area III: the solar house; renewable power plants; biomass; and renewables for rural electricity, local fuel and water.

The third area, expected to receive a further 15 MECU, Area IV, covers: technologies for energy saving in industry and buildings; and energy efficiency in transport.

Information packs with full details should be available later this month, and should be requested in writing or by fax to: the International Liaison Officer, ETSU, B153, Harwell, Oxfordshire OX11 0RA, fax: 0235 432050.

Call for energy VAT be spent on insulation scheme

THE ANNOUNCEMENT by the Chancellor of the Exchequer in his Budget speech that VAT is to be imposed on domestic fuel has meet with dismay from consumer groups.

The Government has attempted to present the tax as a 'green' measure, encouraging domestic energy efficiency, as a back up to their 'Helping the earth begins at home' campaign, and the proposal has been welcomed by the National Energy Foundation (NEF). Deborah Brownhill, director of NEFs Home Energy Rating Scheme, said: "With a drop in the real price of some fuels homeowners have had little incentive to pursue (the) option (of reducing their fuel bills), but the Chancellor's latest Budget will provide a great motivation." Consumer groups, on the other hand, fear the tax will only increase fuel poverty in the UK.

The Royal Institute of British Architects (RIBA) has responded with what it calls a 'constructive' proposal in the light of the new tax. RIBA has written to the Secretary of State for the Environment, Michael Howard QC MP, suggesting that the revenue should be used to implement a nationwide programme to insulate energy inefficient homes, immediately targeting the poor, who will be hardest hit by the increase.

"The best mechanism for undertaking the work would be by means of energy saving companies," said Prof Peter Smith, chair of RIBA's environment and energy committee. "These would carry out the insulation programme and, at the same time, sell energy to the householder. The aim would be to reduce energy consumption by up to 50%. The total annual cost of energy, plus repayments towards the cost of insulation would be less than the householder would have to pay for energy alone at present prices."

Thorn Lighting of Hereford will act as host organisation to the Energy Efficiency Office's (EEO) 200th Best Practice programme Industrial Project. The EEO collaborates through the programme with energy consumers and advice services, helping them to improve their energy efficiency.

The 200th project will be managed and promoted by ETSU for the EEO, as are all Best Practice programme projects.

Pictured above are Stephen Willets, general manager with Thorn Lighting in Hereford (left) and Geoff Scrivener of ETSU's marketing department.

Advice scheme launched

AN ENERGY Design Advice Scheme was officially launched on 5 March by Lord Strathclyde, Parliamentary Under Secretary of State for the Environment, in London.

The scheme is operated by the Bartlett Graduate School at University College London, and establishes a channel of communication between those involved in decisions on design of new build and refurbishment projects, and experts on energy aspects of design.

The criteria for support from the Scheme are that the project should have a minimum aggregate floor area of 500m²; applicants must show evidence of intent to build; and agreement is necessary that the project may be used to promote the Scheme, including monitoring and use of any resulting data.

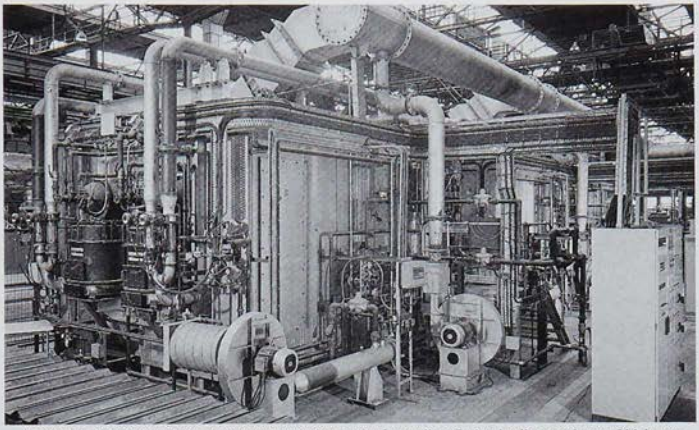
A pilot study was established at the Royal Incorporation of Architects in Scotland, Edinburgh and the Department of Architecture at Strathclyde University in 1989. Its success led to the decision to extend the Scheme to the whole of the UK. There are plans for four more regional centres.

New director for UK Nirex

LORD CAVENDISH of Furness has been appointed as a director of UK Nirex Ltd for a period of three years, from last month.

The appointment is on the nomination of Michael Heseltine, President of the Board of Trade. The other director nominated to the Nirex Board by Mr Heseltine is Professor Sir Hans Kornberg.

Lord Cavendish of Furness was born in 1941 and is a former Government spokesman in the House of Lords. He was appointed a Commissioner for the Historic Buildings and Monuments Commission for England (English Heritage) in 1922. He has been chairman of the Holker Estate Group of Companies since 1977.



A British Gas National GEM Award was recently won by Inco Alloys Ltd, a leading producer of high performance nickel alloys, for the application of a new technology.

The Award is based on new billet reheating facilities, currently being installed in its Hereford plant, which will use 24 innovative Hotwork Regenerative Ceramic Burners, to help improve product quality and achieve energy savings in the order of £82 000 (312 000 therms) per annum.

The Hotwork pulse-fired 20/26 therm/hr RCB burners being installed on six gas-fired (300-1, 250°C) batch furnaces — three of which are now operational — will play a vital role in the cost-effective operation of an £8 million refurbishment project designed to improve the quality of extruded alloy products.

Remote monitoring with POEM

THE National Grid Company has launched an energy metering system which enables power used by a large number of individual appliances to be remotely monitored using a central PC.

The Point of Use Energy Metering (POEM) system provides the information necessary to implement energy saving measures. It collects and analyses electricity demand data from individual appliances in either specific locations or throughout a complete organisation. Each appliance is fitted with an in-line meter using standard plugs and sockets, or a clip-on current transformer, and transmits its demand data by radio or mains-borne signal. Installation is therefore quick and simple, with no need to cut cables.

Fully configured, the POEM system is capable of remotely collecting and analysing the data from 80 000 individual appliances. It is intended for use by energy or facility managers of large organisations.

Each appliance to be monitored is connected to the mains supply via an in-line POEM meter which regularly transmits the demand by short range radio or a mains-borne signal to an LCU (local collector unit). These convert the data into half-hourly demand information and transmits it to the central collector unit (CCU), a standard personal computer running the POEM analysis software.

The CCU can gather data from an LCU via a direct link or up to 5000 LCUs via the public switched telephone network. All system configuration can therefore be carried out via the CCU, so that individual site visits are unnecessary to implement the system software.

The Point of Use Energy Metering demand analysis software is menu driven and easy to use, enabling system configuration, monitoring and management. A help screen prompts the user, with data for each appliance presented in tabular form, with trends being shown on a clear graphical display.

Carbon-in-ash monitors show potential

STURTEVANT Engineering Systems recently completed the commissioning of 24 carbon-in-ash monitors, including UK installations for both National Power and PowerGen.

The on-line carbon-in-ash monitor is called SEKAM, and originates from patented techniques which measure carbon in ash by capacitance method, developed in Finland.

The technique was first adopted in a prototype monitor developed by the former CEGB, and tested at their power stations in the late 1980s. As a CEGB successor, National Power licensed the technology to Sturtevant in 1990, who have developed the SEKAM product as a durable and reliable monitor which can operate in extremes of temperature, vibration and moisture.

Further details from Sturtevant Engineering Systems Ltd, telephone: 0273 601666 or fax: 0273 570549.

Major pollution control project

A MANUFACTURER of advanced low emissions combustion plant, UKPS Ltd, has been awarded a major pollution control contract from the States authorities on the island of Guernsey.

The project will include as part of the supply one of UKPS' state-of-the-art flare stacks. This sophisticated combustion unit will dispose of landfill gas on the island's Bordeaux landfill site. The unit will incorporate a computerised plant controller. This purpose-built device will provide plant operators with remote control, data logging, monitoring and telemetry functions.

The plant design includes a number of equally important aspects that take into account its visual and audio impact on the surrounding environment. When the project is commissioned, the States of Guernsey Board of Administration will be the owner of an environmental tool that parallels and even predicts current and future emissions legislation.

The DTI has recognised UKPS' achievements and awarded the company three research and development grants for projects with a total value approaching £1/3 million.

Seismic activity

NETWORKS for power companies, government agencies and seismic institutions to monitor long-term seismic activity are now available from geophysical specialists, Kalamos.

The networks will be used to study existing or proposed sites of dams, nuclear installations and other major construction projects.

In conjunction with Lennartz Electronic, Kalamos provide a turnkey monitoring network for regions of high seismic risk, where long-term patterns may be required.

Further details from Kalamos International Ltd, 5th Floor, Alexandra Warehouse, The Docks, Gloucester GL1 2LG.

Emission inventories and their calculation

*by H S Eggleston**

ATMOSPHERIC pollution has a wide range of effects. The greenhouse effect is of global dimensions, while acid rain or ground level ozone are regional phenomena. Other concerns may relate to the emissions from a single stack, and be of a very local nature.

In order to understand any of these we first need to know how much of the differing pollutants are emitted. We may also need to know the exact times and location of the emissions. An 'emission inventory' is a complete list of the emissions but, especially where it covers a large area, it will have to have a large proportion of estimated values.

The National Atmospheric Emission Inventory (NAEI) is funded by the Department of the Environment to produce emission inventories of a range of pollutants. The pollutants included in the NAEI are: ammonia (NH_3), chlorofluorocarbons (CFCs), carbon dioxide (CO_2), carbon monoxide (CO), lead (Pb), methane (CH_4), nitrous oxide (N_2O), nitrogen oxides (NO_x — nitrogen oxide and nitrogen dioxide), sulphur dioxide (SO_2) and volatile organic compounds (VOCs). These emissions inventories are used for a number of purposes.

Emissions inventories are required to comply with the Government's legal and international obligations. As a party to the United Nations Economic Council of Europe's (UNECE) convention on transboundary air pollution, the British Government has to provide annual estimates of emissions of a number of these pollutants. These estimates are then used as input to the UNECE's EMEP programme, which inputs them to a large mathematical model to produce matrices allocating deposition in member states to individual source countries.

Inventories are also required for other bodies. For example, the EC Large Combustion Plant directive requires that each state shall send to the Commission an estimate of emissions of SO_2 and NO_x from large combustion plant in order to assess its compliance with the directive.

The increasing need to take environmental policy decisions right up to governmental level, increases the need for accurate information. The work described in this paper, first delivered at the Institute of Energy's *Challenges in Energy Statistics* conference, forms part of the UK DoE's Air Pollution Research Programme.

The EC's CORINE programme also needs emission inventories. CORINE is a programme to produce a database of environmental information for all of the EC. This includes data on soil types, land use, sensitive areas, vegetation, water quality and atmospheric emissions. This work will become one of the inputs into the projected European Environmental Agency.

Emission inventories are required by the government to enable them to formulate sensible policies. In order to reduce a particular pollution problem, we need to know how the pollutant is emitted, how it is dispersed and deposited and how it reacts in the atmosphere. Inventories can help in two ways. They provide the input to mathematical models which simulate the behaviour of the pollutant in the atmosphere. Comparing the output from models with measurement data indicates how well the particular processes are understood. Clearly both the inventories and the models need to be of a high standard to provide accurate information. Secondly emission inventories can be sensibly controlled. The effects of various control measures can then be included in the inventory to indicate the national effect of a particular proposed measure.

As new policies are implemented to reduce emissions, the emission inventories will be able to show how much effect they are having and to check that improvements in some areas are not being compensated for by increased emissions elsewhere. Thus the inventories can be used to devise emission reduction policies to meet specific targets, and to check whether these targets are achieved.

Estimation

When we try to produce an emission inventory for the UK as a whole, it is clearly impossible to attempt to measure each individual source. Some large sources can be measured, and this data can be included. Increasingly new plant will need to measure their emissions. However many old plant and most smaller sources do not measure or accurately know their emissions levels. The approach used to estimate most of the emissions from the UK is based on emission factors.

These factors are usually the results of experimental measurement on a number of typical sources. For example, a number of industrial boilers will have their emissions measured during normal operation. The amount of pollutant emitted per unit amount of fuel used is the emission factor. The annual emission from that boiler is then calculated as the annual fuel consumption multiplied by the emission factor.

In some cases fuel consumption is not a suitable statistic to estimate emissions. The emissions of SO_2 from sulphuric acid manufacture are proportional to the amount produced, and so the factor is in terms of emission per amount produced. Motor vehicle emissions are more complicated, but emissions are estimated in terms of the distance driven rather than fuel used.

Carbon dioxide, carbon monoxide, nitrogen oxides and sulphur dioxide are almost entirely emitted from fuel combustion. Fuel combustion is also a large source of lead and VOC, while ammonia, nitrous oxide and CFCs are emitted from a range of processes, agriculture and consumer goods. This determines the types of emission factors used.

SO_2 and CO_2 are slightly different. For both these pollutants all the SO_2 and CO_2 emitted comes from the sulphur and carbon contained in the original fuel. Thus the emission factor is a function of the amount of sulphur and carbon already present. Not all the

**National Atmospheric Inventory, Warren Spring Laboratory*

sulphur in solid fuels is emitted as SO_2, some is retained in the ash. This retention fraction varies from 5% in power stations to 20% in domestic fires. All the sulphur in solid fuels is assumed to be emitted. Carbon is not retained in the same way. However not all the carbon is emitted as CO_2. Some is emitted as CO, while some unburnt hydrocarbons are emitted as VOC. Normally the fraction of carbon not emitted as CO_2 is very small (much less than 1%) and so is often ignored. In any case the CO and VOC are mainly oxidised to CO_2 in a few months. Vehicles, particularly petrol-engined motor cars, emit large fractions of their carbon as CO and so this may need to be taken into account.

Emission factors need not be directly related to fuel combustion. Emissions from road transport are in fact calculated from a factor in grams per kilometre driven. This is due to the fact that the emissions vary according to the way the vehicle is driven and so an identical vehicle on differing types of road have different emission rates. In this case we need to know a range of information about driver behaviour such as the distance driven on different types of road, the different speed distributions on those road types and average trip length. We also need to take into account a range of other factors such as fuel volatility, average temperature, and diurnal temperature range. The estimation becomes quite complex as all these factors are taken into account.

Not all emissions are from fuel combustion. Some industrial processes emit pollutants as well. The case of the production of sulphuric acid has already been mentioned. Other examples are nitric acid emitting NO_x and cement manufacture emitting CO_2. However these examples all only emit a small fraction of total UK emissions. For other pollutants emissions unrelated to fuel combustion comprise the majority of the emissions.

Up to half of VOCs are emitted from a wide range of processes and solvent uses. In these cases examination of typical plant and uses gives an estimate of their emission rates, and hence the national emissions.

Methane is emitted from a range of sources. The major source is agriculture. Livestock emit methane, and given the large number of animals, this leads to substantial emissions! Other sources are landfill sites, coal mines, the production of oil and gas, and the natural gas distribution system.

Ammonia emissions are also dominated by agriculture. Animals are a large source, with emissions from sheds where animals are housed, from fields where they graze, from manure storage, and from muck spreading. Fertiliser use and manufacture also contribute to total UK emissions.

The national total emissions are important. They give much useful information.

Table 1: UK emissions of air pollutants 1989 (kTonnes)

Source	SO_2	Black smoke	NO_x	CO_2	VOCs	CO
Domestic	135	191	68	23000	50	339
Power stations	2644	25	785	52000	12	47
Industry	595	88	282	36000	42	334
Road transport	54	198	1298	29000	762	5751
Other	260	64	257	17000	1200	51
Total	**3699**	**512**	**2690**	**157000**	**2066**	**6522**
of which non-fuel use	22	60	21	6000	1059	220

However if we wish to examine the spatial distribution of air quality or atmospheric deposition then we need to know the location of the emissions. Again this must be estimated. For the NAEI we estimate annual emissions from 10x10 km squares. Emission sources are divided into two main types: point and area sources.

Spatial distribution

Point sources are those that are large enough to be treated individually. The emissions from a single stack are estimated. Area sources are those that comprise many small sources. Typically there will be too many to treat individually, and so an estimate of the total in each area is made. A typical point source is a power station, while domestic emissions are treated as area sources. The dividing line between point and area sources depends on the scale of the inventory and the uses to which it is put. Sometimes line sources are used as well. These are a special type of area source where the emissions are confined to a linear feature. A road is a good example.

Table 2: UK emissions of methane and ammonia 1989 (kTonnes)

Source	methane	ammonia
Coal mining	947	
Oil and gas	175	
Gas leakage	340	
Landfill	728	
Cattle	804	230
Sheep	344	86
Fertilizer		120
Other	114	100
TOTAL	**3452**	**538**

To estimate area source emissions, data which has a known spatial distribution is used. Population is a good example. Domestic energy use is assumed to be proportional to population. This cannot be translated directly into emissions. For example within smoke control areas, the burning of domestic coal is banned. Some areas have natural gas, others do not. An appropriate mixture of fuel use in each area has to be estimated, taking into account all these local factors. Then the emissions can be estimated.

The accuracy of the results is dependent on the quality of the data used to estimate the inventory. Usually the greatest inaccuracy is in the emission factors. This is because they are determined experimentally on a limited number of plants. The plants are chosen to be representative. Differences in operating conditions, maintenance or fuel quality may all affect the emissions.

Further inaccuracies may occur in the calculation method itself. For example emissions from motor cars are much higher while the engine is cold, compared to when it has warmed up. This is accounted for in the calculation method. However, the calculation depends on knowing the average trip length. If this is not well known, then the results will be affected.

However, the energy statistics are important. Often it is useful to estimate the emis-

sions from individual industrial sectors. This is useful to show the sectors that are significant emission sources. This sectoral fuel use data is not so readily available or accurate.

Some pollutants, NO_x for example, may be emitted at different rates from different types and sizes of boiler. As we do not know the amounts of fuel used by type or size of boiler, then we cannot include this information in our calculations.

In many ways the availability of energy statistics constrains the emissions inventories. The sectors for which emissions are estimated is determined by the energy statistics.

Future developments

The methods for estimating some emissions of some of the pollutants has been used for a number of years. Most of the effort in producing estimates of these pollutants is now directed towards checking that the emission factors and the methodology used is still appropriate. As technologies change and new measurements are made, the methods used might need to be adjusted to take this new information into account.

While some pollutants have been inventoried for some time others have not. Emissions of NH_3 and N_2O are not well known and need to be studied further. More experimental work will need to be done to understand these two emissions.

There is still much to be done with emission inventories. When inventories are used internationally it is important that the inventories are compatible in the different countries. For a study looking at pollution originating over another country it is important that the differences between countries are real, and not just an artifact of the calculation method.

The EC CORINAIR project has resulted in an EC inventory for SO_x, NO_x and VOCs. While problems still remain with the VOC inventory, the others are reasonably compatible between different countries. There still remains much to be done in this area. Other pollutants will need to be examined and there are some sources, international shipping and aircraft for example, where agreed reporting methods need to be agreed.

Road transport has been studied for a number of years in many countries. However the emissions still need to be measured as vehicle technology changes. We need to know more about driving habits in order to estimate emissions more accurately.

As interest and knowledge about pollution increase, the need for inventories grows. The list of pollutants for which inventories are needed continues to grow.

Emission inventories are important for environmental policy. They can assist in the development of policy, as well as monitoring achievements. ❑

Acknowledgement

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Leakage detection of water-polluting fluids

*by Volker Mattil**

IN THE wake of growing public awareness in the fields of ecological protection and accident prevention, and in line with recent legislation and regulations reflecting this increased awareness, decision-makers in many fields will in future attach major importance to effective leakage detection.

The prevalence of 'the polluter pays' principle makes an economic necessity of increasingly efficient monitoring techniques. Volker Mattil, a director of controls manufacturers Jola Ltd, tells us of the latest developments in leakage detection.

The choice of leakage detection measures for new plant is easier than that for existing plant, as new plant design can generally be adapted to incorporate double-jacket tanks, tanks with collection tubs, or double jacket pipes which can be monitored for leakage using relatively elementary equipment.

In the case of old plant, the choice of leakage monitoring system must also take into consideration such factors as whether signalling of escaped leakage fluid on the floor, in a collection tub or from a pipeline is sufficient. If they are high risks associated with the fluid in question, in such systems as pressurised, non-insulated pipes, it is advisable to make additional provisions for effective splash protection and clean air, in the interests of personnel safety.

In particular in plants already in operation, the responsible managers must further take into account whether leakage detection devices are to be used in dry buildings, in humid operating conditions, or in the open, as well as whether pipelines and tanks are insulated or not.

Irrespective of whether leakage detection systems are to be installed in old or new plant, it is also important to ascertain — before a decision is made — the technical and financial feasibility of rapid signalling, and subsequent localisation of any occurring leakage. A decision needs to be made on whether it is adequate to monitor individual zones or whether 'blanket' monitoring is required along a whole section or over an entire area.

Moreover, if a leakage detection system is to be installed in an area exposed to explosion hazard, it must be ensured that the system can be designed to satisfy explosion protection requirements.

The above clearly indicates that there is no one leakage detection that meets all the various requirements. What is important, there-

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fore, is that the decision-maker selects from among the wide range of systems on the market that system which does maximum justice to his particular problem.

Several systems currently on the market, which possess water-related qualification approval, will be looked at in more detail later. However, the following paragraphs do not claim to provide a comprehensive overview of all known types.

Firstly, we shall look at point-based recording leakage detectors, then at linear detectors, and finally at full-area 'blanket' systems.

In the field of point-based leakage detectors, we can distinguish between systems which only signal electrically conductive fluids, systems which respond to all fluids, and which also differentiate between electrically conductive and electrically non-conductive fluids (eg, oils, solvents, chlorinated hydrocarbons, CFCs) and which can transmit signals to this effect.

Point-based leakage detectors, which can only be used to signal the presence of electrically conductive fluids, work on a conductive basis. These include plate, rod and suspension electrodes.

Plate electrodes can be used directly beneath acid or caustic solution pipelines or tanks on normally dry floors in collection rooms, or in the normally dry collection tubs of acid, or caustic solution storage tanks.

The plate electrodes are fitted with two separate electrodes: one control and one earth. As soon as an electrically conductive fluid creates a conductive connection between the plates, a control current flows from the assigned electrode relay. The relay is energised and a contact is made.

The plates contain a line-break monitoring resistor, which, in combination with one of the corresponding electrode relays, permits monitoring of the cable between the electrode and the relay. System versions are available for cable lengths of up to 30 metres between electrode and relay, and can even monitor lengths of up to 1000 metres if the corresponding plate electrode is fitted with an amplifier.

Rod electrodes are often used to monitor double-pipe systems for leakage of electrically conductive fluids. They are installed at the lowest point, to where fluid will flow in the event of leakage. Rod electrodes are also used for signalling leakage of electrically conductive fluids inside double-walled collection tubs, as well as in single-walled tubs.

The rod electrodes work in the same way as the plate electrodes. The connection line between the rod electrode and the corresponding relay (maximum 30 metres in length) is monitored for line break.

Suspension electrodes are mainly used for signalling leakage of conductive fluids in the collection tubs of single-walled chemical tanks made of plastic. They are mounted on the top collection tub rim (or in the tub cover when tanks are in the open) and suspended from there to the base of the tub. These electrodes are also used, for example, at the low points of collection rooms/tubs of acid and caustic solution tank farms situated inside buildings.

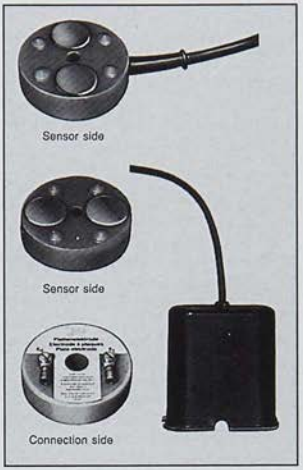

Fig 1: Plate electrodes.

The suspension electrodes function according to the same principle as the plate and rod electrodes described above.

Point-based signalling leakage detection systems for use in both electrically conductive and electrically non-conductive fluids work on a capacitive basis. Capacitive electrodes are used for signalling the presence of electrically conductive and/or non/conductive fluids. They can, for example, be mounted directly beneath pipelines or tanks on normally dry floors in collection rooms or normally dry tubs.

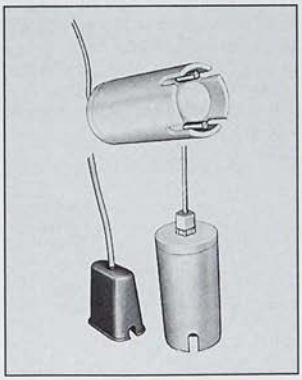

Fig 2: Electrodes with capacitive and conductive sensors.

The possible applications are numerous:

- installation in a collection tub installed under a fuel oil burner to activate an alarm in the event of burner pipe fracture;
- installation in a normally dry collection tub under a plant using water-polluting fluids;
- installation on the floor of a collection room of a chemical store;
- installation in the collection tub of a chemical storage tank, etc.

The capacitive electrodes described are fitted with a sensor which reacts through a change in its power input to a change in capacitance between sensor potential and earth potential caused by the presence of leakage fluid. This change in current consumption switches the corresponding capacitive relay, which in turn activates the alarm.

These electrodes can be designed in different materials to suit the chemical resistance requirements of the specific application. The maximum 100 metre-long cable between electrode and capacitive relay is monitored for line break.

Relays with additional separate line break signalling device and built-in function test button are available as an alternative to conventional capacitive relays. They satisfy the demand for increased information and safety consciousness.

Point-based systems for use in normally dry environments which both respond to both electrically conductive and non-conductive fluids, and also distinguish between the two, as well as signalling the leakage fluid, possess two separate sensor units which operate independently of one another. One is for signalling of electrically conductive fluids by conductive means, one for signalling of non-conductive fluids by capacitive means. Accordingly, the corresponding relays each contain a conductive and a capacitive part. The maximum 30 metre-long connecting cable between electrode and relay is monitored for line break in both the capacitive and conductive sections.

With regard to hosing and encapsulation of the capacitive proximity sensor, the electrodes are available in various designs. Conductive signalling uses two electrodes made of stainless steel or of another metal which is resistant to the aggressive media in question (eg, Hastelloy B or C, titanium, monel or tantalum).

The design of the system provides for priority of conductive signalling over capacitive signalling:

- a capacitive signal cannot be transmitted if a conductive signal is being transmitted at the time;
- if, following a capacitive signal, a con-

ductive medium reaches the electrode, the capacitive signal is terminated and the conductive signal transmitted.

Cable and tape electrodes can be used beneath pipelines or tanks on normally dry floors in collection rooms or tubs, They can also be laid along pipelines or tanks. For such applications, they should be laid inside the insulation. If no insulation exists, the cable or tape electrode must be protected by an insulation sheet, enveloping the entire pipeline or tank. This ensures that, in the event of leakage, the escaping medium reaches the sensor cables or tape with maximum speed. Furthermore, the use of this type of insulation sheet achieves a certain splash protection effect. Pipe-in-pipe systems are a further area of application for cable and tape electrodes.

In addition there are also cable electrodes for the detection of highly aggressive acids in interior rooms in which water and condensation can be expected.

These 'acid' cable electrodes possess two separate electrodes in the form of sensor cables: one control and one earth electrode.

In contrast these acid cable electrodes possess sensor cables whose stainless steel rope cores are protected from water, aqueous salt solutions and lyes by a sealed plastic coating, which is destroyed if it comes into contact with highly aggressive acid.

As soon as the acid has eaten its way through the coating of the parallel-routed second cable and has created a conductive connection between the stainless steel ropes, a control current flows from the assigned electrode relay. The relay is energised and a contact is made.

Potential users should always consult the manufacturer regarding the suitability of the system, as only few acids are sufficiently aggressive to destroy the plastic coating within a short space of time. After an acid alarm has been given, the affected sensor cable sections must be replaced.

Acid cable electrodes possess an integrated line break monitoring device which monitors both the connecting line as well as the sensor cables. System versions are available for sensor cable plus connecting cable lengths of 30 metres, and — if the corresponding electrode head is fitted with an amplifier — for sensor cable runs up to 100 metres, as well as for maximum 100 metres of connecting cables between electrode and corresponding relay.

Full-area 'blanket' leakage signalling of conductive fluids is possible using so-called carpet electrodes or collar electrodes.

A total of 92 electrode sensor cables are used in carpet electrodes, 46 of which are control electrodes and 46 earth electrodes. A control electrode is laid next to an earth electrode, which is next to a further control electrode, and so on. The distance between two electrode sensor cables is approximately 10 mm. To maintain the spacing and thus prevent contact resulting in alarm activation without leakage, the carpet electrode is designed as a fabric. The sensor cables form the warp, whilst the body is made up of insulating plastic threads also woven in a 10 mm matrix pattern.

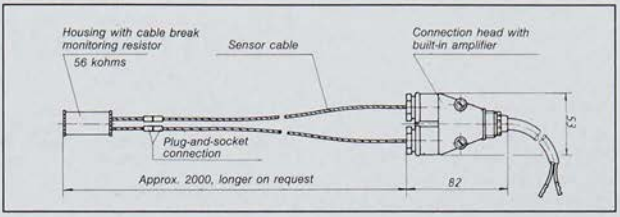

Fig 3: 'Acid' cable electrode.

As soon as an electrically conductive fluid forms a bridge between two sensor cables, a control current flows via the connected electrode relay. The relay is energised and a contact is made.

If there is a risk of the electrode sensor cables coming into contact with conductive objects, such as steel girders or steel pipelines, the carpet electrode must be installed on an insulating intermediate layer.

In order to ensure detection of small quantities of fluid, the carpet electrode must lie flat on an insulating, fluid-tight base surface. Only non-conductive materials may be used to fasten the carpet electrode to the floor.

Carpet electrodes are normally manufactured in 1 metre width, and in lengths of up to 10 metres.

The connecting cable between the carpet electrode and the corresponding electrode relay is monitored for line break. System versions are available for connection cable lengths up to 30 metres and — if the carpet electrode is fitted with an amplifier — even for connection cables up to 1000 metres long between carpet electrode and corresponding relay.

New developments

So-called collar electrodes are a very recent development. In contrast to carpet electrodes, they permit full-area 'blanket' pipeline monitoring not beneath the pipelines or flange connections, but directly on the pipeline/flange connection concerned. These collar electrodes do not yet, therefore, possess water-related qualification approval.

Collar electrodes are similar in design to the tape electrodes already described. Whilst, however, the 30 mm-wide polyester fabric housing six sensor cables, approximately 5 cm apart (as part of the warp), three of which are connected as control electrodes. A control electrode is laid next to an earth electrode, which is next to a further control electrode, and so on.

The design of the sensor cables depends on the monitoring environment. If the job is to detect electrically conductive fluids (eg, acids, caustic solutions) in normally dry surroundings. The sensor cables are designed as bare stainless steel ropes which — thanks to the polyester fabric — are maintained at a constant spacing and almost totally insulated from one another and from the pipeline to be monitored.

If the pipeline and flange connections to be monitored are located in humid rooms, however, the sensor cables take the form of the 'acid' sensor cables.

As soon as an electrically conductive fluid forms a conductive bridge between two adjacent electrode sensor cables of the collar electrode, a control current flows via the connected electrode relay. The relay is energised and contact is made.

Collar electrodes are mounted lengthwise on the pipeline to be monitored in such a way that the sensor cables run parallel to the pipeline. The electrodes can be fastened in place using special cable ties, plastic tapes or cords. If the 30 cm width of the collar electrodes is not enough to monitor the whole outer surface of a pipeline, two or more collar electrodes can be used, or can be joined together in the factory to form widths of 60 cm and 90 cm and so on.

The fabric used provides a certain degree of protection against leakage fluid splash. To improve this splash protection and to protect the collar electrodes from outside influences, customers are advised to use chemical-resistant sheets to cover the collar electrodes, particularly where pipelines are not insulated.

In recent years, the growing demands for work safety and for the conservation of the environment have greatly increased the requirements made on leakage signalling systems. All the manufacturers active in this field have made available contributions towards the solution of the pressing problems. It remains to be seen what the future will bring in the way of new systems and what contribution these new systems can make towards improved personnel safety and better environmental protection. ❑

Home energy rating systems

*by C M J Sutherland**

The home energy rating concept is intended as a means whereby the degree of design installation effort put into a building to reduce its energy consumption can be clearly demonstrated. The author of this article feels that the scheme is not achieving its aim to the extent that it should, because of deficiencies in the original concept and difficulties in practical implementation

SAVING energy used in domestic households is vital if any significant impact is to be made in improving the UK's energy performance. Domestic energy usage is by far the largest sector and all the efforts put into other types of energy saving can only be of peripheral importance in comparison with what needs to be undertaken in the UK's houses.

The vast majority of all the houses that the population will occupy in twenty years time already exist. It follows, therefore, that the crux of the energy efficiency problem is the use of fuel in existing houses. Very few of these houses carry an energy rating.

To achieve an improvement in the use of energy in the home it is thus necessary to persuade individuals and organisations controlling housing to invest in a higher standard of insulation and more efficient heating systems. Lighting and other domestic appliances also have a part to play, but the major problem is heating.

The main task of rating systems is to bring about changes in people's purchasing priorities so that they are more inclined to put resources into energy saving measures. They give a visible acknowledgement of such efforts and by doing so encourage more decisions to be made in the required direction.

BREDEM programme

The basis for the energy efficiency schemes used in the UK is the BREDEM computer programme, maintained by the Building Research Energy Conservation Support Unit. Rights to use the basic programme in their own format were granted to two organisations in 1990. The programme rates houses in relation to the cost of providing the energy they require. This is arrived at by giving a weighting to the various factors that affect that cost, such as structural insulation and the cost of the fuel used based on a four year average price.

The Energy Efficiency Office have operated a policy of encouraging competition in the field of home energy rating, in order to avoid creating a monopoly rating organisation that would use its position to charge high prices for the service. The two schemes that have been permitted to operate are Starpoint and the National Home Energy Rating Scheme (NHER). Starpoint belongs to a commercial organisation that runs a computer-based land registry search system for local authorities. The NHER is run by the National Energy Foundation.

Dr Mary Archer, chairman of the NEF, acknowledges the commitment of the Norwich-based Wherry Housing Association, and presents the first of its NHER certificates to Wherry's Ken Shipman.

From the start of its operation, Starpoint recognised the need for the rating system to be based on a low cost survey. The initial cost was about £30. This has now increased to about £50. Part-time surveyors, without heating system experience, were taken on by Starpoint to undertake the work, much of which was done in the evenings. The scheme also now uses professionals. In most cases the surveyors are basically information gatherers, although some are qualified to give energy saving advice at extra cost. The ratings were issued directly by Starpoint.

The National Energy Foundation (NEF) set up a system of courses and examinations, and invited interested parties and organisations to attend them in order to qualify to undertake NHER surveys. Because of the complication of the training, it was assumed that those hoping to qualify would need a technical background. By charging fees for training, examinations and for registering successful candidates as assessors, the NEF produced a source of income for itself. There were also substantial charges to be met by assessors for the NHER software. As a result the average economic cost of an NHER survey was in the region of £100. For assessors wishing to rate both new and existing housing, all these costs had to be met twice, as the systems were not the same. The NHER issued ratings themselves.

The Starpoint system rated houses on the thermal properties of their structure, their orientation, heating system type, fuel type, control system and methods of domestic hot water production. The NHER system also used the above factors, but also included for the efficiency of electrical appliances, such as washing machines and freezers, geographical location, type of lighting used and cooking method.

Both schemes tried to grow as fast as possible, and obtain as much prestigious support as they could. This led to them offering fuel suppliers the opportunity to undertake surveys. This increased the spread of home energy rating, but at the expense of the objectivity of the advice given regarding improvements to the rating. For example, it is unrealistic to expect a British Gas employee to tell a house owner that they would be better off using storage heaters, or an elec-

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tricity company employee to tell someone that they should use a condensing gas boiler.

Because Starpoint used a five-star rating and the NEF used a ten-point rating, and because the rating basis was not the same, interchangability between the two systems was difficult. This caused confusion for users, and also created a difficulty for the Department of the Environment, who were considering incorporating energy rating in the Building Regulations.

In order to provide a means of comparing the two rating systems and also because of Building Regulations considerations, the Department of the Environment issued a third rating system called the Standard Assessment Procedure (SAP) in December 1991. This uses factors similar to those of the Starpoint scheme. Both of the existing schemes now have to include on their certificates a reference to the equivalent SAP. The SAP is based on a 100 point scale, and includes basically only for space and water heating. This made the comparison fairly straightforward for Starpoint, but the NHER has also now become compatible with the SAP.

The NHER has not been able to develop its rating system for existing homes, because of the high cost, and is now offering an alternative system, similar to that used by Starpoint, where most of the people who call on site are purely information gatherers. This reduces the cost, but means that there is also a reduction in the amount of on the spot advice given to householders about the best energy-saving measures. Lists of standard options generated by computer programme are no substitute for the original aims of individual house energy rating. These were issued on the understanding that there would be discussion with the householder, assisted by the use of the lap-top computer, to list and cost feasible improvements.

Building Regulations

The Department of the Environment has for some time been considering using home energy rating in the Building Regulations. The aim would be to permit a wider choice of ways of achieving a satisfactory level of energy use than is presently offered in the regulations. For instance, if a condensing boiler were fitted, a lower amount of structural insulation might be allowed. There are two problems with this approach. First, all structures should be built to a high standard as a matter of principle, no matter what equipment is installed in them. Second, buildings generally outlast domestic energy-using equipment. It is quite possible for a house owner to replace the condensing boiler, which had enabled the building to comply with the Regulations, with a less expensive, non-condensing model. This would leave the building in a most unsatisfactory condition from an energy conservation viewpoint.

There is also a further difficulty with the schemes, preventing their introduction into the Building Regulations. This is that they are based on the cost of running the home. The advantage claimed for this method is that the rating has an immediate financial impact for users. The disadvantage, however, is that the rating becomes reliant on fuel prices. This means that for a given house with a given degree of insulation and heating control, the NHER rating, for example, could vary between 9.1, if the system was oil fired, to 7.3, if it was gas fired, to 3.4 if fired by LPG. With an electric system it could be 6.5. This merely reflects the average differences in fuel prices over the last four years. It has nothing to do with the effort that has gone into the building and its services to achieve energy efficiency, or to the extent of the emissions of combustion products from that building. There is a feeling that home energy rating was not meant to produce that sort of cost-based information.

This anomaly would mean that the owner of a house heated by an LPG-fired boiler, who had spent time and effort in improving its energy efficiency, and reducing its CO_2 emissions could have a lower home energy rating than a householder who had taken no steps whatsoever, but who lived in an area where natural gas from the mains was available. Further, any house using gas, LPG, solid fuel or electricity for heating can drastically improve its energy rating simply by converting to oil. This reflects the low cost of oil over the past six years, but is that what a home energy rating scheme is intended to achieve?

A further disadvantage of the cost bias is that the gas and electricity companies are now naturally using the rating systems in a competitive manner to produce rival running cost information. This detracts from the whole basis of the home energy rating concept, which is to provide comparisons between different types of property and the degree of insulation and heating control improvements undertaken by home owners and housing developers.

The development of home energy rating in the UK has not followed a straightforward course, and has not achieved the level of suc-

To mark the launch of the DoE's standard assessment procedure, in December 1991, Environment Minister Tony Baldry had his home assessed by Starpoint's Managing Director, Brian Machin.

cess that was hoped for. The Government's original intention to have competing schemes was, however, correct. If there had been no competition, a monopoly provider of ratings would have probably built up an expensive scheme, with a considerable administrative structure. Where the Government's plans were defective was in leaving the operators of the scheme too much freedom to design their own rating scales. The SAP should have been introduced right at the beginning, so that all the ratings would be easily compatible. The Government were also wrong not to have given more thought to what was wanted of home ratings in the long run. The problems that would arise if different rating scales with a different rating basis were permitted, and the difficulties that the BREDEM fuel cost-based rating approach was going to involve should have been considered before the schemes were launched.

A new approach

It is necessary to have a new look at energy rating to see what can be done to redirect it so as to enable it to play the role that it should in our energy efficiency policy programme. Attention needs to be given to who can carry out ratings. There must be a considerable degree of objectivity in this, and the use of personnel who would stand to benefit in any way from a particular fuel use or energy-saving measure should be discouraged.

The SAP with its 100 point scale should be made the only officially backed scale for use in the UK. This will happen in any case eventually, but waiting for this to happen will only introduce a further period of confusion and uncertainty. Starpoint and the NEF would both operate the SAP, each with their distinctive approach and each, possibly, offering add on features. However, it must be accepted that the UK is not a big enough area to support more than one scale.

A non-fuel cost based rating system should be introduced. This can be achieved by making a fairly simple change in the SAP to the effect that its running cost element should not be taken account of when the rating is calculated. It should only be used to illustrate energy saving paybacks.

In order to keep the cost of ratings down to an acceptable level, it is going to be necessary to use non-technical people to carry out the surveys. There should, however, be strict terms in the license regarding the supervision and checking of such staff by an independent inspectorate of professionally qualified persons. This needs to be much more extensive than the current supervision undertaken by the Building Research Establishment.

There also needs to be a training scheme in home energy rating, leading to a qualification and an NVQ. This should be independent of the scheme operators and run under the auspices of the Energy Efficiency Office. The EEO should also produce more literature to be given to householders at the time ratings are being carried out, illustrating and quantifying the benefits of the various energy conservation measures open to them.

The cost of the supervision and of the training would come from a levy on home energy rating certificates as, effectively, it does at the present time.

The consideration being given to including energy rating in the Building Regulations should be ended. The rating movement should have a different, but complementary, approach to the subject of energy conservation to that of the regulations. Rating is primarily an instrument for motivating improvements where a choice exists. Regulations are not a matter of choice.

Saving energy in the home is of vital importance. Home energy rating offers an excellent means of achieving such savings. The UK needs independent assessors. There should be a common training scheme with a national qualification. A significant increase in the independent checking of ratings and advice given is required. There is a need for only one rating scheme, and it should be based on the energy-saving factors that have been incorporated into the building and on the type of equipment installed without the fuel cost element. Having more than one operating organisation is essential in order to introduce competition and prevent administrative costs escalating. Home energy rating should be kept separate from the Building Regulations. ❑

Britain versus global warming

by W H Wheeler CMG BA PhD CEng FInstE

The debate over the extent, indeed even the existence, of global warming rages on. But what most experts now agree on is that greenhouse effect or no greenhouse effect, something must be done to curb carbon dioxide emissions, even if this proves to be an unnecessary precautionary measure.

IT IS now recognised in Britain, by both the public and Government, that global warming is a subject to be taken seriously. But the situation is less simple than is generally assumed.

Quoting from a lecture by Sir John Mason FRS in November 1990 at the Royal Institution: "It is not yet possible to detect a clear signal that can be confidently ascribed to greenhouse warming rather than to natural climatic variations." But he went on to stress that this should be seen in the context of the subject's enormous complexity, affected as it is by clouds and their constant variations, and the tremendous capacity of the oceans to even out temperatures. He says: "Any serious appraisal of the prospective concentration of CO_2 in the atmosphere is a very complicated procedure. It is no subject for facile forecasting."

Scientists point to long-term records of temperature which show only very small increases, of the order of 0.5°C over the last century, in spite of the enormous increase in the emission of 'greenhouse' gases. An earlier prediction by the Met Office of 5.2°C in the next century has been reduced to 1.9°C, and other experts expect the change to be less than 1°C. This is not to say that actions deemed capable of reducing the effect should not be followed: it would be obviously wrong to neglect the possibility of long-term disaster. But it is proper to avoid being panicked into grossly expensive procedures which impose hardship now and may be worthless.

Britain is not a big contributor. The emission of carbon dioxide in Britain is estimated to account for 3% of the world total. Within this, total electricity generation is responsible for about one third, ie 1% of world emission. Transport accounts for a larger share than electricity generation in Britain, and industrial and domestic heating provide the remainder.

Although carbon dioxide has received maximum attention as a major contributor to the greenhouse effect, some other gases contribute. The International Panel on Climate Change (IPCC) has calculated that the emission of one kg of methane into the atmosphere has 63 times the effect of a kg of carbon dioxide. Of course, the amount emitted is much smaller, but it is known that natural gas leakage from high pressure mains in old fashioned cast iron pipes is substantial; and the generation and leakage of methane from municipal landfill sites is sufficient, in some cases, to justify expensive collection arrangements. This is a less well recognised contributor to global warming. An awareness of this has resulted in support by British Gas for research at Cambridge and York Universities into to impact of methane emissions on global warming.

It is not always understood what constitutes a greenhouse gas. In simple terms, greenhouse gases are those capable of absorbing solar infra-red radiation, raising their temperature. The gases with this capability are: CO_2, H_2O, methane and ozone. CFCs and NOx are also active, but in much smaller way. When heated in this way these gases 'share' their heat by mixing with the normal atmosphere — oxygen and nitrogen — which do do of themselves absorb heat from radiation passing through them. These gases do, of course, pick up heat by contact with the ground, losing heat is the ground is cooler, as do greenhouse gases, and this has been going on for all time. But the greenhouse gases bring in extra heat, warming the whole complex of atmospheric gases. It is because of the additional factor that danger from excessive warming is feared.

Energy production

In the generation of energy the aim is to minimise the amount of carbon dioxide that is formed, consistent with sensible economy. With the exception of nuclear power, production of energy depends on the combustion of fossil fuels: coal, oil and natural gas, and to an increasing extent, renewables sources (solar, wind, hydro, tidal and wave power).

All fossil fuels, as well as biomass and wood, produce carbon dioxide when burnt. There is no such thing as a practicable fuel which does not. Lowest among them is natural gas, producing 35-40% less carbon dioxide than oil or coal for the same amount of heat.

Until recently natural gas was regarded as too valuable a resource to be substituted for oil or coal for power generation. But UK gas reserves were greatly augmented by the discovery of the North Sea Bruce Field, containing the largest gas reserves in UK waters. As a result official policy has changed, and plans for gas-fired stations are being approved. Availability of natural gas has also stimulated active development of the combined cycle gas turbine (CCGT).

The CCGT uses natural gas to fire a gas turbine driving the generator. Hot exhaust gases are used to generate steam, which drives a steam turbine, driving a second generator. The result is that the amount of power generated is substantially greater than would have been possible burning the same amount of gas in a conventional boiler. The efficiency is around 50%, against 36-38% for the best conventional installations. And because natural gas produces 35-40% less CO_2 than coal or oil, the overall result is that this system is capable of producing a substantial reduction in the discharge to atmosphere of CO_2 from power generation.

There are no hidden snags: the plant is easier to build, and cheaper. Replacement of the older plants will proceed, but perhaps in time, a limitation will be needed in the amount of natural gas consumed. It still is a valuable resource, indispensable as a raw material in industry. British Coal is developing a corresponding system in which coal is gasified in a pressurised fluidised bed combustor. The hot gas generates steam in a heat exchanger, and the steam is used to drive a steam turbine, which drives the generator. The cooled gas is then used to drive a gas turbine. This system is known as a 'topping cycle' and, like CCGTs, it is a lot more efficient than present conventional systems.

Renewable energy in UK

Solar power comes in two forms, of which the more familiar is solar thermal power. It has not become widely used in Britain or Northern Europe, except in Switzerland, and wherever bright sun is available for long periods, installations are common, and there are now proposals for large-scale power generation using solar thermal radiation. These attract British industrial interest, with the aim of manufacturing large-scale plant for export.

The system requires a central receiver upon which solar radiation is focussed by each of an assembly of heliostats, disposed in front of it. A heliostat is a large focussing reflector, capable of altering its direction to suit that of the sun. The sun's heat is concentrated on an array of heat resisting grills in the receiver. Heat is continuously transferred to the heating system of a boiler which produces high-pressure steam to drive the turbine.

The system has the unique advantage that the heat is free. The cost of fuel, which is the largest item in normal electricity generation, disappears. Nor is there any carbon dioxide or sulphur dioxide production. But when the sun does not shine, and always overnight, the boiler must be fired normally.

The second form of usable energy from the sun is solar photovoltaic energy. It derives from the capacity of certain solid-state substances to convert light radiation to electrical power. It has become familiar through its use in pocket calculators, and more spectacularly, in powering a vehicle to cover long distances in desert conditions. And it is the regular, sole source of power in satellites. Recently it has been developed to the point of the practicable generation of power.

A demonstration system funded by BP, the DTI and the EC, capable of delivering 30 kW is sited at Marchwood power station near Southampton. The rig provides experience and data on continuous performance. In Switzerland, where sunshine is more reliable, solar panels are being erected on the N13 motorways as part of a programme of photovoltaic power stations.

The material used for making solar cells is silicon, a silvery-white metal derived from silica sand. For use in photovoltaic cells the silicon metal must be intensely refined, then doped under controlled conditions with boron and phosphorous. A thin slice of each doped silicon, held in contact with each other, constitutes a cell, and a module is made up by connecting together a number of cells. For example, 36 cells would have an output of 50 watts at 12 volts.

Wind power installations, already numerous in Britain, are on the increase. Wind power is cheap: less than 0.3 p per kWh is reported from well-established sites, using British machines, in California. Reliability is excellent, with very little down time for maintenance. Operating time depends on the strength of the wind, making it impossible to depend on wind alone. Most installations are linked to a power station where the cheap power can be taken whenever it is available, but several private wind farms are operating, using diesel or gas turbine driven generators to fill in the low wind strength periods, or reverting to mains power, by agreement with the company.

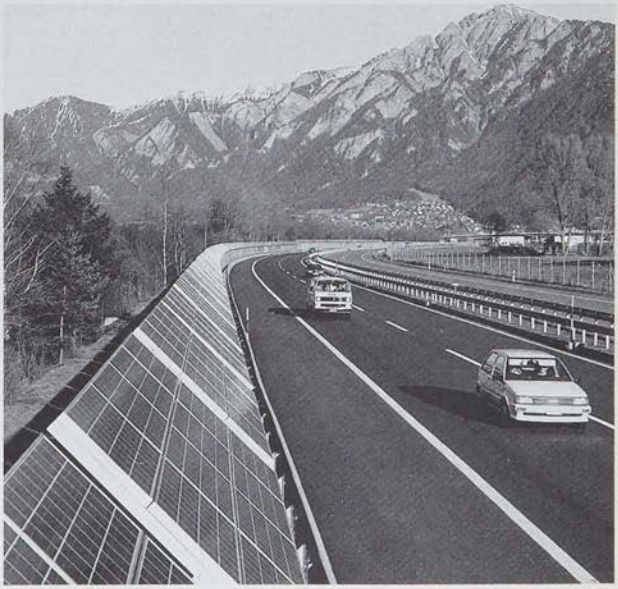
Modern wind turbines are formidable machines. A 1 MW machine built for PowerGen for installation adjacent to Richborough power station in Kent, has a three-bladed rotor 45 meters in diameter, with height to the hub at 55 meters. Larger machines have been built, with a capacity up to 3MW, one for example installed in Orkney. But the majority of users rely on machines of between 300-500 kW.

Two recent new installations by power companies should be mentioned. Yorkshire Water and Yorkshire Electricity have formed Yorkshire Wind Power to develop a wind farm with 30 turbines at Warley Moor, near Bradford. And National Power, as National Wind Power, is to construct three wind farms, with a total of 65 turbines, located at Cemmaes in Wales, Cold Northcott in Cornwall, and a third, as yet unspecified site in Wales. The combined rating of these stations will be 20 MW of wind power by the tear 2000. These are only two of several operators, all of whom are developing substantial wind farms, but in recognising these advances it should be remembered that a large coal-fired plant, such as Drax, is rated at 4000 MW.

The largest hydro electric power station operating in the UK is the Sloy-Awe scheme, supplying electricity to a large section of Scotland's population. The station began operation in 1950, and has an installed capacity of 130 MW. It is run by Hydro-Electric plc, who have a second station at Errochty, with around half of Sloy-Awe's capacity. Despite these large stations, the use of hydro electric power in the UK is not comparable with what exists in Canada or Norway.

Hydro electric power suffers limitations comparable to those suffered by wind power, although less severe in the sense that the head of water only varies — it does not disappear altogether. With large installations, the variations are seldom great, but they must be catered for to maintain constant grid frequency.

The Severn and Mersey tidal barrage schemes have been the subject of detailed engineering studies for some time, and are regarded as completely practicable. New



Solar panels on the N13 motorway in Switzerland, part of their photovoltaic programme.

studies have been described, relating to the Wyre Estuary in Lancashire, with a capacity of 64 MW, and a barrage across the River Dudden, near Askam in Furness. These proposals are modest compared with the Severn scheme, with its 8500 MW plant, which would generate an average of 17 TWh/year (millions of kilowatt hours), and has an estimated life of 120 years. A smaller system on the River Mersey could generate 1.3 TWh/year. But no starting date for either scheme has yet been set. An estimate cost for the Severn scheme is around £9000 million. With capital still heavily involved in the Channel Tunnel operation there is no realistic prospect of raising this amount at the present time.

Wave power is attracting renewed attention. It was previously thought that the ravages of the sea would demand such rugged structures as to make the system impracticably expensive, but recent work has indicated that reliable systems could be developed and a more optimistic view of the potentialities of wave power is now held. A sea wave-powered turbine, driving an electrical generator has been installed on the Island of Islay in Strathclyde. The system design and the turbine which it uses are new and unique. It is intended to act as a test bed for the components and the design. The 75 kW which it produces will be fed into the national grid.

National Wind Power's wind farm at Cemmaes in Wales.

CFCs and ozone

A global consideration, apart from the greenhouse effect, is the destruction of the ozone layer by chlorofluorocarbons (CFCs). These are compounds of carbon, flourine and chlorine which have the convenient property of being converted from gaseous to liquid form when subjected to relatively modest pressure. When the pressure is released, the liquid evaporates to produce the original gas. As always happens when evaporation occurs, the temperature of the liquid falls, more so for CFCs than for other potentially suitable substances. This property makes the CFCs particularly well suited as refrigerants, for which purpose they are almost universally used.

Another application which has come to rely on CFCs is their use as a 'propellant' in spray cans. The liquefied CFC with active substance, is contained in a suitably designed can at a pressure which maintains it as a liquid. When the valve on the can is opened, the release of pressure allows the CFC to evaporate, passing out through the valve, carrying the active substance with it. The contents of the can does its job and is 'fixed', but the CFC gas persists.

Meanwhile, refrigerators wear out and some of their CFC content is released. The result is a steady build-up of CFC content in the atmosphere, and diffusion takes the gases to the upper atmosphere where they encounter ozone. Both gases are, of course, at extremely low concentration, but even so they are immensely significant. Ozone has the benevolent capability of absorbing ultra violet (UV) light, thereby reducing its concentration at ground level. But the active chlorine and flourine atoms react with the ozone and convert it to oxygen, which does not have the absorbing capability for UV radiation which ozone has. Consequently a higher proportion of the UV passes through to the earth, resulting in a higher concentration to which everything is subjected. Everything and everybody. And because this is harmful, it is essential that the use of CFCs should be discontinued.

The trouble is that at the moment effective alternatives are only beginning to be discovered, and therefore intensive research continues, to synthesise new compounds with physical properties comparable to CFCs, but chemically unreactive. Progress has been made, naturally details are secret, but a new plant has been opened at the Conoco Refinery at Killingholme on Humberside.

If one decides that action should be taken to minimise the production of carbon dioxide, certain positive consequences follow.

In basic terms, the combustion of all solid, liquid and gaseous fuels must be curtailed. All of them produce about three times their own weight of carbon dioxide. Hydrogen does not produce any, but it is not, as yet, a practicable fuel for large scale use. The trouble is that it does not occur naturally, and until some catalytic process, or the use of solar voltaic power, or the decomposition of water, or catalysis of a hydrocarbon like methane, is perfected on a commercial scale, its production will continue to consume a lot of energy which has to be derived from combustion of fuels producing carbon dioxide.

There are three parts to the action for reducing CO_2 production. To generate energy in the most efficient possible way, and to use less of it. To pursue as actively as possible the development of renewable resources. And, most effective of all, to greatly increase the use of nuclear power.

The most difficult problem in the search for a reduction in fuel use is the consumption of motor spirit. A great deal of effort is being applied, in all the developed countries, towards production of the electric car. The fundamental problem is the battery.

The difference in the amount of work delivered by a pound of petrol, compared with the charge from each pound weight of battery is not less than 50 to one. There is substantial weight compensation in the absence of engine, gear box and transmission, and braking feeds energy back into the battery. But the weight problem remains. It is also clear that no big saving in CO_2 emissions will be achieved, as the electricity still has to be generated, and batteries rarely achieve little more than a 85% efficiency. Only air pollution on the streets will be reduced.

The development of the renewable sources has been described. Limitations imposed by climate and terraine mean little more can be achieved in this area.

All this leaves nuclear power. It is the only real solution to the generation of power without production of CO_2. In France 70% of all power generated is nuclear. Are they the ones jeopardising the world's future? Or are we? ❑

Energy Conservation Bill 1993

by Johanna Fender

Energy World reports on the latest initiative on energy conservation.

AN Early Day Motion was tabled in the House of Commons recently in support of an all-party initiative on energy conservation.

The motion was in support of the 1993 Energy Conservation Bill, introduced into Parliament on 24 February by the Plaid Cymru member for Ceredigion and Pembroke North, Cynog Dafis MP.

A Government initiative on conserving energy called 'Helping the Earth begins at home' was launched in 1990, when it was criticised for doing little to encourage domestic consumers to invest in energy efficient measures for their homes.

Helping the Earth consisted of a £3 million information campaign, launched by the then Environment Minister, Michael Heseltine, which sought to inform the public about practical measures to increase the energy efficiency of their homes, through television and national newspaper advertisements. Early ads from the campaign caused controversy when they carried photographs taken in the UK of the aftermath of the great storm of 1987, apparently attributing the hurricane-force winds directly to the effects of global warming, without any real scientific evidence to support this.

Doubt was expressed in some quarters that home owners would make the connection between these pictures, and fitting double glazing, condensing gas boilers or high efficiency light bulbs. More could be achieved, it was suggested, by introducing a subsidy on items, such as light bulbs, encouraging people to purchase what could be seen as prohibitively expensive items, as has been done in some other European countries.

In addition the Government's campaign was linked into the home energy rating schemes, run by the National Energy Foundation and Starpoint. In December 1991 the Department of the Environment introduced a standard rating system, in an attempt to bring the two schemes into line, making them comparable.

Running parallel with the Helping the Earth campaign was the 'Making a Corporate Commitment' campaign, which encouraged companies to make a commitment to reducing their energy use.

The latest move towards making the UK an energy efficient nation, the Energy Conservation Bill, was drafted by the Green Party. It was introduced into Parliament by a Plaid Cymru MP, elected to his seat with Green Party support.

The Bill has received the approval and support of the Association for the Conservation of Energy (ACE), whose director is the tireless conservation campaigner Andrew Warren.

The promoters of the Bill worked with Newark and Sherwood District Council on its practicalities. The Council has been an enthusiastic supporter and promoter of energy conservation in its residential accommodation. John Staton, director of housing and environmental health with Newark and Sherwood claims their programme of measures has benefited both the Council and its tenants: "Increased comfort in homes, coupled with money saved on fuel bills has, we believe, helped in reducing rent arrears. Less trouble with cold and dampness has resulted in quicker letting of empty properties — rent loss through void properties has been reduced. The District valuer has assessed that the improved capital value of our housing stock will be £16.4 million."

David Pickles, Newark and Sherwood's chief architect and energy manager saw the benefits for himself: "I visited a single parent family whose house was cold and damp. The children were screaming; the mother in a state of tension and anxiety. I visited again after heating and insulation improvements — the sense of peace was overwhelming. Energy bills had been reduced, with increased levels of comfort. The woman had found a sense of pride in her home and redecorated."

The Bill itself establishes district and borough councils throughout the UK as energy conservation authorities. The UK is divided into energy conservation areas, each with a regional energy board. Board members would be representatives of local authorities and others with experience or expertise, appointed by the Secretary of State for the Environment.

The regional energy boards would have a duty to monitor the implementation of an energy conservation plan; to advise councils and the Secretary of State on implementation and to publish promotional material. This should enable the boards to promote the best practices of local authorities in their areas. The boards are also given the power to direct councils to consult persons/organisations when drawing up their conservation plans.

The energy conservation authorities (ie, district and borough councils) are given the duty of deciding which conservation measures are desirable and practicable in the residential accommodation within their particular area, and to draw up a 'plan' of arrangements needed. This plan must include assessment of measures required to achieve energy savings of 10%, 20% and 30%, as well as an assessment of costs involved, estimated fuel bill savings for tenants; the decrease in emissions of CO_2, SO_2 and NOx that should result, and the number of jobs created. An additional duty on councils would be to consult widely with environmental organisations, businesses and their own tenants.

Once completed, the councils' plans would go to the Secretary of State, who will set a date for the measures to be completed, together with a timetable for action. Government funding should be made available to meet the costs of implementing the plans, together with insulation grants.

The Bill also requires that the Secretary of State could order gas and electricity companies to supply details of their customers suffering the greatest financial hardship to energy conservation authorities, so that these people can be prioritised for energy conservation work — although only with the customers' written consent.

A subsection to the Bill enables the Secretary of State to impose a levy on fuel prices to pay for the works required by the conservation plans. The likelihood is that such a levy would be passed on to customers, leading to higher fuel bills, but the Green Party claim this increase would be more than compensated for by the savings from the conservation measures.

The major benefit from such a piece of legislation would, one would hope, be a reduction in atmospheric pollution. The Green Party believes that in addition their Bill would result in less fuel poverty; lower maintenance costs on local authority housing stock, which would lead to lower health care costs; and last but by no means least, would create jobs. A study conducted for ACE showed that a ten-year programme with a gross investment of £15.5 billion would generate 500 000 jobs-years.

It all seems a good idea, but there are problems. As the Green Party have pointed out the Bill will get little or no Parliamentary time. To counteract this they have called for massive public pressure: calling on the public to lobby their MPs to support the Early Day Motion and the Bill. Must we wait until the eleventh hour before serious steps are taken to reduce emissions? ❑

Designed to prevent a disaster

Overcoming the 'human factor' in industrial accidents

HUMAN operators are crucial to safety in the high-risk worlds of nuclear power, electricity supply and petrochemicals, according to papers being presented at the Ergonomics Society annual conference, held this month.

Ergonomists recommend that, rather than losing lives, plant and property in disasters later attributed to human error, industry should plan for human fallibility, and build in human routines which are able to mitigate the consequences of mistakes or failures of technology.

The public perception of threat from disaster is fuelled by incidents such as Chernobyl in 1986, where 115 000 people were evacuated, and Bhopal in 1984, where 3500 died and 200 000 people were injured following a leak of chemical gases.

After an explosion in Houston, Texas in 1989, the US Occupational Safety and Health Administration (OSHA) predicted that 100 incidents each year could be expected in the petro-chemical industry, leading to 53 deaths, 985 injured and 18 000 people evacuated from their homes. Many such incidents would be attributable to human factors issues, such as inadequate training, insufficient recognition of hazards or unsafe practices.

US ergonomist Daniel Welch of Carlow International Incorporated — whose paper is included in the proceedings of the Ergonomics Society conference — states: "Public response to similar estimates for the nuclear power industry could be easily predicted. Emphasis must be placed on the human operator as the critical safety system. This mind-set is basic to all ergonomics related system improvement, and is a necessary first step in developing a culture of safety in industry. It requires placing the human factor on an equal plane with equipment integrity, management approach and other elements viewed as important."

Response to increased understanding of human factors in safety and disaster management varies from country to country. In a paper to be presented at the annual conference, British ergonomist Linda Herman, of Electrowatt Engineering Services UK Ltd, reviews differing approaches by Nuclear Licensing Authorities in Europe and beyond.

"To reduce human error, the Canadian and Swedish licensing authorities advocate centralised research and development and specification of human factors criteria, which are then incorporated into regulatory procedures and safety standards.

"In contrast, France and the UK devolve research to the individual nuclear utility. The research findings are then discussed and agreed with the licensing authorities, and appropriate human factors criteria are specified explicitly. The emphasis appears to be on self regulation, in the sense that the utility is responsible for demonstrating how safety requirements will be satisfied."

Whatever the approach to human factors issues, all countries should accept the importance of ergonomics if the impact of human error on safety-critical industries is to be minimised, according to Daniel Welch.

Failures of human and technological systems such as that at Three Mile Island in 1979, where at the height of the incident over 100 alarms were flashing simultaneously, and without prioritisation in the control room; or at Houston, Texas in 1990, where air hoses were improperly connected in reverse, should never be possible if ergonomists are properly consulted, he says.

"All levels of organisation need to become familiar with the existence of ergonomics and its applicability in this area, and to commit to implementing ergonomics-related programmes within their own field of responsibility."

A study by Dr Ian Glendon of the Human Factors Research Unit at Aston Business School, Birmingham, makes recommendations as to how ergonomics could reduce risk by cutting down the probability of errors or by mitigating the consequences of errors which do occur. Ergonomists could be involved in workplace design, engineering controls and procedures, reporting systems, safety auditing and employee involvement, for example.

Papers relating to energy, human error and risk at the Ergonomics Society's annual conference in Edinburgh include: An international perspective on human factors in the nuclear industry; Human error incidents in the electricity supply industry; Ergonomics in nuclear power and process safety; The development of design guidelines for nuclear power plant advanced control rooms; Human dependent failures; and Appraisal of the Piper Alpha disaster.

The Society Lecture, by Professor W A Wagenaar of Rijks University, Leiden, is entitled 'Safety in the oil industry.'

This year's Ergonomics Society annual conference is held at Heriot-Watt University, Edinburgh from 13-16 April. The theme, *Ergonomics and Energy*, is broadened to include papers on military ergonomics, workplace design, health and safety, sport, design methods, telecommunications, computer-assisted tasks and driving. ❑

Past President is 59th Melchett Medallist

MR ROBERT EVANS CBE FEng, chairman of British Gas, and immediate Past President of the Institute of Energy, was presented with the Melchett Medal on 11 March. Following the presentation Mr Evans gave the 59th Melchett Lecture, entitled *Evolution of Natural Gas Technology — The Route to Competitive Strength.*

The lecture emphasised the vital part played by technological developments in transforming the gas industry in Britain from an 'also ran' holding less than 8% of the energy market (excluding transport) in the early 1960s, to the leading energy player of today with a market share of over 47%.

The change from small gas companies manufacturing town gas from coal for a local market, to an integrated company using the latest technology to supply natural gas to customers nationwide was illustrated by examples from every aspect of the gas industry.

These included the development of the high pressure transmission pipelines and on-line inspection systems; polyethethylene distribution systems and associated laying techniques; recuperative and regenerative burners to improve energy efficiency; simulations to optimise reservoir exploitation; and safety and environmental studies on all aspects of the company's operations.

Copies of the lecture are available from The Institute of Energy, 18 Devonshire Street, London W1N 2AU.

PHOTOGRAPHS: JOHN BAKER

Pictured above right is Robert Evans CBE FEng receiving his Melchett Medal from Institute of Energy President, Michael Roberts. Above left is the medal itself.

1993 Ellis Memorial Lecture

THE Great Energy Crisis — Could It Have Been Averted? is the title of the Midland Branch's 1993 Ellis Memorial Lecture.

The lecture will be presented by past President of the Institute, Professor Brian Brinkworth, who is Professor of Energy Studies at the University of Cardiff, on Thursday 29 April at the Staff House, University of Birmingham at 7.00 pm.

A coffee reception at 7.00 pm will be immediately followed by the lecture at 7.30 pm. A formal buffet with wine will round off what promises to be a very interesting presentation.

Professor Brinkworth is one of the most eminent and experienced speakers in the energy field. He will approach his subject from the viewpoint of the early 21st century, looking back at the 1990s. He will consider the perceptions of the time, the influences upon policy makers of the day, including the known fuel resources, undeveloped technologies, and the ideology of market forces, with their short-term horizons and lack of global perspective.

Tickets, priced £5 are available from Mr D A E Evans, Honorary Secretary, IoE Midlands Branch, New Wood Lodge, 2A Hyperion Road, Stourton, Stourbridge, West Midlands DY7 6SB.

IoE to hold climate change seminar

THE Institute of Energy's second conference this year will focus on the Government strategy and practical responses to the greenhouse effect.

Entitled *How Climate Change Will Change Your Business*, the provisional programme includes papers from the Rt Hon Michael Howard QC MP, Secretary of State for the Environment; Peter Bach of the Danish Energy Agency; Andrew Warren, director of the Association for the Conservation of Energy; Professor Peter Jones, University of Westminster and Paul Davidson of BRECSU.

The conference will focus on the key areas of fuel selection, transport, buildings and energy management, giving practical advice and case study examples.

Nearly half of UK CO_2 emissions are attributable to energy used by industry and commerce, who will be hardest hit by Government initiatives to reduce CO_2 levels to their 1990 equivalent by 2000.

This poses many questions if businesses are to meet emissions standards and maintain profitability, which this conference hopes to answer.

Further details are available from Judith Higgins at the Conference Department on 071 580 0008, or fax: 071 580 4420.

Sustainable energy workshop a success

PRIME MINISTER John Major launched a 'Technology Partnership Initiative' at the end of March, at a conference in Birmingham, organised to coincide with the Environmental Technology '93 exhibition at the NEC.

Included in *The Global Technology Partnership Conference* programme were a series of 15 workshops on topics such as water and sewage effluent treatment; ozone depletion; environmental management and recycling. One of the more popular sessions was organised by the Institute of Energy, and examined the subject of 'Sustainable energy generation'.

The one and a half hour workshop was repeated twice during the conference, and was well-attended on all three occasions.

'Sustainable energy generation' contained contributions from such eminent experts as Eur Ing Brian Locke of Cadogan Consultants; Tony Marshall of Babcock Energy Ltd and Professor Dunn of University of Reading. They covered generation topics of intermediate scale, which would be of particular interest for applications in developing countries, at whom the conference was targeted. The sessions were ably chaired by Institute of Energy President-elect, Professor James Harrison. A full report will appear in a future issue of *Energy World.*

Significant contribution to the nuclear debate

'Nuclear Power: technical and Institutional options for the future' Published by National Academy Press, Washington DC, September 1992, 215 pp, £19.95 P/B.

THIS report was prepared by a joint team of the National Academy of Sciences (founded in 1863) the National Academy of Engineering (founded 1964), the Institute of Medicine (1970), and the National Research Council (1916). All these organisations were set up with a mandate to advise the Federal Government of the United States on scientific and technical matters. The terms of reference given by the Senate were "to conduct a critical analysis of ... the options for future nuclear power development and formulate coherent policy alternatives."

The report and committee were not asked to consider whether nuclear power should be adopted in the energy plans of the United States, but to assume that the option for nuclear power should be kept open, and decide on what needed to be done. Although there is some reference to nuclear activities outside the US, there is, perhaps surprisingly, no suggestion that there is scope for international cooperation in the programmes.

The developments in the US of PWR and BWR systems have been the basis of the major nuclear power reactor programmes in many countries. Yet, in availability, cost, construction time and many other criteria of excellence, water reactors built in Japan, France and Germany have generally been better than those in the US.

The report first analyses what has to be done before large scale deployment of nuclear power in the future can be seriously considered. This involves contractual arrangements, standardisation, a new look at the licensing system and setting up a safety review body.

In Britain the only active development of new reactor designs — the sodium-cooled fast reactor — has just been abandoned. It is therefore interesting to note that this committee were able to review the status and programmes for 10 advanced reactor designs, including a sodium-cooled fast reactor. Most of the designs are water reactor developments, but there is a CANDU, the Swedish PIUS water reactor, an HTR gas-cooled reactor, as well as the fast reactor.

Some of the designs are only modest developments of existing plants, generally with rather lower power ratings for the fuel than current designs. These, the committee considers, do not need prototypes. The technology is sufficiently developed for designs to be built only with development programmes which can be covered by the tendering companies or the Utilities' Electric Power Research Institute (EPRI).

When the committee reviewed the current federal supported facilities and programmes of reactor development in the US (mainly for fuel for breeder reactors) in the light of the selected design requirements there were three alternative programmes. All retain some fast reactor work, university research and work on improving performance and life extension of existing power plants. The smallest programme adds work on mid-sized reactors with possible safety features. Added to that for the second alternative is extra work on liquid metal reactors, transients, engineering testing and hot fuel examination. The largest programme is aimed at accelerating the fast reactor development.

The British collaboration with Combustion Engineering, and Stone and Webster on the Safe Integral Reactor is not among the systems recommended for federal support. The Swedish PIUS and CANDU are also excluded. Although the High Temperature Gas-Cooled Reactor is also excluded the Committee recommends a continuing programme on the fuel concept as it has other applications.

This report is therefore a significant contribution to a national nuclear debate — how about a British or European review on the same lines?

N G Worley

Clear and precise

'Electricity Economics and Planning' by T W Berrie
Published by Peter Peregrinus Ltd, London, 1992, 270 pp, £39.00.

THIS is volume 16 in the IEE Power Series, and is a follow-on publication from Tom Berrie's earlier work in the series with a book called *Power Economics* (volume 5) published in 1983.

Much has changed since then, particularly in the UK electricity supply industry. Privatisation of energy industries has taken place in the gas and electricity sectors, with coal likely to follow. All the changes which have occurred have been both radical and dramatic. Competition and deregulation are at the heart of these changes, bringing in many new terms, such as 'spot prices' and 'demand management'. In addition, there are new approaches to environmental, conservation concerns and energy efficiency.

Economics of the electricity industry has now to be examined under the fundamental changes which have taken place both nationally and internationally over the past decade. Planning and forecasting decisions were formerly taken on their long-term effects. The present day emphasis is very much on the short term, and short pay-back periods with dynamic and spot pricing methods set in real time.

The book is unique in that it gathers together all the elements of electricity economics and planning for the 1990s, providing the reader with an opportunity to acquire a firm understanding of the subject. It is furthermore a readable book, given the subject matter, having a minimum of mathematics.

Electricity Economics and Planning begins with an executive summary which is an outline precis of its contents. This is an important section in that it will provide readers with an overview, allowing them to tackle defined topics in the text with more ease. The summary covers demand assessment and management, efficiency issues, environmental and maintenance matters, conservation, regulation, financing and pricing and developing programme in the third world.

This then leads to the main contents of the book, which begins with an examination of the world's energy position. The eight chapters are divided into a number of sub-topics, all clearly documented. The contents cover electricity demand aspects, planning, the pros and cons of public versus private utilities, prescribed pricing methodologies, as well as the long and short-term position over the world's generation, transmission, distribution and utilisation programmes. The final two chapters deal with the special problems of electricity supply worldwide, especially in developing countries.

Exceptionally clear, precise and above all, well written, this book is highly recommended.

Eur Ing F John L Bindon

Recently published

'Recycling of Plastics Volume 4'
International Techno-Economic report by Vladmir M Wolpert, 1992, 197 pp, £370.00 (UK & EC) US$740.00 (USA & overseas) inc. postage. This volume contains the latest information and can be read or purchased independently of previous volumes. Available from Vladimir M Wolpert, Hunters, Holly Hill, Colemans Hatch, East Sussex TN7 4EP.

'Chinese Petroleum Directory'
In English, available on floppy disk, 1992, US$ 195.00. Available from Han Ying Shan Consultants, PO Box 71006, Wuhan, Hubei 430071, China. Fax: 86 27 711080.

'The International Coal Encyclopedia 1993'
Available from Coal Services International Ltd, Book Sales Department, 27-37 High Street, Suite No 9, Swanley, Kent BR8 8AE.

Energy, transport and the environment

THE private car has been developed and promoted by manufacturers more to satisfy the perceived needs of the motorist for status and excitement, than to provide socially environmentally and economically acceptable personal transport.

I would suggest that there is great potential cost benefit to be had from a government imposed design standard for the *rate of acceleration* and achievable *top speed*, arising from the following: reduced consumption of fuel, tyres, lubricants, brake material etc; reduced stresses on all vehicle components would allow lower original cost and subsequent maintenance and renewal costs; and possible use of new materials; improved costs of road design, construction and maintenance, higher vehicle capacity and lower policing costs; reduction of economic and human cost arising from accidents; reduced atmospheric pollution from vehicle consumables and loss of road surface, and lower noise pollution through improved design of road surface and tyres.

Obviously new car design would yield the most immediate benefits, but existing cars could be 'limited' with retro-fit equipment or the subject of early scrapping incentives.

The European Community is perhaps the forum for evaluating the above supposed cost benefits, and influencing or imposing a change of attitude towards the means of personal road transport?

Paul C Woods *(Fellow)*
Guildford, Surrey

AS both a chartered chemist and chartered engineer, and as an experienced motorist at present owning a small VW Polo car, fitted with a three-way catalytic converter, I would like to make some observations about vehicular traffic in the UK.

My first observation concerns the exhaust gases of petrol engines — those using leaded and unleaded petrol. Lead is added to petrol as a compound lead tetra ethyl, in order to prevent 'knocking' or detonation in the cylinders instead of the required explosions. Some ethylene dibromide is also added. Particulate lead and lead bromide are emitted from the exhaust, as well as carbon monoxide, carbon dioxide, nitrogen oxides, unburnt hydrocarbon gases, and water with slight quantities of sulphuretted hydrogen. In very hot, bright sunny weather ozone gas can also be produced.

Carbon monoxide, nitrogen dioxide, hydrogen sulphide and ozone are poisonous. Carbon dioxide is not, but it is the main contributor to the greenhouse effect.

Unleaded petrol will require an adjustment to the 'firing time' of the engine, but no lead is emitted from the exhaust. The gases carbon monoxide, nitrogen oxides and unburnt hydrocarbons can, however, be catalysed into carbon dioxide, nitrogen and water. The catalytic converter is a refractory honeycomb with a large surface area covered with a layer of two precious metals: platinum and rhodium. The converter is therefore expensive.

I would like to see legislation making it compulsory for all petrol engines to use unleaded petrol. Diesel engines produce a lower level of toxic emissions, so a small diesel may not require a catalytic converter.

The toxic effect of poisonous exhaust fumes becomes apparent during a period of anticyclonic weather, particularly if the anticyclone is more or less stationary and the weather cool and foggy. Recently over the Birmingham and West Midlands area such a situation occurred over several days. Many people suffered throat and chest infections. Masks should be manufactured and given or sold to the general public for use due such anticyclonic conditions.

The pollution problem could be helped in another way: by the production of electric vehicles. About three years ago General Motors of the USA produced a 'one-off' electric car which was run from a 'battery' of fuel cells. Mass production of such cars will only occur if petrol stations are replaced by 'battery stations'. Solar panels can also be utilised in very bright sunny regions. Solar panels would be somewhat unsuccessful in the UK, but research is being conducted here and in Germany over the creation of suitable cells for making the required batteries.

My second observation is concerned with all types of vehicles, even horse-drawn ones!

For the past three to four years I have been advising people not to spend a lot of money, say in excess of £9000, on purchasing a new motor car. I have correctly forecast the considerable drop in sales of British cars in the UK. The recession is partly, although not entirely, to blame.

The volume of traffic on all our roads, and particularly motorways, is increasingly at an alarming rate. Accidents produce enormous queues, eg, a 19-mile long tailback on the M6 recently. Very few drivers can avoid a collision at some time in their driving lives, and thus damage to their car. Cyclists, especially those who pedal when off the saddle are now becoming a real menace, even the best of drivers have difficulty avoiding them because of the traffic congestion. We will soon be the most 'traffic jammed' country in Northern Europe.

Unless UK car manufacturers can acquire a sustainable export market, it would be better for them to shut down, the sooner the better. Car company management should use their many skilled employees to manufacture something else. In the meantime, good quality, second hand cars, well serviced and with catalytic converters should be the order of the day. Large pedestrianised centres and tramway systems could provide a temporary solution in our cities and large towns.

I have made these observations and comments in the best interests not only of ourselves, but of future generations.

T W Hay *(Fellow)*
Warley, West Midlands

Wind farms are now taking off

I AM loathe to continue correspondence about the viability of the renewables and the economics of wind energy in your columns (*Energy World*, November 1992, December 1992, January/February 1993) for two reasons. First of all, I do not wish to trigger publication of further errors.

For instance, Mr G Daniel is still not clear about the price of wind farms in the UK, and he gets his mean wind power wrong by another factor of two. Having discovered, quite correctly, that "all else being equal, power output varies as the cube of the wind speed". He unfortunately, and incorrectly, cubes the mean wind speed to get the mean wind power. The mean of the cubes is not the cube of the mean — just try it with one and three! There is actually twice the amount of wind energy.

To compete with gas will be hard enough for any source of energy, whether it spreads more pollution, like coal, or is cleaner like the wind. Capital intensive systems have additional problems in combating today's financial short-termism, so that is another difficulty for wind power (one that is even worse for tidal power, by the way). The real facts are tough enough to cope with in a fiercely competitive market, without false facts and opinions being propagated just when wind farms are trying to achieve viability.

My second reason is that exchanges of correspondence over several months cannot keep up with the facts. In the last quarter of 1992, the installed capacity of wind turbines in the UK more than doubled to over 50 MW. As I write, it is 87 MW and in the next two to three months it will pass the 100 MW mark. All of these new wind farms are costing around £1000/kW or even less.

Whatever opinions there may be to the contrary, the facts are clear — in the UK, wind farms are now taking off!

Donald T Swift Hook *(Fellow)*
Chobham, Surrey

Risk guidelines

THE Engineering Council has issued a set of guidelines on risk issues, following the publication of the Code of Professional Practice on engineers and risk issues, which took effect from the beginning of March.

The code, which has been issued to the 290 000 engineers and technicians on the Council's register, is a major initiative to ensure chartered engineers, incorporated engineers and engineering technicians give a high priority to the need for an increasing awareness and understanding of risk management.

It consists of a ten-point plan for the conduct of individual engineers and technicians in exercising their professional competence and responsibility in dealing with risk issues. The guidelines provide practical and ethical guidance.

Sir William Francis, chairman of the Council's working party on risk issues, said: "The guidelines contain background information to help engineers and all others interested in risk issues to gain a fuller understanding of the implementation of the Code and the use of risk assessment and risk management in reducing the chance of an accident or disaster.

"The working party review of recent disasters showed that outright technical failure is rarely the cause. Disasters usually result from a combination of events and prime contributory features are principally a lack of communication, a failure of supervision and shortcomings within the organisation in not imposing a corporate culture and a structured approach to risk management.

"The Code and guidelines will encourage and assist engineers and managers to develop a culture within organisations which should fully address all aspects of risk issues."

In addition to registered engineers and technicians, the guidelines are relevant to employers, managers and supervisors, professional institutions, providers of education and training, trade unions and Government.

They include practical guidance on the ten points in the Code and contain background information to help in its understanding, including examples of good practice, legal implications, case studies of disasters which identify some of the lessons that can be learned and comprehensive reference and bibliography sections.

The primary purpose of the Code is to increase awareness about risk identification, assessment and management among the registered engineers and technicians across all engineering disciplines in the 42 separate engineering institutions. If this is achieved the normal processes of communication between individuals should ensure a proper understanding of risk management throughout the organisation in which they work.

Drawn up by a broadly-based panel of senior engineers headed by Sir William Francis, the Code represents the profession's response to a number of past disasters, such as Piper Alpha and the King's Cross fire. It also shows a determination to be at the forefront of the action necessary to minimise the possibility of such incidents occurring in the future, thus saving lives and injury.

During the Code's embryo stage more than 2600 comments were received from industry, commerce, education, engineering institutions and individual engineers. The working party also visited a number of leading companies in the UK to study practical examples of good practice.

Key areas in which registered engineers and technicians should exercise influence and ensure they act with professional responsibility.

The Code of Professional Practice now becomes a document backed up by the full force of the Engineering Council's bye laws, codes and rules of conduct. This means that in extreme circumstances any registered engineer or technician could be deregistered if they are found to have flagrantly disregarded the Code. The guidelines, however, do not form part of the Code of Professional Practice: they have been produced to guide engineers, technicians and others in the application of the Code.

Copies are available free to registrants upon request; price £5.00 to Industry Affiliates and £10.00 to non-registrants, from the Engineering Council, 10 Maltravers Street, London WC2R 3ER.

Engineering initiative beats targets

THE international competitiveness of the UK's manufacturing industry should benefit from the success of universities in producing a new breed of manufacturing systems engineer, according to the Engineering Council.

Broadly-based courses, introduced as part of the manufacturing systems engineering initiative, are key to meeting industry's needs for engineers who can work with new manufacturing technologies and automated processes.

The £25 million programme to increase the number of students on manufacturing systems engineering courses was launched by the Government and the Engineering Council in 1988.

Commenting on the Government report highlighting the success of the courses, Professor Keith Foster, direction of the engineering profession at the Council said: "The success of this initiative should certainly change the views of those who have blamed industry's lack of growth on the shortage of people qualified in manufacturing disciplines.

"We are very pleased that the manufacturing systems engineering initiative has more than achieved its objectives. The intention was to broaden engineering courses, not only to cover manufacturing technology, but also the organisational and management techniques necessary for improving manufacturing within the context of business.

"The courses appear to have attracted students looking for a broader educational base in engineering. Many will take a career in line management in industry which should lead to excellent prospects for moving into top management."

Engineering courses have traditionally been directed mainly towards specific branches, such as electrical, mechanical, civil and chemical. The new courses were introduced following industry's call for courses relating to the systems of manufacturing.

Professor Foster added: "We applaud not only the support of the Department for Education and the Department of Trade and Industry but also the response of the universities in meeting industry's obvious needs."

Award may benefit remote areas

TRULY lightweight portable generators may become available as a result of a Hinton Fellowship to Mohammed 'Shahram' Etemad of Imperial College, London.

The award of £30 000 is made once every three years to the engineer whose work best applies basic scientific concepts and knowledge to enhance practical engineering achievements.

Named for Lord Hinton, the first chairman of the CEGB, the award is administered by the Institution of Mechanical Engineers and the Royal Academy of Engineering and is one of many made by the Institution to promote good mechanical engineering.

Mohammed Etemad's revolutionary work could lead to 50kW high speed generators being used in remote areas all over the world, replacing heavy diesel engines and similarly inconvenient gearing systems.

His high speed electric generator coupled directly to a gas turbine engine is a major improvement on conventional systems and holds promise for applications, including motor vehicles and auxiliary power units.

Etemad says of his work: "I hope this generator will bring accessible power to people in places where it was previously unavailable. I am especially interested in the prospects of a hybrid automotive application that will mean really low pollution levels."

April 1993

CO_2 reduction targets, energy efficiency and the UK potential
Conference, 23 April, London. Details from Energy Conference, CAN UK, 21 Tower Street, London WC2H 9NS, please enclose an SAE.

Environmental Management for Industry: putting your principles into practice for your company
Course, 26-27 April, Guildford, Surrey. Details from the Robens Institute, University of Surrey, Guildford, Surrey GU2 5XH. Tel: 0483 509209; fax: 0483 503517.

May 1993

12th International Conference on FBC
9-13 May, San Diego, California, USA. Details from ASME, tel: 800 843 2763; fax: 201 882 1717.

International Environment '93 & Analysis '93
Conferences and exhibition, 9-14 May, London.
Details from: Labmate Ltd, Newgate, Sandpit Lane, St Albans, Herts AL4 0BS. Tel: 0727 55574; fax: 0727 41694.

Remote techniques for nuclear plant
Conference, 10-13 May, Stratford-upon-Avon, UK. Details from Sue Frye/Nicola Kerwood, Institution of Civil Engineers, 1 Great George Street, London SW1P 3AA. Tel: 071 839 9801/9806; fax: 071 233 1743.

Jet fuels through the Millennium
Course, 11 May, Brighton, UK. Details from: Dr Eric Goodger, Symposium Manager, 28E Jessopp Road, Norwich, Norfolk NR2 3QB. Tel/fax: 0603 51842.

Effective membrane processes: new perspectives
International conference, 12-14 May, Bath, UK.
Details from Miss Tracey Peters, Conference Organiser, BHR Group Ltd, Cranfield, Bedford MK43 0AJ. Tel: 0234 750422; fax: 0234 750074.

Practical onshore risk assessment
Workshop, 13-14 May, Manchester. Details from: Jane Worman, IBC Technical Services Ltd. Tel: 071 637 4383; fax: 071 631 3214.

Buildings and the environment
International conference, 13-20 May, Watford, UK.
Details from Mrs Lesley James, Building Research Establishment, tel: 0923 664080/664083.

Fluid Machinery for the Oil, Petrochemical and Related Industries
Congress, 17-19 May, The Hague, Netherlands.
Details from: Hazel Anderson or Anne Nolan at IMechE, tel: 071 973 1317.

Energy demand and supply — economics in a changing world
Short course, 17-21 May, Oxford, UK. Details from: The Registrar, The College of Petroleum and Energy Studies, Sun Alliance House, New Inn Hall Street, Oxford OX1 2QD. Tel: 0865 250521; fax: 0865 791474.

CIRED 1993
International exhibition, 17-21 May, Birmingham, UK.
Details from: Jane Chopping, CIRED '93 Secretariat, Conference Services, IEE, Savoy Place, London WC2R 0BL. Tel: 071 240 1871 ext 222; fax: 071 497 3633.

Understanding heat treatment
Course, 18-20 May, Birmingham, UK. Details from: the Course Administrator, Wolfson Heat Treatment Centre, Aston University, Aston Triangle, Birmingham B4 7ET. Tel: 021 359 3611, ext 5212; fax: 021 359 8910.

Integrated pollution control
Conference, 24-25 May, London
Details from: Jane Worman, IBC Technical Services Ltd, tel: 071 637 4383; fax: 071 631 3214.

Energy and the environmental challenge — economics, technology and policies
Short course, 24-25 May, Oxford. Details from: The Registrar, The College of Petroleum and Energy Studies, Sun Alliance House, New Inn Hall Street, Oxford OX1 2QD. Tel: 0865 250521; fax: 0865 791474.

The financing and economics of gas and electricity projects
Conference, 25-26 May, London
Details from: Maura Fay, IBC Financial Focus Ltd, 57/61 Mortimer Street, London W1N 7TD. Tel: 071 637 4383; fax: 071 323 4298.

SFT '93 seminar
Annual meeting of the Societe Francaise des Thermiciens, 25-26 May, Pau, France.
Details from Universite de Pau, Avenue de l'Universite, 64000 Pau, France. Tel: (33) 59 92 33 74; fax: (33) 59 92 33 82.

Cities '93
Conference and exhibition, 25-26 May, Birmingham.
Details from Anna Grabham/Nick Clatworthy, Cities '93, Hemming Group Ltd, 32 Vauxhall Bridge Road, London SW1V 2SS. Tel 071 973 6400; fax: 071 233 5052.

1993 ASME Turbo Expo: land, sea & air
International congress & exposition, 24-27 May, Ohio, USA.
Details from: ASME, 6085 Barfield Road, Suite 207, Atlanta, Georgia 30328. Tel: (404) 847 0072; fax: (404) 847 0151/(404) 843 2517.

Railways
International Conference, 25-27 May, London. Details from:Sue Frye, Institution of Civil Engineers, 1 Great George Street, London SW1P 3AA. Tel: 071 839 9801/5; fax: 071 233 1743.

June 1993

Cogeneration power plants and heat pumps — future engineering markets
Conference, 1-2 June, Essen, Germany. Details from: VDI-Gesellschaft Energietechnik, Postfach 10 11 39, 4000 Dusseldorf 1, Detschland. Tel: 0211 6214 363; fax: 0211 6214 575.

Use of oxygen for production of metals, glass & power
Conference, 8 June, Coventry, UK. Details from: The Combustion Engineering Association, P O Box 15, Farm Road, Aberman, Aberdare Mid Glamorgan CF44 6YZ. Tel: 0685 879119; fax: 0685 879119/878104.

26th UNICHAL Congress
8-10 June, Paris, France. Details from: CGSA/26eme Cogres UNICHAL, 38, rue Croix des Petits-Champs, 7500-Paris, France. Tel: (33) 1 42 61 81 06; fax: (33) 1 42 61 35 62.

Wind energy penetration into weak electricity networks
International workshop, 10-12 June, Chilton, Didcot, UK.
Details from: Mr J E Foster, c/o Energy Research Unit, Rutherford Appleton Laboratory, Chilton, Didcot, Oxon OX11 0QX. Tel: 0235 821900, ext 5440; fax: 0235 446863

Incineration technology in Europe
Course, 23-25 June, Sunderland, UK. Details from: Dr Faisal Salam, tel: 091 515 2711; fax: 091 515 2741.

October 1993

Energy Systems BEng (Hons)
Three-year course, Southampton Institute.
Details from: Geoff Orme, Course Leader, tel: 0703 319354

INSTITUTE OF ENERGY CONFERENCES

Please note that the conference programmes are subject to modification. For the latest information please telephone Judith Higgins on 071 580 0008.
The Institute of Energy, 18 Devonshire Street, London W1N 2AU, UK.

Fuels for Power Generation

20 April 1993, London

Organised by The Institute of Energy in association with the Major Energy Users Council
Speakers include: John Uttley CBE, National Grid Company; John Collier, Nuclear Electric plc; Edmund Wallis, PowerGen plc; Dieter Helm. Oxford Economic Research Associates; Michael Roberts, Institute of Energy; Cedric Brown, British Gas plc; Malcolm Edwards, Edwards Energy Ltd; John Harris, East Midlands Electricity plc; Stephen Littlechild, OFFER, and Peter Rost, Major Energy Users Council.

How Climate Change Will Change Your Business

Government Strategy & Practical Responses

7 July 1993, London

Speakers include: The Rt Hon Michael Howard QC MP, Secretary of State for the Environment; Professor James Harrison, Institute of Energy; Peter Bach, Ministry of Energy, Denmark; John Collins, Advisory Committee on Business & The Environment; Professor Peter Jones, University of Westminster; Paul Davidson, BRECSU; Andrew Warren, Association for the Conservation of Energy.

International Conference on

Combustion & Emissions Control

21-22 September 1993, Cardiff

Keynote speeches from international figures will precede contributions on the following subject areas: Boilers and Furnaces, Emissions Reduction — Gas & Oil Systems, Emissions Reduction — Solid Fuels, Waste Utilisation and Combined Cycle Power Generation.

Making Energy Privatisation Work

The Future of Regulation

17 November 1993, London

Speakers include: Tim Eggar MP, Minister for Energy; Professor James Harrison, Institute of Energy; Professor Nigel Lucas, Imperial College; John Baker, National Power plc; Malcolm Chatwin, Yorkshire Electricity Group, plc; David Jefferies, National Grid Company plc; Cedric Brown, British Gas plc; Alan Marshall, AGAS; Lady Wilcox, National Consumers' Council; Ian Blakey, British Iron and Steel Producers Association; OFGAS speaker to be confirmed; Richard Caborn MP, Trade & Industry Select Committee. Conference Chairmen: Mr Ian Powe, Gas Consumers' Council and Professor Nigel Lucas, Imperial College.

CALL FOR PAPERS *(closing date 30 July 1993)*

2nd International Conference on

Ceramics in Energy Applications

April 1994, London

The conference will consider material solutions to new and existing applications of interest to energy suppliers and users. Important aspects of materials innovation in energy saving will be explored. We would welcome the submission of abstracts on the following areas: New Developments & Applications; Energy Saving & Heat Transfer; Evaluation & Performance; Power Generation; Sensors & Catalysts; Energy Efficiency. For further information please contact Judith Higgins on 071-580 0008.

Events Co-sponsored by The Institute of Energy:

First International Conference on Combined Cycle Power Generation
Calcutta, India, January 1994

General enquiries should be directed to:
Professor Prabir Basu, Technical University of Nova Scotia, PO Box 1000, Halifax, Nova Scotia, Canada B3J 2X4, Tel: 1-902-420 7531

Paper Co-ordinator for the submission of abstracts from European countries:
Dr J R Howard, Tel: 44-21-705 1946

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