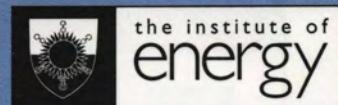


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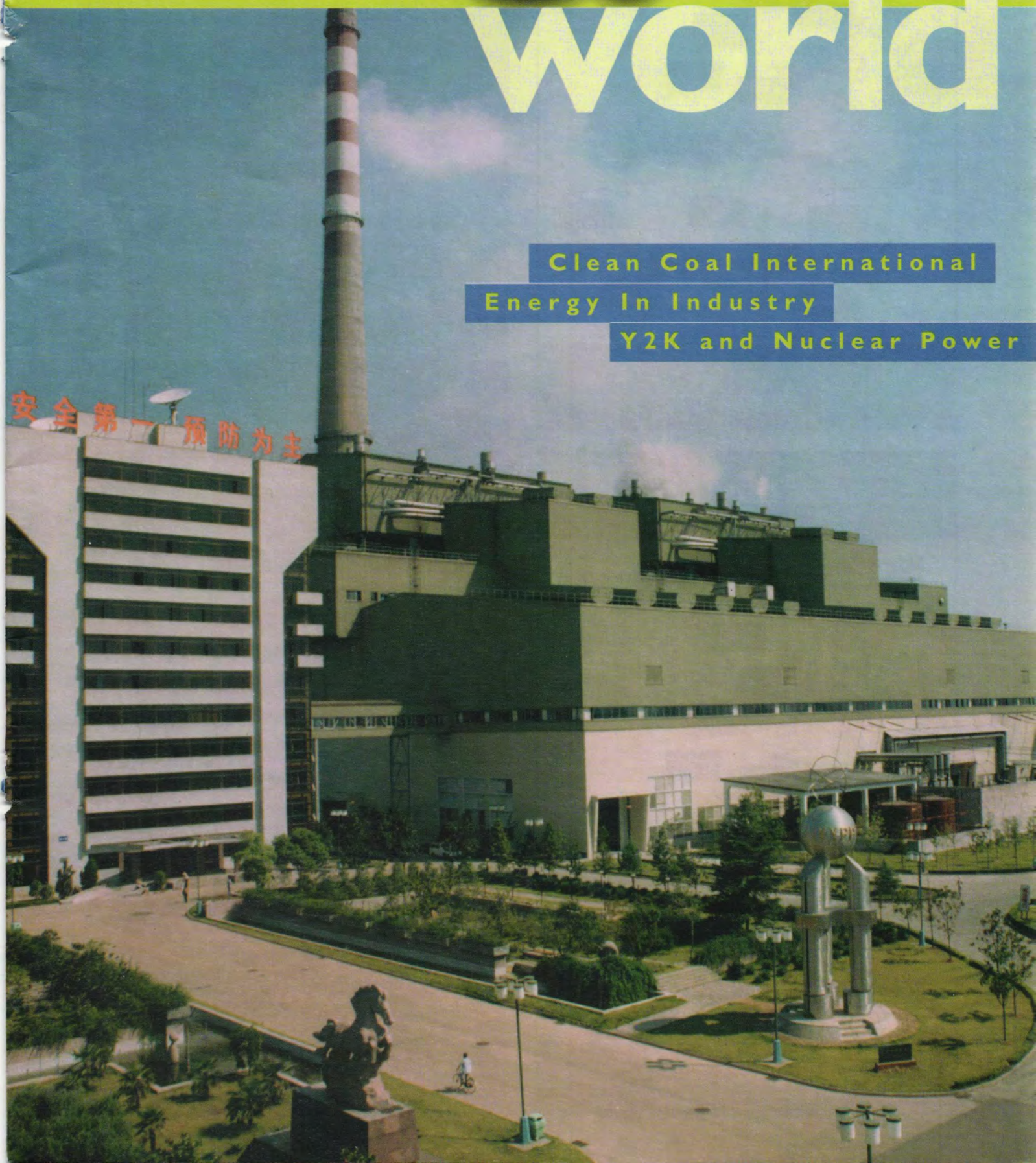
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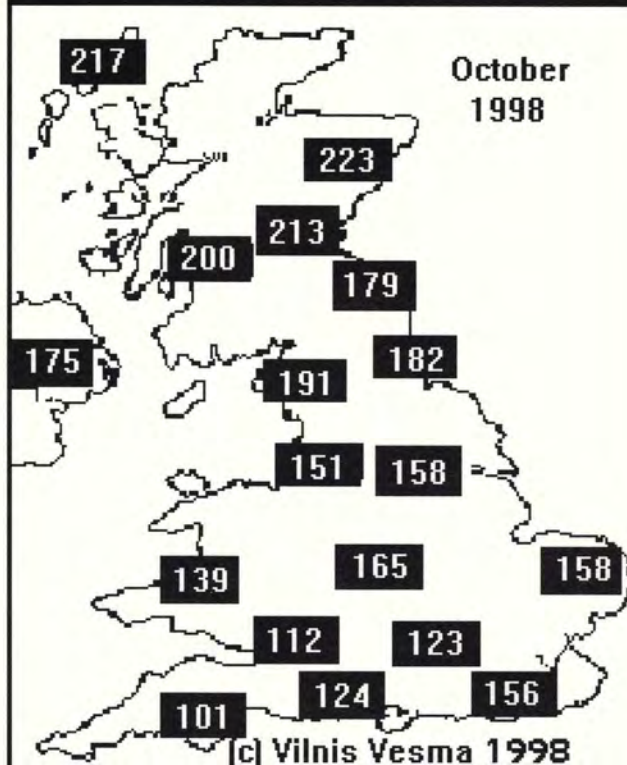
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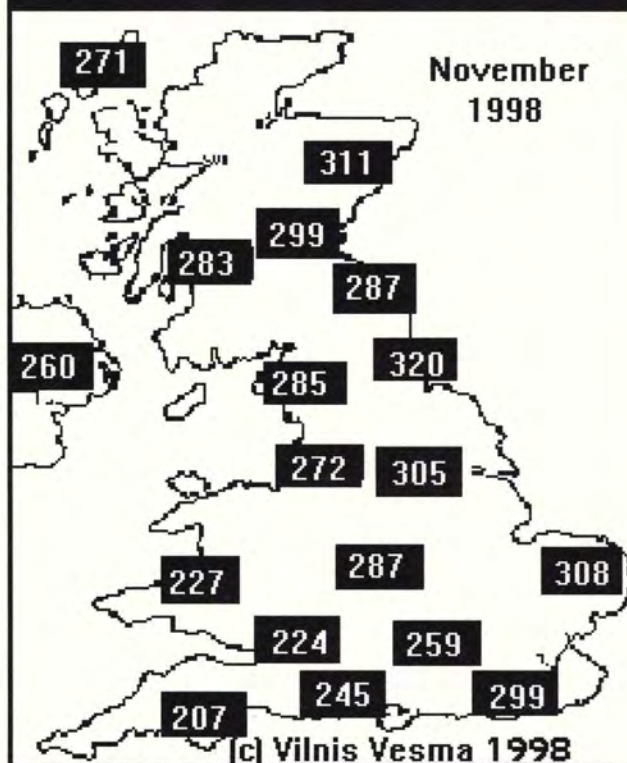


Degree day figures



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Mr John Deane - Managing Director
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18 Devonshire Street, London W1N 2AU
info@ioe.org.uk
eworld@ioe.org.uk
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EDITOR
Steve Hodgson
Tel/Fax: 01298 77601

ADMINISTRATION
0171-580 7124

**MEMBERSHIP, AND
JOURNAL SUBSCRIPTIONS**
Tel: 0171-580 0077 Fax: 0171-580 4420

ART EDITOR
Louise Collins

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COVER

Yue Yang coal-fired power station, Hunan Province in China. The combination of its population, huge coal reserves and rapid economic growth makes China one of the keys to efforts to limit or avoid climate change. Indeed, together with east and south Asia, China represents 70% of the \$500 billion market for clean coal technologies being developed in the west.

This is one of the areas covered in the 1998 annual Robens Coal Science Lecture delivered by Tony Marshall of Mitsui Babcock Energy Ltd (and chairman of the UK Foresight Energy Panel's Clean Coal Power Generation Technology Task Force). An edited version of the Lecture is reproduced on pages 12-15.

(Photo courtesy Mitsui Babcock Energy Ltd)



Modernising energy policy for a sustainable energy future

David Green, Director of the Combined Heat and Power Association

Last November, Environment Minister Michael Meacher gave the most upbeat and positive message to the Combined Heat and Power Association's national conference that I can remember from any politician over the last decade. He was laying out the details of how combined heat and power (CHP) schemes are exempted from the Government's ban on new gas-fired power stations due to their energy efficiency and environmental benefits, as well as repeating the Government's firm support for the technology.

The Government's commitment to a more sustainable energy policy comes through clearly in its desire to curtail the development of energy-wasteful power plant, while stimulating genuine, high efficiency CHP schemes.

Together with other recent moves, it illustrates just how far this Government has moved to embrace a green agenda to tackle climate change - moves which would have been unthinkable a few years ago. Once dubbed the 'dirty man of Europe', Britain is now a leader when it comes to brokering international agreements to cut carbon emissions and tackle climate change.

Deputy prime Minister John Prescott has been credited as one of the architects of the 1997 Kyoto agreement in which the developed countries set targets to cut their carbon emissions. Indeed the Government remains committed to its manifesto target to cut carbon emissions by 20% by the year 2010, despite being allocated a less ambitious (but legally-binding) target by the Kyoto process. Prescott has also expressed his strong support for a recent move by the Department of Energy to double the CHP capacity in the US by 2010.

In order to meet its target, the UK Government plans a major expansion in the use of CHP and renewables - to the point where these two technologies would be responsible for nearly a quarter of the country's electricity needs by 2010. New schemes would themselves promote competition directly in an electricity generation market which the Government has described as "fundamentally flawed".

Indeed current moves to reform the electricity Pool and electricity trading arrangements are also vital to the growth of embedded CHP and renewables schemes.

The other key move is towards taxing the use of energy by business. Energy taxation has been talked about in Europe for more than a decade now, but until now was considered unthinkable for the UK. However, with energy prices now at their lowest for several decades, the incentive to invest in energy

conservation is also low.

Last year Chancellor Gordon Brown asked the then President of the CBI, Lord Marshall, to lead a task force to make a recommendation on the use of 'economic instruments' as a way to encourage business to use less energy. The two main instruments are energy taxes and a system of trading carbon emissions, both of which would encourage the wider use of CHP.

Last October's Marshall's Report said that there is a place for both, as long as the revenues from an energy tax are recycled to business to protect its competitiveness. Some of the revenue should be used directly, says Marshall, to promote energy efficiency and reduce greenhouse gas emissions from UK businesses. This way, a modest tax can produce large results.

The Government's own energy advisors at ETSU have suggested that, far from damaging competitiveness, nearly all UK industries would benefit from such a task. Experience in the Netherlands confirms this and the new German Chancellor, Gerhard Schroder, has said that his new Government will "immediately embark on the path of ecological tax reform".

However, how quickly the UK Treasury is likely to implement an energy tax is another question altogether. Indeed, despite a host of good green intentions, the Government has a long way to go before the war is won.

Yet with so much at stake, momentum must be sustained. Energy Minister John Battle has yet to spell-out exactly how renewables are to be supported now that the last government's subsidy mechanism is about to reach its end. We also need firm details of how the Government is to facilitate the expansion of CHP from the current 4 GW of capacity to the Government's target of 10 GW or more by 2010.

One way forward might be the creation of a 'sustainable energy agency' to bring together the myriad of organisations currently responsible for advising on policy and supporting green energy initiatives. Such an agency could deliver the synergies currently missing as sustainable energy falls between the orbits of the DTI and DETR.

As Michael Meacher's support at our conference showed, the Government has come a long way since its election in May 1997. Now, if the DETR approach on energy and environmental policy prevails and the Treasury remains on-board, Britain will stand a good chance of meeting its 2010 carbon dioxide emissions target and, in doing so, making significant progress towards a sustainable energy future.

Contact the CHPA on tel: 0171 828 4077 or visit the Website at www.chpa.co.uk

Buenos Aires agrees 2000 deadline for climate action

Environmentalists were disappointed at the apparent lack of progress made at the Fourth 'Conference of the Parties' meeting held in Buenos Aires last November to tie-up the loose ends from the 1997 international climate change treaty agreed in Kyoto.

The event ended with an agreement to set a deadline of the end of the year 2000 to finalise the design of methods to deliver carbon dioxide reductions internationally via

'joint implementation', emissions trading and the 'clean development mechanism', which were all agreed in principle at Kyoto.

The methods are designed to allow developed countries to target action in other countries to meet some of their Kyoto obligations, and to bring the developing nations into the process. The US government announced its decision to sign the Kyoto Protocol during the conference, but ratification by

Congress may still prove difficult.

"We now have an action plan with timetables" said UNFCCC executive secretary Michael Zammit Cutajar, adding that "the crunch will come at the sixth session of the Conference of the parties at the end of the year 2000". The World Wide Fund for Nature's spokesman expressed his disappointment: "It's another small turn on the rudder of the climate change supertanker, but governments

have much more to do to steer clear of the rocks".

• Close to a million megawatts of wind power could be installed worldwide within two decades, powering the equivalent of 500 million households with renewable energy, according to an international study produced by Greenpeace, The European Wind Energy Association (EWEA) and the Danish Forum for Energy and Development and released during the Buenos Aires negotiations.

Next month's issue of Energy World will include a major feature article on international carbon trading and sequestration.

UK-Europe gas Interconnector opens

A new era of trade in gas between the UK and continental Europe began with the opening last October of a subsea gas Interconnector pipeline between Bacton in Norfolk and Zeebrugge in Belgium.

Construction of the £420 million, 235 km long pipeline involved nine international energy companies and was one of the largest construction projects in Europe.

Speaking at its inauguration, Interconnector Managing

Director Roger Cornish said: "The Interconnector will fundamentally change the gas map of Europe. As well as providing security for consumers it presents opportunities for those marketing gas within Britain and continental Europe and those engaged in offshore exploration."

The new pipeline links the UK and continental gas transmission systems between a compression terminal at Bacton and a reception facility



Part of the Interconnector being laid off the Norfolk coast back in 1997.

in Zeebrugge. It is able to transmit up to 20 billion cubic metres of gas from the UK to the Continent and can reverse the flow to import gas at a capacity of 8.5 bcm.

The Interconnector is

owned by a consortium of major national and international energy companies: BG Plc (40%); BP, Conoco, Elf, RAQ Gazprom (all 10%); Amerada Hess, Distrigas, National Power, Ruhrgas (all 5%).

Due diligence completed at Three Mile Island

British Energy and its American joint venture partner PECO Energy have announced a definitive asset purchase agreement on Three Mile Island I with GPU Inc, owners of the 790 MW nuclear power station near Harrisburg, Pennsylvania.

The agreement affirms a purchase price of \$100 million

payable in cash - \$23 million for the reactor and \$77 million payable over five years, for existing fuel stocks.

AmerGen will assume full responsibility for the eventual decommissioning of TMI-I which will be pre-funded by GPU.

The agreement also includes a power purchase agreement under which GPU Energy, GPU

Inc's regulated energy delivery subsidiary, will purchase the capacity from TMI-I from January 1, 2000 to December 31, 2001, assuming the deal is closed by December 31, 1999.

The agreement marks the successful completion of three months of on-site due diligence by a team from British Energy and PECO Energy.

While there are still several significant regulatory approvals necessary before the sale can be completed, the transaction would mark the first ever sale of a nuclear power plant in the United States. Formal application to the US Nuclear Regulatory Commission for a transfer of licence to AmerGen will be made shortly.

The Gulf's first private power and water station

Croydon based Mott MacDonald has been appointed developer's engineer for Abu Dhabi's first independent power and water station, Taweelah A2, which will be developed by the US based CMS Energy on a build-own-operate basis.

The \$750 million project is located 80 km from Abu Dhabi city between two existing plants, Taweelah A1 and Taweelah B, both owned by Abu Dhabi Water and Electricity

Authority (ADWEA). The new plant will produce 710 MW of electricity and 50 million gallons of fresh water per day.

The power plant will utilise three of the new generation of 200 MW gas turbines, Siemens V94.3A, and three heat recovery steam boilers. The generated steam will be expanded in two 112 MW steam turbine generators and used for heat input to the desalination plant which will comprise four multi-

stage flash distillers each with a capacity of 12.5 mgd - equal to the largest ever built.

The boilers are designed to accept a high level of supplementary firing to enable the plant to produce its full water output at times of reduced power demand. Natural gas, piped onto the site from local gas fields will be the main fuel with fuel oil used for back-up. The plant will achieve very high thermal efficiency of

above 80%, while complying with stringent environmental standards.

As engineer to the developer Mott MacDonald will supervise all engineering activities and provide assistance with project management.

The first two generators in the plant are being installed in a fast track programme to meet the summer of 2000, with completion of the full plant due the following year.

Climate predictions say '98 was the hottest yet

Dying forests in parts of Northern Brazil, tropical grasslands turned to desert and an increase in malaria are reported by climate scientists in a first evaluation of the new climate predictions from the UK's Hadley Centre.

The latest climate predictions, presented to a world audience of scientists and politicians at the Buenos Aires climate change conference last November, also suggest that by 2050, vegetation

will lose its ability to absorb carbon dioxide thereby accelerating the build-up of CO₂ in the atmosphere.

The latest findings from the Hadley Centre show:

- average global temperature in 1998 likely to exceed 1997 - the hottest on record;
- the 1997/9 El Nino was the most extreme on record;
- man made greenhouse gas emissions have made a substantial contribution to

increase global temperatures in the last 50 years;

- a further 30°C warming in the next 100 years - the land warming faster than the sea; and
- a slowing down of the North Atlantic Circulation of about 20% by the middle of the next century - although Europe still warms.

This will mean that by the 2050s we could see:

- tropical forests die-off in parts of Northern Brazil;
- tropical grasslands transformed to desert or temperate grassland;
- 20% more people at risk of hunger in Africa;
- 20 million extra people at risk of flooding due to sea level rise of 21 cms;
- 170 million extra people living in countries with extreme water stress; and
- increased exposure to malaria.

Auckland-style power failure 'could happen anywhere'

A power blackout similar to that suffered by New Zealand's most important commercial district for more than four weeks in 1998 could occur in any mature, urban electricity network, according to EA Technology, which held a conference on the subject at Capenhurst last October.

More than 120 senior electricity industry figures from both developed and developing countries gathered to discuss the results of the New Zealand governmental inquiry into the

disaster, in which EA Technology was appointed to carry out a peer review of the investigation conducted by Australian company Integral Energy.

EA Technology's director John Walker said: "The mistake which companies often make is to assume that the operational life of assets is equivalent to their financial life - but this does not take into account the performance of assets under load, stress and fault conditions. Even recently-installed components of a

network can fail, so it is vital to assess their condition regularly as a matter of procedure."

The inquiry found that the Auckland failure was triggered by a cascade of incidents, occurring against a background of policy decisions stretching back several years.

The business district was served by four 110 kV underground cables: two oil-filled, two gas-filled. One of the gas-filled cables failed on January 22nd after it was damaged by a contractor, causing an overload

in which a second unit failed: the two remaining cables then broke down. The cables took a week to repair and then failed a second time on February 20th leaving the district with greatly reduced power for more than a month.

The investigation concluded that the cable failures were caused by a combination of gas leakage, thermo-mechanical movement or stress during their lifetime and thermal runaway - with the probability that unusually dry ground conditions were a contributing factor.

Government consults on climate change measures

Deputy prime Minister John Prescott has launched a consultation paper on how the UK is to meet its obligations to cut emissions of a basket of six greenhouse gases by 12.5% below 1990 levels by somewhere between 2008 and 2012.

UK Climate Change Programme is a 60-page document laying out the options for cutting emissions of carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride. It examines the contributions which could be

made by the energy supply industry, business users, the transport, domestic and agriculture sectors and public sector users.

According to the DETR, the consultation paper is the start of a process by which ministers will take the views of key sectors and identify the level of commitment to delivering emission reductions. It stresses that action by Government alone will not be enough - all sectors have a part to play and action by individual firms, local authorities and

households will be critical.

Developing a new climate change programme will be a complex task - there is a large range of measures that could be used, and the impact of these differ sharply. The programme must be balanced and equitable, and based on practical and cost-effective measures. The Government says it will not introduce measures that would damage UK competitiveness or have an unacceptable social cost.

However, discussion on climate change should not all be about costs, it adds. Many measures will have benefits that go wider than emission reductions - better air quality; a less car-dependent transport system; warmer, more comfortable homes; energy savings for business and consumers; and new jobs and market opportunities from more efficient technologies.

The consultation paper sets out the UK's emissions baseline and projections and breaks them down by sector. It quantifies, where possible, the carbon savings individual measures could deliver. It demonstrates that the legally

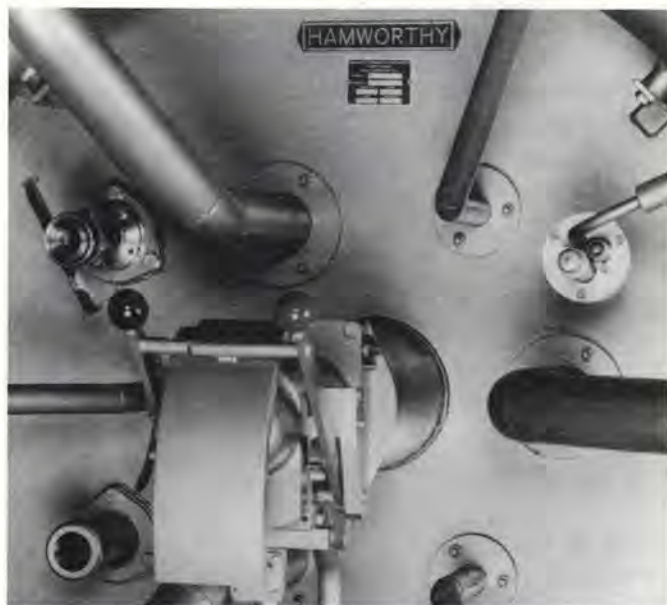
binding target is well within reach and that a 20% reduction in carbon dioxide is achievable.

On current projections the UK is forecast to be about 10% below 1990 emission levels in 2010. This includes the impact of some policies introduced since the election and the new National Road Traffic Forecasts, which imply a reduction of up to about 3% on previous projections.

Emissions from most sectors are currently on a downward trend. This is partly because of the switch to less carbon intensive fuels in the electricity generation sector, but also due to measures in the current climate change programme. However, after 2000 emissions of carbon dioxide will start to rise again.

The consultation period ends on 12 February. Copies of the consultation paper are available from DETR Free Literature, tel: 0870 1226 236, fax: 0870 1226 237, and on the internet at the DETR web site: www.detr.gov.uk

Institute to co-ordinate response - see page 24



Hamworthy Combustion Engineering (HCE) has supplied burners and associated equipment to a novel power station in Norfolk - in which chicken litter is used as the primary fuel for power generation. Owned by Fibrowatt, the new biomass plant is capable of generating 38 MW of electrical power from chicken litter, a mixture of straw, wood chippings and poultry waste.

HCE supplied the two DFLL-650 low-emission, air atomised diesel oil burners to the plant. In addition, the company also provided a burner management PLC control system, local burner valves and instrument module. Each of the burners has a gross heat output of 24 MW. The burners are used for cold light up and for sustaining the heat output when the chicken litter fired is unable to meet demand.

Degree-days via the internet

Energy managers and consultants alike need degree day data when analysing the performance of heating or air conditioning systems. Often the information is needed in a hurry, and preferably in electronic form, so Vilnis Vesma's Degree Days Direct has introduced an on-line service accessible via the

internet. It provides not only heating degree days for the 18 standard regions but cooling too, both to various base temperatures.

To obtain full details of the service by return, send an e-mail with your name, address and telephone number to ddinfo@vesma.com.

Wind, biogas and gasified crops in the same system

De Montford University has launched at its Caythorpe Campus what it describes as the most comprehensive renewable energy system in Europe, including biogas, gasified energy crops and wind power.

The project represents the results of a major EC funded project to design and build a renewable energy facility which combines the output of an anaerobic digester producing biogas from animal and vegetable waste, a gasifier producing gas from coppiced wood and a wind turbine generator.

The project has been co-ordinated by De Montford University and involves the universities of Loughborough and Zaragoza (Spain) and wind turbine manufacturer Vergnet SA of France. The new system will become a base for major research, demonstration and teaching.

With all elements of the system being on one site, the

centre allows for the comparison of individual performances of each of the sources and an evaluation of their combined performance. The results will, says the University, present a viable system that can be used

Innovative Technology Centre said. "Through the design, build and testing of the system we have managed to overcome many of the practical challenges presented by the use of such renewable materials."



De Montford University's three-element renewables scheme - the wind turbine is on the left with wood chip storage beneath, the biogas holder in the centre and the building housing the engine on the right

on a small scale in countries without a strong local electricity grid, or on a larger scale in more developed countries by linking wind farms, digestors and gasifiers on different sites.

Professor Jim Picken, project leader from De Montford University's

How do you stop the pumps on the digester getting clogged with pig hairs? How do you get dry chipped wood in England? These are some of the very real problems we have tackled along the way".

The basic generator chosen for the system was a constant

speed wind turbine. This has the disadvantage of large and uncontrolled variations in power output.

Deficiencies between the wind generator output and the load demand are made up by a spark ignition reciprocating gas engine driving a second generator. This engine can be fuelled by either biogas or gas generated by a wood gasifier.

The wind turbine generator is connected to the load whenever there is sufficient wind. The anaerobic digester supplies a large gas holder which can be connected instantly to the engine generator on demand. The engine then operates at any load between idling and full load depending on the difference between load and wind turbine output. When the biogas stored in the gasholder becomes low, the wood gasifier is started up so that wood gas can take over from biogas as the engine fuel.

Marshall says there is a role for energy taxes

The slow, step-by-step move towards a new tax on energy use by industry and commerce continued with the publication in November of Lord Marshall's report: *Economic instruments and the business use of energy*. The report says that all sectors of economy will have to play their part to reduce greenhouse gas emissions, that tougher reduction targets will inevitably follow the Kyoto figures, and thus that there is a role for 'economic instruments' as part of a wider package of measures.

Of the two types of

instrument, Marshall says that emissions trading will be important in the future and that Britain should set up a pilot scheme, but that energy taxes are also necessary, partly to bring small and medium sized businesses into the picture.

The Report adds that the design of the tax must be such that it does not harm the competitiveness of British industry, so its revenues should be fully recycled back into business - and at least some of the revenue should be used directly to promote energy

efficiency and reducing greenhouse gas emissions. It may be necessary, adds Marshall, to give rebates to very large energy-using industries.

Marshall adds that the leading option for type of tax is a 'downstream' energy tax on the final use of energy by industrial and commercial users, with the rates having some link to the carbon content of the fuels used. The tax should not disadvantage the development of new CHP and renewables schemes, he adds.

With energy prices at a

historical low, yet the need to reduce its use for environmental reasons never more pressing, an energy tax may be the only way to deliver an incentive to business to cut its use.

Certainly, opposition to the concept seems to have melted away apart, that is, from the CBI.

Chancellor Gordon Brown welcomed the report and said that the Government would consider it as part of its wider strategy on climate change. Some observers believe a new tax could be announced as part of this year's budget.

Three millennium energy products

The Aurp energy ACE Platform, an innovative self-installing and removable offshore oil and gas platform, has been granted Millennium Product Status in the second tranche of Millennium Products announced by Secretary of State for Trade and Industry Peter Mandelson. More than 400 new British products and services have been selected by the Design Council for their world-beating and forward-thinking attributes.

The ACE Platform could revolutionise the offshore oil and gas industry by providing an environmentally sound and economic solution to marginal field development, says Arup. Evolving from a desire to find a more economic solution to

supporting and installing facilities offshore, ACE will be of particular benefit for use in fields where traditionally the installation of platforms has not been economically viable - offering an opportunity for countries without a well developed industry to access previously untapped oil and gas resources.

The primary attraction of the platform is that it is self-installing. By using a standard barge as the topside, the platform itself provides the buoyancy required for the tow to field and installation, thus avoiding the enormous expense of offshore assembly. Secondly, the platform can be easily relocated, allowing the capital cost to be shared over a

number of marginal field developments, and the entire platform can easily be removed at the end of its useful life.

Two more products winning Millennium Product status are a unique three-dimensional mapping system being pioneered in a joint venture with Midlands Electricity, and BRE's Environmental Building (which was featured on the cover of *Energy World*, May 1997).

The mapping system, which could ultimately see the end of major roadworks, uses specialised 3D mapping methods and existing directional drilling techniques to lay the underground cables without digging up the road or damaging pipes and cables. After

establishing the technical and financial viability of 3D mapping, MEB now routinely uses the method. Over the next year MEB expects to install up to half of all its cables in pavements and roads using trenchless technology, minimising disruption to traffic, pedestrians and the environment.

BRE's Environmental Building is designed to use 30% less energy than current best practice without reducing the comfort of the people working there. Many innovative features make maximum use of natural lighting and natural ventilation, and of the building's mass to moderate temperature. Also, maximum use was made of waste and recycled material in its construction.



Home of the huge Lovell Telescope, the world famous Jodrell Bank radio astronomy site, has a more reliable electricity supply thanks in part to the installation of PLCs and SCADA packages from Cegelec Industrial Controls. Nuffield Radio Astronomy Laboratories, which are based at the University of Manchester's

Jodrell Bank site, have upgraded the standby power supply by introducing a sophisticated PLC based monitoring system to improve availability.

To be sure of power at all times, two standby power generators are employed to provide power should the main grid supply fail. To monitor the status of all

three supplies, a Cegelec Alspa C80-35 PLC and an Alspa PI200 SCADA package have been installed in the power house. The Alspa C80-35 incorporates a module to communicate with three power monitoring devices whilst the Alspa PI200 has a modem link allowing remote monitoring and control of all SCADA functions.

NIE launches a green electricity tariff

Northern Ireland Electricity has introduced a new Eco-Energy tariff which gives customers the opportunity to purchase electricity from renewable energy sources.

The new tariff, backed by Northern Ireland's Electricity Regulator Douglas McIlldoon, environmental groups and renewable power developers;

will enable customers to purchase their electricity from new renewable generation sources. The tariff is unique in that it is directly linked to new renewable contracts rather than existing renewable output.

Speaking at the launch, Alan Gaston, Managing Director, NIE Supply said: "This initiative highlights our serious

commitment to the environment and also provides customers with the opportunity to do something practical to benefit the environment. For as little as 8p every week, customers can make a very real and positive contribution to protecting the environment. We also hope that this extension to our product range, which is a

direct response to customer demand, enhances the developing market for renewable power generation."

- Meanwhile Eastern Group is looking to extend its green electricity pricing scheme, EcoPower, across the UK in a bid to win wider support for renewable energy projects.

Cutting costs, improving environmental performance at Trafford Park

by Joe Flanagan, March Consulting Group

Environet 2000 is a major EU and UK Government funded environmental project which aims to help north west based companies cut their operating costs and improve their environmental performance. Coordinated and managed by the St Helens-based Nimtech, the project is organised around ten industry sectors - one of which comprises the manufacturing companies based in the Trafford Park area of Manchester. Here, Joe Flanagan describes the work carried out at Trafford Park by March Consulting Group.

The Trafford Park sector project was different from the others in that it was based upon a geographical area rather than an industrial sector. This was viewed as having advantages in that there would be no competitive issues between the

companies and greater openness could be expected. However there were few (if any) processes common to the companies. The project for the Trafford Park area was managed by Trafford Park Business Forum and March Consulting Group.

With a target of eight companies, recruitment for the project started early in 1997. Companies recognised the potential benefits of the project and very soon this target was reached. Although most of the recruited companies were keen on the broad scope of waste minimisation, some joined the project with some very definite environmental issues in mind. Table 1 summarises the companies who joined the project:

PROJECT STRUCTURE

Companies signed up for the project for lengths of time ranging from six to 18 months. Although companies were expected to contribute their own time to the projects, on-site support and project management

was provided by an experienced consultant from March Consulting (usually 1 or 2 days/month) plus there was an input of between 1/2 and 1 day/week from specially recruited project officers. These were recent science or engineering graduates and provided an extremely valuable function since there was often a limited amount of resources that companies could commit to the project. The contribution of the project officers was especially valuable in the collection and analysis of data.

In addition, to the on-site support there was also an important training element to the project and approximately every four weeks nominated representatives for the companies came together in a 'Project Champions' meeting. This forum allowed a very valuable exchange of ideas between the companies. Training sessions were also held at these meetings in subjects such as the methodology of waste minimisation, environmental legislation, technologies for saving electricity, gas and water and project management. On some occasions, equipment suppliers were also invited to give short presentations about their products.

Even if a company had a particular issue that they wanted resolving, a common approach was taken with all the sites:

- definition of the problem
- establish the costs associated with issue from historical production data and utility invoices
- understand the problem
- process flow mapping
- measurement and calculation of energy/mass balances for the factory or process
- comparison with benchmarks (if available)
- establish monitoring
- regular meter readings and other relevant process parameters
- evaluate improvements
- financial and environmental appraisal of all possible options
- implement improvements.

Company	Number of employees	Major activity
Cerestar	350	Refined starches and derivatives (glucose, dextrose, caramel etc.)
HLH Timber	20	Timber processing (machining/cutting)
Polybau	30	Production of moulded resin-concrete drainage channels
John Hogg	60	Dye marker concentrate for tax-exempt diesel fuel
Tenmat	250	Engineering ceramics, high temperature materials
F H Duerr and Sons	170	Jam, marmalade and peanut butter
Trafford Park Bakery	450	Savoury pastry products, potato topped pies
Lastite	30	Latex adhesives, specialist sealants and mastics for the construction industry.
Washington Mills Electro-Minerals	100	Silicon carbide and alumina grits and powders for abrasives and refractories.

Table 1 Members of the Environet 2000 Trafford Park Sector Project

This methodology has proved extremely effective as a systematic approach to identifying potential areas of weakness and opportunities for improvements and savings. Overall, this sort of approach is not dissimilar to the energy audit that was popular in the UK during the 1980s.

RESULTS

The Environet 2000 project finished at the end of last year and all the work at the Trafford park sites had finished by the end of October. It is expected that at least one case study will be produced from each site, these will be published.

The approach outlined above identified scores of opportunities for saving money and achieving environmental improvements. Most of these opportunities were implemented and became reality, for example:

- A faulty controller at one company meant that an air compressor was running 24 hours a day 5 days a week but was only on-load for less than 10% of the time. In fact by reducing leaks, this compressor was switched off completely, saving £13,000/year in electricity.
- Damaged seals to a vacuum vessel meant that it took 30 minutes to achieve vacuum. With new seals a time of 4 minutes was achieved saving £500/year in electricity.
- Repair of damaged pallets rather than scrapping saved £19,000/year in waste disposal costs and new pallets.
- At a cost of £100, fitting a wash hose with a trigger gun saved one company £3,000/year in water costs.

All the participating companies gained benefits from participating in the project. Obviously, the size of the company tended to reflect the magnitude of the savings. It was a general truth that the smaller companies were usually already very good at the obvious no-cost savings (e.g. switching equipment off when not required). This is because the works manager in small companies is usually very 'hands on' and well aware of costs.

A good example of a small company was Polybau, which manufactures drainage channels. The Works Manager was a great

enthusiast for the project and he felt that there were large untapped savings in the business. A teamwork approach involving all the workforce (in particular the operators) was used to identify areas for reducing costs and improving yield. In practice some short awareness training sessions were held for the operatives and suggestions for improvement were encouraged. All these suggestions were investigated and a number of important initiatives were introduced:

- minor modification to the moulds to reduce scrap,
- improved waste management practices, e.g. segregation of waste, regular cleaning of skips (waste resin-concrete quickly accumulates inside skips reducing the usable volume and therefore increasing costs),
- introduction of regular monitoring of utilities, thereby quickly identifying adverse performance,
- reduction of compressed air leakage.

The sum total of all these benefits is worth just over £25,000/year to Polybau, highly significant for a small business.

The larger companies tended to have a number of fixed issues that they wanted resolving but they had never been able to commit the required resources. At two of the larger sites, the project was mainly concerned with the performance of effluent treatment plants. These were studied in great detail in terms of the inputs, outputs and design specifications. At one site the operation of the plant was optimised and the performance obtained was well below the required consent limit - before Environet the company were seriously considering a completely new installation at a cost of £150,000. At the other site, changes in production had resulted in liquid effluent that was outside the design specification of the original plant, therefore modifications were recommended. Although, these modifications cost £18,000 this had a payback of about two years due to reduced trade effluent charges.

Although the savings and projects identified during the project having been pleasing to the companies involved, perhaps the most important aspect has been the emphasis placed upon regular monitoring

of utilities and environmental performance. It is only through such monitoring that performance can be sustained and new projects identified. A good example of this was at Washington Mills where a regime of weekly readings of all water meters was introduced. This allowed excessive water consumption to be quickly identified when the ball cock in a large process water storage tank jammed in the open position allowing water to flow unseen to drain. Previously such an incident would have remained unnoticed until the monthly water bill arrived.

LESSONS LEARNT

The Environet 2000 project has demonstrated that cost effective environmental improvement is possible in small and medium sized manufacturing companies and the measures that were identified were often low or no cost. However, the lack of managerial resources is a major barrier in such companies and they do not have energy or environmental managers who would normally address these issues in larger companies. The external help provided by Environet 2000 has allowed several businesses in Trafford Park to realise the benefits of waste minimisation and environmental improvement, but it must be recognised that many of these savings could not have been realised without external support and all companies would benefit from carrying out the following:

- simple mass and energy balances of a single process or the whole site,
- introduction of regular monitoring of utilities and environmental performance and preferably linking this to activity levels e.g. production,
- encouraging suggestions from employees, particularly operatives (who are the real experts for a process).

Contact Joe Flanagan at the March Consulting Group, tel: 0161 872 3676, fax: 0161 848 0181, e-mail: joe.flanagan@march-consulting.co.uk
All the projects from Environet will be publicised via case histories which can be obtained from the Nimtech website at www.environet2000.org.uk

Higher efficiency significant savings

by Dr Hugh Falkner, ETSU

As a result of their reliability and efficiency, electric motors often tend to be forgotten when companies are thinking about energy efficiency. However, with a yearly energy bill to industry of £4 billion, even the smallest reduction in operating costs will bring a significant return. ETSU's Dr Hugh Falkner argues the case for a thorough review of electric motors and highlights the benefits of switching to new, higher efficiency models.

Most drives in industry are powered by simple and reliable induction motors and, until recently, the options for reducing their energy consumption were fairly limited. Now, a new generation of higher efficiency motors (HEMs) has opened a range of opportunities to reduce energy consumption and cut costs. Efficiency levels have been increased by around 3% as a result of developments in construction materials, winding configurations, cooling circuits and bearings, and the good news is that HEMs are now available at the same

price as the older, less efficient models. In fact, it is forecast that, if sufficient companies adjust their purchasing and operating policies, annual energy savings of £120 million could be made nationally.

Although 3% may not sound too much, in practice, the domination of energy cost over purchase price is making a significant difference to the way that companies look at electric motors. This is well illustrated by a long-term study carried out by the DETR's Energy Efficiency Best Practice Programme, and detailed in the Good Practice Case Study, *Purchasing policy for higher efficiency motors* (GPCS 222).

In the mid-1980s, engineers at ECC International (English China Clay International) compared standard motors with the then newly developed HEMs. Their calculations showed that the HEMs produced payback periods of between 0.5 and 2.5 years, depending on the motor rating, running hours, load and the price of electricity. As a result, the management introduced a purchasing policy that included specifying HEMs for all new plant; an assessment of all existing operational motor duties, with HEM replacement where appropriate; and a change in the

policy of rewinding and repairing motors to one of replacement with HEMs.

Since the initial study and policy review, HEMs have become generally available for the same price as standard motors, and this has led ECC to amend its

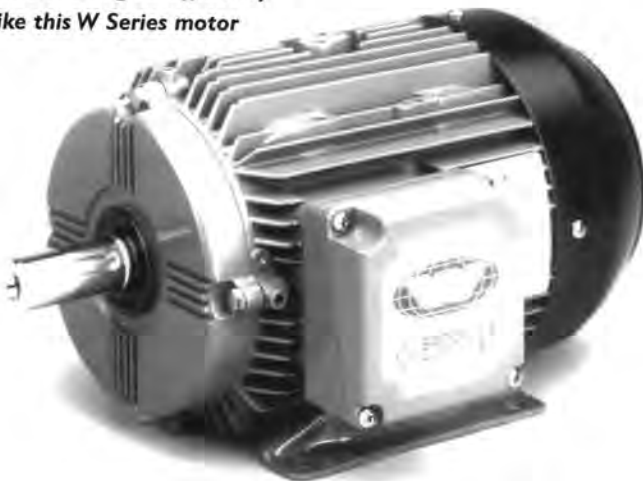
approach. Now, it is company practice to replace all existing motors with HEMs, using the following action plan:

- replace stock motors with HEMs (action now completed);
- carry out a preventative maintenance schedule, using vibration monitoring tests to test motors for bearing failure (all motors failing this test are removed and replaced with HEMs, as are standard motors requiring rewinding);
- implement a replacement schedule for all existing operational motors; and
- where variable speed capability is an advantage, replace existing slipring-type standard motors with HEMs fitted with variable speed drives.

Currently, ECC International is making good progress towards their target of replacing all existing low voltage induction motors with HEMs within five years. The programme is already making energy savings worth £100,000 and is on course for targeted savings of £400,000 within five years. In addition, the success of the company's policy for reducing the energy consumption of electric motors has stimulated the search for energy efficiencies in other areas.

The initial evaluation carried out by ECC's engineers underlined the basic facts of life for the purchase and operation of electric motors. It proved that the key to cutting motor energy costs lies in the relationship between the initial purchase price and actual running costs, with running costs far outweighing initial purchase prices in the majority of cases. With electric motors able to consume their capital cost within just 40 days of continuous operation and with running costs exceeding initial purchase cost by a 100 times in a ten-year lifetime, it makes sense to base decisions on a 'life cost' basis, including all purchase, maintenance, repair and operating costs.

**Switch to higher efficiency -
like this W Series motor**



motors - at no extra cost



Where new motors are required, the benefits of opting for HEMs seem fairly obvious, but the failure of an existing motor is a different matter and is likely to prompt the question of whether the motor should be repaired or replaced. Of course, any decision on repair or replacement may be pre-empted by the need to rapidly reinstate the drive in order to avoid additional costs occurring as a result of equipment downtime. But, if there is less urgency to replace or if a spare motor exists, then repairing the failed unit may appear to be the most cost-effective course of action. However, think carefully before opting for a repair. As Table 1 shows, taking lifetime costs into account can shed new light on any decision. (Payback is calculated on the cost difference between new purchase and repair).

Table 1 clearly illustrates the relationship between long-term running costs and initial purchase price, and shows how replacing a non-working standard motor with an HEM can result in a significant cost benefit for the operator. In these calculations, a fairly conservative 3% is allowed for efficiency gains although, in practice, this may be nearer 4%, as a repaired motor is likely to be up to 1% less efficient than before repair and up to 3% can be gained from

the extra efficiency of an HEM.

When considering motor repair or replacement, it is also worth taking a careful look at the size of motors. Electric motors are generally designed for maximum efficiency at 75% full load and, in fact, there is only a

minimal variation in efficiency between 50 and 100% full load. However, a significant reduction in efficiency occurs at loads up to 25% and, as surveys indicate that motors in industry are running at only two thirds of their rated power, many must be running at below 25% load. As a note of caution, it should be pointed out that efficiency gains made by simply downsizing existing running motors are very unlikely to justify their immediate replacement, but downsizing is an important factor to take into account when considering either repair or new purchase.

The Energy Efficiency Best Practice Programme's Good Practice Guide 2, *Energy savings with electric motors and drives* details the factors that should be

considered when downsizing is contemplated. For example, companies need to be sure that the new, smaller units will fit both existing drives and mounting points, and need to be capable of developing sufficient starting torque for their particular application. Last, but not least, don't forget that most electric motors have to cope with a range of loads, therefore, before downsizing, peak loads above the normal operating range must be taken into account.

One fairly simple no-cost method of improving efficiency is to reconfigure motors from Delta to Star connection. Changing to Star connection cuts energy consumption by reducing the voltage across the motor windings. Although this procedure is only possible where motors can be accurately predicted to always run at less than 58% of their rated motor output, it is worth serious consideration as savings of up to 10% can be made with no additional investment.

All Energy Efficiency Best Practice Programme publications are available free from the Energy Efficiency Enquiries Bureau at ETSU, tel: 01235 436747; fax: 01235 433066, quoting reference A.020198.

motor	Standard rewind	After payback	HEM	Difference	Simple
Efficiency	90.5%	90.0%	92.5%	3.0%	
Input power	33.15 kW	33.33 kW	32.43 kW	0.90 kW	
Cost of repair/purchase		£850	£1,100	£250	
Case 1: 8,000 hr/year @ 100% load					
Annual energy use	265.1MWh	266.6MWh	259.5MWh	7,200kWh	
Annual energy cost (estimated at 5p/kWh)	£13,260	£13,332	£12,973	£359	<1 year
Case 1: 4,000 hr/year @ 75% load					
Annual energy cost (estimated at 5p/kWh)	£4,970	£4,999	£4,865	£134	2 years

Table 1 Total purchase and energy costs of repairing and replacing a failed 30 kW motor (from Good Practice Guide 2 - Energy savings with electric motors and drives)

Advanced coal-fired

The annual Robens Coal Science Lecture was delivered in 1998 by Tony Marshall of Mitsui Babcock Energy Ltd. Mr Marshall is also the Chairman of the Foresight Energy Panel's Clean Coal Power Generation Technology Task Force.



by Tony Marshall, Advanced Coal Technology Manager at Mitsui Babcock Energy Ltd

In recent years, the drivers for coal science and technology RD&D in the UK have changed. The advent of privatisation of the power generation and coal industries has resulted in a complete displacement of coal by gas as the fuel for new power generation plant. In addition, many of the laboratories associated with these industries that carried out or supported much of the UK's coal science and technology R&D, have closed.

The market for the UK's coal technologies has moved overseas and is now a global market. As a result, the centre of gravity of coal science and technology RD&D, and its use, has moved to the plant and equipment suppliers.

In this market, the principal factors affecting the choice of advanced coal-fired power generation technologies are

legislation, e.g. local emission limits; cost of electricity generation, in particular capital cost; and market acceptability, in terms of reference plant and perceived availability.

On a global scale, one factor that is influencing attitudes and the drive for increased generation efficiencies is the Kyoto Climate Change Protocol. This requires an 8% reduction in greenhouse gases (from 1990 levels) by 2012, over the whole European Union.

Consequently, it is worth noting that a consortium of forty leading European (including UK) companies, under the EC's JOULE-THERMIE programme, intends to demonstrate the world's most advanced coal-fired power plant. Its ultra efficiency should reduce CO₂ emissions by some 20% when compared with existing advanced power plants and by some 40% when compared with the average for the European Union. Even greater relative reductions in emissions would result from the adoption of advanced technology in non-OECD countries, although it is also worth noting that the major part of this reduction could be achieved 'simply' by replacing old inefficient plant by modern conventional plant.

MARKETS

Energy demand, particularly the demand for electricity, continues to rise even in times of economic downturn. The availability of electricity is an essential partner of economic growth and developing countries provide over half the world market for power plant and an even higher proportion for competitive access.

Coal is the most widely distributed of fossil fuels and most of it continues to be used in its country of origin. This is particularly important for developing countries. Worldwide about 40% of power generation is coal based and this situation is expected to continue for the foreseeable future.

Coal is a fuel with a wide range of properties, depending upon its type and source/location. Consequently coal science is required, not only to underpin the

development of coal based power generation technology, but also to assist in the development of specific plant designs, the prediction and optimisation of plant performance on both local and imported coals and in coal purchase selection.

To meet the demand for cleaner, more efficient power generation a range of advanced technologies is being developed, as illustrated in Figure 1. These technologies are at various stages of development and are judged by the commercial standards set by sub and supercritical pulverised fuel (PF) plant and natural gas fired combined cycles. Virtually all incorporate a steam turbine, or a gas turbine, or both, and will benefit from advances in steam temperatures and gas turbine entry temperatures.

As a technology is developed its cost tends to rise, often reaching a maximum at the first commercial demonstration plant. Cost then tends to fall over the first few plants, until the technology becomes competitive. Bridging the cost gap over this period is one of the principle obstacles to take-up of new technologies. Subvention is usually necessary and has taken the form of demonstration programmes in the USA, Japan and Europe. To put timescales into perspective, power plant projects often take several years to develop/plan and typically three years to build. However, with increasing deregulation of the power generation industry worldwide, it will become more difficult to finance demonstration projects as competitive utilities are forced to focus only on the 'bottom line'.

A number of coal based technologies are already commercial, or are at or near the demonstration stage. These include conventional pulverised fuel technology (i.e. PF with deSOx/deNOx); the circulating fluidised bed (CFB); pressurised fluidised bed combustion (PFBC); integrated gasification combined cycle (IGCC); and hybrid or topping cycles, such as the air blown gasification cycle (ABGC). Advanced steam cycles, fluidised bed combustion and gasification

power generation

are common to some or all of the above.

The market for these technologies for the 15 years from 1995 to 2010 has been estimated to be over \$500 billion, with about 70% being accounted for by China, East and South Asia. Conventional PF technology was judged to remain dominant during this period, with an approximately 80% market share. However, this still leaves a very sizeable market to be shared among the newer technologies.

In order to succeed in the very large market represented by non-OECD countries, companies in the UK need to continually develop improved or new technologies, to be able to supply what cannot be supplied indigenously.

TECHNOLOGIES

Supercritical and ultrasupercritical PF

Conventional PF based technology, although relatively mature, still has potential for improvement. In particular, development is being directed at higher generating efficiencies, thus reducing fuel costs and CO₂ as well as other emissions and also at specific techniques to reduce emissions of NO_x and SO₂.

One of the World's most advanced coal fired power plants has been in operation since 1994, with high availability. This is the 580 MW Meri Pori (Finland) plant that employs a Benson (once through) supercritical steam cycle of 249 bara, 540/560°C and has a generating efficiency of 43.5%. Very recently, the Nordjyllandsværket Unit 3 (Denmark) was commissioned, producing steam at 285 bara, 580/580/580°C and a generating efficiency of 47%.

Note that the location of these plants enables them to use cold seawater for the condensers. At a typical inland UK location, the generating efficiency would be 1.5 - 2.0 percentage points lower.

Both these plants employ low NO_x burners, catalytic deNO_x and flue gas desulphurisation (FGD). In the case of Meri Pori, this limits NO_x emissions to 200 mg/Nm³ (at 6% O₂) with over 90%

SO₂ removal.

In recent years, considerable RD&D effort, including coal science research, has been directed at reducing NO_x emissions at the boiler furnace. This has involved the development of several generations of low NO_x burners, two stage combustion (via air staging) and reburn by either gas or coal. As a result, uncontrolled emissions of 1000 - 1700 mg/Nm³ can be reduced by in-furnace measures to 200 - 300 mg/Nm³, for typical bituminous coals.

Major development programmes are underway in Europe, USA and Japan, aimed at increasing generation efficiency through increasingly advanced supercritical ('ultra-supercritical') steam cycles and at reducing emissions.

The development project being undertaken under the EC's JOULE-THERMIE programme is the Advanced '700°C' Power Plant. This will use a steam pressure of about 375 bara and temperatures of 700°C, or higher, to produce a generation efficiency in excess of 50%. Much of the development effort will be directed at materials, including nickel based super alloys for some of the more onerous duties at these conditions.

Of approximately 22.4 GW of new coal fired capacity to be commissioned in OECD countries 1997 - 2000, all but 3 GW is supercritical plant. Outside the OECD, where most of the power plant market is to be found, only a few supercritical projects have been undertaken. A recent survey of independent power producers, sponsored by the International Energy Agency, found that supercritical PF technology is viewed as riskier and more costly than subcritical technology; even though about 360 supercritical plants have been built and the latest are as reliable as subcritical plant and can generate electricity more economically. This illustrates the difficulty of winning widespread acceptance, by the market, for new coal-fired power generation technology.

Atmospheric fluidised bed combustion

The largest AFBC plant in the world is a

350 MW plant in Japan. This uses stacked bubbling beds. However, it is now generally accepted that the preferred technology for larger plant, e.g. for power generation, is the CFB, of which the largest is currently a 250 MW plant operating in France.

The CFB has advantages over conventional technology in terms of its fuel flexibility, ability to fire low grade fuels and ability to reduce emissions in the furnace, without the addition of flue gas treatment. As a less mature technology it probably has more potential for development. Larger utility plants, including plants using supercritical steam conditions, are being designed. Once these have been demonstrated, competition with conventional technology will be determined by the fuel to be fired and/or relative plant cost.

A current disadvantage of CFB is that its low combustion temperature produces N₂O, which is a potent greenhouse gas that is not yet subject to emission limits. Research is underway to overcome this problem.

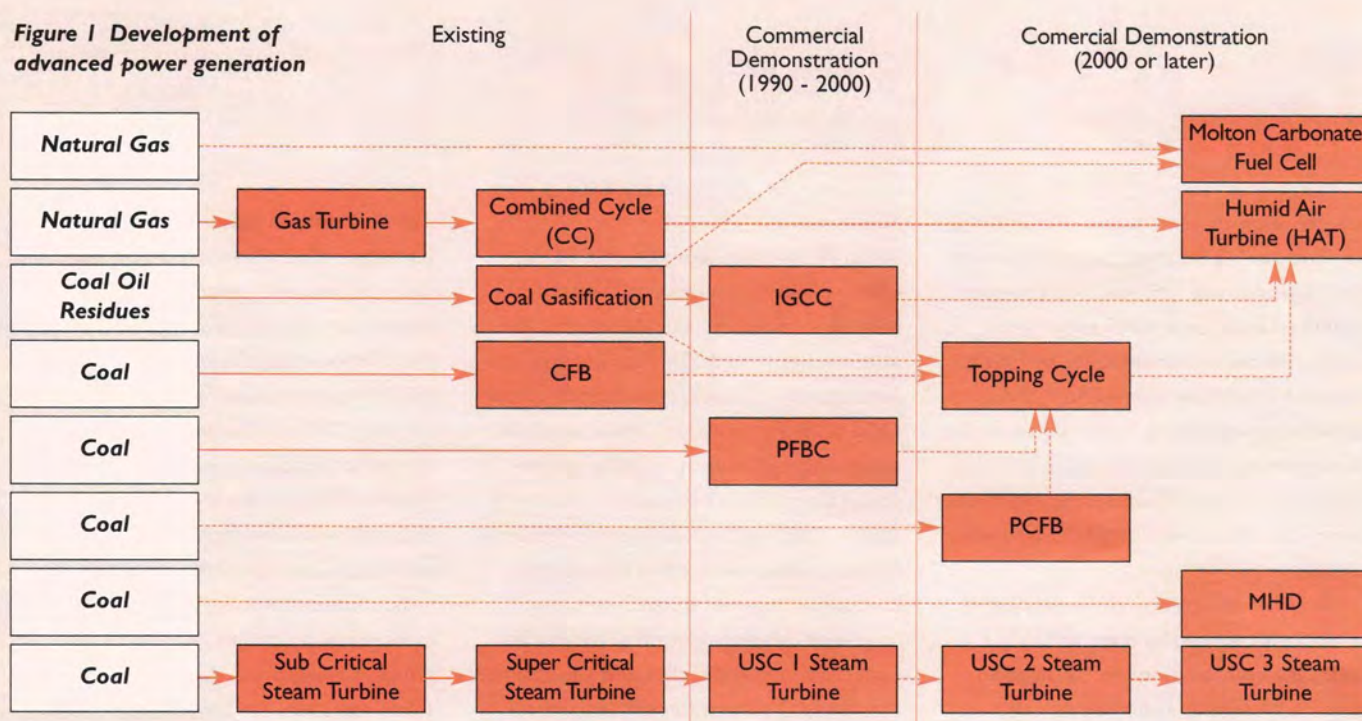
Current CFB boiler designs can be divided into those that absorb all the net furnace heat through the furnace walls and those that remove some of the heat via a fluid bed heat exchanger, located in the solids return line from the cyclone to the furnace. However, as plants increase in size, a fluid bed heat exchanger is more generally being adopted. The flexibility of this arrangement should make the CFB particularly suitable for advanced steam conditions. It will enable the temperature of the furnace walls to be kept within the range of steels that do not require post weld heat treatment and will minimise the lengths of expensive high alloy pipework between the boiler (fluid bed heat exchanger) and the steam turbine. The CFB will thus achieve the same generating efficiency as PF plant.

Pressurised fluidised bed combustion

Combining the high temperature Brayton (gas turbine) cycle with the lower temperature Rankine (steam) cycle leads to increased power generation efficiencies.

PFBC probably represents the first

Figure 1 Development of advanced power generation



commercial coal fired combined cycle. A fluidised bed combustor, contained in a pressure vessel, is located between the compressor and the turbine of a gas turbine. Hot pressurised gases from the combustor drive the gas turbine. Boiler, superheater and reheat tubing, immersed in the fluidised bed, generate steam to drive the steam turbine. There are four operating PFBC power plants world-wide from 75 - 130 MW capacity, with four more being built, including one of 350 MW with a supercritical steam cycle.

Approximately 80% of the power generated by a PFBC plant is produced by the steam cycle. Where a supercritical steam cycle is employed, efficiencies in the mid 40s percent can be achieved. In addition, emissions of NO_x and SO₂ are limited by the fluidised bed combustor, which can also fire low grade coals.

Power generation efficiency will increase further as more advanced steam conditions are employed and with the advent of second generation PFBC. The latter includes the use of a partial gasifier to supply a fuel gas for increasing the temperature of the PFBC gases entering the gas turbine. This represents a topping or hybrid PFBC cycle.

Integrated gasification combined cycle

Coal can be gasified with air or oxygen, together with steam, at elevated

temperature, to produce a low to medium CV gas. Where complete gasification of coal is required, oxygen is usually employed.

There are three main types of gasifier; moving (or fixed) bed, where the gas is in counter current flow and leaves the gasifier at about 500°C, accompanied by some tars; fluid bed that operates at about 1000°C; and entrained suspension (flow) where the gas leaves at about 1500°C, together with some sticky ash particles.

All three types of gasifier are the subject of commercial demonstration projects, but most of these employ entrained flow technology. One of the largest and most efficient plants, in commercial operation since 1997, is located at Buggenum (Netherlands). This is a highly integrated plant, with a net power generation efficiency of 43.5%.

As the technology is further developed and gas turbine entry temperatures increase, efficiencies should rise to over 50%. In addition, gaseous emissions for IGCC plants are very low and solid residues are inoffensive.

However, although the cost of IGCC plant is falling, it still remains higher than for modern conventional plant.

Consequently, for the immediate future most IGCC projects will probably be associated with refineries, where the technology is particularly suitable for gasifying refinery residues to produce

power and a hydrogen rich gas, thus improving the overall process economics.

It is worth noting that 120 MW and 400 MW moving bed gasifier projects, firing sewage/coal and refuse-derived fuel/coal, are planned in Scotland.

Hybrid (or topping) cycles

Many of the original gasification processes were developed to produce a medium CV fuel gas, or a source of hydrogen, rather than for power generation. Hence, total gasification was required. More recently various hybrid combined cycles have been developed, directed specifically at power generation.

One such hybrid cycle, currently being developed in the UK, is the air blown gasification cycle (ABGC). This uses a simple spouted (fluidised bed) gasifier, located between the compressor and turbine of a gas turbine, to gasify about 80% of the fuel and retain most of the sulphur. The remaining 20% of the fuel, in the form of a char, is burnt in a CFB. The fuel gas is subjected to limited cooling and a hot gas clean-up stage before combustion in the gas turbine.

As yet there has been no demonstration of a hybrid cycle, but technologies like the ABGC have the potential advantage of being able to benefit from developments in both gas turbines and steam cycles, which should lead to power generation efficiencies well in excess of 50%.

FORESIGHT

Established in 1993, the Foresight Programme has a decentralised structure of sixteen Panels, representing sectors and technology areas. One of these, the Energy Panel, identified nine technology based themes, and set up a number of Task Forces. In Autumn 1996, two Task Forces were directed at fossil fuel based power generation. These were for:

- advanced combined cycle and gas turbine technology, and
- clean coal power generation technology.

The 'Clean Coal' Task Force recognised the potentially substantial world market for coal-fired power generation plant, to which this paper has already referred and identified UK strengths. The latter included the size of the UK's power engineering industry, which is large and comparable with that of the aerospace sector, with a turnover of over £13 billion, 167,000 employees and a net surplus of exports over imports approaching £1 billion.

The UK has developed a strong clean coal technology (CCT) base in both industry and academia and UK organisations are involved in a wide range of CCT initiatives. UK power plant manufacturers supply systems and components for clean coal power generation that include low NOx burners, boilers, steam turbines, low calorific value gas combustors, gas turbines, etc. The DTI Coal R&D programme has contributed to the development of low NOx burners, gas and coal reburn, advanced fuel control systems, the ABGC, etc., although this programme was scheduled to come to an end shortly.

Recognising the major market drivers, the Task Force drew up a number of technology targets to enable the UK to remain competitive. The following types of clean coal power plant were identified for particular attention, based on market needs, technology targets and the strengths of UK industry:

- advanced PF,
- ABGC,
- IGCC and other CCTs, such as CFB, PFBC, mixed fuel cycles and novel cycles (e.g. coal gasification with fuel cells).

However, it should be noted that the emphasis on particular power plant types may change in future and this would need to be recognised by the Task Force or its successor. The Task Force also identified key components for these power plant types and the underpinning science and technology that will have to be developed if the technology targets are to be met.

The views of the Task Force have been presented at various meetings and published in an Office of Science and Technology Brochure entitled 'Foresight for Energy - Clean Coal Power Generation Technology'. A matching brochure from the 'Combined Cycle/Gas Turbine' Task Force has also been published.

The Task Force set up an industrial Study Group to develop and cost an RD&D programme. Contributions from industry to its preparation have been matched by an input from DTI's Clean Coal R&D Programme, with support from EPSRC.

The Study Group has now completed its work, which included a consultation seminar with Academia. A summary report will be included as an Appendix to an Energy Paper, to be published by the DTI shortly, which will set out the detailed policy on clean coal technology.

The Study Group carried out a cost/benefit analysis of their outline R&D programme, which indicated overall costs of less than 1% of the potential market share of UK manufacturers. Of the total programme, coal science and related topics (combustor/gasification and chemistry/catalysis) accounted for over 20% of the anticipated cost. However, it is worth noting that the health of coal science in the UK is, to some extent, dependent on the progress of other elements in the programme, such as materials technology; since the major driver for the programme will be the search for export success in UK coal fired plant and components.

The Study made the following recommendations:

- The R&D programme should commence as soon as possible.
- The Clean Coal R&D Programme of

the DTI should continue, with emphasis on the technology programmes set out in the study.

- The emphasis of CCT activity in the UK should be on power generation technologies and be an integral part of a power generation programme.
- The Task Force should devise a structure to enable the R&D programme to progress effectively.
- Government, industry and the utilities should enter discussions on mechanisms for the funding of advanced power generation technology demonstrators.

Since the Study was completed, the Government's White Paper containing 'Conclusions of The Review of Energy Sources for Power Generation' has been published. This announced that, as a result of the Foresight findings, the DTI will maintain a Clean Coal Technology Programme, which will act as a focus for R&D collaboration and enable a substantial portfolio of research to be initiated with industry, universities and overseas organisations. The Government proposes to review the position on demonstration before 2005 but meanwhile the DTI will assist companies putting forward proposals for grant aid from the European Commission in future rounds.

In conclusion, it is proposed to effectively combine the activities of the Foresight 'Combined Cycle/GT' and the 'Coal' Task Forces under a Steering Group for Advanced Power Generation, Fossil Fuel and Associated Technologies. One of the principal tasks for this organisation will be to make recommendations as to the technology programmes that are necessary to underpin development priorities and to ensure progression through to component and plant demonstration. Finally, efforts should be made to persuade the Government to review the position on demonstration sooner rather than later.

Contact by Tony Marshall at Mitsui Babcock Energy Ltd, tel: 01293 612888, fax: 01293 584993

Energy and technology - sustaining world development

A personal report on the 17th Congress of the World Energy Council, by 1999 Melchett Medalist, Professor Ian Fells



The 17th Congress of the World Energy Council (WEC) was formally opened by former US President, George Bush, on the 13th September 1998 at the huge Conference Centre in Houston. It was the 75th anniversary of the founding of the WEC, originally the World Power Conference, and the last Congress of the present millennium.

There had been several anxious hours three days earlier when Hurricane Frances had dumped 12 inches of rain on Houston in 5 hours, flooding many areas of the city and stopping work on the enormous exhibition that accompanies the Congress. By dint of some very hard work all was ready for the opening however; the marines paraded with Stars and Stripes, 'God Bless America' was sung, school children performed and many national committees marched in to be presented. It was very like the opening of the Olympic Games and reminded some of those present of the Congress of 1980, held in Germany and described then as the Munich Olympics.

At that time oil stood at US\$40 a barrel and countries were competing for supplies;

the high price of oil had driven the world into recession. Now the oil price has dropped as low as US\$12 a barrel and there is a glut in fossil fuel. Another global recession is looming, perhaps partly the result of a too precipitous dash to privatise and deregulate energy, particularly electricity and gas supplies, putting many large energy investments world-wide in jeopardy. There is a realisation that deregulation and opening up competition through the market place has successfully reduced prices. Though, whilst this has encouraged short-term gain, it is at the expense of long-term planning; research and development has been an early casualty of the privatisation process. Some strategic forward planning will have to be carried out, particularly if we are to meet the Kyoto protocol on reducing carbon dioxide emissions.

The concept of sustainable development was frequently discussed at the Congress, although some members strayed from the Brundtland definition. One US commentator made it clear that, for him, sustainable development meant sustaining the technological growth of the energy industries into the next millennium through new energy technologies and continuing investment. The US Energy Secretary, Bill Richardson, went further to say that energy would be the driver of economic recovery, stability and growth in every region of the world. He continued by saying that this would involve doubling world energy use by 2030, increasing carbon emissions by 3.5 billion tonnes over present levels, as early as 2015.

To keep pace, the world will require up to US\$30 trillion to finance energy projects over the next 20 years. This figure, which includes about US\$5 trillion for environmental protection is almost one and a half times the world's current, annual GDP. It is clear that, somewhere along the

line, something will have to give and it may be environmental protection. As one US government energy advisor confessed to me, "There is no chance of the US government ratifying the Kyoto protocol by which the US will reduce greenhouse gas emissions by 8.5 percent between 2008 and 2012, even though the Clinton administration is committed to it." Secretary Richardson went on to say "through smart government policy and investments in energy research and development we can both grow our economies and protect our environment." There is a hint of paradox here.

POPULATION GROWTH

Mater Abaza, the Egyptian Energy Minister, in a keynote speech, drew attention to the two most important features of world population growth; urbanisation and the concentration of future growth in developing countries. The world urban population will grow from 45% of the whole to 65% during the next 35 years and per capita energy consumption in urban areas is generally much higher than in the countryside. Secondly, over the last three decades developing countries accounted for 87% of the world's population growth. These figures, and their forward projection, have been used together with many others in the ongoing joint study by the WEC and the International Institute for Applied Systems Analysis (IIASA). 'Global Energy Perspectives to 2050 and Beyond' which was presented to the Congress by Michael Jefferson (WEC) and Nebojsa Nakicenouric (IIASA) is published by Cambridge University Press.

According to the scenarios of this study world economic output will grow between three and five-fold by 2050 and 10 to 15-fold by 2100. Developing countries' per capita income will have reached and surpassed the levels of today's developed countries by 2100. This leads to 1.5 to three-fold increase

into the next millennium

in primary energy requirements by 2050 and two to five-fold increase by 2100. Energy intensity will steadily improve as new, more efficient energy technologies are introduced. However, these technologies will only take root in developing countries if they are donated by the industrialised world as part of the aid process.

R&D SLOWDOWN

A warning marker was introduced that there is evidence of real slowdown in research and development in energy technology as deregulation of the energy market is introduced. Research and development seems to be a real casualty of privatisation, together with the reluctance of newly deregulated gas and electricity industries to take a long-term view in their business strategies. Fossil fuels are not expected to run into short supply before 2050 and possibly not even then, though regional shortages may occur as resources, particularly of oil and gas, are not evenly distributed around the world, with Russia and the Middle East having the lion's share.

An intriguing paper by Timothy Collett, of the US Geological Survey, marks the increasing interest in natural gas hydrates. These are naturally occurring crystalline substances composed of water and gas in which a solid water-lattice holds gas molecules in a cage-like structure or clathrate. These gas hydrates, of which methane is predominant, are widespread in permafrost regions and beneath the sea in sediments of outer continental margins. The amount of methane held in hydrate reservoirs could exceed the volume of known conventional gas resources. The problem will be mining the material.

The encouraging analysis of the world's fossil fuel reserves, taken with the anticipated rising demand for energy, illustrates the extreme difficulty of holding

carbon dioxide emissions at their present level, never mind reducing them. There seems to be a growing acceptance that carbon dioxide concentrations in the atmosphere will double from the pre-1900

The hydroelectric potential of central Africa, if tapped, could produce enough electricity to provide for the needs of Africa and provide a surplus for transmission to Europe.

base of 270 ppm to 540 ppm between 2020-2030, with serious implications for global climate change. The rising sea level is already a particular anxiety for many island communities in the Pacific and Indian oceans.

The IIASA/WEC study expects it will take almost a century to restructure the global energy system away from its current dominant reliance on fossil fuels. There was some speculation at the Congress about when the transition from a fossil fuel base to a renewable/nuclear base would take place. There was also a dawning realisation that the nuclear option, which currently supplies 6% of world energy, has enormous potential, although it would only grow to around 14% by 2050.

MEDITERRANEAN RENEWABLES

Renewable energy also holds great promise. For example, the 'Mediterranean basin' countries have potential for bulk solar/thermal electricity generation. The prerequisite infrastructure of gas pipelines, proximity to electric grids and water sources is available. An Egyptian pilot integrated solar/natural gas combined cycle 150 MW project with 15% solar contribution will lead to an accumulated capacity of 4000 MW by 2020. The Southern Mediterranean countries have huge wind potential with the prospect of wind farms spread along the coast from Egypt to Morocco. 6000 MW installed wind capacity for Egypt alone is planned for 2020. Ten percent of primary global energy could be provided by new renewable

energy that excludes large-scale hydro and traditional biomass, but this will require very considerable government incentives and take 30 or 40 years to achieve.

The hydroelectric potential of central Africa, if tapped, could produce enough electricity to provide for the needs of Africa and provide a surplus for transmission to Europe. A proposed hydroelectric project at Inga, on the Congo River, would have an installed capacity exceeding the African countries' additional demand for decades to come.

An ambitious proposal for an extra high voltage interconnection system of the Afro-Mediterranean complex could lead to a Mediterranean Power Pool with revenue accruing from exporting power into Europe and beyond. Such developments could have a profound effect on the energy poor - those two billion people who do not have access to modern energy services, particularly electricity, due to poverty and lack of infrastructure.

ART OF THE IMPOSSIBLE

Sir John Browne, Chief Executive of British Petroleum, in his keynote address paid tribute to Ian Lindsay, Secretary General of the WEC from 1986 until his tragic death in late 1998. Referring to the Congress he said, "It is a very fitting memorial to all that he did for this industry and all that he believed in. Above all...there is a tone of optimism which very much reflects Ian Lindsay's approach".

Sir John reflected this optimistic theme in his speech. "It is technology that is at the heart of the adjustment necessary to keep the industry afloat in the midst of a storm of uncertainty. Continued breakthroughs in scientific knowledge are required and also the ability to integrate science into operational reality." Improved technology has made it possible to drill for oil almost unseen from a footprint a third of the size necessary only ten years ago, and to

increase the oil recovery factor at Prudhoe Bay from 40 to 60%. Every one percent increase in the global recovery average makes available an additional 45 billion bbl of oil per day.

This gives point to his quotation from Dr Bruneau that, "at no time in

man's history has the pattern of primary energy use been ecologically or economically sustainable when extrapolated into the future."

As to the carbon dioxide emission problem, it can be extracted from exhaust gases and re-injected into deep rock formation.

So, as Sir John Browne put it, "This conference is about the art of the impossible. The application of science and technology to break barriers and to challenge the limits."

Kenneth Lay, Chairman of Enron, extolled the demonstrable virtues of natural gas burned in combined cycle gas turbine systems, which give cleaner emissions and efficiencies approaching 60%. He also emphasised the increasingly crucial role information technology and handling will play in future 4D seismic analysis and 3D imaging, together with speedy transmission of information around the globe, in increasing the rate of change not only of technology but marketing strategy. In the longer term other clean energy alternatives will strengthen their position.

ENERGY FROM SPACE

Photovoltaics, wind or wave energy and biomass, 'energy from space', were all discussed during the conference, together with nuclear energy from current and new style reactors. The European Pressurised Reactor (EPR) is due to replace Europe's present reactor populations as older plants are retired from service. In a joint Japanese-Russian paper by Ken Tomabechi and Evgenii Velikov the case was made for an international nuclear fuel bank to provide start up plutonium fuel for a new family of fast breeder reactors. The Russian BN600 fast reactor has been in commercial

operation for 17 years and is seen as the precursor of a family of BN800 fast reactors which will safeguard electricity supply, free from carbon dioxide pollution,

through the next century.

There was considerable discussion of the suggestion that 50%

of energy supply would be renewable by 2060, as the Shell scenario suggests, or the more conservative 10% which comes from WEC and some other scenarios. Even given good political will and subsidy, the dilute nature of most renewable energy forms, wind, solar power and so on, militates against the higher figure and a mixture of renewable and nuclear energy seems the most likely major clean supply scenario, together with fossil fuels burnt as efficiently and as emission-free as possible. Some idea of the magnitude of the renewable problem can be seen in President Clinton's proposal that 5.5% of US electricity generation comes from renewables by 2010 which means a nine-fold increase on the 1998 figure.

Kenneth Lay also pointed to the growth of embedded electricity generation provided by microturbines, fuel cells and other combined heat and power technologies. This will lead to an increase in distributed generation, using systems of only a few hundred MW as opposed to the current very large gas, coal and nuclear power stations in the 1200 to 2000 MW range. The changes stemming from a high technology future will lead to gas and renewables growing at twice the rate of coal; oil and gas will supplant coal as the second fuel world-wide. Computing power will increase 100-fold over the next few years with an associated spectacular increase in information technology. Nuclear power must become competitive with gas and coal generated electricity; even then nuclear or large-scale hydro will continue to be targeted by environmental groups. The industrialised world must help the developing world with new technology and enable them to leapfrog ahead by passing conventional and often polluting technology;

TRANSPORT GROWTH

The same could be true of transport where the WEC concludes that policy action is "needed urgently to initiate technological and behavioural changes that will take years to significantly improve the quality of the environment". Total energy use for mobility is expected to grow by 55% between 1995 and 2020. In China, for example, there will be a five-fold increase from 10 million vehicles to 60 million by 2020. In theory this 'motorisation' of China could be carried out using fuels other than gasoline and with low emission vehicles, but current plans are to establish motor manufacturing plants in China building cars with conventional engines.

A leap to new non-polluting technology would be a great advantage. This will be even more difficult with aircraft whose numbers are set to double by 2015 or so; kerosene is the staple fuel for aircraft although hydrogen could be a possible alternative. The projected growth of the transport sector energy demand of 1.8% per annum will create particular difficulties in attempting to control and reduce carbon dioxide emissions and urgent action must be taken now to develop a sustainable transport system.

A number of papers and Round Table discussions addressed the problem of global climate change and reduction in greenhouse gas emissions to mitigate the effects of a world that is gradually warming up. Robert Priddle, Executive Director of the International Energy Agency, pinpointed the dilemma facing developed or developing countries alike, "Can the link between economic growth or greenhouse gas emissions be broken at reasonable cost?". Technological change and increased efficiency resulting from liberalising energy markets have delivered more efficient resource allocation and increased trade but they do not deliver benefits that are not fully valued in the market place. Climate change and environmental issues fall into this category, along with long-term, high risk research and development. This means that as governments set environmental policy goals for the energy sector that exceed what the competitive markets

alone will deliver; intervention in the market is needed.

The delegates at the conference were more comfortable with technological change than changing public and political attitudes, despite the presence of 35 energy ministers from around the world. Robert Priddle summarised the changes in technology:

- On the supply side, natural gas-fired combined cycle, clean coal and nuclear power stations are expected to play a role together with renewable resources such as large and small scale hydro, geothermal energy, biomass conversion technology, solar electric and wind and wave power.
- Coal will continue to be used extensively and more efficiently in supercritical steam cycles, integrated gasification combined cycle system or pressurised fluidised beds.
- Fuel cells are beginning to reach technological maturity. On the demand side there will be significant increases in the sophistication of measurement, communication and control.
- In the longer term technological breakthroughs will be critical to mitigating greenhouse emissions beyond the Kyoto time frame in a cost-effective manner. They are not likely to come about without government encouragement of often high risk research and development.

The 5000 delegates to the Congress engaged in a tremendous and stimulating exchange of ideas helped by the impressive exhibition of energy technologies, which was integrated with the lunch arrangements to encourage discussion.

THE HOUSTON PERSPECTIVE

The climate in Houston was a topic of conversation not altogether remote from discussion of climate change. We arrived in a tropical storm which was followed a few days later by Hurricane Georges. The temperature was around 96°F (32°C) with 98% humidity; no wonder Houston is the air-conditioning capital of the world! The air conditioning in my rented car took so much power from the engine that I had to

switch it off to have any chance of overtaking. An abundant supply of energy is essential to run the technology that makes the place bearable, even for the dinner for 4000 in the air-conditioned Astrodome and the rodeo in the Astro Arena, where the Chairman of the WEC Executive Assembly, John Baker, rode a huge long-horned bull in the parade.

The chances of getting the Americans to reduce their energy per capita seems slim, especially with gasoline at US\$1 per gallon. Even the extraordinary weather they have experienced in Houston this summer, 12 weeks of drought with temperatures topping 100°F followed by a downpour, is seen as a 'natural' event caused by El Nino rather than a possible hint at global warming and climate change. It would appear that technical fixes are easier to engineer than changing social attitudes towards the prodigal personal use of energy on the part of some countries.

John Baker, in his summing up, highlighted the fuel poverty issue and its appalling consequences of ill health, ignorance and environmental degradation for two billion inhabitants of the world. Sadly those who are short of energy are also short of food, where as in the industrialised world there is a glut of both.

On climate change a consensus is building up that the issue is real, and precautionary measures are required. Premier Zhu Rongji sent a positive message about China's intention to take the issue seriously.

John Baker's optimistic conclusions were that for the foreseeable future we have all the energy resources we need. Technology is rapidly improving our ability to access them and use them in an increasingly efficient and environmentally acceptable way. New technologies are coming along at a great pace and new paradigms are developing in regard to markets, governments, institution and corporations.

Gerald Doucet has taken over as Secretary General of the WEC and will lead the team to the next Congress, which will be held in Buenos Aires in 2001. The new millennium is almost upon us.

POSITIVE OUTCOMES

The World Energy Council concluded that:

- global energy consumption will grow by about 50% in 20 years, posing significant challenges to do with carbon dioxide emissions for which renewable and nuclear energies have roles to play;
- liberalisation also poses challenges, and distributed generation - microturbines, diesels, fuel cells and renewable technologies - will provide options for non grid connected areas; and
- increased end-use efficiency offers the most immediate, largest and most cost-effective way of reducing consumption and environmental degradation.

The Council urged industry and governments to:

- sustain their efforts to widen the energy supply base into cost-effective options;
- provide for genuinely clean fossil fuel production and use;
- resolve uncertainties related to climate change
- close the nuclear fuel cycle and resolve waste disposal issues; and
- pursue economic renewable energy supplies.

It also recommended that the energy industry sustains its commitment to R&D with government support for activities related to fostering the common good.

Contact the World Energy Council's UK office at
www.wec.co.uk

Nuclear industry foresees no serious Y2K problems

How ready for the Y2K 'millennium bug' is Britain's nuclear power industry? In November, Energy World put some detailed questions to both British Energy and BNFL Magnox Generation - these and the replies are given below. While the nuclear and wider electricity industry foresee nothing worse than disruption which is "localised and of short duration", they are also busy making contingency plans.

Could you describe how British Energy (BNFL Magnox Generation) perceives the Y2K issue; particularly how serious is the risk of interruption to the operation of power stations and the generation of electricity?

British Energy is aiming to achieve safe and continued operation into and over the new millennium. We currently see no reason to believe that that will not be the case. We are also working, closely with the other organisations in the electricity sector, and our current view is that there is unlikely to be any major disruption to electricity supplies. This is supported by the recent press statement from the Electricity Association (see box).

As you would expect from a highly responsible industry BNFL Magnox Generation takes the threat very seriously, particularly with regard to our safety and business critical systems. There are two prime sources of risk to our operations - internal systems failures and essential supplies interruption. Our Y2K programme is making good progress on both fronts, in particular we are on target to complete the bulk of our internal systems work this year.

This means that we can be confident, and are capable of demonstrating to our regulator - the Nuclear Installations Inspectorate (NII) - that our reactors can be safely operated, tripped, shut down and cooled, to ensure that we continue to generate electricity safely at the start of the millennium.

Security of supply is also reliant on other generators, the National Grid, and the regional

electricity companies. There is significant co-operative effort amongst all the electricity companies and the Electricity Association to minimise the likelihood of supplies disruption. We are also working closely with telecommunications providers and water companies to assure that our stations have continuity of essential external services. We expect increasing involvement with relevant government agencies to provide the necessary assurance that the UK's infrastructure will not suffer because of the Y2K problem.

Would British Energy's (Magnox Generation's) customers be in a position to demand a guarantee of supply, or to claim recompense for interruptions?

Normal provisions apply.

The vast majority of Magnox Generation's output is traded within the electricity Pool. There is currently no guarantee of production requested from any party; nor offered. The steps we are taking within the ESI as a whole will reduce the impact of electricity supply failures caused by Y2K to a very low level indeed.

Presumably there are safety risks too?

British Energy's year 2000 effort has been prioritised to ensure that any safety-related equipment is addressed first. The inventory of items being investigated has been cross-checked against all safety case documentation and procedures, to ensure that nothing has been missed. We are keeping the Nuclear Installations Inspectorate informed of our progress, and are in regular discussions with them and the other nuclear operators to ensure we have established and are following best practices.

Safety is our number one priority at Magnox Generation. There would be no question of operating our stations through the millennium unless it was safe to do so. This is why every plant has been taking an in-depth look at its safety-related systems to ensure it is fully prepared for the change. Each station has made a full Y2K Compliance Safety Case to our internal Safety Committees. Our regulator,

the NII, is taking the issue very seriously, and has requested all Nuclear Licensees to make "Justifications for Continued Operation" (JfCOs) prior to four potential risk periods (31.12.98 to 1.1.99; 8.9.99 to 9.9.99; the most important, 31.12.99 to 1.1.2000 and 29.2.2000; and 31.12.2000/1.1.2001).

If these justifications do not meet with NII agreement, we will be asked to place our plant in a 'quiescent state'. The NII is undertaking a continuous, in-depth assessment of our progress to enable their consideration of each JfCO as they are presented. We are confident that our JfCOs will meet with NII approval. Contrary to popular belief, the vast majority of our systems have no connection with nuclear safety, being mainly associated with conventional commercial activities such as salaries, procurement and electricity trading. The actual reactor controls in our Magnox power stations have no date-related systems/processes.

Could you describe the work programme that British Energy (Magnox Generation) has undertaken to minimise the problem?

The company is using a methodology that is in line with best practice world-wide. Inventories have been developed and verified, prioritisation has then been carried on the basis of safety and business criticality, and items are then investigated for millennium readiness, and if necessary, replaced, retired or fixed. All business and safety-critical items are targeted for completion by the end of 1998, with other important items to be addressed throughout 1999.

In common with other major businesses across the world, BNFL Magnox Generation has been addressing the millennium issue since 1996. A special project team was set up with strong engineering and business capabilities, accountable to an executive director. Based on international best practice, a five-stage approach was adopted: inventory and verification, impact assessment and prioritisation, detailed investigation, problem fixing as required, and contingency arrangements.

Inventories of all systems have been built up throughout all business units within Magnox Generation. In addition to reviewing safety documentation, power station and other business unit inventories have been cross-compared to ensure nothing is missed. Some 5,000 separate inventory items have each been assessed for safety and business criticality, and prioritised accordingly. Investigations have either led to the conclusion that a system is already millennium compliant or to a decision to:

- apply remedial work to make it compliant,
- replace it with a compliant system,
- accept non-compliance where suitable 'workarounds' can be engineered.

Existing approved controls and procedures are being used for all modifications to ensure safe operation of the resultant systems. The majority (95%) of this work will be completed by the end of 1998. The remainder will be complete by mid-1999.

This answer has covered the next two questions as well.

How is all this work progressing - are programmes on schedule?

(British Energy) business and safety critical items are on target for substantial completion by the end of 1998. Any exceptions are managed on an individual basis and will be closely monitored through to completion.

The Government's guidance on Y2K suggests a three-stage approach to the problem: assessment, action and installing/testing, and that the third stage will take up 70% of the total time and resources. Where is British Energy (Magnox Generation) within this framework?

Each item on the British Energy millennium programme is addressed individually according to our methodology which largely mirrors that recommended by the Government.

Each plant system needs to be individually assessed for millennium readiness, but the proportion of systems that require changes is quite small. A substantial proportion of BE's time and resources is therefore expended on the assessment and testing phase. We are now substantially through our assessment stage for all our key systems and have identified

satisfactory resolutions for those specific systems which exhibited a Year 2000 problem.

Has the company developed a likely scenario yet - that is, an estimate of the amount of disruption likely from 1st January 2000?

Most large UK organisations appear to be



ELECTRICITY ASSOCIATION STATEMENT

The Electricity Association said in November last year that it was confident that all aspects of the problem were being acted upon, either by corrective action or contingency plans. The relevant paragraph reads:

"The electricity industry has an excellent record in maintaining safe and secure electricity supplies. There is a high level of confidence that all aspects of the year 2000 issue have been considered and are being acted upon with corrective action or contingency arrangements, and by working closely with critical suppliers. While electricity supplies may always be subject to some interruption - for example, because of bad weather effects - the electricity industry's objective is to ensure 'business as usual' through the millennium period, with supplies to customers maintained in accordance with present standards."

addressing the Y2K issue in a competent manner, and it would be surprising if there was large scale disruption. Some things will inevitably have been missed, but our assessment at this early stage would be that any key business-related problems are most likely to be localised and of short duration.

(Magnox Generation referred to the Electricity Association statement as a response to this question - see box).

Has the company drawn up contingency plans (eg to close down non-compliant power stations)? Are these plans to be made public?

Standard (British Energy) procedures provide for plant shutdown in case of safety risk. We have no reason to believe that any such shutdown will be necessary, but our plans include a review of all existing contingency plans and emergency procedures to ensure they will function over the relevant date changes. Achieving safe and continued operation is inherent in our company culture.

As outlined earlier, BNFL Magnox Generation's Y2K programme is making excellent progress and it is our intention that it should be business as usual at the start of the millennium by continuing to generate safe and reliable supplies of electricity. While we are not planning to deal with widespread long-lasting disruption in the UK because all our indicators show this to be most unlikely, we are currently identifying appropriate contingency arrangements which will need the agreement of the NII. While this work will not be fully completed until March next year, we already know that we shall be:

- stopping non-essential activities eg refuelling the reactors,
- maximising the availability of plant at our stations (i.e. having no systems/plant out for modifications as far as is possible),
- undertaking a series of pre-and post-millennium checks on our systems,
- entering the millennium with high levels of essential stocks,
- ensuring adequate additional standby arrangements.

These steps augment a robust and comprehensive suite of operational procedures already in place which deal with such items as loss of grid connection or water supplies.

OBITUARIES

James O'Connell C.Eng FInstE

It is with regret that I report the death of James O'Connell C.Eng FInstE on Sunday 11th October 1998. The funeral took place on Saturday 17th October at St Joseph's Church Wrightington, Lancashire. The service was attended by several committee members including past and present Chairmen.

Jim became a member of the Institute in 1963 and

Chairman of the Merseyside Sub section during 1970's. He was elected to the North Western Section in 1968, becoming the Chairman for the years to 1984 and 1985.

Jim was the longest standing active member of the North West committee for which he received an Institute plaque for his services to the branch in May 1998.

He was a conscientious committee member who

attended both committee and technical meetings on a regular basis, Jim's practical experience often came to light during question time at our technical meetings. His knowledge of the history of the branch and its members proved useful on many occasions.

As well as his Institute committee work, he had been deeply involved since 1963 in charitable work for the Wigan and District Spastic Society,

during which time he held the posts of both Secretary and Chairman.

Jim was a devoted father to his daughter Catherine, who sadly died at the end of the 1997. The committee and members of the Institute together with members of the North West fuel luncheon club of which he was also a member, wish to convey their sympathy to his widow Jean.

Eric Curd

Ernest James Bell C.Eng FInstE FIGasE

It is with much sadness that we announce the death of Ernest Bell, a long serving and enthusiastic member of the Institute. Ernest joined the Institute as an Associate in 1960 and rose to become a Chartered Engineer and Fellow of the Institute during his career.

His early career was spent at Lea Bridge District Gas Co, subsequently the North

Thames Gas Board, preparing estimates and specifications for gas and water supplies and space heating schemes. In 1961 Ernest progressed his career with a move to Eastern Gas Board and then onto Southern Gas Board in 1967 as a Regional Industrial Engineer. In 1973 Ernest transferred his membership to the grade of Associate Member. In January 1976 Ernest took up a post as an Energy Technologist for The Electricity Council providing an energy information service to

the electricity supply industry both in the UK and worldwide. On 1 September 1987 he retired from The Electricity Council and continued to contribute to the energy field as an energy technologist and consultant. He also managed to find time to lecture students undertaking an MSc in energy efficiency and management.

Ernest reached the highest grade of membership, becoming a Fellow of the Institute in 1992. He was a very active member of the London &

Home Counties branch for many years, taking on various honorary responsibilities. Most recently the Institute was proud to be represented by Ernest in his capacity as an Engineering Council Senator. In this role Ernest also represented several other College D Institutions.

Ernest was a joyful character who will be greatly missed by his friends and colleagues within the Institute. Our best wishes to his family at this sad and difficult time.

Recognition of services



Malcom Pittwood recognised for his services to the Institute as Honorary Treasurer.



Fraser Ferguson recognised for his services to the Institute as Honorary Secretary.



Colin Chapman recognised for his services to the Institute as Chairman of the Membership Committee.

COUNCIL ELECTIONS

Presidential officers and honorary officers 1999/00

The undermentioned have been elected by Council to take office following the Annual General Meeting on 22 June 1999.

R E D COLDWELL to become President; **Dr P MULLINGER** - Honorary Secretary; **J E INGHAM** - Honorary Treasurer.

ELECTION TO COUNCIL 1999/00

Following the AGM, the undermentioned will retire and are not eligible for re-election:

DR J C WHITEHEAD, J S BAILEY, S M TAULBUT

Following the AGM, the undermentioned will retire and are eligible for re-election:

DR P J PADLEY, P M JOHNSON, D PENFOLD, PROF. P D DUNN

NOTICE OF COUNCIL NOMINATIONS

Council has nominated the undermentioned to be elected following the AGM:

Dr J WADE, M HOGGARTH

Any 10 Corporate Members may nominate in writing any duly qualified person to serve on Council. Any three Corporate or Associate Members may also nominate in writing an

Incorporated Engineer to serve on Council. A vote for Associate Members would be by Associate Members only.

All nominations, together with the written consent of the nominee to serve, should reach the Secretary of the Institute not later than eight weeks before the AGM, but preferably earlier. (Members are not, however, permitted to join in the nomination of more than three persons in any one year).

Piecing together the policy jigsaw

On Thursday 18 March 1999 The Institute will hold a major one day event at the CBI in London. Mr John Battle MP, Minister of State for Science, Energy and Industry, will lead a group of prestigious speakers through a day identifying the direction and major themes for future energy policy in the UK. Discussion and debate will focus on achieving coherence in energy policy in the

face of conflicting economic, social and environmental pressures. Mark Baker CBE, President of the Institute said, "we do not intend this to be a talking shop, it is a chance for major players to get their views across and for all in energy field to challenge the views of policy formers".

For a booking form, contact Maria Adams on 0171 580 0008

South Coast Branch visit to Aerolaminates Ltd

South Coast Branch committee member Geoff Orme, who is also a member of the Systems Engineering tutorial staff at the Southampton Institute, arranged a visit to Aerolaminates in Totton, Southampton, for 27 October last year.

The twenty-four visitors were split into 4 groups under the direction of Mark Hancock, Technical Manager and supplied with protective overalls and goggles.

The manufacturing areas are large and spacious - they had to be in order to accommodate the fabrication/production of massive aerogenerator blades. At this site they are manufactured in two sizes: 23 and 31 m, with respective

weights of 3 and 6 tonnes - the largest in the world.

Manufacturing techniques were briefly explained, including precision mould preparation, blade lamination using a strong combination of 5 mm plywood (Finish birch), resin and glass fibre, tip blade design and construction - the latter vital for air brake control and, of course, the powerful methods of securement to the centre hub.

Aerolaminates, once part of the Taylor Woodrow Group, was acquired last year by company NEG Micon, based in Denmark and with a current annual turnover of £400 million. Aerolaminates is now being a dedicated export supplier to their new parent company.

NEG Micon, in turn,

exports on a worldwide basis. One of their largest aerogenerator turbines: NM1500/64, with three rotor blades of 31 m, gives a total rotor diameter (including 2 m hub) of 64 m, a swept area of 3,217 m², with rotor revolutions of 17 rpm for an output of 1500 kW. This power generation is achieved with optimum performance/wind speed at 16 m/s (57.6 kph), with automatic cut-in/cut-out values at wind speeds of 4 and 25 m/s respectively.

The technology is impressive and, to use the old expression, 'on a grand scale'. Without doubt, the continuing growth and establishment of wind farms will make a valuable contribution to electricity

generation without some of the disadvantages associated with large conventional power stations. They also have the additional advantage, when sited in agricultural locations, of maximising land utilisation. Advances in technology over the last few years have shown considerable improvement relative to noise reduction, although visual intrusion/impact will always pose siting problems, leading in certain circumstances, to the potential for offshore installations.

The evening was rounded off by questions and refreshments, with grateful thanks expressed to our host Geoff Orme.

John Bartlam

BRANCH EVENTS

JANUARY 1999

MIDLAND BRANCH

Thursday 7 January, 7.00pm
Austin Court, Cambridge St.
Refreshments available from
6.30 pm.
"Energy in Transport" - Dr John
Butson from ECOTEC Research
& Consulting Ltd. Contact Mr H
Freeman, tel: 0121 353 2397

SCOTTISH BRANCH

(Date to be confirmed)
Site visit to Blantyre Mini
Hydro Plant. Contact Mr C
Boyd, tel: 0141 270 7060

FEBRUARY 1999

MIDLAND BRANCH

Wednesday 3 February, 6.30pm

Birmingham Chamber of
Commerce, jointly with CIBSE.
Refreshments available from
6.00 pm. "Energy Management -
converting energy information
into lower costs". Alan
Aldridge, Sales Manager, Energy
Auditing Agency Ltd, (TEAM
Software). Contact Mr H
Freeman, tel: 0121 353 2397

LONDON & HOME COUNTIES BRANCH

Thursday 4 February, 6.00pm
"Sugar, Coal, Heat & Power" -
Steve Daldry, Engineering
Manager at British Sugar,
Ipswich. Contact Mr PM
Johnson, tel: 01793 893330

SOUTH WALES AND WEST OF ENGLAND BRANCH

Thursday 4 February, 5.30 for
6.00pm at Rio Tinto, Broadmead,
Bristol. Lecture on Particulate
Emission Control. T
Golesworthy (Branch Chairman)
of EDT Ltd. Contact Dr I
Weslake Hill, tel: 01222 757527

YORKSHIRE BRANCH

Wednesday 17 February,
2.30pm
'Application of Photovoltaics' -
Prof Bob Hill from Nottingham
University. To be held at Dept
of Fuel & Energy, Leeds
University. Contact Mr A
Mallalieu, tel: 0113 276 8888

SOUTH WALES AND WEST OF ENGLAND BRANCH

Friday 26 February, 9.30am for
10.00am. The Idris Jones

Memorial Lecture and
Luncheon, at Cardiff Castle
sponsored by IVO Energy Ltd.
Contact Dr I Weslake Hill, tel:
01222 757527

NORTHERN IRELAND BRANCH

(Date and venue to be
confirmed)
Committee Meeting, talk on
IME Directive & lecture by Prof
John Chesshire. Contact Dr P
Waterfield, tel: 01232 364090
email: p.waterfield@ulst.ac.uk
for more details

SCOTTISH BRANCH

(Date to be confirmed)
Site visit to Tesco Recycling
Plant. Contact C Boyd, tel: 0141
270 7060

'Gain not pain' on climate change?

Mr Prescott published his
paper on the Government's
proposals on Climate Change in
October (see also page 5). He
has invited comments on a range
of suggestions on how the UK
should meet commitments
undertaken at Kyoto, as
elaborated in negotiations with
other EU countries. As many of
the proposals to reduce
greenhouse gas emissions involve
energy, directly or indirectly, it is
appropriate for the Institute to
respond and to base the
response on the wide range of
expertise and experience
available within the Institute.

The international legal
requirement is for UK to
reduce emissions of the basket
of six greenhouse gases by
12.5% from their base levels by
2010, from 216 million tonnes

of carbon equivalent to 189
million tonnes averaged over
the period 2008 - 2012. The
Government is 'seeking to
establish a balanced and
equitable climate change
strategy. Too much of the debate
on climate change has focused
on the cost of taking action. In
contrast, we recognise the
scope for economic benefits
improvements to our quality
of life. . .'

There should be benefits to
UK businesses which could
'build a platform from which to
exploit the world markets'.

The Institute would
welcome views of its members
on these broad objectives.

The consultation paper lists
detailed proposals for each of
the sectors of the economy it
considers - Energy Supply,

Business, Transport, Domestic,
Agriculture Forestry and Land
Use, and the Public Sector.
Targets are set and possible
policies are set out. Comments
are specifically invited on a
series of questions for each
sector. Can 10% of electricity
supply be provided by
renewables by 2010? How
much CHP can be introduced
against a target of 5000
megawatts? How much can be
achieved by voluntary
agreements in the business
sector? What could be the role
of economic instruments? How
can transport emissions be
controlled? We want the views
of members on these issues.

How should the UK meet
its Kyoto obligations? How
much pain? How much gain?
But beyond Kyoto the

Government is also wishing for
a debate on the manifesto
commitment of reducing
carbon dioxide emissions by
20% by 2010.

This will be a much more
difficult task and it is not
surprising that the consultation
paper speaks only of starting a
national debate on moving
towards the 20% target.
Members may have views on
this as well!

If you would like to
contribute to the Institute's
response, please do so quickly
and in any event before the end
of January.

The collective response is
being co-ordinated by Past
President Professor Jim Harrison.
Comments can be sent to him
via the Institute or direct to him
on Fax 01242 269080.

Membership & Education Advisor Training Day



On Tuesday 6 October, the Branch Membership and Education Advisors were invited to Devonshire Street to attend a training day to refresh and update themselves on procedures and activities taking place at headquarters. Eight of the ten branches attended and Tracey Fisher, Membership & Education Manager, together with Deepti Jayawardena

Wilkinson, Membership & Education Officer, led the training session.

All advisors were issued with an updated Branch Handbook together with presentation material for promotional purposes. The advisors were updated on the Engineering Council procedures and the implications of the new SARTOR, which will be

implemented in September 1999. Tracey Fisher reported that Academic Liaison Officers had been established in universities which the Institute has links with. Therefore it would be beneficial for the Advisors and the Liaison Officers to work together in promoting the Institute to university students.

Many new ideas were put

forward to provide existing and potential members with assistance whilst progressing through the grades and when initially applying for membership. It was proposed that the log book, which is used by graduate members when they upgrade, could be used more effectively to record not only training and experience, but also members' CPD.

Further discussions were held on the quality of the Internet site. Efforts are being made by the Projects & Marketing department to update and develop the web pages. Watch this space for details.

The day proved to be very informative and useful. So, members - if you have problems with the requirements or form filling, you know who to call!

NEW MEMBERS

EAST MIDLANDS

Mr J Buxton MInstE
Stockport Metropolitan
Borough Council
Mr PS Court, AMInstE
AHS Emstar Plc
Mr JR Exford, AMInstE
Erwin Sick Ltd
Mr BF Henderson, Graduate
Caterpillar (UK) Ltd

LONDON & HOME COUNTIES

Aon Group
Group Affiliate
Mr NM Brown, Associate
HM Prison, London
Mr GE Clark, FInstE
The Uranium Institute
Mr MN Gunasekera,
Graduate

Mr T Hakim, MInstE
AHS Emstar Plc
Ms A Maguire, MInstE
South Bucks NHS Trust
Mr MD O'Rourke, Associate
CRS Facilities London
Dr J Wade, MInstE
Association for the
Conservation of Energy
Mr SJ Waterfield, Associate
Royal Military School of
Engineering, Kent

MIDLAND

Mr PG Ramsell, FInstE
Ramsell-Naber Ltd

NORTHERN IRELAND

Mr PJS Byrne, MInstE
Craigaron Borough Council

NORTH WEST

Mr DT Davis, MInstE
Cheshire Fire Authority
Mr M McGiveron, Graduate
Liverpool John Moores
University

SCOTLAND

Mr GJ Colville, Student
Heriot-Watt University
Mr M Hobbins, Student
Napier University
Miss L Martinasso, Student
Napier University
Mr S Pain, FInstE
DuPont (UK) Ltd
Miss VC Rudloff, Student
Napier University
South Coast
Mr SJ Bailey, Associate
Brompton Barracks

SOUTH WALES & WEST OF ENGLAND

Mr AP Moss, Associate
RAF St Athan
Miss NE Owen, Student
University of Cardiff

YORKSHIRE

Mr MT Rogers, Associate
North Yorkshire
Mr AG Weekes, Graduate
Arbre Energy Ltd
Overseas
Mr IHA Malek, Graduate
Gulf Aluminium Rolling Mill Co
Mr IG Murshed, MInstE
Dubai Aluminium Co

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