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ersonal viewpoint

ill relevant?

rning over the pages recently of *'Coal and Energy'* which Derek Ezra (now Lord Ezra) wrote in 1978, I found myself ilosophising over the inbuilt inability of most of us, most of the time, to get beyond the idea that things are going to continue ich as they are now through next year, and the year after, and the years after that. I can remember how very soundly based ra's arguments seemed in the prevailing climate of 1978, especially his conclusions which may be summed up in this quote:

> *'It is now* (ie in 1978) *of vital importance to take such action as may be necessary to avert within the next decade or so what could well be a far more serious world energy crisis than was experienced in 1973 or 1974'.*

This is a call to arms which, nine years nearer the crisis (if crisis there is to be) is now, to say the least, unfashionable. The estion is — were the facts, on which these conclusions were so logically drawn (in 1978), so very wrong?

The centre piece of Derek Ezra's case was based on the irrefutable fact that world oil reserves are finite, and on the hypothesis it they would become small relative to the demand within a matter of few decades. Is this hypothesis still reasonable? The solute figure of proven (and especially estimated, so far undiscovered) oil reserves round the world may be argued; but a figure just over 1700 billion barrels given by the US Geological Survey in 1984, as the total oil available for mankind, does not disagree dly with other estimates, including those quoted in Ezra's book. I have taken this figure in the accompanying graph and plotted rate at which the world has eaten into this supply up to 1986 and extrapolated into the future on the conservative assumption it the present world rate of consumption will on average hold steady — until the realisation that the supply is really, and efutably, about to dry up, making that which is left into a precious commodity.

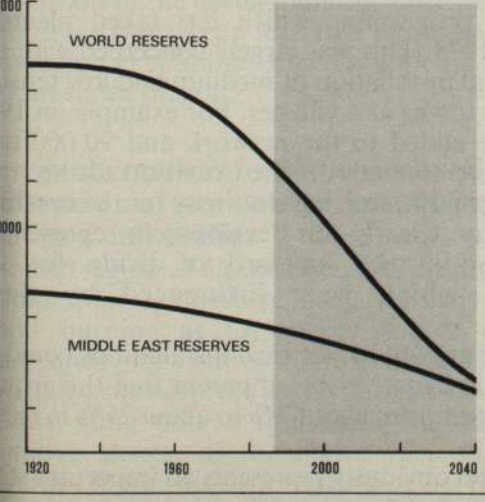
I have also plotted a similar curve for Middle East oil which, if nothing else, supports the argument given in Worldwatch paper *World oil: coping with the dangers of success* by Christopher Flavin (July 1985) that

> *'the Persian Gulf may move back into the driver's seat just at the time when world oil resources are more limited than at any time in recent history'.*

I leave it for the reader to decide how much this should be a cause for concern.

I wonder if any reader is prepared to put forward arguments to show that this graph is nonsense — or even that it is out in y respect by, say, more than 20%. Failing this, should not someone or some body be taking a long, cool look at what needs be done now or, at least, over the next decade to avoid having to rely on 'crisis' decisions when the next world energy crisis eaks sometime in the early decades of the next century. The Institute has already made a proposal about this — in its report *ergy for the Future* (rev in 1986) in which the conclusion is stated that:

> *'in view of the technical complexities of* [energy policy] *questions, the risk of emotional overtones, of the deep concern of public opinion over certain aspects of the subject and of the need for dispassionate thinking to support objective assessments, we regard the case for a National Energy Commission as an extremely strong one'.*



Perhaps the title 'National Energy Commission' has too bureaucratic a ring about it to generate much enthusiasm, even in those who agree that action is required. Or perhaps to others it carries the hint of a restriction by raising questions of long-term effects, in freedom of action to do what seems best for today. No doubt this year's balance sheet, or this year's votes, will seem very pressing enough to leave the future until next year. Whatever the reason, 'Energy for the Future' does appear to have been received, with a few notable exceptions, as mainly irrelevant to present day activities.

I have a picture of our grandchildren, perhaps of our children even, taking Lord Ezra's 'Coal and Energy' from the back of the top shelf, blowing the dust off, turning over the pages and murmuring: 'But they did know it was all going to happen. Why on earth didn't they....?

G G Thurlow *(past president)*

Interaction between energy choices and socio-economic factors ie, energy and growth

Prof J Swithenbank BSc PhD FEng FInstE FIChemE MAIChE*

The common theme of the papers considered in this session was the interaction between the growth in nation's economy and the growth in energy demand. It is well known that for many years it was considered that these two factors were closely linked. The basis for this hypothesis was contained in graphs which showed the annual energy consumption of the nations of the world plotted against their gross national product (GNP). The apparently good correlation revealed by this graph was originally felt to be significant. More recently, several cases have been found where the growth in the economy a nation has not been accompanied by a corresponding increase in energy consumption and it is now popular to see these two factors as only loosely related. A more thorough investigation of the factors involved in the growth in energy consumption reveals the reason for this anomaly. The papers present in this session provide an excellent basis for such an examination

The first point to note is that, as a nation moves from a simple agricultural economy to an industrially based economy, there is a characteristic increase in energy consumption due to the introduction of relatively heavy basic industry (Fig 1). As its industry evolves further towards the production of high technology devices and systems, the energy consumption does not increase in proportion to the value of the products and hence we observe the change in correlation between energy and GNP noted above.

These effects are enhanced by the commendable current trend whereby energy conservation techniques are employed in industry, commerce and the home. Again, the papers presented in this session provided specific examples which illustrated this aspect of the relation between energy and growth.

An important conclusion from these papers was that there is an underlying reason for the evolutionary process in the growth in each nation's energy demand. This tends to lead to an initial rapid growth in energy consumption relative to the growth in GNP, followed by a mo moderate relationship. This information means that t changes in the status of each nation's economy must carefully assessed before being incorporated into a glo energy forecast, rather than attempting to simp extrapolate the global data.

What other lessons do we learn from this exercis Perhaps the most important question is to see if we c ensure that the developing nations move to the po where the initial high slope of the relation between ene consumption and GNP changes to a lower value as so as possible. Since the lower value is largely associated w the use of capital intensive energy conservation measur it is obvious that these measures should be introduced soon as possible. Clearly this can be achieved by grea cooperation between the more developed and l developed nations. This involves the transfer of bo information and capital. However the reward stretching the energy sources as far as possible is v much to the mutual benefit of all nations.

Turning now to the individual papers in this sessi each one will be considered in turn and it will be sho how they fit into the overall pattern. Finally, in conclusions the picture which emerges is integrated i the role of this congress.

The Institute of Energy at the World Energy Conference

Prof Swithenbank (seated) is seen here, talking to another delegate, on the Institute of Energy stand at the World Energy Conference on which was displayed the Institute of Energy's recent report Energy for the Future

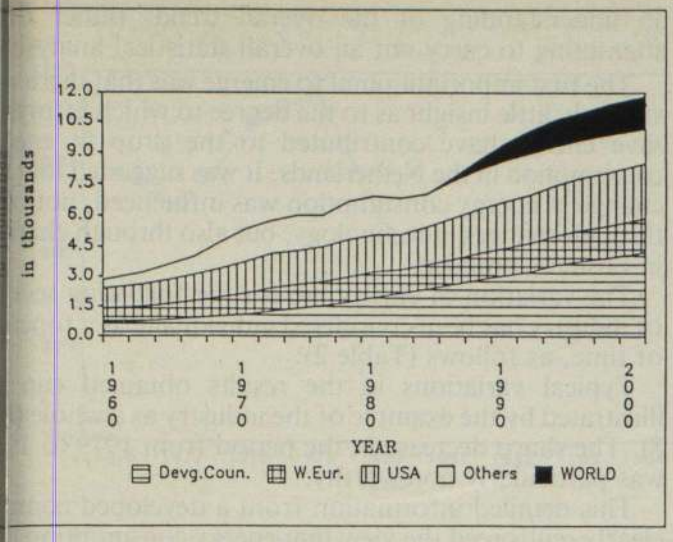
*President, Institute of Energy

Electrification in Algeria: general approach a technico-economical considerations D Djidi, N Se and M El-Ketroussi

The paper presented detailed data on the extens electrification programme which has taken place Algeria since 1978. This was largely concerned with distribution and installation of medium and low tens supplies to the towns and villages. For example, in 19 4000 km were added to the network and 90 000 n subscribers were connected. The extension to the ru zones which are now receiving electricity for the first ti was noteworthy. Clearly this development represent major increase in the standard of living for communities which were influenced by th developments.

In Fig 2, the growth in electrical installations could seen. From this figure, it was apparent that the gro rate had increased from about 7% to about 25% in rec times.

Electrification obviously represents an important st



1: World energy consumption trend

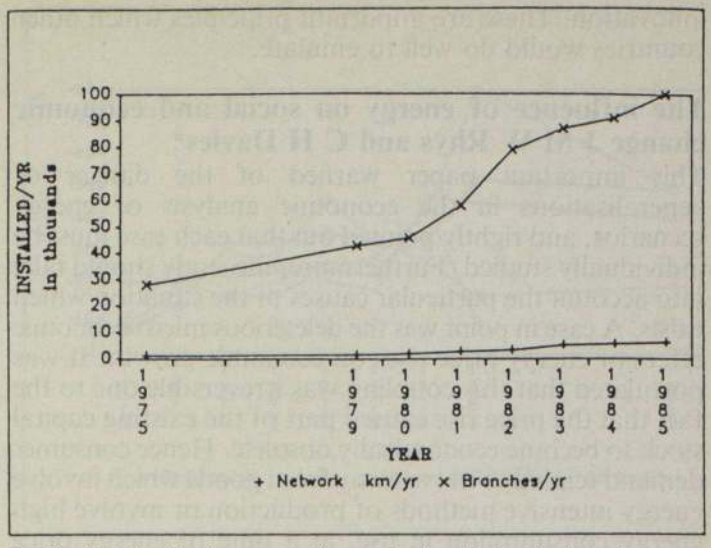
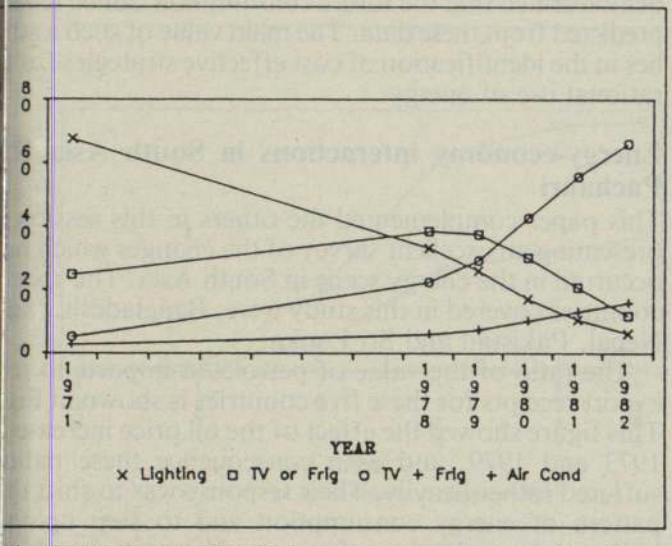


Fig 2: Algeria: development of commissioned electrical services



3: Algeria: national distribution of customers by type of appliance

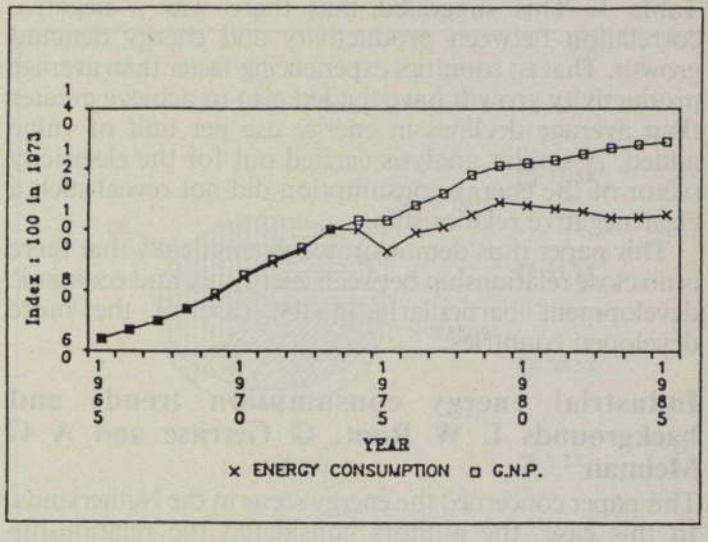


Fig 4: France: energy consumption and GNP

the energy evolution process of a nation. Not only does affect the convenience of the individual, but it also plays important role in the social life of the population, pecially with regard to the communication and ssemination of information through radio, television d the press.

At a later stage in economic development, the despread introduction of air conditioning, which is ade possible by the availability of electricity, becomes important factor. Since air conditioning is a major nsumer of energy, we must carefully review the impact this factor on future energy growth in countries such Algeria. The first stages of this development were parent in Fig 3 where it could be seen that an increasing oportion of the installations included air conditioning. is development can lead to a major redistribution of pulation in countries which experience hot climates at rtain times of year.

ergy alternatives for the agricultural communities the arid and semi-arid region of Coquimbo, Chile C Saez and F Diaz

e arid region of Coquimbo, Chile represented a good ample of a region where there were signs that traditional od burning as an energy source could not be aintained for more than a decade unless major velopments occurred in the reforestation programme. the same time a transition was advocated from imitive stoves, as the major fuel burning devices, wards more modern technology. This document emphasised the role of wood burning in the world energy scene. In view of the large proportion of wood burning used worldwide and the extremely short time scale for its depletion, it does not appear to be receiving a sufficient amount of attention by the world authorities.

Energy management: an economical requirement — a means of development and cooperation M Rolant and B Laponche

This paper was concerned with the economical, technical, ecological, social and political aspects of energy in France, and their interaction with the rest of the world. Using the present trend towards increasing energy prices as a background, the authors made a thorough analysis of the energy policy which has been adopted in France.

As one of the most advanced countries, both with respect to technology and energy policy, France provides an example of a late stage in the evolution of energy utilisation. The growth in France's energy consumption and GNP are shown in Fig 4, based on an index of 100 in 1973. This figure illustrated two important points raised in the introduction: firstly, the de-coupling which is now occurring between the growth in the GNP and the growth in energy consumption; and secondly, the trend towards zero growth in the energy consumption of highly developed countries.

The most important conclusion of this paper is that a *national energy policy* has been implemented to ensure: continuity of action, decentralisation of energy systems, and technological prospects through research and

innovation. These are important principles which other countries would do well to emulate.

The influence of energy on social and economic change J M W Rhys and C H Davies*

This important paper warned of the danger of generalisations in the economic analysis of energy scenarios, and rightly pointed out that each case must be individually studied. Furthermore, the study should take into account the particular causes of the situation which exists. A case in point was the deleterious micro-economic effect of energy price rises on economic growth. It was postulated that this coupling was irreversible due to the fact that the price rise caused part of the existing capital stock to become economically obsolete. Hence consumer demand tended to move away from goods which involve energy intensive methods of production or involve high energy consumption in use, at a time of energy price increases.

An interesting point emerges from consideration of Table 1. This suggested that there was a negative correlation between productivity and energy demand growth. That is; countries experiencing faster than average productivity growth have tended also to achieve greater than average declines in energy use per unit of value added. A similar analysis carried out for the electricity sector of the energy consumption did not reveal such a clear negative relationship.

This paper thus demonstrated dramatically that there is no close relationship between energy use and economic development particularly in the case of the more developed countries.

Industrial energy consumption trends and backgrounds L W Root, G Gerritse and A G Melman

This paper concerned the energy scene in the Netherlands. In this case, the authors considered the relationship between energy consumption and growth, and again identifed the need to look at each sector in detail to gain an understanding of the overall trend, rather th attempting to carry out an overall statistical analysis

The first important point to emerge was that there v still only little insight as to the degree to which efforts save energy have contributed to the drop in ene consumption in the Netherlands. It was suggested that change in energy consumption was influenced, not o through changes in technology, but also through chan in business practice.

The variation of energy use for the following sect of industry has been considered individually as a funct of time, as follows (Table 2):

Typical variations in the results obtained can illustrated by the example of the industry as a whole (5). The sharp decrease in the period from 1979 to 19 was particularly noteworthy.

This detailed information from a developed coun clearly reinforced the view that energy consumption c only be interpreted by detailed analysis of ev component of every sector. Even then, it has yet to demonstrated that the future consumption can be relia predicted from these data. The main value of such a stu lies in the identification of cost effective strategies for rational use of energy.

Energy-economy interactions in South Asia R Pachauri

This paper complemented the others in this session presenting an excellent survey of the changes which ha occurred in the energy scene in South Asia. The speci countries covered in this study were: Bangladesh, Inc Nepal, Pakistan and Sri Lanka.

The ratio of the value of petroleum imports to tc export receipts for these five countries is shown in Fig This figure showed the effect of the oil price increases 1973 and 1979, and as a consequence these natic suffered rather heavily. Their response was to shift th pattern of energy consumption and to step up th indigenous production of energy. In particular, Ne increased its use of coal and Pakistan increased its use natural gas. Significant sources of coal, oil and gas ha been identified in the BIP countries and increas exploitation of these reserves can be anticipated.

Since agriculture is a major contributor to economies of all five countries, it follows that econor growth must be linked to the growth in agriculture. T in turn depends heavily on energy in the form of fertilis and direct energy for the agricultural machinery. Her constraints in energy supply would adversely aff economic growth.

Here we see one reason behind the contrast betwe the growth in energy consumption in the developed a developing countries. Bearing in mind that these f countries possess a population of about a billion peop it follows that the potential energy requirement could r by a very large factor.

The lessons of the past show that energy/econor interactions are at the core of economic development the nations of South Asia. To this conclusion, one co perhaps, add the problem of population growth.

The structural changes in energy demand a economy since the oil crisis — the Japanese ca K Fujime

The author gave extensive data on the relationsl between the changes in energy consumption and GNP Japan. It could be observed that the manner in wh

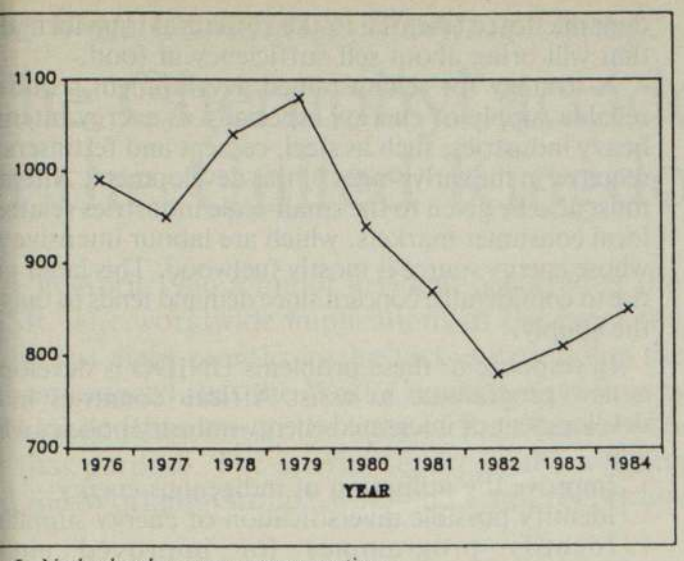
Table 1 International productivity and energy use data

	UK	*Japan*	*France*	*Italy*	*Germany*	*USA*
Value added per person employed	7	113	45	43	38	25
Energy use per unit of value added	−11	−54	−38	−33	−22	−24

Table 2 Percent reduction in energy consumption, corrected for changes in production, with 1979 as the year of reference

	1980	1981	1982	1983
Foods and allied products	− 3	− 7	−10	−14
Textile industry	− 8	−11	−18	−26
Paper and paperware industry	− 6	−15	−17	−22
Chemical industry, fibres	−11	−25	−30	−29
Construction materials and glass	− 5	− 9	−17	−19
Basic metal industry	− 6	− 7	−13	−21
Metal fabrication industries	−15	−22	−29	−26
Remaining industries	—	—	—	—
Industry as a whole	−12	−19	−26	−22

*This paper will be presented in its full form in a forthcoming iss of *Energy World*



5: Netherlands: energy consumption

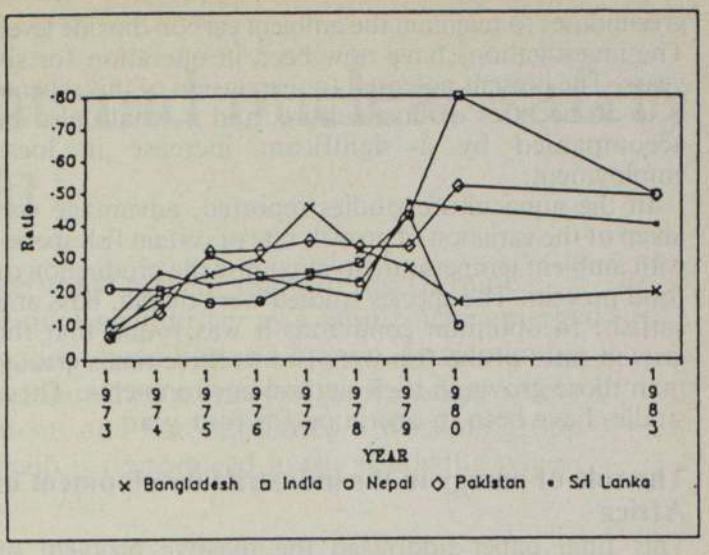
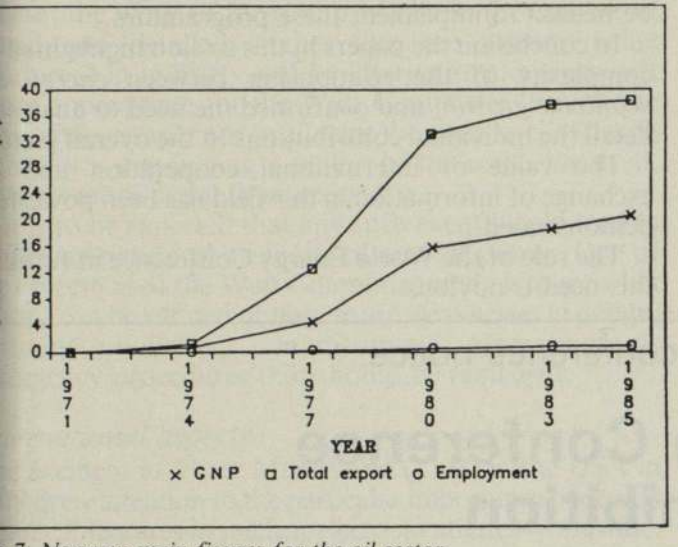


Fig 6: South Asia: ratio of value of petroleum imports to total export receipts



7: Norway: main figures for the oil sector

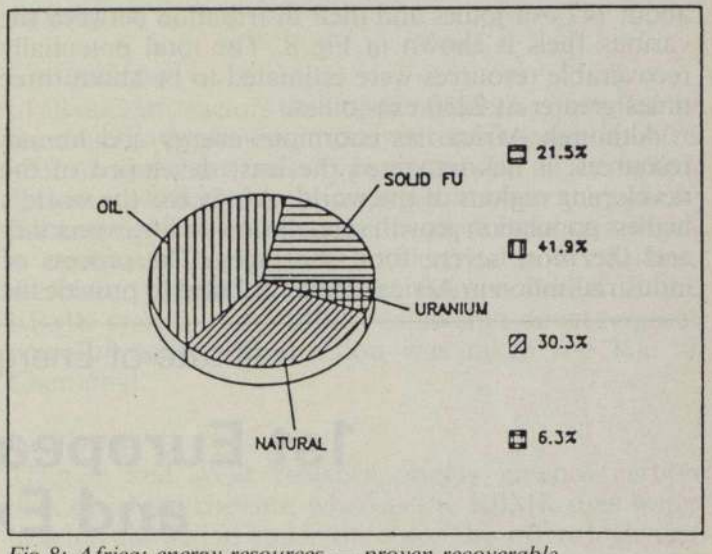


Fig 8: Africa: energy resources — proven recoverable

ese data fitted into the overall pattern was fully nsistent with the advanced nature of the Japanese onomy. Thus, there is a large divergence between the acro-economic growth indicators and the energy mand. Some of this limitation of energy demand is due the shift in the structure of the industrial sector; away om industries such as steel, chemicals and cement, wards high added value industries. It was also estimated at energy conservation in Japan's manufacturing dustries had yielded savings of 30-50% in the period om 1973 to 1984.

orway a newcomer in the petroleum industry Himie

his paper injected an important new factor into the scussion since Norway is now one of the significant oil oducing countries and this has led to some economic oblems. Whilst many nations may wish they had such oblems, it is nevertheless important that we consider the chniques which have been used for their amelioration. The development of the oil sector in Norway is shown Fig 7 in terms of the percentages of GNP, the total nployment and the total export. Thus in 1985, the oil ctor accounted for 20% of GNP.

The use of petroleum income in Norway has had far eater impact for the rest of the economy than the direct fects of the petroleum activity. The main difficulty lies the fact that international oil prices fluctuate quite widely, and the economy tends to be quite sensitive to these fluctuations.

The solution to this problem has been to ensure that there is a separation in the short term between the pertroleum income and the use of this within the country. This economic policy can therefore be regarded as a main feature of Norway's energy policy.

The use of reject heat to improve food production H G Pfeifer and R P Johnson

In developed countries, important new techniques are being evolved for the rational use of energy. This paper presented one such innovation being developed in the USA which could have major implications for future food production.

Energy engineers have long been concerned about the vast waste of low grade heat which is inevitably associated with the production of electricity at power stations. Whilst it is not always economically viable to use this 'waste' heat for district heating, local use of the heat near the power station could be attractive The authors reported on the results of an ongoing study in which controlled environment agriculture and fish production were investigated, using the reject heat from power stations.

In the agricultural studies, crops of tomatoes, lettuce and ornamental plants have been grown in greenhouses heated to about 300K by waste heat at external winter temperatures of 255K. Some fuel is also burned in the

greenhouses to maintain the ambient carbon dioxide level. The investigations have now been in operation for six years. The present potential for expansion of this scheme is to 50 hectares of horticulture, and it would also be accompanied by a significant increase in local employment.

In the aquaculture studies reported, advantage was taken of the variation of growth rate of certain fish species with ambient temperature to maximise the production of food protein. The species studied were tilapia, bass and catfish. In optimum conditions it was found that the growth rates of the fish were two to three times greater than those grown in their natural environments. These studies have been in operation for four years.

The role of energy in the industrial development in Africa

This final paper addressed the massive problem of economic growth in Africa and its impact on the African energy scene.

The proven recoverable energy resources of Africa total about 747 exa-joules and their distribution between the various fuels is shown in Fig 8. The total potentially recoverable resources were estimated to be about three times greater at 2250 exa-joules.

Although Africa has enormous energy and human resources, it has remained the least developed of the developing regions of the world. Africa has the world's highest population growth rate, the lowest life expectancy and the most severe food shortages. The process of industrialisation in Africa has so far failed to provide the dynamic force essential to the structural transformat that will bring about self-sufficiency in food.

A strategy for self-sustained development require reliable supply of energy, especially as energy intens heavy industries, such as steel, cement and fertilisers required in the early stages of this development. Attent must also be given to the small-scale industries relate local consumer markets, which are labour intensive a whose energy source is mostly fuelwood. This latter gi rise to considerable concern since demand tends to outst the supply.

In response to these problems UNIDO is develop a new programme to assist African countries in development of integrated energy-industry policies wh will:

- ☐ Improve the utilisation of indigenous energy
- ☐ Identify possible diversification of energy supplie
- ☐ Identify programmes for improved ener management and energy conservation
- ☐ Identify investment programmes

Concerted action at the national and regional level be needed to implement these programmes.

In conclusion the papers in this session highlighted complexity of the relationship between *energy a economic growth,* and confirmed the need to analyse detail the individual contributions to the overall pictu

The value of international cooperation and exchange of information in this field has been powerfu demonstrated.

The role of the World Energy Conference in fulfilli this need is obvious.

The Watt Committee Working Group:

The Chernobyl accident and nuclear safety in the United Kingdom

ate in April 1986 a major accident occurred at the Chernobyl nuclear plant in the Ukraine, SSR. The worldwide implications of the event for the nuclear industry as a whole have emerged the last eight months as the facts surrounding the accident have become known. In September it as announced that the Watt Committee on Energy had launched a study of civil nuclear safety in ie United Kingdom in the light of the Chernobyl accident, and had appointed a working group or that purpose. The interim report by the working group is reproduced in the following pages, nd the Working Group* will issue a full report later this year

1 1984, the Watt Committee published a Report entitled *uclear Energy — A professional assessment*. This rovided a starting point for the working group. Of ourse, the work of the group will be in the context of road and detailed studies that are already being nducted in industry and by international agencies. It not appropriate for the Watt Committee to replicate em unnecessarily nor to attempt the same level of detail; ther, it is conducting a review of the issues involved, ith no more detail than necessary.

It is to be expected that any such event would lead to re-examination of all facets of nuclear power. One of ie objectives of the Watt Committee study is to see what ssons can be learned or if there are weaknesses in design, anning, building, commissioning, operations or nergency procedures that should be remedied.

nternational aspects

he accident at Three Mile Island (TMI) in the USA in 979 drew attention to the particular importance of certain chnical features in nuclear electrical utilities worldwide. led to a major re-examination of safety procedures, in oth system design and human factors. The events at hernobyl have stimulated world thinking on the subject f nuclear technology.

ey aspects of reactor design

he combination of graphite moderation with boiling light ater coolant as used in the RBMK reactor at Chernobyl as no direct equivalent outside the USSR, and factors lating to these combined effects must be duly noted in xamining the implications for the UK. However, it is relevant to compare key features of this design with those of the Magnox and advanced gas-cooled reactor (AGR), which provide the bulk of the British nuclear power capacity.

Control-rods

In all nuclear reactors the fission process is controlled by inserting or withdrawing motor-driven vertically mounted neutron absorbing rods. Typically, and in all the British designs, the motors are disengaged to allow the rods to fall under gravity into the core for more rapid shut-down in emergency. In the event of electrical power failure, therefore, a 'fail-safe' condition exists in Britain. In the RBMK system in the USSR, rapid shut-down requires operator action. This action was taken too late at Chernobyl.

Coolants

Magnox and AGR reactors employ gaseous carbon dioxide as the coolant, whereas the RBMK uses water which is allowed to boil in the core. This offers high heat transfer and thermal capacity, which, however, may be lost in an accident. The same water is used as a heat-transfer and moderating medium and also, evaporated to steam, drives the turbines.

Containment

Containment systems for nuclear reactor plants vary in both extent and design according to the types of incident that are considered to be probable accidents. The early RBMK reactors had no containment, but the Chernobyl reactor had provision to cope with leakage from the individual pressure circuits. The release that occurred in the Chernobyl accident was considerably beyond the capacity of the system.

Reactor stability

There are two classes of reaction: first, the fundamental nuclear fission process and the associated control and by-product mechanisms; secondly, possible chemical reactions. The stability of a reactor is affected by the power load and also by factors related to temperature, fuel burn-up and fission product generation.

For the RBMK reactors, under normal operating conditions, a proportion of the circulated cooling water turns to steam as it passes through the core. However, under certain conditions, an increase in the proportion

Sponsorship assistance: nuclear safety study

The Watt Committe on Energy is a body established by some 50 British professional disciplines. It is an independent voluntary body, a company limited by guarantee and a registered charity. Its policy is to present to the public independent assessments of the facts on energy-related subjects in a manner commanding professional respect and in a form that the media and the public can readily assimilate. Its work is mainly carried out by groups of experts drawn from the member institutions to study energy-related subjects identified by the Watt Committee Executive. To cover the costs of the Secretariat and other general expenses, being a charity, the Watt Committee relies on the financial support of its sponsors, whilst insisting on retaining its independence and freedom to arrive at an unbiased judgement of the facts. On this condition, the CEGB, together with SSEB, UKAEA, BNFL, and NNC, has agreed to assist in the sponsorship of the study of nuclear safety and to make available to the working group what is known about the Chernobyl accident.

*Members of working group on Nuclear Safety: N G Worley (Chairman); Dr F R Allen, F J L Bindon, Dr D Cope, Prof P M S Jones, Dr J D Lewins, P D Potter, Dr F B Smith, Prof N G Walton, J G Mordue (Secretary)

of steam results in an increase in reactor power, which in turn accelerates the generation of steam leading to a further increase in power.

There are no significant chemical reactions between the coolant and the core components in normal operation. However, if high temperatures are generated, water or steam can react with the zirconium alloy fuel cladding and possibly the pressure tubes. A sudden large increase in the reactor fuel can cause water to evaporate rapidly, and may generate a higher pressure than the pressure tubes can contain, leading to rupture.

Description of the accident

At 01.23 h on 26 April 1986 the number 4 unit of the Chernobyl nuclear power station was operating at low power for the test that was designed to demonstrate the electricity availability from the generator during turbine run-down when a sudden very rapid and uncontrolled power increase occurred. This resulted in the destruction of the reactor core, severe damage to the building and a release of radioactive material.

The accident is now known to have occurred as a direct result of the manner in which the test was conducted, including the deliberate disabling of the safety systems. However, aspects of the reactor design contributed to its response to the prevailing conditions.

The experiment that led to this disaster was one that involved operating the turbine with the steam supply shut off, with the intention of determining for how long significant alternator electricity would be generated. An early experiment at a RBMK plant had given disappointing results, and modifications had been made to the alternator which it was considered necessary to evaluate. The way in which the experiment was to be conducted on 26 April 1986 seems to have been defined by a committee of the central power organisation of the USSR. No reactor studies were considered necessary, probably because it was expected to be a repeat of earlier experiments at this station. The station staff were therefore apparently under considerable pressure to complete the tests because a further opportunity was not possible for at least a year. The tests at Chernobyl were therefore under the control of the electrical engineers, and the reactor was regarded just as a source of steam. The reactor operators were heavily engaged throughout the sequence of events in adjusting reactor output and trying to meet the requirements of the tests.

Why did it happen?

During the staged power reduction from half load (15 MW thermal), the power fell to 30 MW. The operati rules state that operation below 700 MW thermal is r allowed because of a possibility of instability. T operator was eventually able to reach the level of 200 M only by withdrawing the control rods further out of t core than was permitted. Additional reactor coola pumps were then started up as planned but this result in a water flow higher than the permitted value for t conditions prevailing. This caused two problems:

- The additional water caused a reduction in reactiv which had to be compensated for by further withdrav of the control rods.
- The level of water in the steam drums started to dr as more water was pumped to the core; in order avoid automatic shut-down of the reactor, trips sensi the steam drum water level were disconnected.

By 01.22 h the operators concluded that the reactor h reached a reasonable power level and that the tests cou proceed. In fact the reactor was in an unstable conditic So that the tests could proceed, the operators th deactivated the protection that would have caused t reactor to shut down during the test, so removing the l automatic line of reactor protection.

Steam started to form in the core, adding reactivi and the power output started to rise, forming more stea and escalating the power rise. On realising the situati the operator activated the manual trip, sending the cont rods into the core, but by now it was too late for the to have any effect. It has been estimated that power le reached 100 times the nominal full power. The fuel w quickly fragmented, causing a very rapid rise in stea pressure as the water quenched the fragments. This in tu caused the pressure tubes, already weakened by the r in temperature, to fail over large regions of the co Explosive release of steam into the reactor vault blew o the top shield and exposed the core debris to t atmosphere. The ingress of air caused a chemic explosion, the air reacting with hydrogen, formed steam or water reacting with zirconium or the graphi The graphite reached a high enough temperature to cat fire.

The Chernobyl accident was thus directly t consequence of operation at low power, leading instability and a rapid and uncontrolled rise in he generation in part of the core, leading to an explosi evaporation of water and locally very high temperatur

Implications for the world at large

The TMI accident in 1979 — in which no loss of life occurred — prompted a re-assessment of nuclear power production by electrical utilities. What are the implications for the UK and the world at large following the catastrophe at Chernobyl? Clearly, all countries that already have nuclear power plants, as well as those that were anticipating a future nuclear technology, will wish to review their positions.

Preparedness in the UK

The generally accepted aim in the UK, as indeed it must be everywhere, is that, as far as humanly practicable, it should be physically impossible for events such as the Chernobyl accident to happen.

A great deal of study has already been undertaken, particularly in operator training for abnormal conditions. Every effort has been made to ensure that the exercise of constant vigilance over equipment and procedures is the keynote of British nuclear reactor operations.

The nuclear power authorities in the UK have expresse their conviction, at the highest level, that British react designs, both Magnox and AGR, are among the safe in the world, in design and construction as well as operation and maintenance. The Watt Committee grou will review these critical issues in the next study phas

After Chernobyl, the actions that appear absolute necessary are twofold. One concerns the on-site conditio the other the off-site condition.

On-site condition in Britain

There are many aspects of the on-site condition to b appraised. The present system of staff selection, trainin and retraining and the use of simulators — together wi all the legal, statutory, mandatory procedures that suc staff must comply with — are areas that will be amon those reviewed by the working group. Present standar

high, but public opinion will require assurance that y are adequate or in the course of rapidly being made equate.

The electricity boards claim that British nuclear plants more economical to run than fossil-fuelled stations. ey are thus run as far as possible continuously at full d; this demands measures to ensure that operator ilance is not lost.

Training for all operating and maintenance personnel n important issue. The working group will be looking he methods used.

All nuclear power stations of the CEGB and SSEB have nprehensive emergency plans, as do those reactors erated by British Nuclear Fuels and the UKAEA — ie lder Hall, Chapelcross, Dounreay and Winfrith.

These emergency schemes have been in operation since advent of nuclear power in Britain. Over the years se plans have been modified and improved, the perience gained from annual exercises being orporated. In the light of Chernobyl, a further review the adequacy of emergency procedures, including efighting, would appear advisable.

Each power station site licence — the statutory cument required for operation — specifically requires ergency plans for the site.

In the light of the TMI accident, a major review was dertaken of the emergency plans of each British plant. e review highlighted certain areas in Britain where new as should be incorporated for greater response.

In the main, the recommendations were for improving blic relations and new media coverage and improving son with external organisations, telecommunications d population-dose assessments. They provided for the ting up of operational support centres for each nuclear tion site. Since 1979, all these improvements have been ried out, tested and verified.

f-site conditions

ernobyl has enlarged the public perception of the safety eds in the nuclear industry and focuses attention once ain on the adequacy of contingency plans for a large-scale accident. Given a major radioactive release, and given that meteorological conditions and timing might be unfavourable, the effectiveness of British emergency plans will be examined by the working group.

Emergency exercises are undertaken and witnessed by the Nuclear Installations Inspectorate yearly at each nuclear station, followed by thorough de-briefing. The working group will be looking at the scope for such exercises, to see whether it is possible to expand the range of them, bearing in mind the need for the full cooperation of all the public services.

It may not be necessary or possible that the general public in the surrounding areas should be involved to any great degree in such exercises, but an element of public participation should be sought.

Aims of eventual Watt Committee Report

As this statement suggests, in the British nuclear power industry, because the designs and safety procedures used are so different, the possibility of an accident like that at Chernobyl is, by comparison, negligible. These safeguards are not sufficient in themselves, however, because of the international implications of the existence of foreign stations of different design and procedures. In the course of the Watt Committee study, of which this statement is an initial phase, the designs and operational practices used in the nuclear power industry, especially in the UK, will be considered with the purpose of contributing to the maximum attainable safety of these operations.

Dr G K C Pardoe
Chairman, Watt Committee on Energy
N G Worley
Chairman, Working Group on Nuclear Safety

Acknowledgment

Members of the working group, especially F R Allen, F J L Bindon, Prof P M S Jones, Dr J D Lewins, P D Potter and Prof N G Walton, contributed to the above, and the signatories wish to thank them for their time and enthusiasm.

Phasing out Britain's nuclear power stations

Stephen Fothergill
Coalfield Communities Campaign
64pp. £10.00

This is the second special report sponsored by the Coalfield Communities Campaign. The first was on the retraining of redundant miners.

This report was produced as a result of an analysis carried out by Stephen Fothergill of the University of Reading. It assumes that a policy of detachment from nuclear generated electricity is pursued and analyses the effects on the electricity supply and the coal industries. The report even assumes for some strategies that the political purists pursuing this 'no nuclear' policy require the elimination of the mainly nuclear electricity imported from France. This certainly represents an extreme case situation for the analysis.

While the report cannot be regarded as an objective source of information on the subject, it is helpful in spelling out at least some of the consequences of pursuing a policy of reducing to zero Britain's nuclear installations. The report has published information that has come mostly from the CEGB Sizewell submissions and more recent data from them.

As the report has, by its nature, to interpret the data in favour of the coal industry rather than the electricity power industry, the material has been compared with the wholly independent publication by the Joint Energy Programme on Electricity Supply in the UK, written by Richard Eden and Nigel Evans. Comparisons are somewhat difficult as the scenarios for the future in the two reports are different, but as far as can be judged the main figures in the Reading University analysis are reasonable.

The report assumes five different nuclear 'phasing out' strategies, from an immediate shut-down of all nuclear generating plant by 1990 to just letting nuclear plant run until its 'working' life is complete. In this context it is interesting to note that the Americans claim that a PWR would have an operating life of 50 years. This is not altogether relevant as all the scenarios considered assume that the Sizewell B PWR is not built. The report assumes 30 years life for the AGR's.

The electricity industry's future installed capacity depends on the prediction of electricity demand, the planning margin necessary to ensure that the demand is met reliably, the amount of electricity that can be drawn from other sources (France and SSEB as far as the CEGB is concerned) and finally the extent to which storage schemes can be brought into use. Major installations take five to 10 years to bring to full power so new construction ordered now can only produce electricity in the late 1990's.

The section on the way that the capital cost of the unused nuclear power stations affects the cost of power seems to be somewhat superficial. About two thirds of the cost of nuclear electricity con from the capital and interest charges. the decision to close the stations political it is unfair to impose the cost the electricity price. But then ex charges to the Exchequer from this sou will not be welcomed by a Government any political persuasion.

This report challenges, with figu based on the CEGB's own data, the m statements made by Lord Marshall, a other senior officials, on t impractability and cost to the electric consumer of a non-nuclear policy. T author claims that a policy of phasing nuclear power before the end of century, replacing it with extra coal-fi stations, extra coal mining capacity w perhaps some extra imports is practic The cost would not be formidable eit in capital investment or in increas electricity charges. However, electric prices that are even five to 10% hig than really necessary can be considerable burden on a British indus that is trying to compete in both Brit and world markets. The claim is that extra jobs in mining will approximat balance the loss of nuclear jobs.

However one feels about the merits nuclear power, it does seem to be at le economically unwise to build facilit and expertise and particularly technically advanced areas, and th throw them away on the basis o political decision.

Moreover the professionals who r our electricity industry would f incompatible with virtually the whole the industry dependent on one fuel, co that is run by a monopoly supplier a manned by a workforce which in the p has periodically precipitated industr action. It is also an industry wh whatever the long term prospects ha number of years of further reduction demand in immediate prospect.

There is an extra technical issue some political and environmen importance. The reduction in the level the total nitrogen and sulphur oxides a other emissions from British pow stations is considerably assisted by t extension of nuclear power. Increasi the use of coal will inevitably lead to t need for a much larger investment equipment to control emissions in existi plant. This is an extra charge not cover in this analysis and the practicability achieving acceptable standards and t cost effectiveness of extending the life old plant under these conditions requi evaluation.

However the report presents data a arguments which throw some doubt the CEGB published stance and w doubtless provide useful ammunition f politicians and pressure groups interest in reducing the nuclear commitment. T particular virtue of the report is that mu of the information is useful for those us with a more detached view on t subject.

N G Worley

Coke Oven Managers' Association yearbook 1986

323pp.

The 1986 edition is the 67th issue of the COMA yearbook. It contains several of the technical papers presented before the three sections of the Association during the 1984/85 session.

During the last decade there has been a considerable contraction in the number of coke ovens in Great Britain. The yearbook contains a list of the plants currently operating, showing the number and type of ovens, annual capacity of coal, by-products recovered and other local information.

An important part of the text includes the various transactions, there being 12 in all, including the annual addresses of the Association's three chairmen. The other papers presented are of a very high technical standard. Dr J Dartnell produced a thorough review of the cokemaking industry of the European Coal and Steel Community countries. The paper compares age, size and performance of BSC coking plants and the quality of product with that of its European competitors.

The demise and rebuilding of the Redcar coke ovens is examined in a paper by Mr Watson and Mr J Carr (1985/86 president of COMA).

The crème de la crème of the papers is the reprint of the 17th Carbonisation Science lecture: *Carbonisation in the UK — a research view* by Dr Dainton (director, Coal Research Establishment). The papers review the general market situation and a number of technical topics, many of them well known and then defines the useful objectives of research both now and in the future, from the point of view of the UK coal industry.

I have only one criticism of the yearbook — the old-fashioned style of presentation. Surely the editorial committee of the Association could redesign the yearbook so that it reflects the high-technology of a modern industry and not its pre-war predecessor. I consider that this yearbook should be invaluable to anyone concerned with the industry and will prove to be a practical book of reference.

Andrew W Cox

Publications received and noted

Energy efficiency and local authorities — a good practice guide
National Housing and Town Planning Council

lfter Industry Year
Higher education

he relationship between higher ucation and industrial success is pecially important to this country: while dustry provides the resources, ideas and ople, universities, polytechnics and her colleges of higher education fuel ccessful company development. The terchange between industry and higher ucation has been described as 'the otor of the modern industrial onomy.'

Higher education packs, similar to evious *Industry Year '86* publications, e now available. Written for industry ey include examples of student projects, aff development, professional and chnical advice, joint research, re-aining schemes and small business velopment. Copies are available from: dustry Year, 8 John Adam St, London C2N 6EZ.

The Committee of vice-chancellors and incipals published *Universities work for dustry* in November. The brochure scribes some of the services universities ovide for industry and lists the dustrial liaison contacts in every iversity in the country.

The brochure's purpose is to encourage mpanies of all kinds, but particularly all and medium sized enterprises which not have large research development d training facilities of their own, to buy the services they need from their local iversity or a university with special pertise in their area.

Copies are available from the niversities Information Unit, 29 vistock Square, London WC1H 9EZ l: 01-388 0887.

urce: Industry Year News

EC
ncouraging innovation

all and medium sized enterprises MEs) within the EEC should be given ecial treatment to encourage them to novate and make the most of new chnologies, says a report by the onomic and Social Committee. The mmission, it suggests, should look ain at the problem of financing and rticularly at its proposal, developed in 83, for a European innovation loan heme, reports the *Financial Times.*

Additionally, says the report, 'the mmission should review the portunities to provide a credit arantee association at Community level encourage research and development SMEs in certain advanced hnologies. The Commission should o consider the need for low cost loans encourage investment by SMEs in the est technology — either by loans ough the European Investment Bank by providing a Community subsidy channelled through the banks at member state level.'

The report reckons that one of the fundamental causes for the current low level of technological awareness and exploitation stems from as fundamental a weakness as the standard of primary and secondary education. 'Early education which motivates its people away from technology and away from industry will wreck the university technology system which has developed in recent years to increase the transfer of state of the art technology to industry.'

Member-state governments, it is suggested, can play their part in encouraging technology transfer by supporting an efficient national standards institution charged with ensuring that there are modern standards and codes of practice in all relevant industries.

Big business and other large organisations have their part to play. Their behaviour towards SMEs is vital in encouraging small businesses in all areas of technology. 'This is too important to be left to free enterprise. Governments need a definite policy to ensure a mechanism to prevent SMEs from always being swamped by larger companies.'

SMEs would best be served 'if each member state had a minister responsible for science and technology. Relevant council meetings of such ministers could be held to speed the development of the European Technological Community.'

Source: Financial Times

Europe
New energy strategy

In a new energy strategy for the future the twelve European Community nations have agreed that Community oil consumption should be kept down to around 40% of total energy consumption in 1995. They are determined to reduce the Community's dependence on imported oil and the new figure is a perfectly feasible target for a number of reasons.

Oil's share in the Community's energy mix had already fallen to 45% in 1985, as compared to 61% in 1973. Equally important is the fact that the Community has succeeded in breaking the link between energy consumption and economic growth. Its total energy consumption fell by over 6% between 1973 and 1983, although its GDP grew by over 18% during the same period.

Holding down oil consumption to around 40% would allow the Community to keep its net oil imports to less than one-third of its total energy consumption. Thanks to a sharp rise in the use of natural gas, and a fourfold increase in nuclear electricity production, imported oil accounted for only a third of total energy needs in 1983 — as against two-thirds some 10 years earlier.

But the long shadow of Chernobyl has fallen on the Community's energy objectives for 1995. When they were first drafted by the European Commission over a year ago they included;

- ☐ a reduction in the proportion of electricity generated from oil and natural gas to less than 10%
- ☐ an increase in the production of nuclear power to roughly 40% in 1995.

The EC Council of Ministers agreed last year to reduce the proportion of electricity generated from hydrocarbons to less than 15% in 1995. The target for nuclear power has disappeared altogether. The emphasis is on the need to ensure that all aspects of planning, construction and operation of nuclear installations fulfil optimal safety conditions.

The new energy policy objectives also call for the development of new and renewable energy sources, including conventional hydroelectricity, to be maintained. There is to be a more determined attempt to disseminate results and reproduce successful projects. The Commission had proposed that output be tripled before the end of the century — from an estimated real contribution to the Community's energy mix of some 15 (Mtoe) in 1985 to 40 or 50 Mtoe in the year 2000. But the Council has settled for 'a significant contribution'.

The new objectives replace those adopted some 16 years ago for the year 1990. A review carried out by the European Commission last year showed that the 1990 objectives were almost certain to be achieved.

Source: Community News

Sweden
Meteorite gas

The handful of sexagenarians who make up the population of Gravberg could be excused for thinking they have tinnitus. However, the round-the-clock humming in their ears comes chiefly from a 56m highdrilling rig just down the road from this sleepy village in central Sweden, reports the *Financial Times.*

Protruding above the fir trees, the rig has been in place since the summer, drilling for natural gas a few kilometres down.

It is hoped that the drilling will lead to the discovery of as much as 800bn m^3 of gas, and so provide the answer to most of Sweden's energy needs for the next few decades at a time when the country still has to decide how it will cope after the planned closure of its 12 nuclear reactors.

Oil exploration started in the area in the nineteenth century, but it proved to be a fruitless search, prolonged by cunning labourers who — according to local legends — were not averse to topping up the drill holes with their own oil to keep their employers interested in the project.

The latest bout of exploration had a more scientific grounding, although there are some sceptics who consider the hunt

for gas something of a wild goose chase and its devotees akin to flat earth fanatics, chiefly because the geological conditions in this part of Sweden are not those usually associated with twentieth century gas drilling projects.

Geologists believe that a 2 km wide meteorite crashed into central Dalarna about 360M years ago, leaving behind a crater 30 km across. Today, the rim of the crater is easily visible and the depression is marked by a chain of lakes, the Siljan ring.

According to Professor Thomas Gold of Cornell University, the Siljan ring could be the site of natural gas. He believes that gas may come from a source deep inside the earth, not just from the decomposition under pressure of plants and animals.

His 'deep gas theory' suggests that methane has been formed and released in the inner region of the earth, subsequently migrating to the crust and seeping through cracks such as those formed when a meteorite hits the earth.

The scientists now think that there must be a source of gas deep down where the meteorite cracked the earth's crust and caused an upsurge of gas, with a reservoir above containing large quantities of gas which can seep upwards through the cracked rocks, and a sort of cap just below ground level which prevents the gas from escaping into the open air.

Any gas found would be used mostly for industry in the production of heat and power, and for the district heating system.

The original plan to drill to a depth of 5 km has been changed and the drilling will now continue to a depth of 7.5 km, possibly by next February when the funding is due to run out.

Drilling has already encountered problems: at a depth of 4 km, the rock is tending to cave in and has to be cemented so that the walls of the drilling hole stay firm. But if nothing else, the project has at least put Gravberg on the map. Tourism escalated during the summer months, with people turning up in the middle of the night to see the drilling rig.
Source: Financial Times

Code of practice For road tank vehicles

A code of practice for road tank vehicles equipped for bottom loading and vapour recovery has been prepared by the Institute of Petroleum Marketing Sub-Committee and its Bulk Storage and Conveyance Panels and is complementary to the IP Marketing Safety Code (Model Code of Safe Practice, Part 2) 1978 and Road Tank Wagon Design Code.

The increasing requirement for bottom loading and vapour recovery systems in Europe has dictated a need for an Institute of Petroleum code of practice to ensure, where necessary, uniform and compatible standards of equipment.

This code of practice is based to a great extent on API Recommended Practice 1004 for which the Institute of Petroleum acknowledges its debt to the American Petroleum Institute.

Amendments to the code will be issued by the Institute as considered necessary and users are invited to send comments or suggestions for improvement to the Secretary, Marketing Sub-Committee, Institute of Petroleum, 61 New Cavendish Street, London W1M 8AR. Copies of this Code are available from The Institute of Petroleum at a cost of: £5.50 (UK and Europe) £7.50 (Overseas). Orders for copies should be sent to Mrs J J Etherton at The Institute of Petroleum. Orders will only be despatched if accompanied by the correct remittance.
Source: Institute of Petroleum

Fuel for ships Major research programme

The £1 M second phase of a major marine fuel research programme initiated by Lloyd's Register of Shipping is now under way, with the active participation of some 20 major European companies and funding from the EEC Commission. The project, which is designed to make a major practical contribution to the reliability and efficiency of shipboard machinery, will take two years to complete.

The main reason for this research is the variable quality of residual fuel oils available for bunkering. Based on refinery cracking processes, these fuels are commercially available blends made from primary and secondary processed stocks to no rigorous specification. Consequently, marine engines must adapt to the variable quality of these fuels.

Phase one, which has already been completed, was mainly concerned with the characterisation of residual fuels. The second phase has two main objectives. The first is to develop an integrated diesel engine simulation capability for predicting enigne performance with variable quality fuels.

Results from phase one of the programme have already indicated that considerable savings in fuel consumption can be made by optimising combustion. Accordingly, the second objective is to use the engine simulator to design a new fuel management system. This will automatically control such engine operating variables as injection flow rate and timing, charge air temperature, turbocharger characteristics, and so on, to optimise performance and reliability in relation to specific fuel classes.

Compatible testing will be undertaken on a wide range of production engines. These tests will be aimed primarily at defining the degree of gain in fuel economy as well as establishing possible reductions in the detrimental effects of residual fuel combustion by increasing operating parameters beyond the present limits.

The effect of lubricants on deposit formation attributed to specific grades of residual fuel oil and the aspects related lubricating oil contamination degradation will be investigated at t Institut Francais du Pétrole.

The effect of fuel combustion on we rates, and to a certain extent combustion and corrosion, is related the degree of fuel treatment. Newcas University will test different treatme configurations with an appropria matrix of test fuels.

The results from all the experimen work will be incorporated in t development of the central Diesel Engi Fuel Oil Simulator at Lloyd's Regist Complementary work in the engi simulation code will be undertaken Athens Technical University for lo stroke slow speed diesels. Further, mathematical model of the injecti system and the spray interaction with t combustion representation will developed by Southampton Institute Higher Education. Control aspec related to variable engine settings variable geometry turbocharger settin injection timing and charge a temperature) will be developed at Ba University.

In parallel to the analytical wor development testing will be undertaken establish the feasibility and limitations the application of engine control syste Two main sub-systems will investigated: a control system based injection (Newcastle University), and o based on turbocharging (Ba University). In both investigations t optimisation control systems will validated by testing a minimum of fo fuels.

A typical application of the final fu management system and simulatio model would be in an advanced engi monitoring system. Such a system wou require detailed information on variab quality fuels and their effects to enab performance monitoring an optimisation to be incorporated.
Source: Lloyd's Register of Shipping

Scapa oilfield Brings total to 32

In November last year Mr Ali Buchanan-Smith, Minister of State f Energy inaugurated the £120 M Sca offshore oilfield. Scapa brings the tot number of North Sea oilfields production to 32.

Speaking in London at t inauguration ceremony, Mr Buchana Smith described the Scapa project as o of the North Sea's most sophisticat subsea oilfield developments. He sai 'While much is being made about t effects the lower price of oil is having the industry, we must not lose sight of o achievements and our prospects. Scapa one of the new generation of North S oilfields. Its design is innovative a efficient and it focuses world attenti once again on the fact that the UK lea the world in offshore subsea technolog

'The UK's share of the contracts w exceptionally high — a notab achievement in these difficult times

d the project was completed below dget. It has taken just 14 months to sign, construct and install Scapa's bsea production system — an pressive feat and one which brings eat credit to our offshore industry.'
urce: Department of Energy

ndonesia/Japan unt for coal

pan has agreed to cooperate in a joint nt for coal resources in Indonesia.
The agreement, signed by the Japanese vernment-run New Energy velopment Organisation (NEDO) and Indonesian Ministry of Mines and ergy, calls for collaboration in ploring for coal resources in three areas central Sumatra — Rokan (300 km²), renti (also 300 km²) and Sinamar (120 n²).
With Japan providing necessary chinery and equipment and technical istance, both sides will continue their nt hunt until March 1991 and will work t geophysical maps and development ns. They will select a promising coal ne out of the three candidate areas.
Japan, for its part, apparently also sees rit in the collaboration which could ke Indonesia an assured source of coal pplies in the future.
urce: SEAISI

lajor LPG contract

enty million tonnes of Indonesian uid petroleum gas (LPG) will be ivered to Japan over a 10-year period der the terms of a contract recently ned in Jakarta. The deal between donesia's state-owned oil company, rtamina, and seven Japanese firms kes Indonesia the largest supplier of G to Japan.
This illustrates once again the fact that countries can mutually benefit from commercial transaction where close ional ties provide incentives for reasing trade,' said Indonesian nister of Mines and Energy Subroto. Signed in mid-July, the contract cluded a year of negotiations. Its ms specify that, beginning mid-1988, donesia will supply Japan with 1.95 Mt LPG annually through 1998. This new lux of LPG will account for 70% of pan's total LPG imports. Similarly, the es to Japan comprise nearly two-thirds the 3 Mt of LPG Indonesia expects to port annually beginning in 1989.
The benefits to Japan are considerable. plained Pertamina president-director mly, 'Unlike Japan's other supply rces, LPG for these new contracts will ginate from natural gas reserves not ociated with oil deposits'. Because the e of this LPG is independent of the ctuations in crude oil prices, it will be sensitive to the market swings of oil. Diversification of Japan's energy port- o will also be a beneficial result of the G deal, noted Minister Subroto. And, lly, Indonesia has a long track record reliable supplier of energy products Japan, an important factor in providing economic security in the midst of the current erratic conditions prevailing in the energy markets.
Source: Indonesia Development News

British Gas... ...in Indonesia

British Gas has won a £2.5 M contract to help extend the use of natural gas in the Indonesian capital, Jakarta, and the cities of Bogor and Medan.
The contract is to assist the Indonesian state gas company, Perum Gas Negara (PGN). It has been fully funded through a bilateral aid grant from the United Kingdom Overseas Development Administration.
The company is to provide advice and support on all aspects of a planned six fold increase in the utilisation of natural gas in the Indonesian cities. The increase will be mainly in the industrial and commercial market, chiefly in Jakarta, which has a population of 6.5 M.
The work will involve everything from advice on strategic planning and corporate structure to help with management and financial systems as well as advice on computer software requirements. Technical support will involve advising on gas network analysis and design, agreeing specifications and codes of practice and helping with procurement and contract implementation. Assistance will also be given with training PGN staff, most of which will be carried out in Britain.
Total cost of the distribution projects in the three cities is estimated to be £45 M and the World Bank has agreed to provide a loan of approximately £24 M to help finance the project.
Source: British Gas

Gas industry Computerised training

A new £750 000 a year training scheme, using the latest developments in distance learning and computer based training, has been launched by British Gas to contribute towards their staff training needs.
Distance learning, embracing anything from printed matter to a computer program, allows staff to make use of a wide range of specially designed training packages, without having to attend an off-the-job course away from their normal location. Much of the distance learning material in the new scheme will involve computer technology. All the training packages will permit the individual trainees to study at the times most convenient to them and their managers, work at their own pace and call for extra help if they need it.
A team of 14 people are about to be recruited to work from a new centre in Hartford, Cheshire. It is hoped to begin providing the new systems this summer. The centre will respond to training requests from all parts of the company, designing, buying-in or adapting training packages to meet the company's needs.
Mike Hawes, manager, training development, organising the project, said: 'It allows us to make the most efficient use of training expertise at a time when technological and other changes are creating more and more demand for updating and new skills. Also managers and staff who do not think they have the time to attend a course can now tailor one into their schedule and complete it at their own pace.
'Distance learning, using the new technology, is also being improved by applying our increased knowledge about how people do learn. We also look forward to sharing our developing expertise with others through the sale of general training packages.'
The distance learning initiative was preceded by extensive testing using the new systems within the company, involving trainees aged from 16 to over fifty. Many had never used a computer before. Some 75% of all age groups taking part reported back enthusiastically that they would willingly use the proposed techniques.
Much of the new material will be on floppy discs, or will employ interactive video. Interactive video, a recent development, marries the use of video film with computing and allows the trainee to ask questions of the program. The new systems, using advanced graphics, colour and new printing techniques, will be attractive and easy to follow.
Source: British Gas

Explosive welding Solves leak problems

In heat exchangers there are very large numbers of tubes with their associated welds and in a working life of 25 years, some weld failure must be expected.
Tube plate weld failure in a nuclear reactor poses special problems. In conventional power plants mechanical or fusion welded plugs are used to overcome this. Nuclear plants demand a much higher degree of leak tightness in areas where access is extremely difficult — tube ends are often some 6 m from the nearest access point which is through a pipe only a 0.25 m in diameter. Consequently, it is difficult to achieve a satisfactory result by conventional methods.
A solution to this problem has been developed by Prof Bernard Crossland of Queens University, Belfast.* Prof Crossland has been carrying out experiments with welding techniques using explosives for a number of years. Explosive welding is brought about by a high velocity impact between two metal surfaces which creates a solid state weld at the impact point. A simple method to overcome the problem has been developed; it is based upon the insertion of a small explosive plug into the defective

In conjunction with Babcock Power

tube. The technique assures a precise application and the highest quality weld.

The first step was to produce a remotely controlled handling machine capable of a number of complex and varied tasks. The unit had to be flexible, compact, reliable and retrievable. The remote handling machine is an integrated unit with its own hoist to lower itself into the heat exchanger and carries a toolhead mounted on a manipulator which can reach any tubeplate hole.

The head is fitted with a range of tools to carry out the complete explosive welding process. Hole sensors and pressure transducer measuring heads identify and size the weld defect. A camera capable of rotating through 360° feeds back images on a closed circuit television screen. Thermostatic switches give an alarm and de-activate the camera in extreme temperatures. To prepare the surface for welding rotating emery hones are used, before pick-and-place claw grabs locate the explosive plug. After the explosion a vacuum cleaner removes debris and a leak test head checks the integrity of the welded plug.

All of the machine's functions, with the exception of tool changing, can be performed from a remote control console. The operator views the tube plate and tools on the television monitor, the measuring head gives full information read-outs and joy stick controls operate all movements at the toolhead. Safety circuits and interlocks ensure that all functions must be carried out in a correct sequence and, should the machine encounter an obstruction or there is a total loss of power, a manual overdrive ensures that the unit can be retrieved.

Explosive plugging in nuclear heat exchangers has three important advantages over other methods: firstly, the energy for effecting the weld is incorporated within the explosive plug itself; secondly, the technique results in an extremely clean weld without creating crevices which can lead to corrosion problems later. Finally, with the introduction of the remote handling machine, weld preparation and the placing of the plug has become a quick and simple matter.

Source: Babcock Power

Malaysia
World Bank project

Two World Bank assisted projects have been approved for Malaysia. One is to improve energy efficiency; the other to provide capital for 50 to 60 subprojects in manufacturing, transportation, tourism and commercial agriculture.

The first project involves a $100M bank loan to be used for energy efficiency and plant rehabilitation.

The project emphasises improving the efficiency of thermal power stations, replacing oil with natural gas as the primary fuel for power generation, introducing a more effective maintenance management system for thermal and hydropower plants, bringing the transmission system operation and control, and furthering institutional capabilities.

The project, which has an overall cost of $180.5 M and to which the National Electricity Board of the States of Malaysia (NEB) is providing $80.5 M, is expected to result in significant fuel savings, increased capacity, and greater transmission reliability.

Source: World Bank News

Egypt
New oil field

Oil production has begun in the Salam field in Egypt's western desert.

Oil will be pumped to terminal facilities at El Hamra, Egypt, on the Mediterranean coast via a 16 inch, 110 mile pipeline.

The Salam field is part of a $120 M development which began 16 months ago. It is within a 500 000 acre concession 50 miles south of the Mediterranean and 200 miles west of Alexandria, Egypt.

Current production from Salam is being processed through temporary facilities while permanent equipment is installed at the Salam field. Salam will have 14 producing wells, seven injection wells and three water source wells when fully developed.

Related construction underway includes 30 miles of road, an airstrip, storage tanks, offices and living quarters and associated support equipment for 110 people.

Eight rigs are presently in use in an active exploration and development drilling programme on the concession.

Source: Conoco

Battelle
Energy saving software

Innovations in computer software developed at Battelle's Pacific Northwest Laboratories are saving time and money in energy conservation studies for the Bonneville Power Administration.

The software is one of several expert systems being developed at Battelle. Expert systems are computer software programs that combine human-expert knowledge and artificial intelligence programming techniques to solve problems that are generally too complex for conventional computer technology.

Unlike traditional computer programs, which use fixed procedures to perform primarily numeric computations, expert systems use a more flexible approach in applying problem-specific know-how to draw conclusions and recommend solutions. Expert systems can usually explain the line of reasoning if questioned by the user, allowing the user to see how program conclusions are reached.

This emerging software technology can offer solutions to complex commercial problems such as data interpretation and integration, design and process planning, modelling and simulation, operations management and may also be used in autonomous intelligent systems.

This particular system is curre being used to verify that ene monitoring equipment is being corre installed at nearly 600 residential commercial buildings throughout Pacific Northwest (USA). The Log Verification Assistant system diagn installation problems and recomme corrective action.

Engineers have developed data-log devices to help study energy conserva and identify how residential commercial consumers use electric The microprocessor-controlled d loggers are being installed as part of end-use load and conservation assessm program.

The loggers are programmed measure and record electri consumption for more than 50 indivic uses as well as to collect data on ind and outdoor air temperatures, humid wind speed, wind direction and so flux. Data are recorded and transmit via telephone lines to a central compu at Battelle in Richland, Washington, analysis.

The system uses a 'knowledge ba which consists of a series of compu 'rulebases', to review both a si installation configuration and a sampl the data collected by the logger. group of rulebases determines w problems, if any, exist at the installat site and suggests probable causes. second group of rulebases, wh contains information about the goals priorities of the system, analyses potential problems and recomme corrective actions. Finally, a series reports are produced which document resulting problems and corrective actic along with the reasoning that leads to recommended corrections.

Insulation
Gets bigger grants

Proposals to extend bigger loft insulat grants to more low income househo have been welcomed by the cha Neighbourhood Energy Action.

Commenting on the Governmer proposals to extend 90% loft insulati grants to all people on housing ben and supplementary benefit, NEA chairman Lord Ezra said: 'We welco this recognition by the Government t all households on means tested bene need extra help with loft insulation co We hope that they will extend this gr to cover draughtproofing costs for same households, when the current gra for draughtproofing end in 1988. T money being saved by reducing the l insulation allocation from £23 M this y to £15 M next year could clearly be u to do this. Our network of 350 proje is now insulating 150 000 homes ea year and as a result making elderly a disabled people and low income famil much warmer. These grants are essen to enable such work to continue — wo which also provides employment for o 6000 people.'

Source: Neighbourhood Energy Acti

ew gas-fired infrared enerator

new type of gas-fired infrared nerator has been introduced by **ordy Combustion Engineering.** his has a high conversion of gas atural gas, LPG) to infrared ergy: it is claimed that the overall nversion of gross combustion ergy to infrared energy is up to %, which can be double the nversion rates of other types of rared generators including radiant be, direct-fired refractory, porous d perforated refractory and talytic oxidation generators. The stem has been used in a wide range applications involving heating, ring and drying.

eader enquiry no 2/1

il processing system -designed

idland Combustion have re-signed their MIDPAK fuel oil etreatment package system for dustrial and commercial heating. ie new design is more compact minating any chance of uncovering ating elements and ensuring the aximum use of tank volume.

MIDPAK is a self-contained oil ocessing system. Duplex pumps ercome gravity feed problems used by tank location and make re that the burner is constantly well med. Outflow heaters and oil ers prepare and present the fuel oil the burner or ring main in the right te. Temperature and pressure ntrol and isolating valves are built MIDPAK also serves multi-tank tallations with the simple addition outflow heaters in subsidiary lines.

eader enquiry no 2/2

ew Czechoslovak variable eed electrical drive

new Czechoslovak variable-speed ctrical drive designed to drive the mpressors of the CMEA countries' g-distance gas pipeline is replacing gas turbines which have been used to the present. Manufactured by KD Praha's Elektrotechnika tory and exported by **Pragoinvest,** manufacturers claim that in mparison with the gas turbine the ctrical drive has a considerably her efficiency, several times longer vice life and offers the possibility fully automatic operation.

The 25 MW unit consist of a VHT nsformer, a thyristor converter d a high-speed electric motor and ering compensation plant. A ecial four-winding VHT nsformer transforms a three-phase mary voltage of 110 kV (and/or kV) into a six-phase voltage of 5 kV fed into the thyristor verter by means of two secondary dings. The third secondary ding feeds the filtering compen-ion plant. In the thyristor verter the constant frequency of supply mains of 50 Hz is verted into a variable frequency m 0 to 25 Hz by which the speed he six-phase synchronous turbine tor is controlled.

nitially this new unit will be plied to the whole newly built 4 nch of the Czechoslovak transit em as well as to a number of gas eline compressing plants in the SR. It can also be used anywhere n an infinitely variable speed

Specially designed Mogensen sizer

Specially designed Mogensen sizer for screening granular coal

A specially designed Mogensen sizer, in the form of an adaptation of a standard Model 1536 3-deck 1.5 m machine, has been successfully commissioned from **Mogensen Sizers** by Lurgi (UK) to handle granular coal in a fuel cost-saving scheme for the British Steel Corporation.

Installed in the new coal preparation plant to feed blast furnaces at the BSC Scunthorpe plant, the Mogensen handles a throughput of 30 tph, extracting 28 tph of −2 mm fines from the product of the crushing and drying process (the oversize being recycled to the grinder). The fines are subsequently air-injected into the blast furnaces.

The Mogensen machine is specially adapted to combat explosion hazards. Internal dust build-up when the sizer is stationary is minimised by designing out ledges, protrusions etc. The sizer is also connected to an explosion duct which is fitted with a safety bursting panel venting to atmosphere.

Reader enquiry no 2/4

control at a high efficiency. It is possible to extend the control range substantially according to need.

Reader enquiry no 2/3

New production facilities for manufacturing optical fibre cable

ASEA KABEL have inaugurated new production facilities for the manufacture and testing of optical fibre cables. The new plant has a production capacity corresponding to 10 000 km of optical fibres a year. By their investment in the new plant, ASEA KABEL are making the company one of the most advanced manufacturers in this area in Europe today. Optical cables with both multi-mode and single-mode fibres are currently being manufactured. Optical fibre cable technology has experienced a significant breakthrough in recent years and the market is expected to grow at an annual rate of 50%.

Reader enquiry no 2/5

Perkins generating set engines uprated

Perkins Engines have boosted their range of generating set diesel engines in the higher power categories with a series of uprates and developments to existing enignes.

The most powerful is the *DV8-600G,* introduced last year at 50 Hz (1500 rev/min) and now available at 60 Hz (1800 rev/min) for both continuous and standby operations. This eight-cylinder vee-configuration engine, which previously offered a maximum of 825 kVA (660 kWe) at 50 Hz, now offers 913 kVA (730 kWe) at 60 Hz (1800 rev/min) for standby duty. The continuous rating is 830 kVA (664 kWe) at 60 Hz and 750 kVA (600 kWe) at 50 Hz. When introduced last year, the DV8 represented a 20 per cent power increase over the DV8-500 engine previously available.

Reader enquiry no 2/6

Automatic CO/O_2 boiler trim control

The application of automatic combustion trim control in boiler plants of all sizes results in a significant conservation of energy. It is estimated that 90% of the savings available can be achieved using *excess oxygen trim control.* Excess oxygen measurement is an effective method of estimating the amount of excess air in the combustion process, since oxygen in the stack gas is directly proportional to the level of excess air. Zirconium oxide *in situ* O_2 sensors provide direct, maintenance-free measurement of the stack oxygen levels and give a continuous measurement of excess oxygen in the products of combustion.

There are however drawbacks. Any air leaking into the flue can cause inaccurate measurements as can changes in the burner efficiency. While excess oxygen trim control will maintain a constant air/fuel ratio, it will not measure the combustibles that are a direct result of inefficient combustion.

CO measurement offers an additional means of saving energy by providing an indication of combustion conditions, independent of burner operation and air leakage. It can also signal when burner maintenance is required.

Westinghouse have developed a combustion trim control system based on both oxygen and carbon monoxide sensors. The *TC-910* uses the CO sensor as the main control signal. A CO setpoint is established and excess air is trimmed based on the measurement of the CO variable. The highly sensitive CO output is damped to control the trim within certain limits. If these limits are exceeded, then control is passed to the excess oxygen controller until CO returns to normal.

The TC-910 is based on the Westinghouse solid-state oxygen sensor and a Model 620 infrared CO analyser, under the supervision of the Model 1500 microprocessor-based controller. This package has automatic combustion trim control that results in significant energy savings. It is claimed that it provides a payback within two years and often within one year — depending on the size of the combustion process and its original efficiency.

Reader enquiry no 2/7

Relay isolation unit

Instech have announced the introduction of a relay isolation unit, known as Chatter Box. The unit has been designed for intrinsic safety and carries the BASEEFA certification number Ex86B2470.

Chatter Box is designed to interface between a battery-powered gas volume flow corrector and a gas user's energy management system by converting incoming pulses from a corrector into 'isolated' volt-free contact closures for a gas user's system. A jumper link also allows pulses to be input directly from a standard gas meter thereby eliminating, for certain users, the cost of installing a corrector.

Chatter Box is a four-channel unit. However, one input may be connected to give up to four isolated outputs by means of a number of jumper links provided, eg a possible configuration is two inputs connected to give two outputs per input. The unit operates from self-contained batteries that last for over a year.

Reader enquiry no 2/8

Trade publication

Products for the heating and process industries. A new eight-page corporate brochure has been published by **Nu-way,** a manufacturer of oil and gas burners. This includes a review of the wide range of products developed for the heating and process industries. The brochure traces the history of the company since 1932 and its growth into an important international organisation serving over 70 export markets with joint venture operations in Australia and Japan together with licencees in New Zealand and India. Nu-way have been a member of the Wolseley group since 1960 and manufacture a wide range of gas, oil and dual-fuel burners with rated outputs from 15 to 11 000 kW.

Reader enquiry no 2/9

ENERGY WORLD — COMMERCIAL
(Photocopy acceptable)

Please send me further information against the reader enquiry no(s) listed below (please tick)

2/1 2/2 2/3 2/4 2/5 2/6 2/7 2/8 2/9

Name .....

Address .....

.....

Organisation .....

Branch report — North-Eastern

Dinorwig Pump Storage Scheme

The November meeting of the North-Eastern branch (in conjunction with the Institution of Electrical Engineers) was held at the Cleveland Scientific Institute, Middlesbrough. The main item of the evening was a talk given by R H Pope on the Dinorwig Pump Storage Scheme (DPSS) which is located in the Snowdonia National Park, North Wales. Mr Pope is currently working at the CEGB Generation Development and Construction Division, Barnwood, specialising in ergonomics.

The audience were introduced to the subject by an excellent video which had been used as part of a recently successful sales campaign by the CEGB in China. The Board had recently won contracts for a PWR nuclear power station and a pump storage scheme similar to that at Dinorwig.

The scale of the engineering work involved at Dinorwig was illustrated by the use of many interesting slides which supported the presentation. The figures for construction and output of the DPSS were particularly impressive.

The audience were told that at a cost of £425 M and with a workforce of 2700 the whole scheme was completed inside seven years. During this time 16 km of tunnels were driven, some 12.5 km of which were concrete lined. Also the excavation of the main machine hall which houses the generators required the removal of 250 000 m^3 of rock, making it the largest underground excavation in Europe.

The construction work was not without problems. The initial tunnel driveage had to be abandoned due to roof collapse resulting in the loss of a mobile drilling rig. The upper reservoir was also enlarged to hold 7 M m^3 of water — this involved the construction of a dam 600 m long, 60 m high and lined with 52 000 m^3 of asphalt.

Mr Pope also pointed out that Dinorwig is capable of producing 1320 MW of power from its six turbines in 10 seconds and sustaining this output for up to five hours. The speaker concluded by saying that the project was completed to schedule and should start making a profit in 1994. It also caused little environmental disturbance to the National Park. The CEGB have therefore produced an invaluable source of energy for the United Kingdom which has satisfied both economists and conservationists.

The meeting was closed after Mr Burbage-Atter (vice-chairman, North-Eastern branch) gave a vote of thanks on behalf of the Institute of Energy.

Colin Johnston/Andrew W Cox

Personal

We reported briefly in the January issue (p 24) that **J G Collier** had been appointed chairman of the United Kingdom Atomic Energy Authority. On taking office, Mr Collier said that he saw the Authority as 'the vehicle the Government has chosen for continuing the further development of nuclear power in this country'. He also saw the UKAEA's new status as a 'trading fund', with tough financial targets as applied to all nationalised industries, as a particular challenge for an R & D organisation which undertakes a significant amount of basic research as well as customer-orientated R & D.

Mr Collier started as a 16-year old Harwell apprentice in 1951, graduated in chemical engineering in 1956, and rose steadily through the UKAEA, including a period in Canada and in industry. In 1983 he moved to the Central Electricity Generating Board as a director-general in charge of construction of power stations in England and Wales before returning to the UKAEA in November 1986, as deputy chairman.

The new chairman takes a special interest in young people and their perceptions of the nuclear industry. Speaking to new UKAEA graduates, he was surprised and heartened that neither Chernobyl nor the present adverse image of the industry had dampened their enthusiasm for working with the Authority.

MacQueen Air Conditioning have appointed **S D Dorrall** (Member) as technical director responsible for all technical sales in air conditioning products in Scotland and N Ireland. Mr Dorrall is honorary secretary of the Institute of Energy's Scottish branch.

Jim Crummie has been appointed as sales manager responsible for air conditioning and air handling sales in Scotland.

J R Kelsey (Member) has joined the Technical Consultancy Division of Salford University Business Services as senior consultant for Energy Technology and Conservation. He takes up this appointment following continuous activity in the field of industrial energy utilisation with several companies including Pilkington Bros, Hodgkinson-Bennis and Firsteel. He has been on the committee of the North-Western branch of the Institute since 1979 and was chairman in 1984/85.

P Mills (Fellow) has been appointed to the post of deputy manager, Industrial Sales and Services Branch, Marketing Department, British Coal, based in Hobart House. Peter Mills has bee active member of the Midland branc the Institute of Energy and was bra chairman in 1982/83.

D C Sales (Associate) was awarded place and a Certificate of Merit in 1986 Burmah-Castrol Awards for most original and constructive pap on the subject of *Energy conservation* Sales submitted his paper earlier in to the Institute of Engineers Technicians and he was presented wit award at the Institute of Engineers Technician's annual dinner at the Lor Hilton Hotel on 1 November 1986.

Mr Sales has been a consulting engi since 1984. He started his caree building services engineering in 1972 trainee engineer in general conditioning and refrigeration Ductwork Engineering Systems (Carrier UK). After holding positions Humphreys and Glasgow, the Service, and the Buro Happ Consultancy in Bath, Mr Sales wo for both consultants and contracto the London area before turn professional as a consulting enginee

New members

Fellow

Raymond Pow, Bechtel, Lon *(transfer)*

Member

Seung Mo Sammy Chow, China Lig Power, Hong Kong *(transfer)*
Peter John Islip Cross, British C Cheltenham, Glos
Gary Gordon Elliott, Babcock Ene London
Chak Yin Mak, Environme Protection Dept, Hong Kong *(trans*
Derek Beauman Smith, Intl Research Development, Fossway

Technician Engineer

Granville Alfred Rogers, Associated H Services, Manchester

Associate

Kevin David Hughes, British Telec Southend-on-Sea

Graduate

Steven Hugh Jones, Ocean Ene Services, Birmingham *(transfer)*

Student

Syed Suhail Akhtar, University Sheffield

Obituary

L FRANKLIN 1924-1986

rofessor N L Franklin CBE FRS FEng
gion d'Honneur BSc MSc PhD Hon
Sc(Leeds) FIChemE, a distinguished
ientist, who held many senior posts in
e nuclear industry over the past 30 years,
ed on 7 November 1986.

Norman Laurence Franklin was born 1 September 1924 and educated at itley Grammar School and Leeds iiversity, where he took first class nours in chemical engineering in 1945. e then joined the staff of the British oke Research Organisation as a chnical officer working initially at a uth Wales colliery. From 1945 to 1955 was assistant lecturer and later lecturer chemical engineering at Leeds iiversity.

In 1955 Prof Franklin entered the clear industry with which he was to be sociated for the rest of his career, rting in the Technical Policy Branch of e Industrial Group of the recently rmed United Kingdom Atomic Energy uthority (UKAEA). In 1958 he was ade technical manager, Chapelcross ring the reactor commissioning ogramme. After a period as deputy and en technical director of the Production roup at the UKAEA's Risley tablishment, Prof Franklin became clear fuel director in the same Group, sponsible for their commercial activities d for technical aspects of Magnox gas-oled reactor fuel elements. In 1963 he s made assistant managing director for clear fuels and, a year later, deputy naging director, Production Group, th particular responsibility for the oup's Technical, Commercial and Fuel ement Design and Inspection rectorates. In 1968, his work with the KAEA took him to London as special sistant to the chairman, co-ordinating tters concerning the structure of the clear industry. In the following year he ned the Board of the UKAEA as ember for production. On the formation of British Nuclear Fuels in 1971, Prof Franklin was appointed managing director and chief executive.

In 1975 Prof Franklin was appointed chairman and managing director of the Nuclear Power Co (the single organisation responsible in the UK for the design and construction of commercial nuclear power stations) and a director of the holding company. When these were combined into the single-tier structure in 1979, he became managing director of the new National Nuclear Corporation (NNC), remaining a non-executive director of BNFL until 1985 and on the Board of the AEA until his death. He retired from NNC in 1984 and took up a chair as professor of nuclear engineering at Imperial College. He also joined the Board of AMEX, the London-based construction company.

Prof Franklin was made an OBE in 1963 and a CBE in 1975. He was elected to the Fellowship of Engineering in 1977 and a Fellow of the Royal Society in 1981. He was president of the Institution of Chemical Engineers from 1979 to 1980. In 1986 he received the Institute of Energy's Melchett Medal. On this occasion he gave the 52nd Melchett Lecture: *Nuclear fuel — swords and ploughshares (Energy World,* May 1986).

Prof Franklin's career was somewhat unusual in Britain in spanning both academic and industrial life. He was the author of several books and many outstanding scientific papers on separation theory and statistics and maintained these scientific interests throughout his career.

In industrial life, mainly but not exclusively in the nuclear industry, he had an outstanding ability to foresee the necessity for and direction of technical change. An important example of this was his early support and guidance of the development of the gas centrifuge process for the separation of uranium isotopes at a time when most countries were adhering to the original energy intensive gaseous diffusion process. Following the technical success of this work, he played a major role in negotiating the tripartite agreement with Germany and the Netherlands in forming the international group URENCO to exploit the centrifuge process — one of the most successful international enterprises, both technically and commercially, in the nuclear industry.

He was involved in the establishment of United Reprocessors, a cooperative venture for nuclear fuel reprocessing with French and German partners. His enthusiastic role in promoting Anglo-French relations was acknowledged by his being made a Chevalier de la Légion d'Honneur in 1984. Also in Japan, a country of which he was extremely fond, and in which he was much respected, he had a long and successful association with their nuclear industry. He made a major contribution to the initial discussions which led later to the large Japanese contracts for nuclear fuel reprocessing in the thermal reactor oxide fuel reprocessing plant now being built at Sellafield.

He was an outstanding analyst of complex technical situations to which he applied a clarity of thought which was exceptional. A personal quality to which many of his colleagues are indebted was his ability to pass on his ideas and reasoning to people at all levels. He contributed powerfully to the public nuclear debate with formidable knowledge and unfailing good humour and courtesy — strongly supporting fuel reprocessing and advanced gas-cooled reactors.

Proud of his West Riding roots, he was a devoted family man and leaves a widow and a son and a daughter.

T N MARSHAM *(Fellow)*
Managing director, Northern Division, United Kingdom Atomic Energy Authority
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ew members ontinued)

ristopher David Armes, University of eds
ter William Bamforth, University of eds
afqat Ali Chaudhry, Polytechnic of les
ha Ahmed Dafalla, University of eds
arles Peter Dobb, University of Leeds
ed Mahmood Hasnain, University of eds
ristopher James Holland, University Leeds
rk Paul Webley Howell, University of eds
dreas Stylianou Ioannou, Middlesex lytechnic
Andrew Martin Ion, University of Leeds
Caroline Anna Ives, University of Leeds
Rihana Iahaq, University of Leeds
Dimitrios Katsiroubas, University of Leeds
Michelle Anne Knott, University of Surrey
Ernest Ping Yan Lam, University of Sheffield
Poh Hung Leong, University of Leeds
James Edward Leng, University of Leeds
Martin Patrick McCormack, University of Leeds
Ali Mukhtar Nurein, University of Leeds
Petrus Panaka, University of Sheffield
Stephen David Roser, University of Leeds
Piotr Slusarewicz, Polytechnic of Wales
Andrew James Webb, Polytechnic of Wales

Institute of Energy

1987 Branch conferences

Midland

29 Apr (W). One-day symposium: *The future of steam.* University of Aston in Birmingham.

1987 March meetings

Scottish

3 Mar (Tu). The case for waste heat recovery boilers, by Mr Ellerton (Senior Green). Royal Scottish Automobile Club, Blythswood Square, Glasgow at 1830 h (tea/coffee and sandwiches at 1800 h). Joint meeting with Institute of Hospital Engineering.

(continued on p 19)

53rd Melchett Lecture: London, 24 March 1987

The 53rd Melchett Lecture of the Institute of Energy will be given by *Sir George Porter* PRS, president of the Royal Society, in the lecture theatre of the Royal Aeronautical Society on Tuesday 24 March 1987 at 1730 for 1800 h. The title of Sir George's Melchett Lecture is: *Solar energy — past and future,*

London and Home Counties: March meeting

All are welcome on Thursday 19 March 1987 to hear *Dr David Lidgate* of UMIST speak on *Energy and the Institution of Electrical Engineers.* The meeting will be held at 1800 h in the Bernard Sunley Theatre of the Royal Institution, Albemarle Street, London W1. Tea will be served in the Long Library of the Royal Institution from 1710 h. AGM at 1730 h.

Attention all Sheffield graduates!

The annual dinner dance of the Sheffield University Chemical Engineering and Fuel Technology Society will be held on Saturday 14 March 1987, at 1930 h. The venue is the Cutlers Hall and the principal guest is *Sverre Steen,* a 1966 graduate, who is managing director of a/s FIBO, Lyngdal, Norway. For further information contact Mrs Valerie Patrick, Department of Chemical Engineering and Fuel Technology, University of Sheffield, Mappin Street, Sheffield S1 3JD (tel 0742 768555 ext 5252).

March/April courses

1. Computer aided thermal process optimisation

This three-day course will be held at the Institution of Chemical Engineers, 12 Gayfere Street, *London* from 24-26 March 1987.

2. Coal technology and utilisation

The *University of Sheffield* will be the venue for this course that will be held from 29 March-3 April 1987.

Further information on both courses from: Conference section, Institution of Chemical Engineers, Geo E Davis Building, 165-171 Railway Terrace, Rugby CV21 3HQ (tel Rugby (0788) 78214; tlx 311780).

British Wind Energy Association: annual conference 1987

The main object of the British Wind Energy Association, a professional body of some 500 members, is to encourage wind energy research, development and utilisation. The Association's most important platform is the annual conference. The 1987 conference will be held in *Edinburgh* from 1-3 April 1987.

Programme

The programme will contain papers on practical and theoretical aspects of wind technology. Topics covered will include: dynamics; aerodynamics; control; machinery; materials; monitoring; anemometry; components; hybrid system; applications; economics; future concepts. In addition, invited international speakers will give their overviews of t country's wind energy programme.

There will be an exhibition and visits to *Orkney* and to National Wind Turbine Centre at *East Kilbride.*

Further information from Jean Gult, chairman, Scot branch, BWEA, c/o Energy Services, 8a Somerset Pl Glasgow G3 7JT, Scotland (tel 041-331 1111).

Cast irons for thermal cycling applications: BCIRA group research product

Provision for more assured use of cast irons under conditi involving repeated thermal cycling is the object of a new gr sponsored research project announced by BCIRA. The wo which is planned to begin on 1 April 1987, also includes prospect of new alloy compositions to extend the range of of cast irons as a cost-effective route to solving a numbe advanced-engineering problems.

The planned research, which will be in two phases, quantify for design purposes the performance of both allo and unalloyed cast irons already available for use. It improve design and performance of engineering compone by enabling the engineer to select reliably the material m suited for particular applications. But it has a furt important implication for ironfounders and engineers: second phase will concentrate on the development of n alloy/heat-treatment combinations, promising still bet service performance and cost-effective solutions to emerg engineering needs where thermal performance is a prim concern. Several prospective approaches to seek n developments have been identified by BCIRA.

'Club' participation in the two-phase research projec invited, with membership being restricted to individ organisations who are producers or users of castings or w are suppliers of materials to the foundry industry. It anticipated that the project will run for 30 months. Fees exclusive participation in this research, with access to t results confidential for a period of 2 years from completi to members of the project group are £4850 for the first pha which will be completed within 12 months. The fees for t second phase will be approximately £6300. Participation in t second phase is conditional upon payment of full fees for t first phase.

Further information from A G Fuller, assistant director a research manager, BCIRA, Alvechurch, Birmingham B 7QB (tel Redditch (0526) 66414; tlx 337125).

Developments in valves and actuato for fluid control: call for papers

BHRA, the Fluid Engineering Centre, is to hold its seco international conference on this subject at the University Manchester from 28-30 March **1988.** Offers of papers invited.

As modern process, chemical and nuclear plants increasingly hazardous fluids at higher temperatures a pressures, the need for efficient and reliable valves becon more important. The meeting will enable system designe operators, manufacturers and researchers to discuss meth of improving valve performance and promoting better va selection and specification. Ways in which the valve indus can use techniques such as computer aided design and prod quality monitoring to keep pace with future developments, example subsea oil and gas stations, will also be cover Papers are invited on: developments in design; test facili

l standards; valve selection and sizing; operational blems including noise and vibration; reliability; intenance and inspection; and any other topics relevant to scope of the conference.
Further information from the conference organiser *(Valves)*, RA, Fluid Engineering Centre, Cranfield, Bedford MK43 J (tel (0234) 750422; tlx 825059).

ngineering trade mission to South East sia

dland Bank and the Engineering Industries Association are nsoring a trade mission to Thailand, Malaysia and lonesia from 3-18 July 1987.
Three days will be spent in Bangkok, before the mission ves to Kuala Lumpar for three working days and then to arta for the final four days. The two-week mission will be by Col W T Williams, director general, Engineering ustries Association. The mission has the encouragement the British Overseas Trade Board. The estimated basic vel cost is £1323. Midland Bank will contribute £500 vards the cost of each company taking part.
Companies wishing to receive further details and istration forms should contact Anna Small, export director, gineering Industries Association, 16 Dartmouth Street, ndon SW1H 9BL (tel 01-222 2367/9). The last date for eipt of completed registration forms is *Friday 3 April 1987.*

87 Powrmatic and NIFES National nergy Management Award

7 is the ninth year of the Powrmatic/NIFES National rgy Management Award. The competition, which receives cooperation and support of the Department of Energy, is igned to find the most effective energy programme and to ard its manager. It reflects a new impetus in the drive for re efficient use of energy by industry, commerce and local ernment.

A top prize of £1000 will be awarded to the national winner who will be selected, by a panel of independent judges, from regional winners who will each receive £50 and an engraved gold pen. A certificate of commendation will be presented to the winning companies. The national winner's organisation will hold the Energy Management Trophy for one year.
The competition is open to everyone responsible for the efficient use of energy — ranging from large energy management schemes to original individual measures implemented before the end of 1986. The judges will take particular note of the application of sound energy management principles and of the comparative size and resources of each entrant's organisation. Entrants in large and small organisations have an equal chance of winning.
Further information and entry forms from GKPR Ltd, Powrmatic and NIFES, National Energy Management Award, 60/63 Victoria Road, Surbiton, Surrey KT6 4NW. *Entries will not be accepted after the closing date of 1600 h on 1 June 1987.*

ITALGAS prizes for research and innovation

To celebrate their 150th anniversary, SOCIETA' ITALIANA per il GAS pA have established the *ITALGAS prizes for research and innovation* to be awarded each year, starting from 1987, to research workers and scholars of EEC countries.
Within the scope of the three fields of research covered by the prizes, the following subjects have been chosen for 1987: (a) physics; (b) energy sciences; (c) information systems. Candidates may be proposed by directors of scientific institutions, universities and research centres as well as by eminent scientists concerned with the relevant subjects, who can best assess the innovative importance of the results achieved by the candidates.
Copies of the prize regulations and any further information may be obtained from Prof Ing Vincenzo Ferro, Secretariat, ITALGAS, Via XX Settembre 41, 10121 Torino, Italy (tel 011-239.422.6; tlx ITALGAS 221595).
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nstitute news (continued)

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Mar 1987 (W). Second seminar with rliamentarians: *Energy policies and arket forces.* IMechE, Birdcage Walk, estminster. In association with the rliamentary Group for Energy Studies, stitution of Mechanical Engineers, itish Institute of Energy Economics, stitution of Electrical Engineers, and e Watt Committee on Energy.

idland

Mar (Th). The use of fluidised bed ilers and furnaces in British industry, Dr J M Topper. At the University of ton in Birmingham, Senior Common om at 1900 h.

orth-Eastern

Mar (M). Unleaded petrol, by Dr I rwick (director general, UK Petroleum dustry Association). Lecture Theatre, erz Court, University of Newcastle on Tyne at 1800 h (tea and biscuits fore meeting). Joint meeting with hemE.

rkshire

Mar (Tu). Deposits, corrosion and smutting with heavy fuel oil, by J Turner and P Hedges (Steetley Refractory, Hartlepool). Mansion Hotel, Roundhay, Leeds at 1930 h. Joint meeting with the Institute of Petroleum, Yorkshire branch.

East Midlands

12 Mar (Th). Fluidised bed combustor at Grimethorpe Colliery. Orgreave Social Club, near Sheffield. Joint evening meeting with COMA.

Northern Ireland

12 Mar (Th). Annual dinner. Culloden Hotel, Craigavad.

Merseyside

18 Mar (W). Energy savings through lighting controls. Speaker from ECS. Feathers Hotel, Mount Pleasant, Liverpool 3 at 1830 h.

London and Home Counties

19 March (Th). Energy and the Institution of Electrical Engineers, by Dr David Lidgate (UMIST). Royal Institution, Bernard Sunley Theatre, Albemarle Street, London W1 at 1800 h (tea at 1710 h). AGM at 1730 h.

National

24 Mar (Tu). 53rd Melchett Lecture: *Solar energy — past and future,* to be delivered by Sir George Porter PRS (president, Royal Society). Lecture Theatre, Royal Aeronautical Society, Hamilton Place, London W1, at 1730 for 1800 h.

South Coast

25 Mar (W). AGM. British Gas Social Club, Southampton at 1900 h. Details to be announced.

Yorkshire

28 Mar (Sat). Annual dinner dance. Cairn Hotel, Harrogate at 1915 for 1945 h.

North-Western

March. To be arranged.

Midland

March. Dinner and social evening. Birmingham Chamber of Commerce.

South Wales and West of England

March. Young People's Night. Three student papers.
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CONFERENCES

The following conferences, courses and meetings are organised by bodies other than the Institute of Ene
For Institute conferences please see inside front cover

March 1987

Leipzig Fair

Leipzig, GDR, 15-21 March 1987.
Details from Leipziger Messeamt, Postfach 720, Leipzig 7010, GDR (tel 71810; tlx 512294).

Energy from biomass and wastes

Conference XI, Orlando (FL, USA), 16-20 March 1987.
Details from Susan Robertson, *Energy from biomass and wastes XI,* Institute of Gas Technology, 3424 South State Street, Chicago, Illinois 60616, USA (tel 312/567-3881; tlx 25-6189).

Fundamentals of heat recovery and waste heat utilisation

Conference, Essen (FRG), 19 and 20 March 1987.
Details from Haus der Technik eV, Hollestraße 1, Postfach 10 15 43, 4300 Essen 1, FRG (tel 0201/1803-1; tlx 857 669 hdt).

Indoor air quality: acceptable standards and building design

Workshop, Manchester, 25 and 26 March 1987.
Details from National Society for Clean Air, 136 North Street, Brighton BN1 1RG (tel (0273) 26313).

April 1987

Advances in particulate technology

Symposium and exhibition, Manchester, 6-8 April 1987.
Details from D V Greenwood, symposium organiser, 45 Hadrian Way, Sandiway, Northwich, Cheshire CW8 2JT (tel (0606) 888238).

Architecture

European conference and exhibition sponsored by Commission of the European Communities, Munich (FRG), 6-10 April 1987. *Central theme: solar architecture.*
Details from H S Stephens & Associates, European Commercial & Technical Conferences, Agriculture House, 55 Goldington Road, Bedford MK40 3LS (tel *national* (0234) 49474, *international* + 4423449474; tlx 82392 Robins G, quote HSSA).

Safety & reliability after Chernobyl, Challenger and Bhopal

International conference, Birmingham, 14-16 April 1987.
Details from Mrs A Brown, IQA, 54 Princes Gate, Exhibition Road, London SW7 2PG (tel 01-584 9026).

Incineration of mixed and low level radioactive wastes

Sixth annual conference, St Charles (USA), 22-24 April 1987.

April 1987 (continued)

Details from J G Tripodes, manager health physics, EH&S, University of California, Irvine, CA 92717, USA.

May 1987

Materials 87

Conference and exhibition dealing with processing and property control of materials. London (Royal Lancaster Hotel), 11-15 May 1987 *(conference),* 12-15 May 1987 *(exhibition).*
Details from: *(conference)* Jane Butler, conference manager, Institute of Metals, 1 Carlton House Terrace, London SW1Y 5DB (tel 01-839 4071); *(exhibition)* Rebecca Nansoz, Mack-Brooks Exhibitions, Forum Place, Hatfield AL10 0RN (tel 07072 75641).

Advances in machine technology (agricultural applications)

Conference at annual convention of IAgrE, Stoneleigh, 12 May 1987.
Details from Virginia Jackson, conference secretary, Institution of Agricultural Engineers, West End Road, Silsoe, Bedfordshire MK45 4DU (tel (0525) 61096).

Power

Thirtieth Instrument Society of America symposium, Rochester (NY, USA), 18-20 May 1987.
Details from Robert W Hill, general chairman, Amtech Services, 559 Mountain View Dr, Lewiston, NY 14092, USA (tel (716) 284-7374).

Characterisation and quality control of nuclear fuel

Conference, Karlsruhe (FRG), 25-27 May 1987.
Details from Dr D Vollath, Kernforschungszentrum Karlsruhe, Postfach 3640, D-7500 Karlsruhe 1, Federal Republic of Germany (tel 010 49-7247 824005).

June 1987

Petroleum industry applications of microcomputers

SPE symposium, Del Lago (TX, USA), 23-26 June 1987.
Details from SPE Meetings Department, PO Box 833836, Richardson, Texas 75038-3836, USA (tel 214/669-3377; tlx 730989 (SPEDAL).

Condition monitoring for safety

Seminar and exhibition, London (Regent Crest Hotel), 25 June 1987.
Details from Miss Laura Christie, seminar organiser, ERA Technology, Cleeve Road, Leatherhead, Surrey KT22 7SA (tel 0372 374151 ext 290/488; tlx 264045 ERALHD G).

September 1987

Erosion by liquid and solid imp

Seventh international conferen
Cambridge, 6-10 September 1987.
Details from Dr Field, *ELSI* conferer
Cavendish Laboratory, Madingley Ro
Cambridge CB3 0HE, UK (tel (02
337318; tlx 81292 CAVLAB G).

Coal combustion

International symposium, Beij
(China), 7-10 September 1987.
Details from Peter Mills, gene
manager, Combustion Systems, C
Research Establishment, Stoke Orch
GL52 4RZ (tel (0242) 673361).

Reclamation, treatment a utilisation of coal mining wast

Second international symposiu
University of Nottingham, 7-
September 1987.
Details from Dr A K M Rainbow, h
of Minestone Executive, NC
Philadelphia, Houghton-le-Spring, T
and Wear DH4 4TG (tel (0783) 843
ext 402).

Cokemaking

First international congress a
exhibition, Essen (FRG), 13-
September 1987.
Details from Steinkohlenbergbauvere
ICMC, PO Box 1301 40, 4300 Essen
FRG (tel (0201) 1059580; tlx 0857
BERGB D).

WELDEX 87

International welding, cutting and me
fabrication exhibition, Birmingha
(National Exhibition Centre), 14-
September 1987.
Details from Royston Smith, WELDE
87, Industrial and Trade Fairs, Radcli
House, Blenheim Court, Solihull, W
Midlands B91 2BG (tel 021-705 6707;
337073).

Software engineering for real time systems

International conference, Cirencest
28-30 September 1987.
Details from Conference Secretari
Institution of Electronic and Rad
Engineers, 99 Gower Street, Londo
WC1E 6AZ (tel 01-388 3071).

October 1987

Refurbishment and life extensi of steam plant

Conference, London, 14 and 15 Octob
1987.
Details from Paul Wright, Conferen
Department C364, Institution
Mechanical Engineers, 1 Birdcage Wal
London SW1H 9JJ (tel 01-222 7899 e
237; tlx 917944).
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