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Personal viewpoint

A moribund Institute? – No way!

In Viewpoint of August/September 1987 W Tipler (Senior Fellow) expressed his concern and raised the question as to whether we are all members of a moribund Institute. My immediate reaction to that is no way!

Yes, I am a member of Council and therefore one of the active Institute members as identified in Mr Tipler's article. However I am a young member (under 35 years) and female, both a minority in the Institute. The relevant question is why I do not see the Institute as moribund.

Personally I see energy as a major topic, both for the engineering profession and people in general, and I am interested to note that most of the other major institutions cover energy topics. The Institution of Chemical Engineers has a successful coal utilisation subject group and I wish the initiative had been ours. The Royal Institution of Chartered Surveyors handles energy matters relating to building construction. Both illustrate the genuine interest in the energy field. I think that our Institute should and can cover the energy topics successfully and it is perfectly placed to pull together all information and interests in energy.

I expect the Institute to provide stimulation, further education and the chance to meet people both in my own and other related fields. To date my expectations have been fulfilled and I find that the service has improved in the five years since I joined while still at university.

There are currently a number of initiatives in the wings to promote the Institute (eg London and Home Counties branch student meetings). I ask all members to support this type of activity. It is only if we know what your interests are that we can act on them.

In his inaugural presidential address Dr E G Masdin identified the need for improvements. On his initiative a Strategic Group was set up, which presented its initial findings and outline recommendations to the Council meeting in November.

The findings can be summarised as follows:

- The Institute is full of talent, enthusiasm, voluntary efforts, opportunities and good ideas.
- We lack a clear progress path, a clear support staff structure.
- We need to broaden our appeal away from fuels to the whole range of energy topics.
- We need to stand up and be counted.

The suggested possible actions include:

- Restructuring the headquarters operation.
- Introducing a conference organiser to further improve professional education and to generate income by organising the right conferences covering the whole energy field.
- Becoming an information technology organisation both to members and the wider public, eg develop policy statements on the UK energy scene.

The Strategic Group has asked for comments/ideas from the various branches and members, the aim being to discuss and decide on a course of action at the next Council meeting in March.

The Institute is in need of a vitamin injection to revitalise it, the service to members and the image of the Institute both to members and outside bodies needs improving. The process has started and I am hopeful for the future.

A final point to realise is that a large proportion of members are only members of groups for the benefit that they derive from them and not for the benefit that they may give to the group and perhaps we expect too much from too many. As far as the Institute is concerned a large proportion of people are members because they have to or wish to be chartered engineers. Chartered engineers have to be registered with the Engineering Council and be members of an affiliated chartered engineering body, eg the Institute of Energy.

Being an active member is about giving your time and expertise for no tangible recompense. Active members are the only people who can activate and change the Institute. It is up to us (who are or wish to become active) to ensure that the process continues and that the Institute survives. Survive, expand and mature it undoubtedly will.

Dr Anne-Marie Warris

(Member)

Equipment qualification for the Sizewell B pressurised water reactor

A Turner CEng MIMechE*

A programme of equipment qualification in support of the Sizewell B pressurised water reactor is being undertaken within the UK. A brief overview of equipment qualification is presented together with a more detailed discussion of qualification for 'harsh environment' operation, with particular emphasis on the supporting development undertaken by the National Nuclear Corporation

Why is equipment qualification necessary?

It is essential that safety-classified systems and equipment necessary for the achievement and maintenance of a safe shutdown of the pressurised water reactor (PWR) remain operational under both normal, fault and post-fault conditions. These conditions include various postulated hypothetical design basis faults, the more significant of these involving major rupture of either the reactor primary coolant pipework (the loss of coolant accident – LOCA) or reactor main steam supply pipework (a main steam line break – MSLB). These particular faults result in a large release of high-temperature, high-pressure water or saturated steam respectively into the primary containment building within which the nuclear steam supply system is located (Fig 1). High-pressure hot water released during a LOCA changes phase, or 'flashes', into saturated steam, whilst saturated steam released during a MSLB expands to become superheated. The temperature and pressure within the reactor containment building are thus rapidly elevated following such events, with a steam/air environment being produced. A 'cold', chemically-dosed water spray system is subsequently activated to moderate the containment conditions, and in particular to limit the containment pressure.

Essential items of equipment located within the containment building are required to remain functional despite the 'harsh environment' resulting from such fault transients, including the long-term post-accident phase during which saturated conditions may persist within the containment. Such faults must be considered to occur at the most onerous 'end-of-life' conditions when equipment has 'aged' mechanically and due to lifetime exposure to conditions of elevated temperature and irradiation, non-metallic materials often being prone to degradation in such environments. Thus equipment qualification is necessary to confirm end-of-life functionality under design basis fault and post-fault conditions.

In addition, equipment must be shown to remain functional during and after postulated seismic events, again in its end-of-life condition, and this is included in equipment qualification programmes as appropriate.

The PWR is being introduced into the UK essentially as an established system, however some adaptation has been necessary to satisfy the particular safety requirements imposed by both the CEBG and the Nuclear Installations Inspectorate. Given that principally UK-manufactured equipment will be incorporated into Sizewell B and future PWR stations, a UK structure, including facilities and expertise, for qualification of safety-related equipment is being developed.

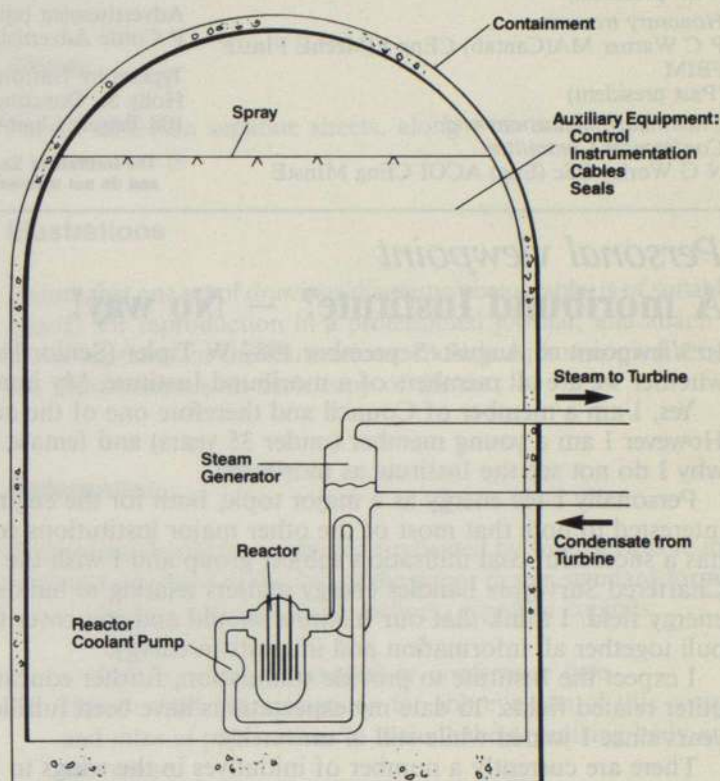


Fig 1 Schematic of nuclear steam supply system and reactor containment building – the major design basis faults are associated with rupture of the primary coolant pipework – the loss of coolant accident – or secondary pipework from the steam generator – a main steam line break

How is equipment qualification undertaken?

The methods used for equipment qualification are based on those developed for the US nuclear programme based on IEEE (Institution of Electronics and Electrical Engineers, eg IEEE 627, 323, 344) standards suitably modified to suit UK specific requirements. Qualification can be by analysis in suitable cases but the preferred qualification method for much electrical/control and instrumentation equipment utilises type-testing, to a programme which typically includes:

- Thermal ageing
- Irradiation ageing
- Seismic testing
- Harsh environment testing

Functional testing of the equipment is performed at intervals throughout the qualification programme.

Ageing

Thermal ageing is simply achieved by means of elevated temperature exposure of equipment to produce accelerated thermal degradation to end-of-life conditions.

* Group head, Research and Development Engineering Department, National Nuclear Corporation

The exposure conditions for equivalent lifetime damage are generally determined using the Arrhenius method which assumes that the ageing mechanism is a function of a single chemical reaction whose rate is governed by temperature, with degradation being related to the activation energy of the particular material.

The treatment of irradiation ageing is similar in principle to thermal ageing and simulates the lifetime plus accident irradiation dosage to which equipment may be subjected by exposing it to an equivalent dose of gamma-radiation from a cobalt 60 source, for example, over a short period. To support the ageing methodology investigations of accelerated dosage effects, the influence of temperature and the gamma-equivalence of beta-radiation are being undertaken. Synergistic effects, which cover the interaction of simultaneously and sequentially applied ageing mechanisms, are also being studied.

Seismic

Seismic qualification has been undertaken for Heysham 2/Torness advanced gas cooled reactor (AGR) equipment and the technology is well established. The procedures involve the use of shaker table and, possibly, modal analysis type testing and/or analytical modelling techniques, as appropriate. Although the PWR and AGR equipment will both be qualified against earthquake levels having the same probability of exceedence, of 10^{-4} per year per site, several differences exist between the procedures required for the two reactor types. These reflect both the differences between the reactor designs and the developing requirement to qualify the equipment when in its most onerous, ie end-of-life, condition.

For qualification by testwork, this latter condition will

be ensured by performing thermal and irradiation ageing work before starting the testwork unless ageing can be demonstrated as not being significant. The equipment will be qualified against two seismic excitation levels. These will correspond to a peak ground acceleration of 0.25g for Sizewell B specific application, and 0.4g to encompass future PWR sites application. All line pipework mounted equipment, such as valves and actuators will be qualified using discrete frequency, ie 'sine beat' or 'sine dwell' type excitation. This is a new UK requirement for such equipment and is referred to as 'required input motion' (RIM) testing.

Harsh environment tests

The major fault transients against which the 'harsh environment' test parameters are specified are the limiting primary and secondary pipework ruptures (LOCA and MSLB). The test parameters must also recognise a wide variety of lesser primary containment transients.

The containment temperature/pressure transients resulting from individual faults are predicted using conservative thermal-hydraulic computer codes which model the containment as a single volume comprising a water and vapour region. Equipment qualification is undertaken in accordance with IEEE specifications which require that equipment be subjected to one or more particular temperature-time/pressure-time transient test 'envelopes' (Fig 2). These envelopes effectively encompass the various different fault transients against which equipment must be qualified and provide for simulation of long-term post-transient ageing effects. Having derived the required enveloping conditions from the plant safety analysis, equipment may be subjected to a single test

TYPICAL TEMPERATURE/PRESSURE PROFILE FOR HARSH ENVIRONMENT TEST

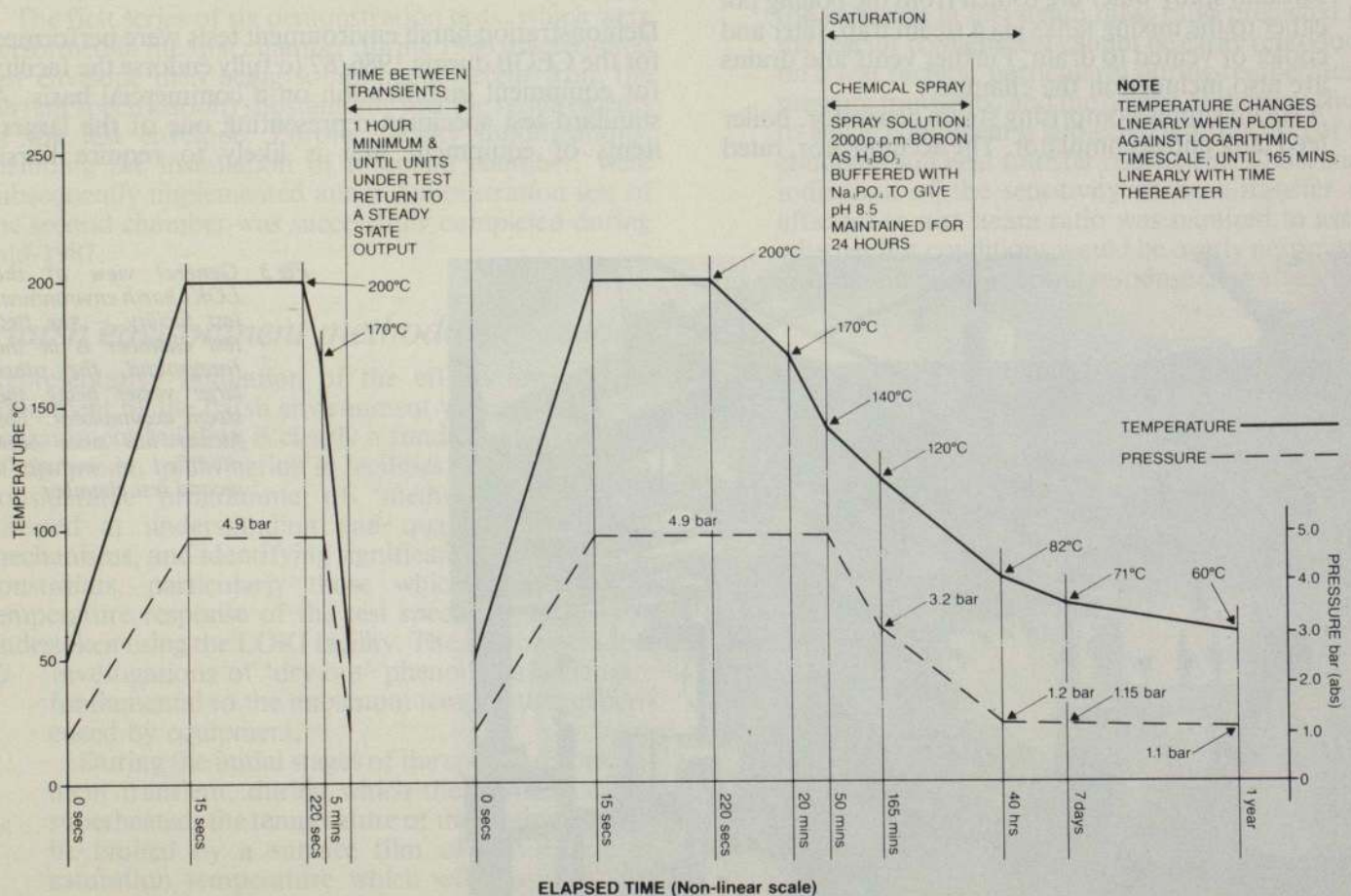


Fig 2 Test envelope for harsh environment equipment qualification – equipment is subjected to two temperature-time/pressure-time transient test 'envelopes': a precursor transient is followed by the main test transient which encompasses the major design basis faults, lesser faults and post-fault exposure

subjected to a single test envelope which includes further margins on the calculated temperature/pressure transients. Alternatively it may be subjected to two test envelopes, the first (or precursor test) corresponding to the peak temperature transient (MSLB fault) with the second test encompassing all transients, but without the addition of any further margins, the precursor test effectively accounting for margin. Sizewell B equipment will be qualified by the latter method, a typical test profile being presented in Fig 2. Whilst test facilities must clearly be capable of reproducing this profile the test component thermal response must accord with the postulated reactor situation ie any 'rig-effects' which may induce non-representative thermal response of the test specimen must be minimised. This necessitates a clear understanding of thermodynamic processes within the test facility.

NNC's Harsh Environment Test Facility, LOKI

The National Nuclear Corporation's harsh environment facility, LOKI (Fig 3), developed within the R&D Engineering Department, is utilised for both equipment qualification testing and investigations of thermodynamic processes on behalf of CEGB. Fig 4 presents a simplified line diagram of the facility in principle which comprises the following fundamental elements:

- (i) Two cylindrical steel test chambers, 1.7 m³ internal volume, capable of operating up to either 6.9 bar g/213°C or 5.0 bar g/285°C, lined with rubber sheet to delay formation of condensate when initially charged with steam, and insulated and trace-heated on the outer surface. An electrically-heated 'boiling pot' located at the bottom of the chamber is utilised during operation at saturation conditions. Condensate and spray water are routed from the boiling pot either to the mixing tanks via a steam trap, filter and cooler or vented to drain. Further vents and drains are also included in the chamber.
- (ii) A steam supply comprising steam generator, boiler feed tank and accumulator. The accumulator, rated

for 20 bar g/215°C operation, is charged with water which is heated by direct injection of steam from the generator. The water level is maintained at centre height throughout the 4-5 hour heating period to provide the maximum surface area from which to 'flash off' steam.

- (iii) A steam pressure control system, utilising flow control valves, pressure reducing valves and flow metering orifices incorporated within the trace-heated pipework which interconnects the accumulator and test chambers.
- (vi) A superheater, which utilises an electrically-heated, low-pressure thermal fluid system to heat steam from the accumulator to 320°C.
- (v) A recirculating spray system which injects a metered flow of chemically-treated water at 50°C into the chambers via spray nozzles.
- (vi) An air injection system to regulate the test chamber air content, and to regulate temperatures during the transition from superheated to saturation conditions.
- (vii) A control and data acquisition system.

In practice, the facility is much more complex than indicated by the simple line diagram of Fig 4.

The specified temperature/pressure profiles are achieved by appropriate control of the steam supply/venting, cold air injection and spray systems to a detailed specification.

The LOKI facility was first conceived during 1981/82 and construction of the facility was completed mid-1984. From that date until about mid-1986 tests and modifications were undertaken to evaluate the facility and provide a capability to meet the evolving UK test envelopes.

Endorsement of the Harsh Environment Facility

Demonstration harsh environment tests were performed for the CEGB during 1986/87 to fully endorse the facility for equipment qualification on a commercial basis. A standard test specimen representing one of the largest items of equipment that is likely to require harsh

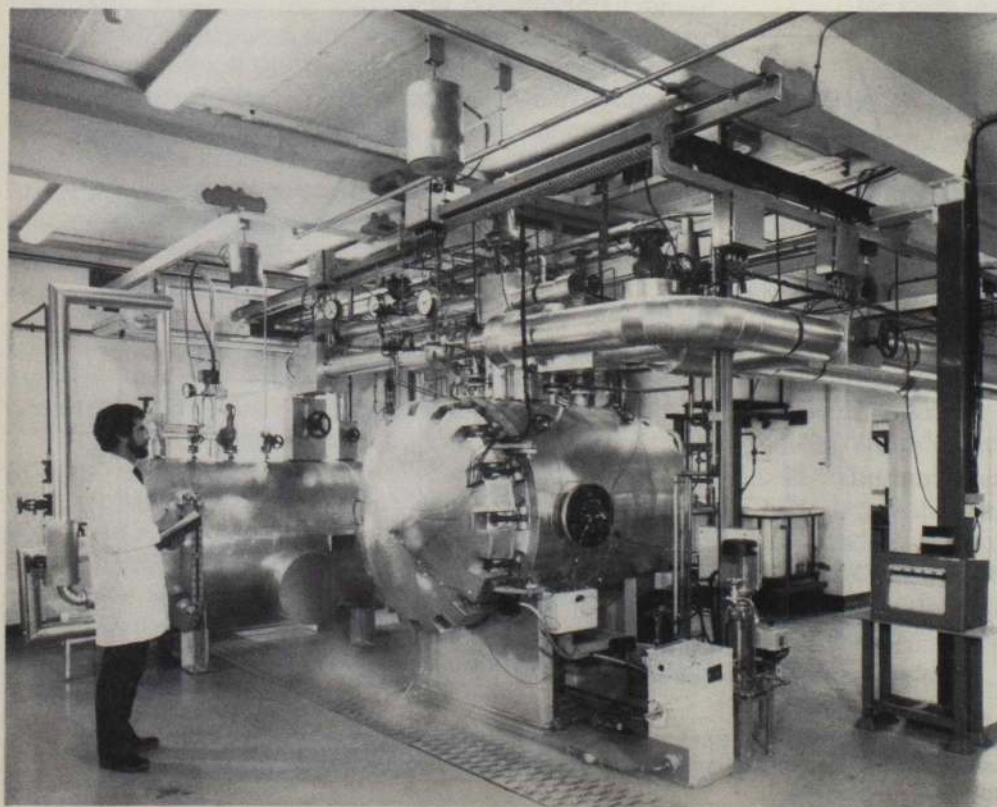
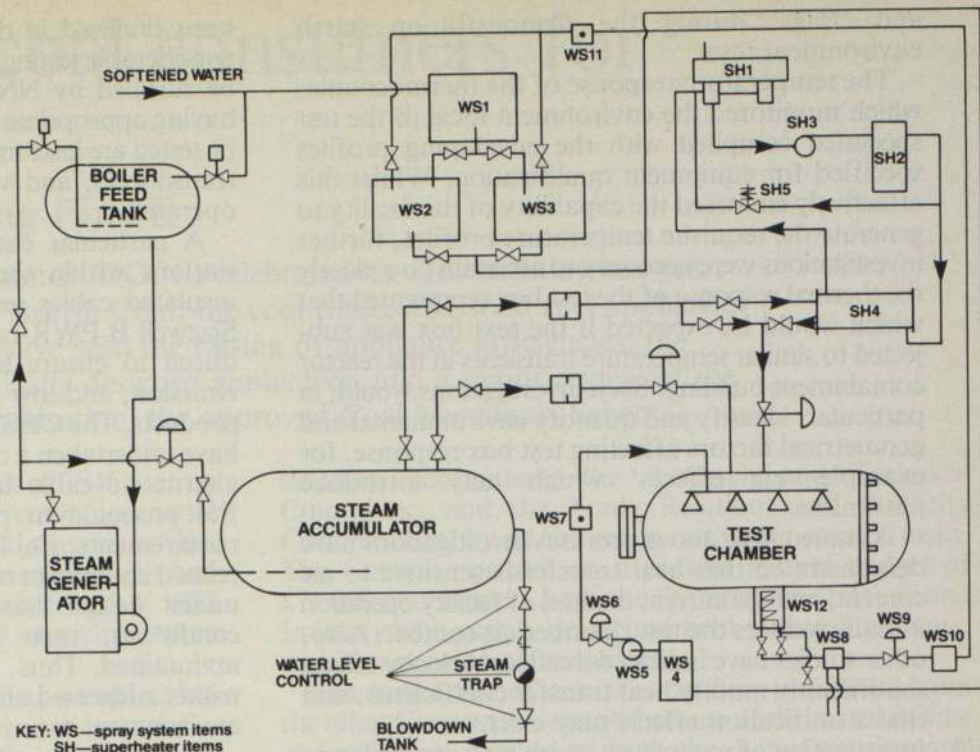


Fig 3 General view of the LOKI harsh environment test facility – the first test chamber is in the foreground, the other large vessel being the steam accumulator. The facility has since been modified to include a second test chamber

Fig 4 Line diagram of the LOKI facility – the main components of the facility in principle are indicated, although this does not represent either the current arrangement or the general complexity



environment testing (the actuator for an 80mm diameter globe valve), is used for equipment simulation during demonstration tests. The specimen comprises a rectangular hollow box, manufactured from 12mm thick stainless-steel, weighing 120 kg with an outside surface area of 1.2m² (Fig 5). The test box is instrumented with thermocouples. Seven 'flags', instrumented with thermocouples, are mounted from the outer surface of the test box to monitor the local environment. Thus, comprehensive information regarding environmental and specimen conditions is available.

The first series of six demonstration tests, which were performed in the first chamber during 1986 (the required test envelope then being somewhat different from the current specification) substantially met the requirements of the test envelope. Further facility modifications, including the installation of a second chamber, were subsequently implemented and a demonstration test of the second chamber was successfully completed during mid-1987.

Harsh environment methodology studies

Representative simulation of the effects imposed on equipment by the harsh environment within the reactor containment building is clearly a fundamental requisite of equipment qualification in facilities such as LOKI. A considerable programme of 'methodology' studies directed at understanding and quantifying thermal mechanisms, and identifying significant parameters and constraints, particularly those which influence the temperature response of the test specimen, have been undertaken using the LOKI facility. These have included:

- (i) Investigations of 'dry-out' phenomena which are fundamental to the maximum temperature experienced by equipment.

During the initial stages of the specified containment transient, during which the environment is superheated, the temperature of the equipment will be limited by a surface film of condensate at saturation temperature which will 'insulate' the equipment from the superheat. Should this film dry out then surface temperature will increase towards that of the environment. This is clearly a significant effect since component damage may be a function

of peak temperature.

Preliminary tests utilised copper discs instrumented with thermocouples to investigate dry-out and to quantify condensation and convection heat transfer coefficients in the pre- and post-dry-out phases. Further testwork of a similar nature used a specially developed 'variable conductance heat-pipe' to measure condensation heat transfer coefficients.

The latter testwork particularly addressed the effects of air content on condensation heat transfer coefficients. This is of particular importance since the variation in air: steam mass ratio predicted for the reactor containment cannot be easily reproduced on a test facility, particularly during temperature/pressure transients, and the degree of thermal shock to which equipment is subjected is a function of the condensation heat transfer coefficient. Thus, some indication of the sensitivity of heat transfer coefficient to air: steam ratio was required to assess whether test conditions would be overly pessimistic.

- (ii) Evaluation of the thermal response of the 'test box'

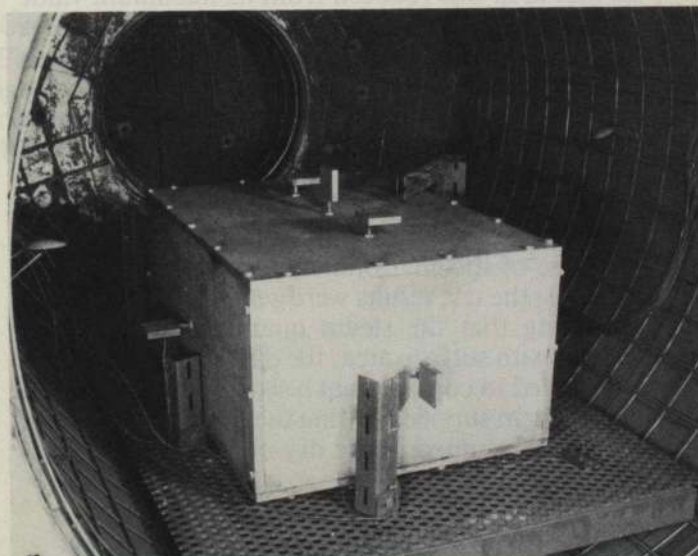


Fig 5 Test box used for demonstration harsh environment test – the test box is shown in position in the test chamber. Instrumented 'flags', mounted from the top and sides of the box, are used in evaluating heat transfer mechanisms

and 'flags' during the demonstration harsh environment tests.

The temperature response of the thermocouples which monitored the environment local to the test specimen complied with the enveloping profiles specified for equipment qualification. Whilst this effectively endorsed the capability of the facility to generate the requisite temperature profiles, further investigations were necessary to ascertain how closely the thermal response of the test box represented that which would be expected if the test box was subjected to similar temperature transients in the reactor containment building. Such investigations would, in particular, identify and quantify environmental and geometrical factors affecting test box response, for example 'rig effects' which may introduce pessimism.

As noted in (i) above previous investigations have demonstrated that heat transfer is sensitive to air content, and the current method of facility operation initially reduces the test chamber air content. Also, other studies have indicated that local velocity effects significantly modify heat transfer coefficients, and that stratification effects may exist.

(iii) Investigation of parameters which may constrain test facility performance, in particular test specimen area effects.

As discussed in (i) above, condensate films are initially formed on the exposed surfaces of the item of equipment being tested. The superheated environment of the facility induces dry-out by means of the superheated steam interacting with the water film. The quantity of steam consumed during this process is almost certain to be a strong function of the specimen surface area, thus for a particular facility there will be an upper limit on test specimen surface area above which the specified enveloping temperature transients cannot be achieved.

A variable-area test specimen of constant mass was utilised for this investigation which determined, as a function of specimen area, the quantity of steam required to achieve the initial 15 second temperature rise to 200°C specified in the precursor transient, and the quantity of steam required to maintain 200°C during the subsequent dwell. The test specimen comprised an array of five 4.75mm thick stainless-steel plates measuring 925 × 600mm arranged vertically in a framework in the form of a 'toast-rack'. The surface area was reduced from its maximum value of 5.9m² by progressively bolting the plates together back-to-back. The test specimen was constructed to have the same total mass (120 kg) as the test box. Thermocouples were used to monitor environmental temperatures local to the test specimen, with several preliminary tests being performed prior to each test proper to determine the rig control settings necessary to achieve the requisite response of the environmental thermocouples.

Whilst the test results were generally as expected, indicating that the steam quantities required increased with surface area, the data could be further interpreted to confirm that a significant proportion of the steam supplied during the initial temperature ramp is consumed in the dry-out process.

Equipment qualification programme

The amount of safety-related equipment requiring qualification for Sizewell B will generate a substantial demand for testing. Although the programme has not

been finalised in detail it is fairly clear that there is a considerable testing requirement during 1988/89. This will be fulfilled by NNC and two other UK organisations having appropriate facilities. Typical of the equipment to be tested are instruments such as pressure and temperature transducers, and valve actuators, both air and motor operated.

A particular case is electric cables. Nuclear power stations within the UK have generally utilised PVC-insulated cables resistant to fire propagation. For the Sizewell B PWR further requirements have been introduced to ensure low smoke emission, low toxic gas emission, and low production of corrosive combustion products. The CEGB, together with cable manufacturers, have undertaken a development programme in respect of alternative cable insulating materials having reduced fire propagation properties and fulfilling the above requirements. Cables associated with Sizewell B safety-related equipment must clearly be capable of functioning under design basis faults, including post-transient conditions, such that a safe reactor shutdown is maintained. Thus, in addition to fulfilling the requirements addressed above, they must be resistant to harsh environment exposure at the end-of-life condition.

The company's R&D Division, on behalf of CEGB are one of the laboratories currently performing environmental qualification tests in respect of a number of mandrel-mounted cables proposed for Sizewell B. The qualification programme requires:

- Thermal ageing
- Irradiation ageing
- Harsh environment exposure

Functional testing is performed at various stages within the programme. In particular the specimens are energised throughout the harsh environment tests to specific voltage/current levels. The condition of the insulation is finally checked by subjecting the cables to a bending test. Testing accords with a detailed written test specification demanding a high level of quality assurance. Accelerated thermal ageing was performed in NNC's thermal ageing ovens at closely-controlled elevated temperatures ranging from 95 to 150°C for up to 24 days. The thermally-aged samples were subsequently irradiated to simulate, in an accelerated manner, the total radiation dose accrued during normal service life plus the accident dose resulting from a LOCA. The samples, which were mounted in heated chambers, were gamma-irradiated to 50 Mrad at a mean dose rate of 0.3 Mrad/hour in a facility at Isotron, Swindon. Harsh environment testing to the prescribed LOCA/MSLB transient envelopes is currently being performed in the LOKI facility, the cable load having been divided between the two test chambers. The overall duration of the test programme, from drafting the test procedure to submitting the final endorsed report is of the order nine months.

NNC R&D capabilities

The responsibility for both equipment qualification testing and investigations of the underlying methodology is primarily with the multi-disciplinary teams of NNC's R&D Division. There is a broad spectrum of professional technological skills in the fields of mechanical engineering, acoustics and vibrations, chemistry and corrosion, tribology and non-metals, heat transfer and fluid flow, materials technology, instrumentation, electronics and computing available, with wide experience of engineering development particularly in support of the other UK nuclear reactor systems (Magnox, advanced gas cooled reactors, steam generating heavy water reactors, sodium

(Continued on p 14)

Representing coal consumers for 40 years

P H Clarke BSc PhD CEng FInstE

The Domestic Coal Consumers' Council (DCCC) celebrated its 40th birthday last year. In the last decade it has influenced British Coal, the coal trade, and solid fuel appliance manufacturers. The last few years have seen the raising of appliance efficiencies, the introduction of improved ergonomically designed appliances, and a major review of the industry's consumer protection organisation, the approved Coal Merchants Scheme

Originally, the Coal Nationalisation Act of 1946,¹ set up two councils, one to safeguard the interests of industrial users, and the other to safeguard the interests of the domestic consumer. The Industrial Council which had overseen the larger market share was abolished in 1972 by the European Communities Act as it was felt by some to amount to a restrictive practice.

The Objects of the Domestic Council as set up in 1946 and amended in 1972 were clear:

... the Council was charged with a duty to consider any matter affecting the sale or supply of coal, coke, or manufactured fuel for domestic purposes, which is the subject of representation made to the Council by consumers, or which appears to them to be a matter to which consideration should be given ...

The Department of Trade and Industry, which sponsors the Council, reviewed the Nationalised Industries Consumer Councils in 1982, and produced *A strategy for reform*.² This required Consumer Councils and their parent industries to discuss the role of each council and prepare agreed guidelines for the future operation of the councils. The Department of Trade and Industry then played a coordinating role in harmonising the different sets of guidelines. DCCC now works to these agreed guidelines, which were published with the Council's 1985 and 1986 Annual Reports.^{3,4} The general aim of the Council as set out in the guidelines is:

... to establish clearly the standards of service which customers should expect; and develop a climate in which all concerned in the (solid fuel) industry see the attainment of these standards as an important part of their job ...

More colloquially the Council summarise their present task:

... to look after the interests of people who burn solid fuel in their homes. Concern with all aspects of supply, quality, and price of house coal and smokeless fuel, and the operation of appliances. All representations from consumers are considered, particularly matters of safety. In short, the Council promotes consumer protection for solid fuel users ...

Council operation and the industry

The Council members are nominated through the Council's sponsoring Government Department for appointment by the Minister responsible. Members of Council represent a wide cross-section of trades and professions. At the end of 1978 the Council membership was 24 and the trend in the last few years has been to a smaller Council, so that by the end of 1986 the Council was down to 14 members. The Council meets as necessary, but at least four times a year by statute. The more detailed work of the Council is done by two

standing committees, the Research and Technical Committee, and the Trade Relations and Publicity Committee, or by *ad hoc* groups set up for specific tasks. The Council operates on a present annual budget of £71 000 plus support from the Department of Trade and Industry who supply on secondment two civil servants, and also provide office services.

The nature of the Council's operation is different from the other Consumer Councils because of the mixed private and public ownership of both the manufacturing and retail ends of the solid fuel industry. Whilst the majority of the fuel is produced by British Coal significant quantities, particularly of manufactured fuels, are produced by private companies. Also since the recent industrial dispute imports make a small but continuing contribution. However, the biggest difference between the coal industry and the other energy industries comes at the retailer consumer interface. British Coal through NFD (National Fuel Distributors) do retail fuel but the majority of fuel is retailed through a variety of different sized companies.

The method of maintaining standards at the consumer/retailer interface is also different from the gas and electricity industries, due to the mixed private and public ownership. The ACMS (Approved Coal Merchants Scheme) was set up in 1962 to define basic standards of service for solid fuel retailers. The scheme, the first such to protect consumer interests, is administered by a national panel, and 10 regional panels. Where numbers allow a member of the DCCC to sit on each regional panel so that the Council can keep in touch with activities occurring within the regions. In general terms the scheme is financed by the consumer through a levy on each tonne of fuel sold.

UK energy use 1947-1987

For the 40 year life of the Council, energy use 1947-87 is shown in Fig 1. For the period from 1947-73 the energy rise was almost predictable but since the oil price rises of 1972 and 1980, compounded by the general depressed

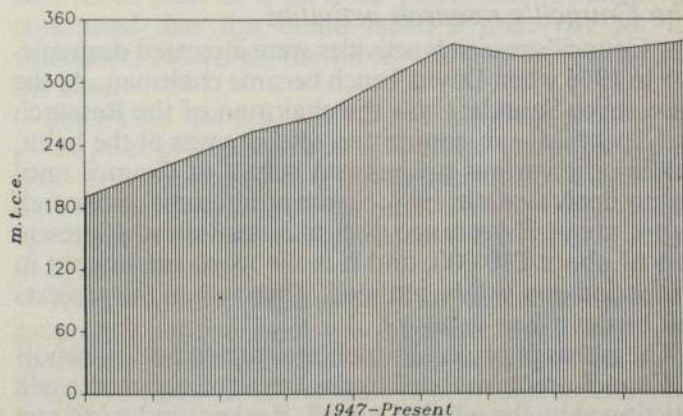


Fig 1: Total UK energy use

energy demand from heavy industry, the problem of predicting future energy requirements becomes very difficult. Fig 2 shows the percentage use of the different primary energy sources, coal, oil, gas, and nuclear. It may be noted that the cheap price of oil has caused the percentage of coal to decrease rapidly in the decade 1957-67. However, the overall need for energy is still rising, and so the actual tonnage of coal used is not falling off as dramatically as first appears from Fig 2. Then, the sharp increases of oil prices in the 1970's led to a fall in the market share of oil. However, this has not reflected in a pick up in the oil share with the present depressed oil price. Medium term predictions for North Sea oil and gas reserves and the present uncertainty about nuclear power means that the predictions about market share for the different primary fuels are even more difficult to make than predicting the country's overall energy requirements.

The general situation for solid fuels used in the domestic market from 1955 to 1985 is shown in Figs 3 and 4. Fig 3 shows the contraction of the solid fuel market with first the impact of cheap oil, followed by the second, the effect of cheap gas. A combination of effects suggest that the earlier rapid decline of the domestic solid fuel market has been halted but at present only an optimist could detect a turnaround in the short term market. Smokeless fuel consumption is different as it does not follow the general decline of bituminous coal sales. This is in part due to the Clean Air Act which created zones that restrict solid fuel burning to smokeless fuel. Also the introduction of higher efficiency appliances, such as room heaters, initially called for more smokeless fuels. However, the latest range of sophisticated appliances will burn bituminous coals which may be used in 'Clean Air Zones'. Fig 4 illustrates the increased share of market taken by smokeless fuels as sales of bituminous house coal has fallen, and the steady, about 10% market share taken by manufactured fuels such as Coalite, Phurnacite, and Rexco.

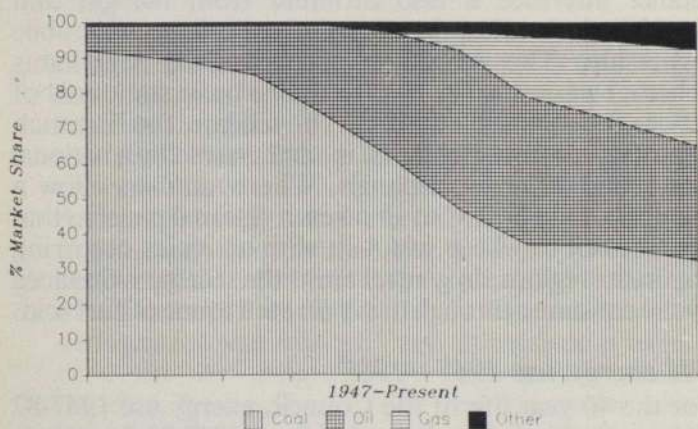


Fig 2: Percentage fuel shares

The Council's research activities

The Council's research activities were increased dramatically in 1976 when David Tench became chairman. At the time Joyce Saunders was the chairman of the Research and Technical sub-committee, and she was at the helm, guiding the various projects on behalf of Council until her untimely death in 1983. So the programme of research started about 11 years ago with an annual spend at present cost of about £30 000, and it is the work carried out in this period that will be outlined. Then two of the projects will be described in detail.

The research projects which are carried out on behalf of Council are formulated by the Research committee and sanctioned by the whole Council. Background work and desk research is carried out either by the Council's

seconded civil servants, or by a part-time research consultant.

The various projects can be considered under the following headings:

- (i) Coal and coal products
- (ii) Combustion systems
- (iii) Ergonomics
- (iv) Service by manufacturers and retailers
- (v) Prices

Some projects overlap between the various headings but it is convenient to assume each project neatly fits one of its categories.

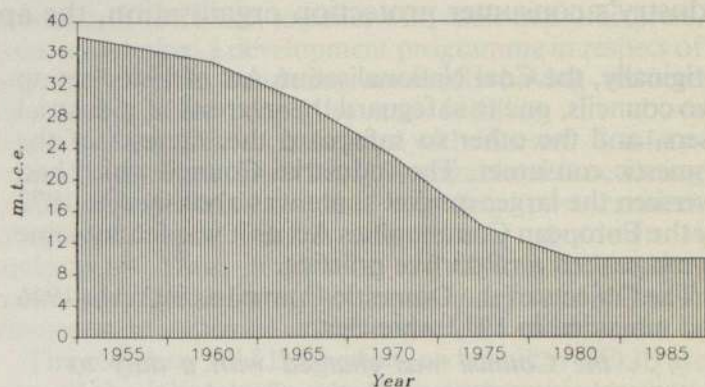


Fig 3: Total domestic solid fuel use 1955-85

Coal and coal products

The Council is charged with the responsibility of investigating the quality of solid fuel, and wishes to see that the consumer is fully informed about the fuels available. To these ends projects were carried out in 1979, 1984 and 1985, and whilst this is an ongoing concern of the Council, present Council policy calls for the consumer to be given all possible information without specifying precisely how this should be done.

With the growth in the last decade of pre-packed fuels work was carried out in 1977, 1981 and 1982 in this area. The availability of different types of fuel, the weight of the pre-pack, and the state of manufactured premium fuels (Coalite, Homefire, Rexco) were examined. The general conclusion for all pre-pack fuels drawn at the time, 1981, was that the consumer was paying a surcharge when buying pre-packs. Also the British Standard applicable at the place of manufacture of premium smokeless fuels could not be applied to individual bags bought by consumers.

All types of solid fuel produce ash and so there is the problem of the disposal of ashes. It was felt that the growth in the mid-1970's of plastic bins and bin liners used in waste disposal could cause problems when consumers used them for ash disposal. Project work in 1979 and 1980 showed that this was not the case. Very few consumers

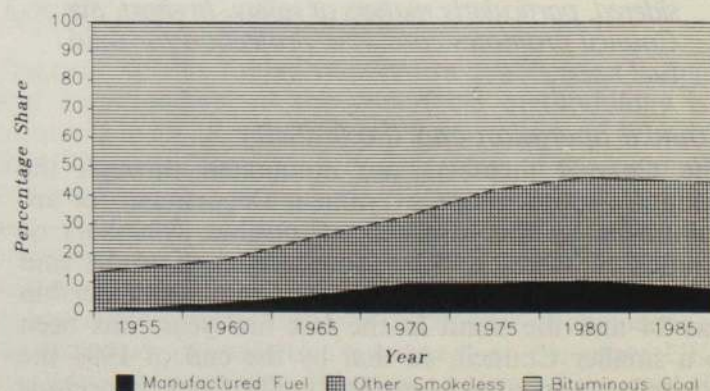


Fig 4: Percentage fuel by type 1955-85

were concerned about the problems of hot ashes melting plastic bins or bin liners. This was an example of a perceived rather than real problem. In fact several local authorities who used plastic bins had made alternative arrangements for solid fuel consumers.

Combustion systems

One of the earlier projects carried out by the Council under the chairmanship of Mr Tench was an investigation into the number of new houses that were being built with chimneys. In 1978, the survey showed that only 16% of new houses were being built with Class 1 flues. It is encouraging to record that pressure in part by the Council has raised the percentage from 16 to 34 in 1985.

An area of prime concern to consumer representatives is the question of consumer safety. The Council examined the safety of the solid fuel appliances in use by the consumer. In 1980, a shopping survey was undertaken into the availability of fire and spark guards. It was disturbing to find that although guards were available there was little choice for the consumer. Further work on safety was carried out in 1981 which investigated consumer reactions to questions on safety. This showed how infrequently guards were used in rooms with fires which were unattended or even worse where children were present. In Scotland where the question of guarded fires when children were present was the subject of legislation the situation was no better. Also resulting from this work was the harmonising of the British Standards on Fire Guards and Fire Settings which previously had made fitting guards to fire places problematical.

In the period 1982-85 the Council used some of its resources to investigate the efficiency of solid fuel appliances. Part of this work was jointly funded by the Consumers' Association and is an example of only a few cooperative ventures carried out by the Council.* This work is considered in more detail later but the DCCC was pleased to note that in Energy Year the DSFAAS (Domestic Solid Fuel Appliance Approval Scheme) raised its efficiency standards to reflect the increases in efficiency possible using modern designs.

Ergonomics

While the technical efficiency of appliances is important this is of little use if the consumer is unable to operate his appliance effectively. Part of the project on combustion systems included a consumer survey amongst solid fuel users to find their perceptions of appliances in the home. This highlighted the need for ergonomic aspects of the design to be considered. Work has been carried out on behalf of Council at the Institute of Consumer Ergonomics in the University of Loughborough. Guidelines have been produced for the design of room heaters which have elements that apply to other types of appliance. The DCCC was grateful for the help and cooperation of appliance manufacturers through ABSAM (Approved British Solid Fuel Appliance Manufacturers) with this work.

Service by manufacturers and retailers

Part of the way in which retail standards are maintained is through the Approved Coal Merchants Scheme. The scheme lays down effective guidelines outlining good practice for merchants and in 1978 a review of fuel storage by retailers was undertaken. This early piece of work led

* The Council while wishing to retain the good relationships with, also wishes to maintain an independence from the solid fuel manufacturers and suppliers

to a lively dialogue between the Council and the trade.

Since the formation of the ACMS in 1962 the whole coal trade has been in recession as illustrated in Figs 2 and 3. Fig 5 shows how the number of members of the scheme have declined in the last 20 years reflecting the decline in the amount of solid fuel sold. In some areas of the UK where there is no natural gas supply, such as Northern Ireland, there is a high density of solid fuel used and hence a larger number of retailers. On the other hand where gas has a large share of the domestic market little solid fuel is used and this is reflected in the number of merchants available to supply consumer need.

In 1984 the Council carried out a major survey that investigated the needs and attitudes of solid fuel users. One aspect of this work was to examine the service provided by the retailer including the mechanism used for dealing with consumer difficulties and complaints. As a result of this work the Council tightened up its methods for reviewing consumer problems and was helped in this task by the cooperation of the ACMS who provided details of consumer problems which they receive.

Energy Efficiency Year, 1986, saw the ACMS revise its logo, and streamline the scheme. It also became more aggressive in forwarding its image. This was done through the trade's publicity programme, the SFAS (Solid Fuel Advisory Service), with advertising on television, in the newspapers and various trade journals. The DCCC welcomes this new approach feeling that some of the impetus for this campaign may have been generated from consumer survey results produced by the Council.

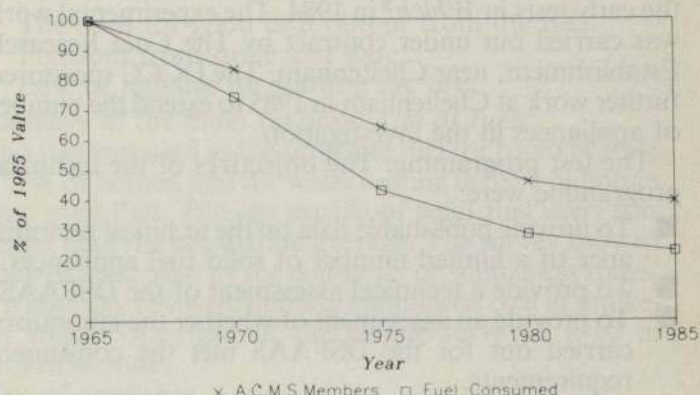


Fig 5: Fuel used and ACMS members since 1965

Prices

Perhaps the area that the public associate with a consumer body is the whole question of 'value for money'. Council has carried out various types of price survey in 1980, 1985-present and 1987. The 1980 price survey was to monitor the change of system of coal pricing when coal was to be sold at a pit-head price. The Council was concerned that this could mean a price rise for the consumer. However, the survey did not show this to be the case.

Since 1985 the Council has had a rolling programme of the price of selected fuels in 13 cities. The objective has been to determine price differentials within cities and to see how the prices vary with time. This has resulted in a fair amount of local newspaper coverage for the Council on local fuel costs.

The 1987 report on prices used the data from the survey mentioned above and was supplemented with data provided by British Coal. This data was then used by the Council's financial consultants to provide a commentary on the historic pricing of fuel. The question was simple: what is a fair price for the consumer to pay for solid fuel?

But the answer was complex, compounded by the 'public private' nature of the industry, however the Council is still interested in unravelling the answer.

Two major projects undertaken by DCCC

The thermal efficiencies of solid fuel appliances⁵

Background: The approval and testing of solid fuel appliances dates back to the 1930's but the present scheme, the DSFAAS, the Domestic Solid Fuel Appliance Approval Scheme, was started in 1970. In addition to thermal performance standards there are constructional and labelling requirements. The thermal performance standards are defined for the type of appliance, for example, open fires with high output back boilers, room heaters, and boilers etc. These may be further subdivided, the open fire group is further divided by grate shape – rectangular or trapezoidal, and the roomheater group is divided into sub-groups depending on whether it is wet or dry back. In the most general terms the minimum thermal efficiency standards range from 37% for a 'dry-back' open fire to 75% for large gravity fed independent boilers.

The Council took the decision in 1982 to test a small number of different appliances choosing those most representative of the market. The Council was fortunate in being able to share the costs of the initial work with the Consumer Association, who published the results of the early tests in *Which?* in 1984. The experimental work was carried out under contract by The Coal Research Establishment, near Cheltenham. The DCCC sponsored further work at Cheltenham in 1985 to extend the number of appliances in the investigation.

The test programme: The objectives of the technical programme were:

- To provide publishable data on the technical performance of a limited number of solid fuel appliances.
- To provide a technical assessment of the DSFAAS.
- To provide an assessment of whether the laboratory carried out for the DSFAAS met the consumers requirements.

All the appliances chosen had been approved by the DSFAAS, and the types chosen represented over 80% of appliance sales to the 'wet-back' market at the time. Four models of open fires, four models of room heaters, one model of cooker, and two models of boilers were tested.

The programme of evaluation was based on the approval tests laid down by the DSFAAS, which in turn are based on British Standards, and the tests covered:

- A general description of the appliance.
- The installation requirements.
- The thermal efficiency at the rated output.

In addition to the standard approval requirements the following specific items were included in the test programme:

- Tests of the thermal efficiency at half of the rated output.
- An extended slumber test.
- Measurements of the appliances' surface temperatures.

Tests results: Fig 6 shows the test results for the four open fires with high output back boilers which were tested. The standard fuel used in the test is Coalite, and the DSFAAS requirement is for the thermal efficiency to be measured with the damper open and closed. The effect of closing the damper is to lower the effective energy release from the fire and to give a greater proportion of

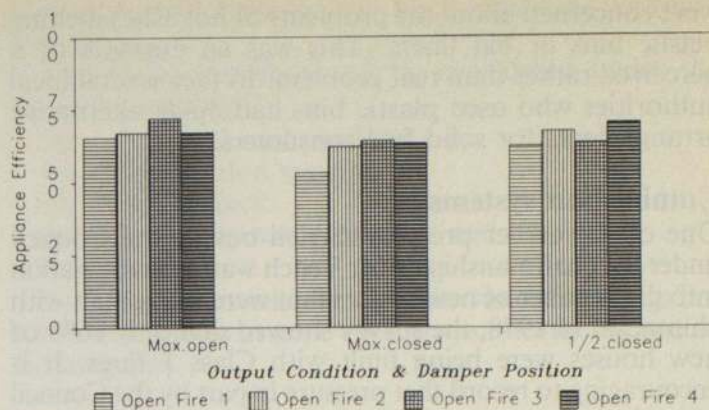


Fig 6: Open fire efficiencies, test at maximum and half-rated outputs (Test fuel: Coalite)

the energy off into the room. The tests were carried out over a six hour period and repeatability was ensured by carrying out duplicate, triplicate, or quadruplicate tests, depending on the agreement between subsequent tests. The extra test at the lower rating, at half of the rated output could only be carried out with the damper closed (as this gave the necessary level of control), and the duration of these runs was nine hours; again tests were repeated to ensure repeatability. On the basis of the first series of tests, with the damper open, the open fires tested had a range of efficiencies between 65 and 72% and the corresponding approval minimum efficiency was 60%. The second test showed a range of efficiencies of 53-64% with the design minimum being 50% – the half rating tests showed an increase of about 5% on the full rated output values. For the lower output condition the gas velocity will be decreased which will decrease the Reynolds number for the flue gases and this will lead to decreases in local convective heat transfer coefficients but the residence time of the gases in the heat exchanger area will give increases in heat transfer.

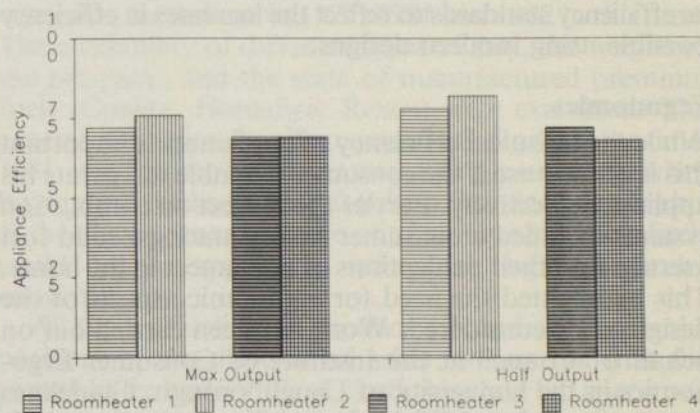


Fig 7: Room heater efficiencies, tests at maximum and half-rated outputs (Test fuel: R1 and R2 – Sunbrite; R3 and R4 – House coal)

The results for the four room heaters, Fig 7, are equally encouraging. Two room heaters were tested that were designed to burn smokeless fuel, the test fuel being Sunbrite, and two room heaters were tested which were designed to burn bituminous coal. This type of appliance burns the fuel in a way that reduces the smoke in the flue gas and hence their nickname – 'smoke-reducers' or 'smoke-eaters'. For room heaters the half rated efficiencies were about the same as the full rated values. The room heaters burning smokeless fuel had a rated efficiency of about 76% compared with the approval standard of 65%. The bituminous coal fired appliances had an efficiency of 69% at rated output compared with a design requirement of 65%. The results showed that all the appliances

tested could be slumbered for 15 hours.

The surface temperatures on the whole were satisfactory, but it was felt that attention to design detail of catches and knobs could improve appliance safety. If a knob or catch is to be operated directly with the hand one set of rules apply, but if the item is hot and designed to be operated with a tool then another set of design rules apply.

Conclusion: The Council was delighted to hear that from July 1986 the DSFAAS revised the efficiency pass levels for over half of the appliance categories, and that in many cases the standard was increased by 10% or more. It is good to know that in an area, appliance design, that might be considered mature, that new designs and further research are increasing efficiencies, and lowering consumer costs.

A survey of the solid fuel consumers needs and attitudes⁷

Introduction: A primary objective of a Consumer Council must be to test whether the perceptions of the Council members truly reflect the needs and attitudes of the wider population of consumers. Whilst the Council is regularly engaged in discussions with other bodies in the solid fuel industry it is more difficult to quantify the consumers satisfaction and dissatisfaction with solid fuel. The Council set out to obtain such data, and the objectives of the project were:

- To determine the level of consumer satisfaction concerning various aspects of solid fuel usage and merchant service.
- To determine any unmet needs among solid fuel users.
- To investigate any problems or dissatisfaction experienced by solid fuel users.

Methodology: A draft specification was drawn up by the Council's research consultant and agreed by Council, and a number of survey organisations tendered for the work. The contract was given to Research Surveys of Great Britain and the detailed aspects of the programme such as the sampling method, the questionnaire format, and the method for analysing the responses were worked up. The survey was conducted among a nationally representative sample of households who claimed to have used solid fuel (either as a main or subsidiary fuel) during the winter heating season 1983-84. The addresses were sampled from the AGB Home Audit file, and the field work was carried out between February and April 1984.

Due to the prolonged industrial dispute during 1984 a follow-up survey was carried out in February 1985, with a sample number of 241 to confirm the major findings of the original survey.

The main sample group of 988 households was drawn from the Home Audit panel which is a random sample of 25 000 households. One-hundred and sixty-two sampling points were selected from 500 sampling points throughout England, Scotland, and Wales, and the sample was drawn so that all geographical regions were correctly represented. The interviews were carried out in the home by trained and experienced members of the RSGB's regular field force. The person interviewed in each household was the person responsible for looking after the appliances. The questionnaire was extremely comprehensive with a total of over 70 questions, although the branching nature of parts of the questionnaire meant that any individual answered a sub-set of the questions. Because the population of solid fuel users varies from the overall population pattern, the results were weighted to correct for the variations. For example, in the South East the percentage of solid fuel users is 5%, whereas in

Table 1: Fuels used by domestic consumers

	All solid fuel users %	Users	
		main fuel %	subsidiary fuel %
Coal	48	46	58
Nat Smokeless	15	18	4
Coalite	15	13	25
Sunbrite	8	9	1
Phurnacite	5	6	1
Homefire	4	3	7
Other	5	5	4

Scotland the number is more than doubled at 11%.

Two examples of detailed results from the survey: Table 1 shows the variety of fuels used by consumers and in overall detail reflects what is shown in general in Fig 4. About 48% of coal and the remainder, 52%, of smokeless fuel is used by the consumer. This is split between almost equal quantities, 15%, of naturally smokeless fuel (mainly anthracite), and Coalite, and a smaller amount of Sunbrite, 8%. The remainder, 14%, is made up of a large number of other, mainly manufactured fuels.

In contrast Table 2 shows the importance of solid fuel attributes as rated by the consumer and presented in a quantified form. The order of importance is seen to vary with the type of main appliance but of major importance to consumers are:

- The need for good heat output from the fuel.
- Freedom from stone and slate.
- Ease of lighting for starting the fire.

Summary of the main findings: *Use of fuels*

Solid fuel was used as the principal fuel for room heating in 73% of homes, and for water heating in 68% of homes using solid fuel. The age profile of solid fuel users was greater than the population average. The survey showed a lack of awareness by the consumer of 'smokeless zones' – a minority 6% were burning bituminous coal in smokeless zones. One-third of the people surveyed lived in smokeless zones.

Type of appliance

Of all solid fuel homes, 63% used open fires, 26% room-heaters, 8% solid fuel boilers, and 4% solid fuel cookers. For those using solid fuel as the main form of heating the figures change with roomheater use rising to 31%, boilers

Table 2: The consumers rating of solid fuel attributes

	All users	Open fire users	Room heater users
Give out a lot of heat	3.93	3.95	3.90
Free of stone and slate	3.89	3.91	3.86
Easy to light	3.79	3.80	3.76
Little dust when delivered	3.68	3.65	3.70
Not crackle or spit when burnt	3.65	3.76	3.56
Not produce much smoke	3.57	3.53	3.69
Burn slowly	3.54	3.45	3.67
Few cinders/little clinker	3.44	3.37	3.57
Burn brightly	3.37	3.52	3.33
Free from dampness	3.36	3.36	3.38
Consistent size	2.84	2.69	3.04
Mainly small pieces	2.32	2.20	2.44
Mainly large pieces	2.26	2.34	2.19

(Mean Scores 1-4, 4- very important, 1- not so important)

use rising to 10%, and open fire use dropping to 56%.

Knowledge about fuel

The fact that house coal is sold in three groups was not used by two-thirds of consumers when ordering their fuel, and whilst consumers wanted more details about fuels the grouping systems is little understood.

Problems with fuel

In spite of a relatively high level of overall consumer satisfaction, 18% of all consumers reported at least one problem with a fuel consignment in the previous year. Most problems were regarded by the consumer as serious, but only about 40% were raised with anyone. In the case of problems which were raised nearly half of the complaints were unresolved.

The survey also covered two specific potential problem areas: fuel consistency and availability. One in four consumers said that their fuel varied from one delivery to the next. As might be expected the problem was greatest for coal and least for manufactured fuels.

One in 12 consumers had been affected by problems of availability in the previous 12 months. Where consumers had experienced problems they had occurred on average on 2.5 separate occasions during the year surveyed.

The consumer and the coal merchant

Most people, 88%, bought their fuel from a merchant, and of these, 93%, always used the same merchant. In general consumers were very satisfied with the level of service which they received. However, one in eight replied that they could think of ways of improving the service provided by the merchants. The most frequently made suggestions were about the information provided about types of fuel, about the grouping system for bituminous coals, and delivery dates of fuels.

About half the consumers did not know if their merchant was a member of ACMS.

Chimney cleaning

The advice from the SFAS is that chimneys should be swept twice a year, but only 56% of consumers swept their chimneys once a year. Chimneys where bituminous coal was burnt were swept on an annual basis by 71% of consumers, and by 39% of users of manufactured smokeless fuel.

The general level of satisfaction with chimney sweeps was high, even among the 12% who reported that the sweep had used vacuum techniques without using brushes.

Information and advice

Consumers were asked where they would go to find help on a series of topics:

■ On appliances	25%	Solid Fuel Advisory Service
■ On solid fuels	52%	Coal merchant
	23%	Solid Fuel Advisory Service
■ Finding a merchant	38%	Telephone book
	33%	Friends/neighbours
■ Finding a sweep	49%	Telephone book
	28%	Friends/neighbours

Conclusions

A consumer council has to have a strategy for best representing consumer interest on a restricted budget. In the last decade the DCCC has chosen to operate through:

- discussion
- persuasion
- publicity
- government

The work of the Council has been instrumental in the consumer seeing: increases in appliance efficiency; an

overhaul in the guidelines governing merchant service; increased publicity about coal and the industry; a growing awareness of the need for more ergonomic design in appliances; an increased number of new houses being built with chimneys.

The Council's work on solid fuel appliances, prices, fuel quality, safety and service, continue in an attempt to help consumers. If the coming 40 years are anything like the last 40 years there are still many changes ahead for the solid fuel industry and the consumers it supplies.

References

- 1 The Coal Industry Nationalisation Act, 1946 (9 & 10 Geo 6 C 59).
- 2 A Strategy for Reform. The Department of Trade. December 1982.
- 3 Annual Report for 1985, The Domestic Coal Consumers Council. Appendix 6.
- 4 Annual Report for 1986, The Domestic Coal Consumers Council. Appendix 6.
- 5 Unpublished work carried out by The Coal Research Establishment, British Coal. Summary: *Appliances and fuel quality*. A research seminar. The Domestic Coal Consumers Council, pl-19, June 1985.
- 6 Efficient Boilers. *Which?* The Consumers Association. March 1984.
- 7 A Survey of Consumer needs and attitudes. The Coal Consumers Council. 1984.

The author is chairman of the DCCC Research and Technical Committee, and senior lecturer in the School of Applied Science at the University of Durham

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Institute of Energy conferences

The following programme of conferences is currently being organised by the Institute of Energy, and its associated overseas societies, and other UK societies 'in association' for the event. See also Branch Conferences on p21.

In 1988

25/26/27 April **Gasification – status and prospects**
Venue: To be announced
Chairman: H B Locke (Cadogan Consultants)

14/15 December **Fluidised combustion in practice – clean, versatile, economic**
Venue: London
Chairman: J S Harrison (British Coal)

In 1989/90 (Dates and venues to be announced)
Ceramics for energy – new opportunities and applications
Chairman: M L Hoggarth (British Gas Midlands Research Station)
Industrial energy management conference (see loose insert in this issue)
Chairman: J R Monson (British Steel Corporation)

Conferences with which the Institute is in association: 1988/89

In 1988 **Engineering for profit from waste** (Institution of Mechanical Engineers)
 15 March **Venue:** Crest Hotel, Coventry
Contact: Conferences Department, Institution of Mechanical Engineers on 01-222 7899

21-24 March **First European conference on industrial furnaces and boilers** (see loose insert in this issue)
Venue: Hotel Penta, Lisbon, Portugal
Contact: Prof A Reis on (010 351 2) 564849 (Oporto). Telex 26261 ENTEC P

13 May **Process technology for the clean use of fossil fuels**
Venue: Society of Chemical Industry, London
Contact: Mrs A Potter at the Society of Chemical Industry on 01-235 3681

20/21/22 **First European conference on desulphurisation for coal processing systems**
 September (Institution of Chemical Engineers)
Venue: University of Sheffield
Contact: Conferences Department, Institution of Chemical Engineers on (0788) 78214

In 1989

7-12 May **6th international conference on fluidisation** (Engineering Foundation, New York)
Venue: Banff, Alberta, Canada
Contact: Harold Comerer, Engineering Foundation, 345 East 47th Street, New York 10017. Telex: 126022

Equipment qualification for the Sizewell B pressurised water reactor *(continued)*

cooled fast reactors), but also in relation to overseas and non-nuclear projects for the offshore gas and oil industry, micro-electronic industry, British Gas and the motor industry. The company's capabilities include the total design and construction of nuclear power stations, NNC having been responsible for 16 nuclear stations in the UK (14 of which are operational, the other two being the latest AGRs at Heysham and Torness which are due to raise power in the near future), and overseas stations at Latina in Italy and Tokai Mura in Japan.

The project management and overall station design of Sizewell B is the responsibility of the CEGB through the Project Management Team (PMT): this organisation is staffed by both CEGB and NNC professionals. NNC further supports the project by means of direct contracts, the principal ones being for system specification and safety analysis work, engineering support tasks and R&D support. Furthermore, a joint NNC/Westinghouse

project and design group, PWR Power Projects, is being established as a contracting organisation for the engineering, supply and setting to work of many reactor auxiliary systems.

Under the R&D contract from the PMT, NNC have established a number of major facilities specifically directed to PWR work in addition to those described for environmental qualification, notably in the areas of component development, circuit chemistry, plant corrosion and tribology. Test rigs have also been constructed to model specific post-fault heat transfer conditions in the reactor vessel and to model the flow characteristics of fluid safeguard systems. The CEGB are encouraging the development of PWR expertise based on a 'centres of excellence' concept whereby particular organisations and associated facilities are recognised as the primary centres of expertise in certain fields.

□

RWMAC – an independent body

I feel I should make a personal response to the personal viewpoint by Stewart Boyle of Friends of the Earth (*Energy World*, October 1987). He referred to me as a 'strong nuclear power supporter'.

I fear this is a mis-statement by one who is himself strongly against nuclear power. I was a member of the Royal Commission on Environmental Pollution from 1973 to 1979. In 1976, when Lord Flowers was the chairman, we produced a report on nuclear power in the environment. This report was by no means popular throughout the nuclear industry. Since 1981 I have served, and still serve, on RWMAC (the Radioactive Waste Management Advisory Committee). Transport issues arise in connection with the movement of *all* radioactive materials, including medical and in-

dustrial isotopes, and I chair ACTRAM (the Advisory Committee on the Transport of Radioactive Materials).

I consider that my role in all these complex areas is to ask, or encourage others to ask, the 'idiot questions' of those with the statutory responsibilities. In so doing I can represent the point of view of the uncommitted member of the general public. I hope to elicit and test replies that can be passed on in language that will help members of the public to make up their own minds rationally and on the basis of correct and sufficient information.

I have stated to Dr Donn, who works on behalf of Friends of the Earth, 'I would not myself say "no" to nuclear power as such, though I am concerned that it should be operated with real

regard to environmental safety and I think RWMAC contributes to this end'. RWMAC in Chapter 3 of its 7th Annual Report stated that it would welcome a further member, or members, with relevant expertise in the environmental field if ministers wished to appoint them. I have stated personally that I should like RWMAC to be perceived by the public as an independent body in the same sense as is the Royal Commission on Environmental Pollution.

I believe our future energy policy should be based on a diversity of sources. The need to include nuclear power within such a policy depends both on financial considerations and on the pace of development of alternative technologies including fusion.

LADY ANGLESEY

ESI is not burying its head in the sand

I am glad to have the opportunity to reply to RJR Budden's letter printed in the October issue of *Energy World* (Letters, p18).

Mr Budden was perhaps understandably perplexed when I referred to the Electricity Council's Medium Term Development Plan (MTDP), as a recent publication when it was published in this journal nine months after the issue of the Plan (*Energy World*, July 1987).

Regrettably summaries of this type may sometimes be delayed because of a lack of space, but nevertheless it was deemed important enough for it to be subsequently published by the editor.

The supposition that future Plans would be published was reasonable at the time of writing, November/December 1986, because the Plan has been available annually ever since the Church House conference in 1976. At that conference it was decided to indicate the direction and intended objective of all the varied facets of the ESI (Electricity Supply Industry) which the Council, as the quasi-federal body, deemed to be appropriate. Each Plan looks forward over a seven-year

period indicating how efficiency and performance will be improved within strict tenets of an economic plan.

Some of the views expressed in my article would have obviously been amended if it had been written after the June 1987 elections. It is abundantly clear that ever since the Conservative Party came to government under Mrs Thatcher in 1979, and again in 1983, that her policy of the privatisation of the ESI would be carried out. Nothing other than a reversal of government policy by some other political party will change that action. It is thus quite useless for the Opposition to waste time and money on attempting to do so. Far and away the best approach will be to work to obtain the best deal for consumers and the staff in the industry to ensure a greater degree of performance as each year passes. That was the lead I was looking for from the Council.

It is open to public debate whether the policy pursued by the Electricity Council, CEGB and Area Boards should have encompassed plans for the restructuring of the industry along privatisation lines. Not to do so, was I submit, wrong, hence

my expression 'head in the sand'. To underline the point: one is unable to see clearly what is to be gained by the major restructuring of the CEGB which has taken place over the last two or three years. This has been undertaken at considerable cost during the 11th hour of this monolithic industry.

The money so spent in undertaking such a reorganisation gives rise to the question, 'what will be the economic return'? It will not be possible to measure it in any known terms. Efficiency and performance are placed against technical parameters and those have risen every year since 1948.

RJR Budden is quite correct to state that Sir Philip Jones, chairman of the Electricity Council, did refer to the privatisation issue briefly at the time of the Annual Report presentation in July 1987. One hopes that the plans for privatisation of the ESI are not delayed too long, because until then all are left in a static position, which is not good for consumers and industry alike.

F JOHN L BINDON
(Member)

UK tidal power schemes

I continue to read of new developments in the Severn and Mersey power generating barrage schemes.

We know that the greatest difficulty in development of these is that there is no direct customer for the output, since the power is mainly generated when it is not wanted. They are not in fact power stations but rather harvesters of tidal energy. As with any other harvest, what

is needed is a store to put the harvest in until there is a demand for it. What is needed to turn these tidal energy stations into true power stations is an energy store, and, in the context of these two schemes, an energy store somewhere between where the energy is released and where it is consumed is required. That is a store somewhere between Bristol or Liverpool and the south-east of England. Could not

the authorities promoting these schemes look again at the concept of underground pumped storage?

To my own knowledge this concept (that of a large underground cavern excavated at the maximum depth possible with the head available from current state-of-the-art high head hydroelectric machines, filled with water at times when

(Continued on p 16)

Gas turbine theory (third edition)

H Cohen, G F C Rogers and H I H Saravanamuttoo
Longmans, 1987
414pp. £19.95

This third edition of the highly successful student textbook first published in 1951 follows the original approach based mainly on the thermodynamic and aerodynamic theory of gas turbine design.

The first chapter deals with the various gas turbine systems, starting with single systems, combined cycles, and then sequentially open cycles (single and twin-shaft arrangements), multi-spool arrangements, closed cycles, aircraft propulsion and industrial applications. This introductory chapter closes with an outline of gas turbine design procedures. The subsequent approach is then conventional with chapters dealing in turn with cycles, compressors, combustion, turbines and then the performance of the overall system; an excellent appendix gives a summary of the gas dynamic background. Gas turbine cycles are next considered, in two chapters, the first dealing in reasonable detail with shaft power cycles, including COGAS cycles, cogeneration schemes and closed cycles. The second chapter deals with gas

turbine cycles for aircraft propulsion. The following two chapters give good accounts of the basic theory of centrifugal and axial flow compressors.

The sixth chapter deals with combustion systems but as the authors point out this is not yet so amenable to theoretical treatment as the other components of a gas turbine. This may be the case but the treatment here, whilst adequate, is very qualitative and quite short. However, the main factors influencing combustion chamber design are clearly given.

The next chapter deals with axial and radial flow turbines and again a good basic coverage is undertaken. The last two chapters deal with the prediction of performance of a gas turbine system as a whole, including briefly control systems. The book concludes with problems taken from university examination papers and a list of some 93 references.

The book gives an excellent coverage of basic gas turbine theory for undergraduates. It does not cover some of the more advanced areas and in particular does not deal with computational fluid mechanics (although references are given for this aspect) nor advanced combustion theory, and consequently is of little value to workers in the field in that respect.

Prof Alan Williams

today's large industrial plants have been built for maximum economic gain, but however, sees them as having greater potential for accidents although they have more resources to reduce the risk. In many ways these two points are self cancelling although they are at the core of the problem.

In a later chapter the author quantifies hazards and discusses the measurement of accident potential in terms of a mortality approach. In this, a series of indices are used for vapour cloud, fireballs, toxic releases and other chemical reactions. These comparisons can be seen as extremely meaningful in accident analysis.

The case histories given in this book are most interesting covering as they do, many of the major industrial accidents which have occurred since the Second World War. These cover cataclysmic fires, rarefied gas explosions, toxic releases and other forms of chemical accidents.

The author presents a very knowledgeable view in a chapter on the siting and protection of buildings and yet another chapter dealing with training and management control. The book concludes with a major summary of the complete work and a series of technical conclusions. A number of appendices are provided as well as an excellent series of references and a splendidly devised index.

F John L Bindon

Major chemical hazards

V C Marshall
Ellis Horwood, 1987
587pp. £59.50

This book is an important and authoritative work on the chemical industry written by Dr Marshall. He is a noted authority in the field and has served as a member of the Major Hazards Advisory Committee from its inception in 1975 until the completion of its work in 1983.

The book is a comprehensive survey of chemical hazards, but it does not include coverage of any nuclear radiation incidents.

The objective of any industrialised society is to seek ways to eliminate or at least minimise accidents, and to ensure that the risks encountered in any activity are not serious to the workforce or the public.

The aim of this book is to:

- Identify hazards which possess the potential for major harm to a population.
- Examine the circumstances involved in hazards which might lead to potential danger.
- Identify the consequences likely to ensue if such a potential is realised.
- Examine the various methods of control.
- Survey the preventable measures required to mitigate hazards.

This book certainly meets all its ob-

jectives and the need for such a book is very apparent if one looks back at the major accidents which have occurred in the last 50 years. We have witnessed cataclysmic fires and explosions and massive releases to the environment of toxic substances. Events at Bhopal, Mexico City, Seveso, and Flixborough are amongst the 40 or so case histories which have been specifically re-appraised for the reader.

Regardless of the consequences and the media coverage given to major accidents, disastrous events with a loss of human life do not appear to have had other than a momentary passing concern for society. The chemical accident at Flixborough with the loss of 28 lives was dwarfed by the enormous loss of life at Bhopal and Mexico City. Despite rapidly advancing technology, it is quite apparent that we have much to learn.

Past events fade in the memory and given a decade or so, a new generation of technical managers emerge. The author appears to make a plea to retain a constant pool of technical expertise which every industry can call upon. This is a new idea and although obvious it is one which certainly in Britain we need to pay greater attention to.

Dr Marshall's book can be described as a standard work of reference in this field. He examines the nature of the problem in chemical engineering safety and portrays the growth of the chemical and process industries worldwide. He concludes that

LETTERS (continued)

power is required and pumped out when surplus power is available) has been around for two or three decades. The predecessor of my own company studied it quite seriously in the early seventies when, of course, it met with no favour from the CEGB because it would have spiked the wheels of Dinorwig. However now that Dinorwig is with us and is, one hears, operated in 'spinning reserve' mode (that is not in diurnal storage and recovery), could not the case for storage underground be reconsidered? It is accepted that it would greatly increase the capital cost associated with tidal power but since it would also seem to greatly increase its value to the CEGB there might still be a favourable cost/value relationship. Since it would also greatly increase the constructional work, the present tidal power promoters should view it favourably, as should ETSU (or whoever else it is authorising the present funding). Tidal power is incontrovertably a potential fossil/nuclear fuel energy saver.

H J HIBBERD
(Member)



European Commission Energy technology grants

The European Commission offers grants to support demonstrations of the technical and economic effectiveness of novel energy technology at commercial scale.

Up to 40% support is available (with no requirement for repayment) for projects on:

- *Energy savings* in industry, transport, buildings, agriculture and energy industries.
- *Substitution of hydrocarbons* by use of electricity and heat or by use of solid fuels.
- *Renewable energy sources*: biomass and energy from wastes, geothermal, small scale hydro, solar and wind energies.
- *Liquefaction and gasification of solid fuels*.

Applications are invited annually from suppliers of equipment or technology or from users working with their suppliers. Novelty may be in the technology, in its scale or application, or in a new combination of established techniques. Projects must include a monitoring phase to prove the performance. Payback must be

attractive to subsequent users and proposers are required to promote the wider commercial use of their equipment.

Industrial pilot projects are accepted in liquefaction and gasification of solid fuels, but the scale must be sufficient to give reliable economic and technical data.

The Commission welcomes (but does not insist on):

- proposals involving cooperation between organisations in two or more member states,
- proposals which offer environmental benefits as additional features to the main requirements.

About 100 MECU (£70 M) is available each year. Many British companies have benefitted from this programme.

If you want further information or help, contact: Fraser Ferguson at Department of Energy (01-211 3772) for enquiries on solid fuel sectors; Ken Linacre at Energy Technology Support Unit (0235 834621 ext 3502) for enquiries on all energy saving sectors, biomass and energy from wastes and use of electricity and heat; Eric Bevan at Energy Technology Support Unit (0235 834621 ext 3459) for enquiries on other renewable energy sources.

Source: *Department of Energy*

Technology centres A first for Wales

Ian Grist MP, Parliamentary Under Secretary at the Welsh Office, has announced that Britain's first regional technology centre is to be based at the Welsh Development Agency, Cardiff. The centre will be designed to bring industry and the skills of the education sector closer together.

An initial £100 000 is being used to set up the project. The money comes from the PICKUP programme, which is jointly funded by the Manpower Services Commission, the Welsh Office Education Department, and the Department of Trade and Industry. Dr Glyn O'Thomas has been appointed coordinator.

The centre will be managed by WINtech, the technology arm of the Welsh Development Agency, which exists to assist the growth of all kinds of technology related companies in Wales and helps with new product acquisition

and development, use of new production techniques, market analysis, training requirements and the improvement of industry's links with academia.

Ian Grist said: 'The setting up of this technology centre is an important partnership between the world of industry and education. Research and development in the field of technology, which is already very much part of WINtech's role, will be strengthened by the inherent expertise and training available in colleges.'

The main aim of the centre, which will be known as the Wales Technology Centre, will be to bring together industry and academia to identify training expertise in South Wales. The ventures resulting from the work of the centre will provide the platform for a stronger knowledge base between academics and industrialists, that will ultimately enable a well structured growth path for the development of technology education in Wales.

Source: *Welsh Development Agency*

Wind power In the sun

The British territory of the Turks and Caicos Islands has taken the first step towards developing a full-scale wind farm by commissioning a 50 kW vertical axis wind turbine.*

The \$300 000 project is being financed by the Canadian International Development Agency, Turks and Caicos Utilities (TCU) and the Turks and Caicos Govern-

ment to demonstrate the feasibility of using wind energy to offset the use of diesel fuel.

The 65 ft high machine is expected to produce about 65 MWh of electricity annually and result in a 1% saving on the cost of fuel. Discussions are taking place for the development of a \$600 000, 300 kW commercial project which would result in a 10% reduction in fuel costs for the islands.

Source: *RTZ Group*

PEP awards Winners save £4 M

A company producing potato crisps in Newport, Gwent, and a manufacturer of alloy car wheels of Rochester in Kent, were presented with the electricity supply industry's national PEP - Power for Efficiency and Productivity - Awards for 1987 by Mr Peter Morrison MP, Minister of State for Energy.

The winning firms, Benson's Crisps (South Wales) and GKN Kent Alloys, were judged the best of an initial entry of 344 companies in this nationwide energy efficiency competition. They were first selected as two of 28 regional winners which, between them, made total annual production cost savings of over £4 M and had an average payback on capital investment of just 20 months.

The PEP Award scheme was introduced by the electricity supply industry to reward companies who have significantly improved their performance by adopting an electrical process or service. Regional competitions were held by the 14 Electricity Boards in England, Scotland and Wales this year, and produced winners in two categories - for companies with up to 100 employees and for those with over 100.

In introducing the presentation ceremony, Sir Philip Jones, chairman of the Electricity Council, stressed that many PEP projects show that a simple reduction in energy costs, vital though this is to industry's competitiveness and profitability, is only part of the case for using electricity. The regional winners show that there is scope for big improvements in business performance by using electricity to improve labour productivity, to reduce material waste, to speed up the production process. There are many examples where introducing the electrical option has made an impact on the quality of the product, and for some, increased the range of products available.

Benson's Crisps (South Wales) won first place in category one for the production benefits gained from the installation of an electric air knife for drying potato slices before cooking.

The air knife directs a 'blade' of low velocity air to remove 245 litres of water per hour from the washed produce. This has reduced energy use by 25%, which was previously wasted in heating the water carried over into the cooking oil. This benefit alone recovered the capital investment in just 17 weeks. Benefits of increased productivity, fewer rejects and improved product quality have also been gained.

Winner of category two (companies employing more than 100 people), GKN Kent Alloys, recovered their investment in electric induction melting and resist-

* Indal Technologies of Canada

ance holding furnaces in seven months. The new equipment, which has replaced gas-fired furnaces, has increased output by 66% of cast aluminium alloy wheels for the quality car market.

Metal quality has been improved and scrap reduced because there are no longer any combustion gases to cause water vapour reaction in the metal. Also, reduction of dross formation has nearly halved melting losses, which has previously cost the company about £250 000 a year.
Source: Electricity Council

Electricity privatisation Scottish boards disagree

Clear differences of opinion are emerging between the two Scottish electricity boards over the way in which they would like the Scottish electricity industry to be privatised, reports the *Financial Times*.

The North of Scotland Hydro-Electric Board (NSHEB), which serves the northern part of the country, is believed to be opposed to the plan for the future structure for the industry favoured by the much larger South of Scotland Electricity Board (SSEB).

The SSEB has made clear in recent weeks that it wants a single holding company set up to own both the SSEB and the NSHEB. The public would have shares in that holding company.

The two boards finance their generating systems jointly and utilise their power stations according to a single merit order, similar to that operated by the Central Electricity Generating Board in England and Wales.

Power is drawn from the most efficient power station in the merit order, irrespective of which board runs it. The Scottish boards handle generation and transmission, as well as distribution.

The SSEB believes that the two boards would keep their autonomy under the holding company. The NSHEB believes that under a holding company it would lose its identity, staff morale would suffer, and the service to remote communities would suffer.

The NSHEB would prefer the two boards to be privatised separately, a solution that would also provide more competition, since it would be possible to compare the performance of the boards against one another.

The NSHEB does not think that the existence of separate boards would hamper the close collaboration between the two boards. Charterhouse, its financial advisers, are thought to believe that with revenues that in 1986/87 totalled £324.5 M the NSHEB would make a sizeable public company in its own right.

The NSHEB's financial advisers are also understood to think that the board would be attractive to investors as a separate entity, although some conversion of the NSHEB's debt into equity might be necessary. In the last financial year, the board made a net profit of £22 M.

Source: Financial Times

Sizewell B Validation contract awarded

The Inspection Validation Centre (IVC) has been awarded a £13 M contract for the validation of procedures and equipment for the ultrasonic inspection of Sizewell B incredibility of failure plant. The contract has been placed by the Central Electricity Generating Board's Sizewell B Project Management Board and utilises the facilities established at the IVC under the terms of an earlier contract to validate operators, equipment and procedures for the ultrasonic inspection of the Sizewell B reactor pressure vessel.

The new contract involves several Sizewell B primary circuit components – the steam generators, pressuriser, primary pumps and reactor internals.

The ultrasonic inspections considered are those to be applied to the ferritic forgings, plates and welds and the austenitic forgings and plates.

The aim of the validation is to provide independent confirmation that the ultrasonic inspections are capable of achieving

the purpose for which they are intended. A total of 48 procedures are to be validated and for each procedure the IVC is required to assess the procedure capability for flaw detection and sizing against the flaw types specified by CEGB.

The assessment will include a demonstration that a typical ultrasonic operator is capable of applying the procedure in a satisfactory manner. A statement on the findings of the IVC will be issued to CEGB after each validation.

The practical validation work will require the fabrication of test specimens of representative geometry containing flaws of known character and precise size.

For ferritic material the welding techniques developed under the reactor pressure vessel contract may be used for flaw manufacture and implantation.

For austenitic material however, IVC will have to develop alternative methods because flaw implantation by welding would highlight the flaws and give away their position too easily.

The Incredibility of Failure contract, which is worth £13 134 812, is scheduled to extend until February 1993.

Source: UKAEA

LPG a training package

Liquefied Petroleum Gas (LPG) is the most common hazardous substance in use today and the fact that most people handle it without realising they are doing so is a testimony to the good safety record in Britain, Dr John Cullen, chairman of the Health & Safety Commission said at the launch of the Institution of Chemical Engineers training package on the safe handling of LPG.

The video training package has drawn on the experience and expertise of the Health & Safety Executive and a number of large companies. The package combines video texts, case studies, slides and guidance notes. It will be of value for the training of new recruits and of in-service personnel alike. One important characteristic is that it has been developed by engineers – who are well placed both to assess the hazards and the practical aspects of training that need to be addressed.

Source: Institution of Chemical Engineers

. . . a British standard

BS 4250 *Specification for liquefied petroleum gas*, first published as a specification for commercial butane and propane, has now been issued in two parts with modifications to the existing requirements due to growth in the usage of LPG for automotive purposes.

BS 4250: Part 1 *Commercial butane and propane* will particularly affect the LPG production industry, also those who use LPG for heating and cooking, domestic or industrial. The revision of the standard will overcome previous inadequacies which have come about

because of changes in the various applications of liquefied petroleum gases. New features in this revised version include the introduction of a limit for copper corrosion, a valve freeze test requirement (previously a recommendation) for propane and a new test temperature for vapour pressure, 40°C. The vapour pressures limit for portable containers has been deleted. A limit for C₃ hydrocarbons replaces the volatility test.

BS 4250: Part 2 *Automotive LPG* will also benefit the LPG production industry, along with the motor industry and users of engines operating on LPG, or engines originally designed to operate on fuel specified by standards BS 4040 and BS 7070 with suitable modification. A requirement for residual matter included in Part 1 only for guidance is incorporated into Part 2 as a limiting requirement. Requirements for motor octane number to ensure satisfactory engine performance and a minimum vapour pressure limit for cold starting performance are specified for fuels whose usage does not include stationary engines and fork lift trucks.

Copies may be obtained from BSI Sales, Linford Wood, Milton Keynes MK14 6LE. Price: Part 1 £16.20 (£6.48 to BSI subscribing members). Part 2 £11.00 (£4.40 to BSI subscribing members).

Source: BSI

Danger at work On the increase

The latest statistical report containing information on accidents at work over a five-year period, published by the Health and Safety Executive, shows an increase in fatal and major injury rates in manufacturing from 71 to 91 per 100 000 employees and in construction from 164

to 232 between 1981 and 1985. Within this, the rates for fatal injury remained fairly constant as compared with a previous declining trend.

The report estimates the rate of reported major injuries to be 50% higher in small manufacturing establishments employing less than 100 people compared with larger ones. Another study in the report shows that men in the 16-24 age group are most at risk of injury at work.

The figures have to be interpreted with care because of changes in the accident reporting system in 1981 which imposed new requirements to report certain kinds of work-related injuries. In some sectors this may have led to the reporting of more injuries, but the report says that this factor is much less likely to have affected the construction and manufacturing industries.

A scrutiny of injuries to children at work show only 14 cases of reported injury to children aged 13 to 15 in casual employment between 1981 and 1984 — considerably fewer than earlier estimates suggested.

The report also contains statistics on prosecutions and enforcement notices which have continued to be issued at roughly the same level over the period, though the provisional 1985 figures are lower than in preceding years.

The available information on occupational diseases shows continuing downward trends for pneumoconiosis and byssinosis but the number of new cases of asbestosis has increased as has the number of death certificates mentioning mesothelioma which reflects the increasing use of asbestos through the 1940s and 1950s. For the first time the mesothelioma deaths have been analysed by age and sex and suggest that the number of female deaths may have levelled off.

Another new feature is the information on gas safety statistics which is included because HSE took responsibility for enforcing gas safety functions from February 1984 and statistics relating to the supply of piped mains gas, including carbon monoxide incidents, fires and explosions, are published.

Health and Safety Statistics 1984-85 is available from HMSO or booksellers, price £9.00.

Source: *Health and Safety Executive*

Science research The funds are not available

The low level of spending on research is depriving scientists of the tools of their trade, without which basic knowledge cannot be improved, the president of the Royal Society said in December, *The Times* reports.

Sir George Porter predicted dire consequences for industry and the economy, when he said 'no great industrial nation has been able to succeed for long without a strong indigenous scientific base'.

In his annual address on the state of health of science in Britain, Sir George

New Technologies in Coal Fired Power Stations

The merits of coal gasification for combined cycle power generation were discussed at a recent meeting of the Institution of Chemical Engineers Coal Utilisation Subject Group. Delegates were told that there was enough experience of pressurised coal gasifiers in the world to demonstrate that technically, coal gasification had been proved. A figure of 39% for net thermal efficiency was implied by one recent study.

In opening the meeting Prof Jim Swithenbank (immediate past president of the Institute of Energy) pointed to data from the World Energy Conference that predicted a large growth in coal use in the period 2150-2500. It was expected that coal use would rise to 24 billion t/year. Prof Swithenbank also cited the correlation between energy savings made by nations and their GNP; Japan headed the international league table.

Prof Swithenbank ended with the conclusion that coal was on the upswing and that there were clear incentives for energy conservation and environmental improvements.

New developments in solids handlings that employed hydraulic and pneumatic systems were presented. The sheer size of coal and ash handling operations was clear.

said: 'The simple logic is that one cannot apply science if one has no science to apply'.

His main criticism was aimed at the management of the funding of research and development.

He said: 'While in other respects the United Kingdom is prospering, it seems that the pursuit of natural knowledge is to be allowed to diminish.'

On levels of funding, he observed that total government spending on research and development, as a proportion of gross domestic product, was comparable with other countries. Yet the amount spent on improvement of natural knowledge, or strengthening the country's science base, was very small.

He suggested there was a confusion between essentially different activities which flourished in different environments.

One grew from the ideas of talented individuals who were given the freedom and independence to work in finding new knowledge. The other was directed research, often by an interdisciplinary team, including those experienced in markets and finance as well as technology.

Sir George said: 'We should encourage industry to do its own applied research and development, and much more of it. Equally, we should encourage the universities to concentrate on individual, innovative work which, although it will inevitably be exploitable if it is good science, is pursued with the objective of improving knowledge for its own sake.'

Sir George said that little more than

The different alternatives and associated costs of the flue gas desulphurisation programme currently being undertaken by the CEBG were reviewed and Jim Harrison (Fellow) of British Coal detailed the developments and experience at Grimethorpe fluidised bed. He referred to tube wastage and sulphur retention in the bed.

Mr Grinzi of Snamprogetti brought a global view to the proceedings with reference to a recent USSR power station conversion to coal water mixture (CWM) firing. The project involved the pumping of CWM from the colliery 256 km away, through part of Siberia to the power station.

The meeting concluded with a lively discussion.

The next technical meeting of the Coal Utilisation Subject Group will be 23 February 1988 on the Technical Aspects of Internationally Traded Steam Coals (see Special Announcements). Further meetings are planned in 1988 covering a range of topics.

Is there any interest in setting up a Special Interest Group on coal, possibly to collaborate with the IChemE? Please let me have your views: Dr Anne-Marie Warris, Babcock Power Division, 165 Great Dover Street, London SE1 4YA. Tel: 01-407 8383 ext 2390.

0.5%, or £27 M, of the total government research and development funding was spent on the improvement of knowledge in main-line physics, chemistry, biology and mathematics in universities.

'We are particularly well endowed with bright young people in this country and their loss is the saddest and most deplorable result of the philosophy of the present time.'

He added: 'It is no longer possible for scientists everywhere and in every discipline to have the funding they think they need.'

Source: *The Times*

New boiler development A real pearl

British Coal has produced a fully automatic coal-fired central heating boiler aimed at the commercial and domestic markets.

The boiler was the result of five years' work by the Coal Research Establishment to scale down proven automatic industrial combustion plant, to cater for the commercial and domestic markets. It uses a new processed coal called Coalflow Pearls. The fuel is specially manufactured for the Coalflow boiler to be small and clean enough to be mechanically and pneumatically handled, as well as being highly responsive to combustion control, as well as low in ash. What little ash there is can be automatically removed to a bin for easy disposal.

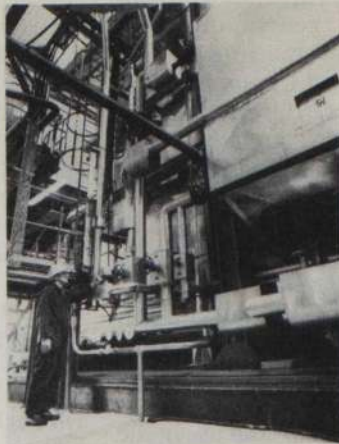
Source: *British Coal*

Waste heat boiler provides CHP scheme for paper products

Foster Wheeler Power Products have installed a waste heat boiler as part of a combined heat and power scheme for a large paper producing company, Rigid Paper Products. Consultants and project managers Zenith Engineering had proposed a Ruston gas turbine/generator set in conjunction with a Foster Wheeler Power Products supplementary-fired waste heat boiler and economiser plant.

A Ruston TB5000 gas turbine drives the generator set to provide RPP with up to 3.8 MW of electricity. The turbine is normally fired by natural gas but is also capable of being fired by light fuel oil. When the electricity supply exceeds the demand, the surplus is sold to the Yorkshire Electricity Board and fed into the local distribution network.

The Foster Wheeler boiler has the capability of producing up to 27.3 t/h of steam to meet intermittent peaks by supplementary firing and can produce 11.7 t/h of steam when operating from the turbine exhaust



The operator adjusts the solenoid valve controlling the steam to the circulation system on the Foster Wheeler Power Products waste heat boiler recently installed at Rigid Paper Products

gases only. In common with the gas turbine, the boiler is fired by natural gas but can be converted to burn light fuel oil, should the necessity arise.

Reader enquiry no 1/1

New domestic fuel

A competitively priced smokeless fuel produced by a new process has been introduced to the British solid fuel market by **Alfred McAlpine Energy**. FLAMELITE is the result of research to reconstitute fine-grained Welsh anthracite from mine tips into a high-quality pelletised domestic fuel.

The low-ash, clean-to-handle smokeless fuel is suitable for open fires, with or without back boilers, non-gravity feed boilers, glass-fronted room heaters and cookers. The FLAMELITE pellets are produced in a custom-built plant using a cold-bonding process originally pioneered by British Coal, before being brought up to large-scale manufacturing standards by Alfred McAlpine Energy. The process uses a new starch-based binder which needs no heat for bonding, making it cheaper than the heat-based process traditionally used for anthracite briquettes.

Reader enquiry no 1/2

Controlling acid gas emissions from waste incinerators

Until comparatively recently it was considered sufficient to minimise dust emission from waste incinerators by means of electrostatic precipitators. Whilst this type of plant ensures that statutory emission levels for particulate matter are adequately met, it is not designed to remove the harmful acid gases such as sulphur dioxide, hydrogen fluoride, hydrogen chloride, and heavy metals, which have continued to be discharged to atmosphere.

The design, manufacture and installation of gas scrubbers therefore has long been one of the more important activities of the **Peabody Holmes Process Division**. The considerable volume of practical experience accumulated by this company over many years has been further extended by recent projects in Europe in which gas-scrubbing systems have been retro-fitted on waste incinerators.

In each of these installations, plate-type scrubbers incorporating specially designed impingement baffle plates

are used. These provide the necessary close gas/liquid contact which ensures maximum cleaning and maximum absorption of solubles. An additional feature of this type of unit is the use of a venturi slot stage to provide an integral venturi scrubbing system for the removal of residual dust and heavy metals.

A typical installation at Berne in Switzerland comprises two domestic waste refuse incinerators each of which is fitted with a flue gas scrubber based on the Peabody Holmes design. Each scrubber handles 72 000 m³ of flue gas at 270°C. In operation, hot gases from the incinerators are pre-cooled with recycled water sprays until they reach the adiabatic saturated temperature of about 60°C. The gases then pass through impingement plates. The hydrogen chloride and dust, together with heavy metals, are removed by the circulation of water. Sodium hydroxide solution is circulated in the upper section of the scrubber for the removal of sulphur dioxide. Before the cleaned gases pass to the outlet fan, an entrainment eliminator removes any remaining droplets.

Reader enquiry no 1/3

Plant winterising surveys

The **National Industrial Fuel Efficiency Service (NIFES)** have launched a programme of plant winterising surveys aimed at drawing attention to the problem of frozen water pipes. NIFES, one of Europe's leading energy technologists and engineering consultants, have nine operating units spread throughout the UK and employ approximately 160 professional engineers skilled in the conducting of energy surveys. These assess the problems encountered in previous winters, review existing and recently added plant and pipework and propose solutions to past and future potential problems.

Plant winterising surveys cover much more than water pipework, and are tailored to individual clients' production plant. Major areas of investigation during a survey include:

(a) All outdoor water pipework and indoor water pipes in buildings which can be left unheated.

- (b) Storage facilities for water, oil and chemicals.
- (c) Hoppers and silos containing production feedstock, eg cement, roadstone, plastic granules, powder station fly-ash and other hygroscopic powders.
- (d) Compressed air lines, where condensation could freeze and block lines.
- (e) Oil-fired boiler pipework.
- (f) Fire fighting foam tanks and sprinkler pipework.
- (g) Fire escape doors and stairways which are likely to freeze.
- (h) Roof gutters and downpipes which could block with ice and cause floodings in roofs and buildings.
- (i) Steam condensate pipework.
- (j) Coal handling facilities which suffer from blockages owing to flash freezing.

Survey reports can also be commissioned which detail not only recommendations to prevent problems, but also the approximate cost of providing the required equipment, material or services.

Reader enquiry no 1/4

New Volvo Penta industrial diesel engine

The introduction of a 16-litre industrial diesel engine extends the range of engines that **Volvo Penta** now offers from 83 kW to 378 kW. The new T1D 162 adheres to Volvo Penta's proven in-line six-cylinder concept but with significant design innovations. Three versions of the engine are available to manufacturers of generators, power packs and mobile plant or heavy machinery respectively.

Developments include a fuel system that gives effective combustion through the high precision of the rapid injection; effective distribution via vertically mounted injectors with five-hole nozzles and an RQ speed governor to give stable operation in the generator applications.

The turbocharging and inter-cooling system has also been developed to provide high power, low fuel consumption and low exhaust emissions. Careful design of the intercooler offers low initial resistance and short air routes to promote fast response and reduced thermal stresses. An electric air preheater promotes fast starting, good load acceptance and less smoke.

Reader enquiry no 1/5

Fan coil units

Thermal Technology have received an order for fan coil units to be used

on an upgrading project for laboratories at University College, London. Each fan coil unit will be complete with a heater battery and chilled water cooling coil. The VPN style units are designed for horizontal mounting in false ceilings. Each unit will be provided with a remote mounted fan speed controller. Advantages include attention to detail in the design and good acoustic performance.

Reader enquiry no 1/6

Digital display oxygen indicator

The microprocessor-based Z96M digital display oxygen indicator has been designed by **Kent Industrial Measurements** for use with the Kent Z-GP2 and Z-FG zirconia oxygen probes. It has been developed from the Kent P96M controller and is programmable to accept signals from both the O cell and the thermocouple in the Z-GP2 zirconia probe and compute the percentage O₂ from the Nernst equation. Alternatively a fixed temperature may be programmed when operating with either the Z-FG probe or the Z-GP2 probe with no thermocouple.

The Z96M provides analogue retransmission of percentage O₂ with either a second analogue retransmission signal or a serial data communication interface to RS422. An option of up to two alarm relays is also available.

Reader enquiry no 1/7

Boiler efficiency analysing kit

A new low-cost chemical boiler efficiency analysing kit from **Tubemaster** is suitable for use on oil-, coal- and gas-fired boilers. The oxygen, carbon dioxide content and flue gas temperature is measured and boiler efficiency easily established on the four-fuel chart.

Reader enquiry no 1/8

Trade publication

Advanced warm air heating systems. A new 12-page brochure describes and illustrates **Combat Engineering's** full range of gas-, LPG- and oil-fired heaters. Produced mainly for industrial engineers and purchasers, the new brochure contains full technical specification data and product performance standards for every type of warm air heater and ancillary equipment produced. Tabulated data for each heater enable easy reference and rapid assimilation of information relating to heat outputs, fuel consumption, and air flows as well as all mechanical and physical details.

Reader enquiry no 1/9

ENERGY WORLD - COMMERCIAL

(Photocopy acceptable)

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

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

Name

Address

Organisation

**Institute of Energy
1988 Branch conferences**

North-Western

23 and 24 Mar (W and Th). Conference: *Energy for the future*, Royal Insurance Building, Liverpool.

South Coast

8 Sept (Th). One-day symposium: *NO_x generation and control in boiler and furnace plant*. The Crest Hotel, Southsea. In association with the Combustion Institute (UK section).

1988 February meetings

Scottish

2 Feb (Tu). Building energy simulation: present and future, by Dr Joe Clark (University of Strathclyde). Royal Scottish Automobile Club, Blythswood Square, Glasgow at 1800 for 1830 h. Joint meeting with Inst of Hospital Engineering.

Midland

4 Feb (Th). The application of contract energy management to reducing energy costs, by R M B Prosser (Emstar). University of Aston in Birmingham, Senior Common Room at 1900 h.

North-Eastern

9 Feb (Tu). Industrial gas utilisation – recent developments and implementation, by J Masters (British Gas, MRS). Lecture Theatre, Engineering Research Station, Killingworth at 1730 h (tea and biscuits before meeting). Joint meeting with IGasE and Tyneside Energy Managers Group.

London and Home Counties

9 Feb (Tu). Privatisation of the electricity supply industry, by Prof R J Eden (University of Cambridge). Royal Institution, Albemarle Street, London W1 at 1800 h (tea at 1730 h).

Merseyside

10 Feb (W). Investigative analysis of fuels and buildings, by Noel Edge (Bootle Analytical). The Feathers Hotel, Mount Pleasant, Liverpool 3 at 1830 h.

Yorkshire

10 Feb (W). Recent research at the Department of Fuel and Energy, University of Leeds. At the University of Sheffield at 1430 h.

East Midlands

16 Feb (Tu). Visit to see CHP system at British Gas East Midlands HQ, Leicester. Limited numbers. Please apply to J R Agg, hon sec (tel 0533 549414 ext 2037).

North-Western

17 Feb (W). Morecambe Bay development, by R J Martin (British Gas). Ladbroke Mercury Motor Hotel, Nr Chester at 1900 for 1930 h. Joint meeting with Inst of Petroleum.

19 Feb (F). Annual dinner. Manor Hey Hotel, Urmston at 1900 h. Speakers: Lord Ezra; Canon Smith (Rector of Bury).

Personal

Sir Denis Rooke (Honorary Fellow), chairman of British Gas, received the James Watt International Gold Medal of the Institution of Mechanical Engineers on 9 December 1987. It is the premier award of the Institution of which Sir Denis is also an Honorary Fellow. The medal is presented every two years to an engineer of any nationality who has achieved international recognition by his work as a mechanical engineer and by his ability to apply science to the progress of mechanical engineering.

Sir Denis has worked for most of his life in the gas industry. During that time he took part in experimental work to import liquefied natural gas from Algeria and, as development engineer of the then Gas Council, oversaw the many technical

***Institute secretary
appointed chief
executive of IMLS***

Dr H M Lodge has been appointed chief executive of the Institute of Medical Laboratory Sciences and is expected to take up his new post on 1 March 1988.

Dr Lodge has been secretary and chief executive of the Institute of Energy since 1975 and, at a meeting of the Council held on 26 November 1987, formally tendered his resignation as secretary of the Institute.

In his letter to the president, Hilary Lodge wrote: 'It has been a pleasure and privilege to serve as secretary and chief executive of the Institute of Energy for the past 12 years. I have greatly valued the friendship extended to me by officers, members and staff alike.'

'My visits to branches and representation of the Institute at a number of important events have been a particular pleasure. I wish the Institute and all associated with it continued success in the future.'

changes which took place in gas manufacture and distribution during the 1960s and 70s. His contribution to scientific and engineering development in the gas industry has been outstanding and his influence has been international.

Dr A Sanyal (Fellow), Babcock Energy, recently visited India under the auspices of the British Council to deliver lectures on *Energy conservation in heavy manufacturing industries*. He visited three steel plants, and a copper extraction plant in Eastern India. He also gave a seminar in Calcutta to the members of the Confederation of Engineering Industries, Eastern Region on *Coal-fired boilers: optimum utilisation, economic operation and emission control*.

London and Home Counties branch

**Privatisation of the electricity
supply industry**

by

**Prof R J Eden
(University of Cambridge)**

Please see 1988 February meetings above

New Year Honours

We congratulate the following whose names appeared in the New Year Honours List:

CBE

C E Pugh (president-elect), lately managing director, National Nuclear Corporation.

OBE

Prof P E O'Sullivan (Fellow), Institute of Science and Technology, Chair of Agricultural Science, University of Wales, for services to energy conservation.

Members who receive awards in Honours Lists are reminded that they should let staff at the Institute know as soon as possible so that records can be altered.

54th Melchett Lecture: Shell Centre, London, 8 March 1988

The 54th Melchett Lecture of the Institute of Energy will be given by Dr Frank Fitzgerald FEng, managing director, technical of the British Steel Corporation. Dr Fitzgerald will speak on *Energy, high technology and economics in modern steelmaking* in the Shell Centre lecture theatre on Tuesday 8 March 1988 at 1800 h. There will be tea at 1730 h in the lecture theatre foyer.

Admission is free but tickets will be necessary (please apply to the Institute of Energy).

Attention all Sheffield University graduates!

The annual dinner of the Chemical Engineering and Fuel Technology Society will be held on Saturday 6 February in the Kenwood Hall. For further information please contact Lynn Williams (tel 0742 768555 ext 5340).

London and Home Counties: Energy and you, 25 February 1988

The London and Home Counties branch are arranging a special event for student and graduate members in the London area. It will be held on *Thursday 25 February 1988* between noon and 1400 h at South Bank Polytechnic, Borough Road, London SE1, in the Function Room in the Borough Road building (2nd floor) close to the Elephant and Castle. Dr Guy Masdin, president of the Institute, and head of research at Shell is going to talk about *Energy and you*. There will be a buffet lunch (free!) and time to ask questions and meet members of the Institute. We hope that students and graduates will use this opportunity to hear about the world of energy and also benefit from career advice which will be available.

For further information contact Linda Austin (tel 01-940 8161) or Anne-Marie Warris (tel 01-407 8383) during working hours.

Damage prevention in energy engineering plants: Hanover, 24 and 25 February 1988

Besides the investigation into and research on damage, prevention becomes of increasing importance. The conference deals with the following subjects:

1. Risk analysis.
2. Determination and evaluation of damage.
3. Examples of damage.

4. Reliability from the planning stage up to completion.
5. Reliability during operation.
6. Successful results of damage prevention.

Further information from VDI-Gesellschaft Energietechnik (VDI-GET), Postfach 1139, D-4000 Düsseldorf 1, FRG (tel (0211) 62 14-363).

The technical aspects of internationally traded steam coals, 23 February 1988

The next technical meeting of the IChemE Coal Utilisation Subject Group will be held on 23 February 1988 on *The technical aspects of internationally traded steam coals*. Further meetings are planned covering a range of topics. For further information contact Dr G O Davies at the Coal Research Establishment or Dr Anne-Marie Warris at Babcock Power.

Spray combustion: Rouen (France), 28-29 March 1988

ILASS-Europe are organising this conference, which will cover both fundamental and practical work in all industrial areas from oil burning to aircraft and rockets.

Further information from ILASS-conference 88, Prof M Ledoux, Université de Rouen, U.A. CNRS 230-CORIA, BP 118, 76134 Mont Saint Aignan Cedex, France.

Engineering trade mission to South Korea and Japan

For the third successive year, the Engineering Industries Association (EIA) are sending a British Overseas Trade Board supported trade mission to South Korea and Japan. The mission will be for two weeks from 20 May to 4 June 1988 and will be based in Seoul for the first week and Tokyo for the second week. Delegates may visit one country only if they wish.

The Korean economy is performing strongly. Industrial production rose over 20% in the first quarter of 1987 compared with the same period in 1986. Government expenditure and private investment are expected to continue to increase. The country's import liberalisation programme is opening up the market and joint venture operations with British manufacturers are of particular interest. The UK share of the market is falling behind that of West Germany and France. British exporters should not be left behind.

A sharp increase in imports is contributing to Japan's falling trade surplus. In the first half of 1987, imports of manufactured goods rose 32.9%, with imports from EC countries up 35.6%. Since the revaluation of the yen, manufacturers are looking at new sub-contractors, seeking higher quality goods at lower cost. There are increasing opportunities emerging for British exporters, including industrial cooperation in third markets and joint venture operations either in Japan or Britain.

The round-trip travel cost is £1915. The British Overseas Trade Board grant is £800 for companies visiting both markets on a BOTB supported mission for up to five visits. Applications for the mission must reach EIA by *12 February 1988*. Further information from Anna Small, export director, EIA, 16 Dartmouth Street, Westminster, London SW1H 9BL (tel 01-222 2367).

Recognition for education/industry collaboration

The RSA Recognition Scheme for achievement in education/industry collaboration, initiated in Industry Year 1986, will

REGISTER OF ENERGY COURSES

Members are invited to make use of the Institute of Energy's national register of energy courses, through which we can supply salient details of forthcoming courses of all types. As well as the member's name and address, we need to know (a) the specific subject in which he is interested; (b) his present level of technical qualification; and (c) the preferred geographical location. Only details of suitable courses will be sent in reply.

Course No 00-368

Title: Energy management controls and systems – Part 1 Basic control theory.
Duration: 1 day.
Location: Polytechnic of the South Bank, London.
Starting: 16 February 1988.
Content: An introduction to control, theory and application.

Course No 00-369

Title: Energy management controls and systems – Part 2 Microprocessors and control.
Duration: 1 day.
Location: Polytechnic of the South Bank, London.
Starting: 17 February 1988.
Content: An introduction to microprocessor control, interfacing and compatibility.

Course No 00-370

Title: Energy management controls and systems – Part 3 Specification, experience and the future.
Duration: 1 day.
Location: Polytechnic of the South Bank, London.
Starting: 18 February 1988.
Content: This course is intended for specifiers and intending purchasers of energy management systems and controls.

Course No 00-371

Title: An introduction to air conditioning and refrigeration.
Duration: 4 days.
Location: Polytechnic of the South Bank, London.
Starting: 1 March 1988.
Content: An introduction to the fundamentals of air conditioning and refrigeration and an overview of the different types of system employed in modern buildings in the UK, with a strong emphasis on energy conservation and efficient control.

Course No 00-372

Title: Application of computers to building services engineering.
Duration: 2 days.
Location: Polytechnic of the South Bank, London.
Starting: 8 March 1988.

Course No 00-372 (continued)

Content: Experience in the use of computers as a part of the design process and the selection of computer systems. Advice on the different ways in which engineers can get started with computers.

Course No 00-373

Title: Energy management and targeting.
Duration: 1 day.
Location: Polytechnic of the South Bank, London.
Starting: 16 March 1988.
Content: Introductory talks followed by an opportunity to tackle examples under supervision.

Course No 00-374

Title: Basic refrigeration.
Duration: 3 days.
Location: Polytechnic of the South Bank, London.
Starting: 21 March 1988.
Content: Basic thermodynamics of the vapour compression cycle. Description of refrigeration equipment, its operation and control. Aspects of installation and copper piping, pressure testing, leak detecting, evacuating and charging of systems. Fault analysis to cover symptoms, diagnosis and rectification of system faults in refrigeration systems.

Special announcements (continued)

be repeated for 1987/88. In Industry Year over 2000 schools, colleges and companies were awarded recognition certificates, which demonstrated the high standard of work going on across the UK.

The purpose of the Scheme is to recognise, and so encourage, joint activities involving schools or colleges with business and industry. Judging is carried out by local assessment panels which include at least one member from each sector.

The Scheme is not competitive, but assesses activities against criteria of which the most important are that there is evidence that the activity is an integral part of the curriculum, that it is of benefit to students in achieving a better understanding of the role of industry, and that there is a clearly expressed intention to sustain the initiative in future.

Submissions should be sent by companies or schools/colleges to the local assessment panels from now up to 31 March 1988. Further information from Linda Jackson, *Industry matters*, 8 John Adam Street, London WC2N 6EZ (tel 01-930 9120/9129/9139).

Retired Chartered Engineers' Association (Worthing)

The object of the Association is to provide a common meeting ground for retired engineers with similar backgrounds and

interests. Membership is restricted to retired Chartered Engineers and includes members of many of the chartered institutions. The Association is a friendly organisation, it is non-political and non-sectarian. Members meet regularly for coffee, weekly in Worthing and monthly in Hove and East Preston. A coffee morning to include the ladies is held monthly at the Beach Hotel, Worthing.

Meetings with talks and discussion are held on the third Friday of alternate months from September to May. The September meeting is the AGM, the November meeting is given up to the 'Cooch Memorial Lecture' and other meetings are usually addressed by members on subjects of their choosing.

Other activities include: works visits; summer outings, and an annual dinner in October. Further information can be obtained from C S Gibson, honorary membership secretary, 4 Hopedene Court, Wordsworth Road, Worthing, W Sussex BN11 1TB (tel Worthing 201008).

Stop Press . . .

As we were going to press we heard with regret of the deaths of Dr C C Hall CB, a former chairman of the Institute's Finance and General Purposes Committee (now Executive Committee), and G N Critchley, president of the Institute of Energy in 1966-67. Fuller obituaries will be published in later issues.

CONFERENCES

The following conferences, courses and meetings are organised by bodies other than the Institute of Energy. For Institute conferences please see page 14

February 1988

Business opportunities in the 1990s Conference, London (Selfridge Hotel), 11 February 1988. Details from European Study Conferences, Douglas House, Queen's Square, Corby, Northants NN17 1PL (tel (0536) 204224; tlx 341543 CORWKS G).

External revitalisation of buildings Seminar, London (Kensington Close Hotel), 24 February 1988. Details from External Wall Insulation Association, PO Box 12, Haslemere, Surrey GU27 3AN (tel 0428 54011; tlx 8588819 PRADMN G).

March 1988

Oceanology international Exhibition and conference, Brighton, 8-11 March 1988. Details from Spearhead Exhibitions, Rowe House, 55-59 Fife Road, Kingston-upon-Thames, Surrey KT1 1TA (tel 01-549 5831; tlx 928042 SPEARS G).

Multiphase systems and combustion

Meeting, Harwell, 15 March 1988. Details from Dr G T Kalghatgi, Shell Research, Thornton Research Centre, PO Box 1, Chester CH1 3SH (tel 051 373 5703).

On-line condition monitoring and performance assessment

Conference, London (Grosvenor Hotel), 17 March 1988. Details from Rosamund da Gama, Conference Division, Institute of Measurement and Control, 87 Gower Street, London WC1E 6AA (tel 01-387 4949; tlx 943763 Crocom G).

Oil and gas economics - 1990s

Conference, London, 21 March 1988. Details from Nadia Ellis, IBC Technical Services, Bath House (third floor), 56 Holborn Viaduct, London EC1A 2EX (tel 01-236 4080; tlx 888870).

Into 88

Industrial training opportunities exhibition and conference, Birmingham (NEC), 22-24 March 1988. Details from Annie Gould/Elisabeth Coles at EMAP International Exhibitions, 12 Bedford Row, London WC1R 4DU (tel 01-404 4844).

Wind energy technology and its applications

BWEA annual conference and exhibition, London, 23-25 March 1988. Details from Miss Irene Martin, Secretary's Department, Sudbury House, 15 Newgate Street, London EC1A 7AU (tel 01-634 5931).

March 1988 (continued)

The North Sea in the 1990s: economics and technology Conference, Edinburgh, 25 March 1988. Details from Conference Section, Institution of Chemical Engineers, 165-171 Railway Terrace, Rugby, Warwickshire CV21 3HQ (tel 0788 78214; tlx 311780).

April 1988

Disaster and emergencies: the need for planning Conference, London (Regent Crest Hotel), 12 and 13 April 1988. Details from Miss Louise Marriott, IBC Technical Services (see address above).

Managing international 88

Conference, Atlanta (GA, USA), 17-20 April 1988. Details from the American Society of Mechanical Engineers, 345 East 47th Street, New York, NY 10017, USA.

Information technology for nuclear plants

Conference, Geneva (Switzerland), 28 and 29 April 1988. Details from Louise Marriott, IBC Technical Services (see address above).

May 1988

Thermal aspects of materials Société Française des Thermiciens meeting, Limoges (France), 3-5 May 1988. Details from Société Française des Thermiciens, 3 rue Henri-Heine, 75016 Paris, France (tel 42-24-59-35 / 45-24-46-14).

Environmental pollution

Ninth European conference, Corfu (Greece), 19 and 20 May 1988. Details from Dr V M Bhatmagar, Alena Enterprises of Canada, PO Box 1779, Cornwall, Ontario K6H 5V7, Canada (tel 613 932-7702).

Transportation for the nuclear industry

INucE international conference, Stratford-upon-Avon, 23-25 May 1988. Details from Institution of Nuclear Engineers, 1 Penderley Road, London SE6 2LQ (tel 01-698 1500).

July/August 1988

International cooperation for advancement of energy technology Conference, Denver Marriott (USA), 31 July-4 August 1988. Co-sponsored by ASME Advanced Energy Systems and Solar Energy Divisions. Details from Loren Anderson, Dept of Mechanical and Aerospace Sciences, University of Central Florida, PO Box 25000, Orlando, FL 32816-0993, USA.

August 1988

Combustion 22nd international symposium, Seattle (WA, USA), 14-19 August 1988. Details from Prof G M Faeth, programme chairman, 218 Aerospace-Engineering Department, University of Michigan, Ann Arbor, MI 48109-2140, USA.

Peat

Eighth international congress, Leningrad (USSR), 14-21 August 1988. Details from Organising Committee of 8th international Peat congress, Ministry of Fuel Industry of the RSFSR, Sadovaya-Chernogryazskaya 8, Moscow 107813, USSR.

September 1988

Coal Fifth annual international Pittsburgh coal conference, Pittsburgh (PA, USA), 12-16 September 1988. Details from Pittsburgh Coal conference, MEMS, 1 Northgate Square, 2 Garden Centre Drive, Suite 211, PO Box 270, Greensburg, Pennsylvania 15601, USA.

Aquatech 88

Exhibition and conferences, Amsterdam (Netherlands), 19-23 September 1988. Details from Rai Exhibition Centre, Europaplein, 1078 GZ Amsterdam, The Netherlands (tel 020-549 12 12; tlx 10613).

October 1988

GASTECH 88 13th international LNG/LPG conference and exhibition, Kuala Lumpur (Malaysia), 18-21 October 1988. Details from Gastech, 2 Station Road, Rickmansworth, Herts WD3 1QP (tel (0923) 776363; tlx 924312 Gastech).

December 1988

Nemex National energy management exhibition and conference, Birmingham (Metropole Hotel), 7 and 8 December 1988. Details from Energy Systems Trade Association, PO Box 16, Stroud, Glos GL5 5EB (tel 045 387 3568).

Courses (overseas)

Powder mixing technology, Amsterdam (The Netherlands), 22-24 February 1988. Computer aided process engineering, Amsterdam (The Netherlands), 7-9 March 1988. Evaluation and control of process hazards, Amsterdam (The Netherlands), 28-30 March 1988. Details of all three courses from Centre for Professional Advancement, Pales-trinastraat 1, 1071 LC Amsterdam, The Netherlands (tel 02062.30.50; tlx 10662 (cfpa nl)).