

THE SAFE ENERGY

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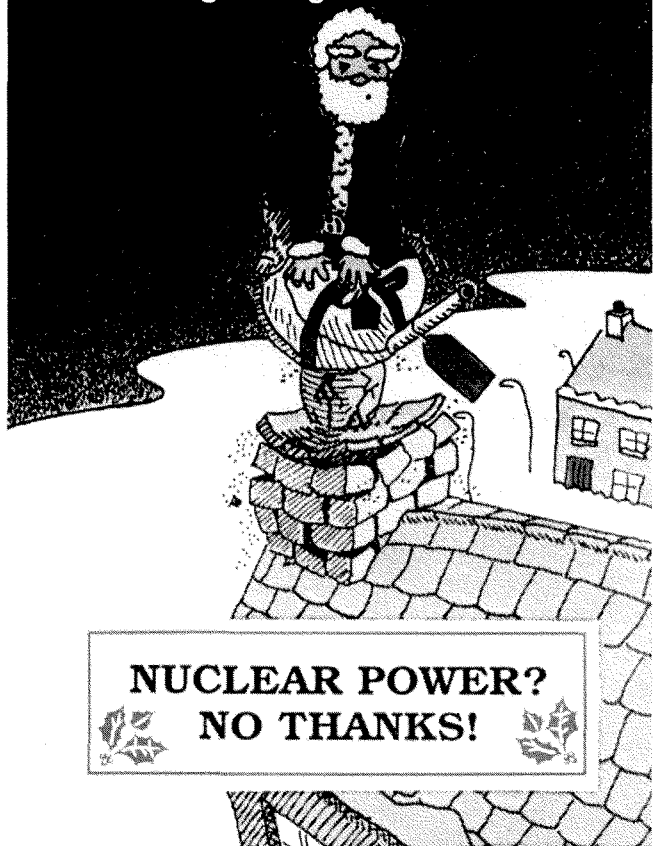


Nuclear waste hits the road

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A dying industry?

CHOOSING *British Energy*, as their new name says a lot about the soon to be privatised UK nuclear generators. Even the nuclear industry doesn't like the word nuclear any more.

The industry appears to be on the rack. It is a long time since it enjoyed majority support from the general public, but it is now having to come to terms with the fact that it has lost the support of government too.

British Energy will be looking to Eastern Europe and the Far East for its future. Western Europe and North America have a level of environmental awareness which makes nuclear activities hard to undertake.

Sellafield and Dounreay survive because they have created a dependency in the surrounding communities, dominating the local economy. Sellafield employs one in every three workers in Cumbria, Dounreay directly supports about one in seven of Caithness jobs. These two sites are now frantically grubbing around to make the UK the nuclear laundry for the world.

As Nirex is finding out at the public inquiry into its proposed Rock Characterisation Facility near Sellafield, it is getting harder to blind people with half-baked science. The public inquiry is weighted heavily in Nirex's favour, with taxpayers' money paying for its case, while hard-pressed environmental groups have to make their case with a fraction of the cash. But Nirex has become more and more anxious as the inquiry has proceeded. Enough doubts have been raised that even if Nirex wins the inquiry there is no certainty that its aim of turning the site into a massive underground dump for low and intermediate-level waste will ever be achieved.

The situation at Dounreay highlights the democratic deficit even more clearly. The

decision on whether up to 14,000 US-origin spent fuel rods from around the world are sent to Dounreay will be made by the US Department of Energy. In considering alternative options, it has consulted widely with the US public. But for Scotland, the DoE is colluding with the UK Department of Trade and Industry to limit the impact of opposition.

It was left to a local group, Caithness Against Nuclear Dumping, to organise a referendum in the county. At the time of writing, the outcome of the referendum is not known, but even a close defeat for those opposed to reprocessing would be significant. Throughout Scotland there is no doubt that the overwhelming majority of people oppose this deadly trade.

An increasingly desperate Dounreay management has condemned the referendum as being hurried. The process will actually have taken around two months. What Dounreay really means is it would rather the result was delayed until after the US decision.

Dounreay management's main justification for the increased emissions of radioactive material which would arise is the economic benefit. But it admits that the US-origin work would create just 25 jobs (and help sustain another 40). Meanwhile, it has been announced that a private contractor, W S Atkins, is to be brought in to manage the nuclear reprocessing and waste plants at the site. The consultants will be looking to cut costs and improve efficiency amongst the 600 employees. Presumably this means job losses — but no outrage from the management about the economic loss to the local community.

If these two campaigns against the nuclear industry are won, it will be in spite of our 'democratic' processes. □

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“Even the nuclear industry doesn't like the word nuclear any more”

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Nuclear industry profits before safety

SAFETY is being dangerously sidelined as the nuclear industry attempts to make itself an attractive proposition to the 'City', according to Scottish Nuclear's (SN) former head of safety, Captain Richard Killick.

In October, Killick related his fears to Labour's Trade and Industry Spokesman, Brian Wilson, warning that low morale amongst over-worked operators caused by the rush to cut costs in preparation for privatisation all pose the threat of a "significant reduction in safety".

Killick has also outlined three main concerns about British Energy (BE), the proposed private successor to SN and Nuclear Electric (NE):

- The new company is unlikely to devote its full attention to the business of running nuclear power stations safely as it concentrates on "overseas developments and other diversifications ... The Board's interests will be on how to develop the company, which does not include developing nuclear." As a result "the nuclear side will become dull and worthy" and as "the brightest staff" are put into "thinking up these new exciting ideas" the lower-management will become demoralised, causing a reduction in safety standards.
- The amalgamation of the roles of Chair and Chief Executive, contrary to all current management practices, contradicts the first rule of nuclear safety: "if you've got key decisions, don't allow a single person to make decisions on his own, unchecked."
- Under private ownership, safety will be left open to a variety of abuses: hundreds of small shareholders would reduce oversight; large institutional shareholders would be intent on "extracting maximum profit"; and a single, possibly foreign, owner might have a radically different idea of safety.

A former director of Nuclear and Radiological Safety at Rosyth dockyards, Killick was invited by Dr Robin Jeffrey — the new chair and chief executive of the SN subsidiary of BE — to join SN's Chairman, James Hann, on the dole queue in September. Stressing that he has no complaints about his treatment or the financial settlement, Killick said: "SN operators are fully aware of the pressures to increase output. There are outputs to be met. They are realisable but they do put pressures on people. It was in the

back of their minds two years ago at Wylfa and is in the back the minds of those at SN. Those pressures haven't reduced yet."

Killick's claims have been echoed by Tony Cooper, secretary of the Electricity Supply Trade Unions' Council, who, in a memorandum to the Commons Trade and Industry Select Committee which is investigating nuclear privatisation, has warned that the new owners of a privatised industry should not be allowed to put profit before safety. He noted that a great many experienced staff have already left, the industry's payroll has dropped by 38% over the last five years: "Facing managers and staff with repeated organisational changes and commercial challenges may yet cause a lack of attention or delay in corrective actions with devastating effects."

SN, however, has strongly rejected the claims, saying: "Safety will remain the company's top priority." Recent accusation from the Health and Safety Executive (HSE) that the management at NE's Wylfa Magnox station had put profit before safety during an accident two years ago have given added poignancy to the safety fears.

NE received a record fine of £250,000, plus £180,000 costs, at Mold Crown Court in September, for taking over nine hours to close down its Wylfa Magnox station on 31 July 1993 after a 280kg piece of a 'parasol' grab fell into a fuel channel. Mr Justice Moorland, presiding over the case, dismissed the HSE's claims: "I am utterly sure that safety was at the forefront of their minds, though they were in error in failing to trip the reactor." He added that although the procedural failures which led to the delay had now been amended to avoid repetition, the fine should be exemplary "to underline the public insistence that the nuclear industry should be conducted with absolute safety."

During the three-day court hearing, it was revealed that the plant's operators originally assumed that the missing

piece of crane had been caught in the refuelling chute which has a bend in it precluding, they thought, direct access to the fuel channels. However, eventually they realised that the two foot long, four inch wide, metal rod was in the reactor. Even when it was spotted by a remote control camera, operators did not believe it was a significant problem. The passage of carbon dioxide coolant gas — which passes through the channels and the roof of the reactor core — would have been blocked, causing dangerous overheating, if it hadn't been for cracks in the graphite moderator which is used to control the chain reaction.

Dr Sam Harbison, head of the Nuclear Installations Inspectorate, described the incident as "a matter of grave concern" and said he was "particularly concerned about the blatant failure of NE's safety culture." He warned that had one more thing gone wrong the core could have caught fire, leading to a "serious release of radioactive material".

Originally classified as level zero on the International Nuclear Events Scale — an anomaly — it was later re-classified as level 2, "an incident with no significant environmental impact, but which involves some internal plant failure."

Meanwhile, in its evidence to the Trade and Industry Select Committee, Greenpeace has said that while it "does not believe that nuclear power stations can be adequately safe in either the public or private sector ... a privatised nuclear industry should not necessarily be more unsafe." Safety advantages could be found in privatisation, according to its evidence, "if regulators take a more searching and rigorous role." Ultimately, "the strength of regulation is a product of political decisions including legislation, personnel appointments, funding and Ministerial and official attitudes to regulation. These decisions may be positively or negatively influenced by privatisation." □



Waste inquiry: cause for concern

A programme of work which threatened to undermine the safety arguments for pursuing Sellafield as a site for an underground nuclear waste repository has been stopped because the government agency charged with finding an answer to the problem of low and intermediate-level waste, Nirex, has refused to pay for it.

After an initial study cast doubt on the long-term integrity of the Sellafield site, Nirex has cut funding into further investigations by HM Inspectorate of Pollution (HMIP).

According to a report commissioned by HMIP from WS Atkins and leaked to the *Independent on Sunday*, plutonium from the repository could heavily contaminate local drinking water, possibly exposing people to radiation doses 10,000 times the current limit.

A second, incomplete study, by R M Consultants, suggests that the movement of underground water could transport radionuclides back to the surface directly above the repository. Yet, at the ongoing public inquiry into Nirex's application for a Rock Characterisation Facility at Sellafield — to study the area's geology and hydrogeology — the company's Director of Science, Allan Hooper, said: "In assessment studies, plutonium-239 is found to return to the surface environment in such low concentrations as to make no significant contribution to radiological risk."

Although Nirex didn't receive a copy of the plutonium report until after Hooper had delivered his evidence, Tom Curtin of Nirex dismissed it: "As far as we are concerned it's been deliberately slanted to find an unrealistic case. It has no basis in reality."

While the nuclear waste dump will cost the taxpayer billions of pounds, the work which raises disturbing questions about its long-term safety has been ended prematurely because the Treasury will not pay the required £1.34 million to finish it. Instead, it insists that under

the 'polluter pays' principle the costs should be met by Nirex.

Curtin, said: "Cost recovery effectively comes into play when you make an application to discharge waste to a repository. At the moment we are applying for an investigatory facility, not to dispose of waste, so to say we 'pulled out' of the cost recovery is totally the wrong word."

Nirex also tried to block HMIP from giving evidence to the inquiry. Hardly surprising given that Nirex knew that HMIP was going express the concern that insufficient baseline data has been collected to justify going underground. If adequate baseline data on the geology and hydrogeology of the area is not collected before the RCF is built, then it may never be possible to predict how radionuclides will behave underground as the act of constructing the RCF will fundamentally alter the area's hydrodynamics.

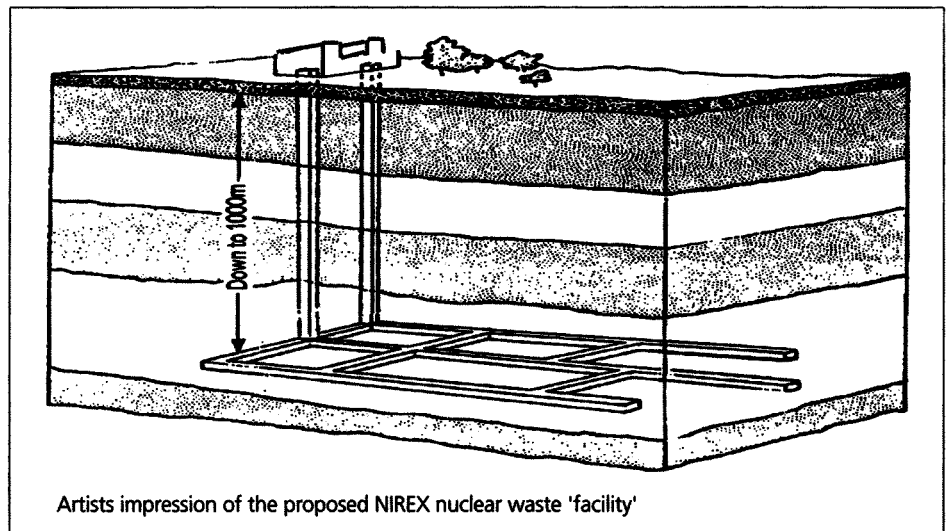
Michael Folger, managing director of Nirex, has also told the inquiry that Sellafield was not chosen because it is the safest site but because it is the cheapest: "There could well be sites on the short list of 12 considered in 1989 which would

enable a repository to offer an even lower level of post-closure radiological risk to an individual than that which, in the company's view, could be offered by the Sellafield site. However, government policy does not require a repository site to be chosen so as to provide an annual level of individual risk even lower than the [one in one million] target." In other words, Sellafield isn't the safest but it is the cheapest and Nirex believes it is safe enough.

While Dounreay and Sellafield emerged as Nirex's preferred sites, the company is still refusing to divulge the identity of the 11 other sites on its short list (Sellafield wasn't even on the list of 12).

The inquiry is expected to be over by the end of January, but no final decision is due from the Environment Secretary until August 1996.

■ Rwmac, the government's Radioactive Waste Management Advisory Committee, is investigating allegations that the work of Nirex is undemocratic and shrouded in "excessive secrecy". A report is expected by the end of the year. □



Artists impression of the proposed NIREX nuclear waste 'facility'

Nuclear waste dumped at sea

OVER 1.5 million tonnes of conventional and chemical weapons have been dumped in the seas around the UK alongside thousands of tonnes of radioactive waste according to documents obtained by *The Scotsman* newspaper.

According to *The Scotsman*, the Ministry of Defence (MoD) and the UK Atomic Energy Authority (UKAEA) dumped some 75,000 tonnes of low and intermediate-level waste at 15 sites in the

North Atlantic over a 33-year period up until 1982.

The dumping began in 1949 with the MoD ordering 9 tonnes of waste from the atomic weapons programme to be sunk at a site off the Bay of Biscay. In 1951, 84 tonnes were sealed into concrete-lined drums and dropped into Rockall Deep, next to a munitions dump. The UKAEA took over responsibility for the operations in 1954. Hurd Deep took the bulk of the waste, but other sites off the south-

west coast of Ireland were also used.

According to Dr John Large, an independent nuclear consultant, the build-up of hydrogen within the waste drums will almost certainly have led to the radioactivity being released. "It's an environmental time bomb," he warned.

Large said his main concern was the likely chemical reaction between the nuclear waste and the munitions: "These reactions could destabilise already unstable weapons." □

Plutonium flights to Dounreay

OVER ten tonnes of plutonium could be flown from Germany to the UK in flasks widely condemned by aviation authorities as being inadequate, following a decision by the International Atomic Energy Agency (IAEA) to put cost before safety.

In drawing up new nuclear transport regulations, the Agency has decided that Mixed Oxide (Mox) nuclear fuels — a combination of plutonium and uranium oxides — can be flown in type-B transport flasks.

The IAEA rejected calls from the US Transport Department, the UN's international Civil Aviation Organisation, the Federation of Airline Pilots and the International Air Transport Association, which represents 232 airlines, for a complete ban on the use of the flasks for air transports.

The Agency has banned using the flasks for flying plutonium because they are unlikely to survive a crash. However, a German suggestion that the ban should exclude nuclear cargoes which contain "very low dispersible material" has been accepted following pressure on the Agency from Germany, Britain, France, Belgium and Japan — all of which play a part in the Mox business.

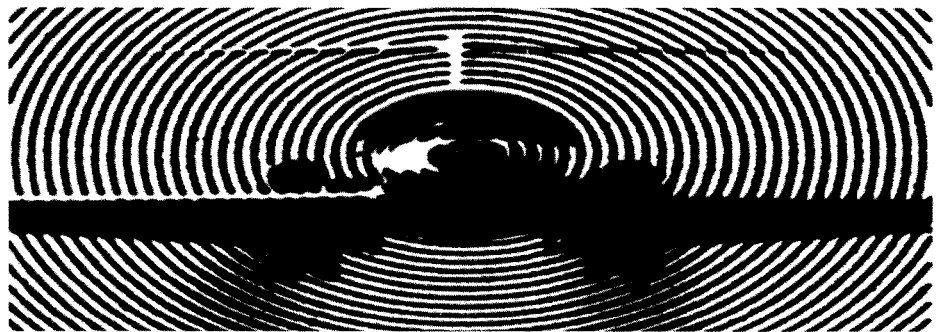
Aviation safety experts wanted the

IAEA to adopt standards that were much closer to stricter US regulations for flying such material. A new, type-C, flask would have been required. In the US such flasks would have to be able to withstand crash impacts of up to 464km/h followed by immersion in fire at 800 degrees C for one hour. The design which was being considered by the IAEA would withstand impacts of 324km/h but not a subsequent fire. Type-B flasks are expected to stay intact up to impact speeds of only 48km/h.

According to Martin Cossak of the German Federal Office for Radiation Protection: "A hundred per cent safety cannot ever be guaranteed and there is a very low probability that the Type-B flask will fail in an accident." He denies that

profit is being put before safety. However, the minutes of the IAEA working group looking into transport safety tell a different story: "The difficulties of producing Type-C packages and their high production costs were cited as supporting the need for adoption of the very low dispersible material concept."

Germany is particularly keen on flying Mox which it will receive from fabrication plant in the UK and France following the cancellation of its Mox production facility in Hanau. The development of a new flask would be prohibitively expensive for the fledgling international Mox industry which already suffers from dubious economics. □



Dangerous Bulgarian reactor to restart

BULGARIA'S decision to restart unit one at Kozloduy — known as the most dangerous nuclear power station in the world — has provoked an international outcry and highlighted confusion at the centre of the European Commission's (EC) Eastern European energy programme.

The Bulgarian government said it had little choice but to restart the ageing Soviet VVER-style reactor to meet power demand over its bitter winters. While the country has adequate conventional plant to meet the expected shortfall, it lacks the hard currency to buy in the necessary coal stocks.

France's Institute for Nuclear Safety (IPSN) and the German Association for Reactor Safety have issued a joint statement "deploring" the decision. Jean-Luc Milhem, IPSN's Eastern European safety expert, believes unit one is the most dangerous of Kozloduy's six reactors and fears that the embrittled welds around the reactor's pressure vessel could give way at any time. Neutron bombardment weakens the welds, especially when they contain impurities: "The more impurities, the more fragile it becomes." IPSN says the

welds in unit one are believed to contain four times the level of phosphorous considered safe in France.

The reactor has no form of containment, so even a minor leak of radioactivity would escape directly into the environment. According to IPSN's deputy director of safety, Daniel Queniat: "The type of accident would not be like Chernobyl, because there would be no explosion. But, the quantity of radioactivity leaking into the environment would be just as large."

The EC, which has already spent 30 million Ecus on improving safety at the site's other reactors — four of which will be closed down over winter — has now offered Bulgaria three months' supply of free coal or electricity, plus further safety checks at the site, in return for closing the reactor.

In addition to the money spent by the Commission, the European Bank for Reconstruction and Development (EBRD) has spent 24 million Ecus on the site. However, neither spent much on unit one because they believe it should not be restarted. Curiously, when faced by the danger of an accident at the site the Commission has also responded by

freezing a further seven million Ecus set aside for safety work there.

Much of the money spent by the EC and the EBRD has benefited the Western nuclear industry, which is in a state of serious decline following the massive down-turn in reactor construction in the wake of the Chernobyl disaster.

However, attempts to back-fit safety measures at the inherently unsafe reactors would have been unnecessary had they listened to their own energy experts. According to Michael Scholand of the International Institute for Energy Conservation in London, analysts working for the World Bank, the Commission and private western companies have identified energy efficiency projects that could cut Bulgaria's demand by 9.3 terawatt hours (TWh) per year. The four oldest units at Kozloduy produce 7TWh a year.

Most of the identified projects had pay-back times of less than 10 years, through fuel savings. Further, the EC Phare programme of assistance to Eastern Europe calculates that 4 TWh a year could be saved for "little or no investment", says Scholand. □

Dounreay reprocessing questioned

BALLOT papers were despatched in November to the 20,632 registered electors of Caithness asking them whether they support the reprocessing of up to 14,000 US-origin research reactor spent fuel rods at Dounreay ("Dounreay pitches for reprocessing work", SEJ 106).

The referendum, carried out by the Electoral Reform Society, has been organised by Caithness Against Nuclear Dumping (CAND) to redress the 'democratic deficit' in Scotland caused by the governments of both the UK and the US. While the US has held several periods of public consultation over what to do with the weapons-grade spent highly enriched uranium (HEU) fuel rods currently stranded in some 33 countries, no such consultation is to be held in the UK.

According to a Department of Trade and Industry (DTI) information sheet, which is being sent to those who write to express their concern about the reprocessing plans, there is no "requirement for a public consultation on the reprocessing of overseas fuels". However, the DTI does suggest that the public will be given an opportunity to express an opinion during a consultation period associated with Dounreay's application for a revised discharge permit. Yet, as the DTI notes, the US decision on whether to back the use of Dounreay is expected by the end of this year, while no consultation on discharge permits will take place until February next year.

The US government has no intention of courting opinion in the UK. In the wake of massive public protest following the importation to Dounreay of 52 spent US-origin fuel rods from Germany, at the beginning of October, Charles Head, of the US Office of Spent Fuel Management, told *The Scotsman* newspaper that no amount of public demonstration would effect the US decision: "If we were to accept public demonstration as a reason for not taking action, that would only encourage people who are opposed to the action to try to incite a riot."

He continued: "Short of holding an election or referendum, I don't know how you demonstrate a verifiable ground swell of opinion."

The true extent of collusion between the US and UK governments has been revealed in a 'leaked' letter from Head to Dr David Lumley of the DTI and Mark Hammond at the British Embassy. Head writes: "Within the last couple of days we have received additional correspondence from Scotland. Since this correspondence is from groups which might have more influence than private citizens, I thought you might like to see

what they are saying."

The first of the protest letters attached was to the US Energy Secretary, Hazel O'Leary, from the Nuclear Free Local Authorities' legal adviser, Jamie Woolley.

Head continued: "We will be replying to these letters shortly, along the lines we have discussed in the past. In other words, we will note that actions within the UK are subject to your laws and regulations, not those of the US, and we will refer them to the DTI for follow-up within the UK. We will use the language that Mark sent us wherever it fits."

It has also emerged that Australia wants to send some 800 spent HEU rods, from its Lucas Heights research reactor to Dounreay for reprocessing. The rods, which were originally supplied by the UK, represent half of the Australian stockpile, the other half are US-origin and Canberra wants them sent back to the US. A final decision is awaited following an Australian public consultation, which was concluded at the end of November.

One of the main reasons for sending the material to Dounreay, offered in the Australian consultation document, is that "no other alternative meets the objective specified in the government's decision that the present inventory should be reduced."

Dounreay insists that it will not become an international nuclear waste dump. Site director John Baxter has reacted angrily to accusation in a Greenpeace report that the waste created by reprocessing foreign spent fuel will remain at the site indefinitely.

Baxter has accused Greenpeace of "putting out misinformation and propaganda." However, Dounreay has confirmed calculations in the report which say that reprocessing will increase the volume of waste to be disposed of by 85 times.

Baxter insists that all foreign contracts include waste return clauses. These clauses permit the waste to remain at Dounreay for up to 25 years. US documents reveal that it cannot accept the waste created by Dounreay because the cementation process used at the site, to make the waste easier to handle, is not acceptable under strict US environmental laws. Greenpeace points out that many of the countries currently burdened with the spent fuel have no nuclear power programmes and therefore no plans for nuclear waste disposal facilities and are unlikely to be in a position to accept their waste back, now or in the future.

Dounreay has suggested to the US

that instead of returning the bulky intermediate-level waste created by reprocessing it could send much smaller quantities of high-level waste from Sellafield instead. While no application for 'substitution' has been made for Dounreay, government policy laid down in the 1995 radioactive waste white paper backs the approach.

Such is the strength of opposition to Dounreay becoming an international centre for reprocessing HEU fuel that Highland Regional Council has decided to seek the opinion of a Queen's Counsel on whether the planning consents for the site, dating back to the 1950s, are sufficient to allow the work. It has also asked Dounreay to submit a new planning application "in order to allow full public examination of all the implications of their proposals."

■ "There is now a high probability, on the basis of customer inquiries and market research, that a substantial commercial materials testing reactor (MTR) [HEU] fuel reprocessing programme will be undertaken over the next five years," claims Dounreay in a report on *The Social and Economic Effects of Dounreay's Projected Programme of Work 1995-2005*.

It anticipates reprocessing up to 6,000 HEU rods in contracts worth up to £180 million. However, the associated health detriment is calculated to have a cost of only £190,000. Clearly, in Dounreay's mind, the financial incentives by far outweigh the disincentives.

"For the customer, the benefits are many and varied but in the case of MTR [HEU] operators is chiefly the ability to continue their operations within their national regulatory constraints."

It concludes: "There are no objective grounds relating to social and economic effects on which to refuse to continue to authorise, at appropriate levels, waste of low radioactive content from Dounreay." □



Possible fallacies in present

Current risk estimates for exposure to radiation, based largely on an established interpretation of data on survivors of Hiroshima and Nagasaki, may be inadvisable, argues Dr Alice Stewart.

EXPOSURE to radiation is an occupational hazard for those working in the nuclear industry or in medical radiotherapy; it is well-known that radiation can induce cancer in tissues. But there is a widespread belief that by monitoring radiation exposure of workers and making sure exposure never exceeds a recommended annual 50mSv dose-related cancer risks have been kept at near zero level.

For example, a study on occupational dose and subsequent cancer risk published in 1990 by the US Committee on Biological Effects of Ionizing Radiation (BEIR) indicated that even an annual dose of 10mSv per year for 48 years — ten times higher than the average for all badge monitored workers at the Hanford nuclear facility in the US — the risk of cancer death would still only be 23% compared with a general population risk of 20% .

As a rule, risk estimates are derived not from occupational data but from epidemiological studies of Hiroshima and Nagasaki A-Bomb victims. Hanford became operational in 1944, time enough for some direct risk estimates to be made. However, this is deemed unnecessary since both BEIR and the International Commission on Radiological Protection are of the belief that the A-bomb data and its interpretation by the Radiation Effects Research Foundation (RERF) offer reliable risk estimates for all occasions. This consensus has lasted for more than 30 years and is now so strong that only risk estimates which conform with A-bomb data are allowed to influence radiation safety regulations.

A-bomb data collection and analysis left room for different conclusions to be drawn, conclusions sometimes contradictory. The original interpretation is subscribed to by the establishment, but may be flawed.

Study subjects were assembled five years after the event and included those with in utero as well as post natal exposure. The then Atomic Bomb Casualty Commission (ABCC) — now RERF — took all survivors within a 2.5km radius of the two hypocentres as 'cases' and the 'control' consisted of two groups, from greater distances, of the same size, age and sex composition as those cases under 2km.

Here, then, was the first mistake in the data collection. By comparing matched samples which differed only in their distance from the hypocentre, ABCC failed to facilitate the easy interpretation of age-at-exposure related radiation effects. Given this less than perfect data base, subsequent mistakes, this time in data interpretation by RERF, exacerbate the problem.

RERF presumed an even spread of high to low doses across all ages of exposure. The evidence shows that high dose survivors were mainly young adults, suggesting some sort of survival of the fittest selective process by the high dose radiation. This theory is given added weight by the fact that the deaths before ten years of age of children of these surviving young adults was much smaller than the expected number.

RERF deduced no increase in non-cancer⁽¹⁾ deaths as a result of the radiation. If the A-bomb surviving population is compared to the controls, no significant differences are found in the rate of non-cancer deaths. There is a presumption here of two like-for-like populations being compared. However, it may be that the non-specific effects of the A-bomb left a highly selected population which would be less likely than normal to suffer any kind of death at a particular age. If the radiation nevertheless caused bone marrow damage in these survivors (a cell-killing effect), this would have the effect of increasing their chances of later death (deaths from aplastic anaemia — a disease arising from bone marrow destruction — were unusually common before 1950 and remained common after 1950). Thus these two opposite effects of increased and simultaneously decreased chance of survival would cancel each other out, masking a real increased risk of non cancer deaths caused by the radiation.

According to RERF, although the effects of foetal irradiation include brain damage, young embryos were not affected. Hence, a widespread



cancer risk estimates

assumption that until eight weeks of foetal age the human embryo is immune to any brain damage effects of radiation. This is despite the fact that there was a significant deficit of births seven to nine months after the bombing, suggesting that doses of radiation were sufficient to kill embryos.

Finally, a total absence of childhood leukaemias in children born after in utero exposure to the A-bomb is in direct contradiction to the findings of the Oxford Survey of Childhood Cancers (OSCC) which found a positive association between foetal irradiation and childhood leukaemia. This difference was originally ascribed to faulty interpretation of the OSCC data relating to prenatal x-rays. But work by my colleague George Kneale has shown that the latent phase of childhood leukaemia is characterised by an increased infection susceptibility. Coupled with the above mentioned probable lethal A-bomb radiation effects on young embryos this suggests that the difference is more likely due to prenatal and post-natal death of the Japanese children, before an age when childhood leukaemia would become apparent.

An alternative analysis

ABCC had collated data on sustained acute injuries effected by the blast, but considered the resultant variables of little value in analysis. RERF released the data to Kneale and he carried out his own statistical tests. If those with the highest level of multiple acute injuries are considered as the closest possible approximation to the original population, ie, the unselected population, then findings for this subset might give some insight into the selective process.

Acute injuries were categorised as burns, oropharyngeal lesions, purpura and epilation. Using injury as a variable, various additional findings were uncovered: a strong association between injuries and leukaemia; doses sufficient to have non-cancer effects were not confined to those with obvious injuries, supporting our theory that sustained injuries included bone marrow loss, leading to aplastic anaemia; a disproportionately high number of very young and very old people were among those with multiple injuries, which could be interpreted to mean that these people, most close to death, had been selected against by the A-bomb.

Potentially wrong risk estimates based on A-bomb data may have consequences for recommended safe levels of worker exposure. Pooling of monitoring records of nuclear installation workers from three countries, the

US, Canada and Britain, has resulted in no findings of any dose related cancer risk, according to researchers from the International Agency for Research on Cancer (IARC). The risk estimates agree with those from A-bomb data. It has been noted, however, that the IARC researchers failed to appreciate that relations between exposure age and cancer risk are very different for workers and A-bomb survivors, and that they mistakenly assumed that the dosimetry standards within the nuclear industry are sufficiently uniform to allow pooling of data from several facilities.

Work by Kneale et al has shown that if the data is disaggregated and then analysed, evidence can be found of a cancer risk much greater than any A-bomb estimate. Kneale has also shown that for workers in US nuclear facilities the cancer risk increases progressively with age when exposed. RERF has repeatedly shown from A-bomb data the exact opposite — that cancer risk was lower for those exposed at an age of 50 years and over compared to those who were under 50 years at the time of bombing.

Clearly, application of A-bomb data to very different sets of circumstances, flawed or not in its interpretation, is invalid.

The supposition of no low dose radiation risk to early embryos, based on A-bomb data interpretation, has obviously been influential in clinical practice. It is possible that the risk of foetal exposure has been dangerously underestimated, as evidenced by findings of the OSCC study.

Entrenched as it is in estimating cancer risk, A-bomb data is showing no signs of being superseded in its use for setting safe exposure levels. It is still regarded as the gold standard. In its latest report, IARC makes no reference to the work of those proposing alternative A-bomb data interpretation.

Revisions of cancer risk estimations are bound to be sensitive, and no one wants to be alarmist. But if the nuclear industry persists in purporting its safety, surely there is an obligation for it to take on board the strong doubts as to the advisability of relying on A-bomb data for the setting of safety limits for fetuses, young children and adults over 50 years of age. □

Note

(1) Non-cancer deaths from radiation effects result from radiation killing cells, also termed non-stochastic deaths. Cancer deaths from radiation result from radiation induced cell mutations, also termed stochastic deaths.

“Clearly, application of A-bomb data to very different sets of circumstances, flawed or not in its interpretation, is invalid.”

Dr Alice Stewart is a senior research fellow at the University of Birmingham.

Low-energy housing

David Olivier outlines his project to build a house which will use a tenth of the energy of a conventional new UK dwelling.

WITH the threat of global climate change, Western Europe needs to greatly reduce its carbon dioxide (CO₂) emissions. One part of this will be to cut energy consumption of new UK dwellings, ultimately to the point where they use no fossil fuel. Dramatic reductions in energy use are more feasible here than they are in other sectors of energy use such as existing buildings or industrial processes. This article describes one attempt to move in this direction, to show what can be done to produce a new home which causes minimum damage to the environment, and meet the goal of sustainable development.

Located on a site 15km west of Leominster, Hertfordshire, this project will combine well-established energy-efficient features and renewable energy systems with some other, more novel, technologies. The aim is to design, construct and monitor a dwelling which consumes about 90% less energy than a conventional new UK dwelling, and obtains about 80% of this reduced energy demand from the sun. As a result, it should consume 97% less fossil fuel than normal new dwellings.

At its heart, the project is a long-overdue demonstration building, which refines the design of projects built since the 1970s in Canada, Denmark, Switzerland and elsewhere and proves that the same technology also works superbly in the UK.

Except for research projects, it is intended to be one of the most advanced energy-conscious dwellings in Europe. By exceptionally energy-efficient design, it will be possible for the sun to meet virtually all the dwelling's energy needs.

The technology

The house will have no mains energy services except electricity and in a normal year it will export slightly more electricity than it imports, through a small area of solar cells integrated into its south-facing roof and the use of state-of-the-art electrical equipment to minimise the demand for electricity. Water will come from an existing borehole, and to minimise disturbance to the site's water balance, water will be used as efficiently as possible within the house then, after effective treatment, waste water will be returned to the site.

An area of high-performance solar collectors will provide most of the hot water. Fuel for cooking and as a back-up for water heating in mid-winter will be provided by liquid petroleum gas (LPG). Though a fossil fuel, the LPG will only be used in very small amounts, and the piping is sized so that it could be used to transport methane from biogas as renewable energy is further developed in the future.

Using electricity for cooking or for back-up water heating would increase the building's peak

demand on the grid, possibly five fold, which would be hard to reconcile with the long-term aim of eventually powering the grid mainly by renewables.

The building will be monitored in detail to check predictions of energy use and show how well technology which was developed in other climates works in the UK.

Zero space heating

In principle, with a serious reduction in the house's heat loss, enough solar energy is available, even in a southern UK winter, to create a built environment which stays within the comfort zone. The windows literally become the heating system. We owe a debt of gratitude to those who carried out decades of research to this end in Scandinavia, North America and central Europe.

About a thousand computer simulations have been made, and it is predicted that the house will stay reasonably warm and comfortable all year round on solar energy. No central heating system, or wood-burning stove, will be needed.

Prototype glazing units will be provided by Canadian firms, to be installed in frames made in the UK from Herefordshire-grown timber. There was little interest in Europe for providing the glazing. One firm was interested, but they are already fully stretched to meet the demand for high-performance windows in Switzerland and Germany. Also, perhaps not surprisingly, they could not see any UK market developing in the short term.

By contrast, government programmes in Canada have resulted in a flood of new innovations with high-performance windows, of a kind which are able to capture more heat from the sun than they lose.

Besides the house being very energy conscious, the materials used to construct it are being chosen to cause reduced environmental impact, both in a local sense (eg they will be chosen to have no adverse affect on indoor air quality) and in a global sense (eg materials which cause damage to the ozone layer or the world's forests need to be avoided). The aim is to exclude PVC, lead flashing, materials foamed with HCFCs, urea-formaldehyde and similar glues, wood preservatives and some other plastics.

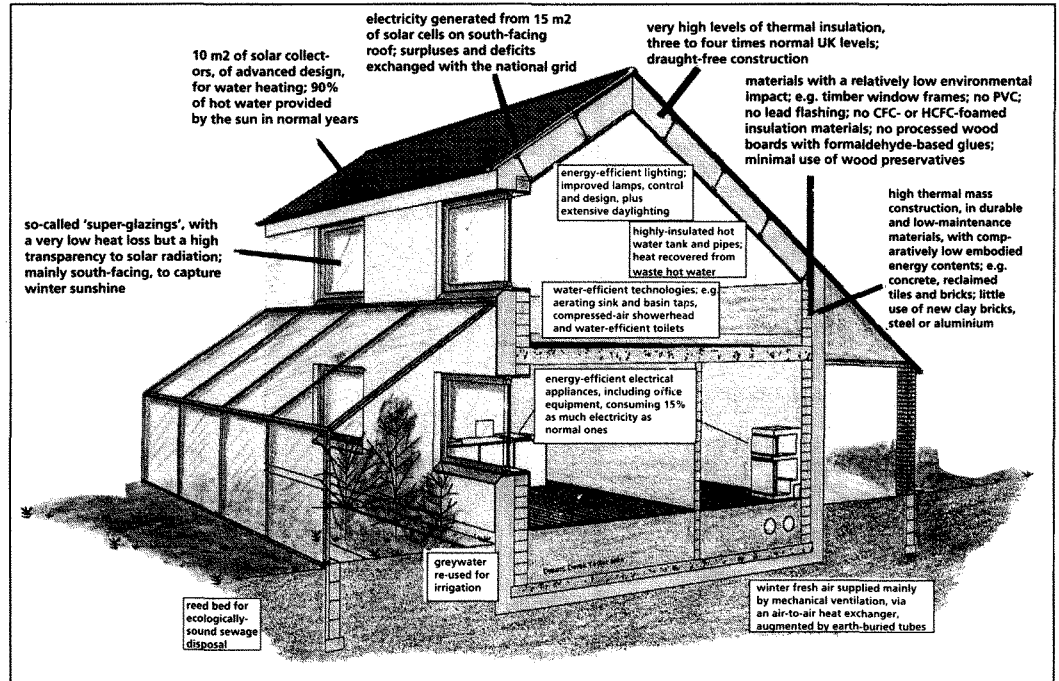
The heavyweight load-bearing structure will be of concrete, which takes about a third as much energy to make as the same mass of clay bricks and, except for the cement, is sourced locally. There will be some use of local stone, which has minimal embodied energy. Despite its very high energy efficiency, the amount of embodied energy in the materials of the house will be slightly less than in a normal UK dwelling.

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There are two principal environmental goals: zero CO₂ emissions, measured over, say, a 50-year timescale; and zero net consumption of non-renewable energy sources, including the fossil fuel consumed to construct the building and the fuel used to operate it.

The overall result is a building whose net CO₂ emissions over the 50 years are slightly negative; that is it will be not be a CO₂ source but a sink.

The residual fossil fuel use, and its CO₂ implications, can be fairly easily compensated for by minor measures. One example is planting-up part of a moderately large, 1,200m², garden with temperate trees, including a small orchard. This will also offset the CO₂ emitted in the construction of the house.



If all new UK dwellings were as energy efficient as this, the impact would be large: within a few decades, the savings of energy would exceed the amount of gas which remains in the North Sea.

In other countries such projects are financially supported by local and national government with pump priming: a large initial input of public funds brings down the cost of new technology to the point where everyone can afford it, and this catalyses substantial, and accelerated, private investment.

UK funding of small and/or innovative projects is far less favourable.

Research also suggests a gross disparity between countries in the performance of so-called 'low-energy' buildings. Make no mistake — this house will meet German, Swedish or Canadian standards, not the recently revised but still less strict UK standards.

Sponsorship is being raised from grant-making trusts and from firms in the UK and abroad who are active in the ecological buildings field, and see this as an opportunity to demonstrate a highly innovative application of their products. Sponsors include Naturesave Trust Oxford, and most of the design team are giving their expertise free or at reduced rates. The list of commercial sponsors is still growing.

Replication

The design principles described here are applicable anywhere in the temperate world. Nevertheless, every site considered for a new dwelling is unique. The long-term aim is an intelligent application of the principles utilised here, not the replication of identical dwellings.

The house is designed with a low slate north roof, rendered walls, and long thin shape giving a built

form which is ubiquitous in this area. Only the small area of south roof is slightly different, comprising glazed blue or grey areas for solar energy collection instead of blue-grey slate.

The house design reconciles many different priorities. It is a house design for the 21st century, by which time the burning of fossil fuels may be curtailed or forbidden because of their environmental impact. But many of its features are also seen in old Herefordshire cottages: built before the age of cheap fossil fuels they face south, with small windows to the north, to take advantage of the sun's winter heat.

The project has had its fair share of planning problems. Back in 1991/2, district councils' attitudes to the general idea seemed to range from circumspect to suspicious. No less than three candidate sites had to be dropped.

The current plot is in the parish of Lyonshall, and near the border with Pembrokeshire. It already had detailed approval for a replacement cottage-style dwelling, but there was great resistance that the house be turned around to face south. The planning department wanted the largest windows and the most prominent facade of the house to face the highway, which happens to be to the north.

The process took about 12 months redrawing, waiting and a little talking to local councillors. Finally the application was approved, but the delays give concern that future applications for solar houses may continue to meet great resistance. The environmental benefits of new dwellings will suffer considerably if planning departments continue to treat such issues as the orientation of a house as more important than global issues.

Here, though, these issues are now water under the bridge, and construction should begin at any time. □

"This house will meet German, Swedish or Canadian standards, not the recently revised but still less strict UK standards."

Nuclear transport risks

The nuclear industry would have us believe that the transportation of nuclear material is perfectly safe. Martin Bond offers a different view.

Martin Bond is a freelance journalist and photographer and the author of *Nuclear Juggernaut* (Published by Earthscan, 1992) about the transport of radioactive materials.

IN December 1994, CND activists Pat Arrowsmith and David Polden sat on railway lines at Stratford station in London. For twenty minutes they held up a train transporting irradiated nuclear fuel from Bradwell power station to Sellafield. Polden was quoted as saying "reprocessing nuclear fuel rods will add to the plutonium mountain which this country is accumulating."

Plutonium shipments have themselves been targets of protest. Back in 1981 demonstrators attempted to blockade the first shipment of plutonium nitrate from Dounreay to Sellafield. Shipments of plutonium oxide from France to Japan (in 1984 and 1993) met similar opposition, while a consignment of plutonium travelling between Sellafield and Aldermaston was besieged by Greenpeace in March 1995. In the following month, the first shipment of vitrified high-level waste left France for Japan amid protests from environmentalists and governments en route. The transport of radioactive materials remains as controversial as ever.

Health and safety has always been a major issue. Could accidents or sabotage lead to a release of radioactivity? Is the 'normal' transport of materials which emit radiation a health hazard? These questions highlight how the nuclear industry and its critics perceive the issues in fundamentally different ways.

The industry points to statistics: accidents in Britain are summarised annually by the National Radiological Protection Board (NRPB). Detailed reports have now been published for each of the last five years (1990 to 1994) and itemise 80 "accidents and incidents" during that period.⁽¹⁾ These were not disasters; 48 involved the transport of radioisotopes for medical or industrial use (often containing small quantities of radioactivity) and industrial radiography sources. They included relatively trivial events such as inaccurate labelling or problems with transport vehicles. At the other end of the scale, the transport of irradiated nuclear fuel flasks, which when loaded contain massive amount of radioactivity, accounted for 16 events. These included two low-speed collisions in sidings, two derailments (two wagons carrying empty flasks) and one case of contamination (on the outside of a 'Unifetch' flask transporting research reactor fuel from India to Dounreay). Most incidents involved flask trains or vehicles rather than the flasks themselves. The remaining 16 events mainly concerned fuel materials or waste. The reports show no leaks or spillages and although 12 events led to increased dose rates, according to the NRPB "none... resulted in any significant radiological consequences". The official conclusion? Transport is not a problem.

Critics, on the other hand, counter that past experience does not guarantee a safe future. Major nuclear accidents (like Three Mile Island) tend to

be preceded by industry assurances that such events can never occur (or at least, are statistically too remote to worry about). Hence a fear that a major transport accident is as inevitable as a Chernobyl. Moreover, past experience can always be interpreted less favourably. The 16 flask events recorded between 1990 and 1994 included problems with a flask seal (wrong type), a valve gasket (missing) and valve screws (failed "most likely due to a manufacturing fault") — flask components which critics have regarded as vulnerable especially in a crash or fire. On another occasion, a flask failed a leak test on its valves and lid seals. Several events involved fires, affecting for example a lorry carrying radioisotopes (burnt out but with no apparent leakage) and a ship transporting yellowcake (mainly uranium oxide) at a British port. Other incidents included theft where radioisotopes were not recovered: potential hazards — whereabouts unknown.

Furthermore, the NRPB's published records include only civil radioactive materials. Excluded, for example, are the various accidents which have befallen nuclear warhead convoys. If accidents have affected the movement of military nuclear materials — tritium and plutonium for warheads or highly enriched uranium for submarine reactors — they will not be in the published records.

Increased movements

Meanwhile, movements of some of the most radioactive materials around are set to increase, notably deliveries of plutonium and high-level waste from the reprocessing plants of BNFL and its French counterpart to their European and Japanese customers. A central issue is whether the standards set by the International Atomic Energy Agency (IAEA) for testing the various types of transport packages — flasks, cylinders, containers etc — are severe enough. Packages must demonstrate that they can withstand severe impacts, high temperature fires and immersion in water. The tests have long been criticised. After the CEGB's 1984 flask test at Old Dalby — when an empty train was crashed into the 368mm thick steel side of a Magnox flask — it was pointed out that other flasks in use were of different designs. For example, Excellox 3 and 4 flasks, which bring irradiated fuel to Sellafield from Japan, have sides comprising only 90mm of steel backed with a 160mm lead liner. How would they have survived? In addition, it has since been admitted by the Department of Transport⁽²⁾ that the Old Dalby test, though spectacular, submitted the flask to maximum stresses only around half the level of those under the inadequate IAEA tests.

The adequacy of the IAEA's fire test criteria — subjecting packages to 800 degrees C for 30

minutes — has been a particular concern, criticised even within the industry. A higher temperature fire test — 1,100 degrees C — was proposed at the industry's 1992 PATRAM conference on the packaging and transport of radioactive materials. In 1980 a UKAEA report about the test criteria for plutonium air transport packages noted "... the IAEA fire specification is rather unsatisfactory. The temperature is low (by about 25%) for a hydrocarbon fuel fire."⁽³⁾

The safety of packages for the air transport of plutonium has also been questioned after US standards were tightened in the 1980s. The US Nuclear Regulatory Commission increased the severity of the impact test by raising the required impact velocity from 13 metres/second to 129m/s. This was followed by the Murkowski Amendment which stipulated that the integrity of packages transporting plutonium through US air space must be demonstrated by crashing an actual aircraft with a test package on board. If the more rigorous US test criteria — albeit only applicable in certain circumstances — are accepted as appropriate, then by implication the less stringent standards of the IAEA, to which BNFL subscribe, are inadequate. In the event, plutonium deliveries from Europe to Japan are expected to go by sea. However, plutonium must still be delivered from Sellafield to BNFL's European customers and these will travel by plane — in packages which although acceptable to the IAEA could under US regulations be considered substandard.

Safety doubts

Doubts about the adequacy of package testing criteria and the possibility — however remote — of accidents releasing radioactivity lead to questions about emergency procedures. Who would deal with a serious accident and could they cope? There are in fact contingency plans organised by the industry, notably NIREP (Nuclear Industry Road Emergency Plan) and NAIR (National Arrangements for Incidents Involving Radioactivity). These rely on expertise from nuclear establishments and other organisations, principally hospitals, with relevant resources. A separate Irradiated Fuel Transport Flasks Emergency Plan (IFTFEP) exists, while NARO (Nuclear Accident Response Organisation) is available for accidents to military materials.

Questions have been raised about the effectiveness of these plans in dealing with a catastrophic accident, not least because of disagreements about the potential consequences of such an event and the appropriate emergency response. In the US, for example, the release of fissile material after a warhead accident would trigger an initial recommendation of "precautionary sheltering" in a 130km² area downwind. By contrast, Britain's Ministry of Defence (MoD) would advise sheltering for an area less than 13km². Indeed, the MoD has only recently acknowledged that nuclear warheads, containing a lethal mixture of fissile material and high explosives, could potentially be affected by an accident. (A 1994 MoD exercise in



Martin Bond

Photo: Nuclear waste on its way to Sellafield.

Northamptonshire, simulating an accident during the refuelling of a nuclear warhead road convoy vehicle, showed that fire is a recognised hazard). "Worst-case" scenarios postulated by critics — for example, a plane-load of plutonium crashing in flames and releasing radioactive material — are dismissed as virtually inconceivable by the industry. Such uncertainties are especially worrying for the emergency services and local authorities who would have an important role to play if evacuation or sheltering were necessary.

Underlying these issues is a broader question of whether the industry can be trusted to act in the public interest; to be open and honest with information. The 1984 Mont Louis accident provides an example. When the ship sank off Zeebrugge with a cargo of uranium hexafluoride, BNFL chair Con Allday lambasted the media and environmental groups for getting their facts wrong. Yet, while the UKAEA's magazine *Atom* reported "there was no leakage",⁽⁴⁾ the Paris-based Nuclear Energy Agency has stated that one of the hex cylinders lost 50kg of uranium.⁽⁵⁾

Getting the right information is further hampered by secrecy. Predictable for all things military, it is also basic security practice for the movement of civil nuclear materials. Transport operations are guided by international standards such as the Convention on the Physical Protection of Nuclear Material. These recommend practical measures to protect materials in transit including the avoidance of regular schedules and restricting prior knowledge of movements. It is hard to see how an industry with a institutionalised history of secrecy — never mind commercial vested interests and a vital role in building weapons of mass destruction etc. — can ever satisfy those opposing, or demanding more information about, the movement of its raw materials. Protests against nuclear fuel flasks, plutonium and radioactive waste look set to run and run. □

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Energy in a sustainable Scotland

A study of 'environmental space' suggests that Scotland could make significant progress towards a sustainable energy policy by 2010, reports Chris Revie.

FRIENDS of the Earth Scotland is involved in a three-year European project which is attempting to assess and set sustainability targets for 30 European nations and for the continent as a whole. This involves calculating the limits that the environment imposes on a country in terms of the resources that it uses — its 'environmental space'.

The environmental space for any resource is assessed by two criteria: the absorption capacity of the environment and the lifetime of reserves. For energy, it is argued that while the long-term reserves of fossil and nuclear fuels are limited, it is the first criterion, the absorption capacity of the environment, which is of more immediate concern — primarily because of global climate change.

How these criteria are interpreted is governed by three principles.

Under the **precautionary principle** we must act now to tackle the potential threat from global climate change, one of the most pressing energy-related problems facing the world today. The environmental space of energy is defined in terms of the carbon dioxide (CO₂) emitted. So, for example, while reserves of coal would indicate that it would be a good fuel source (at least for the next 100 years or so) its high CO₂ emissions mean that its use needs to be restricted.

Traditionally, it has been argued by some that although Western nations may consume far more of the world's resources than the poorer countries, the growth of the world economy would mean that the poorer nations would eventually catch up. The limits defined by environmental criteria mean that this argument is no longer justifiable (if it ever was). If there is a finite amount that we may consume or a level of use beyond which we cannot go without inflicting further serious damage, then we must share available resources far more than is currently the case. **Equality** of access to the world's global resources therefore must be a **guiding principle**.

Rich countries will have to reduce their consumption of resources by far more than is dictated by the purely environmental criteria outlined above. The poorer nations must be allowed to develop their infrastructures so that they can provide their citizens with services necessary for a safe, healthy and civilised life.

Applying the equity principle means that each country's share of the available resources (as defined by the environmental criteria) must be calculated on a per capita basis.

Sustainability additionally implies that equity must also be applied across the generations. Within this context, nuclear power is unsustainable as we are leaving our descendants a deadly legacy.

The Proximity Principle states that environmental problems should be solved as near to their source as possible.

Using these three principles, Friends of the Earth estimates that to meet the limits set by the Intergovernmental Panel on Climate Change (IPCC) to restrict the impact of global climate change, global emissions of carbon dioxide should not exceed approximately 1.7 tonnes per capita per year by the middle of the next century. Friends of the Earth has also set an intermediate target of 5.4 tonnes per capita by 2010. This will actually allow poorer nations to increase emissions up to 2010.

Scotland's target

Scotland currently emits slightly less than the UK average (approximately 10 tonnes per capita) at around 9.5 tonnes per capita, including emissions from gas flaring from offshore oil platforms and coal burning from exporting electricity to England and Wales. If emissions resulting from activity only in Scotland is accounted for then per capita emissions are just over 8 tonnes.

Taking the larger figure, this means that Scotland will have to reduce CO₂ emissions by around 44% by 2010. At the same time Scotland should phase out the two nuclear stations at Hunterston and Torness and should commit itself to eliminating fuel poverty by 2010.

This may seem very ambitious and some might argue impossible, but the potential for change in Scotland is significant. *The Scottish Energy Study* in 1993 estimated that in the domestic sector alone demand for energy can be halved, and at the same time lead to significant improvements in the quality of life for many people.⁽¹⁾ Encouraging a modal switch in transportation away from roads could reduce energy use in the transport sector by 40%. And initial estimates from industry and services showed that 10% cuts in demand could be cost effective.

An additional reason for investing in energy conservation is social. Fuel poverty is a major problem in Scotland. Energy conservation will not only reduce the cost of heating for many people, it will also reap significant benefits in health terms, reducing the incidence of respiratory, cardiovascular and mental illnesses.

Chris Revie is a researcher in the Friends of the Earth Scotland Sustainable Scotland project.

However, a number of considerations need to be borne in mind when assessing the potential for energy conservation.

- Energy prices are declining overall making energy savings less cost-effective.
- In the domestic sector the efficiency gained by installing insulation, modern appliances and energy-efficient light bulbs do not necessarily show up as cuts in energy consumption. People may take advantage of the efficiency gains by heating their homes to a higher temperature or for longer.
- The Scottish Energy Study concentrated on heating requirements. A more recent study carried out in Edinburgh showed that electricity consumption by lighting and appliances could be cut by 30%. The overall savings for the domestic sector therefore could be greater than 50%.⁽²⁾
- The Scottish Energy Study calculated savings for the industrial and service sectors that were based upon internal estimates by a number of companies. However in recent years pilot waste minimisation projects have shown that industry is very bad at estimating the potential for savings through efficiency. The Royal Society has recently estimated that industry could reduce energy consumption by 18% (even allowing for a 25% discount rate!).⁽³⁾

On the supply side, Scotland is extremely rich in renewable energy sources. A study funded by the Scottish Office and the electricity companies estimated that there is at least 1,500MW of additional capacity to be accessed with only modest upgrading of the transmission grid. The theoretical amount of wind power alone is estimated to be 100,000MW. Even after environmental and planning considerations are taken on board the capacity from wind is still 7,300MW, larger than the present maximum electricity demand.⁽⁴⁾

Job potential

Estimates for the number of jobs that could be created by a sustainable energy policy vary between 4,000 to 7,000 in energy conservation in the domestic sector alone.⁽⁵⁾ Building renewable capacity will create construction and maintenance jobs. The Scottish Energy Study estimated that building 1,000MW of capacity of wind turbines could create around 1,500 construction jobs.

As part of the Sustainable Scotland Project, Friends of the Earth Scotland set up a consultative forum on energy to help assess whether it was possible, by 2010 to: reduce CO₂

emissions to around 5.4 tonnes per capita; phase out nuclear power; and eliminate fuel poverty.

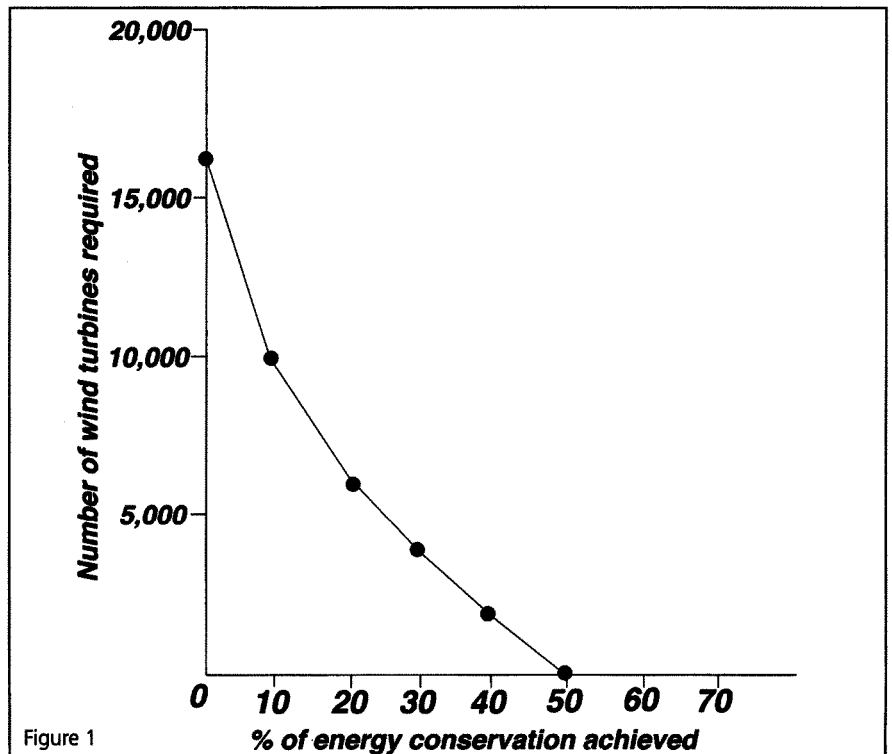
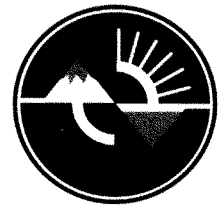
Briefly, it concluded that Scotland had the spare capacity to stop generating from nuclear stations almost immediately. However, this would mean a rise in carbon dioxide emissions through increased use of fossil fuels. What is required therefore is large-scale investment in renewables. How much new renewable capacity is required will be determined by the success of energy efficiency measures (see figure 1). The group concluded that a Scottish energy policy should concentrate initially on energy efficiency measures, but make sufficient provision for an expansion of renewables in the longer term.

The problem for Scotland is that government policies have not been conducive to the development of a sustainable energy strategy. The government seems little concerned about long-term requirements, basking in the knowledge that the dash for gas will enable it to comfortably meet its emission targets for the year 2000 without doing anything. The Scottish Renewables Order has proved woefully inadequate in promoting renewable energy development. Although there has been considerable effort in energy conservation, it still falls short of the estimated £2.5 billion needed to upgrade the 350,000 substandard homes in Scotland.

Clearly further action is required by government and others. By outlining the extent of the problem and offering positive solutions, Friends of the Earth Scotland hopes to place the urgent need for a sustainable energy policy high on the political agenda. □

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Magnox avoidable costs revisited

Should the UK's ageing Magnox reactors be kept open? Mike Sadnicki suggests that on economic grounds alone most should be closed immediately.

A new study⁽¹⁾ of the avoidable costs of Magnox power stations has been prepared for the Nuclear Free Local Authorities (NFLAs). It was submitted in October 1995 to the Trade and Industry Select Committee (TISC) currently assessing the government's plans for nuclear privatisation. The study recommended that the TISC consider the case for immediate closure of Magnox stations.

The Magnox stations were the first generation of commercial reactors built in Britain, with 11 constructed between 1956 and 1971. Six of the eight inherited by NE are still operating — Bradwell, Dungeness A, Hinkley Point A, Oldbury, Sizewell A and Wylfa. Two, Berkeley and Trawsfynydd, were closed because improvements, required to satisfy the Nuclear Installations Inspectorate (NII) that continued generation was acceptably safe, were judged to be too costly. Scottish Nuclear's (SN) Hunterston A was closed just before SN was formed and an important factor in its closure was the avoidable cost of generation from the competing fuel, coal.

To operate beyond 30 years, a Magnox must pass a Periodic Safety Review (PSR) by the NII. Bradwell's PSR was completed in 1992 and Hinkley A's was completed this summer. For Hinkley A, the NII stated that "no safety factors have been identified which would limit the life of the station to less than 40 years". A 37-year average Magnox lifetime is now a central planning assumption — used for example in the press release from the Department of Trade and Industry (DTI) when publishing the nuclear review white paper.⁽²⁾

However, the 2,959 MW of Magnox capacity do not generate economic electricity. Nuclear Electric (NE) has performed well in reducing unit operating costs, but the 1994/5 figure was still 3.0p/kWh, compared with an average electricity price of 2.645p/kWh. The stations were loss-making in profit and loss terms, at an overall deficit of £96 million. Why then are they kept open? The reason is claimed to lie with low avoidable costs.

Avoidable costs

In 1993 the government's coal review white paper concluded that there was no case for immediate closure of any of the Magnox stations.⁽³⁾ A significant proportion of the Magnox costs were argued to be either sunk, or fixed contractually, or unavoidable in the sense that ultimate decommissioning is unavoidable. The view was taken that all these unavoidable costs had been incurred or would be incurred, whether the stations were closed or operating.

In NE evidence to TISC in 1992, the avoidable cost for the Magnox tranche had been quoted as 1.5p/kWh, with no individual station higher than 1.7p/kWh. TISC was suspicious that avoidable costs

were such a small proportion of the average accounting cost (4.3p/kWh in 1991/2) and thought the claimed cost structure unusually inflexible.⁽⁴⁾ Friends of the Earth, Greenpeace and other commentators challenged NE's estimates. All commentators agreed that estimates of avoidable fuel cycle (reprocessing) and avoidable operations and maintenance (O&M) were surprisingly low.

A subsequent review by Ernst and Young, to the DTI's remit, confirmed the 1.5p/kWh figure, but earned notoriety with its treatment of "commercially sensitive" results. In a report on a matter of national importance, with a large number of pit closures at issue, 75% of the numbers were replaced, in the public version, by asterisks. Ernst and Young also confirmed that analyses were "specific to NE and thus do not attempt to represent the national economic effect; this would entail 'looking through' the transactions of the other UK nuclear entities"⁽⁵⁾ — it seems scarcely credible that the DTI did not include such looking through at BNFL in Ernst and Young's remit.

A study in November 1993 by this author reaffirmed the doubts. However, NE's most recent Report and Accounts still cite a Magnox avoidable cost of 1.2p/kWh, and a similar figure of about 1.4p/kWh was reported in the government's nuclear review white paper.

Magnox liabilities

The white paper recommends that the Magnox stations remain in the public sector, for eventual take-over by BNFL. The massive Magnox liabilities, an undiscounted £16,200 million from NE and SN together, represent a significant future drain on the taxpayer. The DTI, in the white paper press release, tried to demonstrate that in discounted terms enough funds will be available following privatisation to meet these liabilities. In this demonstration, the future net cash income from further Magnox operations (income from sales less front fuel costs and O&M costs) was estimated at £1 billion.

However, the arithmetic separated the net cash income of marginal generation from its reprocessing costs. The net contribution of continuing Magnox generation may be much less than the DTI's £1 billion once these marginal reprocessing costs are included. If the total avoidable cost equals the electricity price, further Magnox operation makes no contribution to liability funding. Beyond this point, where the total avoidable costs exceed the selling price, Magnox stations become uneconomic and should be closed.

So, now is an opportune time to revisit the avoidable cost issue. The NFLA study calculates the avoidable costs of continued operation of the Magnox stations to the average 37-year life,

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compared with a hypothetical closure on 1 April 1995. The study tries to build up a 'central case' estimate, using a soundly-based, high probability assumption for each important factor. For example, for medium-term future electricity prices, the study follows the DTI in using 2.5p/kWh. The main results hinge on assumptions on reprocessing costs and station O&M costs.

In its 1992 evidence to TISC, NE argued that reprocessing charges were almost completely unavoidable because of the presence of the contract (then unsigned) with BNFL. The NFLA study argues that this seems an extremely inflexible interpretation of the true situation. Since the government in one guise or another owns both parties to any Magnox reprocessing contract (both now and in the future) the existence of a contract does not mean that it is unavoidable.

There are two related issues. First, considering the withdrawal of individual stations, there is the determination of the genuine marginal costs of reprocessing the extra quantities of spent fuel that would arise from extended operations. Second, there is the question of what costs would be avoidable if the whole tranche of Magnox stations were withdrawn, allowing eventual withdrawal (after reprocessing of the final cores) of the whole reprocessing line. We are back to Ernst and Young's vital looking through. In the absence of such an opportunity, the NFLA study had to manage with the extremely limited information in the public domain.

A similar problem holds with O&M costs: NE does not produce operating data for individual power stations. There have been repeated attempts from Select Committees to remedy this situation, for example the Energy Select Committee in 1990 and 1992. However, to date, only once have individual station costs been published, in the NE evidence to TISC in late 1992. Even these were stack bars with poorly presented calibration, making precise interpolation difficult.

In evidence to TISC in 1992, NE envisaged substantial future reductions in what is termed its 'controllable costs' and such assumptions seemed to be built into its avoidable cost calculations. Successive Report and Accounts show that such reductions do not appear to be materialising. Controllable costs seem to be levelling out — the 1994/95 figures are almost identical to those of 1993/94. This makes particular sense for the ageing Magnoxes, the oldest tranche of reactors in the

world. Therefore in the NFLA study, future station costs are assumed to be constant in real terms, except in one sensitivity test.

In Figure 1, the calculated avoidable costs are summed over each cost category for each station, for the central case result of the NFLA study. The resultant total station avoidable costs are then compared with the yardstick of estimated medium-term electricity price of 2.5p/kWh.

Three stations — Bradwell, Hinkley A and Oldbury — are estimated as having an avoidable cost greater than the 2.5p/kWh yardstick. Sizewell A is right on the margin at 2.49p/kWh. Dungeness A comes in at 2.2p/kWh, and Wylfa, the cheapest and newest at 1.62p/kWh.

On national resource cost minimisation grounds, the correct comparison is between Magnox avoidable costs and the avoidable costs of its competitor stations. The NFLA study argues that the current competitor is still coal. The 1992 TISC coal avoidable costs provide a useful guide — 'current coal' at 1.84p/kWh; coal with Flue Gas Desulphurisation at 2.40p/kWh.

Thus four or possibly five of the Magnox stations have avoidable costs such that immediate closure should be considered. Only Wylfa, and possibly also Dungeness A, should be excluded from such considerations. These results were robust to a large number of sensitivity tests.

The results are very close to those obtained in November 1993. It is important that it is understood that the contention is not that avoidable costs have suddenly increased since 1993; rather, the contention is that avoidable costs have probably been of the order indicated in Figure 1 all the time. Indeed, they show a consistency with the original South of Scotland Electricity Board estimate of avoidable cost for Hunterston A of 2.225p/kWh in 1990, equivalent to about 2.65p/kWh in October 1994 prices. □

References

1. M J Sadnicki, *Magnox Avoidable Costs*, October 1995.

A copy of the full paper with full references can be obtained from SEJ or from author on request.

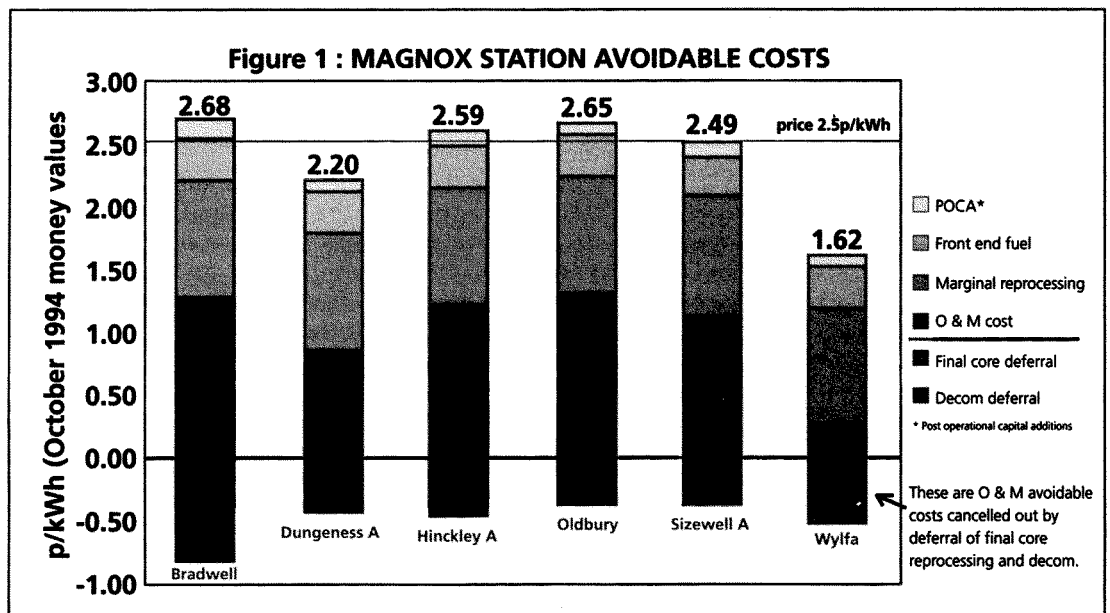
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Also: DTI Press Notice P/95/310 9.5.95 and Attachment concerning Magnox liabilities.

3. Department of Trade and Industry, *The Prospects for Coal, Conclusions of the Government's Coal Review*, March 1993.

4. Trade and Industry Committee, *British Energy Policy and the Market for Coal*, Report Proceedings HC 237, 26.1.93 see especially paras 110-117; also Evidence submitted by Nuclear Electric, HC 237-ix.

5. Ernst and Young, *Review of Magnox avoidable and unavoidable costs* 5.2.93; especially Section 2.3.



Electricity associations may merge

THE Association of Electricity Producers (AEP), which dropped the word 'Independent' from its title earlier in 1995, is now rumoured to be planning a merger with the Electricity Association possibly as soon as April 1996.

Until recently, the AEP lobbied for the small independent generators, but privatisation of the industry led to PowerGen joining their ranks, and Ed Wallis, chief Executive of PowerGen, is the current president of the association.

The Electricity Association (EA) (which represents the regional electricity companies, Scottish utilities and the major generators — most of whom are also members of the AEP) has been searching for a role for itself since electricity privatisation.

David Porter, chief executive of the AEP commented: "There are clearly some areas where the two associations have common views and a single, strong voice could be helpful. Liberalisation of

European electricity markets is a good example.

"On the other hand, there are some big differences between the two associations. AEP represents producers, but the EA includes the monopoly wires businesses with whom we often disagree."

■ Changes are taking place at the other end of the market too. Disaffected members of the Major Energy Users' Council (MEUC) have formed a new lobbying group for companies which use large amounts of electricity, gas and water.

The breakaway group, headed by Peter Rost, the former chairman of MEUC, has been named the Utility Buyers' Forum. Rost has complained that "there were too many dictatorial decisions being taken by one founder member," adding that "the executive committee has not met for more than 18 months." □

MMC referral

LAN LANG, the President of the Board of Trade, has finally taken action on the takeover frenzy which has hit the electricity industry. Two of the biggest bids, National Power's for Southern Electric and PowerGen's for Midlands Electricity, have been referred to the Monopolies and Mergers Commission.

Merger and takeover bids had reached fever pitch as the electricity sector carries out post-privatisation restructuring, with reintegration of generation and distribution businesses a main aim. Five other bids had been approved by Lang and his predecessor Michael Heseltine, four of which have gone through.

Interest in South Wales Electricity by Welsh Water is another example of cross utility merger plans, following the successful bid for Norweb by North West Water. □

Pump storage sell-off

THE National Grid Company is selling off its pumped storage division: two Welsh plants, the 1,728MW Dinorwig and 360MW Ffestiniog schemes. Together they represent about 5% of English and Welsh peak demand.

Three companies have been short-listed for the final bidding stage. Scottish Hydro-Electric is joined by two US companies, Dominion Energy, a subsidiary of Virginia-based Dominion Resources, and Mission of California.

The division made a profit in 1994/5 of £75.1 million on a turnover of £153m. Analysts had expected a sale price of £350m to £400m, but the initial bid from Scottish Hydro is believed to be around £450m. Mission, which is keen to expand further in the UK market, has bid even higher at about £600m.

Final bids are due to be submitted by 15 December with an announcement of the successful bidder before the end of 1995.

■ The National Grid Group itself, currently owned by the twelve regional electricity companies (recs) in England and Wales, is to be demerged during the coming year. 'Grey market' trading in National Grid shares, in advance of unconditional trading which begins on 11 December, valued the company at £3.8 billion. The recs must dispose of their shareholdings within a year. □

Pollution permits

EMISSIONS quotas — set by the Large Combustion Plants Directive — are to be transferred between UK companies for the first time. National Power (NP), which has cut emissions of sulphur and NOx below its quota mainly through a switch from coal to gas-fired plant, is to give some of its quota to Northern Ireland Electricity (NIE), at no charge.

NIE will be able to discharge an additional 12,000 tonnes of SO₂ in 1995 and 17,000t in 1996 together with 1,000t of NOx in each year and will save NIE around £4-6m each year by reducing the amount of low sulphur fuel it has to purchase.

The Department of Environment (DoE) has approved the move as it will "not result in any increase in overall UK emissions limits" and "the higher emissions from Northern Ireland ... are not expected to exceed 0.5%-1.0% in each of the two years of the transfer."

However, the Solway River Purification Board has sent a strongly worded letter of protest to the DoE, and board director Dr David Tervet described the change as "most definitely a backward step, Galloway's acid rain problem is bad enough without adding to it." □

Turbine troubles

GAS turbine problems at several new power stations could see large electricity users facing another winter of high bills. At least three new combined cycle gas turbine (CCGT) schemes have had problems with turbines, and their hoped-for extra capacity may not be ready for this winter.

Pool prices rocketed last winter following breakdowns at two nuclear power stations and delay in commissioning of a third, Sizewell B, and major users who buy direct from the electricity pool could see their electricity costs soar once again.

The three projects delayed are the 680MW Keadby, 680MW Little Barford and 660MW Medway power stations, which are all using the GE type 9F turbine, which has been suffering vibration problems.

One new CCGT station, the 1,000MW Barking plant, has been completed — with a different type of turbine — and was officially opened in October.

The £700 million project will provide much-needed new capacity in the south-east of England. But at around £700/kW it is much more expensive than the estimated £400-£500/kW of other new CCGTs. □

Climate change has started

GLOBAL warming has already started! The consensus of over 2,000 top meteorologists and other scientists is that the world has started to heat up and this is at least in part because of pollution. Furthermore, the scientists are agreed that the warming will have dramatic climate change effects, and could accelerate out of control.

These views are contained in draft documents from the Intergovernmental Panel on Climate Change (IPCC) which will be presented to the *IPCC 11th plenary session to adopt the 2nd assessment report*; meeting in Rome on 11-15 December 1995.

The IPCC warns that even if governments were to act now to stop any further rise in the man-made emissions causing global warming, the planet will continue to heat up and the seas rise for centuries to come. There will be: increased flooding and droughts; one-third of the world's forests will be threatened; and tropical diseases such as malaria and yellow fever will spread.

While overall the world will get

warmer, the UK and the rest of northern Europe could become colder through a weakening of the Gulf Stream.

■ A world crisis in food production in 1995, caused by heat and drought, has seriously reduced the European food mountain. It is the third year in a row that world food production has fallen short of consumption. Europe's grain mountain has dropped from 33 million tonnes to 5.5 million tonnes in two years.

■ Research by the US National Oceanic and Atmospheric Administration suggests that temperate forests in the northern hemisphere are a much greater carbon sink than previously thought. The research also indicates that the oceans are absorbing far less carbon dioxide than previously believed.

However, the researchers admit that their figures have large margins of error. And David Hall of King's College London warns that much more work needs to be done before industrialised countries can use tree planting at northern latitudes as an alternative to reducing the burning of fossil fuels. □

Efficiency move

FOLLOWING Parliament's decision earlier this year not to increase VAT on domestic fuel bills from 8% to 17.5%, a strong campaign has been mounted to have VAT on energy-saving materials reduced to 8%.

The Energy Saving Materials (Rate of Value Added Tax) Bill, introduced into Parliament by a cross-party group of MPs, led by Alan Simpson (Labour), received the backing of a majority of MPs. The Early Day Motion was signed by 331 MPs and at least another 20 have declared their support.

For procedural reasons the Bill was withdrawn before the end of the last parliamentary session, but it is hoped it will be taken up by one of the MPs high up in the Private Members Bill ballot which took place on 23 November.

■ The European Commission (EC) has produced a draft directive proposing integrated resource planning (IRP) in the electricity and gas distribution sectors. This would require energy companies to give equal consideration to demand-led planning geared to energy saving as well as supply options. □

CHP set-back

SEVERAL industrial and residential combined heat and power (CHP) schemes have reached completion recently, the largest being a 4.5MWe plant run by National Power Cogen for paper tissue manufacturer Jamont's at Bridgend, Mid-Glamorgan.

However, a leading UK CHP company, Combined Power Systems (CPS), is to withdraw from manufacture and installation of CHP plants.

The company, which has suffered a loss for the second year running, will concentrate on maintenance contracts for its existing 400-odd CHP schemes.

Julian Packer, CPS's engineering director, explained the move, saying:

"The market is just not there any more". He attribute the downturn to the "downward slide in prices in the electricity market," and the trend towards short-term contracts.

This is not good news for the government which has set a target of 5,000MWe of CHP plant in the UK by the end of the century as part of its carbon dioxide stabilisation programme. The inclusion of CHP in the latest round of the NFFO ("", p20) is of limited help as it is restricted to schemes fuelled by waste.

■ Euroheat & Power, the international association of CHP, heat producers and distributors, has set up an office in Brussels to lobby the European Union on the environmental advantages of CHP. □

Clean coal

Ademonstration plant for converting coal to methanol fuel is being built in Tennessee, USA, under the US Department of Energy's \$2,300 million clean coal technology programme. The \$214m plant will produce around 260 tonnes of methanol a day.

Unlike conventional coal-gas to methanol technologies which send the synthesis gas through a bed of dry catalyst particles, the new plant will convert the coal gas to liquid fuel in a single vessel containing catalyst particles suspended in mineral oil.

The methanol could be used to fuel power plants and vehicles, or as a chemical feedstock. □

EC R&D funding

A promise to restore research and development (R&D) funding for renewables has been made by the European Commission (EC) following controversy over 20% underfunding by the Joule programme ("EC R&D funding diverted", SEJ 106).

An investigation by eight MEPs was launched in September 1995 to look into allegations that renewable projects had been sabotaged by EC officials. It has been suggested by one German Green MEP, Hiltrud Breyer, that Electricité de

France and German utilities were behind the downgrading of projects to "stop the market breakthrough of renewables." It was claimed by a German television programme that technical reports on renewables projects were altered to give more negative evaluations, justifying the withholding of funding.

The main suspect was the Director of Energy at DGXII, Ezio Andreta, and as well as the allegation of changes in expert reports, there were accusations from MEPs that minutes of meetings had been altered.

The MEPs investigating the affair

were unhappy with the lack of transparency in the Commission's procedures, but seemed willing to accept a promise by the EC to fully restore funding and are unlikely to press for an official Commission of Inquiry.

Renewables will be given top priority in the next round of project selection. In addition, a supplementary round of Joule is being prepared for publication in January 1996.

The head of the EC renewable energy unit, Wolfgang Palz, was removed from his post, allegedly for leaking information on the affair. □

NFFO-4 & SRO-2 plans announced

NEW renewables orders in the UK, announced by the government in November, have not been well received by renewables developers. There was little new in the announcements, with few of the improvements which had been hoped for.

In England and Wales, the Non-Fossil Fuel Obligation (NFFO) fourth order will be for about 400-500MW, to be made in early 1997, and will be followed by another order of similar size in 1998. The scheme has been extended to include combined heat and power (CHP), but only if it is run using municipal or industrial waste. In addition CHP projects will be subject to a 'will secure' test for their heat output as well as their electricity. Unlike power sales, heat contracts are often not signed until well after a plant has begun operating, says David Green, director of the CHP Association.

The 1996 Scottish Renewables Order, of 70-80MW, will not be extended to include wave power nor has there been any mention so far by the Scottish Office

of CHP schemes being included north of the border.

Many developers have been critical of the time and cost involved in applying for these renewables orders, and the uncertainty about receiving a contract, but the government is satisfied that it will reach its target of 1,500MW (declared net capacity) for new renewables in the UK by the end of the century and seems unconcerned by these difficulties.

■ One scheme which is hoping to bid for the SRO is a planned waste wood-fired combined heat and power project to meet the energy needs of the 900 residents of Newcastleton in the Scottish Borders, on the edge of Kielder Forest. The proposal, which would use 20,000 tonnes of waste wood a year, is being developed by the local community council in conjunction with Borders Biofuels.

Although the heat supply element will not come under the SRO, there is a specific tranche for electricity from energy crops and forestry waste. □

Bad big hydro

MALAYSIA is pushing ahead with its huge Bakun dam project despite local opposition and widespread criticism of the economic viability, and environmental and social impact.

The development, eight times the cost of the Pergau dam, will flood 70,000 hectares of virgin forest — an area the size of Singapore.

As well as the environmental problems, there is doubt about the need for the electricity it will produce; forecasts are that Malaysia will already have a surplus of electricity generating capacity by the time the dam is completed, due to development of gas-fired power stations.

While the Malaysian prime minister hopes the project will promote industrial growth, and make the country a power exporter, it is unlikely that other countries in the region will want to be reliant upon electricity from Malaysia. The project will require the longest ever underwater cable, using more cable than the present annual world output. □

Wind round-up

Noise

A report from a Department of Trade and Industry working party looking at the planning regulations on noise from wind farms has been delayed over disagreements on acceptable levels for the more intrusive tonal noise.

Preliminary findings were announced to the British Wind Energy Association annual conference in July. The group, which includes planners, developers and advisers, has accepted that the 350-400 metre separation between turbines and houses is not sufficient protection, and should be replaced with specific noise levels. It has been proposed that a limit of 5dB(A) above background noise be set.

Imports

British-made Wind Energy Group (WEG) machines will not now be used at the wind farm at Trysglwyn on Anglesey, Wales National Wind Power, which is developing the NFFO-3 project, has opted for importing Bonus wind turbines from Denmark despite the fact that the proposal was originally fronted by WEG.

Burgar Hill

The 3MW turbine at Burgar Hill on Orkney, which was restarted in mid August, is now under new management. The Department of Trade and Industry, owners of the turbine which had stood idle for three years, leased it to a group led by Prof. John Twidell of De Montfort University. After repairs to cracks in one of the blades, the turbine was able to

operate at full load. It will now be run by Sustainable Resources, which hopes to make a modest profit despite receiving just 1.4p/kWh from Hydro-Electric.

Offshore

Britain could see its first offshore wind project at Blyth Harbour, Northumberland, following a successful application for funding under the European Union's Thermie programme. Border Wind, which already operates nine 300kW turbines placed along the harbour wall, hopes to site two 750kW turbines offshore.

New Zealand

New Zealand is to get its first commercial wind farm with seven 500kW turbines due to be erected in the Wairarapa area. □

Photovoltaics make the running

JAPAN'S Ministry for Trade and Industry has increased its solar budget from £87m to £220m, and coupled with price cuts of as much as 30% by some of Japan's twelve photovoltaic (PV) system suppliers, government subsidies are set to reduce the cost of a typical 3kW domestic PV system to below £13,000. This should help the Ministry reach its target for installed PV of 4.6GW by 2010.

Meanwhile the US Department of Energy funded Utility PhotoVoltaic Group is part financing eight projects totalling 8.5MW of grid connected PV costing \$44m, along with scores of autonomous PV installations — all intended to help create a sustainable US PV industry.

The recently completed, European Solar Prize winning Pontaise Olympic Stadium in Lausanne, Switzerland,

having 600m² of PV panels with a capacity of 65kW, will be eclipsed by the 340kW PV system at Atlanta's 1996 Olympic Aquatic Centre — the world's largest rooftop PV plant. The Australians plan to go a stage further, intending the Sydney 2000 Olympics to be the first games powered exclusively by alternative energy. This will be provided by a combination of wind, solar and hydro power, and landfill gas. □

Osprey revival highlight of wave conference

OVER 100 of the world's leading wave power engineers and scientists — gathered in Lisbon, Portugal, for a three-day conference — were given the news they had hoped for: the Osprey wave power machine would live again, writes David Ross.

Lloyds of London has accepted the claim by the owners of the Osprey, Applied Research and Technology (ART), over the damage to the 2MW wave power station off Dounreay, Scotland, in August ("Wave power ups and downs", SEJ 106).

Allan Thomson, ART's managing director, said he was delighted with the speedy resolution of the claim and "we anticipate that Osprey Two will be built during the early part of next year, with installation going ahead in the summer of 1996." Lloyds had accepted that Osprey was destroyed by "the peril of the sea" and the insurers would pay "the reinstatement value". The undisclosed sum is probably around £1 million.

There had been much speculation about the cause of the problem which saw the tail end of a hurricane rip open the steel structure during installation. In particular, the revelation that two of the nine ballast tanks, the two that were later holed, were damaged at launch seemed to point to an inadequate repair, but this work had been checked and approved by the insurers.

Thomson said settlement of the claim "confirms the view of the developers that Osprey One's demise was due to unusual weather conditions during the sensitive installation period." This is for him the most favourable outcome. If there had been any suggestion that the Osprey's failure was due to damage by human error at the launch, then there could have been protracted legal proceedings, which would have delayed a settlement.

The Osprey was at its most vulnerable because the steel ballast tanks had not been filled with sand when exceptionally heavy weather struck. Two of the compartments crumpled — described to *The Safe Energy Journal* by Thomson as the "empty coke can" problem. In future, he said, they would reduce the number of marine operations and make them as short as possible.

Other speakers told the conference of their plans. India said its Oscillating Water Column (OWC), of 150kW capacity, had been operating since 1992 on the west coast near Trivandrum, and a 1.6MW project is planned, with 15 modules of 55kW being built into harbour walls. A large number of small units is most appropriate for the lower amplitude of waves in India compared

to the North Atlantic. India is also planning a hybrid plants for islands, with diesel back-up.

The Japanese, led by Commander Yoshio Masuda who invented the OWC, said that they had been guaranteed £16 million (US\$24 million) by their government for a five-year development programme. The government, said Hitoshi Hotta of Jamstec (Japan Marine Science and Technology Centre), had published a report recognising the importance of a stable supply of energy "with consideration of the global environmental issues. So the situation becomes better, little by little."

Norway has signed a contract for the building of a 1,000kW Tapchan (Tapered Channel) system, with a yearly output of 6.1GWh, at Baron on the south coast of Java. Portugal has an OWC due for completion in the summer of 1996 on the island of Pico in the Azores.

Albert Russell from the European Commission told the conference that wave energy had a significant part to play in reducing carbon dioxide emissions. "It is immature compared with some other renewables. Difficulties have meant that high risk has discouraged development. Setbacks and disappointments are inevitable. Wind energy in the early days had serious problems, like blades braking and being thrown several kilometres. These problems were tackled and surmounted. Now we have 2,000MW of wind energy in the EU." He sympathised with the Osprey team and hoped that they would continue — a signal that the EU would continue its support. The EU will be spending hundreds of thousands of Ecus on the main European projects, prime among them being Osprey Two.

Another project is being undertaken by Prof. Stephen Salter, of Edinburgh University, and others to take wave

power into high technology by building a full-scale, variable-pitch turbine. It will be installed in an OWC, probably the one in the Azores.

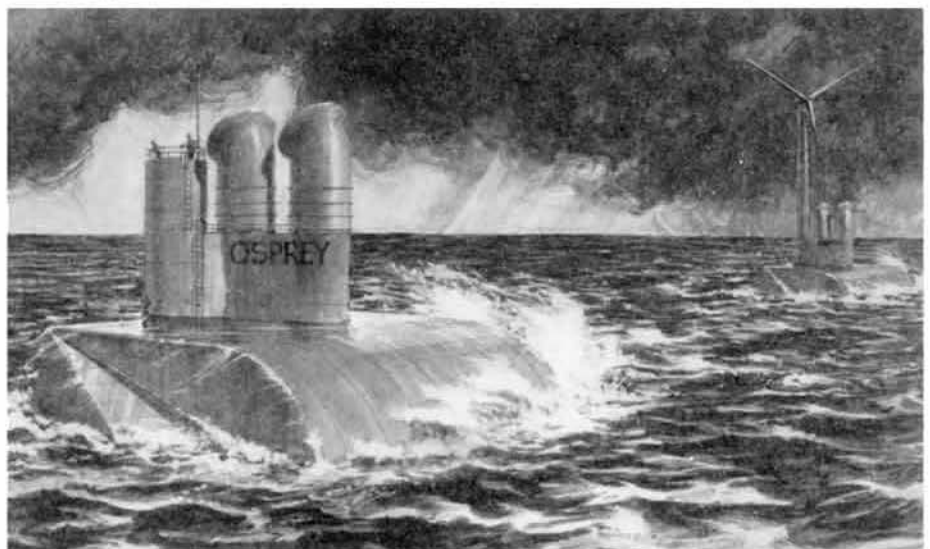
A computerised atlas showing the European wave energy resource is being developed in Portugal. It will be "a user-friendly, PC-based system, designed to run on widely-available PC 486s using Windows 3.1", reported Teresa Pontes, leader of the Portuguese team.

Trevor Whittaker of Queen's University, Belfast, who built a 75kW shoreline wave station on Islay in the Inner Hebrides, which has survived eight winters, told of a plan to build a larger, 500kW, successor on the Atlantic-facing coast of the island. His project is backed by ART, and will be a steel construction, much more like the Osprey than the original concrete device. ART intends to have a portfolio offering a choice of machines to potential customers to suit their particular needs.

However, Whittaker is one of the victims of the EU system of awarding contracts to different national groups. In the next round, most of the money will be going to two UK projects — the Osprey and the variable pitch turbine — and the EU is unable to award funding to a third UK project, so Whittaker has lost out.

This could be the opportunity for the UK government to return to a technology it helped launch in 1976 and abandoned in March 1994, just when success was starting.

■ An assessment of the Osprey has been carried out by Tom Thorpe of the government's Energy Technology Support Unit. Thorpe, who undertook the wave review published in 1992, has priced electricity from the Osprey at 6.4p/kWh or 5.1p/kWh including an add-on 1.5MW wind turbine, at an 8% discount rate. □



202-page books aren't always so clever either

Small is Stupid;
by Wilfred Beckerman

Duckworth, 1995, 202pp, £20 hb

ECONOMISTS and environmentalists are often to be found on opposite sides: this book does nothing to change that. In calling it "Small is stupid", Beckerman, an emeritus professor at Oxford's Balliol College, concedes that people who do not know him might imagine that he has "a confrontational style that only equips [him] to write a book on how to make enemies and antagonise people." Indeed.

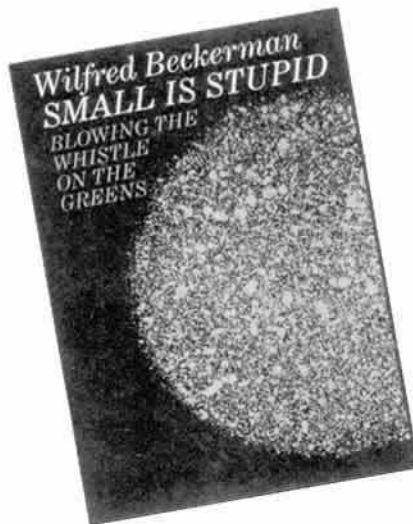
Beckerman is less than convinced by predictions of global temperature rise as a result of global warming; he further rejects any notion that a scientific consensus exists through the Intergovernmental Panel on Climate Changes (IPCC) on likely temperature rise.

However, even if global warming did result in a reduction in the world's agricultural production this would be more than compensated for by scientific advances in agricultural yield: "Even if, on balance, global warming did raise the costs of achieving a given agricultural output by, say, 10 to 20 per cent by the middle of the next century, these are likely to be covered many times by the savings from continued increase in control over production, possible production of new proteins, technological progress in water conservation and irrigation and so on.

"Furthermore, over the last four decades food production has been rising faster than demand, so that some barely noticeable cut in the rate of growth of agricultural production — if any — does not spell mass starvation."

Time and time again Beckerman resorts to non-sequiturs: "Famines, as we now know, have been more the result of wars, appalling policies, civil strife and ethnic discrimination than of acute physical food shortages in any given area." This, in some cases, may well be true, but it doesn't detract from the very real fear that any decrease in — or change in availability of — global resources brought on by climate change or any other environmental problem can only serve to increase the conflict sparked by the desire to control these resources. If, as predicted by some, global warming causes an increased shortage of water in the Middle East then this can only increase conflict in the area.

'Sustainable development' and the 'precautionary principle', according to



Beckerman, are fundamentally confused. He is worried that politicians might give way to public pressure and embark on programmes based on "hastily devised, inefficient and expensive environmental regulatory policies that usually involve unwarranted intervention in the operation of the market."

After quibbling about definitions, as academics are wont to do, Beckerman concludes that "economic growth is still a necessary condition for remedying most of the serious environmental problems facing the world today, particularly in developing countries." But what kind of economic growth? The kind Shell has imposed on the Ogoni people? As Beckerman claims that most famines in developing countries are caused by war or bad government, surely economic growth can do little to solve either. He can't have it both ways.

He does not deny that the world is "facing serious environmental problems" nor would there appear to be any argument about the failure of conventional economics to counter them. Indeed Beckerman observes: "... the environment exhibits certain technical characteristics that hamper the operation of market forces."

However he concludes that Governments would be well advised to devote their attention to "designing policies to enable market forces to operate in the environmental sphere, or to mimic the operation of the market."

If Beckerman were a lone voice speaking from the 'home of lost causes' — Oxford — pouring curious economic conundrums into some obscure academic press then this volume would have no more than curiosity value. However, his is not a lone voice. It has

echoes throughout the world's corridors of power.

Recently the IPCC employed conventional economic thinking to conclude that a western life was some 15 times more valuable than a life in the developing world — and presumably therefore 15 times more worth saving. Confident in the economic analysis employed, the Panel did not challenge the results of this calculation. However, if it had paid more

attention to the result and the simple fact that all life should be valued equally then it would have realised that conventional economic theory is fatally flawed — more fatal for some than others. In making such calculations, the Panel only serves to underpin the 'business-as-usual' philosophy of Beckerman and his ilk.

One part of Beckerman's analysis is correct. In facing up to the environmental debate we must resolve three central differences: "First, between the claims of different environmental concerns on the available resources. Secondly, the conflict between different interests of different countries and, thirdly, the conflict between interests of different generations."

This is a valuable contribution to the environmental and equity debates. By collecting a series of outdated and dangerous arguments in one place he has produced the definitive volume. All of those who seek to influence the policy agenda for the coming millennium and beyond would be well advised to familiarise themselves with the arguments he presents.

Mike Townsley

Power from the waves;
by David Ross

Oxford University Press;
December 1995, 212pp, £19.99 hb

DAVID ROSS is a regular contributor of articles on wave power, to this and other journals. As a freelance journalist he has spent 20 years following wave power developments, becoming a real enthusiast — though never an unquestioning one. His latest book updates his earlier *Energy from the waves*, published in 1979.

Ross offers a fascinating account of the hesitant progress in UK wave power research and development (R&D). It is a story which reflects little credit on politicians or their civil servants. As a

The environment in a world market

Blueprint 4: capturing global environmental value;
by David Pearce

Earthscan, 1995, 212pp, £10.95 pb

FOR those of you who have managed to miss this professor of Economics at UCL, Pearce is one of Britain's best-known advocates of 'green economics'. The reasoning goes along the lines of: why waste energy struggling against the entrenched economic system, when it is perfectly feasible to utilise what is only a tool for the benefit of the environment.

Blueprint for a Green Economy, published in 1989, was Pearce's first stab at the popularisation of the basic principles of green economics. Subsequent *Blueprints*, 2, 3 and now 4 have been just the popular edge of Pearce's prolific book output.

Blueprint 1 was an introduction to the incentivisation of sustainable development through corrections of government policy and market workings to reflect environmental values. *Blueprint 2: Greening the World Economy*, applied the aforementioned procedures to environmental problems shared on a global scale. *Blueprint 3: Measuring Sustainable Development* focused on sustainable development in the UK, proposing that funds be set aside to offset depreciation of all types of capital, including the natural environment. *Blueprint 4: Capturing Global Environmental Value* returns to the global scene in analysing international bargaining on behalf of the environment. We are told we can also look forward to *Blueprints 5*, etc ...

To the subject of this review, *Blueprint 4* has as its central theme the cost effectiveness of global bargains to protect natural



resources. Part I is an introduction to the relevant issues, namely global warming, ozone depletion and biodiversity loss. Explanation of just why such all-encompassing goods are so susceptible to economic failure is also given — to take clean air as an example, it is almost impossible to impart ownership on diffuse entities such as air and, up to a point, usage by one person doesn't compromise usage by another. Such non-exclusive non-rival goods are dubbed public goods by economists and lack of control over their use often leads to abuse.

Part II, entitled Explaining Resource Degradation, examines in detail how present applications of economics not only fail to protect the natural environment, but often actively encourage degradation. There is a summary of GATT for those, including your reviewer, who are somewhat confused on that matter. Part III, Capturing Global Value, winds up with methods for correcting mistakes. It looks

at global bargains, both high profile — Rio, Montreal and so on — as well as smaller-scale examples like energy companies in the US undertaking afforestation projects in developing countries to offset carbon dioxide emissions from new capacity in their own country.

Blueprint 4 is packed with information and I am now the wiser on GATT, Rio and the Global Environment Facility. Having said that, if I wasn't compelled to read it in its entirety for the benefit this review and for the gems of information I knew it would contain, I don't know if I would have made it to the back cover. It was a concerted effort to wade through the continued repetitions and lengthy discussion of issues rounded up in a few sweeping statements ("correcting economic failures will correct overconsumption"). Pearce makes minimal acknowledgement of problems inherent in valuation techniques which renders many of his recommendations inoperable. After having read the book, I am still left wondering what exactly he was trying to say in some cases. The author obviously knows his stuff, but his self-congratulatory style of writing was hard for me to stomach.

According to Pearce in the preface to *Blueprint 4*: "The 'ideological' battle ... has been won. The challenge is to design incentive systems in practice ... [which is] undeniably difficult but eminently worth pursuing." So, while Pearce is busy honing his willingness to pay, governments will misuse his studies and continue to take the political rather than the maximum welfare option. I am certainly not against the use of economic tools to attain cost-effective compromises, but I personally believe Pearce goes too far in the faith he places in the [unattainable] 'perfect' market.

Helen Snodin

Charting the progress of wave power

former Fleet Street journalist, Ross has an interesting perspective on events. He has taken the time to speak at length to the key players, to understand the engineering and the politics.

The secretive way in which the UK government has dealt with wave power has resulted in a dearth of information. The terrier-like approach of Ross has enabled him to gather together those scraps of information which are publicly available and unearth some which the government had wished to keep buried. From this Ross is able to paint as full a picture as possible of the real story of wave power. And in the circumstances, he can be forgiven for occasionally seeming to draw too strong a conclusion from too few facts.

Ross's contribution to wave power has been much more than just reporting and analysing events. While it is people like Professors Salter and Wells and Dr Trevor Whittaker who are the pioneers of wave energy technology, without Ross, they may never have got the funds they have needed.

As is recounted in the book, in the chapter "Brussels stumbles into action", Ross reported on a misleading Commission answer to the European Parliament which claimed that a report had proposed no funding for wave power, a negation of the truth.

The answer had come from Commission Vice-President Sr Filippo Pandolfi, whose embarrassment at having been used, without his knowledge, to

mislead the parliament led to him taking a keen interest in securing European Union (EU) funding for wave power R&D. The EU is now the main source of funding on European wave power R&D.

Traditionally, engineers, like other scientists, have little regard for journalists. It is a tribute to Ross that he has the respect of the wave energy community, without which he would never have been able to produce a book with such insight into the subject. Those engineers trust has been amply rewarded. Ross's vision of wave power as a major source of energy is both explained and promoted with this book.

Graham Stein

PR problems



Dounreay has not been having a happy time of late. A few months ago it was strongly criticised by Thurso community council for its "poor" public relations. In its defence, Dounreay's head of PR, Ian Shepherd, explained that the failure to present Dounreay in a positive light was because: "When we give out information about environmental issues we ... have to be very careful that the facts are correct."

Perhaps as a way to circumvent this restriction, a new group, Dounreay Action Group, was recently set up ostensibly to "seek out the truth about Dounreay". The group's impartiality was put in serious doubt when one of the first to volunteer to serve on the body was Derrick Milnes, one of Dounreay's public relations officers.

As one of its first acts, the group took out an advert in the local paper, the *John O'Groat Journal*, attacking Greenpeace. Designed to promote reprocessing at Dounreay, the ad mentioned a 1984 train crash test on a nuclear flask organised by the CEBG at Old Dalby. Strange, but the organisation which raised that mock accident in regard to Dounreay was not Greenpeace but the Department of Trade and Industry (DTI).

The DTI, which is promoting the use of Dounreay for reprocessing, cited the 'test' in arguing that the transportation of nuclear material to Dounreay was safe. What the DTI failed to say was that the test, though spectacular, subjected the nuclear flask to stresses of only around half of those under the inadequate international standards.

Don't take Little Black Rabbits word for this — it was admitted by the Head of Radioactive Materials Transport Division, Department of Transport at a 1986 public inquiry in, of all places, Thurso.

Eggar on his face



Energy minister Tim Eggar had been looking smug at having persuaded electricity utilities to up their proposed handouts from

the sale of their stakes in the National Grid to as much as £50 per customer. But think this feel-good measure through.

The money, to come off bills in the first quarter of 1996 will see a sudden drop in the Cost of Living Index. However, this one-off fall will be offset the following year by a one-off increase in the spring of 1997, coincidentally, the favoured date for the next general election.

Not so good, Tim.

Board games



Following the recent merger of Norweb and North-West water, some analysts have been questioning the financial sense of the deal. But as a regular player of the board game Monopoly, Little Black Rabbit is well aware that ownership of both the electricity and the water company will increase the potential rate of return by 150%. Gentlemen, play on.

Holy smoke



In the town of Kalmar in southern Sweden, elders of the Lutheran church of the Holy Cross are setting new standards in energy conservation. Heat is being recycled from the adjacent crematorium. There is thought of be no truth in rumours that the elders now have plans to site a wind turbine on top of the steeple.

Labour pains



After receiving a special mention in this column in the last issue ("Jackass or Jackal?"), Dr Jack Cunningham, MP for Greater Sellafield, has rather carelessly lost his post as opposition Trade and Industry spokesperson. Could it be that the curse of the Little Black Rabbit has struck again?

Another casualty of the shadow cabinet elections was Martin O'Neill MP, replaced as energy spokesperson by John Battle MP. Little Black Rabbit had expressed concern that O'Neill, undertaking a review of the Labour Party's energy policy, was inclined

to favour a switch away from a radical, eco-friendly anti-nuke position back towards a pro-nuclear line. O'Neill has now returned to the backbenches. LBR strikes yet again?

Fantasy billing



A meter reader working for Hydro-Electric decided it was far easier to make up customers' readings than actually visiting their homes. When the time came to take the reading, the employee would make a calculated guess and then determine the final digits with a role of the dice. He was only discovered after a victim of phantom meter readings complained to Hydro-Electric that no meter reader had called.

Was this the remote meter reading the industry has been working on?

Cut price



Five years after the electricity industry was sold off for £5,200m, it is capitalised at almost £16,500m. Quite clearly, taxpayers have lost out to the tune of more than £11,000m. If only the financial advice given to the government at the time of the sell off had been a little more astute, or even accurate.

Price cut



The cost of decommissioning Britain's ageing Magnox reactors has been cut, miraculously, by £900m. The House of Commons committee investigating the sale of the more modern nuclear power stations seemed more than a little surprised by this sudden mark down. At least Mark Baker, from the old Nuclear Electric board and now responsible for running and decommissioning the stations, had the grace to look embarrassed when challenged on these figures. Perhaps he's worried that the difference between this figure and the actual cost will be taken out of his pay packet.

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