

THE SAFE ENERGY JOURNAL

SCRAM

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*Nuclear Power:
the industry they
couldn't give away!*

**The nuclear
industry's
CO₂ myth**

**1994: the
next battle**

**THORP's case
continues to
crumble**

**Dounreay:
an alternative
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the future**

**"Quo Vadis",
East German
nuclear?**

**Proliferation
safeguards
inadequate**

COMMENT

THE evidence against the Thermal Oxide Reprocessing Plant at Sellafield, like nuclear waste, continues to pile up. Just since the last Journal we've heard the government's Radioactive Waste Management Advisory Committee (RWMAC) tell us that "there are no compelling reasons to reprocess oxide fuel", and that "reprocessing and the disposal of the resulting waste costs about twice as much as conditioning and the direct disposal of spent fuel". Department of Environment consultants have confirmed, as we already knew, that dry storage is "environmentally cleaner" than reprocessing. Now from the Science Policy Research Unit we learn that reprocessing could be up to four times more expensive than storage, even ignoring the construction costs of THORP.

RWMAC's remit doesn't allow them to make a judgement on "whether the radiological and environmental impact of reprocessing [spent] fuel is justified by the benefits to the UK economy". But the vast majority of the UK public have already made their judgement. The Gardner report will have put paid to any lingering doubts which some voters - eager to see Britain's balance of payments problems solved - may have had. As we go to press we have learnt that there is a rate of eye cancer in the grandchildren of Sellafield workers 500 times greater than would have been expected. How much more evidence is needed before the politicians take notice? Do we have to wait until THORP is up and running for governments to admit their mistake, as they eventually did with Torness. The "Torness a £2,500 mistake" headline in the Glasgow Herald, may have drawn a wry smile on campaigners' faces, but similar headlines about THORP in 5 years time are not going to help the children, nor protect us from the dangers of transporting plutonium around the globe.

It is particularly galling, therefore, that the Labour Party have dropped plans to abandon THORP. One (unnamed) Labour MP was quoted as saying "It would be completely impractical to close the plant. It is going to earn billions in overseas earnings, and what would we do with the nuclear waste in Britain?"

It is time that voters in this country (and Ireland as well) told their political representatives that the situation is quite the reverse - IT IS COMPLETELY IMPRACTICAL TO OPEN THORP.

EVERYONE, including institutions and political parties are 'green' these days. Yet the Government's latest money spinner, the electricity industry, is lumbered with the title of being Britain's number one polluter. As people increasingly become aware of the 'Pollute Electric' image, investment in the Regional Electricity Companies (RECs) assumes an increasingly high risk profile.

Under such circumstances you'd expect Robert Malpas, as chairperson of PowerGen to be well positioned. Amongst the older executives, he alone voiced an alternative future, and proposed to, "use less to produce more, both to conserve resources and to reduce waste". He is one of the few to realise the feasibility of achieving "world economic growth over the next 30 years for not much more than the current total energy consumption". He had the vision and the job to tackle green concerns where it could have greatest effect.

That's why he had to go. He occupied the pivotal position in the industry but could not overcome the contradiction in the Government's privatised energy structure, that the generators and distributors can only profit from increased sales. In the end he had nowhere to manoeuvre and presumably lacked a power-base of his own. It is a clear indication of the industry's inability to respond to a deteriorating situation. The Government will claim popular support and success in the sale. Shortly after, the usual third of share punters will cash in their windfall, and the big companies and institutions will be in control. A few shareholders will be winners in the short-term, but in the long-term everyone will lose as the environment, as well as Robert Malpas, pay the price.

scram, skram, v.
to shut-down a nuclear
reactor in an emergency.

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Dr Nigel Mortimer challenged the nuclear industry's assertion that it produces no carbon dioxide in his Hinkley Inquiry submission (FoE9). **Graham Stein** looks at the continuing debate and finds that the nuclear industry has had to give considerable ground.

8 1994: the next battle

The Hinkley C Inquiry Report provides evidence that the Tory Party has not given up on nuclear power. **Jane Roberts**, a founder member of Stop Hinkley Expansion warns of the possible return of nuclear power in 1994.

10 THORP's case continues to crumble

Pete Roche considers the prospects for the Thermal Oxide Reprocessing Plant (THORP) at Sellafield, and finds that while Labour have ducked making a commitment to abandon it, economic reality may intervene.

12 Dounreay: an alternative development

The search for alternative employment at Dounreay has been given new impetus by the Governments decision to phase out the Fast Reactor programme. The first tentative steps towards a renewable energy programme have been taken by the AEA with the appointment of a project manager. **Kenneth Low**, an Orcadian engineer, argues that much more can and should be done.

14 ICRP putting wealth before health

Reductions in recommended dose limits for radiation workers set by the International Commission for Radiological Protection do not go far enough, argues **Patrick Green**, Friends of the Earth's Radiation Campaigner. The ICRP has put industry profitability before worker safety, and their recommendations should not be the basis for UK or European law.

16 Building for the future

With major cuts in fossil fuel consumption required to control global warming, **David Olivier**, Principal of Energy Advisory Associates, has been on a fact finding trip to mainland Europe to look at the use of energy efficiency and renewables in new and existing buildings.

18 "Quo Vadis", East German nuclear?

The future of eastern Germany's nuclear industry, following unification, is considered by **Sebastian Klinke**, a student of political sciences at Bremen University.

20 Proliferation safeguards inadequate

The effectiveness of safeguards on plutonium bulk-handling facilities is questioned by **Marvin Miller**, a senior research scientist with the Department of Nuclear Energy at the Massachusetts Institute of Technology, in a paper published by the US Nuclear Control Institute, and summarised for SCRAM.

Nirex opposition

HIGHLAND Regional Council hosted a major conference in November attended by more than 100 delegates from Scottish campaigning groups, councils, trade unions, the business community and MPs, to search for common ground in the fight against the Nirex proposals to dispose of nuclear waste at Dounreay.

Speakers from local businesses and trade unions were keen to point out the close association between the unique Highland environment and their products. Major sectors of the Highland economy: the fishing, farming, and the whisky industries are especially dependent on Scottish waters. "These waters are our precious asset" said Douglas MacLeod of the Association of Scottish Shellfish Growers.

The relevance to overseas markets was

stressed by Jamie Stone of Highland Fine Cheeses who said: "In a European context, people do not make a distinction between Caithness and other parts of Scotland, therefore producers throughout the area will be tarnished by the presence of a nuclear waste dump. We need to sell the area as being of unparalleled quality of life and environment, producing some of the finest food and drink in Europe." For these reasons he urged businesses to further the campaign.

Campaigners from Scotland Against Nuclear Dumping (SAND) argued for a united stand between institutional and campaigning groups to prevent Nirex exploiting differences in the broad alliance.

Support was forthcoming from over 25 regional, district and community councils, as well as the Scottish Nuclear Free Local Authorities. Highland's Vice-Convenor, Councillor Peter Peacock said: "It was most unacceptable that Scottish Secretary, Malcolm Rifkind, had ridden

roughshod over the Council's decision to reject planning permission for two deep test boreholes to be drilled at Dounreay and then removed from the Structure Plan policies opposing research into and establishment of a nuclear repository."

The council called for: only waste produced within the Highland Region to be stored there; nuclear waste produced elsewhere to be stored at its point of production and stored above ground; and a public inquiry commission, rather than a local public inquiry, if Nirex decide to site its repository in Caithness, to allow a wider consideration of the issues involved.

Throughout the conference, the quality of debate was high. Several proposals for a co-ordinated campaign were agreed, leaving delegates expressing considerable optimism. They also felt that bringing so many groups together from all over Scotland was itself a considerable achievement. □

THORP-less

AN independent report*, commissioned by Greenpeace, reveals that, even when the construction cost of THORP is ignored, reprocessing has no economic advantage over spent fuel storage, and could be up to four times more expensive.

The report, "THORP and the economics of reprocessing" by Frans Berkhout and William Walker of the Science Policy Research Unit at Sussex University, concludes that "On all counts ... the original case for THORP now lies open to question. The strategic justification has evaporated, the basic economic context appears to have swung against reprocessing, and there are no clear waste management benefits to be gained."

It is now generally accepted that reprocessing cannot be commercially justified for a utility not already committed to it. "Reprocessing survives largely because it provides a temporary solution for utilities' spent fuel storage problems, and because of inertia."

The construction costs of the THORP

plant, however, are already committed in binding contracts, so it is running costs which are important. Between £450m and £1bn could be saved in operating costs over the first 10 years if THORP were abandoned.

Using plutonium as a fuel in thermal reactors or reprocessed uranium is more expensive than using natural uranium, and storing plutonium is also costly.

Abandoning THORP would avoid these extra costs as well - totalling about £375m. On top of this about £650m worth of waste management and disposal costs could be avoided.

These costs compare, in the worst case scenario, with the cost to British Nuclear Fuels (BNF), if THORP were abandoned, of storing the full 6,400 tonnes of spent fuel for another 50 years. Assuming that Sellafield's ponds were replaced with dry stores, this would cost about £700m.

The costs of operating THORP appear to be little different from the costs of storing and eventually disposing of the fuel committed to THORP, but the gap is likely to widen in favour of the spent fuel storage route given the uncertainties connected with reprocessing. Though disposal costs

are slightly higher for the storage option, an overall saving is achieved because these costs will be delayed for at least 50 years, and because reprocessing could be up to four times more expensive than storing the spent fuel. The report concludes that the storage strategy comes out being significantly cheaper overall.

BNF's profit is estimated by the authors at between £300m and £370m (a rate of return of 6.5-7%) on the first ten years' operation. But the additional cost to the British electricity consumer is estimated at £1.7bn. Foreign earnings have to be set against future (and possibly higher) waste management liabilities and losses on fixed-price contracts.

Overall it appears that abandoning THORP could save £1.5bn over the first decade. What is needed now are the right conditions for negotiations to begin between BNF, the utilities and various governments to discuss the alternatives to continuing with this financial and environmental millstone. □

* *THORP and the Economics of Reprocessing* by Frans Berkhout and William Walker. Science Policy Research Unit, November 1990.

Emergency response

MICHAEL BARNES, the Hinkley Inquiry Inspector, made a series of recommendations on emergency planning in his Report. The Nuclear Installations Inspectorate (NII) have now responded by producing "an extended release scenario".

Barnes recommended that a firm decision should be taken on whether to install warning sirens, advice on sheltering indoors and on the pre-distribution of iodate tablets. These questions are under discussion within the Department of Energy's Nuclear Emergency Planning Liaison Group. The purpose of the NII's latest document is to respond to

recommendations concerning the extendibility of detailed emergency arrangements. It does not extend the area for which detailed emergency planning is required, but is intended to be "helpful as guidance for the formulation of outline extended plans."

The NII report* quantifies a radioactive release against which plans for an extended response can be drawn up and exercised, and gives guidance on the content of extended response plans, giving due regard to the need to avoid "the waste of resources which could occur if there was over-planning for the most improbable accidents" (as Sir Frank Layfield said in the Sizewell report). The plans, therefore, would be expected to be of a more outline nature than those drawn up for the detailed planning zone.

■ Meanwhile schools around Sellafield are being issued with potassium iodate tablets, to be given to pupils in the event of a nuclear accident. Up to now Cumbrian police have been responsible for distributing them, but they are now being given directly to schools because of fears that roads near Sellafield would be so blocked with traffic in the event of a nuclear accident and police would be unable to distribute them quickly enough. Discussions are also taking place on how to make the tablets more readily accessible to all 8,000 people living near Sellafield. □

* *NII response to the Barnes Report on An Extended Release Scenario and its Application to Emergency Planning for Nuclear Power Reactor Sites*. October 1990.

Nuclear cost cutting

CANCELLATION by the Government late last year of three PWRs does not mean that the nuclear industry is dead. The UK moratorium on new reactor construction has forced the industry to examine its costs, and prepare a case for the 1994 review, in an attempt to get the nuclear construction programme underway again.

On-site dry storage of spent fuel, followed by direct disposal could halve costs compared with reprocessing. Continuing to dispose of low-level waste at a life-extended Drigg, rather than at Nirex's proposed deep disposal site would also save money, and billions of pounds could be saved by encasing old reactors in concrete and covering them with a mound of earth, rather than attempting to return the areas to green field sites.

In the short-term Nuclear Electric (NE) hopes to be able to convince the Nuclear Installations Inspectorate that for a relatively modest extra investment of between £10m and £15m each, the life of the old Magnox stations can be extended from 30 to 35 years. This would be worth

an extra £1bn in revenue. On the AGRs, which are generating little more than half the electricity they should be capable of, NE's chair, John Collier says "I'm determined to get them good - even Dungeness B" - which only managed a 9% average load factor in 1989.

NE proposes to offer the Government a range of options for the 1994 review to allow them to start building more reactors. It has so far identified three alternatives.

The short-term option would be to use the Sizewell B design, with only minimum modifications, (for example to allow the use of longer fuel rods), to build a new power station at Hinkley Point in Somerset. This would clearly be the quickest way to restart construction, because planning consent has already been granted, but it is also likely to be the most expensive option.

The medium-term choice would be to go for an American, French or Japanese

PWR design, which would allow bigger stations, potentially capable of generating cheaper electricity, to be built. NE is looking at the French N4 reactor under construction at Chooz, the Mitsubishi reactor, and the US Combustion Engineering System 80+. None of these designs has yet been licensed in Britain so NE wouldn't expect to be able to begin construction before 1996-8.

Longer-term alternatives include the "inherently safe" reactors, such as the Westinghouse AP-600 and the UK-US Safe Integral Reactor (SCRAM 74). These systems will first require a demonstration reactor, ruling out commercial construction this century.

Despite all the cost cutting measures, NE believes the industry will still require support after the 'nuclear levy' ends in 1998. It is working on proposals for an environmental credit to recognise nuclear's role in combating global warming (see page 7). A credit set at £8 per tonne of CO₂ saved, for example, would help its competitiveness with coal by 0.8p a unit. NE also believes it should be credited for its role in maintaining a diversity of fuel supply (see pages 8 & 9). □



**Nuclear
Electric**

High-level waste dumping

DEPARTMENT of Environment consultants, GEC Alsthom, have recommended looking "into whether the disposal of HLW [high-level waste] into a suitably designed ILW [intermediate-level waste] repository compares economically with separate disposal." While their conclusion that long-term dry storage and direct disposal of unprocessed fuel is "environmentally cleaner than the reprocessing route" (see page 11) has vindicated the campaign for on-site storage of spent fuel, the report has also increased fears that the Nirex repository could eventually end up with HLW - both vitrified waste and spent fuel.

At their 1987 seminars, Nirex pointed out that HLW could be reclassified as ILW after being cooled for 50 years. They went on to say there was no danger of reclassified HLW ending up in their repository,

because after 50 years it would be full up. The Government has also said that "no procedures exist for the reclassification of high-level radioactive waste" (Hansard 12 Nov 1990 cmns 82-83).

Since the 1987 seminars, British Nuclear Fuels (BNF) have put forward proposals to extend the life of their low-level waste (LLW) dump at Drigg (SCRAM 79) - they say it could accommodate all the UK's LLW until at least 2050. Therefore, available space is no longer a constraint on the disposal of reclassified HLW in the repository, if indeed it ever was - they could always build it larger. At the November 1990 seminar in Edinburgh, Nirex's Managing Director, Tom McInerney, said a "reallocation exercise" was currently being carried out between Drigg and the Nirex repository, and should be finished by February 1991. He is certain that some LLW will still go to the repository, but if not all the space was required Nirex would slow construction.

Joan Walley MP asked a parliamentary question earlier this year (Hansard 18 Jan 1990 cmn 363) about the implications "of the findings of the European Commission's PAGIS study into the suitability of British geology for high-level waste disposal, for the search by Nirex to establish a deep disposal facility for ILW and LLW." In reply David Trippier said the report pointed out the benefits of "a repository in hard rock with sedimentary cover as advocated by Nirex" for high-level waste disposal.

Nirex continue to insist that there is no possibility of HLW going to their repository "unless our remit is changed". Until Nirex and the Government give a categorical assurance that no "reclassified" HLW will end up in the repository, anti-dumping campaigners will continue to be suspicious that LLW and ILW are simply a "stalking horse" for HLW. Even if such an assurance was given, policy has changed so many times, it would be almost worthless. □

Critical advice

NIREX'S timetable for completion of a deep repository by 2005 is "optimistic" according to the government's independent Radioactive Waste Management Advisory Committee (RWMAC).

In its eleventh Annual Report RWMAC says it is "concerned that the lack of site-specific geological data may weaken the safety case that must be made at a public inquiry". The Committee's chair, Profes-

sor John Knill has warned that the earliest date he could foresee for a final safety case is "well into the early 2000s".

Nirex hopes that the public inquiry into the proposals will be completed by 1994, but may not be required to present its final safety case to the inquiry. RWMAC recommends "a two-stage public inquiry with additional opportunities to maintain public awareness of the safety case."

Turning to reprocessing, the report says that the rationale for reprocessing "has become more questionable in recent

years" and "a judgement needs to be made whether the radiological and environmental impact of reprocessing [foreign spent] fuel is justified by the benefits to the UK economy".

As far as returning waste to the country or origin is concerned, RWMAC say "in practice high-level waste may be returned instead of greater volumes of intermediate-level and low-level waste. The Committee considers that it is important to develop a soundly based method for determining such equivalence of wastes, and will keep this under review." □

Leukaemia studies

Scientific debate about the link between cancer incidence and exposure to low-level radiation is bound to intensify following the release of new US study in October (Nature 18 October 1990). The 3 year study by the Massachusetts Department of Public Health (MDPH) concluded that adults living and working within a 10 mile radius of Boston Edison's Pilgrim reactor between 1978 and 1983 had a four times greater risk of contracting leukaemia than those living elsewhere. The study also concluded that the risk of leukaemia increased the closer one lived and worked to the plant.

The Massachusetts study directly contradicts the recent National Cancer Institute (NCI) study of cancer mortality around nuclear sites. NCI found no evidence of increased fatal cancers near nuclear plants. However, the MDPH argues that its study was much more thorough. It focused on a much smaller and more specific geographic area than did the NCI study, which drew only upon county data that would not detect highly-local increases in cancer. The MDPH also studied cancer incidence rather than just mortality.

Three years ago, the Pilgrim Plant was described by federal officials as "the worst-run" nuclear plant in the United States. In the 1970s residents were subjected to estimated exposure levels above the Environmental Protection Agency's (EPA) limit of 0.25mSv per year, due to higher than normal airborne emissions of radionuclides; though exposure stayed well within the Nuclear Regulatory Com-

mission's (NRC) limit of 5mSv/yr. Emissions fell off considerably after 1978 and since 1980 exposure levels are believed to have been below the EPA's limit.

The MDPH found no relationship between leukaemia cases and proximity to the plant for the period 1983-86. Assuming it takes five years for leukaemia to develop, the 1979-83 increase in leukaemia can be linked to the period when exposure levels were above the EPA's limit. The MDPH has now begun studies on the incidence of childhood leukaemia in the vicinity of Pilgrim as well as leukaemia among workers at the plant.

David Hoffman, a researcher at the US Centre for Disease Control, who led the committee reviewing the results, called the study "well-designed, impressive and surprising". The MDPH conducted detailed interviews of cases and controls in order to ensure that other factors, such as smoking, occupational hazards, proximity to hazardous waste sites etc. were not the causes of the elevated risk. Hoffman says the study "suggests strongly that there may be increased risk levels at levels of exposure far lower than we would expect."

Since the results of the study Massachusetts Governor, Michael Dukakis, has asked the State to adopt the strictest radiation emission standards in the country, which would limit exposure for those living near nuclear plants to 0.1mSv per year. Dukakis has sent a copy of the MDPH report to the NRC, urging them to implement tougher emission standards nationwide. However, the NRC is widely expected to release new radiation standards which will allow public exposure levels of up to 1mSv/yr, with exemptions up to 5mSv/yr permitted in some cases.

Further fuel to the debate has been added by two other recent reports, but like the NCI study, both looked only at mortality. One study was on deaths from childhood cancer in the vicinity of six French nuclear installations (including the reprocessing plants at La Hague and Marcoule), the other was by Leo Kinlen and colleagues at the Cancer Epidemiology Unit at Edinburgh University (SCRAM 69).

The French study (Hill and Laplanche, *Nature*, 25 October 1990) was based on mortality between 1968 and 1987 in the 0-24 year age group around each of the nuclear plants. Leukaemia deaths recorded in the population residing in the vicinity of the nuclear installations was found to be similar to that recorded in control areas, and to that expected from national statistics.

Kinlen et al. (*Lancet*, 8 Sept 1990) studied childhood leukaemia deaths in 14 new towns in Britain. The results, Kinlen claims, support his hypothesis that some childhood leukaemias are caused by an unidentified infection that is promoted by the mixing together of a large number of people of diverse origins. Nine of the new towns studied were 'overspill' towns and received an already well mixed population from a nearby city. The other five were 'rural' and housed populations from several industrial areas. The results showed a significant excess of leukaemias in the early years after the establishment of the 'rural' but not the 'overspill' new towns. Kinlen argues that these patterns are precisely those expected if an unrecognised infection, similar to the feline leukaemia virus infection, was responsible for the excess of childhood leukaemia. Kinlen's 1988 paper argued that leukaemia in young people near Dounreay and Sellafield may be caused by a virus. □

The 'Gardner effect'

A number of new studies are being set up to investigate the link, suggested by Professor Martin Gardner, between paternal radiation exposure and childhood cancer. Gardner's work suggested a seven to eightfold increase in the chance of a child contracting leukaemia if the father had received either a total radiation dose of 100mSv or more than 10mSv in the 6 months before conception.

The UK Health and Safety Executive (HSE) will look at everyone who has worked at Sellafield since 1949. The full work histories of fathers of leukaemic and unaffected children will be looked at, so that factors other than radiation, such as carcinogenic chemicals, can be considered.

Gerald Draper, from Oxford University, plans a wider study linking Oxford's National Reg-

istry of Childhood Tumours with the National Radiological Protection Board's radiation dose records for all British radiation workers. Draper says if the, so-called, 'Gardner effect' does exist, and the risk factor is anything like as large as Gardner suggests, his survey should be large enough to detect it.

Leo Kinlen, of Edinburgh University, will link records of Scottish leukaemia cases and controls, with radiation records for the entire Scottish nuclear industry. This will include workers at Rosyth, Faslane, Chapelcross, Dounreay and Hunterston. All employing authorities are providing data, and the unions are also co-operating. A second study is planned by the Scottish Health Service, but both Scottish surveys may be too small to give definitive answers on the 'Gardner effect'. □

Testing leukaemia links

Two surveys commissioned to investigate the excesses in leukaemia near Dounreay, and Aldermaston and Burghfield are nearing completion.

The Aldermaston and Burghfield study should be published before the end of 1991, while the Dounreay study should be out quite soon. Even though only two of the Dounreay leukaemia cases had fathers working at the plant, the study is rumoured to support Gardner's findings. The Atomic Energy Authority has already begun its damage limitation exercise.

Researchers at the AEA's Harwell laboratories set out to disprove one theory for the 'Gardner effect': that ingested plutonium concentrates in the testicles and damages sperm

production. (Gardner, himself actually only looked at external radiation.) The AEA injected plutonium (Pu-237 citrate) into a 62 year old volunteer to see how much ended up in his skeleton, blood, excreta and gonads. It is commonly believed that only 0.035% should end up in the testicles. They actually found that 0.1% had concentrated, but they still managed to conclude that "there is nothing to invalidate existing assumptions concerning testicular uptake of plutonium".

Dr Barry Lambert, a radiation biologist at St. Bartholemew's Medical College, London, called the experiment scientifically insupportable. The uptake in the testicles varies from individual to individual. □

Electricity privatisation has revealed some of the hidden economics of nuclear power. Left, like the Emperor without his clothes, the industry clutches at global warming as the fig leaf with which to cover its embarrassment. Here GRAHAM STEIN charts the argument between the industry and Dr Nigel Mortimer over carbon dioxide emissions and finds the industry considerably exposed.

The nuclear industry's CO₂ myth

NUCLEAR power produces no carbon dioxide, argues the industry, and is therefore needed to ameliorate the greenhouse effect. It is a line many find compelling, but one which Dr Nigel Mortimer*, an independent energy consultant, has set out to disprove. His submission to the Hinkley C Public Inquiry FoE9⁽¹⁾ (SCRAM 74) suggests that of a range of alternatives to fossil-fuelled power stations, nuclear power – through its fuel cycle and construction – produces the most carbon dioxide (CO₂).

His submission also considers a complete switch to nuclear power for electricity production, concluding that increasingly poorer grades of uranium ore would have to be used, resulting in higher levels of CO₂ release during mining and processing. A 'point of futility' – where as much CO₂ would be released in producing nuclear power as from direct use of fossil fuels in power stations – would be reached, possibly in just 23 years.

Mortimer believes that Fast Breeder Reactors (FBRs) are not the answer to the uranium problem, as their achieved system doubling times of greater than 20 years (31 years in the case of the world's largest FBR – Superphenix in France) is well short of the 13 years that would be required for combating global warming.

AEA riposte

A response to Mortimer's thesis came from Dr Dan Donaldson and Gerald Betteridge of the UK Atomic Energy Authority in their house magazine *ATOM*⁽²⁾. They seem to accept Mortimer's use of 100 parts per million (ppm) uranium as the practical limit for uranium ore and estimate: "For a nuclear contribution that expands continuously to about 50% of demand, uranium resources are only adequate for about 45 years." This is close to Mortimer's 23 years for a 100% nuclear scenario. However, the AEA staff argue that the uranium resource should include 'speculative reserves' and non-conventional sources such as Chattanooga oil shales and marine phosphates. They also suggests lower CO₂ emission levels in reprocessing, through use of more modern techniques, and champion the FBR as part of a mixed thermal/fast breeder system. Their article has been held up

as the rebuttal of FoE9, allowing the nuclear industry to maintain its environmental claims.

Nigel Mortimer has now defended his original work in a paper⁽³⁾ published by Natta. On uranium reserves, Mortimer points out that Chattanooga oil shale contains uranium at between 20 and 50 ppm – below the uranium ore grade limit that both he, and Donaldson and Betteridge have used.

The Atom critique claimed that "Mortimer does not even mention another important source ... marine phosphates"; but, counters Mortimer, FoE9 included marine phosphates in the category "other unorthodox sources". Much of this resource, according to Mortimer, is also below the ore grade limit. He explains that past economic recovery of uranium from this source was a by-product of phosphoric acid production, and that large scale exploitation of the resource for uranium would significantly alter the energy (and therefore CO₂) and costs attributed to the uranium.

Speculative

Mortimer also questions Donaldson and Betteridge's assumption that 50% of 'speculative resources' will be available between 2020 and 2050, when an official report from the OECD Nuclear Energy Agency and the International Atomic Energy Agency⁽⁴⁾ states: "Speculative resources refers to uranium, in addition to Estimated Additional Resources, that is thought to exist mostly on the basis of indirect evidence and geological extrapolations ... the existence and size of such resources is highly speculative." Further reason to doubt the soundness of Donaldson and Betteridge's assumption is found by Mortimer in the quote "geologically based extrapolations suggest that ultimately around 25 million tonnes [of uranium] might be found, but their can be no certainty of this". Mortimer's source this time is an article⁽⁵⁾ which appeared in *ATOM* just two months before Donaldson and Betteridge's.

On the FBR Mortimer iterates what he said in FoE9, that a combined thermal/FBR system, because of the inefficiency of thermal reactors, would result in "problems with uranium availability and the significant CO₂

emissions associated with thermal reactors fuelled by low grade ores". He stands by his comments on the problem of system doubling time, and also comments that "the exact role of the fast reactor is rarely discussed [by its advocates] due to its currently very poor economic prospects".

Major shift

In amongst the fine detail of this continuing debate Mortimer has succeeded in establishing some key facts. CO₂ is produced in generating electricity by nuclear power, and at levels significantly higher than for a range of renewables and energy efficiency. Any sizeable increase in the use of nuclear power means that the grade of uranium ore will drop and CO₂ emissions will increase – the rate at which this will occur cannot accurately be quantified and cannot therefore sensibly be ignored.

Mortimer has gone much of the way to ensuring a major shift in the debate on nuclear power and global warming, "nuclear power produces no CO₂" is a phrase we can expect to hear less and less from the nuclear industry. □

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Those who think the Tories have turned their back on nuclear power would do well to read the Hinkley Point 'C' Inquiry Report, writes JANE ROBERTS, a founder member of Stop Hinkley Expansion. Nuclear Power's long haul back to financial acceptability has already begun - by 1994 it will be 'cheap' again.

1994: the next battle

NOT with a bang, but with a 3,288 page thud on the door-mat, the Barnes' Report⁽¹⁾ is out. Remembering the heady days of early 1987, when all campaigning stops were pulled out to try to halt Sizewell, the reaction to the Hinkley 'C' Inquiry Report seems almost indifferent. The grant of consent by John Wakeham, Secretary of State for Energy, was greeted by the main opposition groups as an irrelevant face saving manoeuvre. All seem convinced that the station is doomed by its economics. Yet an alternative interpretation of the decision is that it is a canny move which, if the political will is there, will enable the next government to give the nuclear option a kick start in 1994.

The fate of the project always depended much less on the Inquiry deliberations than on the upheaval in the electricity supply industry caused by privatisation. Most objectors recognised this from the start, expecting that the Inspector would recommend the granting of consent but that financial pressure would lead to the eventual abandonment of the project.

Thus far these expectations seem justified. The crucial difference between the Hinkley 'C' Inquiry and its predecessors was that the credibility of the objectors was dramatically demonstrated, not after the decision was taken, as at Windscale and Sizewell, but while the Inquiry was still sitting. The collapse of Government policy on 9 November 1989 was exactly what objector after objector had predicted. The stalling of the project until 1994 is an important victory, but it is a battle that has been won, not necessarily the war.

The main benefits claimed for the project in the Report are:

1. Permission would enable the station to help to meet a predicted 11-12GW capacity shortfall in the early years of next century.
2. Hinkley 'C' would enhance security

of electricity supplies, by protecting against price and supply interruptions to fossil fuelled generation plant, and by providing insurance against long term uncertainties, such as restrictions on CO₂ emissions.

3. Hinkley 'C' would give "major environmental benefits" in terms of sulphur dioxide and carbon dioxide emissions.

4. "The grant of consent would have the benefit that it would accord with important aspects of Government policy." (HPI Report: 68.16)

Not all over yet

Those who feel that the Tories have turned their back on nuclear power would do well to read Barnes' analysis of Government policy in Chapter 17 of the Report. He is quite clear that the exclusion of Hinkley 'C' from the non-fossil fuel obligation (NFFO) does not mean that Government policy is not in favour of the station. He finds 4 elements of post-9 November policy to bolster the case for consent:

1. There is a continuing general policy in favour of diversity, which remains even though its specific manifestation, the NFFO, no longer applies to Hinkley 'C'.
2. Diversity and "the environmental benefits anticipated from nuclear facilities" mean the Government believes nuclear power continues to have "an important strategic role".
3. It is policy that Nuclear Electric is to retain its ability to construct and build nuclear power stations.
4. The Government has stated that it attaches the highest importance to the completion and operation of Sizewell 'B'.

All this can be read as pure rhetoric: making the best of what has turned out to be a political disaster for the Tories. The timing of the Hinkley 'C' Report, to coincide with the recall of Parliament to discuss the Gulf crisis,

ensured both that immediate coverage was low and that potential for follow up by the opposition constrained. But the adoption of a low profile, face saving approach does not mean that hopes are not still harboured of getting a nuclear power programme off the ground in four years' time. Remember the 1979 leaked Cabinet minutes?

Barnes lists the disadvantages of consent as: the extra cost of Hinkley 'C'; the radiological risk, which he finds acceptable; local environmental effects, especially the visual impact of the station; and the now inevitable delay in implementing the consent, which will adversely affect those living near the site and render the evidence on which the consent was granted out of date.

Given the 1994 review, it might have been supposed that Barnes would have recommended that some areas of evidence be looked at afresh before the proposal proceeds. Looking at the changes in fuel prices, waste management charges, radiological protection standards, not to mention Chernobyl, all of which occurred between the close of the Sizewell Inquiry in 1985 and the opening of the Hinkley 'C' Inquiry in 1988, a 1990 consent looks to be a very inadequate basis for a 1994 decision. But Barnes suggested only that the Inquiry might be re-opened to consider transport issues in the event of a go-ahead in 1994.

What then is the legacy of the Hinkley 'C' Inquiry? As far as the station itself is concerned, now consent has been granted, construction can be started by the whim of the Secretary of State at any time. Granted this is unlikely before 1994, and especially unlikely before the next election, but, in granting permission, Wakeham extended the usual five year consent period to seven years. That wasn't necessary to save face.

But the Barnes' Report, and Wakeham's response to it, also have important implications for the 1994 review. Firstly, Barnes makes the

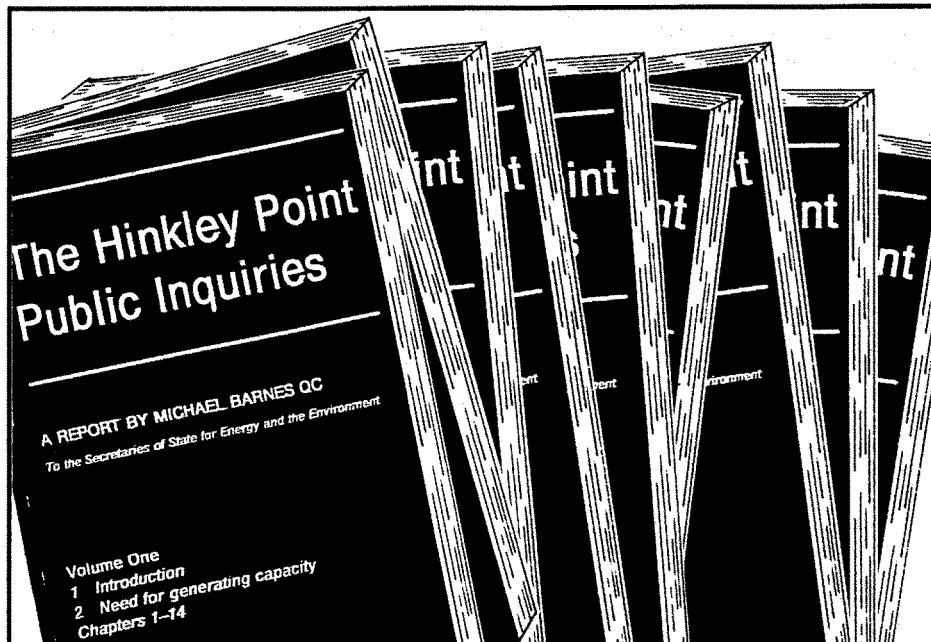
point that consent for Hinkley 'C' now makes an eventual decision in favour of nuclear power more likely. John Collier, who chairs Nuclear Electric, has said that a combination of growth in electricity demand, lower interest rates, higher fossil fuel prices, carbon taxes and a Conservative victory at the next election would provide a background necessary for a "positive" outcome of the 1994 review. Given this outcome Hinkley 'C' "will provide the fastest restart of nuclear construction in the UK"⁽²⁾, although on technical grounds more modern designs might be preferred.

The Report has also made an important contribution to the methodology with which the decision will be made. The case for Hinkley 'C' was essentially subjective⁽³⁾, based on Government policy on diversity, the benefits of which were claimed by the CEBG to be unquantifiable. Although the Inspector's economic assessor, Professor Alistair Ulph, did derive, jointly with the CEBG, an economic expression of the benefit of diversity in providing protection against future fossil fuel price rises, the CEBG maintained in its closing submission that other, additional, benefits (eg. protection against industrial action in the pits) were a matter for political judgement.

Half baked

This half baked approach was roundly criticised by Barnes: "I am afraid I am not able to accept that the CEBG were correct on these fundamental matters" (HPI Report: 16.8). He recommends that if diversity is to be used to justify future nuclear development, then the Ulph/CEBG approach should be further developed. Wakeham agreed. The crucial paragraph in his decision letter reads in part:

"... I do share the Inspector's view that the general volatility of fossil fuel prices and the interruptability of their supply are important arguments in favour of nuclear power as a means of achieving diversity in fuel sources; I have endorsed his recommendation that there should be further studies to consider how far this benefit can be quantified. There are also potentially substantial advantages to the global environment from the displacement of fossil fuel combustion by nuclear power. It is the Government's policy not to approve investment in further PWR stations unless they are assessed as being economic over their life as a



whole, having regard to these wider factors." (my italics)

Nuclear Electric therefore has until 1994 to come up with a *Pearce Report*⁽⁴⁾ type methodology to show that new nuclear power stations would be cheap if externalities were taken into account. On the face of it, greens should welcome the adoption of environmental accounting by the nuclear industry. However, costing externalities is not a value free process, and we can be sure that, for example, the uranium mining, back-end and proliferation externalities of the nuclear industry will be minimised in whatever computer model is adopted.

Given the Greenhouse factor, coal, oil, and even gas will be easily seen off by this assessment. Costing in externalities ought to favour renewables and energy efficiency. However, energy efficiency already makes economic sense, and still isn't happening, and bias against renewables could easily be built in to some extent. Industry propagandists, anyway, tend now to promote nuclear power as the natural companion to, rather than competitor with, renewables and energy efficiency.

Don't forget that most of the economic dirt that emerged last year was related to either Magnox or the PWR in the private sector. The Department of Energy line on public sector PWR costs has shifted little. By 1994 new nuclear power will be cheap again - official.

The nuclear industry is so serious about ensuring this big sum comes up

with the right answer that they are shedding sacred cows left, right and centre. Decommissioning to a green field site is not, perhaps, the best option after all, we are told. Scottish Nuclear looks set to break ranks on AGR fuel reprocessing.

The third implication of the Hinkley 'C' Inquiry for 1994 is procedural. To the great surprise of objectors, who were often left floundering to keep up, Barnes suggests procedural changes that might expedite future Inquiries. These include taking technical evidence as read and restricting irrelevant cross-examination (HPI Report; 4.37-40).

Tinkering with the existing system, however, may not prove adequate for the purposes of a serious attempt to resuscitate the British nuclear programme. The lesson of the abortive UK PWR programme is that delays caused by Public Inquiries can prove fatal. We can expect that any proposals which emerge in 1994 will not be dependent on the Public Inquiry system for their implementation.

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As the case for the Thermal Oxide Reprocessing Plant at Sellafield crumbles, PETE ROCHE bemoans the Labour Party's lack of commitment to abandon the plant, but points out that the free marketeers may kill it off anyway.

THORP's case continues to crumble

LABOUR'S 'green' policy document, *An Earthly Chance* (see page 22), has failed to commit the Party to abandoning Sellafield's Thermal Oxide Reprocessing Plant (THORP), due to come on stream at the end of 1992. The document merely promises "a review of Britain's arrangements for dealing with all irradiated materials".

Bryan Gould, Labour's environment spokesperson, had, according to *The Independent* (4/10/90), included the abandonment of THORP in a draft of the document, but this was subsequently dropped. Contrary to claims by British Nuclear Fuels (BNF) about the plant's profitability, evidence has been emerging since the beginning of October which proves the plant to be a liability. The Labour Party has missed an important opportunity to convince voters they are serious about the environment, by not committing themselves to cancel the project which will, in fact, be a drain on the public purse.

The only compelling reason for reprocessing arises if plutonium is required for military purposes or as a fuel for fast reactors. However, there is now a stockpile of plutonium in excess of 40 tonnes. The Government's 1988 review of the fast reactor programme concluded that fast reactors would not be required for at least 30 or 40 years and expenditure of £100m per year could no longer be justified. Funding for the Dounreay Prototype Fast Reactor will cease in 1994.

In France, the 1,200 megawatt Superphenix prototype fast reactor has been shut down for most of its 'operating' life, and the French authorities are now seriously considering closing the station permanently. The German fast reactor at Kalkar, which has been dogged by political opposition from the State Government, still does not have an operating licence. Many German politicians now believe the fast reactor in Germany is dead.

As reported in SCRAM 79, Scottish Nuclear (SN) is considering storing its spent AGR fuel at their power station sites for up to 100 years, and then directly disposing of the fuel into the ground. James Hann, chair of SN says "There is a massive stock of uranium and plutonium, so we're saying why

not dispose of the fuel on-site in a dry or wet store, avoiding transporting it. If necessary it could be reprocessed in later years." Long-term at-reactor storage is expected to cost SN roughly half what BNF wants to charge for reprocessing and waste handling.

Since the 1977 Windscale Inquiry, the price of uranium has fallen in real terms, rather than rising as BNF convinced Justice Parker (the Inquiry Inspector) it would. Because reprocessing costs have spiralled upwards during the same period, the UK nuclear companies are now sustaining a large loss as a result of recycling their spent fuel through Sellafield rather than buying natural uranium on the world market. It is now evident from the annual accounts of the old Central Electricity Generating Board that back end costs have jumped to the point where they are now one third of total cost, and more than any other factor have been responsible for destabilising the nuclear industry.

Data from the OECD Nuclear Energy Agency for PWR fuel cycles gives a cost of 0.203 cents/kWh for the reprocessing cycle and 0.097 cents/kWh for the once through cycle. The opportunity cost of reprocessing is, therefore, 0.106 cents/kWh. These figures, however, were for 1985, and reprocessing costs have increased in real terms since then.

Contracting

SN is contracted to send 530 tonnes of spent fuel to THORP - roughly the fuel coming out of its reactors until the end of 1993. If SN does decide not to reprocess, Nuclear Electric (NE) would certainly reconsider its position. NE took care to ensure that its PWR, Sizewell B, will have sufficient storage capacity to hold at least 18 years worth of spent PWR fuel. It is contracted to send 1,320 tonnes of spent fuel arising from its AGRs until the end of 1996, so it has more time in which to reach a decision, but is expecting to decide in 1991 on whether to go ahead with a spent AGR fuel store at Heysham.

BNF is now looking for contracts for the second decade of THORP's operation. So far they have only reached agreement with western German utilities to reprocess 1,600 tonnes of spent fuel. If either or both of the UK companies

TABLE: Customers for THORP's first decade of operation.

Japan	2,300 tonnes
UK (NE)	1,320
UK (SN)	530
Germany	760
Switzerland	350
Italy	190
Spain	150
Sweden	140
Netherlands	60

withdraw from placing reprocessing contracts with BNF, it would be certain to damage the company's prospects of securing further orders. THORP has a design life of at least 25 years, but it is not immediately obvious where its future business is going to come from. Japan, THORP's biggest customer, is unlikely to sign any further contracts because their own reprocessing plant at Rokkashomura is due to come on stream by 1998. Sweden and Spain have opted for on-site storage. Italy will not have much more spent oxide fuel remaining after its contract expires. Reprocessing is still part of the Swiss waste management policy, but the option of direct disposal is being examined, and a 10 year moratorium on building nuclear plants was recently passed in a referendum. The Dutch have indefinitely postponed any decision on whether to expand their nuclear capacity.

German utilities continue to reprocess their spent fuel because of a licensing condition of German Atomic Law which specifies that utilities must have a disposal plan for nuclear waste for six years. Work at the high level waste repository at Gorleben has been stopped, so for the time being they have no alternative. However, the *Observer* (14/10/90) reported that even the German utilities were having second thoughts, and German experts say they don't expect their fuel will ever be sent to BNF.

All this puts SN and NE in a very strong bargaining position. But if BNF is forced to drop its prices, this will eat into THORP's profit margins. Even if the UK utilities join the Germans and sign more contracts, there is a very real possibility that business for the remaining 50% or so of THORP's capacity for the second decade will not be forthcoming.

To add to BNF's problems, the Government's Radioactive Waste Management Advisory Committee's (RWMAC) annual report, published in November, concluded that "there are no compelling waste management reasons to reprocess oxide fuel." This followed hot on the heels of a revelation that in November 1989 the Department of the Environment received a report⁽¹⁾ from their consultants, GEC Alsthom, which concluded that dry storage of AGR spent fuel was feasible and "there appears to be no fundamental reason why the direct disposal of AGR fuel should not be feasible." The consultants concluded that long-term dry storage followed by direct disposal of the unprocessed fuel into the ground "is environmentally cleaner than the reprocessing route. There are fewer waste streams produced and the volumes of material requiring disposal are lower." No great advances in technology would be required. Long term dry storage would introduce a large degree of flexibility into waste management. Spent fuel could be stored for 50-100 years, during which time "the future disposal of the fuel can be investigated, planned, designed and constructed without time scale constraints."

Spurious profits

It is hardly surprising, therefore, that on 25 October, the *Independent's* 'leader' called for THORP to be mothballed: "The only remaining excuse for THORP is that it will earn foreign currency from contracts already signed with the Germans, the Japanese and others. But if the true costs are taken into account the profits may be spurious, and in any case foreign customers can make precisely the same calculations as Scottish Nuclear, so it would not be surprising if they were willing to renegotiate contracts." The *Independent* said just how expensive THORP is, nobody knows, because the figures have been, "to put it mildly, opaque".

Economist, Colin Sweet estimates that operating the plant will produce a greater loss than closing it now. In a report⁽²⁾ published by Cumbrians Opposed to a Radioactive Environment (CORE), Sweet estimates that if the plant were closed now, around £1bn in capital would have to be written off. However, if the plant is completed and operated, the loss will be somewhere between £1.1bn and £3.8bn.

Neville Chamberlain, chief executive of BNF, accused him of making "highly misleading allegations". He said THORP's customers are committed to spending £6bn, while construction and operating costs for 10 years are £5.5bn. Sweet's reply is that £500m profit is "marginal" anyway - less than 10% - especially when you consider that they

are being optimistic particularly about maintenance costs. "All the experiences with advanced chemical plant, particularly reprocessing plant, is that maintenance costs are absolutely enormous compared with a typical manufacturing process," says Sweet. He accuses BNF of "massively understating the costs of operating the plant. So what, on their own admission now, is a marginal operation, could very easily be a loss maker."

In a letter to Martyn Jones MP, Christopher Harding, Chair of BNF, makes clear that "capital investment figures for THORP do not include interest during construction, R&D or decommissioning." The letter also confirmed that the cost of capital is not included: "The only area in the Accounts which is currently affected by discounting are the provisions for long term nuclear liabilities (eg. decommissioning). The industry norm of a 2% real (post tax) rate is utilised (ie. inflation plus 2%)."

Sweet comments: "The failure to discount all costs and benefits in an appraisal statement is a sharp departure from public sector investment requirements as laid out by the Treasury." BNF are carrying a £2bn debt at the moment, and at current rates of interest it will cost them a considerable amount of money. The cost of capital alone could be sufficient to soak up the £500m 'profit'.

BNF claim that THORP's capital cost is £1.75bn plus £800m for support facilities. Interest during construction, research and development costs and the cost of capital should all be added to this figure. Sweet estimates they could add another £1bn to THORP's costs, before decommissioning costs are included.

BNF give the decommissioning cost as £750m. Yet in their evidence to the House of Commons Select Committee on Energy, published in December 1989, they gave a figure of £3,555m for all Sellafield reprocessing plant. "Why are they only apportioning £750m to THORP?" asks Sweet "it should be round about half - £1.5bn to £2bn is a much more realistic figure for decommissioning."

Originally THORP's economics were based on a ten year life, but BNF now claim that the plant's lifetime can be doubled. This may be considered by BNF to be a way of resolving some of its economic problems - it delays the costly and unwelcome task of decommissioning, for example. However, there is no evidence that BNF have made an economic appraisal in support of the extension, which is surely a minimum requirement. Maintenance costs can certainly be expected to be a major expenditure item after the first decade. Overall, therefore, extending

the life of THORP could add to the total losses, especially if the market moves away from reprocessing.

BNF have consistently asserted that, not only will THORP be profitable, but also its capital costs will be met before its construction has been completed. To put it mildly, these statements are misleading. The evidence leads to the conclusion that BNF will be a considerable economic burden on the consumer. Sweet concludes that "the viability of BNF as a corporate body becomes more questionable the deeper it gets into the THORP project ... There is considerable evidence that BNF management is adopting financial strategies to cover its basic economic weaknesses which are unorthodox and unsound."

Market distortions

The economic cost of THORP has never been fully assessed, by BNF, the Department of Energy, or any other body in the public domain. BNF give very little evidence to support their claims of profitability. Sweet calls for a detailed investigation of BNF's finances by an independent body. "There can be no justification for the risks being taken at the social level if there are no economic gains."

BNF survives through the creation of severe distortions in the market. Sooner or later these distortions will become transparent, and may at some point be removed. Reprocessing services would then collapse. The run down that is now taking place at Dounreay should be a warning. Surely it would be better to foresee that now, than to face it as an economic shock at some unspecified point in the future.

Labour's 'green' document says the Party "must overcome our traditional image as a 'producing' party, apparently giving priority to jobs and pay packets rather than to environmental concerns." If Labour green policy is to be taken seriously, they must grasp the nettle and commit themselves to abandoning THORP. If they don't do it soon, there is every chance that the free marketeers will deal the final blow, thus denying the Labour Party an obvious opportunity for earning valuable 'greenie' points. □

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The Government's decision to phase out the Fast Reactor programme at Dounreay, has given new impetus to the search for alternative employment. The AEA have recently taken the first tentative steps towards a renewable energy programme, but KENNETH LOW, an Orcadian Engineer and co author of a report* on the development of an alternative energy centre at Dounreay, argues that the Dounreay has the facilities, personnel and environment, to do much more.

Dounreay: an alternative development

IGANESS Bay Fish Farm, a highly successful salmon company in the Orkneys, is hardly the place you would expect to find mother nature playing a key role. A shrewd investment of £50,000, however, for a 75kW windmill has cut the farms electricity bills by 25%. With an expected life span of about 20 years, the turbine is expected to pay for itself after only 6.

The concept of small money-saving wind devices is not new to the Orkneys. Way back in the 1930s and '40s some of its more remote islands employed the wholesale use of "tirlies". These were small propellers located inside chimney stacks, which turned almost continuously to provide battery charging and lighting for crofters. Since then the idea of wind and other renewable forms of energy has lain relatively dormant, as we have come to rely more and more on large fossil and nuclear fuelled power stations to meet our increasing energy demands.

Dounreay

Across the Pentland Firth, the stretch of water which separates Orkney from the Scottish mainland, lies Caithness, home of Dounreay's prototype fast reactor. Yet, the potential for renewable energy in Caithness is huge, with high mean wind speeds and a coastline ideally suited for wave power developments.

Since 1954 however, when the fast reactor programme was initiated, the economy of the region has come to rely heavily on the Dounreay nuclear plant, which employs some 1,800 workers. The programme has already consumed a staggering £4 billion of the taxpayers money, with estimated costs of completing the development and building a full scale commercial reactor put at a further £3 billion. When you consider that there are still many unsolved technical problems and couple this with the large sums of money involved there is little difficulty in understanding why the

Government has decided to cease funding the reactor in 1994 and its associated reprocessing plant in 1997.

The political expendability of the north of Scotland is there for all to see: the planned European Demonstration Reprocessing Plant (EDRP) and the strong possibility of a national nuclear waste repository. Yet, public hostility in the region towards these plans has never been more evident, the threat posed is widely recognised as the greatest yet to face the communities of the north.

Fishing, farming and tourism

The economy of the north of Scotland is based firmly on three main industries: fishing, farming and tourism. In Caithness, with Dounreay also playing its part in the economy, the issue of reprocessing is understandably very sensitive. The tourist board for instance is non-committed; opinions are very definitely split. On the one hand we have Lord Thurso, honorary president of the Tourist Board, who has gone as far as to offer his land as an alternative waste repository should difficulties arise over planning permission at Dounreay. On the other, the more plebeian stance prefers not to comment at all. Many of the main industries in Orkney are deeply concerned about Dounreay and the consequences of having international reprocessing on their doorstep.

The recent BSE scare clearly illustrates the disastrous consequences of Dounreay becoming globally acclaimed as a nuclear dumping ground. Even though no hard evidence was produced linking BSE in cattle with any such condition in humans, the reputation of British beef was tarnished and consequently consumer purchases dropped substantially. This potential for psychological damage, and the fickleness of the human mind, was recognised as far back as the late 70's by Orkney's director of tourism, Josh Gourlay. He believes that the presence

of Dounreay nuclear power station has damaged the reputation of Orkney in the eyes of the tourist and is, "totally against future plans for Dounreay after its closure". If the Government are allowed to carry out their plans in and around Dounreay, then the economy of the whole of the north of Scotland will be devastated; Lord Thurso and co. please take note.

There is an alternative for Dounreay and a nuclear dependent Britain. An alternative which by its very nature is simple, benign and staring the energy authorities in the face - renewable energy. A massive increase in funding for the renewable energy research programme is needed, a mere £160 million in total has been spent to date, compared to the countless billions consumed by the nuclear industry. Even so, when comparing unit cost of electricity generation from nuclear sources and many renewables, such as wind and wave power, it is renewables which come out on top.

Tails between their legs

The results and achievements of renewable energy research and development on such limited budgets are remarkable to say the least, leaving the nuclear boys with heads hanging and tails tucked firmly between their legs. Had only a fraction of nuclear's endless supply of money been diverted towards renewable research, we would be world leaders in the field. We must get away from this short sighted view of energy supply, which has forced us into the crazy position of having to import nuclear waste and irradiated fuel, and recognise that the only realistic way forward for a sustainable energy future is through renewables and energy efficiency.

As I've already pointed out, the potential for renewable research in Caithness is huge. It should be ignored no longer. The potential lies primarily with wind and wave power developments. In wind technology we

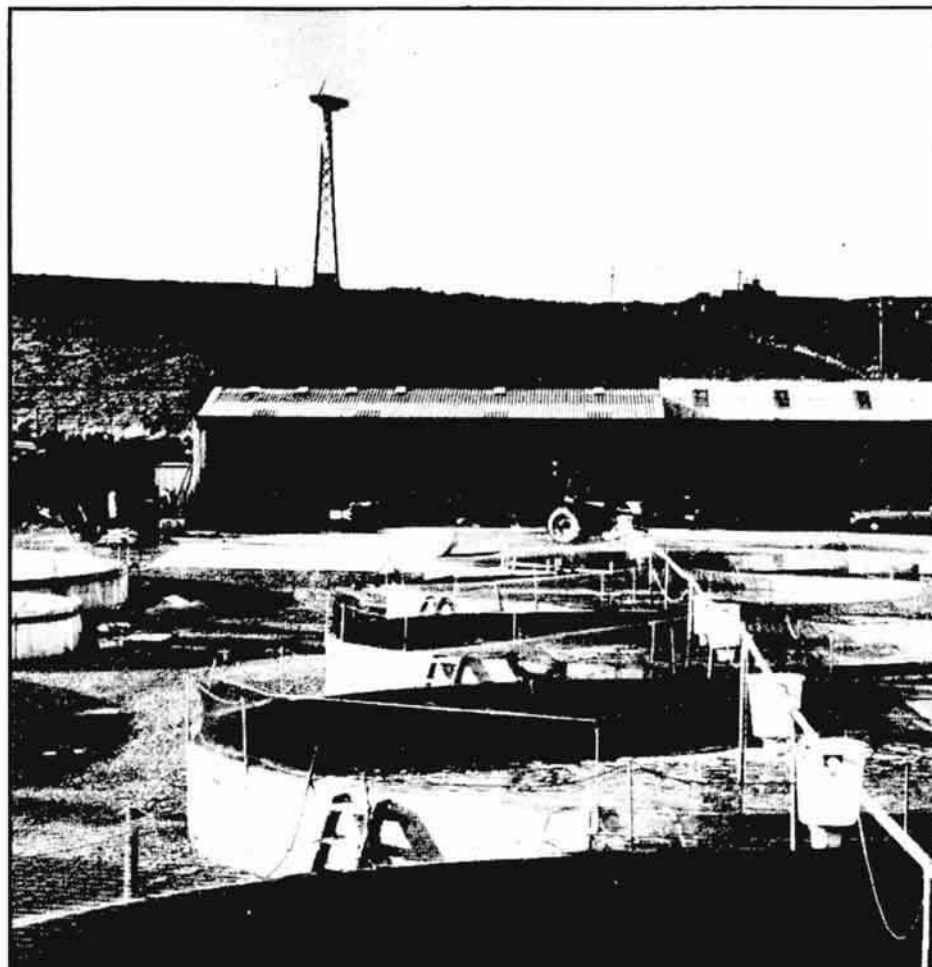
are many years behind countries such as the USA and Denmark and should therefore be trying to close the gap. To do so, it is generally agreed that the next stage of development is to build windfarms of varying sizes, incorporating machines of different design and rating. Caithness has a reasonably flat terrain which makes the job of building essential access roads very easy. Also, mean wind speeds are somewhere between 8 and 10 metres/second. These two very important factors make the region arguably one of the best in Europe for building windfarms.

The potential for power generation through harnessing wave energy is obvious to anyone who has witnessed the sea at work, pounding the northern coastline. The time is right for real government commitment to wave power and a substantial re-introduction of funding. The gullied coastline required for certain forms of wave technology dominates the north and north-west of Scotland. All presently recognised forms of wave technology are therefore possible, from "ducks" to oscillating water columns.

Workers and workshops

Given that the natural environment is ideal, what other features exist to further persuade us of the need for such a centre in Caithness and not, say, the Hebrides or North Isles? There are of course several very good reasons as to why this particular area of Scotland is suitable. Perhaps the most important factor, certainly to the work force of Dounreay is that after 1994 and 1997 considerable unemployment will sweep the region, and practically all of the plants highly skilled people will find themselves seeking alternative employment.

There are extensive engineering workshops at Dounreay, where many of these workers ply their trade. What is to become of them after the closures? Further, Dounreay will cease to supply electricity to the national grid after 1994, and the power transmission lines running southwards will become redundant. A centre for alternative developments in energy would solve these problems, providing employment, utilising the engineering workshops and maintaining a northern source supplying the national grid, albeit on a somewhat reduced scale to begin with.



Iganess Bay Fish Farm in the Orkneys – powered by the wind

Initially the employment created by such a centre could not hope to match the job losses from Dounreay over the next seven years. However, the centre's rapid development would eventually generate more than enough employment to compensate.

Self-financing

Undoubtedly, a substantial contribution from central government will be initially required to fund the centre, however, given time it should become entirely self-financing. With a firm foundation built around wind and wave power, it seems logical that branching into other areas of renewables such as solar and geothermal power would be the next step.

Hopefully a visitor centre would be built, acting both to educate the public and attract potential customers from the UK and abroad. A common sense approach to energy policy would eventually be adopted, with energy conservation being practised and preached throughout the centre. Specialised knowledge will gradually be acquired by employees through research links with universities and colleges. The establishment of a

scientific centre and University of the North could also evolve. There would certainly be a need for large-scale manufacturing once renewable energy devices are developed, and at the risk of being political, it seems a waste to be running down Ravenscraig and the Scottish manufacturing industry at a time when switching to renewables could not only save but positively regenerate them for years to come.

The exclusion zone which has suppressed employment around Dounreay for so many years would be destroyed by switching to renewables. The door would then be open for manufacturing in Caithness itself, providing further employment and prosperity to the region. The possibilities are endless, and very exciting. Who knows, one of the first items to come off the production line may be an updated version of the "tirle"? Better late than never. □

* *Centre for Alternative Development in Energy* by Edward Kelsall & Kenneth Low. Caithness Against Dounreay Expansion, 1990, 6pp, £1. Available from: Richard Levens, Berriedale Cottages, St Margaret's, Orkney (SCRAM 79).

Reductions in recommended dose limits for radiation workers set by the International Commission for Radiological Protection do not go far enough, argues PATRICK GREEN, Friends of the Earth's Radiation Campaigner. The ICRP has put industry profitability before worker safety, and their recommendations should not be the basis for UK or European law.

ICRP putting wealth before health

THE International Commission on Radiological Protection (ICRP) has now agreed the final form of its 1991 recommendations. Even though the Commission increased its estimates of radiation risk by a factor of four to five, it only recommended a 2.5 fold reduction in its dose limit for radiation workers. Documents leaked to Friends of the Earth show that the Commission has bowed to pressure from the nuclear industry and has recommended a dose limit that can be achieved without resulting in a massive economic penalty.

The ICRP met in Oxford during the second week of November to agree on the final form of its 1991 recommendations. These were initially circulated in draft form in February this year. The November meeting has been reported in the media as resulting in "more than halving" the dose limits for radiation workers following a three fold increase in risk.

However, it did not increase its fatal cancer risk estimates by a factor of three, but by a factor of four to five. As discussed in SCRAM 76, the ICRP failed to act on its assessment of risk. It would seem logical to expect that increases in risk estimates would result in a proportional reduction in dose limits. This would be the

minimum step necessary to maintain safety standards. A desire to improve safety standards or considerations of the Gardner report and the risk of leukaemia in workers' children would probably mean even larger reductions.

Unsafe

However, the Commission has not even attempted to maintain levels of safety. Exposure at its old limit of 50mSv was previously considered to produce a risk of death from fatal cancer of 1 in 2000 per year. This risk limit was used by the UK National Radiological Protection Board (NRPB) in 1987 when it recommended that workers should be exposed to no more than 15mSv per year, on average. It would now imply an annual dose limit for radiation workers of around 10mSv, and not 20mSv as recommended by the ICRP. A dose of 20mSv produces a risk of death from fatal cancer of 1 in 1250 per year.

Consequently, the Commission's new recommendations actually amount to a weakening in the overall level of protection offered to radiation workers. Furthermore, the ICRP is not recommending an absolute limit of 20mSv per year. This figure only refers to average doses. It argued that annual limits, which have been applied since 1959, are too inflexible

and recommended that a limit of 100mSv should be applied over a five year period.

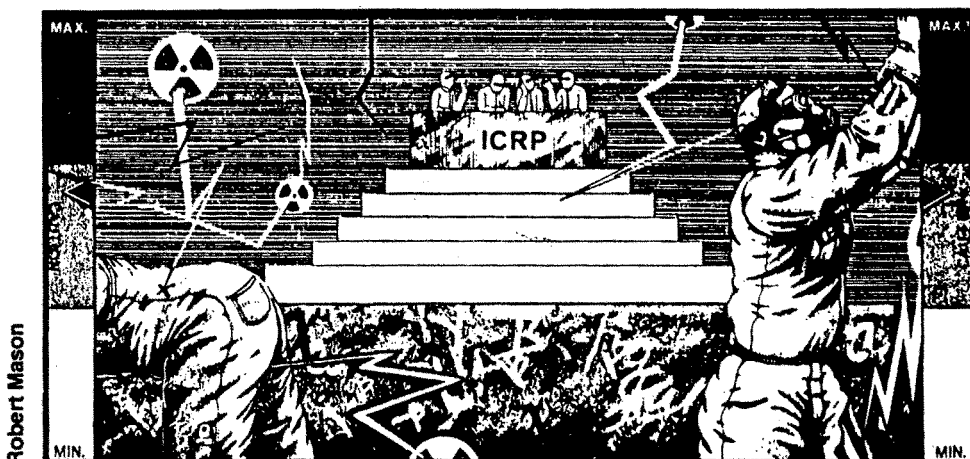
As a result workers can still receive doses up to the current limit of 50mSv, in some years, even though the NRPB has described the risk resulting from any such exposures as "intolerable".

Such flexibility is not designed to protect the health of those at risk. A leaked French Atomic Energy Commission (AEC) document shows that this flexibility is needed by the nuclear industry if it is to survive. Quite simply, the industry, and uranium mines in particular, experience major difficulties and suffer severe economic penalties in meeting more stringent limits.

French fears

The document is the AEC's comments on the draft ICRP recommendations. It argues that the ICRP's proposed limit of 100mSv in five years would cause major problems for French uranium mines: "It must be realised that the limit of 100mSv over five years would have dramatic consequences for the operation of uranium workings. In the period between 1984 and 1988 410 miners were exposed to radon - out of 1,276 who were monitored, ie. 32% - exceeding the value of 100mSv. The same problem certainly exists in all countries throughout the world."

The problem however, was not just confined to uranium mines: "Certain activities, such as the fabrication of fuel, the maintenance of reactors, emergency action in the event of operating accidents, and work associated with the dismantling of facilities result in exposure levels exceeding 100mSv in five years for small groups of individuals of high technical competence. It is estimated that there are some 1,500 persons who exceed the 20mSv per year



threshold in French organisations as a whole".

The French AEC also argued that a dose limit reduction even to 20mSv per year would have: "disastrous psychological effect on the public and the staff of nuclear installations. How could the public be prevented from seeing it as justification for its fears and a disavowal of the technical managers?".

Levelling down

The French authority argued that the 100mSv limit in five years was too inflexible. It stated: "The French proposal is the following: In addition to the current 50mSv per year, a regulatory 1Sv lifetime limit would be introduced making it possible to make no exceptions, even for uranium miners".

Following its June meeting the Commission announced that its dose

limit was being reduced to an "average of 20mSv in a year with some provisions to allow year to year flexibility". A decision confirmed by its November meeting.

So what of the French criticism? Ideally, the French wanted to avoid any reduction in dose limits. However, the Commission would not be able to get away with this. It should be remembered that the Commission has been widely criticised in recent years for not taking any action in response to the increases in risk estimates. This led to the NRPB taking unilateral action in 1987. Quite simply, for the Commission to retain its status it could not avoid taking action any longer. However, as seen in SCRAM 76, it fudged the issue, moved the goal posts and took the minimum action possible.

Furthermore, while the ICRP proposals appear to represent a reduction in dose limits they actually

provide most of, if not all, the flexibility requested by the French authorities. The French argued for a lifetime limit of 1Sv (1000mSv). The new ICRP recommendations amount, over a working lifetime at 20mSv a year, to practically 1Sv. This coupled with the flexibility to allow doses up to 50mSv in some years is more than sufficient to meet the French demands.

Clearly the Commission has bowed to pressure from the nuclear industry and put profitability before the health of radiation workers. It should have recommended a five fold reduction in its dose limits. Instead, it recommended a limit in a sufficiently flexible form to ensure that it could be achieved, without massive expenditure, by even the dirtiest ends of the nuclear industry. This is unacceptable and the ICRP's claim to be an independent organisation is unjustifiable. The ICRP's recommendations must never form the basis of UK or European law. □

The following points are part of a Statement from the 5th International Conference of Nuclear Free Zone Local Authorities, held in Glasgow in November, to be circulated to around 4,500 NFZs world-wide for their approval.

[NFZs are, within our powers,] to support all victims of radiation damage in our localities, by:-

(1) promoting within Government departments responsible for health and social security recognition of all diseases induced by high- or low-level radiation exposure, past or present, and wide qualification for invalidity pensions and compensation payments;

(2) as regards victims of the Chernobyl disaster within the Soviet Union emphasising that any support should be provided through local authorities or non-governmental organisations;

(3) encouraging medical research and monitoring;

(4) supporting by grant aid and/or local access to local authority resources and premises, recognised local groups supporting radiation victims;

(5) adopting resolutions that recognise that there is no safe level of radiation exposure. All levels of exposure will produce a proportional level of risk i.e. a linear no threshold dose-response model of radiation exposure applies - as set out in the US National Academy of

Sciences BEIR5 Report.

(6) recognizing that the International Commission on Radiological protection (ICRP) now recognises that the total cancer risk estimates of radiation are 4-5 times higher than when it set its present safety standards;

(7) recognising that a report recently published in the UK, the Gardner report, which found a significant association between a fathers occupational radiation exposure and childhood leukaemia, demonstrates that radiation workers AND their children are at risk from radiation exposure;

(8) condemning the ICRP for FAILING to recommend a 5 fold reduction in its dose limits, for radiation workers and members of the public, in line with recognition of the increase in risk;

(9) support all campaigns such as that organised by Friends of the Earth (UK) which seek to achieve reductions in the ICRP dose limits;

(10) support all legitimate calls for the payment of compensation to the victims of occupational and environmental radiation exposure.

To control global warming, and reduce the risk of devastating climatic change, major cuts in fossil fuel consumption are needed, starting now. DAVID OLIVIER, Principal of Energy Advisory Associates has been on a fact finding trip to look at the use of energy efficiency and renewables for new and existing buildings in the Netherlands, Germany and Switzerland.

Building for the future

TO reduce carbon dioxide (CO₂) emissions by 80% or 90% in the next 60 years requires a systematic approach to improving energy efficiency and use of renewable energy sources. This article presents a small selection of energy efficient housing projects underway in mainland Europe.

A house in Castricum, north of Amsterdam, was completed in 1989, with financial support from the Energy Department of North Holland (one of the Netherlands' 14 counties). It is at the edge of the town, but it operates with no connection to the electricity grid, only to the gas main.

Photovoltaic (PV) cells, with a peak capacity of about 2 kilowatts (kW), have been built into the roof structure. The house also has a tiny gas-fired combined heat and power plant. Thanks to the use of energy-efficient electrical appliances, lights and ventilation, the system covers the whole demand for electricity (there is even a considerable summer surplus; at present it is used for water heating and refrigeration, but future houses of this type would probably be grid-connected and sell this electricity to the public supply).

The house has cavity brick walls, which are insulated with 120mm of polyurethane foam (CFC free). The roof and the ground floor have a similar level of insulation. The timber windows have sealed double-glazed units, with a 15mm space filled with argon and with a silver oxide selective coating (this system insulates nearly as well as quadruple glazing). The house is quite tightly-sealed, justifying a mechanical ventilation system with heat recovery.

The heat loss is 4 times less than a house meeting the 1990 UK Building Regulations. Because the heating system could be much simpler, and cheaper, than normal, the house was built within the cost limits that apply to 'social' housing. The ventilation system recovers 85% of heat in the outgoing air to pre-heat the fresh cold air, and it uses 20 watts to provide a fresh air flow of 150 cubic metres per hour. This consumption is 85% less than typical systems on the European market.

To minimise conversion losses, nearly all the electrical equipment within the house operates at 24 volts direct current (DC). The house is lit mostly by compact fluorescents, with

electronic ballasts (DC versions). Within the constraints of the low voltage and DC, the other appliances were also chosen for low electricity consumption. As a result, the house not only consumes about 70% less energy than usual for space and water heating, but uses 70% less electricity.

This is the first properly-monitored PV house in the Netherlands, many more such buildings are expected in the long-term. PV costs have dropped sharply in the last decade, and are still falling. Already, three electrical utilities are planning grid-connected PV systems, each involving 20 to 200 houses.

German projects

Many new experimental building projects are underway, with support from the Federal Government, state governments and city councils. In the most experimental of all, the Fraunhofer Institute for Building Physics, Stuttgart, is starting to design two dwellings, suited to the very different climates of south and north-east Germany. The project is funded by the Federal Ministry for Research and Technology.

Construction will begin in late 1991, and the aim is to demonstrate measures which are justified at energy prices which central Europe might face in the future. These costings will also reflect the environmental benefits of energy efficiency and renewables, so far as they can be quantified.

The dwellings will probably use negligible energy for space heating and 80-90% less energy for other purposes than new German houses. This goes even beyond Germany and Switzerland's other pioneering new housing projects (eg. Wadenswil, below).

Another important project is a medieval timber-frame house in southern Germany. Between 1978 and 1985, it was retrofitted to a superinsulated standard without significantly changing its external

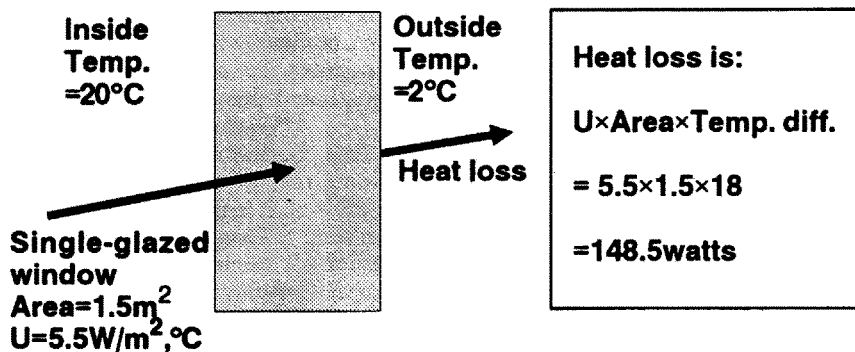


The U-value

U-values are a measure of thermal conductance - and shows how much heat a particular material or materials (eg. wall, window) lets through per unit area. It is expressed as the amount of heat energy, in watts (W), transmitted through a unit area, square metre (m^2), for a certain temperature difference between the inside and outside, in $^{\circ}C$.

U-values are therefore given in $W/m^2, ^{\circ}C$; the lower the U value the better the insulation.

Example for single-glazed window



appearance (it is in a conservation area). For instance, the timber walls were fitted with a vapour barrier and 250mm of insulation.

Double glazing illegal

In many areas of Switzerland, not just the high Alps, the buildings have been double-glazed since 1890! However, this is no longer enough. Zurich Canton recently adopted new building regulations which require triple glazing, or its equivalent, in all new buildings, and two or three times more insulation than in the UK. This makes Zurich's building standards as energy efficient as those of Scandinavia.

Timber-frame buildings are a rarity in any country on mainland Europe. These high levels of energy efficiency are being achieved in the same building materials that are 'traditional' in the UK; namely brick, stone and concrete.

In a further step forward, ten experimental semi-detached houses are being built in Wädenswil, a small town near Zurich. The project is financially supported by the town council and the Energy Office of Zurich Canton.

The heat loss of these houses is about 5 times less than if they only conformed to the UK 1990 Building Regulations. The windows alone have

a U-value of about 0.6W/m²! (This compares with single-glazed windows with a U-Value of 5.5, which can still be installed in the UK. Most current UK building stock has solid brick or stone walls, with a U-value of about 2). They are expected to use less energy for space heating than a normal house uses for the fridge-freezer!

They also have solar-assisted water heating, and energy-efficient electrical appliances and cooking. The total energy consumption is expected to be 75-80% less than normal. Although the cost of building the houses is 15% higher, the extra cost would drop sharply if the measures were widely applied.

Environmental concerns

As an example of what can be done, consider the Netherlands. Public concern for environmental matters has surged since 1989. To reduce CO₂ emissions by more efficient energy use and renewable energy is now officially considered an environmental policy, not just an energy policy, and action will be taken regardless of oil prices.

Gas and electricity transmission and distribution have been separated from supply and generation, but unlike UK electricity privatisation, they mostly remain in public ownership. Within a few years, the Netherlands will have about 100 horizontally-integrated

municipal utilities who are responsible for the provision of all mains energy services (gas, electricity, heat) in a local government area.

These local distributors will be free to invest in local generation plant; eg. gas-fired combined heat and power stations, in competition with the national electricity supply companies. As part of the country's National Environmental Protection Plan, all the distributors are required to prepare local energy plans to reduce CO₂ emissions. Most future public investment in energy efficiency and renewables - for instance, grants and loans for the insulation of existing dwellings - will also be channelled through the utilities. To pay for these investments in energy efficiency, the price of electricity and gas will be increased.

Some power companies have bought compact fluorescent lamps cheaply, in bulk, for their consumers. As a result of such promotions, the number in use has reached almost one per dwelling. Their use in the UK is still almost undetectable.

Market forces were insignificant in these changes. The Netherlands Government, one of the most environmentally-conscious on mainland Europe, is taking such decisions because they are perceived to be in society's long-term interests.

UK must learn

Probably few people have appreciated the scale of what is necessary, still less considered how we could achieve it. In energy efficiency terms, new UK buildings not only fail the standards attained by new Swedish houses in the 1940's, but they are several decades behind the standards set by Switzerland.

Of course, Scandinavia is also doing a great deal to tackle global warming. But the activity in the Netherlands, Germany and Switzerland also makes UK work almost pale into insignificance. We had better learn from them fast. If our descendants in the year 2050 realise that important steps could have been taken to halt global warming in the early 1990's, but were not, they will not thank us. □

David Olivier is Principal of Energy Advisory Associates, tel. (0908) 220182. A detailed report on these and other projects is available.

Sebastian Klinke, a student of political sciences at Bremen University, considers the future for the Nuclear Industry in eastern Germany following unification.

"Quo Vadis", East German nuclear?

DUE to the German unification, former East Germany is the first of the eastern bloc countries to have its nuclear power stations fully examined by western experts. The questions are, whether it is possible to upgrade Soviet design nuclear power stations to western standards; and, if they have to be shut down, whether it is possible, within a reasonably short time, to substitute those reactors and East Germany's highly polluting lignite fired power stations for modern means of power generation.

The western nuclear industry is quite aware of the fact, that eastern Germany is a test site for their claim that there will be a "nuclear revival" in the near future. Delegates at the European Nuclear Conference in Lyon, at the end of September 1990, expressed the belief that there would be a growing demand for nuclear power, particularly from Eastern Europe and developing countries. They argued that nuclear energy will be the only opportunity for those countries to avoid severe energy shortages, meet CO₂ reduction targets, and be able to afford sufficient energy supply. Leaving aside the last argument, which has already been proven wrong, the remaining two can be examined in the case of East Germany.

Closures.

On 1 June 1990, 4 months before German unification, the 4 operating reactors at Greifswald power station in the GDR (Greifswald-1 to 4) were shut by order of the GDR Minister for Environment and Energy, Hermann Steinberg. The order was triggered by a devastating report on the reactor's safety by West German experts of the Gesellschaft fuer Reaktorsicherheit mbH (GRS - the reactor safety agency).

They not only discovered major design defects in the Soviet-built PWRs (VVER-440 Model 230s) but also "serious deficiencies in the safety culture". In February 1990, GRS said one of the Greifswald units had been operated at full power for several hours, despite a leak in the coolant purification system, so that primary coolant was allowed to flow outside the local containment structure. GRS found that these VVER-440s tend to suffer from severe pressure vessel embrittlement, which

alone would be reason enough to call for the indefinite closure of all the early VVER-440s. This poor design means that the 440s are in danger of a sudden total collapse of the vessel structure, especially in the case of emergency cooling, which then would lead to a core melt-down. These reactors are spread all over Eastern Europe.

GRS will now investigate the remaining 4 units Greifswald-5 to 8, which are more recent VVER-440 Model 213s, although construction of these is incomplete. Meanwhile, the International Atomic Energy Agency (IAEA) moved into Eastern Europe to conduct parallel studies on the old 440MW soviet reactors, because of growing concern within Eastern Europe over operating and design problems. Although Greifswald-5 is ready for trial operation, it cannot proceed as a full operating license cannot be granted because of low safety standards. Even "considerable safety improvements", according to Power in Europe, will not bring Greifswald-5 to 8 up to Western standards.

Positive reactivity coefficient

Two more reactor units are under construction at Stendal. The fate of these most modern Soviet VVER-1000s is very uncertain. It would cost DM1.5bn (£0.5bn) to bring them up to western safety standards, while completion would cost an estimated DM7bn (£2.3bn). Siemens/KWU has shown an interest in the units, but has not yet offered to continue building them, nor has it accurately calculated the costs. The earliest date work could be resumed, they say, would be 1993-94.

East German reactor experts said earlier, that VVER-1000s tend to have a positive reactivity coefficient, like the Chernobyl reactor. According to officials at the Central Institute for Nuclear Research at Rossendorf, near Dresden, the core instability is due to a "very narrow geometry", which also increases the risk of later vessel embrittlement. There are 14 operating VVER-1000 units in the USSR and two in Bulgaria. Apart from East Germany, there are units under construction in Czechoslovakia.

The East German experts assertion that VVER-1000 cores are "inherently

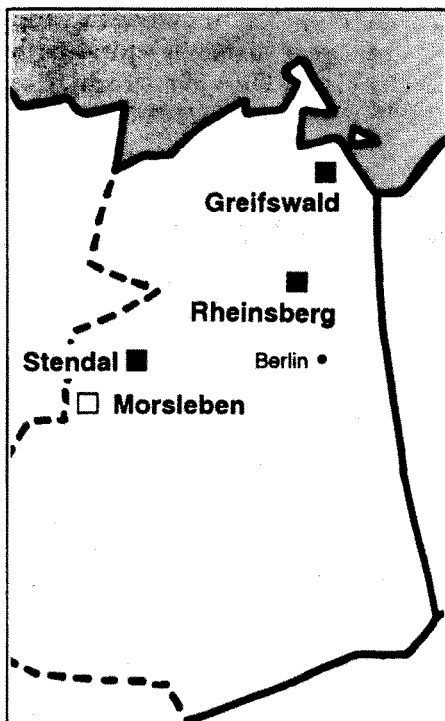
unstable" has been denied by Vsevolod Vosnesensky, deputy scientific head of the USSR's Kurchatow Institute of Atomic Energy. He claimed that "designers had sought economic optimisation ... which dictated the choice of the smallest possible vessel". It is not clear whether it was scientific blindness or something else that precipitated this own goal.

In East Germany, the small 70 MW training reactor at Rheinsberg was also shut down. It is unlikely to restart as its operating license expires in 1992. So, at present all nuclear power stations in eastern Germany are shut down, and even the Federal Environment Minister, Klaus Toepfer, does not think it is possible to start, or restart, any of the existing units under German or EC atomic authorities laws. Backfitting the Soviet VVER reactors appears to be either totally uneconomic or just technically impossible.

Transformation

The complete shutdown of all eastern German nuclear plants means a 7.6% loss of generating capacity on former GDR territory. Due to age, EC Commission rules and the German Clean Air Act, which have applied to the territory since unification on October 3, about 30% of lignite fired power stations will have to be shut down by the end of 1994, causing a combined shortfall of one-third of eastern Germany's 1989 capacity. The remaining brown-coal capacity will be reduced further, as lignite production has to be halved by 1998, giving a total shortfall of 40%.

This huge capacity shortfall will be compensated for in many ways. First, electricity demand in eastern Germany is expected to drop drastically, mainly because of factory closures but also because of increasing electricity prices (present prices per unit will treble by 1 January 1991), insulation schemes and the introduction of meters for district heating. This could result in an 18% reduction in demand on 1989 figures by 1995. The missing 22% will be supplied by 4 new transmission links from western Germany, which will come into operation by 1992-93. By 1995 three newly built coal-fired power stations will be available for eastern Germany. To substitute the Greifswald reactors,



Siemens/KWU is going to supply eight mobile oil-fired heating stations, rated at 200MW each, for operation by 14 December 1990. By 1995 nuclear power will have been replaced in eastern Germany by a new energy supply system. A revival of nuclear power seems unlikely, as finding new sites and undergoing unpredictable long licensing procedures will probably deter every possible investor.

The conservative/liberal Government of the unified Germany committed itself on 7 November to a 30% reduction in CO₂ emissions by 2005, the most ambitious target in the world. The CDU/FDP Government is well known for its pro-nuclear attitude, but nonetheless seems to have decided to reach its emission targets primarily by "improving energy efficiency, rationalising energy conversion and use, energy savings, and expanded use of renewable energy sources".

Uranium mines

Other relics of the East German nuclear industry include the large Wismuth uranium mines, an area commonly known as the highly contaminated "uranium province". The Soviet-German uranium producer, is expected to end its mining operations at the end of 1990 because of low uranium world market prices, the radiation hazards for the employees and the problem of decontamination.

An installation which may not be closed, because it could be vital for the western German nuclear industry, is the Morsleben nuclear waste dump. According to Dr. Viehl, spokesperson for the Federal Agency for Radiation

Safety (BfS), eastern German nuclear waste will continue to be dumped at Morsleben. German environmentalists fear that the Federal Government will try to achieve at Morsleben, what they could not achieve at Gorleben - the planned high-level waste repository where work has been stopped by the Niedersachsen State Government. The Morsleben dump, near the former east-west border town of Helmstedt, was a large salt mine, and is currently used for low and intermediate level waste. The Federal Ministry of Environment (BMU) has urged GRS to examine the present licensing regulations for Morsleben. Their report should be completed by the beginning of 1991. The government will then decide if western German nuclear waste can be dumped there.

The western German Oeko-Institut - an independent environmental institute - published a report on the safety conditions of the salt mine at Morsleben (also known as the Bartensleben pit), which concluded that, in comparison to West German safety standards, Morsleben is "a sheer catastrophe". Liquid waste has been dumped without proper solidification, a practice not allowed in western Germany. Most of the solid waste has been dumped without containment or occasionally in simple barrels, which are corrosive and many are already damaged. Most worrying of all, the mine is in danger of collapse and water penetration, which could cause vast soil contamination and water supply contamination of the whole area.

If eastern Germany is taken as a model for Eastern Europe, it shows how it is possible to transform a highly polluting energy system in a highly industrialised country, to one which matches West German standards - some of the toughest in Europe - without using nuclear power. If the governments of the other East European states have watched the developments in the former GDR, they should be safe from the advances of the western nuclear industry. Although, if Czechoslovakia is anything to go by, it seems that some of the eastern governments have not been watching. Siemens/KWU have recently signed contracts to backfit the two Soviet type reactors presently under construction at Mochovce.

RWE goes green

The 'Big Three' West German electricity utilities, RWE, Preussenelektra and Bayernwerk, have secured between them a minimum 60% stake in the eastern German electricity market by signing an agreement with the Government on 22 August. They will make every effort to maintain the existing power station sites and preserve the large existing units in order

to prevent replacement by decentralised smaller power stations. This strategy is not an attempt to maximise efficiency and minimise emissions, but to make it more difficult for the municipal utilities, who operate small decentralised power plants, to establish themselves in eastern Germany.

Initially the former East German Government passed a law, one of the few made without help from Bonn, which ruled that towns and 'Kommunen' (municipalities) should be able to take over their own electricity, gas and water supply plants free of charge. Under the new unification treaty they have to prove that their supply system would be better and more economic than one maintained by the 'Big Three', which would be an uphill task, because the 'Kommunen' are only now beginning to organise themselves. Therefore eastern German municipal energy supply is expected to be even more marginal than it has been in West Germany (around 9% of power station capacity and 29% of public electricity supply).

Not surprisingly the municipal utilities are angry about the East German government contract with the 'Big Three'. To calm them down RWE has set up a DM100m (£33m) programme called ProKom, which offers funds for towns and 'Kommunen' to establish district heating, renewable energy systems and the leasing of electric vehicles. By offering this, RWE also hopes to be able to counter the municipal utilities' advertising slogans: "We are the only utilities pleased about lower consumption" and "we are not a concern which pays fine dividends to shareholders through ever higher electricity sales."

Berlin, capital of unified Germany, will be one of the few towns or 'Kommunen' in eastern Germany with full control over its energy supply. The control of energy generation by town or municipal utilities in Germany shows that this is also a good opportunity to get rid of nuclear power, as decision making is decentralised and municipal utilities in general operate small plants and combined heat and power stations, automatically excluding most nuclear power stations.

Apart from another form of centralisation - now in the form of private ownership by the 'Big Three' - unification seems to have brought more choice to eastern Germany. In terms of energy production, this appears to exclude nuclear energy. In other words, democracy can be the most effective weapon against nuclear power. Let's hope the East European countries turn out to be more democratic than western countries. □

In August 1990 the US Nuclear Control Institute published a paper – the third in its series on extending and strengthening the Nuclear Non-Proliferation Treaty – by MARVIN MILLER, a senior research scientist with the Department of Nuclear Engineering at the Massachusetts Institute of Technology. Here we summarise Miller's paper which asks: are IAEA Safeguards on Plutonium Bulk-Handling Facilities Effective?

Proliferation safeguards

THE rationale for extracting plutonium from spent fuel is that conventional nuclear reactors are too inefficient in their use of limited uranium resources to sustain a large contribution from nuclear power, so plutonium-fuelled fast reactors will be required in future. In response to widespread opposition to nuclear power and the realisation that low-cost uranium resources are abundant, the emphasis, particularly in the United States has shifted away from the plutonium breeder economy. However, several countries, particularly France and Japan, still insist that in the long run the plutonium breeder will be needed.

The counter argument is that, given the potential for energy efficiency and the wider use of renewables, the breeder will not be needed until well into the 21st century, if ever. Whether the uncertain economic benefits of the plutonium economy can outweigh the substantial risk of diversion of plutonium by both states and sub-national groups for the production of nuclear weapons is open to serious question.

The International Atomic Energy Agency (IAEA) define their safeguards objective as "the timely detection of the diversion of significant quantities of nuclear materials from peaceful activities ... and deterrence of such diversion by the risk of early detection."

The Standing Advisory Group on Safeguards Implementation (SAGSI) of the IAEA submitted numerical estimates for some of the goals in the above definition to the Director of Safeguards of the IAEA in 1977.

A 'significant quantity', for example, was defined as "the approximate quantity of nuclear material in respect of which, taking into account any conversion process involved, the possibility of manufacturing a nuclear explosive device cannot be excluded." For plutonium the significant quantity was taken to be 8kg; for highly enriched uranium (HEU), 25kg of contained U-235; for low-enriched uranium (LEU), 75kg of contained U-235.

Detection time (the maximum time that should elapse between a diversion and detection) should be of the same order of magnitude as conversion time, defined as the time required to convert different forms of nuclear material to the components of a nuclear explosive device. For metallic Pu and HEU, conversion time was estimated as 7-10 days; for pure unirradiated compounds of these materials such as oxides or nitrates, 1 to 3 weeks and so on.

The values recommended by SAGSI for the detection goals were carefully described as provisional guidelines for inspection planning and for the evaluation of safeguards implementation, not as a requirement, and were so accepted by the Agency. However, the view of a sector of the non-proliferation community, which was particularly influential in the US during the Carter Administration, was that unless these goals could be met in practice, safeguards were not effective, and plutonium extraction therefore posed too great a proliferation risk. This perspective was embodied in the Carter Administration's Nuclear Non-Proliferation Act (NNPA) of 1978. The NNPA attaches great importance to the concept of "timely warning" ie the

detection of a diversion quickly enough to take diplomatic action to prevent the fabrication and insertion of the diverted material into a first bomb that is otherwise complete. Thus, detection time must be even shorter than conversion time, in order to allow for evaluation and response. In the case of Pu or HEU compounds in unirradiated form, detection time must be even shorter than 1-3 weeks.

Material accountancy

The document which details the safeguards obligations of states party to the Non-Proliferation Treaty (NPT) (INFCIRC/153) delineates the methods to be used in timely detection of diversion. The Agreement between the Agency and the State "should provide for the use of materials accountancy as a safeguards measure of fundamental importance, with containment and surveillance as important complementary measures." The nuclear facility operator must prepare a material balance covering a specified period, showing that all the nuclear material can be accounted for. More specifically, adding the material inputs and subtracting the removals from the beginning inventory gives the amount that should be in the ending inventory. The IAEA inspector performs an independent check on at least some of the data presented by the facility operator to confirm the absence of deliberate falsification. The procedure works well at nuclear facilities where the nuclear material is present only in the form of identifiable and countable items eg. fuel assemblies at power reactors.

However, unlike fuel assemblies, the quantity of bulk materials, such as plutonium in reprocessing and fuel fabrication plants and uranium in fabrication and enrichment plants, can only be measured approximately. As a result, even in the absence of diversion, there can be 'materials unaccounted for' (MUF). Materials accountancy must rely on statistical tests to distinguish whether the existence of MUF is due to diversion or a chance combination of measurement errors. Unfortunately even if the MUF is a small percentage of the quantity of material measured in a plant processing large quantities of material, it can still build up over a

According to IAEA Director General, Hans Blix, SAGSI "is in the process of reviewing a number of the safeguards procedures presently in effect". The Nuclear Control Institute are concerned that the review might lead to a weakening of the Agency's safeguards efforts. The IAEA, prohibited from borrowing money to meet expenses and limited to a zero-growth budget, is examining how it could save money, including the safeguards area. The IAEA's financial woes are compounded by the fact that a number of countries, the US in particular, are often late in paying their annual contributions. Obviously any weakening of the IAEA's safeguards efforts must be fiercely resisted. The debate over plutonium safeguards is far from finished.

sufficiently long period to an amount in excess of the 'significant quantity'.

A relevant example is the planned 800 tonne per year Rokkasho reprocessing facility at Aomori in Japan. The minimum amount of diverted plutonium which could be distinguished from the 'noise' of the measurement process is 246kg of plutonium, equivalent to more than 30 significant quantities.

Besides the fact that the minimum detectable diversion in such a plant greatly exceeds a 'significant quantity', the detection time will also exceed the timeliness goals for the various forms of plutonium in the plant. There are 3 reasons for this. In the first place, while the material balance is measured on a yearly basis, the diversion of 8kg or more of plutonium could take place at any time following plant startup. Secondly, the determination of the concentration of plutonium in the input and output accountability tanks, as well as in the process tanks, currently requires the tank samples taken by the plant operator and given to the IAEA inspector be shipped back to the IAEA analytical laboratory outside Vienna for measurement. Because of stringent national regulations on the shipment of plutonium, this is often a time-consuming process: delays in measuring samples of the order of months are not unusual.

Finally, in the Agency's view, a false accusation of diversion would be extremely serious, and could discredit the safeguards system. Thus detecting a diversion means, first, detecting a suspicious event, technically an "anomaly" indicative of a possible diversion, such as a large MUF or a film picture indicating unreported movement of nuclear material. The Agency then attempts to systematically eliminate all other possible explanations, such as larger than estimated measurement errors, unreported material losses, defective safeguards equipment etc. This process is apt to be very time-consuming, especially if re-measurement is required, and the greater the degree of certainty that is required, the longer the process will take. Thus, detection in the spirit of the timely warning philosophy cannot in practice be realised both because of the nature of the measurement process and because of the Agency's philosophy of being extremely careful to avoid an unjustified accusation of diversion.

One obvious way round this would be to perform material balance measurements more frequently eg. weekly. This would increase the potential for both greater detection

sensitivity and timeliness in the detection of an abrupt diversion. Unfortunately, making inventory measurements in large plants, particularly reprocessing plants, is time consuming and expensive because it involves a shutdown of the plant and a washout of the process equipment. Only one or two inventory takings per year would be acceptable to the plant operator.

It is impossible, therefore, to meet the IAEA's safeguards detection goals at large reprocessing and plutonium fuel fabrication facilities using conventional materials accountancy. The IAEA's attempts to remedy this situation by defining alternative safeguards goals are widely seen as a retreat, indicative of both the Agency's inability to meet its original detection goals and its unwillingness to admit this fact. The result has been a loss of confidence in IAEA safeguards, particularly in the US.

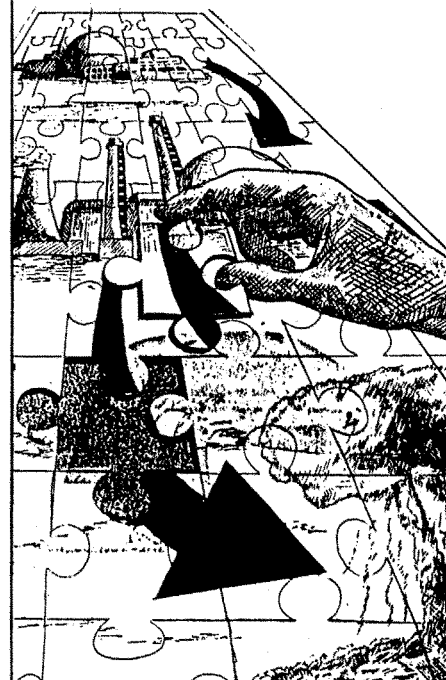
Improving safeguards

Near-Real-Time Accountancy (NRTA) is a method of making measurements of the material balance more frequently than in conventional materials accounting eg. weekly instead of yearly. What makes NRTA practical is the feasibility of making frequent measurements of the plant's plutonium inventory without shutting it down. This is accomplished by actual measurement of plutonium in most of the process equipment, and reliance on estimates of the plutonium content of those vessels which are inaccessible to measurement. Since the throughput between measurements is proportionately smaller, the minimum amount of diverted plutonium which could be distinguished from measurement 'noise' is much smaller. In the case of the 800 tonne per year plant, it would be about 8kg.

Weekly material balance takings would also increase the timeliness of diversion detection, if the measurement samples could be analysed more quickly. Several techniques amenable to rapid analysis by IAEA inspectors on-site are in the development and demonstration stage.

NRTA proponents argue that this method should also be able to detect protracted diversion of plutonium over many weeks, assuming that one has a significant data bank of MUF values for a period when there was no diversion. However, if diversion begins when the plant starts operation and continues as long as safeguards are applied then NRTA is no better than conventional materials accountancy. Nor can NRTA detect more sophisticated diversion strategies, such as putting material into

The Plutonium Puzzle



the system to increase measurement 'noise'. NRTA would also be labour intensive for both plant operator and the IAEA. Higher safeguards costs as well as some degree of opposition from plant operators are likely.

Technical measures, especially NRTA, but also more reliable and effective containment and surveillance measures (eg seals on tanks containing plutonium products and cameras to provide surveillance at spent fuel ponds), greater at-plant IAEA measurement capability, and more accurate measurements of the plutonium in waste streams, could lead to a significant improvement in the effectiveness of international safeguards at large plutonium-handling facilities.

Implementation of such measures would increase public confidence in the ability of the IAEA to minimise the risks of the use of plutonium in nuclear fuel cycles. Until these measures can be implemented and demonstrated, it would be prudent to limit plutonium use to research, development, and demonstration projects only. But, even if these improvements can be practically achieved, there are still diversion risks as well as environmental hazards associated with large-scale transport of plutonium between reprocessing/fabrication plants and reactors. □

* Are IAEA safeguards on plutonium bulk-handling facilities effective?; by Marvin M Miller. Nuclear Control Institute, 1000 Connecticut Avenue NW, Suite 704, Washington DC 20036, USA; August 1990.

Paper Tiger II

DOGGED adherence to "ideological preconceptions" will not bring about the environmental renaissance, warns the 'new' Labour Party in its contribution to the politics of protecting the planet*. Although not exactly an inspired document it does offer more hope than the Government's bland White Paper on the Environment - This Common Inheritance (SCRAM 79).

Despite their refusal to give a commitment on the abandoning of Sizewell B and their endorsement of the Thermal Oxide Reprocessing Plant at Sellafield, Labour's energy strategy represents a major leap forward, with a commitment to the Association for Conservation of Energy's favourite hobby-horse - Least Cost Planning (SCRAM 72), which requires "energy utilities to consider whether expected demand for electricity can be satisfied more economically by investing in the consumer's energy efficiency rather than in new generating plant": embracing the principle that the best way to cut pollution is to stop creating it.

By taking control of the National Grid Company they would overcome the private energy industries obligation to "maximise sales" and turn them into "energy-service companies". The burden of responsibility for security of supply, the promotion of alternative energy sources and the careful stewardship of our fuel supplies would then fall on the publicly controlled Grid Co.

Reiterating their commitment to set up an Energy Efficiency Agency (EEA), they say that energy efficiency will not be left solely up to the utilities. The new Agency will be responsible for establishing an energy labelling scheme, and will advise on all major policy areas, "including the efficiency, cost and environmental impli-

cations of alternative energy sources."

Renewable energies will also have their own Agency, which like the EEA will report annually to Parliament. Research and development money will be redirected to renewables from nuclear power. However, it would have been better if the document gave estimates of how much money and perhaps some concrete targets for the use of renewable energy sources.

Biomass will be first off the starting blocks. Labour believe it makes sense to generate electricity from landfill sites, because as the organic waste decomposes it produces methane gas which is not only explosive but far more potent as a greenhouse gas than CO₂. CHP schemes, using either landfill gas or incineration of domestic waste, would be best run by Local Authorities. This will alleviate some of the pressure on waste disposal authorities and provide a useful source of income to the Authorities.

"The neglect of wave power research in Britain is a scandal and a direct result of the pro-nuclear culture which has dominated the energy industry." Labour will reactivate the wave programme.

They are "opposed to a large scale expansion of gas-powered electricity generation in Britain." Many reasons for this are given, some more convincing than others. Gas is a premium fuel which is easy to distribute and plays a far more useful role in domestic and industrial use. It is also a major chemical feed stock.

Clean coal technologies in conjunction with CHP offers a more acceptable way to tackle global warming. They say CHP can give pollution savings of "more than 50%". Indeed they point out that about 70% of the electricity used in this country is generated by burning coal, and this is not likely to change significantly in the near future.

Although global warming "must now count as the most urgent environmental

challenge, it is not the only air pollution problem we face". Acid rain must also be tackled. The power station contribution will be reduced by retrofitting Flue Gas Desulphurisation (FGD) units to coal plant, not by relying on imports of low-sulphur coal. The choice of FGD design has been the subject of considerable debate (SCRAM 62). Labour will re-examine the debate and seek a design which produces more useful by-products than the limestone/gypsum method favoured by the Government.

Whitehall needs a green overhaul. The functions of environmental protection in the Department of Environment will be "upgraded". Policy control will be undertaken by a new standing inter-ministerial committee, served by the Cabinet Office, and chaired by the PM. Changes in Whitehall, although necessary, will not be sufficient, so they propose to establish an Environmental Protection Executive - "a tough green watchdog". It will, they promise, have "the teeth and resources to ensure that action to clean up our environment is taken nationally, regionally and locally".

An end to secrecy "is the best way of ending unsubstantiated scares and rumours that do far more harm than informed public debate". A Freedom of Information Act will be an "early priority" for the next Labour government. In the case of the environment they promise to go even further and set up and maintain registers of environmental information, presented in understandable form, covering "water and land contamination, pollution permits, food quality and air pollution." These registers should be available "in on-line electronic form for ease of access by campaign groups, voluntary bodies and research groups". □

* *An Earthly Ch.* : Labour's Programme for a cleaner, greener Britain, a safer, sustainable planet. The Labour Party, 150 Walworth Road, London. 1990, 37pp, £2.50.

Waste Paper

DESPITE promises made in the Environment White Paper (SCRAM 79), the Government is cutting the budget for energy efficiency next year and opposing European Commission proposals for improving the efficiency of electrical appliances.

According to the Chancellor of the Exchequer's Autumn Statement all expenditure on energy conservation will be frozen at 1990 levels. Although disguised by switching the responsibility for home energy efficiency from the Department of Employment to the Department of Energy's Energy Efficiency Office (EEO), a cut of about 10% in real terms has been made. Subtracting the £26 million for the Home Energy Efficiency Scheme (HEES), the EEO's budget will remain at £15 million - less than the PR costs of electricity privatisation.

Two days before the Statement, Mrs

Thatcher, in a now predictable burst of 'green' rhetoric, told the World Climate Conference in Geneva of the UK's "ambitious programmes to promote energy efficiency." She also warned: "Promises are easy. Action is more difficult."

The White Paper promoted energy efficiency as being the "cheapest and quickest way to combat global warming," and said it was "in the economic interest of energy consumers - from individuals in their homes to large companies." It claimed energy efficiency would be given a "renewed boost". It also promised that the Government would "press" the European Commission (EC) "for minimum standards to be set for a range of electrical appliances."

When DoEn officials met with their European counterparts in Brussels at the beginning of November they blocked - along with Germany - the EC's proposals for legally binding standards on domestic appliances. This also runs contrary to an EEO report published in September (SCRAM 79) which said that energy effi-

ciency standards were necessary to stimulate the massive potential for energy efficiency improvements in domestic electrical appliances.

Energy labelling was also a key feature of the Government's commitment to energy efficiency as defined by the White Paper: "the Government will press for an effective Community scheme, if possible a voluntary one, to label electrical appliances with information about their energy efficiency." It adds: "This would help consumers to choose appliances which are cheapest to run and best for the environment, and encourage manufacturers to make them." However, when presented with the chance of turning their promises into action the EEO will bow to pressure from the Government, in turn under pressure from manufacturers, and promote labelling only for the most efficient appliances. Thus leaving the worst free from the strain of damning efficiency reports.

Clearly the Government's policy on the Environment is not worth the 'white' paper it is written on. □

Anglo-Scottish wind power

PLANs to build Scotland's first wind farm could well be saved by a power board from south of the Border.

National Power, the largest of the CEBG's daughter products, has held talks with the Scottish Development Agency (SDA) and the National Engineering Laboratories (NEL) on the possibility of building a 9MW farm near Eaglesham, south of Glasgow. Its flat terrain and high average wind speed makes it one of the best sites in Europe for wind farming.

Formerly the SDA and NEL along with James Howden, a world leading wind turbine manufacturer, were part of Scottish Windpark Developments, a consortium which two years ago (*SCRAM 66*) an-

nounced their intention to build the UK's first windfarm. The consortium was dissolved, however, when Howden pulled out of the wind business. One of the reasons cited by Howden was the lack of Government support for the Scottish wind industry.

The time may now be right for the project. Richard Morris, head of the SDA's energy and environment technologies section, comments: "The agency and NEL are actively pursuing this with the Department of Energy. A submission is being prepared and the Department has made it clear that it's interested."

National Power is well aware of the problems it would face in Scotland. Under electricity privatisation legislation the Scottish Boards have no obligation to buy power from generators who use renewable energy. In England and Wales the story is quite

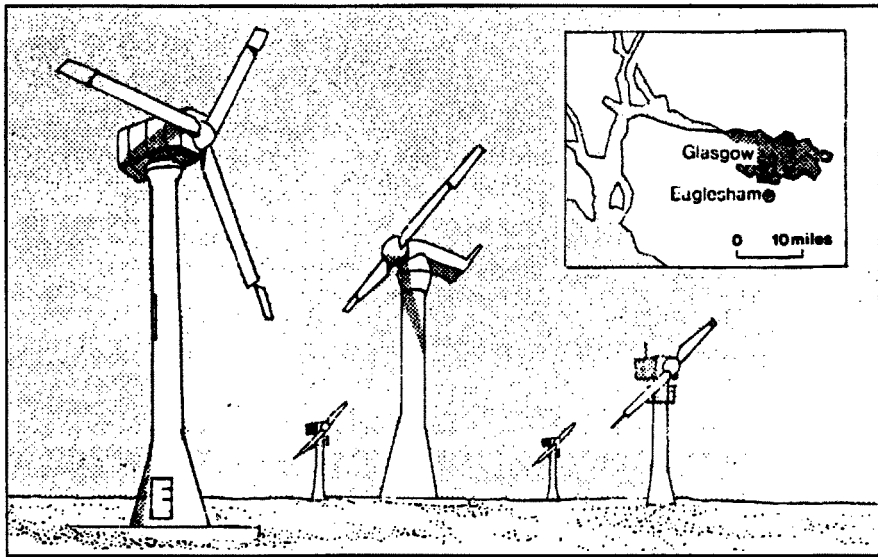
different, renewable energy projects entered under the non-fossil fuel obligation will be paid premium prices of around 6p/kWh, compared with 2p North of the border. They might also run into difficulty finding a market for the electricity because Scotland has a generating capacity of twice the peak demand.

However, there is another reason to proceed - the growing world export market for wind technology. Exploiting which, as John Twidell, the Director of Strathclyde University's Energy Studies Unit, has pointed out on many occasions, would require a home market where wind technology can be tested and demonstrated. The best wind site in Europe, Eaglesham, would provide the best shop window for British technology.

■ Dounreay has appointed a project manager to develop alternative power sources. David Glass, who is also responsible for the Nirex geological study, will now be commissioning and developing proposals to take on alternative energy work at Dounreay. Although the programme will initially focus upon research and development it is hoped that Dounreay and the Caithness area could eventually expand into installation, manufacture and operation of renewable energy plant.

Dounreay assistant director, Ken Butler, believes that they "are well placed to undertake this work, given our scientific and engineering skills, and especially with all the renewable energy resources in the Highlands and Islands."

"Although it is too early to determine the extent of Dounreay's involvement I believe that given the right political and financial support Dounreay could become a major centre for renewable energy." □



Scottish energy review

AN environmental survey is being conducted of Scotland's future energy needs. At a cost of £237,000, the work is being backed by the Scottish Development Agency, the European Commission, both non-nuclear power boards and the Scottish Office.

The SDA's chief executive, James Scott, thinks the study will have a significant im-

pact: "The end result will be a series of recommendations that will cover energy efficient investments and prompt initiatives designed to stimulate economic activity, promote long-term energy resource management and environmental improvement in Scotland."

The work will be carried out by Emstar, the energy consultancy arm of Shell UK. John Ashcroft who will head the team said it will be the start of a major environmental programme for Scotland. It will examine the scope for energy efficiency improvements, both domes-

tic and industrial, and look into the prospects of tapping Scotland's considerable renewable energy potential. The creation of new jobs through the manufacture of energy-related equipment will also be high on the list of priorities.

Hamish Morrison, chief executive of the Scottish Council, Development and Industry, who chaired the study promotion, said that it will also examine possible ways round the lack of a non-fossil fuelled obligation in Scotland. □

Wind Industry talks green

THE first tentative steps towards building closer links between the wind industry and conservation, environmental and amenity groups were taken at the beginning of November, writes Mike Harper. On Friday 9th November, the British Wind Energy Association (BWEA) hosted a seminar at the Institution of Electrical Engineers on the environmental impacts of wind energy.

Kicking-off with two introductory presentations; one on the broader environmental issues of UK energy policy, in particular global warming, and the other giving a round up of wind energy in the UK and

abroad, the seminar then moved on to the more specific environmental issues. Papers were presented on the economics of wind energy, siting criteria for windfarms, noise, electromagnetic interference and visual impact, the wind resource of the UK, public attitudes and experience from mainland Europe. The day was rounded off with an inconclusive discussion section and summing up by Jonathon Porritt.

The information sessions provided a useful updating of the issues and, for those not familiar with the details of the debate, a helpful introduction. However, the seminar did not in fact allow for sufficient input from the environment/amenity groups. On account of the inevitable time overruns, little time was left for discussion, thus squeezing the opportunity for

input from those whose primary concern is protecting the environment. In addition, most of those presenting papers were drawn from the wind industry, giving the impression of confrontation rather than communication. Hopefully this was only a presentational oversight, which could easily be addressed in further meetings by inviting papers from conservation groups.

If the cause is more deep rooted, then the wind industry will need to take time trying both to understand and appreciate the views of conservation groups as much as those groups need to understand the environmental urgency of developing wind energy. Only by this means can we ensure that the development of wind energy in the UK does not fall victim to unnecessary and inappropriate discord. □

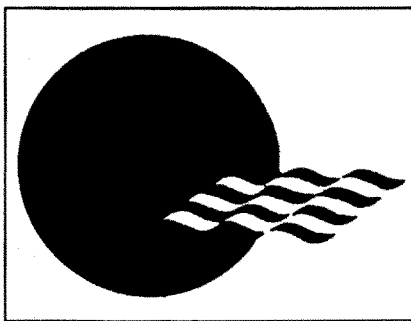
Wave power politics

THE European Parliament has been given false information about the prospects for exploiting wave power in the Community.

British MEP, Llewellyn Smith, was told at the end of September by Filippo Pandolfi, Vice President of the Commission with special responsibility for research and science, that a Commission report opposed further work on wave power because it would be premature. In fact the report, published in 1985, recommended a £9.5 million programme of research and development. It was never carried out.

Pandolfi said: "A study was carried out in 1985 by Professor Tony Lewis of Cork University. This study confirmed that it

would be premature to start demonstration in this field." However, Tony Lewis believes Pandolfi's comments are "misleading." He continued: "I did not say do nothing. I did say do something, and I did lay down what had to be done. I think Pandolfi could have alluded to the four point programme and highlighted what



the conclusions really said."

Lewis's report also showed that the Community could generate some 110GW of wave power a year, roughly 85% of its current electricity demand.

Edinburgh University's Professor Stephen Salter, designer of the Salter's Duck wave power device, who has been on the receiving end of a scandalous dirty tricks campaign since his funding was stopped in 1983, commented: "This is further evidence of hostility in some establishment circles to wave energy. Why are there some people in official circles who are worried about wave energy? Could it be that this is the one which is a threat to certain established technologies?" □

* Wave Energy, Evaluation for the Commission of the European Community, by Tony Lewis. Graham and Trotman, £20.

Fuel cell surge

EUROPEAN research and development into fuel cell technology has received a boost with the formation of the European Fuel Cell Group (EFCG) in September.

The Group involving 21 founder members, including GEC Alsthom, Johnson Matthey and the UK Departments of Energy and Trade and Industry, hopes to challenge Japanese and US dominance of the technology.

Fuel cells offer considerable benefits (SCRAM 76). They can convert fuel energy directly into electrical energy without intermediate heat energies or electromagnetic generators. They offer high efficiencies and are environment friendly. When fuelled by hydrogen, they produce only water and when run on hydrocarbons they generate

carbon dioxide without the usual outpourings of other noxious substances created by their counterparts.

However, at the inaugural meeting of the Group, Dr Leo Blomen, of the Dutch company Kenetic Technology International, warned that although there has been great advances made in the technology in recent years, its reliability and economic viability remained to be proved.

The European Commission is already spending some £17.7 million on fuel cell research, with member countries spending a further £21 million. The most ambitious European project is said to be a 1MW fuel cell plant in Milan, which is due on stream next year.

The UK DoEn, for its part, has commissioned a study from consulting engineer W S Aitkin. A favourable report on fuel cell combined heat and power plant is expected to be published shortly. □

Tyre power

PLANNING permission has been granted for the UK's first power station to be fuelled by scrap rubber tyres (SCRAM 78). The 22MW plant - the largest single project in the renewables section of the non-fossil fuelled option - was given the go ahead by the Wolverhampton Metropolitan Borough Council on October 25.

As with many projects geared towards using waste to generate power, Elm Energy and Recycling's £36 million tyre plant will have other useful, revenue generating, by-products.

The initial stages of generation are very similar to a conventional plant. The tyres are put into a boiler, this creates heat and then steam which is used to drive a turbine generator set. However, the system also involves reburn tunnels which reach some 1,000°C. The high temperature is necessary to burn off most of the nitrous oxides and dioxins created by the initial combustion process.

The remaining particles from combustion are then filtered in a 'bag house' to separate out the valuable zinc content. The gasses generated during combustion are treated with lime to remove the sulphur in a scrubber, a process similar to that proposed for some coal-fired plant.

It is believed 20% of Elm's profit will come from these sidelines. The calcines - particles containing zinc - will be sold to chemical industries, ferrous metals left in the boiler grate will be sold to the scrap metal industry and gypsum, a by-product of the scrubber, will be sold to the building industry. Elm will also be paid a fee from those seeking to dispose of the tyres.

Each tyre is estimated to have the energy content of about 2 gallons of oil. The station will use up about 45% of the UK's annual tyre dump and generate 22MW of electricity which will be sold to the Midlands Regional Electricity Company. □

National Power rubbish

UP to 10% of the UK's domestic and industrial waste could be used for generating electricity within the next 10 years if plans being drawn up by National Power (NP) come to fruition.

NP hopes that after it is privatised in February to become a prime mover in the UK waste disposal industry, providing what its new head of waste management, David Keeling, describes as "an alternative, environmentally friendly waste disposal service generating green power."

They expect that 60% of their profit will come from waste handling fees paid by local councils, with the remainder coming from electricity sales. It is also hoped that, once the business has established itself, joint ventures can be set up with the local councils.

A management team has been set up to co-ordinate the development of two preliminary schemes, each involving about 1 million tonnes of waste. The first, called "mass burn", will consist of three or more 25MW waste-to-energy stations. NP plan

to site these in areas where it is not represented, possibly London, Merseyside and the West Country. The stations will use technology developed principally in the US and will cost £40-60 million.

The second scheme, entitled "co-firing", will require 5 plants capable of converting domestic and light industrial waste into a form suitable for burning alongside coal in conventional plant. Each plant will cost between £4 million and £5 million, with an additional £500,000 spent at each power station taking the fuel.

A final decision on whether to launch the plan commercially will be taken in March next year. Keeling is optimistic: "It will go ahead, unless there are unassailable barriers, or we can't find a business that will stand on its own feet."

Whilst NP's initiative should be applauded, it is worth noting that the 10% target would still leave the UK well down the European league table for converting waste into useful energy: France converts 25%; West Germany, Denmark and the Netherlands 30%; and Switzerland about 80%. □

Watt renewables

IN the long term "the UK has a technical abundance of renewable energy resources, and if all this could be utilised through a substantial programme of research and development, there would be far more than could ever be used domestically", concludes a new report from the Watt Committee on Energy *.

However, it notes that the substantial exploitation of these resources can occur only in a European context, "which implies considerable transmission of electricity by undersea cable into a larger European grid."

Preparing a report on renewable energy sources in the UK at this time - with the goal posts moving - is not an easy task. The Watt Committee have produced as good a technical and economic survey as is possible. It does, however, lack the all important political dimension. Separate sections are given over to the different categories of renew-

ables. The closing sections on integrating renewables into the grid system and economics are particularly welcome.

Highlighting the inadequacies of the short-term thinking of a privatised electricity industry, they comment on schemes with high capital and low running costs and long life times: "In such cases of long-term benefit of the nation there must remain a role for public funding if private capital will only initiate short-term ventures."

Professor Michael Laughton, chair of the working group on renewable energy, who edited the report, predicts that privatisation will have adverse effects on the development of renewables. He argues: "New institutional and financial factors would seem to harm the prospects of increasing the proportion of electricity supplied by renewable sources."

Among the recommendations are:

- continued government support for R&D of all renewable technologies;

- the preparation of a detailed geographic survey of domestic on and offshore resources of all renewable energy types;
- the removal of institutional barriers which distort the market for renewable energy, particularly biased taxes and electricity prices; and,
- the government should in particular consider the position of Scotland where the very high surplus generating capacity coupled with the availability of some low cost hydro is resulting in uneconomically low prices being offered for electricity from renewable sources. In addition there are no non-fossil fuel/renewable obligations for Scotland in the Electricity Bill. This situation is unfortunate in view of the high concentration of wind and wave resources there coupled with the already limited transmission capacity between Scotland and England. □

* *Renewable Energy Sources*. Watt Committee Report 22. Elsevier Applied Science, 168pp, £50.

US advances

WHILE the US's Bush administration continues to be coy about global warming, California State and the Environmental Protection Agency (EPA) are beginning to see the full benefits of energy strategies incorporating both renewables and energy conservation.

Senior EPA environmental scientist, Cathy Zoi, revealed at the recent Windpower '90 conference, held in Washington DC, that their upcoming report on the potential for renewables in the US is likely to raise a few eyebrows. She said of renewables: "We really have cost effectiveness in many cases - it will say to utilities, clearly you should be moving ahead ... We say that renewable energy has got to be part of the solution to global warming."

The EPA have become increasingly supportive of renewable energy sources, and

believe that Bush's continuing rejection of global warming and support for conventional energy sources is likely to change. The possibility of carbon taxes being introduced is central to their view of the future for renewable energies. Even small taxes, they say, will give renewables a clear advantage over conventional supplies in the future. Their final report is expected in December.

Meanwhile, California's Pacific Gas and Electric (PG&E) - one of the largest private US utilities - has announced that it wants to treble the amount of power it gets from renewables. Currently under one quarter of their power is generated by renewables.

Dr Carl Weinberg, PG&E's research manager, says that although the utility does not expect to build any new generating capacity until 2000, it hopes to choose wind and solar as its preferred technologies. In the meantime the utility will be trying to overcome biases inherent in the current electricity bidding system. Wein-

berg says: "We are pushing for multi-attribute bidding that takes environmental issues into consideration. We'd prefer to use those technologies to the limits of our ability to manage the system."

The utility is also pursuing methods of energy storage which make intermediate sources such as wind much more attractive. The favoured technique is the use of compressed air in depleted natural gas caverns.

Not to be outdone, the state Public Utilities Commission has announced a 2 year \$560 million budget to promote energy efficiency. Its backers say that the plan will not only forestall the need for new plant but it will cut the annual fuel bill by \$1 billion. Although consumers will face slightly higher bills, prices will drop considerably in the long-term. While the exact details of the campaign are not known, it is believed that low energy light bulbs and home insulation will be at the top of the list. □

Climate criminals

PREDICTABLY, science and politics clashed at The Second World Climate Conference: while scientists called with a single voice for a 20% reduction in industrialised countries' carbon dioxide emissions by 2000, the international political circus - involving some 80 ministers and prime ministers - gathered in Geneva, failed to unite on ways of mitigating global warming.

So disturbed by the lack of targets in the Conference's final declaration, many of the 130 countries represented refused to sign. Initially the declaration contained a phrase calling on industrialised nations to agree targets to freeze or cut emissions of greenhouse gasses over the next decade. This was forcibly removed by the key oil-producing nations headed by the 'gang of four': the

US, UK, USSR and Saudi Arabia.

In the end the statement read: "we urge all developed countries to establish targets and/or feasible national programmes or strategies which will have significant effects on limiting emissions of greenhouse gases not controlled by the Montreal Protocol."

It is believed that the declaration was tailored to keep the US involved in climate treaty talks which are due to begin in Washington in February. The European Commission (EC) wanted the statement to at least call for a freeze in CO₂ at 1990 levels by 2000, a target that has already been agreed within the EC. However, Brice Lalonde, Klaus Topfner and Chris Patten, respectively the French, German and British environment ministers, and Carlo Ripa di Meana, European Environment Commissioner, all said in Geneva that a treaty without targets was preferable to a dispute over targets that would alienate the US.

Many developing nations, who will be hardest hit by global warming, reluctantly held their peace because of concern that aid packages promised by the US to help deal with climate change would be withdrawn. Thomas Vakatora, Fiji's minister for urban development, said: "The conference statement did not go far enough. But the islands need the transfer of technology and financial resources."

Greenpeace responded to the bland conference statement by branding Mrs Thatcher, Presidents Bush and Gorbachev and King Fahd of Saudi Arabia as climate criminals. For now, they will remain criminals - mercilessly condemning defenceless millions in developing countries to a watery grave - at least until the parole board meets at the United Nations environment and development conference in Brazil in 1992, where a binding climate convention is due to be signed. □

**Global Warming: the Greenpeace Report;
Ed. Jeremy Leggett.
Oxford Paperbacks; 1990, 554pp, £5.95.**

It is sometimes difficult when writing about global warming to remember that it is only a theory, albeit one which has the backing of the Intergovernmental Panel on Climate Change (IPCC) - a collection of over 300 top scientists brought together under the aegis of the United Nations to examine the global warming theory.

The Greenpeace Report is billed as a companion volume to the IPCC's findings. It is much more than that. It is a guide showing this is not an intractable problem; there are solutions, measures which if adopted will not only avert ecological disaster but do so at a negative cost.

Greenpeace's new director of science, Jeremy Leggett, warns against the NIMTOO - Not In My Term Of Office - breed of politicians, arguing that effective policies to combat global warming are not for the political faint of heart. The world spends up to a trillion dollars a year on its coal, oil and gas, and a further trillion on its weapons.

He points out that: "The multinational structures spawned by these juggernauts over the years cannot look with relish on a world in which fossil fuel burning must be cut to the bone, and concepts of national security transpolined from the military to the environment."

Perhaps the chapters of most interest to readers of SCRAM are those dealing with energy efficiency, renewable energy and nuclear power written by Amory Lovins, Carlo La Porta and Bill Keepin respectively.

Energy efficiency is widely recognised as the most powerful weapon in the counter warming armoury. Lovins argues a case that he has been promoting for many years, however, it now has a new dynamic: "The order of economic priority, however, is also the order of environmental priority." He supports the technological fix. Not that of solar powered satellites or fusion reactors, but high tech loft insulation and microelectronic motor control. Yet, Lovins warns that we must not ignore "the limits of technical fixes, the restricted relevance of markets to achieve justice, the ever shifting tapestry of social values, the importance of surprises, and the inherent frailty of the human design."

La Porta argues that "technology exists that can produce electricity, or any temperature heat (up to 1,400°C) directly from natural resources available at a remote location in nearly any country. The demand can be satisfied without transporting a continuous, long-distance stream of fuel or running

long-distance electric-power lines - or emitting vast quantities of greenhouse gases ... There is no qualification needed for these statements. Technically, it is possible. Economically, it is a more limited situation, but not nearly as limited as most observers and analysts believe ..." Again we are talking about a different kind of technical fix: "Renewable energy sources offer safe, clean, reliable, and economic energy. The challenge in a world that must address global-climate issues is to understand the changing climate economy, appreciate the potential of alternative energy strategies and technologies, recognise that exponential growth in renewable-energy capacity is on the horizon, and put the wider range of energy choices in the hands of individual decision-makers, wherever they are."

Anyone who follows the energy debate concerning nuclear power will be familiar with the arguments of Kats and Keepin from the Rocky Mountain Institute. Their study on the role of nuclear power in combating global warming has been widely adopted by the anti-nuclear movement. Here, Bill Keepin updates the 1988 paper.

Given generous assumptions - that there is no nuclear waste problem, the nuclear industry is economic, stations can be built on time, no proliferation problem etc - the nuclear industry is still not up to the challenge. Glo-

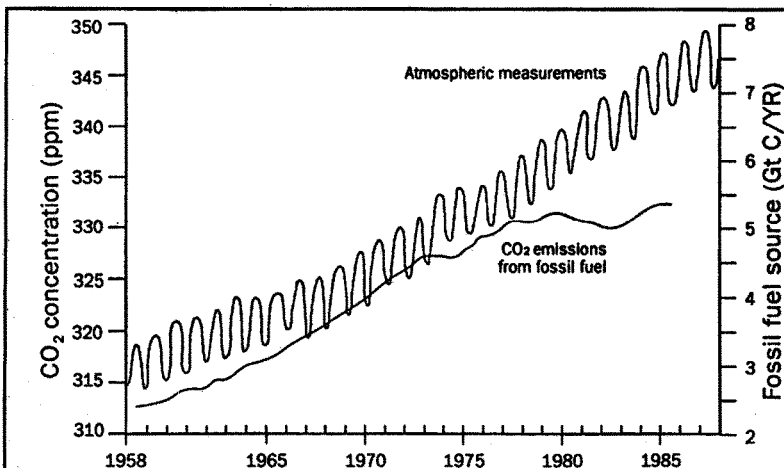
bal expansion of nuclear power "even to absurd proportions, cannot prevent future fossil-fuel carbon dioxide emissions from growing."

Also, as was previously pointed out "every dollar invested in electrical efficiency displaces nearly seven times more carbon than a dollar invested in new nuclear power." Keepin favours renewable energy sources for the long-term generation of electricity. He believes that they "offer greater promise than nuclear power for clean, inexpensive generation of electricity."

When weighed against the alternatives, "nuclear power appears increasingly irrelevant to a sustainable energy future for the world. Given the bright prospects for energy efficiency today and renewable energy in the near to long term, it is unlikely that substantial nuclear power will be needed in the future - either as fission or fusion."

This is perhaps borne out by the fact that in the US, which has the worlds largest nuclear programme, renewable sources already produce more energy than nuclear power. Energy is not the only parameter in the greenhouse equation. The other chapters in the book are equally well argued. Of particular note is the chapter on Policy Responses to Global warming by Jose Goldemberg and Susan George's view of the problem, focusing on the third world factor.

MIKE TOWNSLEY



Atmospheric carbon dioxide concentrations (as measured at Mauna Loa, Hawaii, since 1958). Note how the CO2 emissions from fossil fuels increased less rapidly after the oil-price hike in the early 1970s, yet the concentrations of CO2 in the atmosphere has continued its steep rise. This could be due to an escalation of tropical deforestation, or release of carbon dioxide from soils warmed by the removal of forest cover, or possibly a decreasing ability of the oceans to draw down CO2 from the atmosphere, or a combination of factors. Note also the seasonal changes in photosynthesis and respiration.

Source: D A Lashof and D A Tirpak (Eds), Policy Options for Stabilizing Global Climate (US Environmental Protection Agency, 1989).

REVIEWS

Electropollution; by Roger Coghill.
Thorsons; 1990; 192pp; £5.99.

Currents of Death; by Paul Brodeur.
Simon and Schuster; 1989, 333pp; \$19.95.

"It would be naive to think that nature ever bestows a riskless benefit" says Roger Coghill in the first of these two books about the hazards of electromagnetic radiation. Coghill draws on his experience in brain biology to hypothesise a possible mechanism whereby electromagnetic waves affect the human body.

He then goes on to suggest ways you can protect yourself against electropollution. He does qualify this by saying more research is necessary, but it is better to be safe than sorry.

This is a well referenced text, although many of the conclusions are necessarily tentative. Coghill points the finger at electromagnetic radiation as a possible cause of cot deaths, cancer, multiple sclerosis, and even AIDS, which will doubtless be difficult for many people to accept, but he makes no unsubstantiated claims.

Currents of death is a much more readable account of the

'electromagnetism' debate, by Paul Brodeur, who wrote perhaps the first ever book on the subject, *The Zapping of America* in 1977.

A portion of the book has already been serialised in *The New Yorker*, and many people in the UK following the subject will have already seen copies, and be familiar with Brodeur's style.

The book reads like a medical detective novel, beginning with Nancy Wertheimer's pioneering study in 1974 of the connection between childhood cancer and electrical transformers, and ending with modern studies of the health hazards of VDUs.

Currents of Death is a story of cover-ups, and vendettas against researchers determined to expose the truth. Nothing posed such a risk, says Brodeur "to the search for the truth about ELF (extremely low frequency) electromagnetic fields as did the obfuscation of industry, the

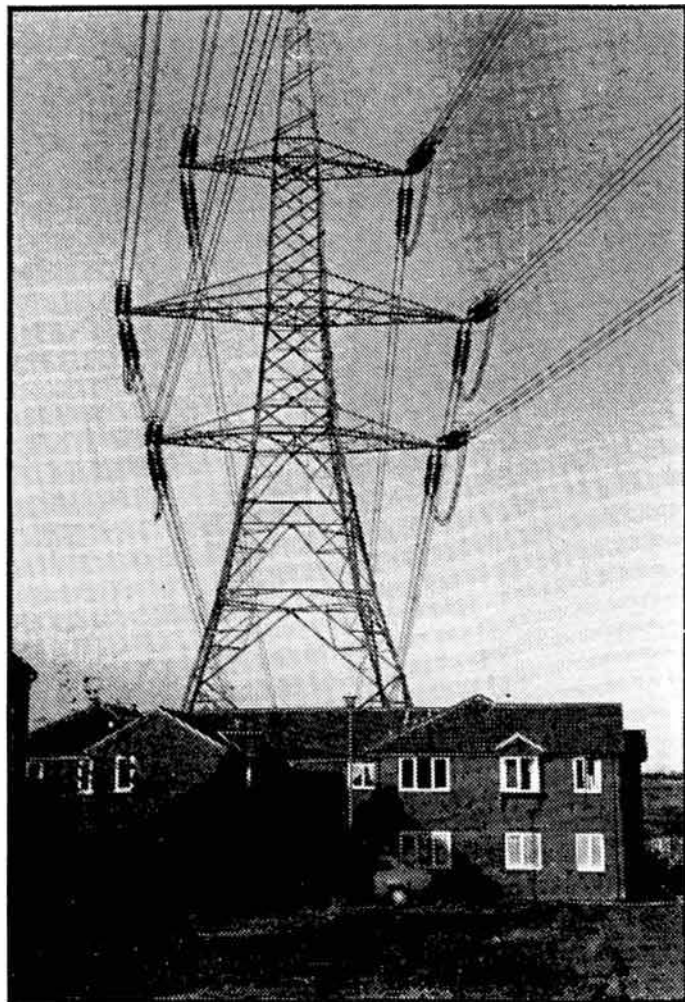


PHOTO: ROGER COGHILL

mendacity of the military and corruption of ethics that industrial and military money could purchase from various members of the

medical and scientific community."

A familiar story.

PETE ROCHE

LETTERS

Dear SCRAM

Dave Toke (*Stand up for Renewable Energy* SCRAM 79) wants sniffy environmentalists to refrain from objecting to mega-renewable projects like the Severn Barrage because "everything we do has environmental impact", "we require a quick build-up of renewable energy" and "renewables should be providing us with the bulk of electricity in as little as 30 years time".

All of these are true, but the fact is that replacing mega-sized coal or nuclear power

plants with equally huge renewable plants merely replicates many of the failings of the current system of electricity supply. We can afford to sniff at the Severn Barrage and its like for the very simple reason that they aren't necessary, we can achieve a significant renewable generation of power much quicker by installing already-proved renewable technology on a local basis, like individual wind turbines, individual water turbines on upland streams, individual wave power

machines for coastal communities, etc. Severn Barrage type projects will take years to design and construct for the impressive amounts of electricity they will generate, much of which will be lost in transmission before reaching the end consumer. Generate power locally and you significantly reduce these transmission losses, thus reducing the overall generation capacity you require. These technologies, if implemented immediately, could, combined with a realistic attack on the energy conservation issue,

substantially reduce Britain's dependence on fossil fuel generation much quicker than 30 years hence and in a much more acceptable fashion.

Yours sincerely
Paul Grigson
Swindon

SCRAM welcomes the submission of letters for publication, while reserving the right to edit letters to fit the available space.

LITTLE BLACK RABBIT



Little Black Rabbit knows nuclear power is a risky and costly business. The risk was demonstrated by the Chernobyl accident - though by no means a worst case scenario. It can hardly be the nuclear industry's favourite example for cost either. The USSR clean up operation has already cost 11 billion roubles, with a further 16 billion programme to come. LBR calculates that this 27 billion rouble total would pay for 54 reactors of the Chernobyl type - so the Chernobyl clean up has doubled the cost of the USSR's entire civil nuclear programme.

Of course the UK nuclear industry has always dealt with Chernobyl, and three mile island before it, and any other overseas nuclear accident you care to mention, with the stock phrase "it could never happen here". This is of course the same UK nuclear industry which has welcomed the Hinkley Inquiry Report. However, Inquiry Inspector, Michael Barnes, may have given Hinkley C the go ahead, but the Report contains one paragraph which should be of interest to the "it could never happen here" brigade. Barnes states "an accident of Chernobyl type proportions could happen to a PWR at Hinkley Point."

Another little noticed section of the Barnes Report is tucked away in Volume 9. It contains a remarkable letter from the Economic Assessor who felt he could not associate himself with the approval of the CEBG's plans. Professor Ulph considered

it impossible to weigh the benefits and disadvantages without government go-ahead for the project. He saw the need for extra capacity was without proof; of diversity there was a lack of evidence concerning the weight attached; and costs being deferred until 1994 could not be accounted for accurately.

For Michael Barnes, the Professor was too "concerned with arguments on the interpretation and implications of government policy. This is not a matter for an Economic Assessor." Barnes continued "I consider that the law and practice of public inquiries is an area in which I must do my best to help the Secretaries of State unassisted by an Economic Assessor."



There was food for thought for LBR in a post card from some Canadian cousins. They report that their favourite fields, close to the Hydro-Quebec experimental nuclear power plant near Trois-Riviers, are looking a bit experimental as well. Filled with tempting clover with two heads and often lucky(?) four or five leaves, not to mention dandelions the height of a kitchen table. A local farmer was overheard to remark "I try to avoid thinking if the deformities are caused by radioactivity". LBR's cousins are less complacent - they decided to turn down the herbivorous feast, packed their bags and moved burrows!

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